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S3100 Series Inverter User Manual V1.2



# S3100 Series Inverter

## Multi Function Economy (Asynchronous)

### User Manual



User Manual

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## Multi Function Economy (Asynchronous)

### User Manual

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Thank you for choosing SAVCH inverter! This instruction manual, which includes operation descriptions and notes for maintenance, shall be delivered to the end-user.

For safety running and effective operation, this instruction manual shall be read thoroughly prior to use, which shall also be preserved for later use. Provided problems occur and solution is not provided in this instruction manual, contact your SAVCH ELECTRIC representative or contact with our company directly. Our professional technicians will serve for you actively. And please continue to adopt products of SAVCH, give valuable opinion and advice.

## **1. READING INSTRUCTIONS**

Symbols of "DANGER" and "CAUTION" in the manual indicates that, for safety running or maintenance of inverters or other electrical products, attention shall be attached during delivering, installation, operation and checks for the inverter. And these notes shall be applied for a better and safer operation.

 **DANGER** If not used correctly, personnel damage even death may be caused.

 **CAUTION** If not used correctly, serious damage to inverter or machine may be resulted.

### **DANGER**

- Never connect wires while power on. Do not check components or signal for circuit board during operation.
- Do not dismantle or change inner wire, circuit or components unnecessarily.
- Make sure grounding terminals are correctly grounded, 220V level: Grounding III; 440V level: Special Grounding

### **CAUTION**

- Do not perform a withstand voltage test for components of inverter, it can cause semiconductor components to be damaged by high voltage.
- Never connect the output terminals U, V, W to AC power supply.
- IC of CMOS on control circuit of the inverter shall be damaged by electrostatic influence. Do not touch main circuit board.

## **2. PRODUCTS RECEIVING**

All products have been performed with strict test and inspection. After receiving the inverters, the following checks shall be performed.

- To check that SAVCH inverter, an instruction manual is inside of the package.
- To check whether model number correspond with model and capacity your purchase order.
- To check whether there are damaged parts during transportation and delivering. If there are, do not connect with power supply.
- If any of the above checkpoints are not satisfactory, contact your SAVCH ELECTRIC representative for a quick resolution.

# 1.SAFETY INSTRUCTIONS

## 1.1 NOTES FOR OPERATION

### Before wiring

#### CAUTION

- Specification of applying power supply shall correspond to input voltage of the inverter.

#### DANGER

- Main circuit terminals must be correct, R/L1, S/L2 and T/L3 is input terminals and it's forbidden to use mixing with U/T1, V/T2 and W/T3. Failure to observe this may cause the inverter damaged.

### Installation

#### DANGER

- When handling the inverter, do not draw front cover directly but handle it by the heat sink to prevent the cover from falling off and to avoid the falling of the inverter and causing personal injury or damage to the inverter.
- Install the inverter on a base made of metal or other non-flammable material, Do not place flammable object nearby to prevent fires.
- If several inverters are installed in a electric cabinet, add extra cooling fan to keep the temperature lower than 40 °C to prevent over-heating or fire.
- Operator shall be dismantled or refitted after power supply is off. Fixed operator shall be processed as diagram shows.
- Confirm whether the input voltage is identical with the voltage in the nameplate on the right side of the inverter, Otherwise the malfunction could happen.

### Operation

#### DANGER

- Never put in or take off the motor during operation, otherwise over-current even over burning the main circuit of the inverter may happen.
- Do not remove the cover while current is flowing. Failure to observe this may result in electrical shock to personnel.
- When auto-restart function is set, do not approach the machine since motor can be reset suddenly after being stopped.
- Since STOP button can be selected by function set, which is different from usage of emergency stop/on switch, attention shall be given to the usage.

 **CAUTION**

- Never touch heat sink or discharging resistor since temperature may be very high.
- Pay attention to relative settings before using the brake.
- Do not check signals during running.
- Turn off the power and check that the charging resistance lamp "CHARGE" goes out before reassembling or checking.

**Check and maintenance**

 **CAUTION**

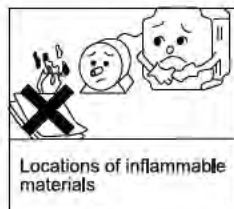
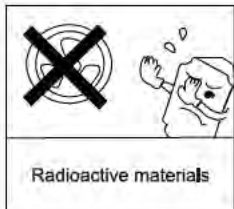
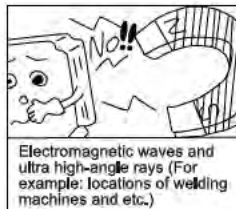
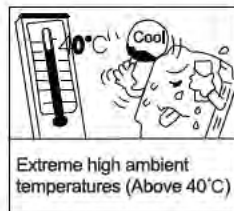
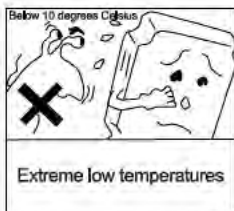
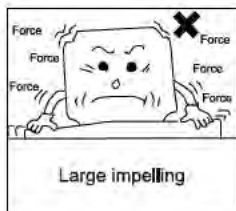
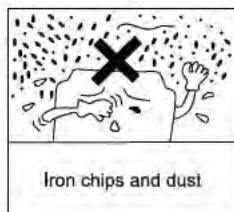
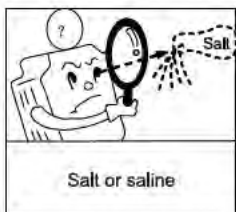
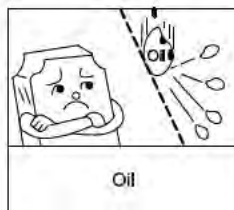
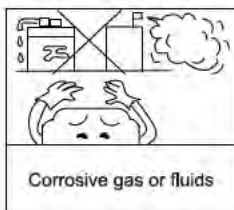
- Ambient temperature for operating the inverter shall be  $-10\text{ }^{\circ}\text{C}$  to  $+40\text{ }^{\circ}\text{C}$  and 90%RH non condensation.
- After removing the dust-cover, ambient temperature for operating the inverter shall be  $-10\text{ }^{\circ}\text{C}$  to  $+50\text{ }^{\circ}\text{C}$  and 95%RH non condensation. However under this condition, the ambient environment must be without drips of water or metal dust. If there are, the dust cover shall be refitted and check whether ambient temperature is within  $-10\text{ }^{\circ}\text{C}$  to  $+40\text{ }^{\circ}\text{C}$  simultaneously.

**Disposal precaution**

 **CAUTION**

- Explosion may occur when burning the electrolytic capacitor of the main circuit and printing plate. Toxic gas may be generated when burning control panel and other plastic fittings.
- It shall be treated as Industrial waste when disposing of it.

## 1.2 NOTES FOR OPERATION ENVIRONMENT





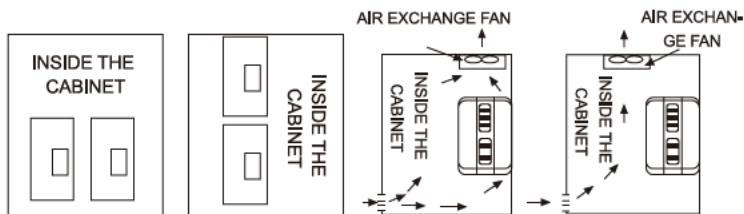
## **2.HARDWARE DESCRIPTION AND INSTALLATION**

### **2.1 OPERATIONAL ENVIRONMENT**

Since operation environment can directly influence functions and operation life, to ensure proper performance and long operation, follow the recommendations below when choosing allocation for installing the inverter:

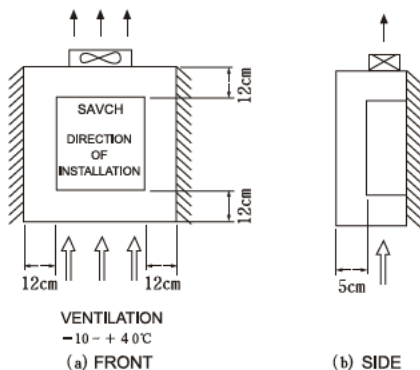
- Use only with the ambient temperature range:  $-10^{\circ}\text{C}$  to  $+40^{\circ}\text{C}$ ;  $-10^{\circ}\text{C}$  to  $+50^{\circ}\text{C}$  applicable when dust cover is removed.
- Avoid Rain, moisture
- Avoid Direct sunlight,(Avoid using outdoors)
- Corrosion of oil sprays or salt
- Corrosive fluid and methane
- Dust or batting and metallic particles in the air
- Radioactive materials and inflammable materials
- Electromagnetic interference (Avoid using together with welding machine or dynamic machines.)
- Vibration. (If inverter must be used in this environment, an anti vibration pad is necessary).

Attention shall be attached to clearance of inverters allocated closely. A fan shall be installed to make sure temperature is lower than  $40^{\circ}\text{C}$




For cooling off, face shall be toward front and upper parts shall be upwards.


Clearance shall meet the following specifications: (If the inverter is installed inside the cabinet or environment is allowable, dust cover shall be available to be removed for ventilating.)



## 2.2 MODEL DESCRIPTION

Model →  
 Input power supply Spec →  
 Output power supply Spec →  
 Output frequency →





**TYPE: S3100-4T1.5G/2.2P** 

**SOURCE: AC 3PH 380~460V 50/60Hz**

**OUTPUT: 3PH 0~460V 2.8kVA 3.7/4.7A**

**FREQUENCY RANGE: 0.1~500Hz**

**S/N:**  NJ3019380000037 

Designed by Taiwan Savch Electric  
 SAVCH ELECTRIC CO.,LTD

S	3100	-	4T	1.5	G
SAVCH	Product series name		Input power source: 2T: 3 ph 220V (Note: 2T.2G or below with compatibility of single phase) 4T: 3 ph 440V	0.4 : 0.4kW 0.75 : 0.75kW 1.5 : 1.5kW 2.2 : 2.2kW : 15 : 15kW : 400 : 400kW	G: General P: Light load

## 2.3 INVERTER SPECIFICATIONS

### 2.3.1 Standard Specifications

220V single phase/Three phase Series

Item		Specifications							
Type(S3100~2T***G) (*)		0.4	0.75	1.5	2.2	4.0	5.5	7.5	
Nominal applied motor [kW] ( rated output )		0.4	0.75	1.5	2.2	4.0	5.5	7.5	
Rated Output	Rated power [kVA] <sup>(2)</sup>	1.1	1.9	3.0	4.1	6.4	9.5	12	
	Voltage [V]	3 ph 200~240V ( With AVR function )							
	Rated current [A]	3	5	8	11	17	25	33	
	Overload capability	150%~1min							
Input Power	Voltage, frequency	200 ~ 240V, 50Hz /60Hz							
	Voltage, frequency variations	Voltage: ± 10%(Interphase unbalance rate is within 2%, frequency:+5~-5%)							
	Rated input current [A]	Three phase	3.1	5.3	9.5	13.2	22.2	31.5	42.7
		Single phase	5.4	9.7	16.4	24.8	—		
Braking	Braking transistor	Standard built-in							
Enclosure		IP20 closed type							
Cooling method		Fan cooling							

(\*) 2T,2G and below the power can be compatible single, select any two power as input terminal.

(\*)2 Rated capacity is calculated by assuming the output rated voltage as 220V.

#### 440V Three phase Series

Item		Specifications														
Type(S3100-4T***G)		0.75	1.5	2.2	4.0	5.5	7.5	11	15	18.5	22	30	37	45	55	
Nominal applied motor [kW] ( rated output )		0.75	1.5	2.2	4.0	5.5	7.5	11	15	18.5	22	30	37	45	55	
Rated Output	Rated power [kVA] <sup>(1)</sup>	1.9	2.8	4.1	6.8	9.9	13	18	22	29	34	45	57	69	85	
	Voltage [V]	3 ph 380-460V ( With AVR function )														
	Rated current [A]	2.5 (3.2)	3.7 (4.7)	5.5 (6.5)	9.0 (11.8)	13 (15.0)	18 (21.7)	24 (28.5)	30 (35.4)	39 (45)	45 (60)	60 (75)	75 (91)	91 (112)	112 (150)	
	Overload capability	G Specifications: 150%-1min(P Specifications: 120%-1min)														
Input Power	Voltage, frequency	380 ~ 460V , 50Hz /60Hz														
	Voltage, frequency variations	Voltage: ± 10%(Interphase unbalance rate is within 2%, frequency:+5--5%)														
	Required power supply capacity (with DCR) [kVA] <sup>(2)</sup>	—										40	48	58	71	
	Rated input current (without DCR) [A]	3.1	5.9	8.2	13	17.3	23.2	33	43.8	52.3	60.6	—				
	Rated input current (with DCR) [A]	—										62	76	90	105	
Braking	Braking transistor	Standard built-in										—				
	DC reactor(DCR)	—										Model customization				
	Enclosure	IP20 closed type										IP00				
	Cooling method	Fan cooling														

Item		Specifications								
Type(S3100-4T***G)		75	90	110	132	160	200	220	280	315
Nominal applied motor [kW] ( rated output )		75	90	110	132	160	200	220	280	315
Rated Output	Rated power [kVA] <sup>(*)</sup>	114	134	160	192	231	287	316	396	445
	Voltage [V]	3 ph 380~460V ( With AVR function )								
	Rated current [A]	150 (176)	176 (210)	210 (253)	253 (304)	304 (377)	377 (415)	415 (520)	520 (585)	585 (650)
	Overload capability	G Specifications: 150%-1min(P Specifications: 120%-1min)								
Input Power	Voltage, frequency	380 ~ 460V, 50Hz /60Hz								
	Voltage, frequency variations	Voltage: ± 10%(Interphase unbalance rate is within 2%, frequency:+5--5%)								
	Required power supply capacity(with DCR) [kVA] <sup>(*)</sup>	96	114	140	165	199	248	271	347	388
	Rated input current (without DCR) [A]	—								
	Rated input current (with DCR) [A]	140	160	210	240	290	370	410	500	559
Braking	Braking transistor	—								
DC reactor ( DCR )		Model customization	Optional <sup>(*)</sup>							
Enclosure		IP00								
Cooling method		Fan cooling								

(\*1) Rated capacity is calculated by assuming the output rated voltage as 440V.

(\*2) Obtained when a DC reactor (DCR) is used.

(\*3) DC reactor (DCR) is optional part, inverter of 110KW or above must use together with the DC reactor (DCR).

(\*4) brackets "(\*\*\*\*)" in the table is the content for the P-type machine rated current and overload capacity

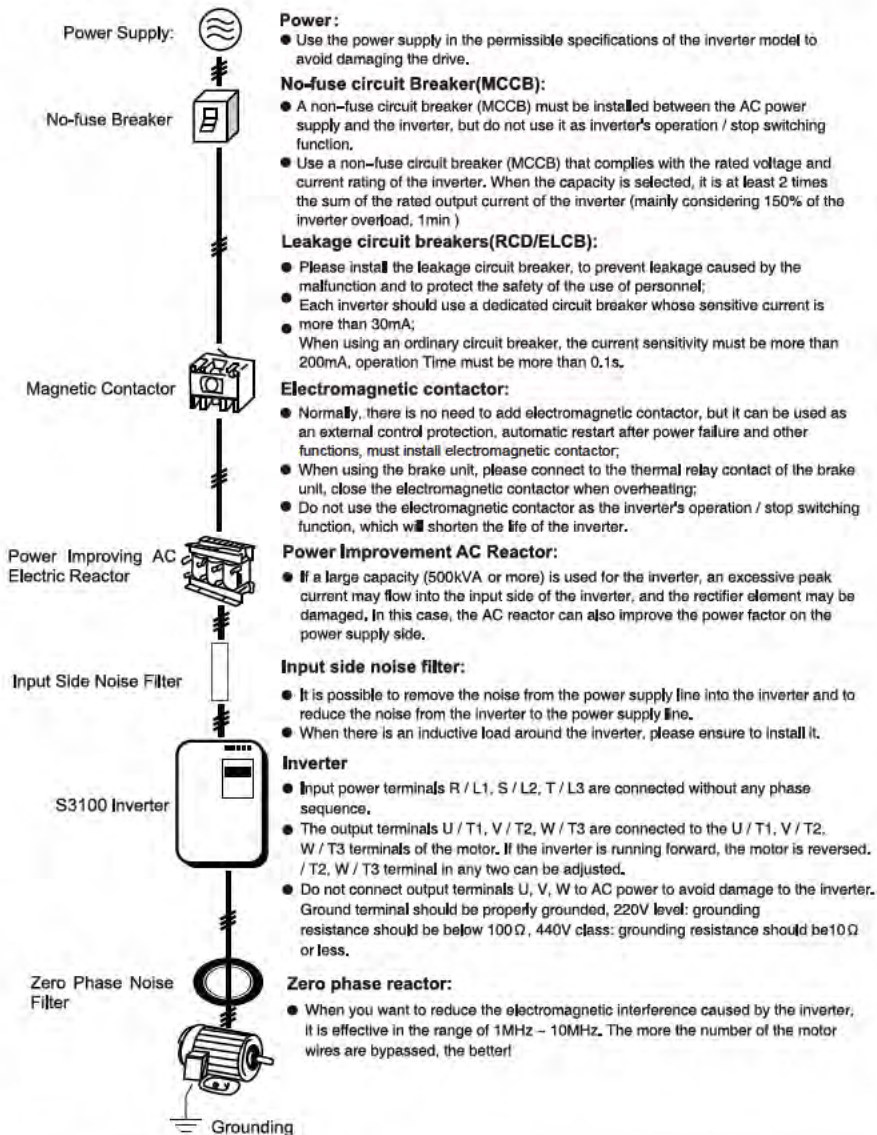
## 2.3.2 Common specifications

Item		Explanation	
Output frequency	Setting range	Max frequency	25 to 500 Hz (changeable setting, Vector control maximum output frequency of 200Hz)
		Base frequency	25 to 500 Hz (changeable setting)
		Starting frequency	0.1 to 60.0 Hz (changeable setting)
		Carrier frequency	<ul style="list-style-type: none"> <li>0.75–12kHz (The maximum carrier values of different power will be variable)</li> <li>Note: the carrier frequency may automatically drop depending upon the surrounding temperature or output current to protect the inverter. (The automatic drop function can be disabled)</li> </ul>
Setting resolution		<ul style="list-style-type: none"> <li>Keypad setting: 0.01 Hz (99.99 Hz or less), 0.1 Hz (100.0 to 500.0 Hz)</li> <li>Communication operation setting: 1/20000 of maximum frequency or 0.01 Hz (fixed)</li> </ul>	
Control	Control method		<ul style="list-style-type: none"> <li>V/f control</li> <li>Dynamic torque vector control</li> </ul>
	Voltage /frequency characteristics		<ul style="list-style-type: none"> <li>Possible to set output voltage at base frequency and at maximum frequency</li> <li>AVR control ON/OFF selectable. Non-linear V/F pattern with three arbitrary points</li> </ul>
	Torque boost		<ul style="list-style-type: none"> <li>Auto torque boost (for constant torque load)</li> <li>Manual torque boost: Desired torque boost (0.0 to 20.0%) can be set</li> <li>Select application load with function (Constant torque load or variable torque load)</li> </ul>
	Starting torque		<ul style="list-style-type: none"> <li>When the slip compensation and torque boost occurs, the torque can exceed 150%.</li> </ul>
	Start/stop operation		<ul style="list-style-type: none"> <li>Keypad ( RUN/STOP keys), external signals (run forward (run reverse) run/stop command etc.), Communications link (RS485).</li> </ul>
	Frequency Setting		<ul style="list-style-type: none"> <li>Keypad (Potentiometer adjustment, or by UP/DOWN button to set.)</li> <li>Analog input: DC0 to +10V/0 to +100%( terminal AV1 . AUI) DC4 to 20mA/0 to 100% (terminal ACI)</li> <li>UP/DOWN operation: Multi-frequency (16 steps)</li> <li>Pulse train input (standard): Pulse input = MI7 terminal, Rotational direction = general terminals</li> <li>Reference frequency switching, Auxiliary frequency setting, and Inverse operation.</li> </ul>
	Acceleration/ deceleration time		<ul style="list-style-type: none"> <li>0.00 to 3600 s, Linear/S-curve/curvilinear</li> </ul>
	Stop control		<ul style="list-style-type: none"> <li>Running continued at the stop frequency, coast-to-stop, or force to stop</li> <li>DC braking: Braking starting frequency (up to 60Hz), time (up to 30.0s), and operation level (up to 100%).</li> </ul>
	Auto-restart after momentary power failure		<ul style="list-style-type: none"> <li>Alarm at power failure, alarm when power on again.</li> <li>Restart at the frequency at which the power failure occurred, restart at the starting frequency</li> </ul>
	Hardware current limiter		<ul style="list-style-type: none"> <li>Settable Current limiting action value</li> <li>Over current limiting by hardware (it can be canceled)</li> </ul>
Torque limiter		<ul style="list-style-type: none"> <li>Torque limit value (200%)</li> <li>Torque limiter 1/2, torque limiter enabled/disabled, analog torque limit value.</li> </ul>	
Control functions		<ul style="list-style-type: none"> <li>Analog input adjustment (gain/offset/filter time constant), frequency limiter (high and low), bias frequency, jump frequency, 2nd, motor setting, universal DI, universal DO, universal AO, rotational direction limitation.</li> <li>Overload prevention control, slip compensation, over voltage stall prevention, droop control, PID process control, PID dancer control, auto energy saving function.</li> <li>Auto-tuning (Operating modes: motor load, do not connect the mechanical transmission parts.)</li> <li>Fault restart, command loss detection.</li> </ul>	

Item		Explanation
Control	Digital input	Run/stop forward and reverse command, select multi-frequency , select ACC/DEC time, Enable 3-wire operation , Coast-to-stop command,reset alarm, enable external alarm trip, ready for jogging, select frequency command 2/1, select motor, enable DC braking, select torque limiter level, UP/DOWN command, enable data change with keypad, cancel PID control, switch normal/inverse operation, universal DI, force to stop, reset PID integral and differential components, hold PID integral component, pulse train input, pulse train sign, select droop control.
	Transistor output	Inverter running, frequency arrival signal, frequency detected, under voltage detected (inverter stopped), inverter output limiting, auto-restarting after momentary power failure, motor overload early warning, keypad operation, inverter ready to run, inverter output limiting with delay, auto-resetting, universal DO, heat sink overheat early warning, reference loss detected, inverter operating, overload prevention control, current detected, PID alarm, Motor switch, brake signal, alarm relay contact output (for any fault).
	Analog output	<ul style="list-style-type: none"> <li>• AFM:Output a selected signal with DC voltage (0 to +10 V)</li> <li>• DFM: output the selected signal by the way of pulse(the pulse of the highest frequency is 25~6000p/s ).</li> </ul> (FM terminal switches AFM/DFM by switch). Output frequency (before slip compensation, after slip compensation), output current, output voltage, output torque, load factor, input power, PIDfeedback amount, DC link bus voltage, universal AO, motor output, PID command , PID output.
Indication	Running /stopping	Speed monitor (reference frequency (Hz), output frequency, motor speed, load shaft speed). Output current, output voltage, torque calculation value, input power, PID command value, PID feedback amount, PID output, load factor, motor output.
	Alarm information	Alarm history: saves and displays the last 4 alarm code and their detailed description
Others	Communications	RS485 COM port 1 (for keypad connection), RS485 COM port 2 (on terminal block)
	Protection against momentary power failure	Upon detection of a momentary power failure lasting more than 15ms, this function stops the inverter output. If restart after momentary power failure is selected, this function invokes a restart process if power is restored within a predetermined period (allowable momentary power failure time).

## 2.4 Inverter using and the main circuit wiring, the basic wiring diagram

### 2.4.1 Peripheral equipment application and precautions





Wiring shall be checked whether correct or not. Peripheral wiring shall fulfill the following requirements.

(Warning: do not use a buzzer of control circuit to check wiring)

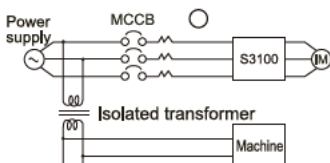
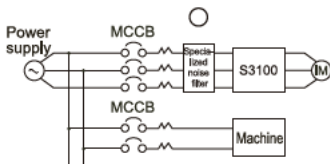
(A) Wiring for control circuit Power supply must be isolated or far from other high voltage wirings or high current power lines, thus electromagnetic interference can be avoided.

See diagrams below:

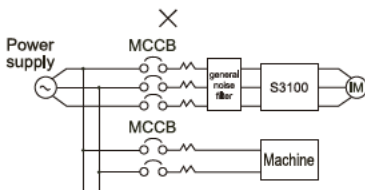
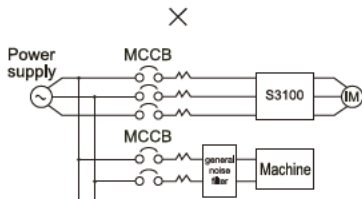
- Individual power supply bridge for inverter



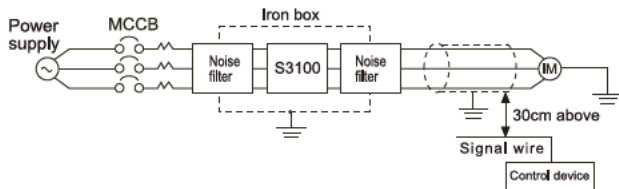
- If inverter power supply circuit is used commonly with other machines, inverter-specialized noise filter or isolating transformer shall be added.



- Good effect may not be received if general use noise filters are applied



- Interference during transmission can be prohibited by adding an inverter-specialized noise filter at main circuit output side. For preventing electromagnetic radiation, a metal tube shall be installed, and distance from signal wiring of other control machines shall be 30cm at least.



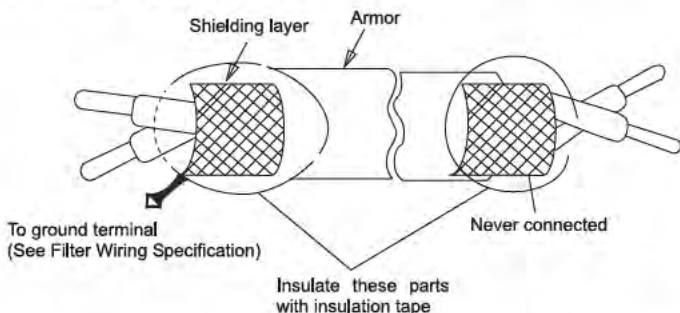
- Voltage drop of wiring shall be considered providing that inverter and motor are with an excessive distance. Voltage drop  $(V) = 3^{1/2} \times \text{wiring resistance } (\Omega/\text{km}) \times \text{wire length (m)} \times \text{current(A)} \times 10^{-3}$ , carrier frequency shall be modified according to wiring prepared.

Distance between inverter and motor wiring	Below 50M	Below 100M	Above 100M
Allowable carrier frequency	Below 12kHz	Below 9kHz	Below 6kHz
Set value for parameter 00.26	12	9	6

**(B) Wiring for control circuit shall be isolated or far from main circuit wiring or other high voltage/current power lines, thus electromagnetic interference shall be avoided.**

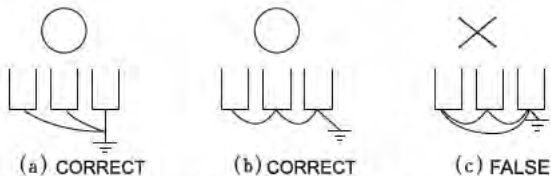
- For preventing electromagnetic interference and malfunction, shielding twisted pair shall be used for control circuit. Shielding wiring shall connect grounding terminals.

**Distance for wiring shall be 50m or less.**



**(C) Grounding terminal for inverters shall be grounded properly.** 220V: Ground resistance below 100Ω, 440V: ground resistance below 10Ω.

- AWG shall be taken as electrical equipment technical standard for ground wire. Ground wire shall be as short as possible.
- Never ground simultaneously for inverter ground wire with other large current load (such as welding machine or large power motors). They shall be grounded separately.
- Ground circuit shall be avoided when several inverters are grounded simultaneously.



**(D) Cable line width for main circuit and control circuit shall be selected according to power line standard.**

**(E) After completing of grounding and wiring, check for the following items: wiring is proper; wire is not broken and screws are securely tightened.**

## 2.4.2 The Selection of Peripheral Devices

Moulded Case Circuit Breaker (MCCB) / Earth Leakage Circuit Breaker (ELCB)

Supply voltage	Applicable standard motor(kW)	Type of inverter	Rated Current (A) of MCCB, ELCB
Three phase 220V	0.4	S3100-2T0.4G	5
	0.75	S3100-2T0.75G	15
	1.5	S3100-2T1.5G	20
	2.2	S3100-2T2.2G	30
	4.0	S3100-2T4.0G	40
	5.5	S3100-2T5.5G	63
Three phase 440V	7.5	S3100-2T7.5G	100
	0.75	S3100-4T0.75G/1.5P	5
	1.5	S3100-4T1.5G/2.2P	10
	2.2	S3100-4T2.2G/4.0P	15
	4.0	S3100-4T4.0G/5.5P	20
	5.5	S3100-4T5.5G/7.5P	30
	7.5	S3100-4T7.5G/11P	40
	11	S3100-4T11G/15P	50
	15	S3100-4T15G/18.5P	63
	18.5	S3100-4T18.5G/22P	100
	22	S3100-4T22G/30P	125
	30	S3100-4T30G/37P	150
	37	S3100-4T37G/45P	150
	45	S3100-4T45G/55P	175
	55	S3100-4T55G/75P	200
	75	S3100-4T75G/90P	250
	90	S3100-4T90G/110P	315
	110	S3100-4T110G/132P	400
	132	S3100-4T132G/160P	500
	160	S3100-4T160G/200P	630
200	S3100-4T200G/220P	630	
220	S3100-4T220G/280P	800	
280	S3100-4T280G/315P	1000	
315	S3100-4T315G/355P	1200	

Note:

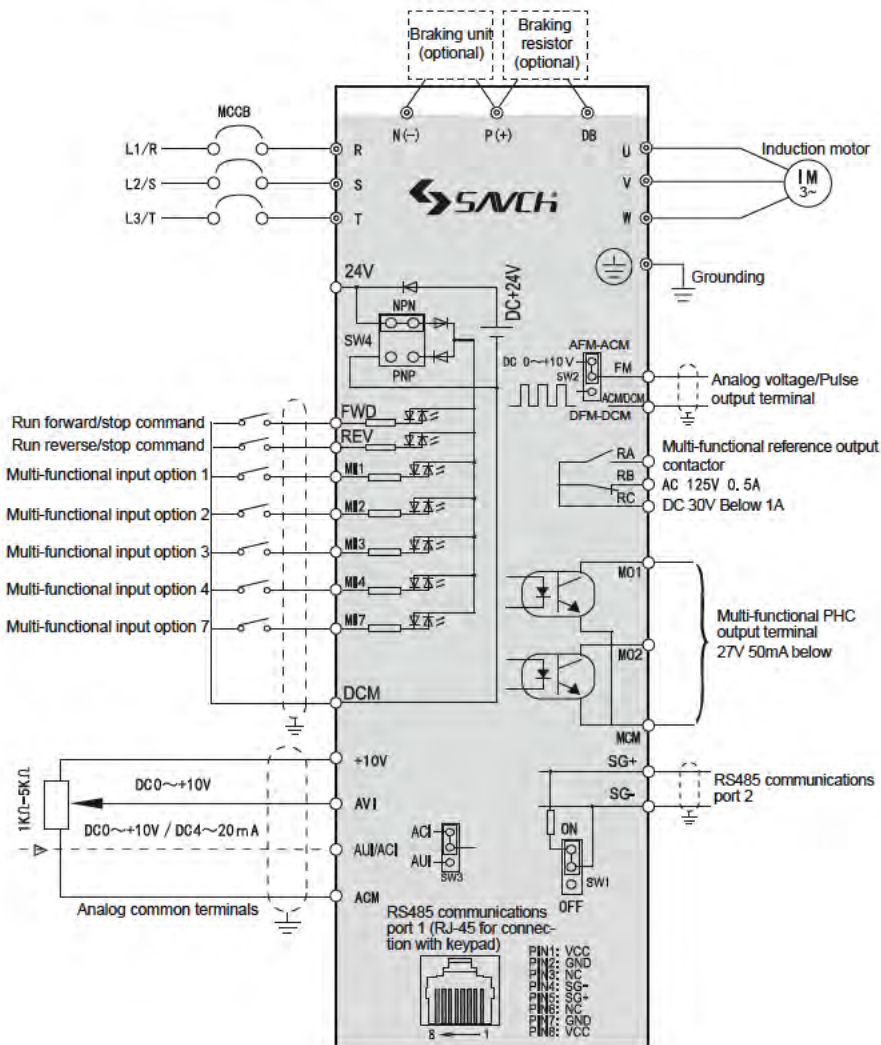
- (1) In order to avoid the residual current circuit-breaker error, please select current sensitivity above 200mA, and operation time with 0.1s or above.
- (2) Breaker rated current must be 2~4 times the rated input current of frequency inverter.

## Recommended wire specification

Supply voltage	Applicable standard motor(kW) (kW)	Type of inverter	Recommended wire specification (mm <sup>2</sup> )		
			Input [L1/R,L2/S,L3/T]	Output [U,V,W]	Ground terminal [G]
Three phase 220V	0.4	S3100-2T0.4G	2.5		2.5
	0.75	S3100-2T0.75G	4		
	1.5	S3100-2T1.5G	4		
	2.2	S3100-2T2.2G	6		
	4.0	S3100-2T4.0G	6		3.5
	5.5	S3100-2T5.5G	6		
	7.5	S3100-2T7.5G	10		
Three phase 440V	0.75	S3100-4T0.75G/1.5P	2.5		2.5
	1.5	S3100-4T1.5G/1.5P	2.5		
	2.2	S3100-4T2.2G/4.0P	2.5		
	4.0	S3100-4T4.0G/5.5P	4		
	5.5	S3100-4T5.5G/7.5P	4		
	7.5	S3100-4T7.5G/11P	6		
	11	S3100-4T11G/15P	6		
	15	S3100-4T15G/18.5P	6		
	18.5	S3100-4T18.5G/22P	10		5.5
	22	S3100-4T22G/30P	16		
	30	S3100-4T30G/37P	25		8
	37	S3100-4T37G/45P	25		
	45	S3100-4T45G/55P	38		
	55	S3100-4T55G/75P	38		14
	75	S3100-4T75G/90P	60		
	90	S3100-4T90G/110P	70		
	110	S3100-4T110G/132P	100		
	132	S3100-4T132G/160P	150		22
	160	S3100-4T160G/200P	185		
	200	S3100-4T200G/220P	240		38
220	S3100-4T220G/280P	150*2			
280	S3100-4T280G/315P	185*2			
315	S3100-4T315G/355P	240*2		60	

## 2.4.3 Wiring of main circuit terminal and grounding terminal

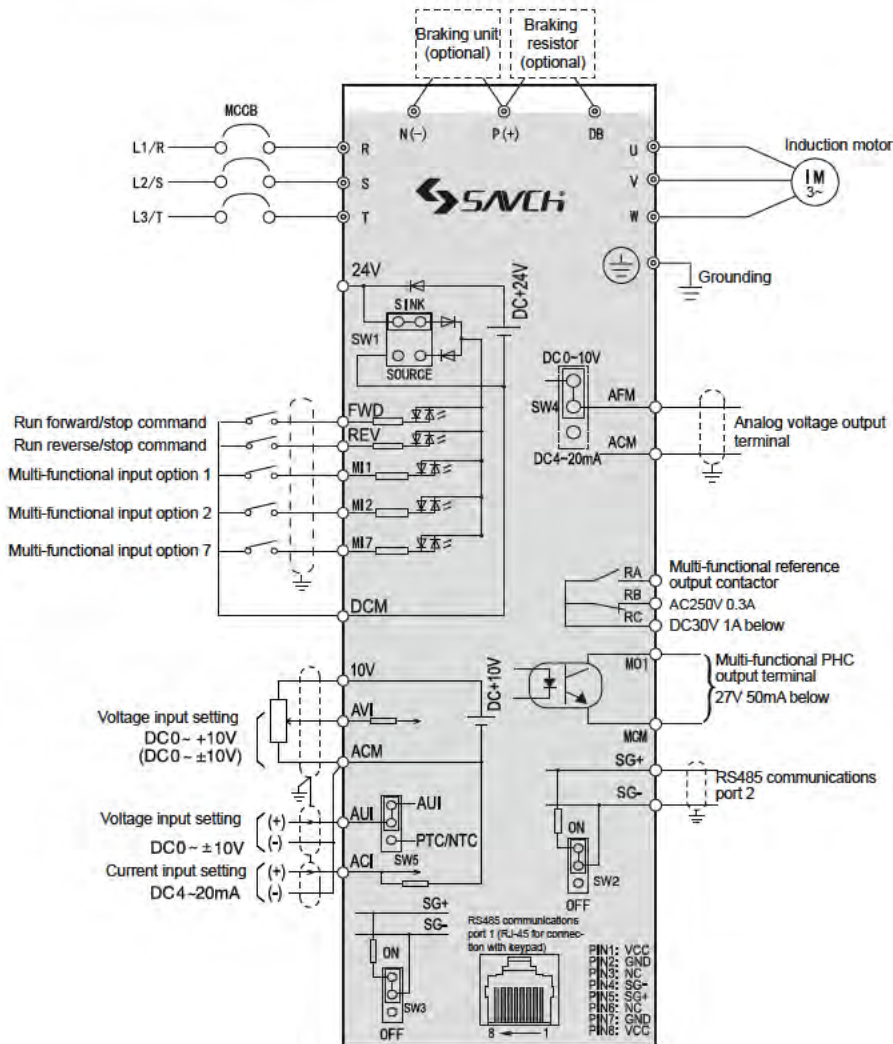
Wiring diagram(below 15kW (include 15kW))



● Main circuit terminal ○ Control circuit terminal

## 2.4.3 Wiring of main circuit terminal and grounding terminal

Wiring diagram(above 18.5kW (include 18.5kW))



(Note 1) Remove the shorting chip between terminal P1 - P(+) before connecting if it's used to connect DC reactor (DCR) (accessories). Inverter of 110kW or above must use DC reactor (DCR).

(Note 2) In the inverter below 22kW built-in with brake unit. Make sure to remove the connection to the built-in braking unit when connecting external braking resistor (accessories). Please must select modes according to user manual.

(Note 3) The motor operations are set by a variety of transfer switches on the electric panel. For details, see "Transfer of various switches in 2.4.5".

(1) The inverter's ground terminal (⚡G)

It's the inverter's ground terminal. Please make ground terminal properly grounded for safety and noise prevention. It's obligatory construct the metal frame ground of electrical equipment in electrical equipment technical standard to prevent electric shock or fire accidents.

Connect the ground terminal in one side of the power supply as follows.

- 1) According to the electrical equipment technical standards, 440V series uses special grounding, 220V series uses the third grounding.
- 2) Ground wiring should connect the coarse wire with large surface area as short as possible.

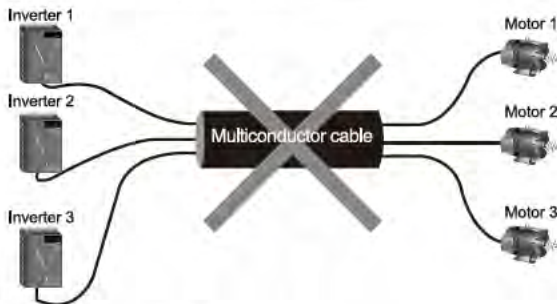
#### Equipment Ground Specified in Electrical Equipment Technical Standards

Supply voltage	Types of ground	Ground resistance
440V	Special ground way	Below 10Ω
220V	Category III ground way	Below 100Ω

(2) Inverter output terminals U, V, W and motor ground terminal (⚡G).

- 1) Connect the terminals U, V, W of 3-phase motor in the phase sequence.
- 2) Connect the ground wire of the output wires (U, V, W) to the ground terminal (⚡G).

Note: When there is more than one combination of an inverter and motor, do not use a multiconductor cable for the purpose of running the leads together.



(3) DC reactor connection terminals P1, P(+).

Connect DC reactor (DCR) used for improving power factor.

- 1) Remove shorting chip from the terminal P1 - P(+).
- 2) Connect terminals P1, P(+ ) of DC reactor (option).

NOTE • Keep the length of wiring below 10m.

• Do not remove the shorting chip with no use of DC reactor.

 **Danger**

Be sure to connect an optional DC reactor (DCR) when the capacity of the power supply transformer exceeds 500 kVA and is 10 times more than the inverter rated capacity (accessories).

**Otherwise fire could happen!**

(4) Connect the brake resistor terminals P(+), DB (22kW or below)

1) Connect the braking resistor terminals P (+), DB.

2) Keep the wiring distance between the inverter and braking resistor below 5m and two lines twisted or paralleled.

 **Danger**

Do not connect to terminals other than terminals P (+) and DB when connecting the DC brake resistor.

**Otherwise fire could happen!**



## 2.4.4 Control terminal wiring

Functions of control terminals are listed in the following table. Control terminal connection methods are different due to different function parameter settings in line with use purpose of the inverter. Perform wiring properly to reduce the noise caused by the main circuit wiring.

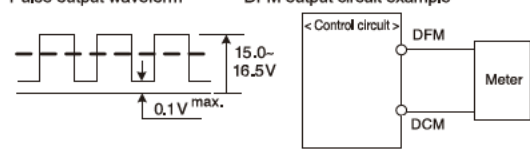
Function of Control Terminals

Category	Terminal symbol	Terminal name	Functions
Analog input	10V	Power for speed setting	Power for external frequency setting (DC +10 V)
	AVI	Analog voltage input setting	(1) Analog voltage inputs the command value for frequency setting DC0~10V/0~100 (%) (positive running), DC10~0V/0~100 (%) (reverse running) (2) Analog input for the PID instruction, PID control feedback signal, the frequency auxiliary setting. (3) Hardware Specifications * Input Impedance: 22 (kΩ) * The maximum possible input DC + 15V. Apply DC + 10V when it exceeds DC + 10V. * set the function parameter 02.35 as "0" when inputting the analog voltage of positive and negative (DC0 ~ ± 10V) via terminal AVI (ps: only above 18.5kW (include 18.5kW) support negative polarity analog, selecting DC~±10V)
	ACI	Analog current input setting	(1) Analog current inputs the command value for frequency setting DC4~20mA/0~100 (%) (positive running), DC20~4mA/0~100 (%) (reverse running) (2) Analog input for the PID instruction, PID control feedback signal, the frequency auxiliary setting, ratio setting, torque limit setting, and analog input monitor allocation. (3) Hardware Specifications * Input Impedance: 250 (kΩ)
	AUI	Analog voltage input setting	(1) Analog voltage inputs the command value for frequency setting DC0~10V/0~100 (%) (positive running), DC10~0V/0~100 (%) (reverse running) (2) Analog input for the PID instruction, PID control feedback signal, the frequency auxiliary setting, ratio setting, torque limit setting, and analog input monitor allocation. (2) Hardware Specifications * Input Impedance: 22 (kΩ) * The maximum possible input DC +15V. Apply DC +10V when it exceeds DC + 10V. * set the function parameter 02.45 as "0" when inputting the analog voltage of positive and negative (DC0 ~ ± 10V) via terminal AUI (ps: only above 18.5kW (include 18.5kW) support negative polarity analog, selecting DC~±10V)
	ACM	Analog common terminals	Common terminals for the analog input and output signals (terminals 10V, AVI, ACI, AUI, AFM) are insulated for terminals DCM, MCM.

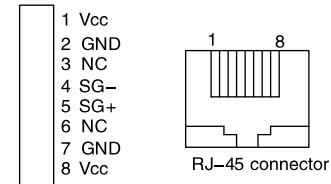
Function of Control Terminals(continued)

Category	Terminal symbol	Terminal name	Functions																			
Digital input	MI1	Digital input 1	(1) Set various signals towards function parameters 01 . 01~01 . 07 . 01 . 98 . 01 . 99. (2) Input modes of trigger: drain / source switching. (3) Switch from [short circuit ON] to [short-circuit OFF] of the operation mode between each digital input terminals and terminals DCM. (4) Digital input terminals MI7 is set to be pulse input terminal by modifying the function parameter. Maximum wiring length is 20m Maximum input pulse is 30kHz: pull the resistor up and down when connecting to a pulse generator of open collector output. Refer to the digital input precautions. 100kHz: when connecting to a pulse generator of complementary outputs. < Digital input circuit specifications >																			
	MI2	Digital input 2																				
	MI3	Digital input 3																				
	MI4	Digital input 4																				
	MI7	Digital input 7																				
	FWD	Forward running • Stop command input	<table border="1"> <thead> <tr> <th>Item</th> <th>Minimum</th> <th>Maximum</th> </tr> </thead> <tbody> <tr> <td rowspan="2">Operating voltage (SINK/NPN)</td> <td>ON Value</td> <td>0V</td> </tr> <tr> <td>OFF Value</td> <td>22V</td> </tr> <tr> <td rowspan="2">Operating voltage (SOURCE/PNP)</td> <td>ON Value</td> <td>22V</td> </tr> <tr> <td>OFF Value</td> <td>0V</td> </tr> <tr> <td colspan="2">Operating current when ON (Input voltage 0V)(Input terminal MI7)</td> <td>2.5mA (4.8mA)</td> </tr> <tr> <td colspan="2">Allowable leakage current when OFF</td> <td>0.5mA</td> </tr> </tbody> </table>	Item	Minimum	Maximum	Operating voltage (SINK/NPN)	ON Value	0V	OFF Value	22V	Operating voltage (SOURCE/PNP)	ON Value	22V	OFF Value	0V	Operating current when ON (Input voltage 0V)(Input terminal MI7)		2.5mA (4.8mA)	Allowable leakage current when OFF		0.5mA
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OFF Value		22V																				
Operating voltage (SOURCE/PNP)	ON Value	22V																				
	OFF Value	0V																				
Operating current when ON (Input voltage 0V)(Input terminal MI7)		2.5mA (4.8mA)																				
Allowable leakage current when OFF		0.5mA																				
REV	Reverse running • Stop command input	<table border="1"> <thead> <tr> <th>Item</th> <th>Minimum</th> <th>Maximum</th> </tr> </thead> <tbody> <tr> <td rowspan="2">Operating voltage (SINK/NPN)</td> <td>ON Value</td> <td>0V</td> </tr> <tr> <td>OFF Value</td> <td>22V</td> </tr> <tr> <td rowspan="2">Operating voltage (SOURCE/PNP)</td> <td>ON Value</td> <td>22V</td> </tr> <tr> <td>OFF Value</td> <td>0V</td> </tr> <tr> <td colspan="2">Operating current when ON (Input voltage 0V)(Input terminal MI7)</td> <td>2.5mA (4.8mA)</td> </tr> <tr> <td colspan="2">Allowable leakage current when OFF</td> <td>0.5mA</td> </tr> </tbody> </table>	Item	Minimum	Maximum	Operating voltage (SINK/NPN)	ON Value	0V	OFF Value	22V	Operating voltage (SOURCE/PNP)	ON Value	22V	OFF Value	0V	Operating current when ON (Input voltage 0V)(Input terminal MI7)		2.5mA (4.8mA)	Allowable leakage current when OFF		0.5mA	
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Allowable leakage current when OFF		0.5mA																				
24V	Auxiliary control power	(1) Connect output signal power of programmable controller. (Rated voltage DC +24V (supply voltage range: DC +22 ~ +27V) Maximum 100mA) (2) Use as load power for transistor output.																				
DCM	Digital common terminal	Common terminals for digital input signal are absolutely insulated for ACM. MCM terminals.																				
Analog output	AFM	Analog monitor	Output the monitor signal of current voltage DC0 ~ 10V or current voltage DC4 ~ 20mA. Output specification (VO / IO) switches above 18.5kW (include 18.5kW) through SW4 and functional parameters 00.29 (0: AFM, 1: 4~20mA output) on circuit board. Output specification (VO / DFM) switches the power under 15kW (include 15kW) through SW2 and functional parameters 00 . 29 (0: AFM, 2: DFM pulse output) on circuit board. Content of the signal can be chosen from the following through the setting of function parameter 00 . 31. • Output frequency      • Output current      • Output Voltage • Output torque          • Load factor          • Consumption power • PID feedback value      • DC bus voltage • Universal AO              • Motor output • PID command value      • PID output value * Impedance can be connected: Minimum 5kΩ (DC0 ~ 10V output) (Up to two analog voltmeter can be connected (DC0 ~ 10V, the input impedance is 10kΩ) * Impedance can be connected: Maximum 500Ω (DC4 ~ 20mA output) * Gain adjustment range: 0 to 300%																			
	ACM	Analog common terminals	Common terminals of analog input and output signals are insulated for DCM, MCM terminals.																			


## Function of Control Terminals(continued)

Category	Terminal symbol	Terminal name	Functions														
Pulse output	DFM	Pulse monitor DFM function	<p>Only the powers under 15kw (include 15kw) have DFM output function. Content of the signal can be chosen from the same function as the AFM through the setting of function parameters 00. 31.</p> <p>* Impedance can be connected: Min 5kΩ (Up to two analog voltmeter (DC0~10V can be connected, the input impedance is 10kΩ).</p> <p>* Pulse working state: about 50% Pulse rate: 25~ 6000p / s (full scale)</p> <p>• Pulse output waveform • DFM output circuit example</p> 														
	DCM	Digital common terminals	Common terminals for analog input signals and terminal DFM output are insulated for ACM, MCM terminals.														
Transistors Output	MO1	Transistors Output 1	<p>(1) Output various signals set by 01. 20~01. 21 parameters (2) Switch from "signal output ON" to "signal output OFF" of the operation mode between the transistor output terminal MO1~MO2 and the terminal MCM.</p> <p>&lt;Transistor output circuit specifications&gt;</p> <table border="1"> <thead> <tr> <th colspan="2">Items</th> <th>Maximum</th> </tr> </thead> <tbody> <tr> <td rowspan="2">Operating voltage</td> <td>ON Value</td> <td>2V</td> </tr> <tr> <td>OFF Value</td> <td>27V</td> </tr> <tr> <td colspan="2">Maximum load current when ON</td> <td>50mA</td> </tr> <tr> <td colspan="2">Leakage current when OFF</td> <td>0.1mA</td> </tr> </tbody> </table>	Items		Maximum	Operating voltage	ON Value	2V	OFF Value	27V	Maximum load current when ON		50mA	Leakage current when OFF		0.1mA
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	Operating voltage	ON Value	2V														
OFF Value		27V															
Maximum load current when ON		50mA															
Leakage current when OFF		0.1mA															
MO2	Transistors Output 2	<p>Note: ♦ Connect a surge-absorbing diode at both ends of the field coil when connecting control relay.</p> <p>♦ Use terminal 24V as power supply terminal (DC24V (supply voltage range: DC22 ~ 27V), maximum 100mA) when turning the circuit on. Perform short-circuit between the terminals MCM=DCM.</p>															
MCM	Transistor outputs common terminal	Common terminals output by the transistor are relatively insulated to the terminals DCM, ACM.															
Contact output	RA-RB-RC	Relay contact output	<p>(1) Perform output through relay contacts (1C) when the inverter alarm stops. Contact capacity: AC250V 0.25A cosφ = 0.3, DC30V 1A</p> <p>(2) Select and output various signals the same as terminals MO1~ MO2.</p> <p>(3) Switch from "ON signal output" when turned on between terminals RA-RC to "ON signal output" when turned off between terminals RA-RC.</p>														

Function of Control Terminals(continued)

Category	Terminal symbol	Terminal name	Functions
communication	SG+/ SG	RS485 communication terminal	Connect input and output terminals of computers and programmable controllers via RS485 communication.
	RJ-45 connector for connection with keypad	RS485 communications port 1 (for connection with keypad)	<p>(1) Connect keypad use.                      (2) Remove keypad and connectors used for communication between RS485, computers and programmable controllers.</p>  <p>RJ-45 connector</p> <p>Pin definition of RJ-45 connector</p> <ul style="list-style-type: none"> <li>• Use 1, 2, 7, 8 pins for the power supply for the keypad. Connect the RJ-45 connector to other equipment and do not use these pins.</li> </ul>

### 2.4.5 Transfer of various switches

 <b>Danger</b>
<p>When the control panel finger switch or jumper switch, turn OFF the power and wait at least five minutes for inverters of 22kW or below, or at least ten minutes for inverters of 30kW or above. Make sure that the LED monitor and charging lamp are turned OFF. Further, make sure, using a multimeter or a similar instrument, that the DC link bus voltage between the terminals P(+) and N(-) has dropped to the safe level (+25 VDC or below)</p> <p><b>Otherwise an electric shock could happen!</b></p>

Functions of various switches(below 15kW (include 15kW))

Switch symbol	Functions									
SW1	<p>&lt;RS485 Communication termination resistors switch (RS485 Communicate Port 2 (Terminal block))&gt;</p> <ul style="list-style-type: none"> <li>• Set shorted cap to ON for RS485 communication when connecting the inverter to the terminal.</li> </ul>									
SW2	<p>&lt; voltage / current output switch of S3100 terminal AFM/DFM &gt;</p> <p>Select the AFM output specification switch. Change the function parameters 00. 29 when switching short circuit jumper.</p> <table border="1" style="margin-left: auto; margin-right: auto;"> <tr> <td style="text-align: center;">Input specifications</td> <td style="text-align: center;">SW2</td> <td style="text-align: center;">00. 29 data</td> </tr> <tr> <td style="text-align: center;">Voltage output (factory state)</td> <td style="text-align: center;">AFM side</td> <td style="text-align: center;">0</td> </tr> <tr> <td style="text-align: center;">Frequency output</td> <td style="text-align: center;">DFM side</td> <td style="text-align: center;">2</td> </tr> </table>	Input specifications	SW2	00. 29 data	Voltage output (factory state)	AFM side	0	Frequency output	DFM side	2
Input specifications	SW2	00. 29 data								
Voltage output (factory state)	AFM side	0								
Frequency output	DFM side	2								

Functions of various switches(below 15kW (include 15kW))

Switch symbol	Functions
SW3	<The input switch of AUI/ACI terminal> Select analog voltage input setting or analog current input setting.
SW4	< digital input terminals drain / source switch > • For the digital input terminals MI1 ~ MI4,MI7, FWD, REV drain / source switches for jumper selection. • The factory state is NPN(SINK) side .

Functions of various switches((above 18.5kW (include 18.5kW))

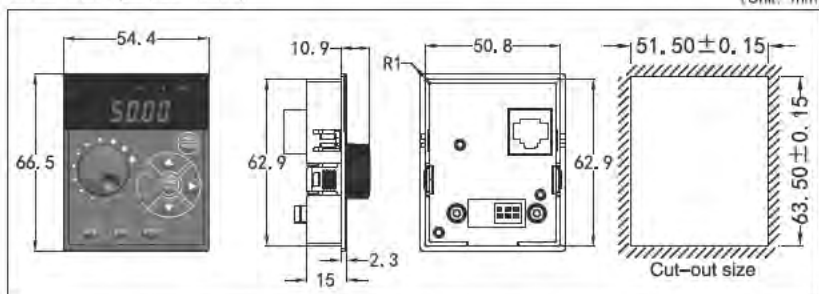
Switch symbol	Functions												
SW1	< digital input terminals drain / source switch > • For the digital input terminals MI1 ~ MI7, FWD, REV drain / source switches for jumper selection. • The factory state is SINK side .												
SW2	<RS485 Communication termination resistors switch (RS485 Communicate Port 2 (Terminal block))> • Set shorted cap to ON for RS485 communication when connecting the inverter to the terminal.												
SW3	<RS485 Communication termination resistors switch (RS485 Communicate Port 1 (for connection with the keypad))> Set it to OFF (Factory state) when connecting keypad, •Set shorted cap to ON for RS485 communication when connecting the inverter to the terminal.												
SW4	< voltage / current output switch of terminal AFM > Select the AFM output specification switch. Change the function parameters 00. 29 when switching short circuit jumper.												
	<table border="1"> <thead> <tr> <th>Output specifications</th> <th>SW5</th> <th>00. 29 data</th> </tr> </thead> <tbody> <tr> <td>Voltage output (factory state)</td> <td>VO side</td> <td>0</td> </tr> <tr> <td>Current output</td> <td>IO side</td> <td>1</td> </tr> </tbody> </table>	Output specifications	SW5	00. 29 data	Voltage output (factory state)	VO side	0	Current output	IO side	1			
Output specifications	SW5	00. 29 data											
Voltage output (factory state)	VO side	0											
Current output	IO side	1											
SW5	< function switch of terminal AUI > Select the analog voltage input setting or PTC / NTC thermistor input. Change function parameters 04. 26 when switching short circuit jumper.												
	<table border="1"> <thead> <tr> <th>Input specifications</th> <th>SW5</th> <th>00. 29 data</th> </tr> </thead> <tbody> <tr> <td>Analog voltage input setting (factory default)</td> <td>V2 side</td> <td>0</td> </tr> <tr> <td>PTC thermistor input</td> <td>PTC/NTC side</td> <td>1 (alarm) or 2 (alarm)</td> </tr> <tr> <td>NTC thermistor input</td> <td>PTC/NTC side</td> <td>3</td> </tr> </tbody> </table>	Input specifications	SW5	00. 29 data	Analog voltage input setting (factory default)	V2 side	0	PTC thermistor input	PTC/NTC side	1 (alarm) or 2 (alarm)	NTC thermistor input	PTC/NTC side	3
Input specifications	SW5	00. 29 data											
Analog voltage input setting (factory default)	V2 side	0											
PTC thermistor input	PTC/NTC side	1 (alarm) or 2 (alarm)											
NTC thermistor input	PTC/NTC side	3											

## 2.5 Multi-functions operation keypad

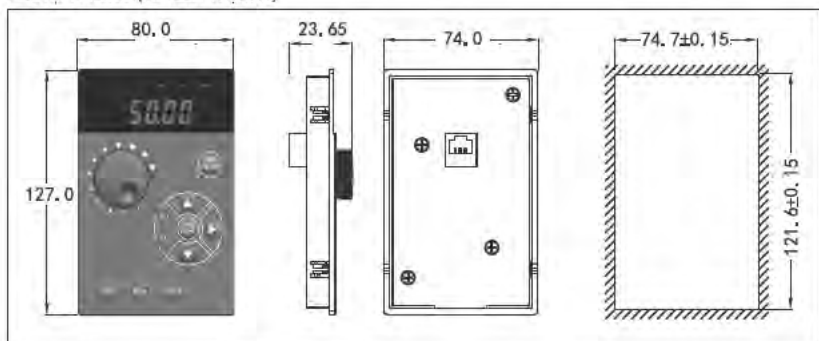
S3100 special operator external dimensions and mounting hole size  
(can use ordinary cable for extension)

Below 15kW (include 15kW)

(Unit: mm)



Above 18.5kW (include 18.5kW)



## 2.6 External Dimensions

### 2.6.1 Inverter Size

Unit:mm

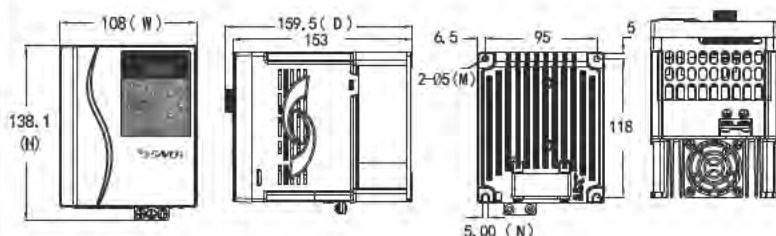
Inverter type	W	W1	W2	H	H1	H2	D	M	N
				Hanging Standing					
S3100-2T0.4G	108	95	95	138.1	118		159.5	5	5
S3100-2T0.75G									
S3100-2T1.5G									
S3100-4T0.75G/1.5P									
S3100-4T1.5G/2.2P									
S3100-4T2.2G/4.0P									
S3100-2T2.2G	130	108	108	209	198		169.8	5	5
S3100-2T4.0G									
S3100-4T4.0G/5.5P									
S3100-4T5.5G/7.5P									
S3100-2T5.5G									
S3100-2T7.5G	180	160	160	298	284		180	6.5	6.5
S3100-4T7.5G/11P									
S3100-4T11G/15P									
S3100-4T15G/18.5P									
S3100-4T18.5G/22P									
S3100-4T22G/30P	250	160	160	386	370		201	9	9
S3100-4T30G/37P									
S3100-4T37G/45P	298	176	176	470	454.5		225	6.5	12
S3100-4T45G/55P									
S3100-4T55G/75P									
S3100-4T75G/90P									
S3100-4T90G/110P	468	160	160	778	745	744	340	12.5	18
S3100-4T110G/132P									
S3100-4T132G/160P									
S3100-4T160G/200P	490	270	270	1274 (1491.5)	1231		405	13	23
S3100-4T200G/220P									
S3100-4T220G/280P	750	245	250	1363 (1668)	1327		417	13	18
S3100-4T280G/315P									
S3100-4T315G/355P									

## 2.6.2 External Dimensions of Inverter

Size 1

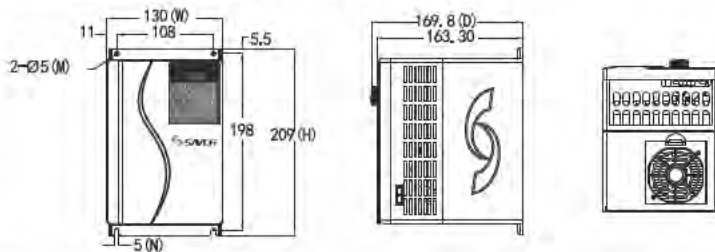
Unit:mm

S3100-2T0.4G-1.5G/4T0.75G/1.5P-4T2.2G/4.0P



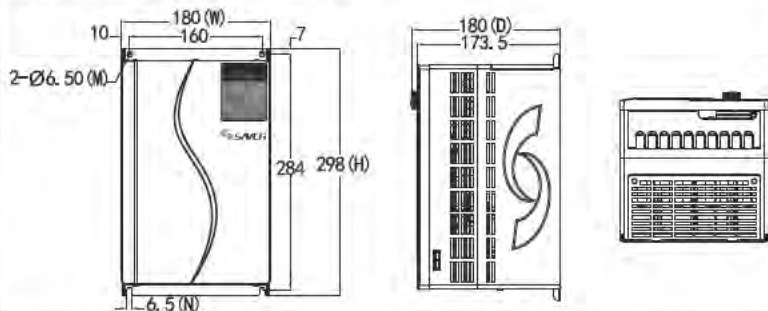
Size 2

S3100-2T2.2G-4.0G/4T4.0G/5.5P-4T5.5G/7.5P



Size 3

S3100-2T5.5G-7.5G/4T7.5G/11P-4T15G/18.5P

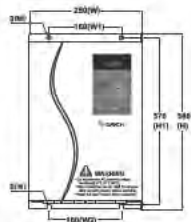




## 2.6.2 External Dimensions of inverter

Size 4

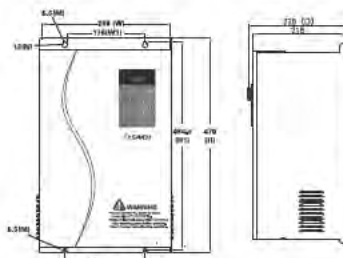
S3100-4T18,5G/22P-4T22G/30P



Size 5

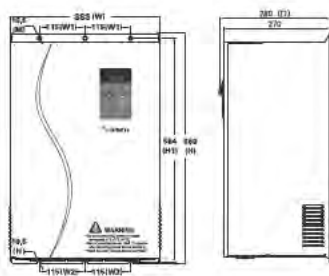
Unit:mm

S3100-4T30G/37P



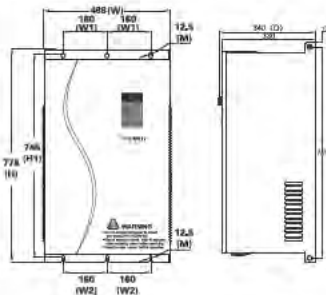
Size 6

S3100-4T37G/45P-4T55G/75P



Size 7

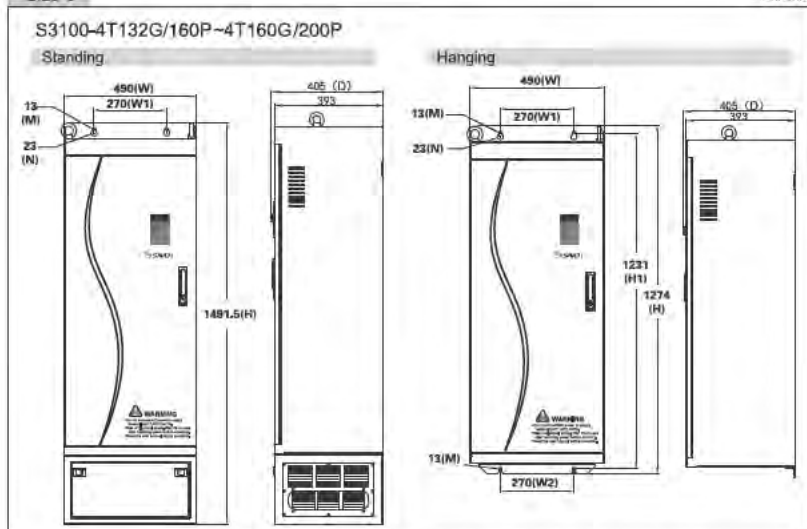
S3100-4T75G/90P-110G/132P



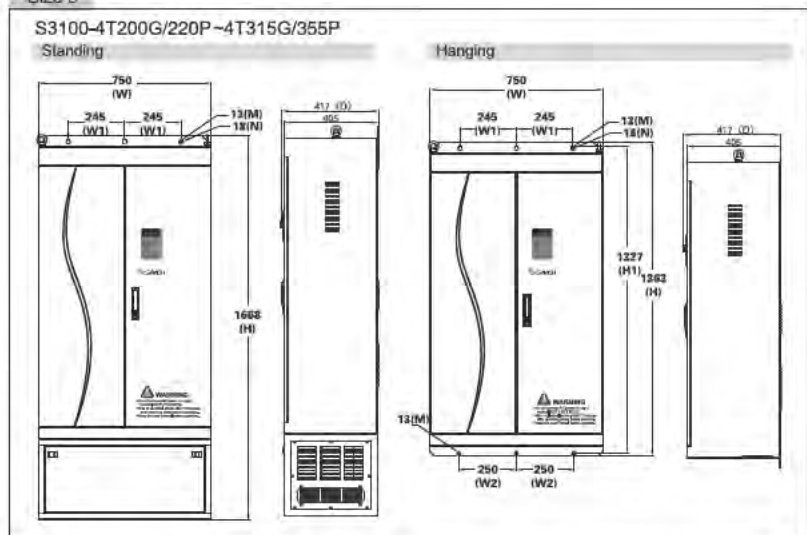
## 2.6.2 External Dimensions of inverter

Size 8

Unit:mm



Size 9



## 3. KEYPAD DESCRIPTION

### 3.1 Overview of Keypad Functions

The keypad could be divided into two parts, i.e. display area and key control area. Display area displays parameter settings and indicates different operation status. Key control area is convenient for the user to take operation for the inverter.



Overview of Keypad Functions

Monitors and Key	Functions Overview
	Displays output frequency, current, voltage and other Running status information Function parameters and data, Alarm codes
	Switches the operation modes of inverter : Running mode, Programming mode and Alarm mode When alarm codes appears, pressing this key to clear the alarming information.
	Switches the monitoring item of running status. Displays the functional parameter and establishes the newly entered data Switches to display the alarm information.
	Jog mode switching
	Run key
	Stop Key
	Selects the setting items or change the function parameter data.
	Shift right key(select data shift right to next number)

## Overview of Keypad Functions

Monitors and Key	Functions Overview
RUNNING LED lamp	The indicator lamp is on when it has run command status.
PU LED	When the <b>(RUN)</b> key of keypad as run command is valid, the indicator is on. In the programming mode and alarming mode, it cannot take <b>(RUN)</b> key operation when the indicator is on.
Unit of LED lamp (3)	Hz, A, kW It means these indexes show the unit of the number displayed and the running status by the combination of 3 LED lamps. Refer to "3.1 Monitoring Item Under Run Mode" on detailed contents.
×10 LED	If the displayed data is exceeding 9999, ×10 LED lamp is on, and the "displayed data ×10" is actual data. When the data is hexadecimal, the indicator light of "×10" flickers.

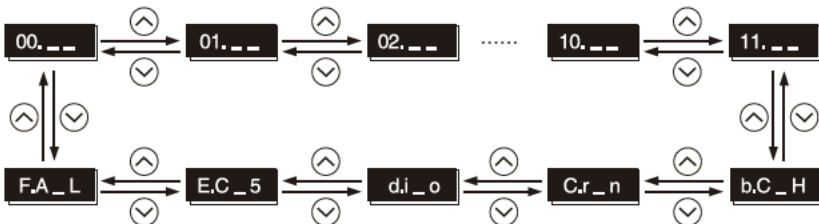
### Operation using the Keypad

#### Operation Modes Selection



Tips: Double key operation means: operation by pressing 2 keys simultaneously and the sign is "+".

#### Menu switching under programming mode



## Functional parameter setting or modification

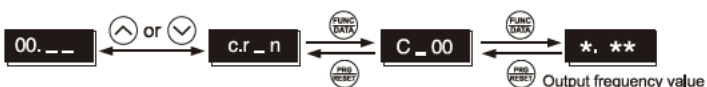


Tips: Cursor moving: When functional parameter data is changed, press **PROG RESET** key for more than 1s continuously. It enables move the flashing position and the data on the position could be changed.

## Alarming information query



## Run information query



## I/O Signal Checking



## 3.2 Overview of Operation Modes


The S3100 features the following three operation modes.

Operation Modes

Operation Mode	Description
Running Mode	It is the mode enters into automatically after power on. It could take frequency setting, PID setting, specify run/stop commands in regular operation. It could monitor the running status in real time. If a light alarm occurs, the "L-AL" appears on the LED monitor,( Above 18.5kW (include 18,5kW))
Programming Mode	It could allow you to configure function parameter data and check a variety of information relating to the inverter status and maintenance.
Alarm Mode	If an alarm condition arises, the inverter automatically enters the Alarm mode in which you can view the corresponding alarm code and its related information.

## 3.3 Running Mode

### 3.3.1 Monitoring Item under Run Mode

Under run mode, it could monitor 14 items which listed in the following table. Immediately after the power is turned ON, the monitor item specified by function code 01, 43 is displayed. Pressing the  key in Running mode switches between monitor items in the sequence shown in the following Table.

Monitored Items

Monitored Items	Example	LED Display	Unit	Description of Display Value	01. 43 Function parameter	
Function parameter 01,48 specifies what to be displayed						
Speed Monitor	Output Frequency before Slip Compensation	50.00	<input type="checkbox"/> Hz <input type="checkbox"/> A <input type="checkbox"/> kW	Hz	Display value = Output frequency (Hz)	0 (01. 48 = 0) (01. 48 = 1) (01. 48 = 2) (01. 48 = 3) (01. 48 = 4) (01. 48 = 5) (01. 48 = 7)
	Output Frequency after Slip Compensation	50.00	<input type="checkbox"/> Hz <input type="checkbox"/> A <input type="checkbox"/> kW	Hz	Display value = Output frequency (Hz)	
	Setting Frequency	50.00	<input type="checkbox"/> Hz <input type="checkbox"/> A <input type="checkbox"/> kW	Hz	Display value = Setting frequency (Hz)	
	Motor Speed	1500	<input type="checkbox"/> Hz <input checked="" type="checkbox"/> A <input type="checkbox"/> kW	r/min	Display value = Output frequency (Hz) × $\frac{120}{03. 01}$	
	Load shaft speed	200.0	<input type="checkbox"/> Hz <input checked="" type="checkbox"/> A <input type="checkbox"/> kW	r/min	Display value = Output frequency (Hz) × 01. 50	
	Line Speed	200.0	<input type="checkbox"/> Hz <input checked="" type="checkbox"/> A <input checked="" type="checkbox"/> kW	m/min	Display value = Output frequency (Hz) × 01. 50	
	Speed (%)(*1)	60.0	<input type="checkbox"/> Hz <input type="checkbox"/> A <input type="checkbox"/> kW	%	Display value = $\frac{\text{Output frequency}}{\text{ax, frequency}} \times 100$	

ON  OFF

Monitored Items	Example	LED Display	Unit	Description of Display Value	01. 43 Function parameter
Output Current	13.50	<input type="checkbox"/> Hz <input checked="" type="checkbox"/> A <input type="checkbox"/> kW	A	Current output from the inverter in RMS	3
Output Voltage	380U	<input type="checkbox"/> Hz <input type="checkbox"/> A <input type="checkbox"/> kW	V	Voltage output from the inverter in RMS	4
Output Torque	50	<input type="checkbox"/> Hz <input type="checkbox"/> A <input type="checkbox"/> kW	%	Calculated output torque	8
Input power	8.60	<input type="checkbox"/> Hz <input type="checkbox"/> A <input checked="" type="checkbox"/> kW	kW	Input power to the inverter	9
PID command	10.00.	<input type="checkbox"/> Hz <input type="checkbox"/> A <input type="checkbox"/> kW	—	PID command/feedback amount transformed to that of physical value of the object to be controlled, Refer to function parameters 01. 40 and 01. 41 for details. When a PID command is displayed, the dot at the lowest digit on the LED monitor blinks.	10
PID Feedback amount	9.00.	<input type="checkbox"/> Hz <input type="checkbox"/> A <input type="checkbox"/> kW	—		12
PID Output	100.0.	<input type="checkbox"/> Hz <input type="checkbox"/> A <input type="checkbox"/> kW	%	Display the PID value in max output frequency (00. 03) as percentage of 100%. When PID is output, the dot at the lowest digit on the LED monitor blinks.	14
Load factor	50 <i>l</i> .	<input type="checkbox"/> Hz <input type="checkbox"/> A <input type="checkbox"/> kW	%	Load factor of the motor in % as the rated output being at 100%	15
Motor output power	9.85	<input type="checkbox"/> Hz <input type="checkbox"/> A <input checked="" type="checkbox"/> kW	kW	Motor output in kW, LED blinks	16
Analog Input(*1)	90.00	<input type="checkbox"/> Hz <input type="checkbox"/> A <input type="checkbox"/> kW	—	Analog input to the inverter in a format suitable for a desired scale Refer to function parameters 01. 40 and 01. 41 for details The analog input monitor appears only when the analog input monitor is enabled by any of function parameters 01. 61 to 01. 63. (Select terminal function). Torque current command value	17
Torque Current(*1)	48	<input type="checkbox"/> Hz <input type="checkbox"/> A <input type="checkbox"/> kW	%	Torque current command value	23
Magnetic flux command (*1)	50	<input type="checkbox"/> Hz <input type="checkbox"/> A <input type="checkbox"/> kW	%	Magnetic flux command value (Available only under vector control) When it is V/f control, it displays 0 (zero).	24
Input watt-hour(*1)	100.0	<input type="checkbox"/> Hz <input type="checkbox"/> A <input type="checkbox"/> kW	kWh	Display value = $\frac{\text{Input watt hour (kWh)}}{100}$	25

(\*1) Adapt to above 18.5kW (include 18.5kW).


ON  OFF

### 3.3.2 Monitoring light alarms on keypad(above 18.5kW (include 18.5kW))


Inverter failure is divided into Alarm, and Light alarm. If the former occurs, which appears the inverter immediately alarm, if the latter occurs, which the L-AL appears and PU LED blinks on the LED monitor, but the inverter continues to run. The Light alarm object should defined with function codes 04.81 and 04.82 beforehand. If the Light alarm [mLALM](data = 98) is distributed to general output terminal (function parameters 01. 20~01. 24. 01. 27), enables the inverter to output the LALM signal on that terminal upon occurrence of a light alarm.

Please refer to **Chapter 7 Failure Indication and Countermeasures** on the causes of minor failure.

#### ■ Check a light alarm

If a light alarm appears, it displays L-AL on the LED monitor. If the light alarm would be required to check, enter programming mode by pressing  key and check on "Maintenance Information" E\_36. Additionally, To check the past light alarm ,it's also possible to check on E\_37 (light alarm (previous)) ~E\_39(light alarm (previous 3)) simultaneously. Refer to "4.4 Maintenance Information"








#### ■ Remove the current light alarm



After checking the current light alarm, to switch the keypad from the L-AL indication back to the running status display, press the  key in Running mode If the light alarm has been removed, the PU LED doesn't blink, and general output signal[mLALM] turns OFF. If not, PU LED and general output [mLALM] will keep showing "Light alarm" status.

### 3.3.3 Preliminary operation-not-connected with motor

#### ■ About the setting method of keypad giving the frequency

The frequency setting is made via the operation panel(00.01=0 factory default)

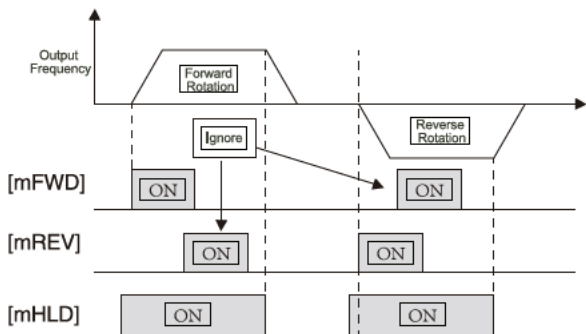
- (1) parameter 00.01 data is set to 0, that is to use the keyboard  /  to set the frequency (if there is integrated potentiometer, the potentiometer is priority)
- (2) After pressing the button  / , the frequency is displayed, and the last bit of the set frequency flashes
- (3) You can change the setting frequency by pressing  /  again
- (4) If you want to save the setting frequency, please press  within 3s after the frequency adjustment is feed, it will display "SAUE" means being saved.

Note: If the operation panel is an integrated potentiometer and it is necessary to switch to the feed method of the keyboard  / . It needs to set the function parameter 11.50 Function switch bit (hexadecimal display) 1: Potentiometer panel switch to key reference (0 : Potentiometer, 1: function up and down key) The last factory default bit of parameter 11.50 is changed from 0 to 2 that is switched to the operation panel to a feed frequency mode via up and down keys. The saving of up and down keys operation, please refer to the description of above (4) point

#### ■ On the three-wire operation controlled by an external signal

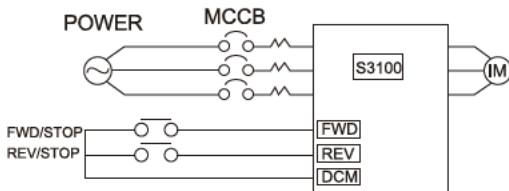
The external signal of the terminal [mFWD] [mREV] is a two-wire operation in the initial state, but by assigning "mHLD", it can be used as a Self-locking holding signal when the three-wire operation controlled by [mFWD] [mREV] [mHLD]. When [mHLD] is ON, the self-locking holding [mFWD] or [mREV] signal, when OFF, is released. There is no assigning to [mHLD] function, only there are [mFWD] [mREV] two-wire operation



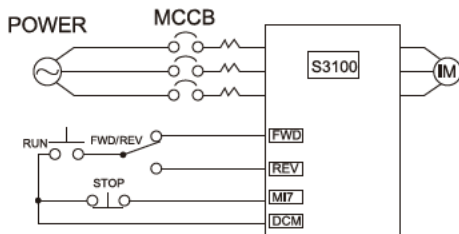


The wiring of the external signal control operation is as below

Two-wire operation control "forward rotation/reverse rotation" and "reverse rotation/stop" (00,02=1)



Three-wire operation control mode (00,02=1) (01,07=6 Self-locking hold[mHLD])



### 3.4 Programming Mode

Programming mode provides you with these functions--setting and checking function code data, monitoring maintenance information and checking input/output (I/O) signal status. These functions can be easily selected with a menu-driven system. The following table lists menus available in Programming mode.

When the inverter enters Programming mode from the second time on, the menu selected last in Programming mode will be displayed.

Program Mode Menu

No.	Menu	LED Display on keypad	Main Functions
1	DataSetting	00.___	00 Group Parameters (Basic Function)
		01.___	01 Group Parameters(External Terminal Function)
		02.___	02 Group Parameters(Control Function)
		03.___	03 Group Parameters(Motor 1 Parameter)
		04.___	04 Group Parameters(Advanced Function)
		05.___	05 Group Parameters(Motor 2 Parameter)
		06.___	06 Group Parameters(Motor 3 Parameter)(*1)
		07.___	07 Group Parameters(Motor 4 Parameter)(*1)
		08.___	08 Group Parameters(Application Function 1)
		09.___	09 Group Parameters(Application Function 2)(*1)
		10.___	10 Group Parameters(Application Function 3)(*1)
		11.___	11 Group Parameters(Serial Communication Function)
			Display/change the data of the selectable function code
2	Data Checking	b.C_H	Displays the function code selected and its data on the same screen. Also this menu is used to change the function code data or check whether the data has been changed from the factory default.
3	Run Monitoring	C.r_n	Displays the running information required for maintenance or test running.
4	I/O Checking	d.i_o	Displays external interface information.
5	Maintenance Information	E.C_S	Displays maintenance information including cumulative run time.
6	Alarm Information	F.A_L	Displays the recent four alarm codes. Also this menu is used to view the information on the running status at the time the alarm occurred.

(\*1) Adapt to above 18.5kW (include 18.5kW).

### 3.4.1 Checking changed function codes

Changed Function codes could be checked by menu code "b" in programming mode: "b.C\_H" shall be check. The keypad monitor shows the function codes whose data has been changed from the factory defaults, in Programming mode allows you to check function codes and their data that has been changed.

### 3.4.2 Monitoring the running status

Menu C "Drive Monitoring" in Programming mode allows you to monitor the running status during maintenance and test running. The display content of "Drive Monitoring" is listed in Table below.

Drive Monitoring Items

Keypad Display	Item	Unit	Description
C_00	Output Frequency	Hz	Output frequency before slip compensation
C_01	Output Frequency	Hz	Output frequency after slip compensation
C_02	Output Current	A	Output Current
C_03	Output Voltage	V	Output Voltage
C_04	Output Torque	%	Output Torque
C_05	Setting Frequency	Hz	Setting Frequency
C_06	Running Direction	None	Display the output run direction. F: Forward, r: Reverse, —: Stopped
C_07	Running Status	None	Display the run status with 4-bit in hexadecimal. Refer to ■Run Status (C_07 ) and Display Method of Run Status 2 (C_23 ) on the following page on detailed information.
C_08	Motor Speed	r/min	Display Value =Output Frequency(Hz)× 120/ P01(motor pole) When display value is more than 10000, ×10 LED is on ,and motor speed= display value × 10.
C_09	Load shaft Speed	r/min	Display Value =(Output Frequency Hz) × Functional Parameter 01. 50 (Speed display factor) When display value is more than 10000, ×10 LED is on .and load speed= display value × 10.
C_10	PID command value	None	The PID command value is displayed after conversion to the virtual physical values (e.g., temperature or pressure) of the object to be controlled using function parameter 01. 40 and 01. 41 data (PID display coefficients A and B). Display value = (PID command value) ×(Coefficient A - B) + B When PID control is set as no action, it displays "—".

Keypad Display	Item	Unit	Description
C_11	PID Feedback amount	None	The PID feedback amount is displayed after conversion to the virtual physical values (e.g., temperature or pressure) of the object to be controlled using function parameter 01.40 and 01.41 data (PID display coefficients A and B). Display value = (PID feedback amount) × (Coefficient A - B) + B When PID control is set as no action, it displays "—".
C_12	Torque Limit Value	%	Driving torque limit value A (based on motor rated torque)
C_13	Torque Limit Value	%	Braking torque limit value B (based on motor rated torque)
C_14	Ratio setting(*1)	—	When this setting is 100%, the LED monitor shows 1.00 time of the value to be displayed. When no rate setting value is selected, it displays "—".
C_15	Line Speed (*1)	m/min	Display Value=(Output Frequency Hz) × Functional Parameter 01.50 (speed display coefficient) When display value is more than 10000, ×10 LED is on and line speed= display value × 10.
C_16	Reserved (*1)	—	—
C_17	Reserved (*1)	—	—
C_18	Reserved (*1)	—	—
C_19	Reserved (*1)	—	—
C_20	Reserved (*1)	—	—
C_21	PID Output Value(*1)	%	Display PID output value, displayed in % (assuming the maximum frequency as 100%). When PID control is set as no action, it displays "—".
C_22	Magnetic flux command value (*1)	%	It displays Flux command value in %.
C_23	Running Status 2(*1)	None	Display the run status 2 in 4-bit in hexadecimal. Refer to ■ Run Status (C_07) and Display Method of Run Status 2 (C_23) on the following page on detailed information.
C_24	Motor Temperature (*1)	℃	Temperature detected by the NTC thermistor built in the motor. When it is not connected NTC thermistor setting, it displays
C_25	Reserved (*1)	—	—
C_26	Reserved (*1)	—	—
C_27	Reserved (*1)	—	—
C_28	Reserved (*1)	—	—

(\*1) Adapt to above 18.5kW (include 18.5kW).

■ Run Status (C\_07 ) and Display Method of Run Status 2(C\_23 )

To display the run status /run status 2 in 4-bit in hexadecimal, as shows in table below.


Bit Distribution of Run Status (C\_07 )

Bit	Mark	Content	Bit	Mark	Content
15	mBUSY	Writing functional parameter data is 1.	7	mVL	Voltage in limiting is 1.
14	Reserved	0	6	mTL	Torque in limiting is 1.
13		0	5	mNUV	DC bus voltage> Low voltage level is 1
12	mRL	Valid communication (run instruction, setting frequency status) is 1.	4	mBRK	Braking is 1.
11	mALM	Alarming is 1.	3	mINT	Output open circuit of inverter is 1.
10	mDEC	Speed reducing is 1.	2	mEXT	DC in braking is 1.
9	mACC	Speed accelerating is 1.	1	mREV	Reverse rotation is 1.
8	mL	Current in limiting is 1.	0	mFWD	Forward rotation is 1.

Bit Distribution of Run Status (C\_23 )

Bit	Mark	Content	Bit	Mark	Content
15	-	Reserved	7	-	Speed in Limiting (in Torque Control)
14			6	-	Reserved
13			5	-	Motor Selection
12			4	-	00: Motor 1 01: Motor 2 10: Motor 3 11: Motor 4
11			3	-	Control Method 0000: V / f control with slip compensation inactive 0001: Dynamic torque vector control 0010: V/f Control with Slip Compensation active
10			2	-	
9			1	-	
8			0	-	

### Display Example of Run Status

LED No.	LED4				LED3				LED2				LED1				
Bit	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0	
Mark	mBUSY	mWR	mRL	mALM	mDEC	mACC	mL	mVL	mTL	mNUV	mBRK	mINT	mEXT	mREV	mFWD		
Display Example	Binary System	1	0	0	0	1	0	0	0	0	0	1	1	0	0	0	1
	LED keypad In hexadecimal	<div style="text-align: center;">           LED4 LED3 LED2 LED1   </div>															

#### ■ Hexadecimal conversion table

Use binary system 4 bit unit to be converted into hexadecimal. The conversion table is as the following.

#### Conversion of Binary and Hexadecimal

Binary				Hexadecimal	Binary				Hexadecimal
0	0	0	0	0	1	0	0	0	8
0	0	0	1	1	1	0	0	1	9
0	0	1	0	2	1	0	1	0	A
0	0	1	1	3	1	0	1	1	b
0	1	0	0	4	1	1	0	0	c
0	1	0	1	5	1	1	0	1	d
0	1	1	0	6	1	1	1	0	E
0	1	1	1	7	1	1	1	1	F

### 3.4.3 Checking I/O signal status

Menu #d "I/O Checking" in Programming mode allows you to check the I/O states of digital and analog signals. It is used to check the running status during maintenance or test running.

#### "I/O Checking" Items

Keypad Display	Item	Description
d_00	Input signals on the control circuit terminals(Input/output)	Display ON/OFF status of I/O signals on the control circuit terminal block. refer to the next page*■ I/O Display of Control Terminal" for related details.
d_01	Reserved	—
d_02	Terminal AVI Input Voltage	Display terminal AVI input voltage. Unit: V
d_03	Terminal ACI Input Current	Display terminal ACI input current. Unit: mA
d_04	Terminal AFM Output Voltage	Display terminal AFM output voltage. Unit: V
d_05	Terminal DFM Output Voltage(*1)	Display terminal DFM output voltage. Unit: V
d_06	Terminal DFM Output Frequency	Display terminal DFM output pulse count in unit time. Unit: p/s
d_07	Terminal AUI Input Voltage	Display terminal AUI input voltage. Unit: V
d_08	Terminal AFM Output Current(*1)	Display terminal AFM output current. Unit: mA
d_10	Reserved	—

### "I/O Checking" Items

Keypad Display	Item	Description
d_11	Terminal MI7 Pulse Input Monitor	Display pulse count of input terminal MI7 pulse train signal.
d_15	Reserved	—
d_16	Reserved	—
d_17	Reserved	—
d_18	Reserved	—
d_19	Reserved	—
d_20	Reserved	—
d_21	Reserved	—
d_22	Reserved	—
d_23	Reserved	—
d_24	User Timing Sequence Timer Monitoring (*1)	Monitor functional parameter 10.91 set user timing sequence timer and counter values.

(\*1) Adapt to above 18.5kW (include 18.5kW).

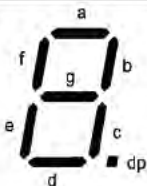
#### ■ I/O Display of Control Terminal

I/O signal status of control terminal displays the I/O status of terminal block in two ways, "LED Each Segment On/Off" "Display in Hexadecimal".

#### ▪ LED Each Segment On/Off Display

As in following table and the following Fig, the segments a~dp of LED1 and LED2 are on when the digital output terminals (FWD、REV、MI1~MI7) are on, and off when OFF. The segments a~e of LED 3 are on when output terminals MO1~MO2-MCM are closed, and off when disconnected. The segment a of LED 4 is used to represent terminal RA/RB/RC. When terminal RC and terminal RA appear short circuit, segment a of LED 4 is on and is off when it is disconnected.

Tips: When all signals are disconnected, all segments g of (LED1~LED4) are on("—").



Segment Displays of External Signal Information

Segment	LED4	LED3	LED2	LED1
a	RA/RB/RC	MO1~MCM	MI7	FWD
b	—	MO2~MCM	—	REV
c	—	—	—	MI1
d	—	—	—	MI2
e	—	—	—	MI3
f	—	—	—	MI4
g	—	—	—	—
dp	—	—	—	—

● Display in Hexadecimal

Distribute all I/O terminals as 16-bit binary system from 0 bit to 15-bit. It is viewed as "0" when there is no distribution. Distributed data is displayed as 4-bit hexadecimal number system number in keypad (0~F).

Digital input terminals FWD and REV are distributed to bit 0 and bit 1. MI1~MI7 are distributed to bits 2~8. In all bits, when all input terminals are ON, it is set as "1", and it is set as "0" when OFF. E.g., when terminals FWD and MI1 are ON and the rest are OFF, the display of LED4~LED1 is 0005.

Digital output terminals MO1~MO2 are distributed to 0-1. When output terminals MO1~MO2-MCM are ON (short circuit), it is set as "1". When OFF (disconnected), it is set as "0".

The status of contact output terminals RA/RB/RC is distributed to bit 8. When the output terminals RA-RC are closed, it is set as "1". When RA-RC is disconnected, it is set as "0". E.g. when the terminal MO1 is ON, MO2 is OFF, RA-RC is closed, the display of LED4~LED1 is 0101.

Terminals distributed as 0-15 bits and 7-segment LED hexadecimal display examples are as the following.

Hexadecimal Display of 7-segment LED (Examples)

LED No.	LED4				LED3				LED2				LED1			
Bit	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Input terminal	—	—	—	—	—	—	—	MI7	—	—	MI4	MI3	MI2	MI1	REV	FWD
Output terminal	—	—	—	—	—	—	—	RA/RB/RC	—	—	—	—	—	—	MO2	MO1
Display Example (Input terminal) LED keypad In hexadecimal	Binary System	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1
<div style="display: flex; justify-content: center; gap: 10px;"> <span>LED4</span> <span>LED3</span> <span>LED2</span> <span>LED1</span> </div>																



### 3.4.4 Reading maintenance Information

Menu code E “Maintenance Information: E.C\_S” of program mode displays necessary information in inverter maintenance.

Maintenance Information Items

Keypad Display	Item	Display Contents
E_00	Cumulative run time	Displays the content of the accumulative power-on time counter of the inverter. Measurement Range: 0~65,535 h Display: Divided the accumulative run time into interactive display of front 2 bits and back 3 bits. E.g. 0 ⇔ 535h (535 h) 65 ⇔ 535h (65,535 h) When the back 3 bits are displayed, it displays h (hour) at the final bit. When the count exceeds 65,535 hours, the counter will be reset to "0" and start over again.
E_01	DC link bus voltage	Displays the DC link bus voltage of main circuit of inverter. Unit: V
E_02	Max. Temperature inside the Inverter(*1)	Displays the max temperature –inside of the inverter for per hour. Unit: °C (it displays 20 °C when it is below 20 °C.)
E_03	Max. Temperature of cooler	Displays the max temperature of –cooler for per hour. Unit: °C (it displays 20 °C when it is below 20 °C.)
E_04	Max. effective current	Displays the maximum current in RMS for per hour. Unit: A
E_05	Reserved	—
E_06	Reserved	—
E_07	Cumulative running time of the cooling fan	Displays the content of the cumulative running time of the cooling fan. When the cooling fan ON-OFF control (functioncode 04.06) is valid and the fan stops, the counter does not work. Displays method is the same with E_06.
E_08	Number of startups for the 1 <sup>st</sup> motor	Cumulative starting times of the 1st motor and display value Measurement Range: 0~65,530 times Display: 0~9999 If it is beyond 10,000 times, ×10 LED is on. It displays by dividing the times by 10. When it is beyond 65,530 times, it will be reset to "0" and start over again
E_09	Input watt hour	Displays Input watt hour Displays: 0.001~9999 Input watt hour= "Display" × 100kWh It can reset Input watt hour and accumulative power data through setting functional parameter.01. 51 as "0.000" When it is beyond 999,900kWh, it will be reset to "0" and start over again.

Maintenance Information Items(continued)

Keypad Display	Item	Display Contents
E_10	Cumulative power data	Cumulative power data means the data of Input watt hour(kWh)*functional parameter 01. 51. The setting range of functional parameter 01. 51 is 0.000~9999. Displays Unit: None (Display: 0.001~9999. it will be reset to"0" when it is more than 9999. (fixed at 9999)) According to the accumulative power data, move the decimal point, and change the display resolution. It can reset accumulative power data through setting functional parameter 01. 51 as "0.000".
E_11	RS485 error times (communication port 1)	Cumulated error times in RS485 communication (communication port 1: connection of keypad). When it is beyond 9,999 times, it will be reset to"0" and start over again
E_12	RS485 error content (communication port 1)	Latest error appears in RS485 communication (communication port 1). It displays in decimal system code form.
E_13	Reserved	—
E_14	TheInverter ROM version	The ROM version of inverter is displayed in 4 bits form.
E_15	Keypad ROM version	The ROM version of keypad is displayed in 4 bits form.
E_16	RS485 error times (communication port 2)	Accumulated error times in RS485 communication (communication port 2: terminal block). When it is beyond 9,999 times, it will be reset to"0" and start over again
E_18	RS485 error content (communication port 2)	Latest error appears in RS485 communication (communication port 2: terminal block). It displays in decimal system code form.
E_19	Reserved	—
E_20	Reserved	—
E_21	Reserved	—
E_23	Cumulative running time of motor 1	Displays cumulative power-ON time counter of the 1st motor. Measurement Range: 0~99,990 h Display: 0~9999×10 LED on (Accumulative running time of motor = display value × 10 h) If it is beyond 99,990 hours, it will be reset to"0" and start over again.
E_24	temperature value inside the inverter(*1)	Displays the -current temperature inside the inverter. Unit: °C
E_25	Temperature value of the cooler(*1)	Displays the current temperature of cooler inside the inverter. Unit: °C
E_26	Reserved(*1)	—
E_27	Reserved(*1)	—
E_28	Cumulative running time of motor2(*1)	Displays cumulative power-ON time counter of the 2nd motor. Display method is the same with E_23.
E_29	Cumulative running time of motor 3(*1)	Displays cumulative power-ON time counter of the 3rd motor. Display method is the same with E_23.
E_30	Cumulative running time of motor 4(*1)	Displays cumulative power-ON time counter of the 4th motor. Display method is the same with E_23.
E_31	Remaining time before the next maintenance for motor 1(*1)	Displays the time remaining before the next maintenance, which is estimated by subtracting the cumulative run time of motor 1 from the maintenance interval specified by 04. 78 Display: 0~9999 ×10 LED on (remaining time for maintenance = display value × 10 h/)

Maintenance Information items (continued)

Keypad Display	Item	Display Contents
E_32	Number of startups for the 2 <sup>nd</sup> motor (*1)	Displays cumulative starting times of the 2 <sup>nd</sup> motor. Display method is the same with E_08
E_33	Number of startups for the 3 <sup>rd</sup> motor (*1)	Displays cumulative starting times of the 3 <sup>rd</sup> motor. Display method is the same with E_08
E_34	Number of startups for the 4 <sup>th</sup> motor (*1)	Displays cumulative starting times of the 4 <sup>th</sup> motor. Display method is the same with E_08
E_35	Remaining startup times before the next maintenance for the 1 <sup>st</sup> motor (*1)	Displays the startup times remaining before the next maintenance, which is estimated by subtracting the number of startups from the preset startup count for maintenance specified by 04. 79 Display method is the same with E_08
E_36	Latest Light alarm (*1)	Displays Latest Light alarm content as an alarm code.
E_37	Last Light alarm (*1)	Displays the last light alarm as an alarm code. For the details, refer to “Chapter 7 Failure Indication and Countermeasures”
E_38	2 <sup>nd</sup> Last Light alarm (*1)	Displays the 2 <sup>nd</sup> last light alarm as an alarm code. For the details, refer to “Chapter 7 Failure Indication and Countermeasures”
E_39	3 <sup>rd</sup> Last Light alarm (*1)	Displays the 3 <sup>rd</sup> last light alarm as an alarm code. For the details, refer to “Chapter 7 Failure Indication and Countermeasures”
E_40	Reserved (*1)	—
E_41	Reserved (*1)	—
E_42	Reserved (*1)	—
E_43	Reserved (*1)	—
E_44	Reserved (*1)	—

(\*1) Adapt to above 18.5kW (include 18.5kW)

### 3.4.5 Reading Alarm Information

Menu code F “Alarm Information” in programming mode displays cause of the past 4 alarms information as an alarm code, It is also possible to display the related alarm information on the current inverter conditions detected when the alarm happened. The display content of “Alarm Information” is listed in table below.

Alarm Information Items

Keypad Display	Display Content	Description
F_00	Output frequency	Output frequency before slip compensation
F_01	Output current	Output current
F_02	Output voltage	Output voltage
F_03	Calculated torque	Calculated motor output torque
F_04	Setting frequency	Setting frequency
F_05	Rotational direction	Displays the output run direction. F: : Forward \, r: Reverse, —: Stopped
F_06	Running status	Displays the running status with 4-bit in hexadecimal. Refer to ■Running Status (C_07 ) (C_23 ) of “3.4.2 Run Status Monitoring Item” on detailed information.

Alarm Information items (continued)


Keypad Display	Display Content	Description
F_07	Cumulative running time	Displays the cumulative time of power-ON time counter of the inverter. Measurement Range: 0~65,535 h Display: Divided the accumulative run time into interactive display of front 2 bits and back 3 bits. E.g. 0 ↔ 535h (535 h) 65 ↔ 535h (65,535 h) When the back 3 bits are displayed, it displays h (hour) at the final bit. If it is beyond 65,535 hs, it will be reset to "0" and start over again.
F_08	Number of startups	Displays the content of the motor startup counter. Measurement range: 0~65,530 times Display: 0~9999 When the count is more than 10,000 times, the ×10 LED is on. It displays the times value of divided by 10. When the count is beyond 65,530 times, it will be reset to "0" and start over again.
F_09	DC link bus voltage	Displays the DC link bus voltage of main circuit of inverter. Unit: V
F_10	Temperature inside the Inverter(*1)	Displays the temperature inside inverter. Unit: °C
F_11	Max. temperature of cooler	Displays the max. temperature of the cooler. Unit: °C
F_12	Terminal I/O signal status	Displays ON/OFF status of digital I/O terminal. refer to "I/O Display of Control Terminal" of "3.4.3 Detection I/O Signal Status" on related display contents.
F_13	Terminal input signal status (Display in Hexadecimal)	
F_14	Terminal output signal status (Display in Hexadecimal)	
F_15	Continuous appearance times	The continuous appearance time of the same alarm.
F_16	Multiple alarm 1	Appear the 1 <sup>st</sup> alarm codes simultaneously (it displays "—" when there is no alarm has appeared.)
F_17	Multiple alarm 2	Appear the 2 <sup>nd</sup> alarm codes simultaneously (it displays "—" when there is no alarm has appeared.)
F_18	Reserved	—
F_19	Reserved	
F_20	Reserved	
F_21	Error sub code	Secondary error code for alarms.
F_22	Run status 2(*1)	Displays the run status 2 in 4-bit in hexadecimal. Refer to ■Run Status (C_07) (C_23) of "3.4.2 Run Status Monitoring Item" on detailed information.
F_23	Speed detection value	Displays speed detection value.

(\*1) Adapt to above 18.5kW (include 18.5kW).

### 3.5 Alarm Mode

When an alarm appears, then is the inverter switches to alarm mode automatically, and it displays the alarm code in the keypad.


#### ■ Resetting alarm

After the alarm cause is removed and key  is pressed, the alarm condition will be reset, and the inverter will go back to the Running mode.

#### ■ Displays alarm history

In addition to the current (latest) alarm, we can view past 3 alarms and multiple alarms, press  /  keys when the current (latest) one is displayed.

#### ■ Display of running status information at the time of alarm

When displaying alarm code, press  key and you can confirm the output frequency, output current and all kinds of running information. The item No. and data of all kinds of running information can be displayed alternatively.

Note: After the alarm cause is removed and key  is pressed, the alarm condition will be reset, the motor will be operated immediately if there is running instruction. Be careful!

#### ■ Transition to Programming mode

If double key operation of  key +  key is executed under alarm information is displayed, it is switched to programming mode and it can take modification for function-code data.

## 4.1 Test Run

### 4.1.1 Confirmation before power-ON

Before power- ON, check the following items.

(1) Check that the wiring is correct.

Especially check the wiring to the inverter input terminals L1/R, L2/S and L3/T and output terminals U, V, and W. Also check that the grounding wires are connected to the grounding terminals (⊕G) correctly. (See Fig 4.1)

#### **⚠ Danger**

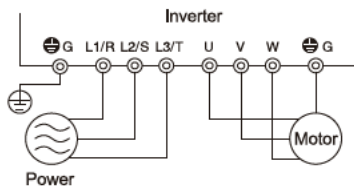
- Never connect power supply wires to the inverter output terminals U, V, and W. Doing so and turning the power ON breaks the inverter.
- Make sure to connect the grounding wires of the inverter and motor to the ground electrodes. **Otherwise, it may cause electric shock!**

(2) Check the control circuit terminals and main circuit terminals for short circuits or ground faults.

(3) Check for loose terminals, connectors and screws.

(4) Check that the motor is separated from mechanical equipment.

(5) Make sure that all switches of devices connected to the inverter are turned OFF. Power-ON the inverter with any of those switches being ON may cause an unexpected motor operation.



Connection Diagram of Main  
Circuit Terminals

### 4.1.2 Selection for a desired Motor driven Control

00. 42* Data	Control Method	Basic Control	Speed Feedback	Control Method	Speed Control	Other Restriction
0	V/f Control with slip compensation inactive	V/f Control	Disable	V/f	Frequency Control	—
1	Dynamic torque vector control				Frequency Control with Slip Compensation	—
2	V/f Control with Slip Compensation active				—	
5	Vector control without speed sensor	Vector Control	Estimated speed	without PG	Speed control with automatic speed regulator (ASR)	Max. output frequency: 120Hz

#### ■ V/f Control with slip compensation inactive

Under this control, the inverter controls a motor with the voltage and frequency according to the V/f pattern specified by function parameters. Because the transfer compensations disabled, causes the output to have the slip fluctuation.

#### ■ V/f Control with Slip Compensation active

Applying any load to an induction motor causes a rotational slip due to the motor characteristics, decreasing the motor rotation. The inverter's slip compensation function first presumes the slip value of the motor based on the motor torque generated and raises the output frequency to compensate for the decrease in motor rotation. This prevents the motor from decreasing the rotation due to the slip. That is, this function is effective for improving the motor speed control accuracy.

Related function parameters of compensation amount: 03. 12(rated slip frequency), 03. 09(Slip compensation gain for driving), 03. 11(Slip compensation gain for braking).

Furthermore, through functional parameter 04. 68, it can set valid/invalid slip compensation according to all status of motor.

04. 68 Data	Motor driving conditions		Motor driving Frequency range	
	Accel/Decel.	Constant speed	Base frequency or below	Above the base frequency
0	Valid	Valid	Valid	Valid
1	Invalid	Valid	Valid	Valid
2	Valid	Valid	Valid	Invalid
3	Invalid	Valid	Valid	Invalid

#### ■ Dynamic torque vector control

To get the maximal torque out of a motor, this control calculates the motor torque for the load applied and uses it to optimize the voltage and current vector output. Selecting this control automatically enables the auto torque boost and slip compensation function.

This control is effective for improving the system response to external disturbances such as load fluctuations, and the motor speed control accuracy.

Note that the inverter may not respond to a rapid load fluctuation since this control is an open-loop V/f control that does not perform the current control, unlike the vector control. The advantages of this control include larger maximum torque per output current than that the vector control.

#### ■ Vector control without speed sensor

This control estimates the motor speed based on the inverter's output voltage and current to use the estimated speed for speed control. It also decomposes the motor drive current into the exciting and torque current components, and controls each of those components in vector. No PG (pulse generator) interface card is required. It is possible to obtain the desired response by adjusting the control constants (PI constants) using the speed regulator (PI controller).

The control regulating the motor current requires some voltage margin between the voltage that the inverter can output and the induced voltage of the motor. Usually a general-purpose motor is so designed that the voltage matches the commercial power. Under the control, therefore, it is necessary to suppress the motor terminal voltage to the lower level in order to secure the voltage margin required. However, driving the motor with the motor terminal voltage suppressed to the lower level cannot generate the rated torque even if the rated current originally specified for the motor is applied. To ensure the rated torque, it is necessary to increase the rated current. (This also applies to vector control with speed sensor.)

Note: Since slip compensation, dynamic torque vector control, and vector control without speed sensor use motor parameters, the following conditions should be satisfied; otherwise, full control performance may not be obtained.

- 1 control motor
- Motor parameters 03. 02, 03. 03, 03. 06-03, 23, 03. 55 and 03. 56 should be properly configured or auto-tuning should be performed.
- The capacity of the motor to be controlled should be two or more ranks lower than that of the inverter under the dynamic torque vector control; it should be the same as that of the inverter under the vector control with/without speed sensor, the inverter may not control the motor due to decrease of the current detection resolution.

• The wiring distance between the inverter and motor should be 50m (or 164ft) or less. If it is longer, the inverter may not control the motor due to leakage current flowing through stray capacitance to the ground or between wires. Especially, small capacity inverters whose rated current is also small may be unable to control the motor correctly even when the wiring is less than 50m (or 164ft). In that case, make the wiring length as short as possible or use a wire with small stray capacitance to minimize the stray capacitance.

#### 4.1.3 Function parameters basic Settings and auto-tuning <1> of V/f Control / Common Dynamic Torque Vector Control

When under "V/f control (00. 42=0. 2)" or "Common Dynamic Torque Vector Control (00. 42= 1)", it is adopted to drive general motor and the wiring between the motor and inverter is too long or reactor is connected, it requires configuring the basic function parameters or implement auto-tuning for motor controlling before starting operation, set the function parameters data in the following table according to the motor ratings on the motor's nameplate.

Function parameter	Function	Data	Factory default
00. 04 *	Base frequency 1	Motor ratings (printed on the nameplate of the motor)	50Hz
00. 05 *	Rated voltage at base frequency 1		380V
03. 02 *	Motor 1 (Rated capacity)		Nominal applied motor capacity
03. 03 *	Motor 1 (Rated current)		Rated current of nominal applied motor
00. 03 *	Max. output frequency 1	Machinery design values Note: For a test-driving of the motor, increase values so that they are longer than your machinery design values. If the specified time is short, the inverter may not run the motor properly.	50Hz
00. 07	Acceleration time 1		Below 22kW: 6.00s Above 30kW: 20.00s
00. 08 *	Deceleration time 1		

Note: When configuring the function parameter 03. 02, take into account that changing the data automatically updates the data of the function parameters 03. 03, 03. 06~03. 23, 03. 53~03. 56 and 04. 46.

#### Auto-tuning procedure

##### (1) Selection of auto-tuning type

Select "auto-tuning under motor stopped status (03. 04\* = 1)" or "auto-tuning under motor running status (03. 04\* = 2)". For the latter tuning, set appropriate acceleration and deceleration (00. 07, 00. 08) times, and specify the rotation direction that matches the actual rotation direction of the machinery.

03. 04 Data	Auto-Tuning type	Motor parameters subjected to tuning	Tuning Action	Select under the following conditions
1	Tune while the motor stops	Primary resistance %R1 (03. 07*) Leakage reactance %X (03. 08*) Rated Slip (03. 12*) % X correction factor 1 (03. 53, 03. 54)	Tuning with the motor stopped	Cannot rotate the motor





03. 04 Data	Auto-Tuning type	Motor parameters subjected to tuning	Tuning Action	Select under the following conditions
2	Tune while the motor is rotating under V/f control	No-load current (03. 06 *) Primary resistance% R1 (03. 07 *) Leakage reactance% X (03. 08 *) Rated Slip frequency (03. 12 *) Magnetic saturation factors 1-5 Magnetic saturation expansion factors a ~ c (03. 16 * ~ 03. 23 *) % X correction factor 1, 2 (03. 53 * 03. 54 *)	Tuning the %R1 and %X, with the motor stopped. Tuning the no-load current and magnetic saturation factor, with the motor running at 50% of the base frequency. Tuning the rated slip frequency, with the motor stopped.	Under no-load status (motor idling, not connect to the mechanical transmission part) Tuning with load applied decreases the tuning accuracy.

When taking auto-tuning for 03. 04, auto-tuning data is saved in the function parameter of motor 1\*.

## (2) Mechanical System Preparation

Take dismantling for motor gearing.

### (3) Auto-tuning execution procedures

- ① Set "1" or "2" in function code 03. 04 and press  key.
- ② Enter a run command. (Press  key on keypad as forward running. If it takes reverse running, change the data of function parameter 00. 02).
- ③ After enter a run command, Tuning starts with the motor stopped. Auto-tuning time: max. 40 to 80 s.
- ④ When function parameter 03. 04\* = 2, after the tuning in ③ above, the motor is accelerated to around 50% of base frequency and then tuning starts Upon completion of measurements, the motor decelerates to a stop.  
(Estimated tuning time: Acceleration time + 20 to 75s + Deceleration time)
- ⑤ When function parameter 03. 04\* = 2, after the motor deceleration to a stop in ④ above, tuning continues with the motor stopped.  
(Max. tuning time: 40 to 80s).
- ⑥ Automatically turn the run command OFF to complete tuning.

### ■ Auto-tuning errors

Improper tuning would negatively affect the operation performance and, in the worst case, could even cause hunting or deteriorate precision. Therefore, if the inverter finds any abnormality in the tuning results or any error in the tuning process, it displays er7 and discards the tuning data.

Listed below are possible causes that trigger tuning errors.

Main tuning error causes	Content
Error in tuning results	When it has been detected that interphase voltage unbalance or output phase loss, or Tuning has resulted in an abnormally high or low value of a parameter due to the output circuit opened.
Output current error	An abnormally high current has flown during tuning.
Sequence error	During tuning, when a run command has been turned OFF, or force to stop [mSTOP], or Coast to a stop [mBX], to Protect from dew condensation, [mDWP] or other similar terminal command has been received as so on.
Error due to limitation	During tuning, any of the operation limiters has been activated.
Errors appears	An undervoltage or any other alarm has occurred.

Note: Do not execute motor tuning with output filter unless the filter is a reactor type only. A tuning error may result if any other type filter is in use., please set the primary resistance% R1, leakage reactance% X, no-load current, and rated slip frequency of the inverter in function parameters before replacement.

Vibration that may occur when the motor's coupling is elastic can be regarded as normal vibration due to the output voltage pattern applied in tuning. The tuning does not always result in an error; however, run the motor and check its running state.

#### 4.1.4 Basic Function parameters Setting and Auto-tuning of Vector Control without Sensor <2>

If no sensor control (00. 42 = 5) is adopted, No matter what kind of motor need to be auto-tuning. set the function parameters data in the following table according to the motor ratings on the motor's nameplate.

Function parameter	Function	Data	Factory default
00. 04 *	Base frequency 1	Motor ratings (printed on the nameplate of the motor)	50Hz
00. 05 *	Rated voltage at base frequency 1		380V
03. 02 *	Motor 1(Rated capacity)		Nominal applied motor capacity
03. 03 *	Motor 1 (Rated current)		Rated current of nominal applied motor
00. 03 *	Max. output frequency	Machinery design values Note: For a test-driving of the motor, increase values so that they are longer than your machinery design values. If the specified time is short, the inverter may not run the motor properly	50Hz
00. 07	Acceleration time 1		Below 22kW: 6.00s Above 30kW: 20.00s
00. 08	Deceleration time 1		

Note: When 03. 02 is changed, 03. 03, 03. 06~03. 23, 03. 53~03, 56, 04. 46 will be modified automatically.

When it is no sensor torque control, to reduce motor rated voltage (reference frequency voltage) control, please set regulated value for the reference frequency. After self-learning, it takes control automatically values lower than reference frequency voltage.

##### ■ Auto-tuning procedure

##### (1) Selection of tuning type

Select "auto-tuning under motor running status (03. 04\* = 1)". As the running of motor, please set appropriate acceleration and deceleration (00. 07, 00. 08) time value. Furthermore, set running direction with combination actual running direction of mechanical equipments.

Note: For "auto-tuning under motor running status (03. 04\* = 3)" cannot be selected due to the equipments, please refer to " ■ Countermeasures when auto-tuning under motor running status cannot be executed".

All types of control methods are displayed in "V/f:V/f control", "No PG: vector control without sensor".

03. 04*	Auto-Tuning type	Motor parameters subjected to tuning	Tuning Action	Selection Condition of Auto-tuning type	Control Method	
					V/f	with -out PG
1	Tune while the motor stops	Primary resistance %R1 (03. 07*) Leakage reactance %X (03. 08*) Rated Slip (03. 12*) % X correction factor 1 (03. 53, 03. 54)	Tuning with the motor stopped	Cannot rotate the motor	○	△
2	Tune while the motor is rotating under V/f control	No-load current (03. 06 *) Primary resistance %R1 (03. 07 *) Leakage reactance %X (03. 08 *) Rated Slip frequency (03. 12 *) Magnetic saturation factors 1 - 5	Tuning the %R1 and %X, with the motor stopped. Tuning the no-load current and magnetic saturation factor, with the motor running at 50% of the base frequency. Tuning the rated slip frequency, with the motor stopped.	Under no-load status (motor idling, not connect to the mechanical transmission part) Tuning with load applied decreases the tuning accuracy.	○	×
3	Tune while the motor is rotating under Vector control	Magnetic saturation expansion factors a ~ c (03. 16 * ~ 03. 23 *) % X correction factor 1, 2 (03. 53 * 03. 54 *)	Tuning the %R1 and %X, the rated slip Frequency with the motor stopped. Tuning the no-load current and magnetic saturation factor, with the motor running (at 50% of the base frequency).		×	○

○: Auto-tuning available △: Using with additional conditions ×: Auto-tuning unavailable


Motor constants after Auto-tuning will be saved in corresponding function parameters automatically.

#### (2) Preparation Mechanical System

Take dismantling for motor gearing

#### (3) Auto-tuning procedures for vector control running

① Set "3" in function parameter 03. 04 and press  key.

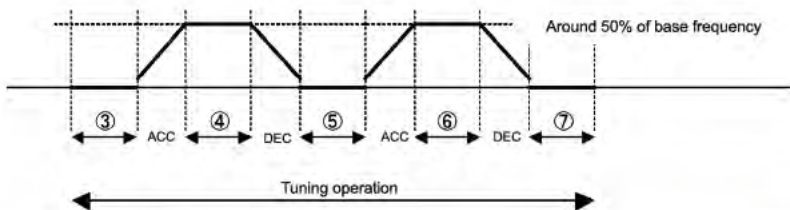
② Enter a run command. (Set  key on keypad as forward running. If it takes reverse running, Change the data of function parameter 00. 02).

③ Enter a run command, Tuning starts with the motor stopped. (Tuning time: max. 40~75s)

④ The motor is accelerated to approximately 50% of the base frequency and then tuning starts. Upon completion of auto-tuning, the motor decelerates to a stop. (Estimated tuning time: acceleration time + 20~75s + deceleration time)

⑤ After the motor decelerates to a stop, tuning continues with the motor stopped. (Tuning time: max. 20~35s.)

- ⑥ The motor is again accelerated to approximately 50% of the base frequency and then tuning starts. Upon completion of auto-tuning, the motor decelerates to a stop. (Estimated tuning time: acceleration time + 20~160 + deceleration time)
- ⑦ After the motor decelerates to a stop, tuning continues with the motor stopped. (Tuning time: max. 20~30s.)
- ⑧ After auto-tuning is completed, a run command is changed into OFF automatically. Tuning is ended.



Note: The default value of the speed regulator is set low to prevent your system from oscillation (hunting). However, hunting may occur during tuning due to machinery-related conditions, causing a tuning error (Er7) or a speed mismatch error (ErE). If a tuning error (Er7) happens, reduce the gain for the speed regulator; if a speed mismatch error (ere) occurs, cancel the speed mismatch detection function (09, 23=0). After that, perform tuning again.



■ If tuning while the motor is rotating cannot be selected

If the "tuning while the motor is rotating under vector control (03, 04\*=3)" cannot be selected due to restrictions on the machinery, perform the "tuning with the motor stops (03, 04\*=1)" by following the procedure below. Compared to the former tuning, the latter may show rather inferior performance in the speed control accuracy or stability, perform sufficient tests beforehand by connecting the motor with the machinery.

(1) Under the condition of motor parameters are not clear.

- ① Specify the 00, 04\*, 00, 05\*, 03, 02\*, and 03, 03\* data according to the motor rated values printed on the motor's nameplate.
- ② Specify motor parameters by obtaining the appropriate values on the datasheet issued from the motor manufacturer. (03, 06\*, 03, 16\*~03, 23\*)
- ③ Execute "the "tuning with the motor stops" (03, 04\* = 1)"

(2) Execution procedures to stop auto-tuning

- ① Set "1" in function code 03, 04 and press  key.
- ② Enter a run command. (Set  key on keypad as forward running. If it takes reverse running, please modify function code 00, 02).
- ③ Enter a run command, it starts tuning with the motor stopped (Tuning time: max. 40s)
- ④ Automatically turns the run command OFF to complete tuning.

■ Auto-tuning errors

Remove the error cause, Refer to the basic function parameters of V/f Control / Common Dynamic Torque Vector Control to set and auto-tuning. ■ <1> Auto-tuning errors

#### 4.1.5 Running the inverter for motor operation check

After completion of preparations for a test run as described above, start running the inverter for motor operation check using the following procedure.

- (1) Set a low reference frequency such as 5Hz, using  $\wedge$  /  $\vee$  keys on keypad.
  - (2) After pressing  $\text{RUN}$  key, the inverter starts forward running.
  - (3) Press  $\text{STOP}$  key, and the inverter is decelerated and stopped.
  - (4) Check that the motor is running in the forward direction, and Check for smooth rotation without motor humming or excessive vibration, Check for smooth acceleration and deceleration.
- When no abnormality is found, then increase the reference frequency to start driving the motor, After test run is passed and it is confirmed there is not any problems, it can be running.

#### ※Modification of motor control function parameter data※

■ Modification at "Common V/f Control", "Common dynamic torque vector control" and "Vector control without sensor"

Modifying the current function parameter data sometimes can solve an insufficient torque or overcurrent incident, Main function parameters are as the following. See Chapter 5 "Function Parameters List" or Chapter 7 "Failure Indication and Countermeasures" on detailed contents.

Function parameter	Name	Regulation Points	Control Method	
			V/f	without PG
00. 07	Acceleration time 1	If the current limiter is activated due to a short acceleration time and large drive current, prolong the acceleration time.	○	○
00. 08	Deceleration time 1	If an overvoltage alarm occurs due to a short deceleration time, prolong the deceleration time	○	○
00. 09 *	Torque boost 1	If the starting motor torque is deficient, increase the torque boost. If the motor with no load is overexcited, decrease the torque boost.	○	×
00. 44	Current limiter (Mode selection)	If the stall prevention function is activated by the current limiter during acceleration or deceleration, increase the operation level.	○	×
00. 09 *	Motor 1 Slip compensation gain for driving	For excessive slip compensation during driving, decrease the gain; for insufficient one, increase the gain.	○	○
03. 11 *	Motor 1 Slip compensation gain for braking	For excessive slip compensation during braking, decrease the gain; for insufficient one, increase the gain.	○	○
00. 80 *	Output current fluctuation damping gain 1 for motor 1	If the motor vibrates due to current fluctuation, increase the suppression gain.	○	×

○: Valid    ×: Invalid

If any problem persists under "vector control without speed sensor", when the problems can not be eliminated even function parameters in above table are modified, then modify the following function parameter data.

The drive controls mentioned above use a PI controller for speed control. The PI constants are sometimes required to be modified because of the load inertia. The table below lists the main modification items.

See Chapter 5 "Function Parameters List" or Chapter 7 "Failure Indication and Countermeasures" on detailed contents.

Function parameter	Function	Modification key points
09. 01 *	Speed control 1 Speed command filter	If an excessive overshoot occurs for a speed command change, increase the filter constant.
09. 02 *	Speed control 1 Speed detection filter	If ripples are superimposed on the speed detection signal so that the speed control gain cannot be increased, increase the filter constant to obtain a larger gain.
09. 03 *	Speed control 1 P (Gain)	If hunting is caused in the motor speed control, decrease the gain. If the motor response is slow, increase the gain.
09. 04 *	Speed control 1 I integral time	If the motor response is slow, decrease the integral time.

#### 4.1.6 Preparation for practical operation

After verifying normal motor running with the inverter in a test run, connect the motor with the machinery and perform wiring for practical operation.

- (1) Configure the application related function parameters that operate the machinery.
- (2) Check interfacing with the peripheral circuits.

##### 1) Mock alarm

Generate a mock alarm by pressing the "STOP" key + "RUN" key" on the keypad for 5s or more and check the alarm sequence. The inverter should stop and issue an alarm output signal (for any fault).

##### 2) I/O checking

Check interfacing with peripherals using Menu d "I/O Checking" on the keypad in Programming mode.

##### 3) Analog input adjustment

Adjust the analog inputs on terminals AVI, ACI, AUI using the function parameters related to the offset, filter and gain that minimize analog input errors. For details, See Chapter 5 "Function Parameters List".

##### 4) Calibrating the [AFM] output

Calibrate the full scale of the analog meter connected to the terminal AFM. using the reference voltage equivalent to +10 VDC. To output the reference voltage, it is necessary to select the analog output test with the function code 00. 31 Calibrate full range of the meter.

##### 5) Clearing the alarm history

Clear the alarm history saved during the system setup with the function parameter (04. 97 = 1).

## 4.2 Special Operations

### 4.2.1 Jogging (inching) the motor

It shall take the following procedure for jogging

- (1) Enter into jogging status. (Displays JoG in keypad)

- Switch the inverter to Running mode.

- Press the "STOP" key + "UP" key" simultaneously. After displaying jogging frequency for 1s in the keypad, it returns to display JoG.

Tips: Function parameter 02, 20 specifies the jogging frequency, specify the acceleration and deceleration times for jogging respectively by function parameters 04. 54 and 04. 55.

It can also switch between the "Normal operation Status" and "ready-to-Jog Status" by using the input terminal command [mJOG].

Switching ("STOP" key + "UP" key) between the "Normal operation Status" and "ready-to-Jog Status" is valid only when it is stopped.

##### (2) Starting jogging

- Hold down the "RUN" key on keypad to continue jogging the motor, decelerate the motor to a stop after release the "RUN" key.

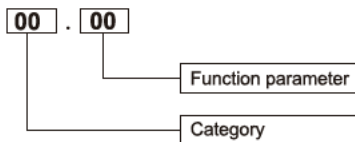
- (3) Exiting the inverter from the ready-to-jog status and returning to the normal operation status.

- Press "STOP" key + "UP" key" simultaneously

## 5.FUNCTION PARAMETERS LIST

### 5.1 Function Parameters List

Users can set the function parameter values to control and apply various functions of S3100 series inverter. Before starting to narrate this chapter, first describe function parameter format as follows:



Then function parameters are classified as follows:

Parameters	Function
00	Basic functions
01	External terminal functions
02	Control functions
03	Motor 1 parameters
04	Advanced functions
05	Motor 2 parameters

Parameters	Function
06	Motor 3 parameters (*1)
07	Motor 4 parameters(*1)
08	Application function 1
09	Application function 2(*1)
10	Application function 3(*1)
11	Serial communication function

(\*1) Adapt to above 18.5kW (include 18.5kW).

■ Changing, validating, and saving function parameters data when the inverter is running  
Function parameters are indicated by the following based on whether they can be changed or not when the inverter is running: The parameters that can be changed during operation are further divided into whether they are reflected in real time. The meanings are as described in the following table.

Mark	Change when running	Validating and saving function parameters data
⚡	possible (current state)	If the data of the parameters marked with ⚡ is changed with ⏴ and ⏵ keys, the change will immediately take effect; however, the change is not saved into the inverter's memory. To save the change, press the ⏴ key. If you press the ⏴ key without pressing the ⏵ key to exit the current state, then the changed data will be discarded and the previous data will take effect for the inverter operation.
⚡	possible (after confirmation)	Even if the data of the parameters marked with ⚡ is changed with ⏴ and ⏵ keys, the change will not take effect. Pressing the ⏴ key will make the change take effect and save it into the inverter's memory.



■ Using negative logic for programmable I/O terminals

To set the negative logic system for an input or output terminal, enter data of 1000s (by +1000 to the data for the normal logic) in the corresponding function parameters.

For example, Terminal MI1 in the case of selecting Jogging command [mJOG] through function parameter 01. 01, the relationship between the setting parameter and the corresponding action is as follows:

Function parameter 01. 01 data value	Action
10	When the terminal MI1 is ON, the jogging is activated
1010	When the terminal MI1 is ON, the jogging is activated

## 00 Basic functions parameters

	Para- meter	Parameter Functions	Setting Range	Fact- ory Defa- ult	Model	
					~15kW	18.5kW~
↗	00.00	Setting Data protection	0: Disable both keypad parameter protection and digital reference protection 1: Enable keypad parameter and disable digital reference protection . 2: Disable keypad parameter protection and enable digital reference protection 3: Enable both keypad parameter and digital reference protection	0	<input type="radio"/>	<input type="radio"/>
	00.01	Dominant frequency 1 source selection	0: The keypad potentiometer (Note: keypad  /  key, please set the 11, 50 end digit number to 2). 1: Analog voltage input (terminal AVI) (DC0 ~ + 10V) 2: Analog current input (terminal ACI) (DC4 ~ 20mA) 3: Analog voltage input (terminal AVI) + analog current input (terminal ACI) 5: Analog voltage input (terminal AUI) (DC0 ~ + 10V) 7: UP / DOWN control input 12: Pulse train input Note: refer to 04. 30 parameters for communication settings.	0	<input type="radio"/>	<input type="radio"/>



## 00 Basic functions parameters

Parameter	Parameter Functions	Setting Range	Factory Default	Model	
				~15kW	18.5kW~
00.02	Operation command source selection	1: External terminal command mode 2: keypad forward command mode 3: keypad reverse command mode	2	<input type="radio"/>	<input type="radio"/>
00.03	Maximum output frequency 1	25.0 ~ 500.0Hz	50.0	<input type="radio"/>	<input type="radio"/>
00.04	Base frequency 1	25.0 ~ 500.0Hz	50.0	<input type="radio"/>	<input type="radio"/>
00.05	Rated Voltage at Base Frequency 1	0: AVR invalid (Output a voltage in proportion to input voltage) 80~ 240V: AVR action (220V series) 160~ 500V: AVR action (440V series)	220/380	<input type="radio"/>	<input type="radio"/>
00.06	Maximum output voltage 1	80~ 240V: AVR action(220V series) 160~ 500V: AVR action(440V series)	220/380	<input type="radio"/>	<input type="radio"/>
↗ 00.07	Acceleration time 1	0.00~ 3600s ※ 0.00 Entering 0.00 cancels the acceleration time, requiring external soft-start.	Type Setting	<input type="radio"/>	<input type="radio"/>
↗ 00.08	Deceleration time 1			<input type="radio"/>	<input type="radio"/>
↗ 00.09	Torque boost 1	0.0~ 20.0% (percentage with respect to "Rated Voltage at Base Frequency 1")	Type Setting	<input type="radio"/>	<input type="radio"/>
↗ 00.10	Electronic Thermal Overload (Protection for Motor )1 Select motor characteristics	1: action (For a general-purpose motor with shaft-driven cooling fan) 2: action (For non-ventilated motor or motor with separately powered cooling fan, an inverter-driven motor.)	1	<input type="radio"/>	<input type="radio"/>
↗ 00.11	Electronic Thermal Overload (Protection for Motor )1 Detection level	0.00 (invalid); The 1 ~ 135% current value of the rated current of the inverter (Unit A).	Type Setting	<input type="radio"/>	<input type="radio"/>
↗ 00.12	Electronic Thermal Overload (Protection for Motor )1 Thermal time constant	0.5~ 75.0min	Type Setting	<input type="radio"/>	<input type="radio"/>
↗ 00.14	Restart Mode after Momentary Power Failure (Mode selection)	0: Alarm LU immediately 1: Alarm LU after recovery from power failure 2: Alarm LU after decelerate-to-stop(*1) 3: Continue to run (for heavy inertia or general loads)(*1) 4: Restart at the frequency at which the power failure occurred (for general load) 5: Restart at the starting frequency	1	<input type="radio"/>	<input type="radio"/>
↗ 00.15	Upper limit of output frequency	0.0~ 500.0Hz	70.0	<input type="radio"/>	<input type="radio"/>
↗ 00.16	Lower limit of output frequency	0.0~ 500.0Hz	0.0	<input type="radio"/>	<input type="radio"/>
00.18	Dominant frequency 1 bias setting	-100.00~ 100.00%	0.00	<input type="radio"/>	<input type="radio"/>
↗ 00.20	DC braking 1 starting frequency	0.0~ 60.0Hz	0.0	<input type="radio"/>	<input type="radio"/>
↗ 00.21	DC braking 1 braking action level	0~ 80%	0	<input type="radio"/>	<input type="radio"/>

## 00 Basic functions parameters

Parameter	Parameter Functions	Setting Range	Factory Default	Model	
				~15kW	18.5kW~
↗ 00.22	DC braking 1 braking time	0.00(invalid); 0.01~30.00s	0.00	○	○
↗ 00.23	Starting frequency 1	0.0~60.0Hz	0.5	○	○
↗ 00.24	Starting frequency 1 holding time	0.00~10.00s	0.00	○	○
↗ 00.25	Stop frequency	0.0 ~ 60.0Hz	0.2	○	○
↗ 00.26	Carrier frequency setting(Motor Sound)	0.75 ~ 12kHz	2	○	○
↗ 00.27	Motor running tone	0: Tone level 0 (invalid) 1: Tone level 1 2: Tone level 2 3: Tone level 3	0	○	○
↗ 00.29	AFM terminal action selection	0: Voltage output (DC0 ~ +10 V) 1: Current output (DC4 ~ 20mA)(*1) 2: DFM output (*2)	0	○	○
⊕ 00.30	AFM terminal output gain (Voltage adjustment)	0~300%	100	○	○
↗ 00.31	AFM terminal function selection (*2)	0: Output frequency before slip compensation 1: Output frequency after slip compensation 2: Output Current 3: Output Voltage 4: Output torque 5: Load factor 6: Input power 7: PID feedback amount 9: DC link bus voltage 10: Universal AO 13: Motor output power 15: PID command value (SV) 16: PID output value (MV)	0	○	○
⊕ 00.33	DFM terminal pulse rate	25~6000p / s (100% of pulse count)	1440	○	○
⊕ 00.34	DFM terminal output gain (*1)	0%: Pulse frequency output (50% of fixed amplitude); 1~ 300%: Output voltage adjustment (2000p / s fixed pulse amplitude adjustment)	0	×	○
↗ 00.35	DFM terminal function selection (*1)	0: Output frequency before slip compensation 1: Output frequency after slip compensation 2: Output Current 3: Output Voltage 4: Output torque 5: Load factor 6: Input power 7: PID feedback amount 9: DC link bus voltage 10: Universal AO 13: Motor output power 15: PID command value (SV) 16: PID output value (MV)	0	×	○

## 00 Basic functions parameters

Parameter	Parameter Functions	Setting Range	Factory Default	Model	
				~15kW	18.5kW~
00.37	Load Selection Automatic torque boost Automatic energy saving operation 1	0: Variable torque load ( general fan and water pump loads ) 1: Constant torque load 2: Auto torque boost 3: Auto energy saving :Variable torque load during ACC/DEC ( general fan and water pump loads ) 4: Auto energy saving :Constant torque load during ACC/DEC ( constant torque load ) 5: Auto energy saving operation ( automatic torque boost during ACC/DEC)		○	○
↗ 00.39	Stop frequency holding time	0.00~10.00s	0.00	○	○
↗ 00.40	Torque limiter level 1-1	20~200%; 999(invalid)	999	○	○
↗ 00.41	Torque limiter level 1-2	20~200%; 999(invalid)	999	○	○
00.42	Drive Control mode selection 1	0: V / f control with slip compensation inactive 1:dynamic torque vector control 2:V / f control with slip compensation active 5:Vector control without speed sensor(*2)	0	○	○
↗ 00.43	Current limiter action selection	0: Invalid (No current limiter works) 1: Constant speed (invalid in acceleration and deceleration) 2: Acceleration and constant speed (invalid in deceleration)	2	○	○
↗ 00.44	Current limiter action level	20~200% (level: rated output current of inverter for 100%)	160	○	○
↗ 00.50	Electronic Thermal Overload Discharging capability(Protection for Braking Resistor)	1~9000kW, OFF (canceled)	Type Setting	○	○
↗ 00.51	Electronic Thermal Overload Allowable average loss(protection for braking resistor)	0.001~50.00kW	0,001	○	○
↗ 00.52	Electronic Thermal Overload braking resistance (protection for braking resistor) (*1)	0.01~999Ω	0.01	×	○
00.80	G/P switch	0:G Specification 1:P Specification	0	×	○

(\*1) Adapt to above 18.5kW (include 18.5kW).

(\*2) The mode function selection of AFM/DFM under 15kW (include 15kW).

## 01 External terminal function parameters

Parameter	Parameter Functions	Setting Range	Factory Default	Model	
				~15kW	18.5kW~
01.01	MI1 terminal function selection	0(1000): Multi-step speed command 1 (0~1 step) [mSS1]	0	○	○
01.02	MI2 terminal function selection	1(1001): Multi-step speed command 2 (0~3 steps) [mSS2]	1	○	○
01.03	MI3 terminal function selection	2(1002): Multi-step speed command 3 (0~7 steps) [mSS4]	2	○	×
01.04	MI4 terminal function selection	3(1003): Multi-step speed command 4 (0~15 steps) [mSS8]	3	○	×
01.07	MI7 terminal function selection	4(1004): Select ACC/DEC time (2 steps) [mRT1]	6	○	○
		5(1005): Select ACC/DEC time (4 steps) [mRT2]		×	○
		6(1006): Enable 3-wire operation [mHLD]		○	○
		7(1007): Coast to a stop [mBX]		○	○
		8(1008): Reset alarm ( abnormal ) [mRST]		○	○
		9(1009): Enable External alarm trip[mTHR] (9=Active OFF, 1009=Active ON)		○	○
		10(1010): Ready for Jogging [mJOG]		○	○
		11(1011): Select frequency command 2/1 [mHz2/mHz1]		○	○
		12(1012): Motor 2 selection [mM2]		○	○
		13:DC braking command [mDCBRK]		○	○
		14(1014): Torque limiter level2 / torque limiter level 1[mTL2/mTL1]		○	○
17(1017): UP command (Increase output frequency)[mUP]	○	○			
18(1018): DOWN command (Decrease output frequency)[mDOWN]	○	○			

## 01 External terminal function parameters

Parameter	Parameter Functions	Setting Range	Factory Default	Model	
				~15kW	18.5kW~
		19(1019): Enable data change with keypad ( data can be changed ) [mWE-KP]		○	○
		20(1020): Cancel PID control[mHz/PID]		○	○
		21(1021): Switch Forward & reverse[mIVS]		○	○
		24(1024): Communication link via selection (RS485)[mLE]		○	○
		25(1025): Universal DI [mU-DI]		○	○
		26(1026): Enable auto search for idling motor speed at starting [mSTM]		○	○
		30(1030): Force to stop [mSTOP] (30=Active OFF, 1030=Active ON)		○	○
		33(1033): Reset PID integral and differential components[mPID-RST]		○	○
		34(1034): Hold PID integral component [mPID-HLD]		○	○
		36(1036): Motor 3 selection [mM3]		x	○
		37(1037): Motor 4 selection [mM4]		x	○
		39: Prevent condensation [mDWP]		x	○
		48: Pulse train input (available only for terminal M17 (01.07)) [mPIN]		○	○
		49(1049): Pulse train symbol [mSIGN](The terminals except of M17 have this function )		○	○
		52: Forward JOG[mFJOG]		○	○
		53: Reverse JOG[mRJOG]		○	○
		59(1059): Battery operation valid command [mBATRY]		x	○
		76(1076): Droop control [mDROOP]		x	○
		80(1080): Cancel customizable logic timers [mCLC]		x	○
		81(1081): Clear all customizable logic timers [mCLTC]		x	○
		100: No function assigned [mNONE]		○	○
		※ Setting the value in parentheses() shown above assigns a negative logic output to a terminal.(True if OFF)			

## 01 External terminal function parameters

Parameter	Parameter Functions	Setting Range	Factory Default	Model	
				~15kW	18.5kW~
01.10	Acceleration time 2	0,00~3600s ※ Enter 0,00 cancels the ACC/DEC. time (requiring external soft-start and -stop )	Type Setting	○	○
01.11	Deceleration time 2			○	○
01.12	Acceleration time 3			x	○
01.13	Deceleration time 3			x	○
01.14	Acceleration time 4			x	○
01.15	Deceleration time 4		x	○	
01.16	Torque limiter level 2-1	20~200% ; 999(invalid)	999	○	○
01.17	Torque limiter level 2-2	20~200% ; 999(invalid)	999	○	○
01.20	MO1 terminal function selection	0(1000): Inverter running [mRUN]	0	○	○
01.21	MO2 terminal function selection	1(1001): Frequency (speed) arrival signal [mFAR]	1	○	○
01.27	RA/RB/RC terminal function selection	2(1002): Frequency (speed) detection [mF DT]	99	○	○
		3(1003): Undervoltage detected (When Inverter stopped)[mLU]		○	○
		4(1004): Torque polarity detection[mB/D]		○	○
		5(1005): Inverter output limiting[mOL]		○	○
		6(1006): Auto-restarting after momentary power failure[mIPF]		○	○
		7(1007): Motor overload early warning[mOL]		○	○
		8(1008): Keypad operation enabled[mKPF]		x	○
		10(1010): Inverter ready to run[mRDY]		○	○
		15(1015): AX terminal function[mAX]		x	○
		21(1021): Frequency (speed) arrival signal 2 [mFAR2]		○	x
		22(1022): Inverter output limiting ( with delay )[mOL2]		○	○
		25(1025): Cooling fan ON-OFF in operation [mFAN]		x	○
		26(1026): Auto-resetting[mTRY]		○	○
		27(1027): Universal DO [mU-DO]		○	○
		28(1028): Cooler overheat early warning [mOH]		○	○
		31(1031): Frequency (speed) detection 2 [mFDT2]		x	○
		33(1033): Reference loss detected[mREF OFF]		○	○
35(1035): Inverter output on[mRUN2]	○	○			
36(1036): In overload prevention control [mOLP]	○	○			
37(1037): Current detected[mID]	○	○			
38(1038): Current detected 2[mID2]	○	○			
39(1039): Current detected[mID3]	x	○			

## 01 External terminal function parameters

Parameter	Parameter Functions	Setting Range	Factory Default	Model	
				~15kW	18.5kW~
		41(1041): Low current detected[mIDL]		x	○
		42(1042): PID alarm output [mPID-ALM]		○	○
		43(1043): In PID control[mPID-CTL]		x	○
		44(1044): Motor stopped due to slow flowrate under PID control[mPID-STP]		x	○
		45(1045): Low output torque detection [mU-TL]		x	○
		46(1046): Torque detection 1[mTD1]		x	○
		47(1047): Torque detection 2[mTD2]		x	○
		48(1048): Motor 1 selected[mSWM1]		x	○
		49(1049): Motor 2 selected[mSWM2]		○	○
		50(1050): Motor 3 selected[mSWM3]		x	○
		51(1051): Motor 4 selected[mSWM4]		x	○
		52(1052): Running Forward Signal[mFRUN]		x	○
		53(1053): Running Reversal signal[mRRUN]		x	○
		54(1054): In Remote operation[mRMT]		x	○
		56(1056): Motor overheat detected by thermistor[mTHM]		x	○
		57(1057): Brake signal[mBRKS]		○	○
		58(1058): Frequency ( speed ) detection 3 [mFDT3]		x	○
		59(1059): ACI terminal wire break detected [mACIOFF]		x	○
		70(1070): Speed valid[mDNZS]		x	○
		71(1071): Speed agreement[mDSAG]		x	○
		72(1072): Frequency (speed) arrival signal 3[mFAR3]		x	○
		76(1076): Speed error detected[mPG-ERR]		x	○
		84(1084): Maintenance timer[mMNT]		x	○
		90(1090): Alarm contents 1 [mAL1]		x	○
		91(1091): Alarm contents 2[mAL2]		x	○
		92(1094): Alarm contents 4[mAL4]		x	○
		93(1093): Alarm contents 8[mAL8]		x	○
		98(1098): Light alarm [mL-ALM]		x	○
		99(1099): Alarm output (for any alarm) [mALM]		○	○
		105(1105): Braking transistor broken [mDBAL]		x	○
		111 (1111): Customizable logic output signal 1 [mCLO1]		x	○
		112 (1112): Customizable logic output signal 2 [mCLO2]		x	○
		113 (1113): Customizable logic output signal 3 [mCLO3]		x	○
		114 (1114): Customizable logic output signal 4 [mCLO4]		x	○

## 01 External terminal function parameters

Parameter	Parameter Functions	Setting Range	Factory Default	Model	
				~15kW	18.5kW~
		115 (1115): Customizable logic output signal 5 [mCLO5] ----- ※ Setting the value in parentheses (shown above) assigns a negative logic output to a terminal. (True if OFF)		×	○
↗ 01.29	Frequency arrival delay (FAR2)	0.01~10.0s	0.10	○	×
↗ 01.30	Frequency Arrival (Hysteresis width)	0.0~10.0Hz	2.5	○	○
↗ 01.31	Frequency detection value	0.0~500.0Hz	50.0	○	○
↗ 01.32	Frequency detection hysteresis width	0.0~500.0Hz	1.0	○	○
↗ 01.34	Overload Early Warning / current detection level	0.00 (invalid); Current value of 1% to 200% of the inverter rated current	Type Setting	○	○
↗ 01.35	Overload Early Warning / current detection timer	0.01~600.00s	10.00	○	○
↗ 01.36	Frequency detection 2 value	0.0~500.0Hz	50.0	×	○
↗ 01.37	Current detection 2 / Low current detection level	0.00 (invalid); Current value of 1% to 200% of the inverter rated current	Type Setting	○	○
↗ 01.38	Current detection 2 / Low current detection timer	0.01~600.00s	10.00	○	○
↗ 01.40	PID display coefficient A	-999~0.00~9990	100	○	○
↗ 01.41	PID display coefficient B	-999~0.00~9990	0.00	○	○
↗ 01.42	Display filter time constant	0.0~5.0s	0.5	○	○
↗ 01.43	Keypad display selection	0: Speed monitor (selected by 01.48) 3: Output current 4: Output voltage 8: Calculated torque 9: Input power 10: PID command value 12: PID feedback amount 14: PID output 15: Load factor 16: Motor output power 17: Analog input monitor (*1) 23: Torque current (%) (*1) 24: Magnetic flux command (%) (*1) 25: Input watt-hour (*1)	0	○	○
↗ 01.44	Display when stopped	0: Specified value 1: Display output value	0	×	○



## 01 External terminal function parameters

Parameter	Parameter Functions	Setting Range	Factory Default	Model	
				~15kW	18.5kW~
01.48	Speed monitoring selection	0: Output frequency before slip compensation 1: Output frequency after slip compensation 2: Reference frequency 3: Motor speed 4: Load shaft speed 5: Line speed 7: Display speed (%)(*1)	0	○	○
01.50	Coefficient for Speed Indication	0,01~200,00	30,00	○	○
01.51	Display Coefficient for Input Watt-hour Data	0,000(cancel and reset), 0,001~9999	0,010	○	○
01.52	Reserved	Reserved	0	○	○
01.54	Frequency detection 3 value	0,0~500,0Hz	50,0	×	○
01.55	Current detection 3 level	0.00 (invalid); Current value of 1% to 200% of the inverter rated current	Type Setting	×	○
01.56	Current detection 3 timer	0,01~600,00s	10,00	×	○
01.61	Terminal AVI extension function selection	0: None 1: Auxiliary frequency 1	0	○	○
01.62	Terminal ACI extension function selection	2: Auxiliary frequency 2 3: PID command 1 5: PID feedback amount	0	○	○
01.63	Terminal AU extension function selection	6: Ratio setting(*1) 7: Analog torque limit value A(*1) 8: Analog torque limit value B(*1) 10: Torque command(*1) 11: Torque current command(*1) 17: Forward (FWD) speed limit value(*1) 18: Reverse (REV) speed limit value(*1) 20: Analog input monitor(*1)	0	○	○
01.65	Reference loss detection(continue running frequency)	0: Decelerate to stop, 20 to 120% , 999 : Cancel	999	○	○
01.78	Torque detection 1 level	0 ~ 300%	100	×	○
01.79	Torque detection 1 timer	0,01 ~ 600,00s	10	×	○
01.80	Torque detection 2 / low torque detection level	0 ~ 300%	20	×	○
01.81	Torque detection 2 / low torque detection timer	0,01 ~ 600,00s	20,00	×	○
01.98	FWD terminal function selection	98: Run forward [mFWD]	98	○	○

## 01 External terminal function parameters

Parameter	Parameter Functions	Setting Range	Factory Default	Model	
				~15kW	18.5kW~
01.99	REV terminal function selection	99:Run reverse [mREV]	99		
		100:No function assigned [mNONE]		○	○
		For other distribution functions, please refer to 01,01		○	○
		※ Setting the value in parentheses()shown above assigns a negative logic output to a terminal.(True if OFF)			

## 02 Control functions parameters

Parameter	Parameter Functions	Setting Range	Factory Default	Model	
				~15kW	18.5kW~
02.01	Jump frequency 1	0.0~500.0Hz	0.0	○	○
02.02	Jump frequency 2		0.0	○	○
02.03	Jump frequency 3		0.0	○	○
02.04	Jump frequency range		0.0~30.0Hz	3.0	○
02.05	Multi-speed frequency 1	0.00~500.00Hz	0.00	○	○
02.06	Multi-speed frequency 2		0.00	○	○
02.07	Multi-speed frequency 3		0.00	○	○
02.08	Multi-speed frequency 4		0.00	○	○
02.09	Multi-speed frequency 5		0.00	○	○
02.10	Multi-speed frequency 6		0.00	○	○
02.11	Multi-speed frequency 7		0.00	○	○
02.12	Multi-speed frequency 8		0.00	○	○
02.13	Multi-speed frequency 9		0.00	○	○
02.14	Multi-speed frequency 10		0.00	○	○
02.15	Multi-speed frequency 11		0.00	○	○
02.16	Multi-speed frequency 12		0.00	○	○
02.17	Multi-speed frequency 13		0.00	○	○
02.18	Multi-speed frequency 14		0.00	○	○
02.19	Multi-speed frequency 15		0.00	○	○
02.20	Jogging frequency			5.00	○

## 02 Control functions parameters

Parameter	Parameter Functions	Setting Range	Factory Default	Model	
				~15kW	18.5kW~
02.30	Dominant frequency 2 source selection	0: Enable(⤴/⤵) keys on the Keypad 1: Analog voltage input ( terminal AVI) (DC0 ~ ± 10V) 2: Analog current input ( terminal ACI) (DC4 ~ 20mA) 3: Sum of Analog voltage and current inputs to terminals ( terminal AVI) and ( terminal ACI) 5: Analog voltage input (terminal AUI) (DC0 ~ + 10V) 7: UP / DOWN control input 12: Pulse train input	2	○	○
⊗ 02.31	Analog input adjustment for offset (AVI terminals)	- 5.0 ~ 5.0%	0.0	○	○
⊗ 02.32	Analog input adjustment for gain (AVI terminals)	0.00 ~ 200.00%	100.00	○	○
⊗ 02.33	Analog input adjustment for filter time constant (AVI terminals)	0.00 ~ 5.00s	0.05	○	○
⊗ 02.34	Analog input adjustment for gain base point (AVI terminals)	0.00 ~ 100.00%	100.00	○	○
⊗ 02.35	Analog input adjustment for polarity selection (AVI terminal)	0: Bipolar(*1)      1: unipolar	1	×	○
⊗ 02.36	Analog input adjustment for offset (ACI terminals)	- 5.0 ~ 5.0%	0.0	○	○
⊗ 02.37	Analog input adjustment for gain (ACI terminals)	0.00 ~ 200.00%	100.00	○	○
⊗ 02.38	Analog input adjustment for filter time constant (ACI terminals)	0.00 ~ 5.00s	0.05	○	○
⊗ 02.39	Analog input adjustment for gain base point (ACI terminals)	0.00 ~ 100.00%	100.00	○	○
⊗ 02.41	Analog input adjustment for offset (AUI terminals)	- 5.0 ~ 5.0%	0.0	○	○
⊗ 02.42	Analog input adjustment for gain (AUI terminals)	0.00 ~ 200.00%	100.00	○	○
⊗ 02.43	Analog input adjustment for filter time constant (AUI terminals)	0.00 ~ 5.00s	0.05	○	○
⊗ 02.44	Analog input adjustment for gain base point (AUI terminals)	0.00 ~ 100.00%	100.00	○	○
⊗ 02.45	Analog input adjustment for polarity selection (AUI terminal)	0: positive and negative polarity 1: positive polarity	1	×	○

## 02 Control functions parameters

	Parameter	Parameter Functions	Setting Range	Factory Default	Model	
					~15kW	18.5kW~
⊕	02.50	Bias base point (Dominant frequency 1)	0.00 ~ 100.00%	0.00	○	○
⊕	02.51	Bias value (PID command 1)	- 100.00 ~ 100.00%	0.00	○	○
⊕	02.52	Bias base point (PID command 1)	0.00 ~ 100.00%	0.00	○	○
↗	02.53	Forward/reverse action selection (Dominant frequency 1)	0: Forward operation 1: Reverse operation	0	○	○

## 03 Motor 1 parameters

	Parameter	Parameter Functions	Setting Range	Factory Default	Model	
					~15kW	18.5kW~
	03.01	Motor 1 (No. of poles)	2 to 22 poles	4	○	○
	03.02	Motor 1 rated capacity	0.01 ~ 1000kW	Type Setting	○	○
	03.03	Motor 1 rated current	0.00 ~ 2000A		○	○
	03.04	Motor 1 auto-tuning	0: Invalid 1: Tune while the motor stops. (% R1,% X, rated slip) 2: Tune while the motor is rotating under V/f control (% R1,% X, rated slip frequency, no-load current, magnetic saturation factors and magnetic saturation extension factors :1~5 and a-c) 3:Tune while the motor is rotating under vector control (% R1,% X, rated slip frequency, no-load current, magnetic saturation factors 1~5, and magnetic saturation extension factors "a" to "c". Valid when the vector control is enabled)(*1)	0	○	○
↗	03.05	Motor 1 (Online tuning)	0: Invalid 1: Action	0	○	○
	03.06	Motor 1 no-load current	0.00~2000A	Type Setting	○	○
↗	03.07	Motor 1 %R1	0.00~50.00%		○	○
↗	03.08	Motor 1 %X	0.00~50.00%		○	○
⊕	03.09	Motor 1 Slip compensation gain for (driving)	0.0~200.0%	100.0	○	○
↗	03.10	Motor 1 slip compensation response time	0.01~10.00s	0.12	○	○
⊕	03.11	Motor 1 slip compensation gain for (braking)	0.0~200.0%	100.0	○	○
	03.12	Motor 1 rated slip frequency	0.00~15.00Hz	Type Setting	○	○
↗	03.13	Motor 1 iron loss factor 1	0.00~20.00%		×	○
↗	03.14	Motor 1 iron loss factor 2		0.00	×	○
↗	03.15	Motor 1 iron loss factor 3		0.00	×	○

### 03 Motor 1 parameters

Parameter	Parameter Functions	Setting Range	Factory Default	Model	
				~15kW	18.5kW~
03.16	Motor 1 magnetic saturation factor 1	0.0~300.00%	Type Setting	x	○
03.17	Motor 1 magnetic saturation factor 2			x	○
03.18	Motor 1 magnetic saturation factor 3			x	○
03.19	Motor 1 magnetic saturation factor 4			x	○
03.20	Motor 1 magnetic saturation factor 5			x	○
03.21	Motor 1 magnetic saturation expansion factor a			x	○
03.22	Motor 1 magnetic saturation expansion factor b			x	○
03.23	Motor 1 magnetic saturation expansion factor c			x	○
03.53	Motor 1% X correction factor 1	0~300%	100	x	○
03.54	Motor 1% X correction factor 2		100	x	○
03.99	Reserved	Reserved	0	○	○

### 04 Advanced functions Parameters

Parameter	Parameter Functions	Setting Range	Factory Default	Model	
				~15kW	18.5kW~
04.03	Data initialization	0: Manual settings 1: Initialize all function parameters data (factory setting) 2: Initialize Motor 1 constant parameters 3: Initialize Motor 2 constant parameters 4: Initialize Motor 3 constant parameters(*1) 5: Initialize Motor 4 constant parameters(*1)	0	○	○
04.04	Auto-reset Times	0: Invalid; 1-10 reset times	0	○	○
04.05	Auto-reset (Reset interval time)	0.5-20.0s	5.0	○	○
04.06	Cooling fan ON-OFF control	0: Invalid (always in operation) 1: valid action (ON / OFF controllable)	1	○	○
04.07	Acceleration/Deceleration Pattern	0: Inactive (linear acceleration and deceleration) 1: S curve acceleration and deceleration (weak) 2: S curve acceleration and deceleration (Enhancement type)(*3) 3: Curvilinear acceleration and deceleration	0	○	○
04.08	Rotation direction Limitation	0: Invalid 1: Valid Action (Reverse rotation inhibited) 2: Valid Action (Forward rotation inhibited)	0	○	○

## 04 Advanced functions Parameters

Parameter	Parameter Functions	Setting Range	Factory Default	Model	
				~15kW	18.5kW~
04.09	Starting Auto search Mode	0: Invalid 1: Valid Action (At restart after momentary power failure) 2: Valid Action (At restart after momentary power failure and at normal start)	0	×	○
✓ 04.11	Deceleration mode	0: Normal deceleration 1: Coast-to-stop	0	○	○
✓ 04.12	Instantaneous overcurrent limiting mode selection	0: Invalid 1: Valid Action	1	○	○
✓ 04.13	Restart mode after momentary power failure (restart time)	0.1~10.0s	Type Setting	○	○
✓ 04.14	Restart mode after momentary power failure (frequency fall rate)	0.00: deceleration time selected, 0.01 ~ 100.00Hz / s, 999 (according to the current limit command)	999	○	○
✓ 04.15	Restart mode after momentary power failure (continuous running level)	200~300V:(220V series) 440~600V:(440V series)	235/ 470	×	○
✓ 04.16	Restart mode after momentary power failure (allowable momentary power failure time)	0.0~30.0s, 999 (the inverter can determine automatically)	999	○	○
✓ 04.26	Thermistor (for motor) action selection	0: Invalid 1: PTC: The inverter immediately alarm with "OH4" displayed 2: PTC: The inverter issues output signal [mTHM], and continues to run 3: NTC: when connected	0	×	○
✓ 04.27	Thermistor (for motor) action value	0.00~5.00V	0.35	×	○
✓ 04.28	Droop control	-60.0~0.0Hz	0.0	○	○
✓ 04.30	Communication link mode selection	Frequency command Run command 0:00. 01 00. 02 1: RS485 communications (port 1) 00. 02 2:00. 01 RS485 communications (port 1) 3:RS485 communications (port 1) RS485 communications (port 1) 4:RS485 communications (port 2) 00. 02 5:RS485 communications (port 2) RS485 communications (port 1) 6:00. 01 RS485 communications (port 2) 7:RS485 communications (port 1) RS485 communications (port 2) 8:RS485 communications (port 2) RS485 communications (port 2) Note: Port 1 is the RJ-45 interface of the operation panel Port 2 is a terminal block (SG+, SG-)	0	○	○

## 04 Advanced functions Parameters

Parameter	Parameter Functions	Setting Range	Factory Default	Model	
				~15kW	18.5kW~
04.42	Capacitance of Main circuit(DC link bus ) capacitor	Reserved	—	○	○
04.43	Cumulative running time for fan	Indication of cumulative run time of fan for replacement (10 hours)	—	○	○
04.44	Startup Counter for Motor 1	For adjustment in replacement (0000 ~ FFFF (hexadecimal))	—	○	○
04.45	Mock Alarm	0: Invalid 1: trigger a mock alarm	0	○	○
04.46	Starting Mode Auto search delay time 2	0.1~20.0s	Type Setting	×	○
04.47	Initial Capacitance of Main circuit (DC Link Bus ) capacitor	Reserved	—	○	○
04.48	Cumulative run time of capacitors on PCB	For adjusting cumulative running time (resettable) in replacement (In 10 hours)	—	○	○
04.49	Starting Mode (Auto search delay time 1)	0.0~10.0s	0.0	×	○
04.50	Non-linear V/f Pattern 1 (Frequency)	0.0(cancelled), 0.1~500.0Hz	Type Setting	○	○
04.51	Non-linear V/f Pattern 1 (Voltage)	0~ 240V: AVR action (220V series) 0~ 500V: AVR action (440V series)	Type Setting	○	○
04.52	Non-linear V/f Pattern 2 (Frequency)	0.0(cancelled), 0.1~500.0Hz	0.0	○	○
04.53	Non-linear V/f Pattern 2 (Voltage)	0~240V: AVR action (220V series) 0~500V: AVR action (440V series)	0	○	○
04.54	Jogging acceleration time (*4)	0.00~3600s	Type Setting	○	○
04.55	Jogging deceleration time			×	○
04.56	Deceleration time for forced stop			○	○
04.57	1 <sup>st</sup> S-curve acceleration range (Leading edge)	0~100%	10	×	○
04.58	2 <sup>nd</sup> S-curve acceleration range (Trailing edge)		10	×	○
04.59	1 <sup>st</sup> S-curve deceleration range (Leading edge)		10	×	○
04.60	2 <sup>nd</sup> S-curve deceleration range (Trailing edge)		10	×	○
04.61	UP / DOWN control initial frequency setting selection	0: take 0.00Hz as the initial frequency. 1: take the final frequency command value as the initial frequency in the last UP / DOWN control	1	○	○
04.63	Frequency lower limiter action selection	0: limit by 00.16 (Frequency limiter: Low) and continue to run 1: If the output frequency lowers below the one limited by 00.16(Frequency limiter: Low), decelerate to stop the motor.	0	○	○

#### 04 Advanced functions Parameters

	Parameter	Parameter Functions	Setting Range	Factory Default	Model	
					~15kW	18.5kW~
✓	04.64	Frequency lower limiter lower action value	0.0: Depends on 00,16 (Frequency limiter, Low) 0,1 to 60Hz.	1.6	○	○
	04.65	Non-linear V/f Pattern 3 (Frequency)	0.0(cancelled), 0.1~500.0Hz	0.0	×	○
	04.66	Non-linear V/f Pattern 3 (Voltage)	0~240V: AVR action (220V series) 0~500V: AVR action (440V series)	0	×	○
✓	04.67	Automatic energy saving operation mode selection	0: Valid only at constant speed running 1: Valid in all modes	0	×	○
	04.68	Slip compensation 1 Operating conditions selection	0: valid in acceleration and deceleration; valid at base frequency or above 1: invalid in acceleration and deceleration; valid at base frequency or above 2: valid in acceleration and deceleration; invalid at base frequency or above 3: invalid in acceleration and deceleration; invalid at base frequency or above	0	○	○
✓	04.69	Overvoltage Automatic Deceleration action selection	0: Invalid 2: Torque limit control;with Force-to-stop if actual deceleration time exceeds three times the specified one 3: DC link bus voltage control; with Force-to-stop if actual deceleration time exceeds three times the specified One 4: Torque limit control;with Force-to-stop invalid. 5: DC link bus voltage control with Force-to-stop invalid.	0.0	○	○
✓	04.70	Overload prevention control	0.00: Follow the deceleration time selected, 0.01~100.00 Hz / s, 999 ( cancel )	999	○	○
✓	04.71	Deceleration characteristics	0 : Invalid 1 : valid action	0	○	○
	04.73	Torque Limiter operating conditions selection	0: valid in acceleration and deceleration, valid at constant speed 1: invalid in acceleration and deceleration, valid at constant speed 2: valid in acceleration and deceleration, invalid at constant speed	0	×	○
✓	04.76	Torque Limiter : Frequency increment limit for braking	0.0~500.0Hz	5.0	○	○
✓	04.77	Service Life of DC link bus capacitor remaining time)	0~8760 (10 hours as a unit)	-	×	○
✓	04.78	Maintenance Interval setting (M1)	0 ( invalid ) ; 1 to 9999 ( 10 hours as a unit))	8760	×	○
✓	04.79	Preset Startup Count for Maintenance(M1)	0000 (invalid) ; 0001~FFFF (hexadecimal)	0	×	○
✓	04.80	Output Current Fluctuation Damping Gain for Motor 1	0.00~1.00	0.20	○	○
✓	04.81	Light alarm selection 1	0000~FFFF (hexadecimal)	0	×	○
✓	04.82	Light alarm selection 2	0000~FFFF (hexadecimal)	0	×	○



## 04 Advanced functions Parameters

	Parameter	Parameter Functions	Setting Range	Factory Default	Model	
					~15kW	18.5kW~
✓	04.91	PID Feedback Wire Break Detection	0.0(invalid alarm detection); 0.1~60.0s	0	○	○
✓	04.92	Continuity of Running (P)	0,000~10,000 times; 999	999	×	○
✓	04.93	Continuity of Running (I)	0,010~10,000s; 999	999	×	○
	04.94	Cumulative motor run time 1	0~9999 The cumulative run time can be modified or reset(resettable). ( 10 hours as a unit)	-	○	○
✓	04.95	DC braking characteristics selection(Braking response mode)	0: Slow response 1: Quick response	1	○	○
✓	04.96	Stop key Priority/ Start Check function	0: STOP key priority is invalid, Start Check function is valid 1: STOP key priority is valid, Start Check function is valid 2: STOP key priority is invalid, Start Check function is invalid 3: STOP key priority is valid, Start Check function is invalid	0	○	○
✓	04.97	Clear alarm data	0: Invalid 1: Setting "1" clears alarm data and then returns to "0".	0	○	○
✓	04.98	Protection/Maintenance Function (Mode selection)	0 to 255 (the data is displayed in hex, with each meaning 0: invalid; 1: valid) Bit 0: Lower the carrier frequency automatically (0: invalid; 1: valid) Bit 1: Input phase loss protection (0: invalid; 1: valid) Bit 2: Output phase loss protection (0: invalid; 1: valid) Bit 3: Reserve (0: based on factory default level 1: based on User setup level) Bit 4: Reserve (0: invalid; 1: valid)	0013H(hexadecimal)	○	○

(\*3) The user can set based on 04.57-04.60 above 18.5kW (include 18.5kW).

(\*4) The parameter under 15kW (include 15kW) is also inching deceleration time.

## 05 Motor 2 parameters

Parameter	Parameter Functions	Setting Range	Factory Default	Model	
				~15kW	18.5kW~
05.01	Maximum output frequency 2	25.0~500.0Hz	50.0	○	○
05.02	Base frequency 2	25.0~500.0Hz	50.0	○	○
05.03	Rated Voltage at Base frequency voltage 2	0: AVR invalid (Output a voltage in proportion to input voltage ) 80~ 240V: AVR action (220V series ) 160~ 500V: AVR action (440V series )	220/ 380	○	○
05.04	Maximum output voltage 2	80~240V: AVR action (220V series ) 160~500V: AVR action (440V series )	220/ 380	○	○
✎ 05.05	Torque boost 2	0.0 to 20.0% (percentage with respect to rated voltage at base frequency 2)	Type Setting	○	○
✎ 05.06	Electronic Thermal Overload (Protection for Motor) 2 Select motor characteristics	1: Action (For a general-purpose motor with shaft-driven cooling fan ) 2 : Action (For an inverter-driven motor, non-ventilated motor, or motor with separately powered cooling fan )	1	○	○
✎ 05.07	Electronic Thermal Overload (Protection for Motor) 2 Detection level	0.00 (invalid) ; 1% to 135% of the rated current of the motor	Type Setting	○	○
✎ 05.08	Electronic Thermal Overload (Protection for Motor) 2 Thermal time constant	0.5~75.0min		○	○
✎ 05.09	DC braking 2 starting frequency	0.0~60.0Hz	0.0	○	○
✎ 05.10	DC braking 2 braking level	0~80%	0	○	○
✎ 05.11	DC braking 2 braking time	0.00(invalid); 0.01~30.00s	0.00	○	○
✎ 05.12	Starting frequency 2	0.0~60.0Hz	0.5	○	○
05.13	Load Selection / Auto Torque Boost / Auto Energy Saving Operation 2	0: Variable torque load ( general fan and pump load ) 1: constant torque load 2: Auto torque boost 3: Auto energy saving operation ( general fan and pump load ) 4: Auto energy saving operation ( constant torque load ) 5: Auto energy saving operation (automatic torque boost)	1	○	○
05.14	Drive Control mode selection 2	0 : V/f control 1 : dynamic torque vector control 2 :V/f control with slip compensation active 5 :Vector control without speed sensor(*1)	0	○	○
05.15	Motor 2 (No. of poles)	2~22 poles	4	○	○
05.16	Motor 2 rated capacity	0.01~1000kW	Type Setting	○	○
05.17	Motor 2 rated current	0.00~2000A		○	○

## 05 Motor 2 parameters

Parameter	Parameter Functions	Setting Range	Factory Default	Model	
				~15kW	18.5kW~
05.18	Motor 2 auto-tuning	0: Invalid 1: Tune while the motor stops. (% R1, % X, rated slip) 2: Tune while the motor is rotating under V/f control (% R1, % X, rated slip frequency, no-load current, magnetic saturation factors and magnetic saturation extension factors : 1~5 and a~c) 3: Tune while the motor is rotating under vector control (% R1, % X, rated slip frequency, no-load current, magnetic saturation factors 1~5, and magnetic saturation extension factors "a" to "c". Valid when the vector control is enabled) (*1)	0	○	○
↗ 05.19	Motor 2 (Online tuning)	0: Invalid 1: Action	0	○	○
05.20	Motor 2 no-load current	0.00~2000A	Type Setting	○	○
↗ 05.21	Motor 2 %R1	0.00~50.00%		○	○
↗ 05.22	Motor 2 %X	0.00~50.00%		○	○
⊙ 05.23	Motor 2 Slip compensation gain for (driving)	0.0~200.0%	100.0	○	○
↗ 05.24	Motor 2 slip compensation response time	0.01~10.00s	0.12	○	○
⊙ 05.25	Motor 2 slip compensation gain for (braking)	0.0~200.0%	100.0	○	○
05.26	Motor 2 rated slip frequency	0.00~15.00Hz	Type Setting	○	○
↗ 05.27	Motor 2 iron loss factor 1	0.00~20.00%		x	○
↗ 05.28	Motor 2 iron loss factor 2		0.00	x	○
↗ 05.29	Motor 2 iron loss factor 3		0.00		
↗ 05.30	Motor 2 magnetic saturation factor 1	0.0~300.0%	Type Setting	x	○
↗ 05.31	Motor 2 magnetic saturation factor 2				
↗ 05.32	Motor 2 magnetic saturation factor 3				
↗ 05.33	Motor 2 magnetic saturation factor 4				
↗ 05.34	Motor 2 magnetic saturation factor 5				
↗ 05.35	Motor 2 magnetic saturation expansion factor a				
↗ 05.36	Motor 2 magnetic saturation expansion factor b				
↗ 05.37	Motor 2 magnetic saturation expansion factor c				
05.39	Reserved				

## 05 Motor 2 parameters

	Parameter	Parameter Functions	Setting Range	Factory Default	Model	
					~15kW	18.5kW~
	05.40	Slip Compensation 2 (Operating conditions)	0: Valid in acceleration and deceleration; valid at base frequency or above 1: Invalid in acceleration and deceleration; valid at base frequency or above 2: Valid in acceleration and deceleration; invalid at base frequency or above 3: Invalid in acceleration and deceleration; invalid at base frequency or above	0	○	○
↗	05.41	Output Current Fluctuation Damping Gain for Motor 2	0,00~0,40	0,20	○	○
↗	05.42	Motor/Parameter Switching 2 (Mode selection)	0: Motor switch (switch to the 2nd motor) 1: Parameter switch ( switch to particular 05)	0	×	○
⊙	05.45	Speed control 2 P term (gain)	0.1~200.0 times	10.0	○	×
⊙	05.46	Speed control 2 I item (integral time )	0,001~9,999s 999: Integral action is invalid	0,100	○	×
	05.51	Cumulative Motor run time 2	0~9999 The cumulative run time can be modified or reset(resettable)(10 hours as a unit)	-	×	○
↗	05.52	Startup Counter for Motor 2	Adjustment in replacement (0000~FFFF (hexadecimal ) )	-	×	○
↗	05.53	Motor 2% X correction factor 1	0~300%	100	×	○
↗	05.54	Motor 2% X correction factor 2	0~300%	100	×	○

## 06 Motor 3 parameters

Parameter	Parameter Functions	Setting Range	Factory Default	Model	
				~15kW	18.5kW~
06.01	Maximum output frequency 3	25.0~500.0Hz	50.0	×	○
06.02	Base frequency 3	25.0~500.0Hz	50.0	×	○
06.03	Rated Voltage at Base frequency voltage 3	0: AVR invalid (Output a voltage in proportion to input voltage ) 80~240V: AVR action (220V series ) 160~500V: AVR action (440V series )	220/ 380	×	○
06.04	Maximum output voltage 3	80~240V: AVR action (220V series ) 160~500V: AVR action (440V series )	220/ 380	×	○
✓ 06.05	Torque boost 3	0.0 to 20.0% (percentage with respect to rated voltage at base frequency 3)	Type Setting	×	○
✓ 06.06	Electronic Thermal Overload (Protection for Motor) 3 Select motor characteristics	1: Action (For a general-purpose motor with shaft-driven cooling fan ) 2: Action (For an inverter-driven motor, non-ventilated motor, or motor with separately powered cooling fan )	1	×	○
✓ 06.07	Electronic Thermal Overload (Protection for Motor) 3 Detection level	0.00 (invalid) ; 1% to 135% of the rated current of the motor	Type Setting	×	○
✓ 06.08	Electronic Thermal Overload (Protection for Motor) 3 Thermal time constant	0.5~75.0min		×	○
✓ 06.09	DC braking 3 starting frequency	0.0~60.0Hz	0.0	×	○
✓ 06.10	DC braking 3 braking level	0~80%	0	×	○
✓ 06.11	DC braking 3 braking time	0.00(invalid); 0.01~30.00s	0.00	×	○
✓ 06.12	Starting frequency 3	0.0~60.0Hz	0.5	×	○
06.13	Load Selection / Auto Torque Boost / Auto Energy Saving Operation 3	0: Variable torque load ( general fan and pump load ) 1: constant torque load 2: Auto torque boost 3: Auto energy saving operation ( general fan and pump load ) 4: Auto energy saving operation ( constant torque load ) 5: Auto energy saving operation ( automatic torque boost)	1	×	○
06.14	Drive Control mode selection 3	0: V / f control 1: Dynamic torque vector control 2: V / f control with slip compensation active 5: Vector control without speed sensor(*1)	0	×	○
06.15	Motor 3 (No. of poles)	2~22 poles	4	×	○
06.16	Motor 3 rated capacity	0.01~1000kW	Type Setting	×	○
06.17	Motor 3 rated current	0.00~2000A		×	○

## 06 Motor 3 parameters

Parameter	Parameter Functions	Setting Range	Factory Default	Model	
				~15kW	18.5kW~
06.18	Motor 2 auto-tuning	0: Invalid 1: Tune while the motor stops. (% R1, % X, rated slip) 2: Tune while the motor is rotating under V/f control (% R1, % X, rated slip frequency, no-load current, magnetic saturation factors and magnetic saturation extension factors: 1~5 and a~c) 3: Tune while the motor is rotating under vector control (% R1, % X, rated slip frequency, no-load current, magnetic saturation factors 1~5, and magnetic saturation extension factors "a" to "c". Valid when the vector control is enabled)	0	x	○
↗ 06.19	Motor 3 (Online tuning)	0: Invalid 1: Action	0	x	○
06.20	Motor 3 no-load current	0.00~2000A	Type Setting	x	○
↗ 06.21	Motor 3 %R1	0.00~50.00%		x	○
↗ 06.22	Motor 3 %X	0.00~50.00%		x	○
⊙ 06.23	Motor 3 Slip compensation gain for (driving)	0.0~200.0%	100.0	x	○
↗ 06.24	Motor 3 slip compensation response time	0.01~10.00s	0.12	x	○
⊙ 06.25	Motor 3 slip compensation gain for (braking)	0.0~200.0%	100.0	x	○
06.26	Motor 3 rated slip frequency	0.00~15.00Hz	Type Setting	x	○
↗ 06.27	Motor 3 iron loss factor 1	0.00~20.00%		x	○
↗ 06.28	Motor 3 iron loss factor 2		0.00	x	○
↗ 06.29	Motor 3 iron loss factor 3		0.00	x	○
↗ 06.30	Motor 3 magnetic saturation factor 1	0.0~300.0%	Type Setting	x	○
↗ 06.31	Motor 3 magnetic saturation factor 2				
↗ 06.32	Motor 3 magnetic saturation factor 3				
↗ 06.33	Motor 3 magnetic saturation factor 4				
↗ 06.34	Motor 3 magnetic saturation factor 5				
↗ 06.35	Motor 3 magnetic saturation expansion factor a				
↗ 06.36	Motor 3 magnetic saturation expansion factor b				
↗ 06.37	Motor 3 magnetic saturation expansion factor c				
06.39	Reserved	Reserved	0	x	○

## 06 Motor 3 parameters

Parameter	Parameter Functions	Setting Range	Factory Default	Model	
				~15kW	18.5kW~
06.40	Slip Compensation 3 (Operating conditions)	0: valid in acceleration and deceleration; valid at base frequency or above 1: invalid in acceleration and deceleration; valid at base frequency or above 2: valid in acceleration and deceleration; invalid at base frequency or above 3: invalid in acceleration and deceleration; invalid at base frequency or above	0	×	○
↗ 06.41	Output Current Fluctuation Damping Gain for Motor 3	0.00~0.40	0.20	×	○
↗ 06.42	Motor/Parameter Switching 3 (Mode selection)	0: Motor switch (switch to the 3rd motor) 1: Parameter switch ( switch to particular 06)	0	×	○
↗ 06.52	Startup Counter for Motor 3	Adjustment in replacement (0000~FFFF (hexadecimal ) )	-	×	○
↗ 06.53	Motor 3% X correction factor 1	0~300%	100	×	○
↗ 06.54	Motor 3% X correction factor 2	0~300%	100	×	○

## 07 Motor 4 parameters

Parameter	Parameter Functions	Setting Range	Factory Default	Model	
				~15kW	18.5kW~
07.01	Maximum output frequency 4	25.0~500.0Hz	50.0	×	○
07.02	Base frequency 4	25.0~500.0Hz	50.0	×	○
07.03	Rated Voltage at Base Frequency 4	0: AVR invalid (Output a voltage in proportion to input voltage ) 80 ~ 240V: AVR action (220V series ) 160 ~ 500V: AVR action (440V series )	220/ 380	×	○
07.04	Maximum output voltage 4	80~240V: AVR action (220V series ) 160~500V: AVR action (440V series )	220/ 380	×	○
07.05	Torque boost 4	0.0 to 20.0% (percentage with respect to rated voltage at base frequency 4 )	Type Setting	×	○
07.06	Electronic Thermal Overload (Protection for Motor)4 Select motor characteristics	1: Action (For a general-purpose motor with shaft-driven cooling fan ) 2: Action (For an inverter-driven motor, non-ventilated motor, or motor with separately powered cooling fan )	1	×	○
07.07	Electronic Thermal Overload (Protection for Motor )4 Detection level	0.00 (invalid) ; 1% to 135% of the rated current of the motor	Type Setting	×	○
07.08	Electronic Thermal Overload (Protection for Motor )4 Thermal time constant	0.5~75.0min		×	○
07.09	DC braking 4 starting frequency	0.0~60.0Hz	0.0	×	○
07.10	DC braking 4 braking level	0~80%	0	×	○
07.11	DC braking 4 braking time	0.00(invalid); 0.01~30.00s	0.00	×	○
07.12	Starting frequency 4	0.0~60.0Hz	0.5	×	○
07.13	Load Selection / Auto Torque Boost / Auto Energy Saving Operation 4	0: Variable torque load ( general fan and pump load ) 1: constant torque load 2: Auto torque boost 3: Auto energy saving operation ( general fan and pump load ) 4: Auto energy saving operation ( constant torque load ) 5: Auto energy saving operation (automatic torque boost)	1	×	○
07.14	Drive Control mode selection 4	0 : V / f control 1 : dynamic torque vector control 2 : V / f control with slip compensation active 5 : Vector control without speed sensor(*1)	0	×	○
07.15	Motor 4 (No. of poles)	2~22 poles	4	×	○
07.16	Motor 4 rated capacity	0.01~1000kW	Type Setting	×	○
07.17	Motor 4 rated current	0.00~2000A		×	○



## 07 Motor 4 parameters

Parameter	Parameter Functions	Setting Range	Factory Default	Model	
				~15kW	18.5kW~
07.18	Motor 4 auto-tuning	0: Invalid 1: Tune while the motor stops. (% R1, % X, rated slip) 2: Tune while the motor is rotating under V/f control (% R1, % X, rated slip frequency, no-load current, magnetic saturation factors and magnetic saturation extension factors: 1~5 and a~c) 3: Tune while the motor is rotating under vector control (% R1, % X, rated slip frequency, no-load current, magnetic saturation factors 1~5, and magnetic saturation extension factors "a" to "c". Valid when the vector control is enabled)	0	x	○
↗ 07.19	Motor 4 (Online tuning)	0: Invalid 1: Action	0	x	○
07.20	Motor 4 no-load current	0.00~2000A	Type Setting	x	○
↗ 07.21	Motor 4 %R1	0.00~50.00%	Setting	x	○
↗ 07.22	Motor 4 %X	0.00~50.00%	Setting	x	○
⊙ 07.23	Motor 4 Slip compensation gain for (driving)	0.0~200.0%	100.0	x	○
↗ 07.24	Motor 4 slip compensation response time	0.01~10.00s	0.12	x	○
⊙ 07.25	Motor 4 slip compensation gain for (braking)	0.0~200.0%	100.0	x	○
07.26	Motor 4 rated slip frequency	0.00~15.00Hz	Type Setting	x	○
↗ 07.27	Motor 4 iron loss factor 1	0.00~20.00%	Setting	x	○
↗ 07.28	Motor 4 iron loss factor 2		0.00	x	○
↗ 07.29	Motor 4 iron loss factor 3		0.00	x	○
↗ 07.30	Motor 4 magnetic saturation factor 1	0.0~300.0%	Type Setting	x	○
↗ 07.31	Motor 4 magnetic saturation factor 2				
↗ 07.32	Motor 4 magnetic saturation factor 3				
↗ 07.33	Motor 4 magnetic saturation factor 4				
↗ 07.34	Motor 4 magnetic saturation factor 5				
↗ 07.35	Motor 4 magnetic saturation expansion factor a				
↗ 07.36	Motor 4 magnetic saturation expansion factor b				
↗ 07.37	Motor 4 magnetic saturation expansion factor c				
07.39	Reserved				

## 07 Motor 4 parameters

Parameter	Parameter Functions	Setting Range	Factory Default	Model	
				~15kW	18.5kW~
07.40	Slip Compensation 4 (Operating conditions)	0: valid in acceleration and deceleration; valid at base frequency or above 1: invalid in acceleration and deceleration; valid at base frequency or above 2: valid in acceleration and deceleration; invalid at base frequency or above 3: invalid in acceleration and deceleration; invalid at base frequency or above	0	×	○
↗ 07.41	Output Current Fluctuation Damping Gain for Motor 4	0.00~0.40	0.20	×	○
↗ 07.42	Motor/Parameter Switching 4 (Mode selection)	0: Motor switch (switch to the 4nd motor) 1: Parameter switch ( switch to particular 07)	0	×	○
07.51	Cumulative Motor run time 4	0~9999 The cumulative run time can be modified or reset (resettable) (10 hours as a unit)	–	×	○
↗ 07.52	Startup Counter for Motor 4	Adjustment in replacement (0000 ~ FFFF (hexadecimal ) )	–	×	○
↗ 07.53	Motor 4 % X correction factor 1	0~300%	100	×	○
↗ 07.54	Motor 4 % X correction factor 2	0~300%	100	×	○

## 08 Application function 1 parameters

Parameter	Parameter Functions	Setting Range	Factory Default	Model	
				~15kW	18.5kW~
08.01	PID control action	0: Invalid 1: PID output is normal characteristics, Process control, 2: PID output is inverse characteristics, Process control 3: Speed control (Dancer control)	0	○	○
08.02	PID control command	0: (▲/▼) keys on Keypad 1: PID command 1 ( analog input terminals AVI, ACI, AU) 3: UP / DOWN 4: Command via communications link	0	○	○
↗ 08.03	PID control P term (gain)	0,000~30,000 times	0.100	○	○
↗ 08.04	PID control I item (integral time)	0.0~3600.0s	0.0	○	○
↗ 08.05	PID control item D (differential time)	0.00~600.00s	0.00	○	○
↗ 08.06	PID control feedback signal filter	0.0~900.0s	0.5	○	○
↗ 08.08	PID control Pressurization starting frequency	0.0~500.0Hz	0.0	×	○
↗ 08.09	PID control Pressurizing time	0~60s	0	×	○
↗ 08.10	PID control anti-integral windup level	0~200%	200	○	○
↗ 08.11	PID control Select alarm output	0: Absolute value alarm 1: Absolute value alarm (with hold) 2: Absolute value alarm (with latch) 3: Absolute value alarm (with hold and latch) 4: Deviation alarm 5: Deviation alarm (with hold) 6: Deviation alarm (with latch) 7: Deviation alarm (with hold and latch)	0	○	○
↗ 08.12	PID control Upper level alarm (AH)	~100%~100%	100	○	○
↗ 08.13	PID control Lower level alarm (AL)	~100%~100%	0	○	○
↗ 08.15	PID control Stop frequency for slow flowrate	0.0(Invalid); 1.0~500.0Hz	0,0	×	○
↗ 08.16	PID control Slow flowrate level stop latency	0~60s	30	×	○
↗ 08.17	PID control starting frequency	0.0~500.0Hz	0,0	×	○
↗ 08.18	PID control:Upper limit of PID process output	~150%~150%; 999(Depends on setting of 00. 15)	999	○	○
↗ 08.19	PID control:Lower limit of PID process output	~150%~150%; 999(Depends on setting of 00. 16)	999	○	○
↗ 08.21	Dew Condensation Prevention (duty cycle)	1~50%	1	×	○
08.22	Commercial Power Switching Sequence	0: Keep inverter operation(Stop due to alarm) 1: Automatically switch to commercial-power operation	0	×	○
↗ 08.56	PID control speed command filter	0,00~5,00s	0.10	○	○

## 08 Application function 1 parameters

Parameter	Parameter Functions	Setting Range	Factory Default	Model	
				~15kW	18.5kW~
08.57	PID control Dancer reference position	-100~0~100%	0	○	○
08.58	PID control Detection width of dancer position deviation	0: invalid PID constant switching; 1 ~ 100%: manual set value	0	○	○
08.59	PID control P term (gain) 2	0.000~30.000 times	0.100	○	○
08.60	PID control I item (integral time) 2	0.0~3600.0s	0.0	○	○
08.61	PID control item D (differential time) 2	0.00~600.00s	0.00	○	○
08.62	PID control block selection	0~3 Bit 0: PID output polarity; 0 = plus(add); 1 = minus(subtract) Bit 1: Select compensation factor for PID output 0 = Ratio (relative to the main setting) 1 = Speed command (relative to maximum frequency)	0	○	○
08.68	Brake signal Brake-OFF current	0~300%	100	○	○
08.69	Brake signal Brake-OFF frequency/speed	0.0~25.0Hz	1.0	○	○
08.70	Brake signal Brake-OFF timer	0.0~5.0s	1.0	○	○
08.71	Brake signal Brake-ON frequency/speed	0.0~25.0Hz	1.0	○	○
08.72	Brake signal Brake-ON timer	0.0~5.0s	1.0	○	○
08.95	Brake signal Brake-ON torque	0~300%	100	×	○
08.96	Brake signal Speed condition selection	0~31 Bit 2: Response for brake-OFF current ( 0: Slow response 1: Quick response)	0	×	○

## 09 Application function 2 parameters

Parameter	Parameter Functions	Setting Range	Factory Default	Model	
				~15kW	18.5kW~
09.01	Speed control 1 Speed command filter	0.000~5.000s	0.020	×	○
09.02	Speed control 1 Speed detection filter	0.000~0.100s	0.005	×	○
09.03	Speed control 1 P item (gain)	0.1~200.0 times	10.0	×	○
09.04	Speed control 1 I item (integral time)	0.001~9.999s 999: Integral action is invalid	0.100	×	○
09.06	Speed control 1 output filter	0.000~0.100s	0.002	×	○

## 09 Application function 2 parameters

	Parameter	Parameter Functions	Setting Range	Factory Default	Model	
					~15kW	18.5kW~
✓	09.09	Speed control (JOG) Speed command filter	0.000~5.000s	0,020	×	○
⊙	09.10	Speed control (JOG) Speed detection filter	0.000~0.100s	0,005	×	○
⊙	09.11	Speed control (JOG) P item (gain)	0,1~200,0 times	10,0	×	○
⊙	09.12	Speed control (JOG) item ( integral time )	0,001~9,999s 999: Integral action is invalid	0,100	×	○
✓	09.13	Speed control (JOG) output filter	0,000~0,100s	0,002	×	○
✓	09.21	Speed Agreement/ Error Hysteresis width	0.0~50.0%	10,0	×	○
✓	09.22	Speed Agreement/ Error Detection timer	0.00~10.00s	0.50	×	○
✓	09.23	Speed Error Processing	0: Continue to run 1: Stop running with alarm 1 2: Stop running with alarm 2 3: Continue to run 2 4: Stop running with alarm 3 5: Stop running with alarm 4	0	×	○
✓	09.25	Automatic speed regulator switching time	0.000~1.000s	0,000	×	○
✓	09.32	Torque control speed limit 1	0~110%	100	×	○
✓	09.33	Torque control speed limit 2	0~110%	100	×	○
✓	09.35	Overspeed detection level	0~120% 999: based on 09. 33 to 09. 32 or parameter values	999	×	○
✓	09.61	Command filter time constant	0.000~5.000s	0,005	×	○
	09.62	Command pulse count factor 1	1~9999	1	×	○
	09.63	Command pulse count factor 2	1~9999	1	×	○
	09.67	Starting Auto search Mode	0: Invalid 1: Action (At restart after momentary power failure) 2: Action (At restart after momentary power failure and at normal start)	0	×	○

PS:The function parameter 2 of 9th group is the senseless vector extra control parameter of above 18,5kw (include 18,5kw)

## 10 Application function 3 parameters

Parameter	Parameter Functions	Setting Range	Factory Default	Model	
				~15kW	18.5kW~
10.00	Customizable Logic (Mode selection)	0: Invalid 1: Valid Action (Customizable logic)	0	×	○
10.01	Customizable Logic: (Input 1) step 1	0(1000): Inverter running [mRUN]	0	×	○
10.02	Customizable Logic: (Input 2) step 1	1(1001): Frequency (speed) arrival signal [mFAR]	0	×	○
		2(1002): Frequency (speed) detection [mFDT]		×	○
		3(1003): Undervoltage detected(When Inverter stopped) [mLU]		×	○
		4(1004): Torque polarity detection [mB/D]		×	○
		5(1005): Inverter output limiting [mIOL]		×	○
		6(1006): Auto-restarting after momentary power failure [mIPF]		×	○
		7(1007): Motor overload early warning [mOL]		×	○
		8(1008): Keypad operation enabled [mKP]		×	○
		10(1010): Inverter ready to run [mRDY]		×	○
		15(1015): AX terminal function [mAX]		×	○
		22(1022): Inverter output limiting ( with delay ) [mIOL2]		×	○
		25(1025): Cooling fan ON-OFF in operation [mFAN]		×	○
		26(1026): Auto-resetting [mTRY]		×	○
		28(1028): Cooler overheat early warning [mOH]		×	○
		31(1031): Frequency (speed) detection 2 [mFDT2]		×	○
		33(1033): Reference loss detected [mREF OFF]		×	○
		35(1035): Inverter output on [mRUN2]		×	○
		36(1036): In overload prevention control[mOLP]		×	○
		37(1037): Current detected [mID]		×	○
		38(1038): Current detected 2 [mID2]		×	○
39(1039): Current detected 3 [mID3]	×	○			
41(1041): Low current detected [mIDL]	×	○			
42(1042): PID alarm output [mPID-ALM]	×	○			

## 10 Application function 3 parameters

Parameter	Parameter Functions	Setting Range	Factory Default	Model	
				~15kW	18.5kW~
		43(1043): In PID control [mPID-CTL]		x	○
		44(1044): PID Motor stopped due to slow flowrate under PID control [mPID-STP]		x	○
		45(1045): Low output torque detection [mU-TL]		x	○
		46(1046): Torque detection 1 [mTD1]		x	○
		47(1047): Torque detection 2 [mTD2]		x	○
		48(1048): Motor 1 selected [mSWM1]		x	○
		49(1049): Motor 2 selected [mSWM2]		x	○
		50(1050): Motor 3 selected [mSWM3]		x	○
		51(1051): Motor 4 selected [mSWM4]		x	○
		52(1052): Running Forward signal [mFRUN]		x	○
		53(1053): Running Reversal signal [mRRUN]		x	○
		56(1056): Motor overheat detected by thermistor [mTHM]		x	○
		57(1057): Brake signal [mBRKS]		x	○
		58(1058): Frequency ( speed ) detection 3 [mFDT3]		x	○
		59(1059): ACI terminal wire break detected [mC1OFF]		x	○
		70(1070): Speed valid [mDNZS]		x	○
		71(1071): Speed agreement [mDSAG]		x	○
		72(1072): Frequency (speed) arrival signal 3 [mFAR3]		x	○
		84(1084): Maintenance timer [mMNT]		x	○
		90(1090): Alarm contents 1 [mAL1]		x	○
		91(1091): Alarm contents 2 [mAL2]		x	○
		92(1092): Alarm contents 4 [mAL4]		x	○
		93(1093): Alarm contents 8 [mAL8]		x	○
		98(1098): Light alarm [mL-ALM]		x	○
		99(1099): Alarm output (for any alarm) [mALM]		x	○
		105(1105): Braking transistor broken [mDBAL]		x	○
		2001(3001): Output of step 1 [mSO01]		x	○
		2002(3002): Output of step 2 [mSO02]		x	○
		2003(3003): Output of step 3 [mSO03]		x	○
		2004(3004): Output of step 4 [mSO04]		x	○
		2005(3005): Output of step 5 [mSO05]		x	○
		2006(3006): Output of step 6 [mSO06]		x	○
		2007(3007): Output of step 7 [mSO07]		x	○
		2008(3008): Output of step 8 [mSO08]		x	○
		2009(3009): Output of step 9 [mSO09]		x	○
		2010(3010): Output of step 10 [mSO10]		x	○
		4001(5001): MI1 terminal input signal [mMI1]		x	○
		4002(5002): MI2 terminal input signal [mMI2]		x	○
		4007(5007): MI7 terminal input signal [mMI7]		x	○
		4010(5010): FWD terminal input signal [mFWD]		x	○
		4011(5011): REV terminal input signal [mREV]		x	○
		6000(7000): RUN Final run command [mFL_RUN]		x	○

## 10 Application function 3 parameters

Parameter	Parameter Functions	Setting Range	Factory Default	Model	
				~15kW	18.5kW~
		6001(7001): FWD Final FWD run command [mFL_FWD] ----- 6002(7002): REV Final REV run command [mFL_REV] ----- 6003(7003): During acceleration [mDACC] 6004(7004): During deceleration [mDDEC] 6005(7005): Under anti-regenerative control [mREGA] ----- 6006(7006): Within dancer reference position [mDR_REF] 6007(7007): Alarm factor presence [mALM_ACT] ----- ※ Setting the value in parentheses(↔)shown above assigns a negative logic output to a terminal.(True if OFF)		×	○
10.03	Customizable Logic: Step 1 Logic circuit	0: No function assigned 1: Through output + general-purpose timer 2: Logic and (ANDing) + general-purpose timer 3: Logic or (ORing) + general-purpose timer 4: Logical XOR (XORing) + general-purpose timer 5: Set priority flip-flop+general-purpose timer 6: Reset priority flip-flop+general-purpose timer 7: Rising edge detector+general-purpose timer 8: Falling edge detector+general-purpose timer 9: Rising and falling edge detector + general-purpose timer 10: Input hold + general-purpose timer 11: Increment counter 12: Decrement counter 13: Timer with reset input	0	×	○
10.04	Customizable Logic: Step 1 Type of timer	0: No timer 1: ON-delay timer 2: Off-delay timer 3: Pulse 4: Retriggerable timer 5: Pulse Train Output	0	×	○
10.05	Customizable Logic: Step 1 time setting	0.00~600.00	0.00	×	○
10.06	Customizable Logic: Step 2 input 1	Same with 10. 01	0	×	○
10.07	Customizable Logic: Step 2 input 2	Same with 10. 02	0	×	○
10.08	Customizable Logic: Step 2 Logic circuit	Same with 10. 03	0	×	○
10.09	Customizable Logic: Step 2 Type of timer	Same with 10. 04	0	×	○



## 10 Application function 3 parameters

Parameter	Parameter Functions	Setting Range	Factory Default	Model	
				~15kW	18.5kW~
10.10	Customizable Logic: Step 2 time setting	Same with 10. 05	0,00	×	○
10.11	Customizable Logic: Step 3 input 1	Same with 10. 01	0	×	○
10.12	Customizable Logic: Step 3 input 2	Same with 10. 02	0	×	○
10.13	Customizable Logic: Step 3 Logic circuit	Same with 10. 03	0	×	○
10.14	Customizable Logic: Step 3 Type of timer	Same with 10. 04	0	×	○
10.15	Customizable Logic: Step 3 time setting	Same with 10. 05	0,00	×	○
10.16	Customizable Logic: Step 4 input 1	Same with 10. 01	0	×	○
10.17	Customizable Logic: Step 4 input 2	Same with 10. 02	0	×	○
10.18	Customizable Logic: Step 4 Logic circuit	Same with 10. 03	0	×	○
10.19	Customizable Logic: Step 4 Type of timer	Same with 10. 04	0	×	○
10.20	Customizable Logic: Step 4 time setting	Same with 10. 05	0,00	×	○
10.21	Customizable Logic: Step 5 input 1	Same with 10. 01	0	×	○
10.22	Customizable Logic: Step 5 input 2	Same with 10. 02	0	×	○
10.23	Customizable Logic: Step 5 Logic circuit	Same with 10. 03	0	×	○
10.24	Customizable Logic: Step 5 Type of timer	Same with 10. 04	0	×	○
10.25	Customizable Logic: Step 5 time setting	Same with 10. 05	0,00	×	○
10.26	Customizable Logic: Step 6 input 1	Same with 10. 01	0	×	○
10.27	Customizable Logic: Step 6 input 2	Same with 10. 02	0	×	○
10.28	Customizable Logic: Step 6 Logic circuit	Same with 10. 03	0	×	○
10.29	Customizable Logic: Step 6 Type of timer	Same with 10. 04	0	×	○
10.30	Customizable Logic: Step 6 time setting	Same with 10. 05	0,00	×	○
10.31	Customizable Logic: Step 7 input 1	Same with 10. 01	0	×	○
10.32	Customizable Logic: Step 7 input 2	Same with 10. 02	0	×	○
10.33	Customizable Logic: Step 7 Logic circuit	Same with 10. 03	0	×	○
10.34	Customizable Logic: Step 7 Type of timer	Same with 10. 04	0	×	○
10.35	Customizable Logic: Step 7 time setting	Same with 10. 05	0,00	×	○
10.36	Customizable Logic: Step 8 input 1	Same with 10. 01	0	×	○
10.37	Customizable Logic: Step 8 input 2	Same with 10. 02	0	×	○

## 10 Application function 3 parameters

Parameter	Parameter Functions	Setting Range	Factory Default	Model	
				~15kW	18.5kW~
10.38	Customizable Logic: Step 8 Logic circuit	Same with 10.03	0	×	○
10.39	Customizable Logic: Step 8 Type of timer	Same with 10.04	0	×	○
10.40	Customizable Logic: Step 8 time setting	Same with 10.05	0,00	×	○
10.41	Customizable Logic: Step 9 input 1	Same with 10.01	0	×	○
10.42	Customizable Logic: Step 9 input 2	Same with 10.02	0	×	○
10.43	Customizable Logic: Step 9 Logic circuit	Same with 10.03	0	×	○
10.44	Customizable Logic: Step 9 Type of timer	Same with 10.04	0	×	○
10.45	Customizable Logic: Step 9 time setting	Same with 10.05	0,00	×	○
10.46	Customizable Logic: Step 10 input 1	Same with 10.01	0	×	○
10.47	Customizable Logic: Step 10 input 2	Same with 10.02	0	×	○
10.48	Customizable Logic: Step 10 Logic circuit	Same with 10.03	0	×	○
10.49	Customizable Logic: Step 10 Type of timer	Same with 10.04	0	×	○
10.50	Customizable Logic: Step 10 time setting	Same with 10.05	0,00	×	○
10.71	Customizable Logic output signal 1 output selection	0: Invalid 1: Step 1 Output [mSO01]	0	×	○
10.72	Customizable Logic output signal 2 output selection	2: Step 2 Output [mSO01] 3: Step 3 Output [mSO01] 4: Step 4 Output [mSO01]	0	×	○
10.73	Customizable Logic output signal 3 output selection	5: Step 5 Output [mSO01] 6: Step 6 Output [mSO01]	0	×	○
10.74	Customizable Logic output signal 4 output selection	7: Step 7 Output [mSO01] 8: Step 8 Output [mSO01]	0	×	○
10.75	Customizable Logic output signal 5 output selection	9: Step 9 Output [mSO01] 10: Step 10 Output [mSO01]	0	×	○
10.81	Customizable Logic Output Signal 1 function selection	0(1000): Multi-step speed command 1 (0-1 step) [mSS1]	100	×	○
		1(1001): Multi-step speed command 2 (0-3 steps) [mSS2]		×	○
10.82	Customizable Logic Output Signal 2 function selection	2(1002): Multi-step speed command 3 (0-7 steps) [mSS4]	100	×	○
10.83	Customizable Logic Output Signal 3 function selection	3(1003): Multi-step speed command 4 (0-15 steps) [mSS8]	100	×	○
10.84	Customizable Logic Output Signal 4 function selection	4(1004): Select ACC/DEC time (2steps) [mRT1]	100	×	○
10.85	Customizable Logic Output Signal 5 function selection	5(1005): Select ACC/DEC time (4steps) [mRT2]	100	×	○
		6(1006): Enable 3-wire operation [mHLD]		×	○
		7(1007): Coast to a stop [mBX]		×	○

## 10 Application function 3 parameters

Parameter	Parameter Functions	Setting Range	Factory Default	Model	
				~15kW	18.5kW~
		8(1008): Reset alarm ( abnormal ) [mRST]		x	○
		9(1009): Enable External alarm trip [mTHR] (9= Active OFF / 1009= Active ON)		x	○
		10(1010): Ready for Jogging [mJOG]		x	○
		11(1011): Select frequency command 2/1 [mHz2/mHz1]		x	○
		12(1012): Motor 2 selection [mM2]		x	○
		13: DC braking command [mDCBRK]		x	○
		14(1014): Torque limiter level2 / torque limiter level 1 [mTL2/mTL1]		x	○
		15: Switch to commercial power (50Hz) [mSW50]		x	○
		16: Switch to commercial power (60Hz) [mSW60]		x	○
		17(1017): UP command (Increase output frequency) [mUP]		x	○
		18(1018): DOWN command (Decrease output frequency) [mDOWN]		x	○
		20(1020): Cancel PID control [mHz/PID]		x	○
		21(1021): Switch Forward & reverse [mVVS]		x	○
		22(1022): Interlock [mL]		x	○
		24(1024): (RS485)Communication link via selection (RS485) [mLE]		x	○
		25(1025): Universal DI [mU-DI]		x	○
		26(1026): Enable auto search for idling motor speed at starting [mSTM]		x	○
		30(1030): Force to stop [mSTOP] ( 30 = Active OFF/1030 = Active ON)		x	○
		33(1033): Reset PID integral and differential components [mPID-RST]		x	○
		34(1034): Hold PID integral component [mPID-HLD]		x	○
		35(1035): Select local (keypad) operation[mLOC]		x	○
		36(1036): Motor 3 selection [mM3]		x	○
		37(1037): Motor 4 selection [mM4]		x	○
		39: Prevent condensation [mDWP]		x	○
		76(1076): Droop control [mDROOP]		x	○
		81(1081): Clear all customizable logic timers[mCLTC]		x	○
		98: Run forward [mFWD]		x	○
		99: Run reverse [mREV]		x	○
		100: No function assigned [mNONE]		x	○
		※ Setting the value in parentheses(⇔)shown above assigns a negative logic output to a terminal.(True if OFF)			

## 10 Application function 3 parameters

Parameter	Parameter Functions	Setting Range	Factory Default	Model	
				~15kW	18.5kW~
10.91	Customizable Logic: monitor Timer (step selection)	1: Step 1 2: Step 2 3: Step 3 4: Step 4 5: Step 5 6: Step 6 7: Step 7 8: Step 8 9: Step 9 10: Step 10	1	x	○

## 11 Serial communication function Parameter

Parameter	Parameter Functions	Setting Range	Factory Default	Model	
				~15kW	18.5kW~
11.01	RS485 communication 1 communication Station address	1~255	1	○	○
11.02	RS485 communication 1: Communications error processing	0: Immediate Er8 alarm 1: Er8 alarm after timer operation 2: Retry start when timer is running, when communication is not resumed: Er8 Alarm, when communication resumes: Continue running, 3: Continue to run	0	○	○
11.03	RS485 communication 1: timer	0.0~60.0s	2.0	○	○
11.04	RS485 communication 1: baud rate	0: 2400bps 1: 4800bps 2: 9600bps 3: 19200bps 4: 38400bps	2	○	○
11.05	RS485 communication 1: data length selection	0: 8 Bit    1: 7 Bit	0	○	○
11.06	RS485 communication 1: parity check selection	0: No ( Stop bit : 2 ) 1: Even parity ( Stop bit : 1 ) 2: Odd parity ( Stop bit : 1 ) 3: No ( Stop bit : 1 )	0	○	○
11.07	RS485 communication 1: stop bit selection	0: 2 bit    1: 1 bit	0	○	○
11.08	RS485 communication 1: No-response error detection time	0: No detection    1~60s	0	○	○
11.09	RS485 communication 1 response interval	0.00~1.00s	0.01	○	○

## 11 Serial communication function Parameter

Parameter	Parameter Functions	Setting Range	Factory Default	Model	
				~15kW	18.5kW~
11.10	RS485 communication 1 protocol selection	0: Modbus RTU protocol 5: Modbus ASCII protocol	0	<input type="radio"/>	<input type="radio"/>
11.11	RS485 communication 2 communication Station address	1~255	1	<input type="radio"/>	<input type="radio"/>
11.12	RS485 communication 2: Communications error processing	0: Immediate Erp alarm 1: Erp alarm after timer operation 2: Retry when the timer is running, when communication is not resumed: Erp alarm when the communication is resumed: Continue running. 3: Continue to run	0	<input type="radio"/>	<input type="radio"/>
11.13	RS485 communication 2: timer	0.0~60.0s	2.0	<input type="radio"/>	<input type="radio"/>
11.14	RS485 communication 2: baud rate	0: 2400bps 1: 4800bps 2: 9600bps 3: 19200bps 4: 38400bps	2	<input type="radio"/>	<input type="radio"/>
11.15	RS485 communication 2: data length selection	0: 8 Bit      1: 7 Bit	0	<input type="radio"/>	<input type="radio"/>
11.16	RS485 communication 2: parity check selection	0: No ( Stop bit : 2 ) 1: Even parity ( Stop bit : 1 ) 2: Odd parity ( Stop bit : 1 ) 3: No ( Stop bit : 1 )	0	<input type="radio"/>	<input type="radio"/>
11.17	RS485 communication 2: stop bit selection	0: 2 bit      1: 1 bit	0	<input type="radio"/>	<input type="radio"/>
11.18	RS485 communication 2: No-response error detection time	0: No detection      1~60s	0	<input type="radio"/>	<input type="radio"/>
11.19	RS485 communication 2 response interval	0.00~1.00s	0.01	<input type="radio"/>	<input type="radio"/>
11.20	RS485 communication 2 protocol selection	0: Modbus RTU protocol 5: Modbus ASCII protocol	0	<input type="radio"/>	<input type="radio"/>
11.50	Function switch bit (Hexadecimal)	Bit 0: Keypad control the broken stop during operation(0: enabled, 1: disabled) Bit 1: potentiometer keypad switch to button feed(0: potentiometer, 1: button)	0	<input type="radio"/>	<input type="radio"/>
11.57	DB level offset	+150~150V	0	<input type="radio"/>	<input type="radio"/>

## 11 Serial communication function Parameter

	Parameter	Parameter Functions	Setting Range	Factory Default	Model	
					~15kW	18.5kW~
✓	11.97	Communication Data Storage Selection	0: Save into nonvolatile storage (Rewritable times limited) 1: Write into temporary storage (Rewritable times unlimited) 2: Save all data from RAM storage to EEPROM (After saving data, the 11.97 data automatically returns to "1")	0	×	○
✓	11.98	Communication function (mode selection)	Frequency command Follow 04.30    Running command Follow 04.30	0	○	○
✓	11.99	Auxiliary communication function (mode selection)	Frequency command Follow 04.30, 11.98    Running command Follow 04.30, 11.98	0	○	○

## 6.FUNCTION PARAMETERS DESCRIPTION

This chapter will describe all parameters in detail. It is divided into 12 parameter groups according to the parameter properties. To make the parameter setting easier, in most of the application, the user can complete the setting before operation according to related parameter setting in the parameter group.

12 parameter groups are as the following:

Parameters	Function	Parameters	Function
00	Basic functions	06	Motor 3 parameters
01	External terminal functions	07	Motor 4 parameters
02	Control functions	08	Application function 1
03	Motor 1 parameters	09	Application function 2
04	Advanced functions	10	Application function 3
05	Motor 2 parameter	11	Serial communication function

### 00 Basic Functional Parameters

<b>00.00</b>	Setting Data protection		Factory default	<b>0</b>
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This function parameter 00.00 specifies whether to protect setting data (except 00:00) and digital reference data (such as frequency command and PID command) from accidentally getting changed by pressing the / keys on the keypad.

Setting value	Changing parameter		Changing digital reference data with keypad
	From the keypad	From Via communications link	
0	○: Allowed	○: Allowed	○: Allowed
1	×: Not allowed	○: Allowed	○: Allowed
2	○: Allowed	×: Not allowed	×: Not allowed
3	×: Not allowed	×: Not allowed	×: Not allowed

To change 00.00 data, simultaneous keying of " key + key " (from 0 to 1) or " key + key " (from 1 to 0) keys is required.

As similar function, [mWE-KP], a signal enabling editing of parameter data from the keypad is provided as a terminal command for digital input terminals.

(Refer to the descriptions of 01.01~01.07, data is 19)

The relationship between the terminal command mWE-KP and 00.00 data are as shown below.

Input Signal [mWE-KP]	Changing parameter	
	From the keypad	From Via communications link.
OFF	×: Not allowed	○: Allowed
ON	According to the 00.00 setting	

Note: • If you mistakenly assign the terminal command [mWE-KP], you no longer edit or modify parameter data, taking short circuit to the [mWE-KP]-assigned terminal ON and terminal DCM, and then reassign the WE-KP to another command.

- [mWE-KP] is only a signal that allows you to change parameter data, so it does not protect the frequency settings or PID command specified by the and keys.

Tips: Even when 00.00=1 or 3, it can be changed from via the communications link.

<b>00. 01</b>	Dominant frequency 1 source selection		Factory default	<b>0</b>
	Related parameters	00. 18 Dominant frequency 1 bias setting 02. 30 Dominant frequency 2 source selection 02. 31~02. 35 Analog input (AVI terminals ) 02. 36~02. 39 Analog input (ACI terminals ) 02. 41~02. 45 Analog input (AUI terminals ) 02. 50 Bias base point (Dominant frequency 1 ) 04. 61 UP / DOWN control initial frequency setting selection 09. 59. 09. 61~09. 63 Pulse Rate Input		

Frequency Command: 00. 01 or 02. 30 sets a command source that specifies reference frequency1 or reference frequency 2.

00. 01, 02. 30 Setting value	Setting Method	Refer to:
0	The keypad potentiometer (Note: keypad  /  key, please set the 11.50 end digit number to 2).	[ 1 ]
1	Enable the voltage input to terminal AVI to set (DC0~±10V, max. output frequency / DC±10V).	[ 2 ]
2	Enable the current input to terminal ACI to set . (DC4~20mA, max. output frequency / DC20mA).	
3	Enable the sum of voltage (DC0 to ±10 V, max. output frequency / DC±10V) and current inputs (DC 4 to +20 mA , max. output frequency / DC20mA ) given to terminals AVI and ACI to set (If the sum exceeds the maximum frequency, only the maximum frequency will apply.)	
5	Enable the voltage input to terminal AUI (DC0~±10V, max output frequency / DC±10V ) to set. SW5 on the control circuit board should be turned to the V2 position (factory default).	[ 3 ]
7	Enable [mUP]and [mDOWN] commands assigned to the digital input terminals to set. (The [mUP]command (data=17) and [mDOWN] command (Data=18) should be assigned to any of digital input terminals MI1 to MI7. For details, See parameters 01. 01~01. 07 on detailed information.)	
12	Enable the Pulse train input [mPIN] command assigned to digital input terminal or a PG interface card to set (option)	

Note: The analog input signal AVI and AUI for negative voltage are supported only by 18.5kW and above.

#### < Frequency Command >

[ 1 ] Enable / keys on the keypad to set (0. 01=0(factory default))

- (1) The data of parameter 00, 01 is set as "0", that is, the keyboard " / key" is used to set the frequency (potentiometer is preferred when there is an integrated potentiometer).
- (2) After pressing key, it displays the set frequency, and the final digit of set frequency is flashing.
- (3) Set frequency can be changed by pressing / keys again.
- (4) If you want to save the set frequency, press the key within 3s after the frequency adjustment is given, and "SAUE" will be displayed.



Note: If the keypad is an integrated potentiometer, need to switch to the keypad "  $\wedge$  /  $\vee$  key" given mode, you need to set the function parameter "11. 50 function switch bit (hexadecimal display)" bit 1: Potentiometer panel switch to the key given (0: Potentiometer; 1: Key up and down keys), the parameter "11. 50" Factory default value is 0 Change to 2, that is, switch to the up and down keys of the keypad to give the frequency.

The frequency given by the up and down keys need to save the operation, refer to the description of the above point (4)!

[ 2 ] Enable the analog input to set frequency. (00. 01=1~3, 5)

When any analog input (voltage input to terminals AVI and AUI, or current input to terminal ACI) corresponding the dominant frequency 1 source selection (00. 01), it is possible to arbitrarily specify the reference frequency by multiplying the gain and adding the bias. The polarity can be selected and the filter time constant and offset can be adjusted.

Adjustment elements of frequency command 1

00.01 Setting value	Input Terminal	Input range	Bias		Gain		Polarity Selection	Filter time	Compensation
			Bias	Base point	Gain	Base point			
1	AVI	0~+10V	00.18	02.50	02.32	02.34	02.35	02.33	02.31
2	ACI	4~20mA	00.18	02.50	02.37	02.39	—	02.38	02.36
3	AVI+ACI (setting by add operation results)	0~+10V	00.18	02.50	02.32	02.34	02.35	02.33	02.31
		4~20mA	00.18	02.50	02.37	02.39	—	02.38	02.36
5	AUI	0~+10V	00.18	02.50	02.42	02.44	02.45	02.43	02.41

■ Compensation (02. 31、02. 36、02. 41)

Specifies a compensation for analog input voltage or current, bias. The compensation also applies to signals sent from the external equipment.

■ Filtering Time constant (02. 33、02. 38、02. 43)

Specifies a filter time constant for analog input voltage or current. Choose an appropriate value for the time constant taking into account the response speed of the machinery system since a large time constant slows down the response. When the input voltage fluctuates due to noise, specify a larger time constant..

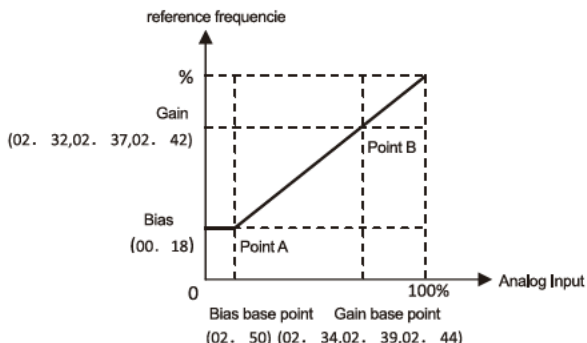
■ Polarity Selection (02. 35, 02. 45)

Specifies the input range for analog input voltage.

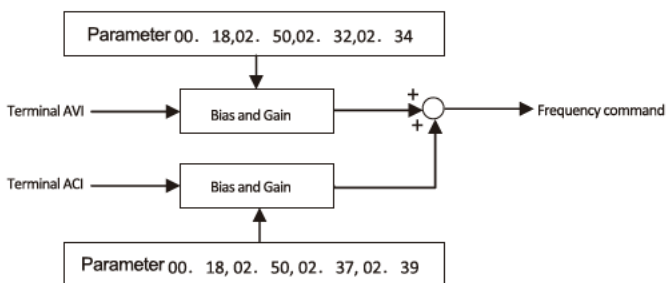
02. 35, 02. 45 Setting value	Terminal Input Specifications
0	-10~+10V
1	0~+10V (Negative voltage is regarded as 0V.)

Note: negative voltage input signal is only supported in 18.5kW and above power range!

## ■ Gain and Bias



Note: terminals AVI and ACI (if the sum of AVI+ACI is enabled), the bias and gain are independently applied to each of the voltage and current inputs given to terminals AVI+ACI, and the sum of the two values is applied as the reference frequency.

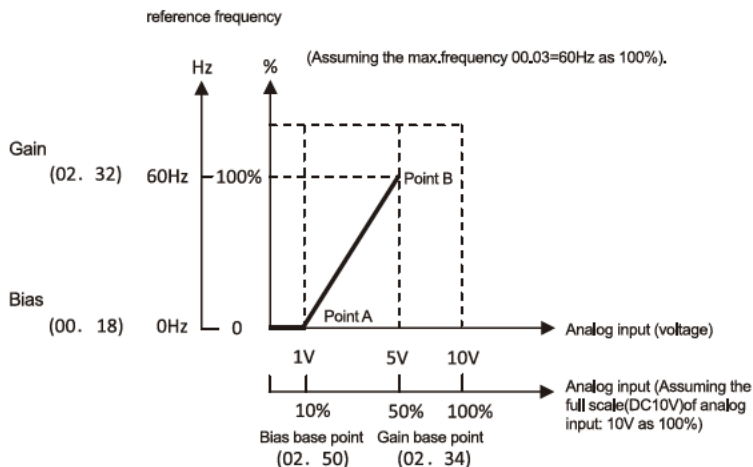


In the case of unipolar input (terminal AVI( with 02. 35 = 1, terminal ACI, terminal AUI with 0.245 = 1). As shown in the graph above, the relationship between the analog input and the reference frequency specified by frequency command 1 can arbitrarily be determined by points "A" and "B". Point "A" is defined by the combination of the bias (00. 18) and its base point (02. 50) Point "B", by the combination of the gain (02. 32 and 02. 34, 02. 37) and its base point (02. 39, 02. 42 and 02. 44). Configure the bias (00. 18) and gain (02. 32, 02. 37 or 02. 42), assuming the maximum frequency as 100%, and the bias base point (02V50) and gain base point (02. 34, 02. 39 or 02. 44), assuming the full scale (DC10V or DC20mA) of analog input as 100%.

Note:

- The analog input less than the bias base point (02. 50) is limited by the bias value.(00. 18).
- Specifying that the data of the bias base point (02. 50) is equal to or greater than that of each gain base point (02. 34, 02. 39, 02. 44) will be interpreted as invalid, so the inverter will reset the reference frequency to 0Hz.

Example: setting the bias, gain and their base points when the reference frequency 0 to 60Hz follows the analog input of 1 to DC5V to terminal AVI (in frequency command 1),



(Point A)

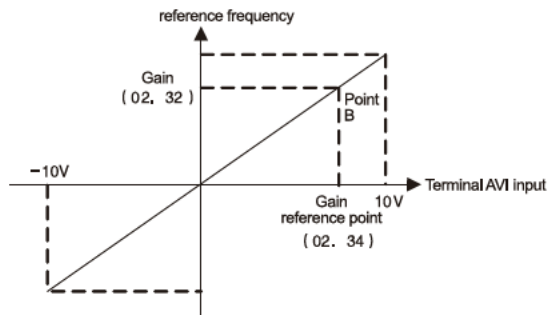
To set the reference frequency to 0Hz for an analog input being at 1V, set the bias (00. 18) to 0%. Since 1V is the bias base point and it's equal to 10% of 10V full scale of terminal AV1, set the bias base point to 10% (02. 50 = 10).

(Point B)

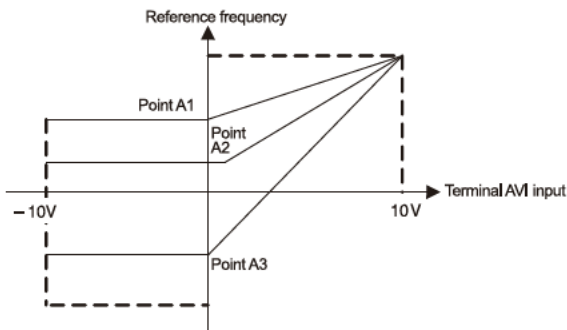
To make the maximum frequency equal to the reference frequency for an analog input being at 5V, set the gain to 100% (02. 32). Since 5V is the gain base point and it is equal to 50% of 10V (full scale of terminal AV1), set the gain base point to 50% (02. 34).

In the case of bipolar input (terminal AV1 with (02. 35=0) and terminal AU1 with (02. 45=0) Setting 02,35 and 02,45 data to "0" enables terminal AV1 ,to be used for bipolar input (-10V to +10V) respectively.

When both 00. 18 (Bias) and 02. 50 (Bias base point) are set to "0", the negative and positive voltage inputs produce reference frequencies symmetric about the origin point as shown below.



Note: Configuring Bias (00. 18) and Bias base point (02. 50) to specify an arbitrary value (Points A1, A2, and A3) gives the bias as shown below.



Note: A reference frequency can be specified not only with the frequency (Hz) but also with other menu items, depending on the setting of parameter 01. 48 (= 3 to 5, 7)

[ 3 ] Using digital input signals [mUP] / [mDOWN] (00. 01 = 7) [mUP] / [mDOWN]

When UP/DOWN control is selected for frequency setting with a run command ON, if turning the terminal command [mUP] or [mDOWN] ON causes the output frequency to increase or decrease, respectively, within the range from 0 Hz to the maximum frequency as listed below.

To enable the UP/DOWN control for frequency setting, it is necessary to set 00. 01 data to "7" and assign the UP and DOWN command [mUP] and [mDOWN]. (Parameter 01. 01~01. 09, data = 17, 18)

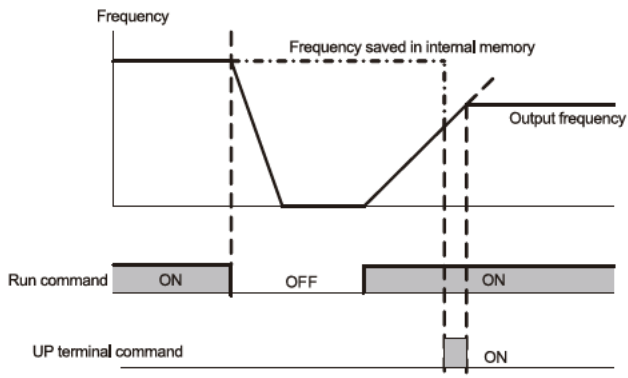
Input signal [mUP] data = 17	Output signal [mDOWN] data = 18	Action
OFF	OFF	Keep the current output frequency.
ON	OFF	Increase the output frequency with the acceleration time currently specified.
OFF	ON	Decrease the output frequency with the deceleration time currently specified.
ON	ON	Keep the current output frequency.

#### ■ Specifying the initial value for the UP/DOWN control

Specify the initial value to start the UP/DOWN control.

04.61 Setting value	Initial value to start the UP/DOWN control
0	Take 0.00Hz as initial value. The inverter automatically clears the value to "0". When restarted (including power on), Speed up by the UP command.
1	Mode holding the final output frequency in the previous UP/DOWN control The inverter internally holds the last output frequency set by the UP/DOWN control and applies the held frequency at the next restart (including powering ON).

Note: At the time of restart, if an UP or DOWN terminal command is entered before the internal frequency reaches the output frequency saved in the memory, the inverter saves the current output frequency into the memory and starts the UP/DOWN control with the new frequency. Pressing one of these keys overwrites the frequency held in the inverter.



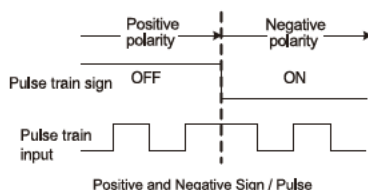
**< Initial frequency for the UP/DOWN control when the frequency command source is switched >**

When the frequency command source is switched to the UP/DOWN control from other sources, the initial frequency for the UP/DOWN control is following table.

Frequency command source	Switching command	Initial frequency for UP/DOWN control	
		04. 61=0	04. 61=1
Setting except UP/DOWN (00. 01, 02. 30)	Main frequency command 1/2 Selection	Reference frequency given by the frequency command source used just before switching	
PID control	Cancel PID control	Reference frequency given by PID control (PID controller output)	
Multi-step speed frequency	Multi-step speed frequency selection	Reference frequency given by the frequency command source used just before switching	Reference frequency at the time of previous UP/DOWN control
Communication link	Enable to select communications link via RS485 or other way	Reference frequency given by the frequency command source used just before switching	Reference frequency at the time of previous UP/DOWN control

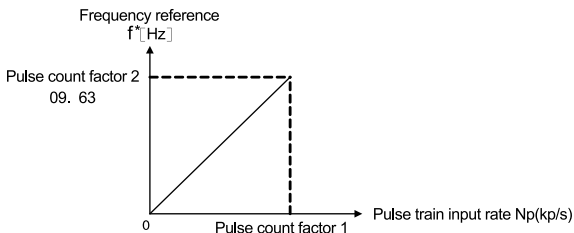
**[ 4 ] Using pulse train input (00. 01=12)**

The pulse input method is a positive and negative sign pulse input, as shown in the figure below.



**■ Pulse count factor 1 (09. 62), Pulse count factor 2 (09. 63)**

For the pulse train input, function parameter 09. 62 ((Command (Pulse rate input) Pulse count factor 1)) and 09. 63 (Command (Pulse rate input), (Pulse count factor 2)) define the relationship between the input pulse rate and the frequency command (reference).



Relationship between the Pulse Train Input Rate and Frequency Command (Reference)

As shown in the figure above, enter the pulse train input rate into function parameter 09. 62 (Command (Pulse rate input)), (Pulse count factor 1)), and enter the frequency reference defined by function parameter 09. 62 to the function parameter 09. 63 (Command (Pulse rate input), (Pulse count factor 2)).

The relationship between the pulse train input rate (kp/s) inputted to the PIN terminal and the frequency reference  $f^*$  (Hz) (or speed command) is given by the expression below.

$$f^*[\text{Hz}] = N_p [\text{kp/s}] \times \frac{\text{Pulse count factor 2(09. 63)}}{\text{Pulse count factor 1(09. 62)}}$$

Note: 15kW and below power range is  $f^* [\text{Hz}] = N_p [\text{kp/s}] \times \frac{\text{Pulse count factor 2(11. 63)}}{\text{Pulse count factor 1(11. 62)}}$

$f^*[\text{Hz}]$ : Frequency reference

$N_p [\text{kp/s}]$ : Input pulse rate

Combination of the polarity of the pulse train input and the FWD/REV command determines the rotational direction of the motor.

The table below shows the relationship between the polarity of the pulse train input and the motor rotational direction.

Pulse Train Polarity	Run command	Motor rotational direction
+	[mFWD] (Run forward command)	Forward
+	[mREV] ( Run Reverse command)	Reverse
-	[mFWD] (Run forward command)	Reverse
-	[mREV] ( Run Reverse command)	Forward


■ Filter time constant (09.61)





09. 61 specifies a filter time constant for pulse train input. Choose an appropriate value for the time constant taking into account the response speed of the machinery system since a large time constant slows down the response. When pulse frequency instructions fluctuate, increase the set time constant.

< Switching frequency command >

Using the terminal command [mHz2/Hz1] assigned to one of the digital input terminals switches between main frequency command 1(00.01) and main frequency command 2(02.30). (parameters 01.01~01.09, data=11)

Terminal command Input signal [mHz2/mHz1]	Frequency command source
OFF	Follow 00.01 Frequency command 1
ON	Follow 02.30 Frequency command 2

 Selects the source that specifies a run command.

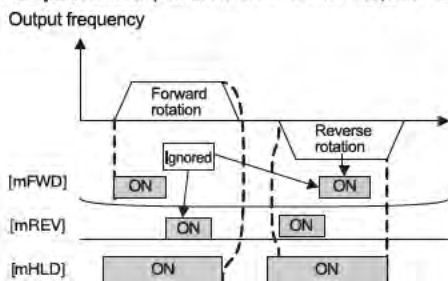
00.02 Setting value	Function	Description	
		Run/Stop	Run direction instruction
1	Terminal command FWD or REV		[mFWD]-[mREV]
2	keypad: Forward rotation	 	Pressing the FWD or STOP keys to run the motor in the forward direction and stop it, Running the motor in the reverse direction is not possible.
3	keypad: Reverse rotation	 	Pressing the REV or STOP keys to run the motor in the reverse direction and stop it, Running the motor in the forward direction is not possible.

Note:

- When 00.02 = 1, the "Run forward" FWD and "Run reverse" REV terminal commands must be assigned to terminals [mFWD] and [mREV], respectively.
- When the [mFWD] or [mREV] is ON, the 00.02 data cannot be changed.
- When changing terminal command assignments to terminals [mFWD] and [mREV] from commands other than the FWD and REV to the FWD or REV with 00.02 being set to "1", be sure to turn the target terminal OFF.


#### ■ 3-wire operation with external input signals (digital input terminal commands)

The default setting of the [mFWD]-[mREV] are 2-wire. Assigning the terminal command [mHLD] self-holds the forward [mFWD] or reverse [mREV] run command, to enable 3-wire inverter operation. When [mHLD] is ON self-holds the first FWD or REV at its rising edge. Turning the [mHLD] OFF releases the self-holding. When no [mHLD] is assigned, 2-wire operation involving only [mFWD] and [mREV] takes effect. (Parameters 01.01-01.09, data=6)




As operation command for setting method, in addition to these setting, there are other setting methods of high priority.

00.03	Maximum output frequency 1	Factory default	50.0
	Setting Range	Unit	0.1Hz
	25.0~500.0(Hz)		

 Specifies the maximum frequency to limit the output frequency. Specifying the maximum frequency exceeding the rating of the equipment driven by the inverter may cause damage or a dangerous situation. Make sure that the maximum frequency setting matches the equipment rating.

- Note:
- Under vector control without speed sensor, at 120Hz or below.
  - If a setting exceeding the maximum setting value (e.g., 500 Hz) is made, the reference speed and analog output (AFM) will be based on the full scale/reference value (10V/500 Hz). However, the frequency is internally limited. Even if 10 V is inputted, the frequency 500 Hz will be internally limited to 120Hz.
  - Modifying (00.03) data to allow a higher reference frequency requires also changing (00.15) data specifying a frequency limiter (high).

<b>00.04</b>	Base frequency 1	Factory default	<b>50.0</b>
	Setting Range	<b>25.0~500.0(Hz)</b>	Unit
	Related parameters	04.50.04.51 Non-linear V/f Pattern 1 (Frequency, Voltage) 04.52.04.53 Non-linear V/f Pattern 2 (Frequency, Voltage) 04.65.04.66 Non-linear V/f Pattern 3 (Frequency, Voltage)	

 Set the rated frequency printed on the nameplate labeled on the motor.

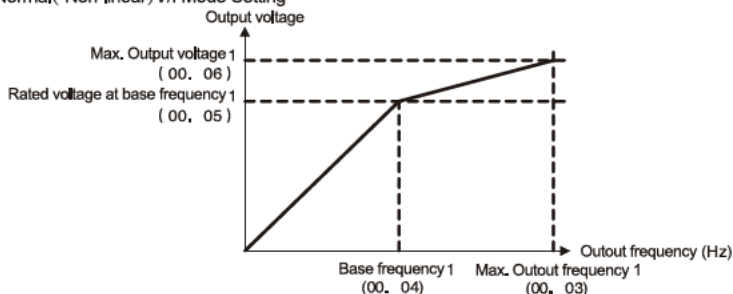
These function codes specify the base frequency and the voltage at the base frequency essentially required for running the motor properly. If combined with the related function parameters 04.50 through 04.53, 04.65 and 04.66, these function codes may profile the non-linear V/f pattern by specifying increase or decrease in voltage at any point on the V/f pattern.

At high frequencies, the motor impedance may increase, resulting in an insufficient output voltage and a decrease in output torque. To prevent this problem, use 00.06 (Maximum Output Voltage 1) to increase the voltage. Note, however, that the inverter cannot output voltage exceeding its input power voltage.

V/f Point	Parameter		Remarks
	Frequency	Voltage	
Max. output frequency	00.03	00.06	The setting of the maximum output voltage is disabled when the auto torque boost, torque vector control or vector control without speed sensor is selected.
Base frequency	00.04	00.05	
Non-linear V/f 3	04.65	04.66	It is invalid when the auto torque boost, torque vector control, or vector control without speed sensor is selected.
Non-linear V/f 2	04.52	04.53	
Non-linear V/f 1	04.50	04.51	

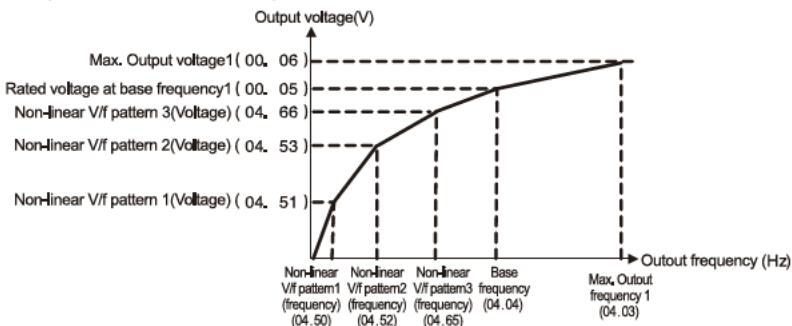
<Setting Example >

■ Normal ( Non-linear ) V/f Mode Setting





■ V/f pattern with three non-linear points



■ Non-linear V/f Patterns 1, 2 and 3 for Frequency (04. 50, 04. 52 and 04. 65) Data setting range: 0.0(cancel), 0.1~500.0(Hz)

Set the frequency component at an arbitrary point in the non-linear V/f pattern.

Note: If it is set as 0.0, Non-linear V/f mode setting is not used.

■ Non-linear V/f Patterns 1, 2 and 3 for Voltage(04. 51, 04. 53, 04. 66) Data setting range: 0~500(V) (AVR action)

Sets the voltage component at an arbitrary point in the non-linear V/f pattern.

Note: Default values may vary according to the inverter power. See the following table.

Voltage	440V series	
Capacity	~22kW	30kW~
04.50	0	5.0(Hz)
04.51	0	40(V)

00. 05	Rated Voltage at Base Frequency 1	Factory default	380
Setting Range	0(AVR invalid) 160~500(V)(AVR action)	Unit	1V

- If the data is set to "0" or sets rated voltage printed on the nameplate labeled on the motor.
- When the data is set as "0", the inverter automatically keeps the output voltage constant in line with the setting. When any of the auto torque boost, auto energy saving, etc. is enabled, the data should be equal to the rated voltage of the motor.
  - When the data is set to an arbitrary value other than 0, the inverter automatically keeps the output voltage constant in line with the setting. When any of the auto torque boost, auto energy saving, etc. is enabled, the data should be equal to the rated voltage of the motor.

Note: In vector control, current feedback control is performed. In the current feedback control, the current is controlled with the difference between the motor induced voltage and the inverter output voltage. For a proper control, the inverter output voltage should be sufficiently higher than the motor induced voltage. Generally, the voltage difference is about 40V for 400V series.

The voltage the inverter can output is at the same level as the inverter input voltage. Configure these voltages correctly in accordance with the motor specifications.

When enabling the vector control without speed sensor using a general-purpose motor, set the (00. 05) (Rated Voltage at Base Frequency 1) data at the rated voltage of the motor. The voltage difference described above is specified by function parameter (03. 56) (Induced voltage factor under vector control). Generally, there is no need to modify the initial setting.

<b>00. 06</b>	Maximum output voltage 1	Factory default	<b>380</b>
	Setting Range 160~500(V)(AVR action)	Unit	1V

☞ Set the voltage for the maximum frequency 1 (00.03).

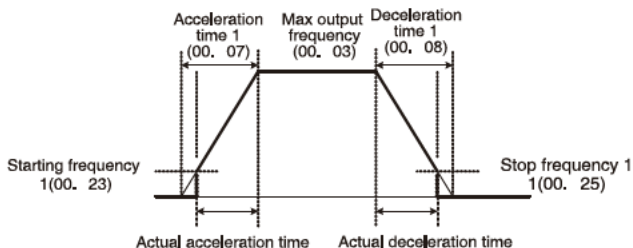
Note: If Rated Voltage at Base Frequency (00.05) is set to "0", settings of 04.50 through 04.53, H04.65, 04.66 and F00.06 do not take effect.

(When the non-linear point is below the base frequency, the linear V/f pattern applies; when it is above, the output voltage is kept constant.)

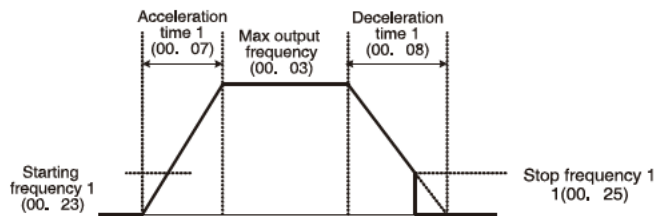
<b>00. 07</b>	Acceleration time 1	↗	Factory default	Type Setting	
<b>00. 08</b>	Deceleration time 1	↘	Factory default		
	Setting Range	<b>0.00~3600(s)</b>		Unit	0,01s
	Related parameters	01. 10、01. 12、01. 14 Acceleration time 2、3、4 01. 11、01. 13、01. 15 Deceleration time 2、3、4 04. 07 Acceleration/Deceleration Pattern 04. 54、04. 55 Acceleration and deceleration time(Jogging) 04. 56 Deceleration time for forced stop 04. 57~04. 60 1st and 2nd S-curve acceleration/deceleration range			

☞ Specifies the acceleration time, the length of time the frequency increases from 0 Hz to the maximum frequency. Specifies the deceleration time, the length of time the frequency decreases from the maximum frequency down to 0Hz.

V/f Control Condition



Under vector control without speed sensor



#### ■ Acceleration and deceleration time

Acceleration and deceleration time type	Parameter		Switching factor of Acceleration and deceleration time (parameters 01.01-01.09)		
	Acceleration time	Deceleration time			
Acceleration and deceleration time 1	00.07	00.08	[mRT2] OFF	[mRT1] OFF	The combinations of ON/OFF states of the two terminal commands [mRT1] and [mRT2], offer four choices of acceleration/deceleration time 1 to 4 (Data=4, 5) If no terminal command is assigned, only the acceleration/deceleration time 1(00.07-00.08) is effective.
Acceleration and deceleration time 2	01.10	01.11	OFF	ON	
Acceleration and deceleration time 3	01.12	01.13	ON	OFF	
Acceleration and deceleration time 4	01.14	01.15	ON	ON	
At jogging operation	04.54	04.55	When the terminal command [mJOG] is On, jogging operation is possible. (data=10) (Parameter 02.20)		
At forced stop	-	04.56	When the terminal command [mSTOP] is OFF, the motor decelerates to a stop in accordance with the deceleration time for forced stop(04.56). After the motor stops, the inverter enters the alarm state with the alarm Er6 displayed. (Data=30)		

#### ■ Acceleration/Deceleration curve (04.07)

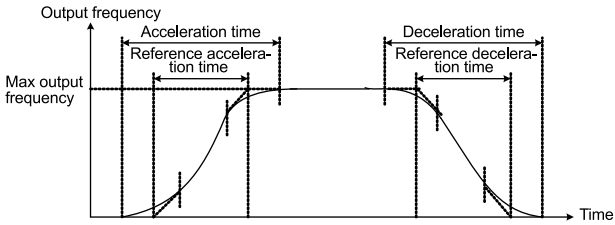
Specifies the acceleration and deceleration patterns (curve to control output frequency).

04.07 Setting value	Acceleration and deceleration pattern	Action		Function Parameter
0	Invalid(Linear Acceleration and deceleration)	The inverter runs the motor with the constant acceleration and deceleration.		-
1	S curve (Weak)	To reduce an impact that acceleration/deceleration would make on the machine, the inverter gradually accelerates or decelerates the motor in both the starting and ending zones of acceleration or deceleration.	Weak: The acceleration/ deceleration rate to be applied to all of the four inflection zones is fixed at 5% of the maximum frequency	-
2	S-curve (Enhanced type)		Enhanced type: Respectively in the S curve fixed to 10% of the highest output frequency.	-
3	Curvilinear	Acceleration/deceleration is linear below the base frequency (constant torque) but it slows down above the base frequency to maintain a certain level of load factor (constant output). This acceleration/deceleration pattern allows the motor to accelerate or decelerate with the maximum performance of the motor.		-

#### S Curve Acceleration and Deceleration

To reduce an impact that acceleration/deceleration would make on the machine, the inverter gradually accelerates or decelerates the motor in both the starting and ending zones of acceleration or deceleration. Two types of S-curve acceleration/deceleration rates are available; applying 5% (weak) of the maximum frequency to all of the four inflection zones.

In S curve acceleration / deceleration (enhanced type), if it is 10%, the actual acceleration / deceleration time is longer than the acceleration / deceleration time set.



	Acceleration Starting zone	Acceleration Ending zone	Deceleration Starting zone	Deceleration Ending zone
S Curve (Weak)	5%	5%	5%	5%
S Curve(Enhanced type) Setting Range: 0~100%	10%	10%	10%	10%

#### Acceleration and Deceleration Time

< S Curve acceleration and deceleration(Weak): when the frequency change is 10% or more of the maximum frequency >

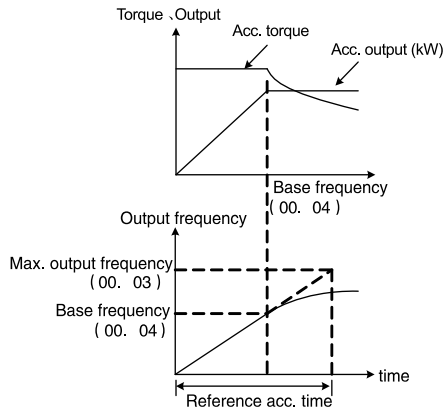
$$\text{Acceleration and Deceleration Time(S)} = \left(2 \times \frac{5}{100} + \frac{90}{100} + 2 \times \frac{5}{100}\right)$$

× reference acceleration or deceleration time

= 1.1 × reference acceleration or deceleration time

#### Curvilinear acceleration/deceleration


Acceleration/deceleration is linear below the base frequency (constant torque) but it slows down above the base frequency to maintain a certain level of load factor (constant output). This acceleration/deceleration pattern allows the motor to accelerate or decelerate with its maximum performance.



- Note:
- If you choose S-curve acceleration/deceleration or curvilinear acceleration/deceleration in Acceleration/ Deceleration Pattern(04. 07), the actual acceleration/deceleration times are longer than the specified times.
  - Specifying an improperly short acceleration/deceleration time may activate the current limiter, torque limiter, or anti-regenerative control, resulting in a longer acceleration/deceleration time than the specified one.

<b>00. 09</b>	Torque boost 1 (refer to 00. 37)		↗	Factory default	Type Setting
	Setting Range	0.0~20.0% (percentage with respect to "Rated Voltage at Base Frequency 1")		Unit	0.1%

<b>00. 10</b>	Electronic Thermal Overload (Protection for Motor )1 Select motor characteristics		↗	Factory default	1
	Setting Range	1: Action (For a general-purpose motor with shaft-driven cooling fan) 2: Action (For non-ventilated motor or motor with separately powered cooling fan, an inverter-driven motor )			

 Specify the thermal characteristics of the motor for its electronic thermal overload protection that is used to detect overload conditions of the motor. (characteristic selection (00. 10) and thermal time constant (00. 12)) and action level (00. 11). Upon detection of overload conditions of the motor, the inverter shuts down its output and issues a motor overload alarm OL1 to protect motor 1.

- Note:
- Thermal characteristics of the motor specified by(00. 10- 00. 12) are also used for the overload early warning.
  - Even if you need only the overload early warning, set these characteristics data to these function parameter(01. 34) [mOL]. Even it is used only in overload prediction, it shall also set the temperature characteristics of motor (00. 10- 00. 12). (Parameter 01. 34), under the vector control used and special motor, NTC thermistor-controlled motor overheating protection comes available, so there is no need to set the electronic thermal. It is set as 00. 11=0.00 (invalid), and connect the NTC thermistor. Additionally, when the PTC thermistor is built in the motor, it can protect the motor through connecting PTC thermistor with the terminal AUI.  
For details, see 04.26 on detailed information.

Select cooling mechanism characteristics of the motor—shaft-driven or separately powered cooling fan according to 00. 10.

00. 10 Setting value	Function
1	For a general-purpose motor with shaft-driven cooling fan (The cooling effect will decrease in low frequency operation.)
2	For an inverter-driven motor, non-ventilated motor, or motor with separately powered cooling fan (The cooling effect will be kept constant regardless of the output frequency.)

<b>00. 11</b>	Electronic Thermal Overload (Protection for Motor )1 Detection level	↗	Factory default	Type Setting
	Setting Range	0.00(invalid); The 1 ~ 135% current value of the rated current of the inverter	Unit	0.01%

The parameter sets the action level of electronic thermal.

In general, set the 00. 11 data to the allowable continuous current of motor when driven at the base frequency (generally, 1.0 to 1.1 times of the rated current of the motor.)

To be invalid the electronic thermal overload protection, set the 00. 11 data to "0.00". (00. 11 =0.00: Invalid).

<b>00. 12</b>	Electronic Thermal Overload (Protection for Motor) 1 Thermal time constan	↗	Factory default	Type Setting
	Setting Range	0.5~75.0(min)	Unit	0.1min

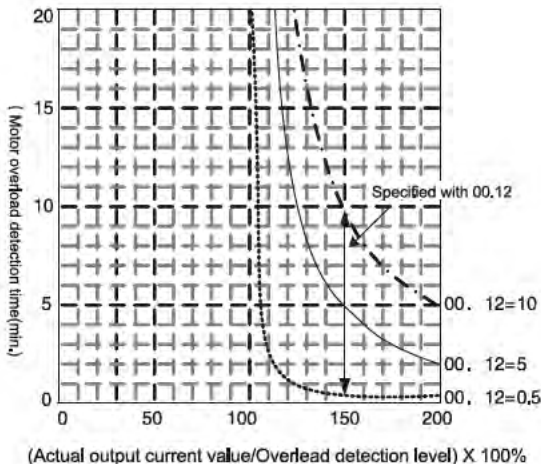
The parameter specifies the thermal time constant of the motor, the current of 150% of the overload detection level specified by 00. 11 flows for the time specified by 00. 12 the electronic thermal overload protection becomes activated to detect the motor overload. The thermal time constant for general-purpose motors is approx. 5 minutes for motors of 22 kW or below and 10 minutes for motors of 30 kW or above by factory default.

(For example) When the 00. 12 data is set at 5 minutes


As shown below, the electronic thermal overload protection is activated to detect an alarm condition (alarm code OL1 ) when the output current of 150% of the overload detection level (specified by 00. 11) flows for 5 minutes, and 120% for estimation 12,5 minutes.

The actual time required for issuing a motor overload alarm tends to be shorter than the specified value, taking into account the time period from when the output current exceeds the rated current (100%) until it reaches 150% of the overload detection level.

< Current-Example of Operating Characteristics >



00. 14	Restart Mode after Momentary Power Failure (Mode selection)	↗	Factory default	1
Setting Range	0: Alarm LU immediately			
	1: Alarm LU after recovery from power failure			
	2: Alarm LU after decelerate-to-stop			
	3: Continue to run (for heavy inertia or general loads)			
	4: Restart at the frequency at which the power failure occurred (for general load)			
Related parameters	5: Restart at the starting frequency			
	04. 13 Restart mode after momentary power failure (restart time)			
	04. 14 Restart mode after momentary power failure (frequency fall rate)			
	04. 15 Restart mode after momentary power failure (continuous running level)			
	04. 16 Restart mode after momentary power failure (allowable momentary power failure time)			
	04. 92 Continuity of Running (P)			
	04. 93 Continuity of Running (I)			

 Specifies restart mode after momentary power failure (such as trip and restart in the event of a momentary power failure etc)

- Under V/f control

00. 14 action setting	Description	
	Auto search disabled	Auto search enabled
0: Alarm LU immediately	As soon as the DC link bus voltage drops below the undervoltage detection level due to a momentary power failure, the inverter issues undervoltage alarm LU and shuts down its output so that the motor enters a coast-to-stop state.	
1: Alarm LU after recovery from power failure	As soon as the DC link bus voltage drops below the undervoltage detection level due to a momentary power failure, the inverter shuts down its output so that the motor enters a coast-to-stop state, but it does not enter the undervoltage state or issue undervoltage alarm LU. The moment the power is restored, an undervoltage alarm LU is issued, while the motor remains in a coast-to-stop state.	
2: Alarm LU after decelerate-to-stop	As soon as the DC link bus voltage drops below the continuous running level due to a momentary power failure, decelerate-to-stop control is invoked. Decelerate-to-stop control regenerates kinetic energy from the load's moment of inertia, slowing down the motor and continuing the deceleration operation. After decelerate-to-stop operation, an undervoltage alarm LU is issued.	
3: Continue to run (for heavy inertia or general loads)	As soon as the DC link bus voltage drops below the continuous running level due to a momentary power failure, continuous running control is invoked. Continuous running control regenerates kinetic energy from the load's moment of inertia, continues running, and waits the recovery of power. When an undervoltage condition is detected due to a lack of energy to be regenerated, the output frequency at that time is saved, the output of the inverter is shut down, and the motor enters a coast-to-stop state.	
	If a run command has been input, restoring power restarts the inverter at the output frequency saved when undervoltage was detected.	If a run command has been input, restoring power performs auto search for idling motor speed and restarts running the motor at the frequency calculated based on the searched speed.
	This setting is ideal for fan applications with a large moment of inertia.	

- Under V/f control

00.14 action setting	Description	
	Auto search disabled	Auto search enabled
4: Restart at the frequency at which the power failure occurred (for general loads)	As soon as the DC link bus voltage drops below the undervoltage detection level due to a momentary power failure, the inverter shuts down the output so that the motor enters a coast-to-stop state.	
	If a run command has been input, restoring power restarts the inverter at the output frequency saved when undervoltage was detected.	If a run command has been input, restoring power performs auto search for idling motor speed and restarts running the motor at the frequency calculated based on the searched speed.
	This setting is ideal for applications with a moment of inertia large enough not to slow down the motor quickly, such as fans, even after the motor enters a coast-to-stop state upon occurrence of a momentary power failure.	
5: Restart at the starting frequency	As soon as the DC link bus voltage drops below the undervoltage detection level due to a momentary power failure, the inverter shuts down the output so that the motor enters a coast-to-stop state.	
	If a run command has been input, restoring power restarts the inverter at the starting frequency specified by function parameter 00.23.	If a run command has been input, restoring power performs auto search for idling motor speed and restarts running the motor at the frequency calculated based on the searched speed.
	This setting is ideal for heavy load applications such as pumps, having a small moment of inertia, in which the motor speed quickly goes down to zero as soon as it enters a coast-to-stop state.	
Auto search enabled : Auto search is enabled by turning ON the digital terminal command [mSTM] ON or 04.09=1 or 2, and select Auto search For details about the digital terminal command [mSTM] and auto search, see the description of parameter 04.09(Starting Mode, Auto Search).		

- Under vector control without speed sensor

00.14 action setting	Description	
	Auto search disabled	Auto search enabled
0: Alarm LU immediately	As soon as the DC link bus voltage drops below the undervoltage detection level due to a momentary power failure, the inverter issues undervoltage alarm LU and shuts down its output so that the motor enters a coast-to-stop state.	
1: Alarm LU after recovery from power failure	As soon as the DC link bus voltage drops below the undervoltage detection level due to a momentary power failure, the inverter shuts down its output so that the motor enters a coast-to-stop state, but it does not enter the undervoltage state or issue undervoltage alarm LU. The moment the power is restored, an undervoltage alarm LU is issued, while the motor remains in a coast-to-stop state.	
2: Alarm LU after decelerate-to-stop	As soon as the DC link bus voltage drops below the continuous running level due to a momentary power failure, decelerate-to-stop control is invoked. Decelerate-to-stop control regenerates kinetic energy from the load's moment of inertia, slowing down the motor and continuing the deceleration operation. After decelerate-to-stop operation, an undervoltage alarm LU is issued.	



- Under vector control without speed sensor

00.14 action setting	Description	
	Auto search disabled	Auto search enabled
3: Continue to run (for heavy inertia or general loads)	As soon as the DC link bus voltage drops below the undervoltage detection level due to a momentary power failure, the inverter shuts down the output so that the motor enters a coast-to-stop state. Even if the 00.14 data is set to "3", the "Continue to run" function is disabled.	
4: Restart at the frequency at which the power failure occurred (for general loads)	If a run command has been input, restoring power restarts the inverter at the output frequency saved when undervoltage was detected.	If a run command has been input, restoring power performs auto search for idling motor speed and restarts running the motor at the frequency calculated based on the searched speed.
5: Restart at the starting frequency	As soon as the DC link bus voltage drops below the undervoltage detection level due to a momentary power failure, the inverter shuts down the output so that the motor enters a coast-to-stop state.	
	If a run command has been input, restoring power restarts the inverter at the starting frequency specified by parameter 00.23.	If a run command has been input, restoring power performs auto search for idling motor speed and restarts running the motor at the frequency calculated based on the searched speed.
	This setting is ideal for heavy load applications (such as pumps), having a small moment of inertia, in which the motor speed quickly goes down to zero as soon as it enters a coast-to-stop state upon occurrence of a momentary power failure.	
Auto search enabled: Auto search is enabled by turning ON the digital terminal command [mSTM] ("Enable auto search for idling motor speed at starting") or setting the 09.67 data to "1" or "2", and select Auto search. For details about the digital terminal command [mSTM] and auto search, see parameter 09.67 (Starting Mode, Auto search).		

 **Warning**

If you enable the "Restart mode after momentary power failure" (00.14=3~5), the inverter automatically restarts the motor running when the power is recovered. Design the machinery or equipment so that human safety is ensured after restarting.

**It may cause an accident!**

- Note:
- When the power is restored, the inverter will wait 2 seconds for input of a run command. However, if the allowable momentary power failure time (04.16) elapses after the power failure was recognized, even within the 2 seconds, the restart time for a run command is canceled. The inverter will start operation in the normal starting sequence.
  - If the "Coast to a stop" terminal command [mBX] is entered during the power failure, the inverter gets out of the restart mode and enters the normal running mode. If a run command is entered with power supply applied, the inverter will start from the normal starting frequency.
  - The inverter recognizes a momentary power failure by detecting an undervoltage condition whereby the voltage of the DC link bus goes below the lower limit. In a configuration where a magnetic contactor is installed on the output side of the inverter, the inverter may fail to recognize a momentary power failure because the momentary power failure shuts down the operating power of the magnetic contactor, causing the contactor circuit to open. When the contactor circuit is open, the inverter is cut off from the motor and load, and the voltage drop in the DC link bus is not great enough to be recognized as a power failure. In such an event, restart after a recovery from momentary power failure does not work properly as designed. To solve this, connect the interlock command [mIL], line to the auxiliary contact of the magnetic contactor, so that a momentary power failure can sure be detected.

Input Signal [mL]	Description
OFF	No momentary power failure has occurred.
ON	A momentary power failure has occurred. (Restart after a momentary power failure valid)

<b>00.15</b>	Upper limit of output frequency	↗	Factory default	<b>70.0</b>
<b>00.16</b>	Lower limit of output frequency	↘	Factory default	<b>0.0</b>
	Setting Range	<b>0.0~500.0(Hz)</b>	Unit	0.1Hz
	Related parameters	04.63 Frequency lower limiter action selection		

04.15 and 04.16 specify the upper and lower limits of the output frequency or reference frequency, respectively. The object to which the limit is applied differs depending on the control system.

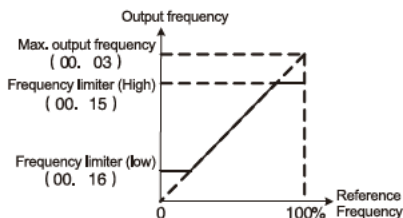
0 frequency limiter		Object to which the limit is applied	
		V/f control	Vector control without speed sensor
Frequency Limiter (High)	00.15	Output frequency	Reference speed (reference frequency)
Frequency Limiter (Low)	00.16	Reference frequency	Reference speed (reference frequency)

Note: When the limit is applied to the reference frequency or reference speed, delayed responses of control may cause an overshoot or undershoot, and the frequency may temporarily go beyond the limit level.

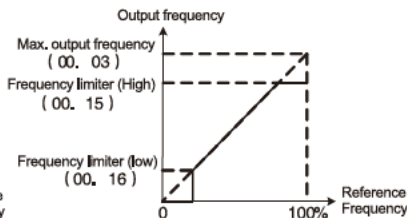
#### Low Limiter (Mode selection) (04.63)

04.63 specifies the operation to be carried out when the reference frequency drops below the low level specified by 00.16, as follows.

04.63 Setting value	Operation
0	The output frequency will be held at the low level specified by 00.16.
1	The inverter decelerates to stop the motor



(In the case of 04.63=0)



(In the case of 04.63=1)

Notes: •When you change the frequency limiter (High) (00.15) in order to raise the reference frequency, be sure to change the maximum frequency (00.03) accordingly.

•Maintain the following relationship among the data for frequency control:


- 00.15 > 00.16, 00.15 > 00.23, 00.15 > 00.25

- 00.03 > 00.16

But, 00.23 and 00.25 specify the starting and stop frequencies, respectively.


If you specify any wrong data for these function codes, the inverter may not run the motor at the desired speed, or cannot start it normally.

<b>00. 18</b>	Dominant frequency 1 bias setting (refer to 00. 01)	Factory default	<b>0.00</b>
	Setting Range <b>-100.00~100.00%</b>	Unit	0.01%


<b>00. 20</b>	DC braking 1 starting frequency		Factory default	<b>0.0</b>
	Setting Range <b>0~60.0(Hz)</b>		Unit	0.1Hz
	Related parameters	04. 95 DC braking characteristics selection(Braking response mode)		


 Specifies the frequency at which the DC braking starts its operation during motor decelerate-to-stop state.

<b>00. 21</b>	DC braking 1 braking action level		Factory default	<b>0</b>
	Setting Range <b>00~100(%)</b> (P Specifications 0~80(%))		Unit	1%

 Specifies the output current level to be applied when the DC braking is activated. The function parameter should be set, assuming the rated output current of the inverter as 100%, in increments of 1%.

Note: The inverter rated output current differs between the G modes and P modes.

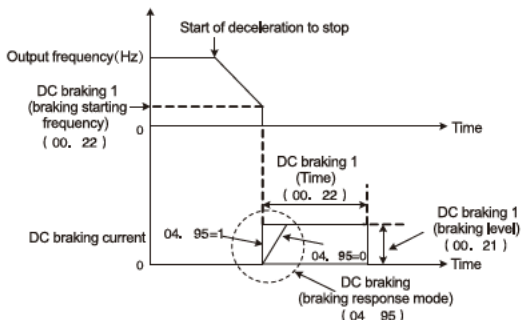
<b>00. 22</b>	DC braking 1 braking time		Factory default	<b>0.00</b>
	Setting Range <b>0.00(invalid), 0.01~30.00(s)</b>		Unit	0.01s

 Specifies the braking period that activates DC braking.  
Specify the DC braking to be valid that prevents motor 1 from running by inertia during decelerate-to-stop operation.  
If the motor enters a decelerate-to-stop operation by turning OFF the run command or by decreasing the reference frequency below the stop frequency, the inverter activates the DC braking by flowing a current at the braking level (00. 21), during the braking time (00. 22) when the output frequency goes down to the DC braking starting frequency (00. 20).  
Setting the braking time to "0.0" by parameter 00. 22 invalid the DC braking.

■ Characteristics selection (04. 95)

Specifies the DC braking response mode. When vector control without speed sensor is selected, the response is constant.

04. 95 Setting value	Characteristics	Precautions
0	Slow response. Slows the rising edge of the current, thereby preventing reverse rotation at the start of DC braking.	Insufficient braking torque may result at the start of DC braking.
1	Quick response. Quickens the rising edge of the current, thereby accelerating the build-up of the braking torque.	Reverse rotation may result depending on the moment of inertia of the mechanical load and the coupling mechanism.



**Tips:** It is also possible to use an external digital input signal as an "Enable DC braking" terminal command [mDCBRK]. As long as the [mDCBRK] command is ON, the inverter performs DC braking, regardless of the braking time specified by 00. 22.

(Parameters 01. 01~01. 09, data=13)

Turning the [mDCBRK] command ON even when the inverter is in a stopped state activates the DC braking. This feature allows the motor to be excited before starting, resulting in smoother acceleration (quicker build-up of acceleration torque) (under V/f control). When vector control without speed sensor is selected, use the pre-exciting feature for establishing the magnetic flux (parameter 04. 84).

In general, DC braking is used to prevent the motor from running by inertia during the stopping process.

**Note:** Normally, specify data of function parameter 00. 20 at a value close to the rated slip frequency of motor. If you set it at an extremely high value, control may become unstable and an overvoltage alarm may result in some cases.

### ⚠ Warning

Even if the motor is stopped by DC braking, voltage is output to inverter output terminals U, V, and W. **Otherwise, it may cause an electric shock!**

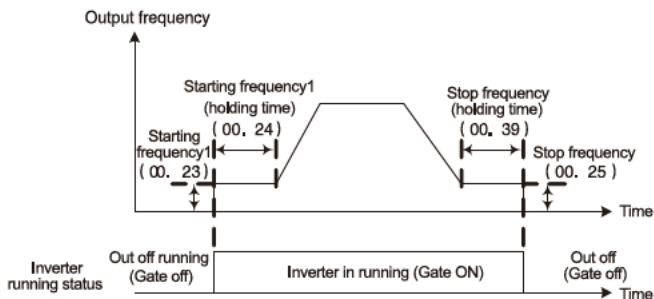
### ⚠ Caution

The DC brake function of the inverter does not provide any holding mechanism. **Otherwise, it may cause an injury shock!**

<b>00. 23</b>	Starting frequency 1	↗	Factory default	<b>0.5</b>
	Setting Range	0.0~60.0(Hz)		Unit
	Related parameters	00. 38 Stop frequency detection mode 00. 39 Stop frequency holding time		
<b>00. 24</b>	Starting frequency 1 holding time	↗	Factory default	<b>0.00</b>
	Setting Range	0.00~10.00(s)		Unit
<b>00. 25</b>	Stop frequency	↗	Factory default	<b>0.2</b>
	Setting Range	0.0~60.0(Hz)		Unit

### Under V/f control

At the startup of an inverter, the initial output frequency is equal to the starting frequency. The inverter stops its output when the output frequency reaches the stop frequency. Set the starting frequency to a level at which the motor can generate enough torque for startup. Generally, set the motor's rated slip frequency as the starting frequency. Specifying the holding time for the starting frequency compensates for the delay time for the establishment of a magnetic flux in the motor; specifying that for the stop frequency stabilizes the motor speed at the stop of the inverter.



Parameter	Description
00. 23	Specifies the starting frequency at the startup of an inverter. Under V/f control, even if the starting frequency is set at 0,0Hz, the inverter starts at 0,1Hz.
00. 24	Specifies the holding time for the starting frequency .
00. 25	Specifies the stop frequency at the stop of the inverter.
00. 39	Specifies the holding time for the stop frequency.

Note: If the starting frequency is lower than the stop frequency, the inverter will not output any power as long as the reference frequency does not exceed the stop frequency.

<b>00. 26</b>	Carrier frequency setting (Motor Sound)	↗	Factory default	<b>2</b>
	Related parameters	04 .98 Protection/Maintenance Function (Mode selection)	Unit	1kHz

The parameter can specify carrier frequency(Carrier frequency and Tone).

It controls the carrier frequency so as to reduce an audible noise generated by the motor or electromagnetic noise from the inverter itself, and to decrease a leakage current from the main output (secondary) wirings.


Item	Characteristics	Notes
Carrier frequency	0.75 ~ 12kHz	0.75~45kW (G specification) 5.5~18.5kW (P specification)
	0.75 ~10kHz	55~200kW (G specification) 22~45kW (P specification)
	0.75 ~ 6kHz	55~315kW
Motor noise	High ↔ low	
Motor temperature (due to harmonics components)	High(more) ↔ low (less)	
Ripples in output current waveform	Large ↔ small	


Item	Characteristics	Notes
Ripples in output current waveform	Large ↔ small	
Leakage current	low ↔ high	
Electromagnetic noise emission	low ↔ high	
Inverter loss	low ↔ high	

Notes: Specifying a too low carrier frequency will cause the output current waveform to have a large amount of ripples. As a result, the motor loss increases, causing the motor temperature to rise. Furthermore, the large amount of ripples tends to cause a current limiting alarm. When the carrier frequency is set to 1 kHz or below, therefore, reduce the load so that the inverter output current comes to be 80% or less of the rated current.

Additionally, When a high carrier frequency is specified, the temperature of the inverter may rise due to a surrounding temperature rise or an increase of the load. If it happens, the inverter automatically decreases the carrier frequency to prevent the inverter overload alarm OLU. With consideration for motor noise, the automatic reduction of carrier frequency can be disabled. Refer to the description of parameter 04. 98




It is recommended to set the carrier frequency at 5kHz or above under vector control without speed sensor. DO NOT set it at 1kHz or below.

<b>00. 27</b>	Motor running tone		Factory default	<b>0</b>
	Setting Range	0: Tone level 0 (invalid)		
		1: Tone level 1		
		2: Tone level 2		
		3: Tone level 3		

 This parameter changes the motor running sound tone (only for motors under V/f control). This setting is effective when the carrier frequency specified by function code 00. 26 is 7 kHz or lower. It can change the tone level may reduce the high and harsh running noise from the motor.

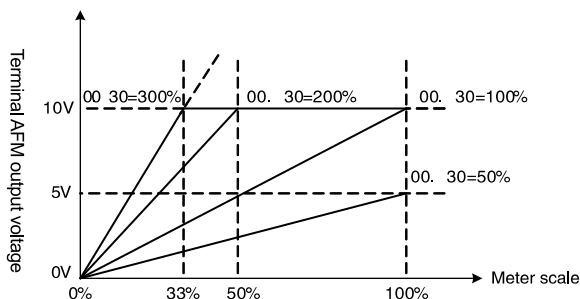
Notes: If the tone level is set too high, the output current may become unstable, or mechanical vibration and noise may increase.

Under vector control, the function is invalid.

<b>00. 29</b>	AFM terminal action selection		Factory default	<b>0</b>
<b>00. 30</b>	AFM terminal output gain(Voltage adjustment)		Factory default	<b>100</b>
	Setting Range	<b>0~300(%)</b>		Unit
				1%
<b>00. 31</b>	AFM terminal function selection		Factory default	<b>0</b>
	Related parameters	00. 35 DFM terminal function selection		

■ Output Voltage adjustment (00. 30)

Allows you to adjust the output voltage within the range of 0 to 300%.




■ Function Selection (00. 31)


Specify what is output to analog output terminal AFM.

00. 31 Setting value	Monitoring items	Contents	Meter scale (Full scale at 100%)
0	Output Frequency 1 before Slip Compensation	Output frequency of the inverter (Equivalent to the motor synchronous speed)	Max.output frequency (00. 03)
1	Output Frequency 2 after Slip Compensation	Inverter output frequency	Max.output frequency (00. 03)
2	Output Current	Inverter output current (RMS)	Inverter rated output current ×2
3	Output Voltage	Inverter output voltage (RMS)	440V series: 500V
4	Output Torque	Motor shaft torque	Motor rated torque ×2
5	Load factor	Load factor (Equivalent to the indication of the load meter)	Motor rated load ×2
6	Input power	Input power of inverter	Inverter rated output ×2
7	PID Feedback amount	Feedback amount under PID control	100% of Feedback amount
9	DC link bus voltage	DC link bus voltage of the inverter	440V series: 1000V
10	Universal AO	Command via communications link	20,000 / 100%
13	Motor output power	Motor output (kW)	Motor rated output ×2
14	Analog output calibration	Full scale output of the meter calibration	It always outputs the Full-scale(equivalent to 100%)
15	PID command(SV)	Command value under PID control	100% of the feedback amount
16	PID Output value(MV)	Output level of the PID controller under PID control (Frequency command)	Max.output frequency (00. 03)

Note: When 00. 31 = 16(PID output value), 08. 01 = 3(speed control (Dancer control), and 08. 62 = 2or 3(Ratio compensation enabled), PID output is equivalent to the ratio against the primary reference frequency and may vary within ±300% of the frequency. The monitor displays the PID output in a converted absolute value. To indicate the value up to the full-scale of 300%, set 00. 30 = 33(%).

<b>00. 33</b>	DFM terminal pulse rate		Factory default	<b>1000</b>
	Setting Range	25 ~ 6000p / s (100% of pulse count)		Unit
			Unit	1

<b>00. 37</b>	Load Selection /Automatic torque boost/Automatic energy saving operation 1		Factory default	<b>1</b>
	Setting Range	0: Variable torque load ( general fan and water pump loads )	Unit	1
		1: Constant torque load		
		2: Auto torque boost		
		3: Auto energy saving :Variable torque load during ACC/DEC ( general fan and water pump loads )		
		4: Auto energy saving :Constant torque load during ACC/DEC ( constant torque load )		
	5: Auto energy saving operation ( automatic torque boost during ACC/DEC)			
	Related parameters	00. 09 Torque boost 1 04. 67 Automatic energy saving operation mode selection		

 00. 37 specifies V/f pattern, torque boost type, and auto energy saving operation in accordance with the characteristics of the load.  
Specify the torque boost level with 00. 09 in order to assure sufficient starting torque.

00. 37 Setting value	V/f characteristics	Torque boots	Automatic energy saving	Applicable load
0	Variable torque V/f pattern	Torque boost specified by 00. 09	Invalid	Variable torque load (General-purpose fans and pumps)
1	Linear V/f pattern	Automatic torque boost		Constant torque load
2			Constant torque load (To be selected if a motor may be over-excited at no load.)	
3	Variable torque V/f pattern	Torque boost specified by 00. 09	valid	Variable torque load (General-purpose fans and pumps)
4	Linear V/f pattern	Automatic torque boost		Constant torque load
5				Constant torque load (To be selected if a motor may be over-excited at no load.)

Note: If a required "load torque + acceleration torque" is more than 50% of the constant torque, it is recommended to select the linear V/f pattern (factory default).

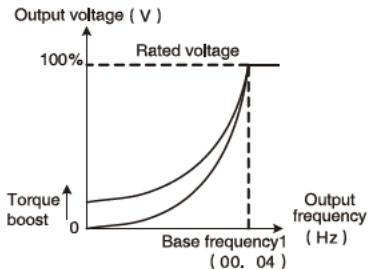
00. 37 Setting value	Action
0~2	automatic energy saving running OFF
3~5	automatic energy saving running ON

Under the vector control without speed sensor, both 00. 37 and 00. 09 are disabled. The auto energy saving operation is also invalid.

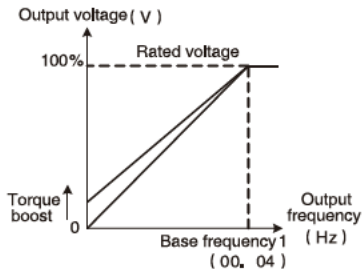


## ■ V/f characteristics

V/f patterns suitable for variable torque load such as general fans and pumps and for constant torque load (including special pumps requiring high starting torque). Two types of torque boosts are available: manual and automatic.



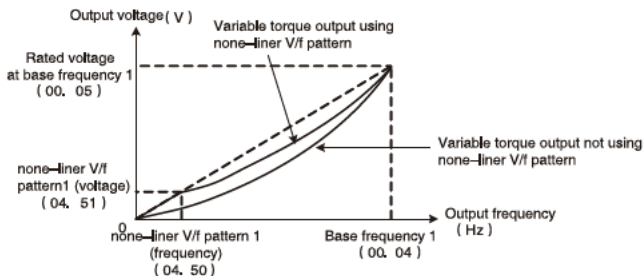
Variable torque V/f pattern (00.37=0)



Linear V/f pattern (00.37=1)

Tips: When the variable torque V/f pattern is selected (00.37=0 or 3), the output voltage may be low at a low frequency zone, resulting in insufficient output torque, depending on the characteristics of the motor and load. In such a case, it is recommended to increase the output voltage at the low frequency zone using the non-linear V/f pattern.

Recommended value: 04.50=1 / 10 of base frequency  
04.51=1 / 10 of voltage at base frequency



## ■ Torque boost Data setting range 0.0~20.0%(100%/ reference frequency voltage)

• Torque boost based on 00.09 (manual adjustment)

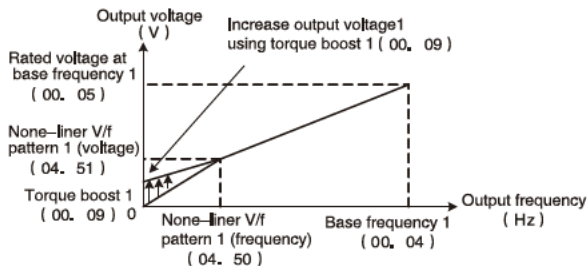
In torque boost using 00.09, constant voltage is added to the basic V/f pattern, regardless of the load. To secure a sufficient starting torque, manually adjust the output voltage to optimally match the motor and its load by using 00.09. Specify an appropriate level that guarantees smooth start-up and yet does not cause over-excitation at no or light load.

Torque boost based on 00.09 ensures high driving stability since the output voltage remains constant regardless of the load fluctuation.

Specify the parameter 00.09 data in percentage to the rated voltage at base frequency. It is set at a boost level which can ensure about 100% start torque when leaving the factory.

Notes: • Specifying a high torque boost level will generate a high torque, but may cause overcurrent due to over-excitation at no load. If you continue to drive the motor, it may overheat. To avoid such a situation, adjust torque boost to an appropriate level.

• When the non-linear V/f pattern and the torque boost are used together, the torque boost takes effect below the frequency on the non-linear V/f pattern's point.



• Automatic torque boost

If the automatic torque boost is selected, the inverter automatically optimizes the output voltage to fit the motor with its load. Under light load, the inverter decreases the output voltage to prevent the motor from over-excitation. Under heavy load, it increases the output voltage to increase the output torque of the motor.

Notes: • Since this function relies also on the characteristics of the motor, set the base frequency 1 (00.04), the rated voltage at base frequency 1 (00.05), and other pertinent motor parameters (03.01~03.03 and 03.06~03.99) in line with the motor capacity and characteristics, or else perform auto-tuning 03.04.

- When a special motor is driven or the load does not have sufficient rigidity, the maximum torque might decrease or the motor operation might become unstable. In such cases, do not use auto torque boost but choose manual torque boost per 00.09 (00.37=0 or 1).

■ Automatic energy saving running (04.67)

The inverter automatically controls the supply voltage to the motor to minimize the total power loss of motor and inverter.

Automatic energy saving control can only be selected whether applying this feature to constant speed operation only or applying to constant speed operation and accelerating/decelerating operation.

04.67 Setting value	Automatic energy saving operation
0	Only for during running at constant speed
1	During running at constant speed or accelerating/decelerating (note: For accelerating/decelerating, enable only when the load is light.)

If automatic energy saving operation is enabled, the response to a motor speed change from constant speed operation may be slow. Do not use this feature for such machinery that requires quick acceleration/deceleration.

Notes: • Use automatic energy saving only where the base frequency is 60Hz or lower. If the base frequency is set at 60Hz or higher, you may get a little or no energy saving advantage. The automatic energy saving operation is designed for use with the frequency lower than the base frequency. If the frequency becomes higher than the base frequency, the automatic energy saving operation will be invalid.

- Since this function relies also on the characteristics of the motor, set the base frequency 1 (00.04), the rated voltage at base frequency 1 (00.05), and other pertinent motor parameters (03.01~03.03 and 03.06~03.99) in line with the motor capacity and characteristics, or else perform auto-tuning 03.04.
- Under the vector control without speed sensor, the auto energy saving operation is invalid.

00.38	Stop frequency detection mode (refer to 00.23)	Factory default	0
	Setting Range	0: Detected speed value	
		1: Reference speed value	

<b>00. 39</b>	Stop frequency holding time (refer to 00. 23)	↗	Factory default	<b>0. 00</b>
	Setting Range	0.00~10.00s		Unit
				0.01s

<b>00. 40</b>	Torque limiter level 1-1	↗	Factory default	<b>999</b>
<b>00. 41</b>	Torque limiter level 1-2	↗	Factory default	<b>999</b>
	Setting Range	20~200(%); 999(Invalid)		Unit
	Related parameters	01. 16 Torque limiter level 2-1 01. 17 Torque limiter level 2-2 04. 73 Torque Limiter operating conditions selection 04. 76 Torque Limiter : Frequency increment limit for braking		

#### Under V/f control

If the inverter's output torque exceeds the specified levels of the torque limiters (00. 40, 00. 41, 01. 16, 01. 17, 01. 61~01. 63) the inverter controls the output frequency and limits the output torque for preventing a stall.

To use the torque limiters, it is necessary to configure the function codes listed in the table below.

Notes: In braking, the inverter increases the output frequency to limit the output torque. Depending on the conditions during operation, the output frequency could dangerously increase. 04. 76 (Frequency increment limit for braking) is provided to limit the increasing frequency component.

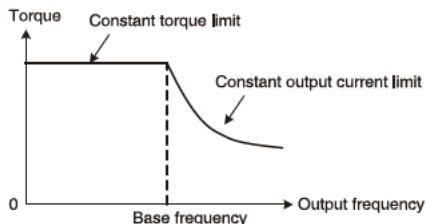
#### Related parameters

Parameter	Name	V/f control	vector control	Notes
00. 40	Torque limiter level 1-1	○	○	
00. 41	Torque limiter level 1-2	○	○	
01. 16	Torque limiter level 2-1	○	○	
01. 17	Torque limiter level 2-2	○	○	
04. 73	Torque Limiter (Operating conditions)	○	○	
04. 76	Torque Limiter (Frequency increment limit for braking)	×	○	
01. 61~01. 63	Extended function selection of terminals AVI, ACI and AUI	○	○	7: Analog torque limit value A 8: Analog torque limit value B

#### ■ Torque limit control mode

Torque limit is performed by limiting torque current flowing across the motor.

The graph below shows the relationship between the torque and the output frequency at the constant torque current limit.



- Torque limiters level (00. 40, 00. 41, 01. 16, 01. 17) Data setting range: -300~300(%), 999(invalid)  
Specify the operation level at which the torque limiters become activated, as the percentage of the motor rated torque.

Parameter	Name	Torque limit feature
00. 40	Torque limiter level 1-1	Driving torque current limiter 1
00. 41	Torque limiter level 1-2	Braking torque current limiter 1
01. 16	Torque limiter level 2-1	Driving torque current limiter 2
01. 17	Torque limiter level 2-2	Braking torque current limiter 2

Note: Although the data setting range is from positive to negative values. If it is set as negative value (-300% to +300%), specify positive values in practice. Specifying a negative value causes the inverter to interpret it as an absolute value. The torque limiter determined depending on the overload current actually limits the torque current output. Therefore, the torque current output is automatically limited at a value lower than 300%, the maximum setting value.

- Analog torque limit value (01. 61~01. 63)

The torque limit values can be specified by analog inputs through terminals AVI, ACI and AUI. (voltage or current). Set parameters 01. 61, 01. 62, 01. 63 (Extended function selection) as listed below.

01. 61, 01. 62, 01. 63 Setting value	Function	Description
7	Analog torque limit value A	Use the analog input as the torque limit value.
8	Analog torque limit value B	Input specification: 200% / DC10V or DC20mA

If the same setting is made for different terminals, the priority order is 01. 61 > 01. 62 > 01. 63.

- Switching torque limiters

The torque limiters can be switched by the function code setting and the terminal command [mTL2 / mTL1]. ("Select torque limiter level 2/1") assigned to any of the digital input terminals. To assign the parameters 01. 01~01. 09 as the terminal function, set any of 01. 01 through 01.09 to "14". If no [mTL2 / mTL1] is assigned, torque limiter levels 1-1 and 1-2 (00. 40 and 00. 41) take effect by default.

- Torque limiter (Operating conditions) (04. 73)

Specifies whether the torque limiter is enabled or disabled during acceleration/deceleration and running at constant speed.

04. 73 Setting value	During accelerating/decelerating	During running at constant speed
0	Valid	Valid
1	Invalid	Valid
2	Valid	Invalid

- Torque limiter (Frequency increment limit for braking) (04. 76) Data setting range: 0.0~500.0(Hz)  
Specifies the increment limit of the frequency in limiting torque for braking. The factory default is 5.0 Hz. If the increasing frequency during braking reaches the limit value, the torque limiters no longer function, resulting in an overvoltage alarm. Such a problem may be avoided by increasing the setting value of 04. 76.

Note: The torque limiter and current limiter are very similar in function. If both are activated concurrently, they may conflict with each other and cause hunting (undesirable oscillation of the system). Avoid concurrent activation of these limiters.

Under vector control without speed sensor

If the inverter's output torque exceeds the specified levels of the torque limiters (00. 40, 00. 41, 01. 16, 01. 17, 01. 61~01. 63) the inverter controls the speed regulator's output (torque command) in speed control or a torque command in torque control in order to limit the motor-generating torque.

### Related parameters

Parameter	Name	V/f control	Vector control	Notes
00. 40	Torque limiter level 1-1	○	○	
00. 41	Torque limiter level 1-2	○	○	
01. 16	Torque limiter level 2-1	○	○	
01. 17	Torque limiter level 2-2	○	○	
04. 73	Torque Limiter (Operating conditions)	○	○	
04. 76	Torque Limiter (Frequency increment limit for braking)	○	×	
01. 61~ 01. 63	Extended function selection of terminals AVI, ACI and AUI	○	○	7: Analog torque limit value A 8: Analog torque limit value B

<b>00. 42</b>	Drive Control mode selection 1		Factory default	<b>0</b>
	Related parameters	04.68 Slip compensation 1 Operating conditions selection	Unit	1

Drive Control of motor Selection.

00. 42 Setting Value	Control Method	Basic control	Speed feedback	Speed control
0	V / f control,V/f control with slip compensation inactive	V/f control	No	Frequency control
1	Dynamic torque vector control (With slip compensation .Auto torque boost)			Frequency control with slip compensation
2	V / f control with slip compensation active			
5	Vector control without speed sensor	Vector control	No (Estimated speed)	Speed control with automatic speed regulator (ASR)

<b>00. 43</b>	Current limiter action selection			Factory default	<b>2</b>
	Setting Range	0: Invalid(No current limiter works)			
		1: Constant speed (invalid in acceleration and deceleration)			
		2: Acceleration and constant speed (invalid in deceleration)			
	Related parameters	04. 12 Instantaneous overcurrent limiting mode selection			

Selects the motor running state in which the current limiter becomes active.

As running states that enable the current limiter, it can set (00. 43=1), it is enabled during constant speed; it can set (00. 43=2), it is enabled during both of acceleration and constant speed operation.

Choose 00. 43 = 1, if you need to run the inverter at full capability during acceleration and to limit the output current during constant speed operation.


<b>00. 44</b>	Current limiter action level			Factory default	<b>160</b>
	Setting Range	20~200%((level: rated output current of inverter for 100%)	Unit	1%	

Specifies the operation level at which the output current limiter becomes activated, in ratio to the inverter rating.




#### ■ Instantaneous Overcurrent Limiting (Mode selection) (04. 12)

Specifies whether the inverter invokes the current limit processing or enters the overcurrent trip when its output current exceeds the instantaneous overcurrent limiting level. Under the current limit processing, the inverter immediately turns OFF its output gate to suppress the further current increase and continues to control the output frequency.

04. 12 Setting value	Function
0	Invalid (An overcurrent alarm occurs at the instantaneous overcurrent limiting level)
1	Valid (instantaneous overcurrent limiting level is valid)

 If any problem happens in use of the equipment or machine is expected when the motor torque temporarily drops during current limiting processing, it is necessary to cause an overcurrent alarm and actuate a mechanical brake at the same time.

- Notes:
- Since the current limit operation with 00. 43 and 00. 44 is performed by software, it may cause a delay in control. If you need a quick response current limiting, also enable the instantaneous overcurrent limiting with 04. 12.
  - If an excessive load is applied when the current limiter operation level is set extremely low, the inverter will rapidly lower its output frequency. This may cause an overvoltage alarm or dangerous turnover of the motor rotation due to undershooting. Depending on the load, extremely short acceleration time may activate the current limiting to suppress the increase of the inverter output frequency, causing the system oscillation (hunting) or activating the inverter overvoltage alarm. When specifying the acceleration time, therefore, you need to take into account machinery characteristics and moment of inertia of the load.
  - The torque limiter and current limiter are very similar function each other. If both are activated concurrently, they may conflict each other and cause hunting in the system. Avoid concurrent activation of these limiters.
  - The vector control itself contains the current control system, so it disables the current limiter specified by 00. 43 and 00. 44, as well as automatically disabling the instantaneous overcurrent limiting (specified by 04. 12). Accordingly, the inverter causes an overcurrent alarm when its output current exceeds the instantaneous overcurrent limiting level.

<b>00. 50</b>	Electronic Thermal Overload Discharging capability (Protection for Braking Resistor)		Factory default	Type Setting
<b>00. 51</b>	Electronic Thermal Overload Allowable average loss (protection for braking resistor)		Factory default	<b>0.001</b>
	Setting Range	<b>0.001~99,99kW</b>	Unit	0,001
<b>00. 52</b>	Electronic Thermal Overload braking resistance (protection for braking resistor)		Factory default	<b>0.01</b>
	Setting Range	<b>0.01~999Ω</b>	Unit	0,01

 Specify the electronic thermal overload protection feature for the braking resistor.

Set the discharging capability, allowable average loss and resistance to 00. 50, 00. 51 and 00. 52, respectively. These values are determined by the inverter and braking resistor models.

Tips: The standard models of braking resistor can output temperature detection signal for overheat. Assign an "Enable external alarm trip" terminal command [mTHR] to any of digital input terminals MI1~MI7, FWD or REV.

Calculating the discharging capability and allowable average loss of the braking resistor and configuring the parameter data

<Applying braking load during deceleration >

In usual deceleration, the braking load decreases as the speed slows down. In the deceleration with constant torque, the braking load decreases in proportion to the speed.

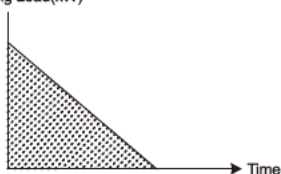
Discharging capability and allowable average loss can be calculated by expressions (1) and (3) given below.

<Applying braking load during running at a constant speed >

Different from during deceleration, in applications where the braking load is externally applied during running at a constant speed, the braking load is constant.

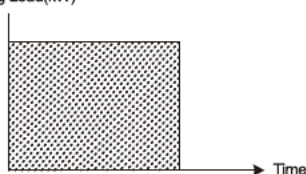
Discharging capability and allowable average loss can be calculated by expressions (2) and (4) given below.

Braking Load(kW)



<Applying braking load during deceleration >

Braking Load(kW)



<Applying braking load during running at constant speed >

Discharge capability (00. 50) refers to kW's allowable for a single braking cycle, which is obtained based on the braking time and the motor rated capacity,

00. 50 Setting value	Function
0	To be applied to the braking resistor built-in type
1~900	1~900 (kW's)
OFF	Cancel the protection function

$$\text{Discharge capability (kW's)} = \frac{\text{Braking time (S)} \times \text{motor rated capacity (kW)}}{2} \quad (1)$$

$$\text{Discharge capability (kW's)} = \text{braking time (S)} \times \text{motor rated capacity (kW)} \quad (2)$$

Allowable average loss (00. 51) refers to a tolerance for motor continuous operation, which is obtained based on the %ED (%) and motor rated capacity

00. 51 Setting value	Function
0.001~99.99	0.001~99.99(kW)

$$\text{Allowable average loss (kW)} = \frac{\frac{\%ED(\%)}{100} \times \text{Motor rated capacity (kW)}}{2} \quad (3)$$

$$\text{Allowable average loss (kW)} = \frac{\%ED(\%)}{100} \times \text{Motor rated capacity (kW)} \quad (4)$$


00. 80	G/P switching	Factory default	0
	Setting Range 0: G Specifications, 1: P Specifications	Unit	1

18.5kW and above power range setting general-purpose G specifications, and P-specification for light load. When changing the data of parameter 00,80, push the button (STOP key + ⬆ / ⬇ key) at the same time. Besides, it is necessary to set the parameters such as pole number, power, rated current and so on of the 03 groups according to the motor nameplate.

Note: If the P type is required for the power range of 15kW and below, you only need to set the parameters such as the number of poles, power, rated current and so on of the O3 group according to the motor nameplate.

## 01 External Terminal Function Parameters

<b>01. 01</b>	MI1 terminal function selection	Factory default	<b>0</b>
<b>01. 02</b>	MI2 terminal function selection	Factory default	<b>1</b>
<b>01. 03</b>	MI3 terminal function selection	Factory default	<b>2</b>
<b>01. 04</b>	MI4 terminal function selection	Factory default	<b>3</b>
<b>01. 07</b>	MI7 terminal function selection	Factory default	<b>6</b>
	Related parameters	01. 98 FWD terminal function selection 01. 99 REV terminal function selection	

-  01. 01 to 01. 07、01. 98 and 01. 99 assign commands (listed below) to general-purpose, programming, digital input terminals MI1~MI7, FWD and REV .  
These function parameter can also switch the logic system between normal and negative to define how the inverter logic interprets the ON or OFF state of each terminal. The factory default setting is normal logic system "Active ON". So, descriptions that follow are given input digital terminals MI1~MI7, FWD and REV in normal logic system. They are, in principle, arranged in the numerical order of assigned data. Refer to corresponding parameters when related parameter column displays related parameter.

### Warning

- On digital input terminals, run commands [mFWD], Coast to a stop commands [mBX], stop function and changed frequency function. Frequency change commands can be assigned to digital input terminals. Depending upon the assignment states of those terminals, modifying the function parameter setting may cause a sudden motor start or an abrupt change in speed. Ensure safety before modifying the function code settings.
- When the inverter is controlled with the digital input signals, switching run or frequency command sources with the related terminal commands [mSS1, 2, 4, 8], [mHz2/mHz1], [mHz/PID], [mIVS] , [mLE] and so on) may cause a sudden motor start or an abrupt change in speed.

**Otherwise, it may cause an accident or physical injury!**

Data		Function	Signal name	Related parameters
Active ON	Active OFF			
0	1000	Multi-step speed command (0-15 steps)	[mSS1]	02. 05-02. 19
1	1001		[mSS2]	
2	1002		[mSS4]	
3	1003		[mSS8]	
4	1004	Select ACC/DEC time (2 steps)	[mRT1]	00. 07, 00. 08
5	1005	Select ACC/DEC time (4 steps)	[mRT2]	01. 10-01. 15
6	1006	Enable 3-wire operation	[mHLD]	00. 02
7	1007	Coast to a stop	[mBX]	—
8	1008	Reset alarm (abnormal)	[mRST]	—
1009	9	Enable External alarm trip	[mTHR]	—



Data		Function	Signal name	Related parameters
Active ON	Active OFF			
10	1010	Ready for Jogging	[mJOG]	02. 20, 04. 54, 04. 55, 09. 09-09. 13
11	1011	Select frequency command 2/1	[mHz2/mHz1]	00. 01, 02. 30
12	1012	Motor 2 selection	[mM2]	05. 42
13	—	DC braking command	[mDCBRK]	00. 20-00. 22
14	1014	Torque limiter level2/torque limiter level 1	[mTL2/mTL1]	00. 40, 00. 41 01. 16, 01. 17
17	1017	UP command (Increase output frequency)	[mUP]	Set frequency: 00. 01 02. 30 PID command: 08. 02
18	1018	DOWN command (Decrease output frequency)	[mDOWN]	
19	1019	Enable data change with keypad (data can be changed)	[mWE-KP]	00. 00
20	1020	Cancel PID control	[mHz/PID]	08. 01-08. 19 08. 56-08. 62
21	1021	Switch Forward & reverse	[mDCBRK]	02. 53, 08. 01
22	1022	Interlock	[mIL]	00. 14
23	1023	Cancel Torque control	[mHz/mTRQ]	04. 18
24	1024	Communication link via selection (RS485)	[mLE]	04. 30, 11. 98
25	1025	Universal DI	[mU-DI]	—
26	1026	Enable auto search for idling motor speed at starting	[mSTM]	04. 09, 09. 67
1030	30	Force to stop	[mSTOP]	00. 07, 04. 56
33	1033	Reset PID integral and differential components	[mPID-RST]	08. 01-08. 19 08. 56-08. 62
34	1034	Hold PID integral component	[mPID-HLD]	
35	1035	Select local (keypad) operation	[mLOC]	4.2.2 External Terminal Command Control / Keypad Command Control Switching
36	1036	Motor 3 selection	[mM3]	05. 42, 06. 42
37	1037	Motor 4 selection	[mM4]	05. 42, 07. 42
39	—	Prevent condensation	[mDWP]	08. 21
48	—	Pulse train input (available only for terminal M17 (01. 07))	[mPIN]	00. 01, 02. 30 09. 62, 09. 63
49	1049	Pulse train symbol (available for terminals except M17)	[mSIGN]	
52	—	Forward JOG	[mFJOG]	
53	—	Reverse JOG	[mRJOG]	
76	1076	Droop control	[mRJO]	04. 28
80	1080	Cancel customizable logic timers	[mCLC]	01. 01-01. 09
81	1081	Clear all customizable logic timers	[mCLTC]	10. 81-10. 85
98	—	Run forward (FWD and REV terminals can be assigned only by 01. 98 and 01. 99)	[mFWD]	00. 02
99	—	Run reverse (FWD and REV terminals can be assigned only by 01. 98 and 01. 99)	[mREV]	

Data		Function	Signal name	Related parameters
Active ON	Active OFF			
100	—	No function assigned	[mNONE]	10. 81~10. 85

Notes: Some logic reverse (Active OFF) commands cannot be assigned to the functions marked with "—" in the "Active OFF" column.

The "Enable external alarm trip" and "Force to stop" are fail-safe terminal commands. In the case of "Enable external alarm trip", when data= 1009, "Active ON" (alarm is triggered when ON); when data = 9, "Active OFF" (alarm is triggered when OFF).

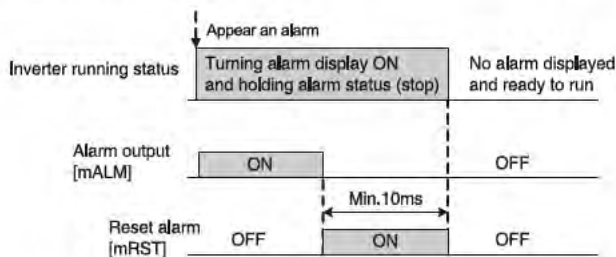
Terminal function assignment and data setting

■ Coast to a stop – [mBX] (parameter data=7)

When turning this terminal command [mBX] ON immediately shuts down the inverter output so that the motor coasts to a stop without issuing any alarms.

■ Reset alarm [mRST] (parameter data=8)

Turning this terminal command [mRST] ON clears the [mALM] state—alarm output (for any fault). Turning it OFF erases the alarm display and clears the alarm hold state. When you turn the [mRST] command ON, keep it ON for 10 ms or more. This command should be kept OFF for the normal inverter operation.



■ Enable external alarm trip [mTHR] (parameter data=9)

Turning this terminal command OFF immediately shuts down the inverter output (so that the motor coasts to a stop), displays the alarm OH2, and outputs the alarm relay (for any fault) [mALM]. The [mTHR] command is self-held, and is reset when an alarm reset takes place.

Tips: Use this alarm trip command from external equipment when you have to immediately shut down the inverter output in the event of an abnormal situation in peripheral equipment.

■ Cancel PID control [mHz/PID] (parameter data =20)

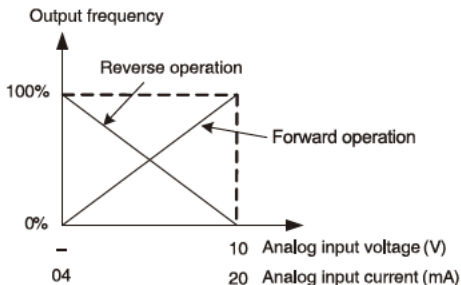
Turning this terminal command [mHz/PID] ON invalid the PID control. If the PID control is invalid with this command, the inverter runs the motor with the reference frequency manually set (by any of the multi-step frequency, keypad, analog input, etc).

Input signal [mHz/PID]	Selected function
OFF	PID control is valid.
ON	PID control is invalid (manual frequency setting)

(Parameters 08. 01~08. 19, 08. 56~08. 62)

■ Switch forward/reverse operation [mIVS] (parameter data = 21)

This terminal command switches the output frequency control between forward (proportional to the input value) and reverse in analog frequency setting or under PID process control. To select the reverse operation, turn the [mIVS].



Tips: The forward/reverse switching operation is useful for air-conditioners that require switching between cooling and heating. In cooling, the speed of the fan motor (output frequency of the inverter) is increased to lower the temperature. In heating, it is reduced to lower the temperature. This switching is realized by this [mIVS] terminal command.

- When the inverter is driven by an external analog frequency command sources (terminals AVI, ACI and AUI)

Switching forward/reverse operation can apply **only** to the analog frequency command sources (terminals AVI, ACI and AUI) in frequency command 1 (00. 01), and does not affect frequency command frequency 2 (02. 30) or UP/DOWN control. As listed below, the combination of the "Selection of forward/reverse operation for frequency command 1" (02. 53) and the [mIVS] terminal command determines the final operation.

02. 53 operation selection	Input signal [mIVS]	Action
0: Forward operation	OFF	Normal operation
0: Forward operation	ON	Reverse operation
1: Reverse operation	OFF	Reverse operation
1: Reverse operation	ON	Normal operation

- When the process control is performed by the PID processor integrated in the inverter

The terminal command [mHz/PID] ("Cancel PID control") can switch the PID control between enabled (process is to be controlled by the PID processor) and disabled (process is to be controlled by the manual frequency setting). In either case, the combination of the "PID control" (08. 01) or "Selection of forward/reverse operation for frequency command 1" (02. 53) and the terminal command [mIVS] determines the final operation as listed below. signal combination.

- When PID control is valid: the forward/reverse operation selection for the PID processor output (reference frequency) is as follows.

PID controlled mode selection (08. 01)	Input signal [mIVS]	Action
1: PID output is normal operation	OFF	Forward operation
	ON	Reverse operation
2: PID output is inverse operation	OFF	Reverse operation
	ON	Forward operation

• When PID control is invalid: manual frequency set forward action/reverse action

Forward / reverse action selection (Dominant frequency 1) (02. 53)	Input signal [mIVS]	Action
0: Forward direction	—	Forward operation
1: Reverse direction	—	Reverse operation

Notes: When the process control is performed by the PID control facility integrated in the inverter, the [mIVS] is used to switch the PID processor output (reference frequency) between forward and reverse, and has no effect on any forward/reverse operation selection of the manual frequency setting.

(Parameters 08. 01~08. 19, 08. 56~08. 62)

■ universal DI [mU-DI] (parameter data =25)

Using [mU-DI] enables the inverter to monitor digital signals sent from the peripheral equipment via an RS485 communications link or a fieldbus option by feeding those signals to the digital input terminals. Signals assigned to the universal DI are simply monitored and do not operate the inverter.

■ Force to stop [mSTOP] (parameter data =30)

Turning this terminal command OFF causes the motor to decelerate to a stop in accordance with the (04. 56) parameter ( Deceleration time for forced stop). After the motor stops, the inverter enters the alarm state with the alarm Er6 displayed. (parameters 00. 07)

■ Reset PID integral and differential components [mPID-RST] (parameter data=33)

Turning this terminal command [mPID-RST] ON resets the integral and differential components of the PID processor. (parameters 08. 01~08. 19, 08. 56~08. 62).

■ Hold PID integral component [mPID-HLD] (parameter data=34)

Turning this terminal command [mPID-HLD] ON holds the integral components of the PID processor. (parameters 08. 01~08. 19, 08. 56~08. 62).

<b>01. 10</b>	Acceleration time 2 (refer to 00. 07)	↗	Factory default	Type Setting
<b>01. 11</b>	Deceleration time 2 (refer to 00. 07)	↗	Factory default	Type Setting
<b>01. 12</b>	Acceleration time 3 (refer to 00. 07)	↗	Factory default	Type Setting
<b>01. 13</b>	Deceleration time 3 (refer to 00. 07)	↗	Factory default	Type Setting
<b>01. 14</b>	Acceleration time 4 (refer to 00. 07)	↗	Factory default	Type Setting
<b>01. 15</b>	Deceleration time 4 (refer to 00. 07)	↗	Factory default	Type Setting
	Setting Range	0.00~6000s ※ Enter 0.00 cancels the ACC/DEC. time (requiring external soft-start and -stop )	Unit	0,01s

<b>01. 16</b>	Torque limiter level 2-1 (refer to 00. 40)	↗	Factory default	<b>999</b>
<b>01. 17</b>	Torque limiter level 2-2 (refer to 00. 40)	↗	Factory default	<b>999</b>
	Setting Range	20~200%; 999(invalid)	Unit	1%

<b>01. 20</b>	MO1 terminal function selection	Factory default	<b>0</b>
<b>01. 21</b>	MO2 terminal function selection	Factory default	<b>1</b>
<b>01. 27</b>	RA/RB/RC terminal function selection	Factory default	<b>99</b>

□ Terminals MO1, MO2, RA / RB / RC are assigned by 01. 20-01. 21, 01. 27, it's a output signals to general-purpose, programmable output terminals. it can also switch the logic system between forward/reverse to define how the inverter interprets the ON or OFF state of each terminal. The factory default setting is normal logic system "Active ON". Terminals MO1, MO2 are transistor output, and terminals RA / RB / RC are relay contact output. For the output of terminals RA / RB / RC, In normal logic, if an alarm happens, the relay will be energized so that RA and RC will be closed, and RB and RC opened. In logic reverse, the relay will be deenergized so that RA and RC will be opened, and RB and RC closed. This may be useful for the implementation of failsafe power systems.

Note: When a logic reverse is employed, all output signals are active (e.g. an alarm would be recognized) while the inverter is powered OFF. To avoid causing system malfunctions by this, interlock these signals to keep them ON using an external power supply. Furthermore, the validity of these output signals is not guaranteed for about 1.5 seconds (for 22kW or below) or 3 seconds (for 30kW or above) after power-ON, so introduce such a mechanism that masks them during the transient period.

Note: Terminals RA / RB / RC are use mechanical contacts that cannot stand frequent ON/OFF switching. Where frequent ON/OFF switching is anticipated (for example, limiting a current by using signals subjected to inverter output limit control such as switching to commercial power line or direct-on-line starting), use transistor output MO1~MO2 instead.

The table below lists functions that can be assigned to terminals MO1, MO2, RA / RB / RC, the descriptions are, in principle, arranged in the numerical order of assigned data. However, highly relevant signals are collectively described where one of them first appears. Refer to the function parameter or signals in the "Related function parameter/signals (data)" column, if any.

Explanations of each function are given in normal logic system "Active ON".

Data		Function	Signal name	Related parameters
Active ON	Active OFF			
0	1000	Inverter running	[mRUN]	—
1	1001	Frequency (speed) arrival signal	[mFAR]	01. 30
2	1002	Frequency (speed) detection	[mFDT]	01. 31, 01. 32
3	1003	Undervoltage detected (When Inverter stopped)	[mLU]	—
4	1004	Torque polarity detection	[mB/D]	—
5	1005	Inverter output limiting	[mIOL]	—
6	1006	Auto-restarting after momentary power failure	[mIPF]	00. 14
7	1007	Motor overload early warning	[mOL]	01. 34, 00. 10, 00. 12
8	1008	Keypad operation enabled	[mKP]	—
10	1010	Inverter ready to output	[mRDY]	—
15	1015	AX terminal function	[mAX]	—
21	1021	Frequency(speed) arrival signal 2	[mFAR2]	—
22	1022	Inverter output limiting (with delay)	[mIOL2]	[mIOL](5)
25	1025	Cooling fan ON-OFF in operation	[mFAN]	04. 06
26	1026	Auto-resetting	[mTRY]	04. 04, 04. 05
27	1027	Universal DO	[mU-DO]	—
28	1028	Cooler overheat early warning	[mOH]	—
31	1031	Frequency (speed) detection 2	[mFDT2]	01. 32, 01. 36
33	1033	Reference loss detected	[mREF OFF]	01. 65

Data		Function	Signal name	Related parameters
Active ON	Active OFF			
35	1035	Inverter output on	[mRUN2]	[mRUN](0)
36	1036	In overload prevention control	[mOLP]	04. 70
37	1037	Current detected	[mID]	01. 34, 01. 35, 01. 37 01. 38, 01. 55, 01. 56
38	1038	Current detected 2	[mID2]	
39	1039	Current detected 3	[mID3]	
41	1041	Low current detected	[mIDL]	
42	1042	PID alarm output	[mPID-ALM]	
43	1043	In PID control	[mPID-CTL]	08. 01
44	1044	Motor stopped due to slow flowrate under PID control	[mPID-STP]	08. 08, 08. 09
45	1045	Low output torque detection	[mU-TL]	08. 08, 08. 09
46	1046	Torque detection 1	[mTD1]	
47	1047	Torque detection 2	[mTD2]	
48	1048	Motor 1 selected	[mSWM1]	05. 42, 06. 42, 07. 42
49	1049	Motor 2 selected	[mSWM2]	
50	1050	Motor 3 selected	[mSWM3]	
51	1051	Motor 4 selected	[mSWM4]	
52	1052	Running Forward Signal	[mFRUN]	—
53	1053	Running Reversal Signal	[mRRUN]	—
54	1054	In Remote operation	[mRMT]	
56	1056	Motor overheat detected by thermistor	[mTHM]	04. 26, 04. 27
57	1057	Brake signal	[mBRKS]	08. 68-08. 72
58	1058	Frequency (speed) detection 3	[mFDT3]	01. 32, 01. 54
59	1059	ACI terminal wire break detected	[mACIOFF]	—
70	1070	Speed valid	[mDNZS]	00. 25, 00. 38
71	1071	Speed agreement	[mDSAG]	09. 21, 09. 22
72	1072	Frequency (speed) arrival signal 3	[mFAR3]	01. 30
84	1084	Maintenance timer	[mMNT]	04. 44, 04. 78, 04. 79
90	1090	Alarm contents 1	[mAL1]	
91	1091	Alarm contents 2	[mAL2]	
92	1092	Alarm contents 4	[mAL4]	
93	1093	Alarm contents 8	[mAL6]	
98	1098	Light alarm	[mL-ALM]	04. 81, 04. 82
99	1099	Alarm output (for any alarm)	[mALM]	—
105	1105	Braking transistor broken	[mDBAL]	04. 98
111	1111	Customizable logic output signal 1	[mCLO1]	10. 71~10. 75 10. 81~10. 85
112	1112	Customizable logic output signal 2	[mCLO2]	
113	1113	Customizable logic output signal 3	[mCLO3]	
114	1114	Customizable logic output signal 4	[mCLO4]	
115	1115	Customizable logic output signal 5	[mCLO5]	

Note: Any logic reverse (Active OFF) command cannot be assigned to the functions marked with "—" in the "Active OFF" column.

■ Inverter running [mRUN] and Inverter output on [mRUN2] (parameter data=0,35)

These output signals tell the external equipment that the inverter is running at a starting frequency or higher. If assigned in negative logic (Active OFF), these signals can be used to tell the "Inverter being stopped" state.

Output signal	Basic function	Remarks
[mRUN]	These signals come ON when the inverter is running. Under V/f control: These signals come ON if the inverter output frequency exceeds the starting frequency, and go OFF if it drops below the stop frequency. The [mRUN] signal can also be used as a "Speed valid" signal.	Goes OFF even during DC braking or dew condensation prevention.
[mRUN2]		Comes ON even during DC braking, pre-exciting, zero speed control, or dew condensation prevention.

Under vector control, both [mRUN] and [mRUN2] come ON when zero speed control or servo-lock function is enabled.

■ Undervoltage detected (Inverter stopped) [mLU] (parameter data =3)

This output signal comes ON when the DC link bus voltage of the inverter drops below the specified undervoltage level, and it goes OFF when the voltage exceeds the level. This signal is ON also when the undervoltage protective function is activated so that the motor is in an abnormal stop state.

■ Torque polarity detected [mB/D] (parameter data =4)

The inverter issues the driving or braking polarity signal to this digital output judging from the internally calculated torque or torque command. This signal goes OFF when the detected torque is a driving one, and it goes ON when it is a braking one.

■ Inverter output limiting [mIOL] and inverter output limiting (with delay) [mIOL2] (parameter data =5, 22)

The output signal [mIOL] comes ON when the inverter is limiting the output frequency by activating any of the following actions (minimum width of the output signal: 100 ms). The output signal [mIOL2] comes ON when any of the following output limiting operation continues for 20 ms or more.

- Torque limiting (00.40, 00.41, 01.16, 01.17 and Max. internal value)
- Current limiting by software (00.43, 00.44)
- Instantaneous overcurrent limiting by hardware (04.12=1)
- Overvoltage Automatic Deceleration action selection (04.69)

Note: When the [mIOL] signal is ON, it may mean that the output frequency may have deviated from the frequency specified by the frequency command because of this limiting function.

■ Keypad operation enabled (parameter data =8)

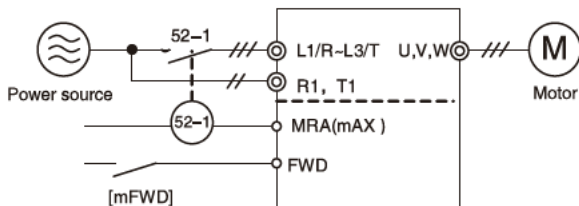
This output signal comes ON when the keypad is specified as a run (run) and (stop) command source.

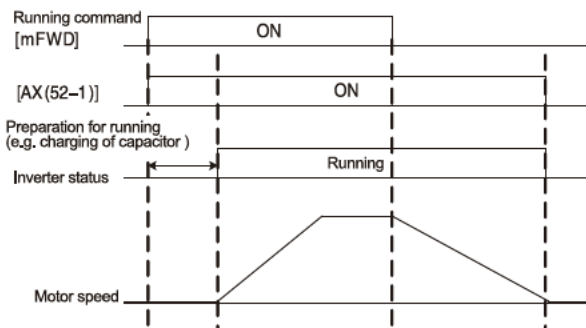
■ Inverter ready to output [mRDY] (parameter data =10)

This output signal comes ON when the inverter becomes ready to run by completing hardware preparation (such as initial charging of DC link bus capacitors and initialization of the control circuit) and no protective functions are activated.

■ Select AX terminal function (parameter data =15)

In response to a run command [mFWD], this output signal controls the magnetic contactor on the commercial-power supply side. It comes ON when the inverter receives a run command and it goes OFF after the motor decelerates to stop with a stop.





■ Universal DO [mU-DO] (parameter data =27)

Assigning this output signal to an inverter's output terminal and connecting the terminal to a digital input terminal of peripheral equipment via the RS485 communications link or the fieldbus, allows the inverter to send commands to the peripheral equipment. The universal DO can also be used as an output signal independent of the inverter operation.

■ Cooler overheat early warning [mOH] (parameter =28)

This output signal is used to issue a heat sink overheat early warning that enables you to take a corrective action before an overheat alarm OH1 actually happens.

This signal comes ON when the temperature of the cooler exceeds the "overheat alarm temperature minus 5°C(OH1)".

This signal goes OFF when it drops down to the "overheat alarm temperature minus 8°C(OH1)".

■ Under PID control [mPID-CTL](parameter data=43)

This output signal comes ON when PID control is valid. (parameter 08. 01).

Note: When PID control is valid, the inverter may stop due to the slow flowrate stopping function or other reasons, with the [mPID-CTL] signal being ON. As long as the [mPID-CTL] signal is ON, PID control is effective, so the inverter may abruptly resume its operation, depending on the feedback value in PID control.

**Warning**

When PID control is enabled, even if the inverter stops its output during operation because of sensor signals or other reasons, operation will resume automatically. Design your machinery so that safety is ensured even in such cases.

**It is possible to cause an accident!**

■ Running forward [mFRUN] and Running reverse [mRRUN] (parameter data=52, 53)

Output signal	Assigned data	Running forward	Running reverse	Inverter stopped
[mFRUN]	52	ON	OFF	OFF
[mFRUN]	53	OFF	ON	OFF

■ In remote operation [mRMT] (parameter data=54)

This output signal comes ON when the inverter switches from local to remote mode.

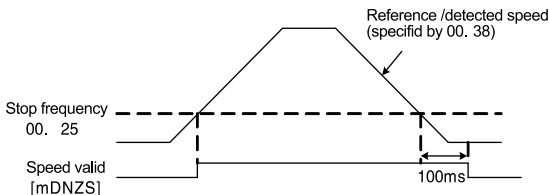
■ Terminal ACI wire break [mACI OFF] (parameter =59)

This output signal comes ON when the inverter detects that the input current to terminal ACI drops below DC2mA interpreting it as the terminal ACI wire broken.



■ Speed valid [mDNZS] (parameter data=70)

This output signal comes ON when the reference speed or detected one exceeds the stop frequency specified by function parameter 00. 38, it goes OFF when the speed is below the stop frequency for 100ms or longer. Under vector control without speed sensor, the reference speed is used as a decision criterion. (parameter 00. 25, 00. 38)



■ Alarm output (for any alarm) [mAL1] [mAL2] [mAL4] [mAL8] (parameter data=90, 91, 92, 93)

This output signal comes ON if any of the protective functions is activated and the inverter enters Alarm mode.

Alarm content (inverter protective function)	Code	Output terminal			
		mAL1	mAL2	mAL4	mAL8
Instantaneous overcurrent protection, short circuit protection for grounding	OC1, OC2, OC3, EF	ON	OFF	OFF	OFF
Overvoltage protection	OU1, OU2, OU3	OFF	ON	OFF	OFF
Low-voltage protection, input phase loss	LU, Lin	ON	ON	OFF	OFF
Motor overload, electronic thermal overload protection (motor 1 to 4)	OL1, OL2, OL3, OL4	OFF	OFF	ON	OFF
Inverter overload	OLU	ON	OFF	ON	OFF
Inverter overheat protection, inverter internal overheat	OH1, OH3	OFF	ON	ON	OFF
External alarm, DB resistor overheat, motor overheat	OH2, dBH, OH4	ON	ON	ON	OFF
Memory error, CPU error, Data saving error during undervoltage	Er1, Er3, ErF	OFF	OFF	OFF	ON
Keypad communications error, optional communications error	Er2, Er4	ON	OFF	OFF	ON
Optional error	Er5	OFF	ON	OFF	ON
Operation procedure error	Er6	ON	ON	OFF	ON
Tuning error, output phase loss protection	Er7, OPL	OFF	OFF	ON	ON
RS485 communications error	Er8, ErP	ON	OFF	ON	ON
Overspeed protection, PG error, excessive position deviation, Speed mismatch or excessive speed deviation, Positioning control error	OS, PG, ErE Do, ErO	OFF	ON	ON	ON
NTC thermistor (motor) wire break detection, PID feedback wire break detection, Mock alarm	Nrb, COF, Err	ON	ON	ON	ON

Normally, any terminal does not output signal.

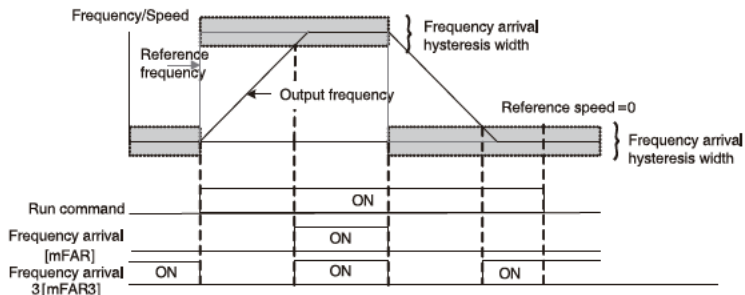
■ Alarm [mALM] (parameter data =99)

When any alarm appears, ON signal is output.

<b>01. 30</b>	Frequency Arrival (Hysteresis width)	↗	Factory default	<b>2.5</b>
	Setting Range	<b>0.0~10.0(Hz)</b>		Unit
				0.1Hz

Output signal	Data assigned to output terminal	Operating condition 1	Operating condition 2
[mFAR]	1	Both signals come ON when the difference between the output frequency (estimated/detected speed) and the reference frequency (reference speed) comes within the frequency arrival hysteresis width specified by 01. 30.	The signal always goes OFF when the run command is OFF or the reference speed is "0".
[mFAR3]	72		When run command is OFF, the inverter regards the reference speed as "0". When output frequency (estimated/detected speed) is within the range of "0 ± the frequency arrival hysteresis width specified by 01. 30, output signal is ON.

The operation timings of each signal are shown below.

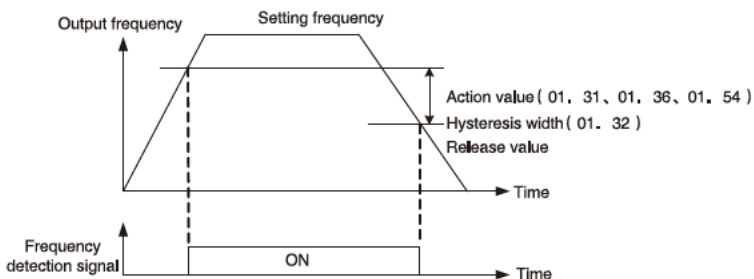


<b>01. 31</b>	Frequency detection value	↗	Factory default	<b>50.0</b>
<b>01. 32</b>	Frequency detection hysteresis width	↗	Factory default	<b>1.0</b>
	Setting Range	<b>0.0~500.0Hz</b>		Unit
	Related parameters	01. 36, 01. 54 Frequency detection 2, 3 value		

When the output frequency (estimated/detected speed) exceeds the frequency detection level specified by 01.31, the "Frequency (speed) detected signal" comes ON; when it drops below the "Frequency detection level minus Hysteresis width specified by 01.32", it goes OFF.

The following three settings are available.

Name	Output signal	Data assigned to output terminal	Action value (range: 0.0~500.0Hz)	Hysteresis width (range: 0.0~500.0Hz)
Frequency detection	[mFDT]	2	01. 31	01. 32
Frequency detection 2	[mFDT2]	31	01. 36	
Frequency detection 3	[mFDT3]	58	01. 54	



<b>01.34</b>	Overload Early Warning / current detection level	⚡	Factory default	Type Setting
	Setting Range	0,00 (invalid); Current value of 1% to 200% of the inverter rated current	Unit	0,01%
	Related parameters	01.37、01.38 Current detection 2 / Low current detection (action level、timer) 01.55、01.56 Current detection 3 (action level、timer)		

<b>01.35</b>	Overload Early Warning / current detection timer	⚡	Factory default	<b>10,00</b>
	Setting Range	<b>0,01~600,00s</b>	Unit	0,01s

These function parameters define the detection level and time for the "Motor overload early warning" [mOL], "Current detected" [mID], "Current detected 2" [mID2], "Current detected 3" [mID3], and "Low current detected" [mIDL] output signals.

Output signal	Data assigned to output terminal	Operation Level	Timer	Motor characteristics	Thermal time constant
		Range: see following content	Range: 0,01~600,00s	Range: see following content	Range: 0,5~75,0min
[mOL]	7	01.34	—	00.10	00.12
[mID]	37	01.34	01.35	—	—
[mID2]	38	01.37	01.38		
[mID3]	39	01.55	01.56		
[mIDL]	41	01.37	01.38		

Motor characteristics:

1: Enable (For a general-purpose motor with shaft-driven cooling fan)

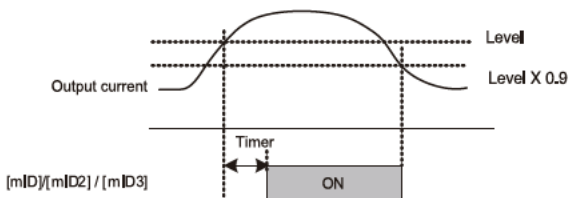
2: Enable (For an inverter-driven motor, non-ventilated motor, or motor with separately powered)

#### ■ Motor overload early warning signal [mOL]

The OL signal is used to detect a symptom of an overload condition (Alarm "OL1") of the motor so that the user can take an appropriate action before the alarm actually happens. The OL signal turns ON when the inverter output current exceeds the level specified by 01.34. In typical cases, set 01.34 data to 80 to 90% against current of Electronic thermal overload (Electronic thermal overload protection for motor 1, Overload detection level). Specify also the thermal characteristics of the motor with Electronic thermal overload (Select motor characteristics and Thermal time constant).

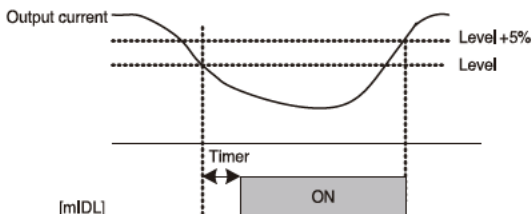
■ Current detected[mID], Current detected 2 [mID2]and Current detected 3[mID3]

When the inverter output current exceeds the level specified by 01. 34, 01. 37 or 01. 55 for the period specified by 01. 35, 01. 38 or 01. 56, the [mID], [mID2]or [mID3]signal turns ON, respectively. When the output current drops below 90% of the rated operation level, the [mID], [mID2]or [mID3]turns OFF. (The minimum ON-duration is 100 ms.)



■ Low current detected [mIDL]

This signal turns ON when the output current drops below the level specified by 01. 37 (Low current detection, Level) for the period specified by 01. 38 (Timer). When the output current exceeds the "Low current detection level plus 5% of the inverter rated current " it goes OFF. (The minimum ON-duration is 100ms.)



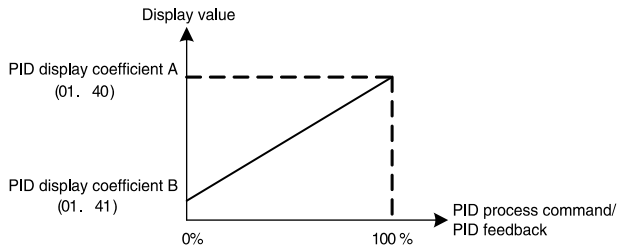
<b>01. 36</b>	Frequency detection 2 value (refer to 01. 31)	↗	Factory default	<b>50.0</b>
	Setting Range	<b>0.0~500.0Hz</b>	Unit	0.1Hz
<b>01. 37</b>	Current detection 2 / Low current detection level (refer to 01. 34)	↗	Factory default	Type Setting
	Setting Range	0.00 (invalid); Current value of 1% to 200% of the inverter rated current	Unit	0.01%
<b>01. 38</b>	Current detection 2 / Low current detection timer (refer to 01. 34)	↗	Factory default	<b>10.00</b>
	Setting Range	<b>0.01~600.00s</b>	Unit	0.01s
<b>01. 40</b>	PID display coefficient A	↗	Factory default	<b>100</b>
<b>01. 41</b>	PID display coefficient B	↗	Factory default	<b>0</b>
	Setting Range	<b>-999~0.00~9990</b>	Unit	0.01

📖 These function parameters PID display coefficients A and B to convert a PID command (process command or dancer position command) and its feedback into mnemonic physical quantities to display.

■ Display coefficients for PID process command and its feedback (08. 01=1or 2)

01. 40 specifies coefficient A that determines the display value at 100% of the PID process command or its feedback, and 01. 41 specifies coefficient B that determines the display value at 0%. The display value is determined as the following

Display value = (PID process command or its feedback (%))/100 × (Display coefficient A - B) + B

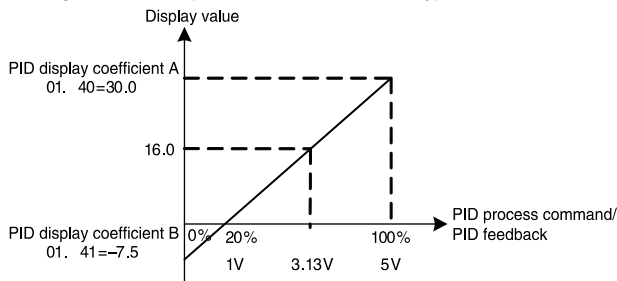


For example: Maintaining the pressure around 16 kPa (sensor voltage 3.13 V) while the pressure sensor can detect 0 to 30 kPa over the output voltage range of 1 to 5 V, Select terminal AVI as a feedback terminal and set the gain to 200% so that 5 V corresponds to 100%.

That determines the display value at 100% of PID process command or its feedback, PID display coefficient A (01. 40) = 30.0

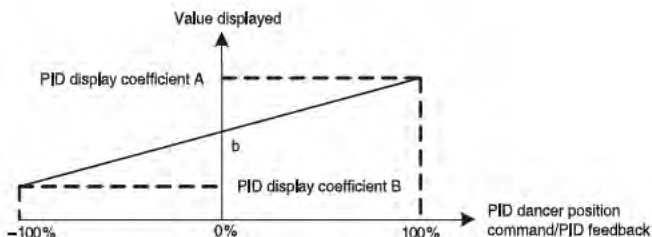
That determines the display value at 0% of PID process command or its feedback, PID display coefficient B (E41) = -7.5

With above setting, to control the pressure at 16 kPa on the keypad, set the value to 16.0.



■ Display coefficients for PID dancer position command and its feedback (08. 01=3)

Under PID dancer control, the PID command and its feedback operate within the range ±100%, so specify the value at +100% of the PID dancer position command or its feedback as coefficient A with 01. 40, and the value at -100% as coefficient B with 01. 41.



If the sensor output is unipolar, the PID dancer control operates within the range from 0 to +100%, so virtually specify the value at -100% as coefficient B.

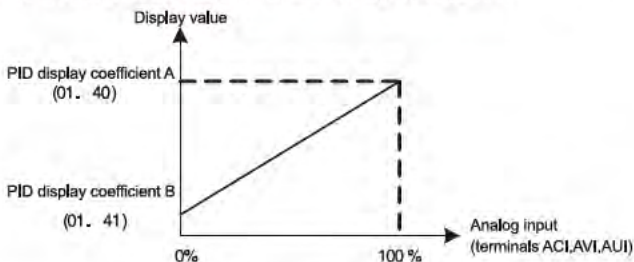
That is, suppose "b" = "Display value at 0%", then: Display coefficient B = 2b - A

For details about the PID control, refer to the description of 08. 01 and later.

For the display method of the PID command and its feedback, refer to the description of 01. 43

■ Display coefficient for analog input monitor

By inputting analog signals from various sensors such as temperature sensors in air conditioners to the inverter, you can monitor the state of peripheral devices via the communications link. By using an appropriate display coefficient, you can also have various values converted into physical values such as temperature and pressure before they are displayed.



To set up the analog input monitor, use function parameters 01. 61 to 01. 63. Use 01. 43 to choose the item to be displayed.

<b>01. 42</b>	Display filter time constant		Factory default	<b>0.5</b>
	Setting Range	<b>0.0~5.0s</b>	Unit	0.1s

01. 42 specifies a filter time constant to be applied for the output frequency and power current. displaying the monitored running status (01. 43 = 0) on the LED monitor on the keypad. If the display varies unstably so as to be hard to read due to load fluctuation or other causes, increase this filter time constant.

<b>01. 43</b>	Keypad display selection		Factory default	<b>0</b>
	Related parameters	01. 48 Speed monitoring selection		

01. 43 specifies the running status item to be monitored and displayed on the LED monitor. For details see the Chapter 3 Keypad Description "3.3.1 Monitoring Item under Run Mode".

<b>01. 44</b>	Display when stopped		Factory default	<b>0</b>
	Setting Range	0: Specified value 1: Display output value		

When the inverter is stopped, select the displayed information on the keypad. When 01. 44= 0, display specified frequency value. When 01. 44=1, display output frequency value. The monitored item depends on the 01. 48 setting as shown below.

01. 48 Setting value	Monitor selection	What to be displayed when the inverter stopped	
		01. 44=0 (specified frequency value)	01. 44=1 (output frequency value)
0	Output frequency before slip compensation	Setting frequency	Output frequency before slip compensation
1	Output frequency after slip compensation	Setting frequency	Output frequency after slip compensation
2	Setting frequency	Setting frequency	Setting frequency
3	Motor speed	Reference motor speed	Motor speed
4	Load shaft speed	Reference load shaft speed	Load shaft speed
5	Line speed	Reference line speed	Line speed
7	Display speed (%)	Line speed	Display speed

<b>01. 48</b>	Speed monitoring selection (refer to 01. 43)		Factory default	<b>0</b>
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<b>01. 50</b>	Coefficient for Speed Indication		Factory default	<b>30.00</b>
	Setting Range	<b>0.01~200.00</b>	Unit	0.01

The coefficient that is used when the load shaft speed or line speed is displayed on the LED monitor(Keypad), (see parameter 01. 43)  
 Load shaft speed [r/min] = Coefficient for speed indication of 01. 50 ×Output frequency (Hz)  
 Line speed (m/min)= Coefficient for speed indication 01. 50 ×Output frequency (Hz)


<b>01. 51</b>	Display Coefficient for Input Watt-hour Data		Factory default	<b>0.010</b>
	Setting Range	0,000(cancel and reset), 0,001~9999	Unit	0.001

Specifies a display coefficient (multiplication factor) for displaying the input watt-hour data (E\_10 ) in a part of maintenance information on the keypad.  
 Input watt-hour data = Display coefficient (01. 51 data) ×Input watt-hour (kWh)

Notes: Setting 01. 51= 0.000 clears the input watt-hour and its data to "0". After clearing, be sure to restore 01. 51 data to the previous value; otherwise, input watt-hour data will not be accumulated.

<b>01. 54</b>	Frequency detection 3 value (refer to 01. 31)		Factory default	<b>50</b>
	Setting Range	<b>0.0~500.0Hz</b>	Unit	0.1Hz

<b>01. 55</b>	Current detection 3 level (refer to 01. 34)		↗	Factory default	Type Setting
	Setting Range	0.00 (invalid); Current value of 1% to 200% of the inverter rated current		Unit	0.01
<b>01. 56</b>	Current detection 3 timer (refer to 01. 34)		↗	Factory default	<b>10</b>
	Setting Range	<b>0.01~600.00s</b>		Unit	0.01s
<b>01. 61</b>	Terminal AVI extension function selection			Factory default	<b>0</b>
<b>01. 62</b>	Terminal ACI extension function selection			Factory default	<b>0</b>
<b>01. 63</b>	Terminal AUI extension function selection			Factory default	<b>0</b>

 Select extended functions of terminals AVI, ACI and AUI. (There is no need to set up the functions if they are to be used for frequency command sources.)

01. 61.01. 62, 01. 63 Setting value	Function	Description
0	No function assigned	—
1	Auxiliary frequency 1	Auxiliary frequency input to be added to the reference frequency given by frequency command 1 (00.01). This is not added to any other reference frequencies given by frequency command 2 and multi-frequency commands, etc.
2	Auxiliary frequency 2	Auxiliary frequency input to be added to all reference frequencies given by frequency command 1, frequency command 2, multi-frequency commands, etc.
3	PID command 1	Command sources such as temperature and pressure under PID control. It is also necessary to configure function parameter 08. 02.
5	PID feedback amount	Feedback amounts such as temperature and pressure under PID control.
6	Ratio setting	This is used to multiply the final frequency command value by this value, for use in the constant line speed control by calculating the winder diameter or in ratio operation with multiple inverters.
7	Analog torque limit value A	This is used when analog inputs are used as torque limiters. (parameter 00. 40)
8	Analog torque limit value B	This is used when analog inputs are used as torque limiters. (parameter 00. 40)
10	Torque command	Analog inputs to be used as torque commands under torque control. (parameter 04. 18)
11	Torque current command	Analog inputs to be used as torque current commands under torque control. (parameter 04. 18)
17	Forward (FWD) speed limit value	
18	Reverse (REV) speed limit value	
20	Analog input monitor	By inputting analog signals from various sensors such as the temperature sensors in air conditioners to the inverter, you can monitor the state of external devices via the communications link. By using an appropriate display coefficient, you can also have various values to be converted into physical values such as temperature and pressure before they are displayed.



Note: Note: If these terminals have been set up to have the same data, the operation priority is given in the following order: 01. 61 > 01. 62 > 01. 63

<b>01. 64</b>	Saving of digital reference frequency	↗	Factory default	1
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☒ Specifies how to save the reference frequency specified in digital formats by the (▲) / (▼) keys on the keypad as shown below.

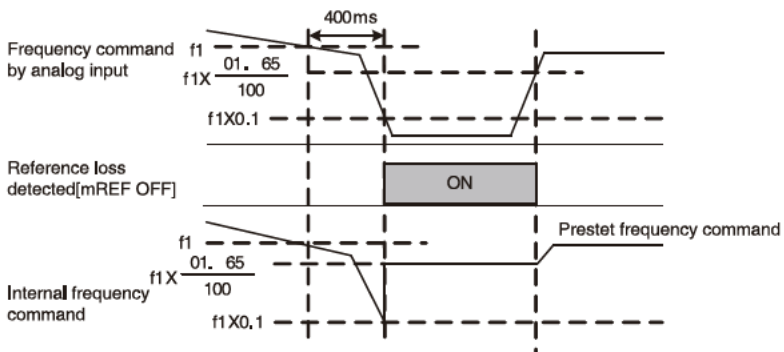
01. 64 Setting value	Function
0	Automatic saving when the main power is turned OFF. The reference frequency will be automatically saved when the main power is turned OFF. At the next power-on, the reference frequency at the time of the previous power-off applies.
1	Saving by pressing (▲) key. Pressing the (▲) saves the reference frequency. If the control power is turned OFF without pressing the key, the data will be lost. At the next power-ON, the inverter uses the reference frequency saved when the (▲) key was pressed last.

<b>01. 65</b>	Reference loss detection(continue running frequency)	↗	Factory default	999
	Setting Range	0(Decelerate to stop), 20 to 120% , 999 : Cancel	Unit	1%

☒ When the analog frequency command (setting through terminals AVI, ACI and AUI), has dropped below 10% of the reference frequency within 400 ms, the inverter presumes that the analog frequency command wire has been broken and continues its operation at the frequency determined by the ratio specified by 01. 65 to the reference frequency, and set the command Reference loss detected [mREF OFF] as ON.

(parameters 1. 20~01. 24, 01. 27 data=33)

When the frequency command level (in voltage or current) returns to a level higher than that specified by 01. 65, the inverter presumes that the broken wire has been fixed and continues to run following the frequency command.



In the diagram above,  $f_1$  is the level of the analog frequency command sampled at any given time. The sampling is repeated at regular intervals to continually monitor the wiring connection of the analog frequency command.

Notes: Avoid an abrupt voltage or current change for the analog frequency command. An abrupt change may be interpreted as a wire break.

Setting 01. 65 = "999" (Disable) allows the [mREF OFF] signal ("Reference loss detected") to be issued, but does not allow the reference frequency to change (the inverter runs at the analog frequency command as specified).

When E65 = "0" or "999", the reference frequency level at which the broken wire is recognized as fixed is "f1 × 0.2".

When E65 = "100" (%) or higher, the reference frequency level at which the wire is recognized as fixed is "f1 × 1".

The reference loss detection is not affected by the setting of analog input adjustment (filter time constants: 02. 33, 02. 38, 02. 43).

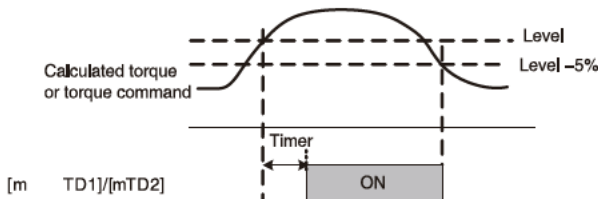
<b>01. 78</b>	Torque detection 1 level	↗	Factory default	<b>100</b>
	Setting Range	0~300%		Unit
				1%
<b>01. 79</b>	Torque detection 1 timer	↗	Factory default	<b>10</b>
	Setting Range	0.01~600.00s		Unit
				0.01s
<b>01. 80</b>	Torque detection 2 / low torque detection level	↗	Factory default	<b>20</b>
	Setting Range	0~300%		Unit
				1%
<b>01. 81</b>	Torque detection 2 / low torque detection timer	↗	Factory default	<b>20.00</b>
	Setting Range	0.01~600.00s		Unit
				0.01s

📖 Set action level and timer of torque detection 1 [mTD1], torque detection 2 [mTD2], low-torque detection [mU-TL].

Output signal	Data assigned to output terminal	Action level range: 0~300%	Timer time range: 0.01~600.00s
[mTD1]	46	01. 78	01. 79
[mTD2]	47	01. 80	01. 81
[mU-TL]	45	01. 80	01. 81

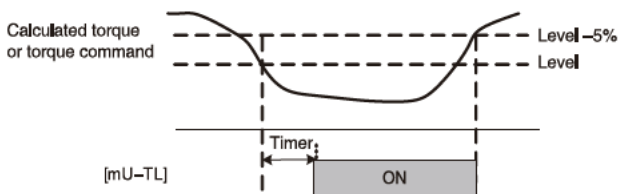
#### ■ Torque detection 1 [mTD1], Torque detection 2 [mTD2]

The output signal [mTD1] or [mTD2] comes ON when the torque value calculated by the inverter or torque command exceeds the level specified (Torque detection (Level)) for the period specified (Torque detection (Timer)), respectively. The signal turns OFF when the calculated torque drops below "the level specified minus 5% of the motor rated torque". The minimum ON-duration is 100 ms.



### ■ Low torque detected [mU-TL]

This output signal comes ON when the torque value calculated by the inverter or torque command drops below the level specified (Low torque detection (Level)) for the period specified (Low torque detection (Timer)). The signal turns OFF when the calculated torque exceeds the "level specified by 01. 80 plus 5% of the motor rated torque". The minimum ON-duration is 100ms.



Since the motor parameters are used in the calculation of torque, it is recommended that auto-tuning be applied by function parameter 03. 04 to achieve higher accuracy.

In the inverter's low frequency operation, as a substantial error in torque calculation occurs, no low torque can be detected within the operation range at less than 20% of the base frequency parameter 00. 04 (In this case, the result of recognition before entering this operation range is retained.)

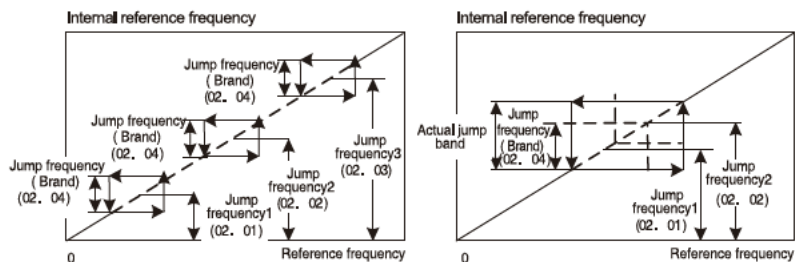
<b>01. 98</b>	FWD terminal function selection (refer to 01. 01-01. 07)	Factory default	<b>98</b>
<b>01. 99</b>	REV terminal function selection (refer to 01. 01-01. 07)	Factory default	<b>99</b>

## 02 Control Function Parameters

<b>02. 01</b>	Jump frequency 1	↗	Factory default	<b>0.0</b>
<b>02. 02</b>	Jump frequency 2	↗	Factory default	<b>0.0</b>
<b>02. 03</b>	Jump frequency 3	↗	Factory default	<b>0.0</b>
	Setting Range	0.0~500.0 Hz (Setting to 0.0 results in no jump frequency band )		Unit 0.1Hz
<b>02. 04</b>	Jump frequency range	↗	Factory default	<b>3.0</b>
	Setting Range	0.0~30.0 Hz (Setting to 0.0 results in no jump frequency band )		Unit 0.1Hz

These function parameters enable the inverter to jump over three different points on the output frequency in order to skip resonance caused by the motor speed and natural frequency of the driven machinery (load).

- While you are increasing the reference frequency, the moment the reference frequency reaches the bottom of the jump frequency band, the inverter keeps the output at that bottom frequency. When the reference frequency exceeds the upper limit of the jump frequency band, the internal reference frequency takes on the value of the reference frequency. When you are decreasing the reference frequency, the situation will be reversed. Refer to the figure on the lower left.
- When more than two jump frequency bands overlap, the inverter actually takes the lowest frequency within the overlapped bands as the bottom frequency and the highest as the upper limit. Refer to the figure on the lower right.



<b>02. 05</b>	Multi-speed frequency 1	↗	Factory default	<b>0,00</b>	
<b>02. 06</b>	Multi-speed frequency 2	↗	Factory default	<b>0,00</b>	
<b>02. 07</b>	Multi-speed frequency 3	↗	Factory default	<b>0,00</b>	
<b>02. 08</b>	Multi-speed frequency 4	↗	Factory default	<b>0,00</b>	
<b>02. 09</b>	Multi-speed frequency 5	↗	Factory default	<b>0,00</b>	
<b>02. 10</b>	Multi-speed frequency 6	↗	Factory default	<b>0,00</b>	
<b>02. 11</b>	Multi-speed frequency 7	↗	Factory default	<b>0,00</b>	
<b>02. 12</b>	Multi-speed frequency 8	↗	Factory default	<b>0,00</b>	
<b>02. 13</b>	Multi-speed frequency 9	↗	Factory default	<b>0,00</b>	
<b>02. 14</b>	Multi-speed frequency 10	↗	Factory default	<b>0,00</b>	
<b>02. 15</b>	Multi-speed frequency 11	↗	Factory default	<b>0,00</b>	
<b>02. 16</b>	Multi-speed frequency 12	↗	Factory default	<b>0,00</b>	
<b>02. 17</b>	Multi-speed frequency 13	↗	Factory default	<b>0,00</b>	
<b>02. 18</b>	Multi-speed frequency 14	↗	Factory default	<b>0,00</b>	
<b>02. 19</b>	Multi-speed frequency 15	↗	Factory default	<b>0,00</b>	
	Setting Range	<b>0.00~500.00 Hz</b>		Unit	0.01Hz

■ These function parameters specify 15 frequencies required for driving the motor at frequencies 1 to 15. Turning terminal commands [mSS1], [mSS2], [mSS4] and [mSS8] ON/OFF selectively switches the reference frequency of the inverter in 15 steps. To use these features, you need to assign [mSS1], [mSS2], [mSS4] and [mSS8] ("Select multi-frequency") to the digital input terminals with (01. 01 to 01. 07) (data = 0, 1, 2, and 3).

The combination ON/OFF of terminal function [mSS1], [mSS2], [mSS4] and [mSS8] and the selected frequencies are as follows.

[mSS8]	[mSS4]	[mSS2]	[mSS1]	Selected frequency command
OFF	OFF	OFF	OFF	Other than multi-frequency *
OFF	OFF	OFF	ON	02. 05(Multi-speed frequency 1)
OFF	OFF	ON	OFF	02. 06(Multi-speed frequency 2)
OFF	OFF	ON	ON	02. 07(Multi-speed frequency 3)
OFF	ON	OFF	OFF	02. 08(Multi-speed frequency 4)
OFF	ON	OFF	ON	02. 09(Multi-speed frequency 5)

[mSS8]	[mSS4]	[mSS2]	[mSS1]	Selected frequency command
OFF	ON	ON	OFF	02. 10(Multi-speed frequency 6)
OFF	ON	ON	ON	02. 11(Multi-speed frequency 7)
ON	OFF	OFF	OFF	02. 12(Multi-speed frequency 8)
ON	OFF	OFF	ON	02. 13(Multi-speed frequency 9)
ON	OFF	ON	OFF	02. 14(Multi-speed frequency 10)
ON	OFF	ON	ON	02. 15(Multi-speed frequency 11)
ON	ON	OFF	OFF	02. 16(Multi-speed frequency 12)
ON	ON	OFF	ON	02. 17(Multi-speed frequency 13)
ON	ON	ON	OFF	02. 18(Multi-speed frequency 14)
ON	ON	ON	ON	02. 19(Multi-speed frequency 15)

\* "Other than multi-frequency" includes frequency command 1 (00. 01), frequency command 2 (02. 30) and other command sources except multi-frequency commands.

■ When enabling PID control (08. 01=1~3)

Under the PID control, a multi-frequency command can be specified as a preset value (3 different frequencies). It can also be used for a manual speed command even with the PID control being canceled ([mHz/PID]= ON) or for a primary reference frequency under the PID dancer control.


[mSS8]	[mSS4]	[mSS1],[mSS2]	Selected frequency command
OFF	OFF	—	Command specified by 08. 02
OFF	ON	—	02. 08
ON	OFF	—	02. 12
ON	ON	—	02. 16

02. 08、02. 12、02. 16 can be specified in increments of 1Hz. The following gives the conversion formula between the PID command value and the data to be specified.

$$\text{PID command} = \frac{\text{Specified data (02. 08, 02. 12, 02. 16)}}{\text{Max. output frequency}} \times 100$$

Manual speed command

[mSS8],[mSS4]	[mSS2]	[mSS1]	Selected frequency command
—	OFF	OFF	Other than multi-frequency
—	OFF	ON	02. 05(Multi-speed frequency 1)
—	ON	OFF	02. 06(Multi-speed frequency 2)
—	ON	ON	02. 07(Multi-speed frequency 3)

02. 20	Jogging frequency		Factory default	0.00
	Setting Range	0.00~500.00(Hz)		Unit
	Related parameters	04. 54、04. 55 Acceleration and deceleration time (Jogging) 09. 09~09. 13 Speed control (JOG)		

 To jog or inch the motor for positioning a workpiece, specify the jogging conditions using the jogging-related function parameters beforehand, make the inverter ready for jogging, and then enter a run command.

■ Making the inverter ready for jogging

Turning ON the "Ready for jogging" terminal command [mJOG] readies the inverter for jogging. (parameter data =10)

Notes: Pressing the "STOP" + "RUN" keys" simultaneously in Running mode also readies the inverter for jogging when the run command source is "Keypad" (00. 02 = 0, 2 or 3) .Pressing these keys toggles between "ready for jogging" and "normal operation."

Starting jogging





Holding down the "RUN" or turning the input terminal command [mFWD] or [mREV] ON jogs the motor. In jogging with the "RUN" key, the inverter jogs only when the "RUN" key is held down. Releasing the key decelerates the motor to a stop.

Note: To start jogging operation by simultaneously entering the terminal command [mJOG] and a run command ( [mFWD], etc.) the input delay time between the two commands should be within 100ms. If a run command [mFWD] is entered first, the inverter does not jog the motor but runs it ordinarily until the next input [mJOG]

The jogging conditions should be specified beforehand using the following parameters.

Parameter	Function	Setting Range	Description
02. 20	Jogging frequency	0.00~500.00(Hz)	Reference frequency for jogging operation
04. 54	Jogging acceleration time	0.00~6000s	Acceleration time for jogging operation
04. 55	Jogging deceleration time	0.00~6000s	Deceleration time for jogging operation
09. 09	Speed control (JOG) Speed command filter	0.000~5.000s	Modification items related to speed control for jogging operation under vector control without speed sensor. Refer to the descriptions of 09. 01~09. 06 for the adjusting method.
09. 10	Speed control (JOG) Speed detection filter	0.000~0.100s	
09. 11	Speed control (JOG) P item (gain)	0.1~200.0 times	
09. 12	Speed control (JOG) I item ( integral time )	0.001~9.999s 999: Integral action is invalid	
09. 13	Speed control (JOG) output filter	0.000~0.100s	

<b>02. 30</b>	Dominant frequency 2 source selection (refer to 00. 01)	Factory default	<b>2</b>
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<b>02. 31</b>	Analog input adjustment for offset (AVI terminals )		Factory default	<b>0.00</b>
	Setting Range	<b>-5.0~5.0%</b>	Unit	0.1%
<b>02. 32</b>	Analog input adjustment for gain (AVI terminals )		Factory default	<b>100.00</b>
	Setting Range	<b>0.00~400.00%</b>	Unit	0.01%
<b>02. 33</b>	Analog input adjustment for filter time constant (AVI terminals )		Factory default	<b>0.05</b>
	Setting Range	<b>0.00~5.00s</b>	Unit	0.01s
<b>02. 34</b>	Analog input adjustment for gain base point (AVI terminals )		Factory default	<b>100.00</b>
	Setting Range	<b>0.00~100.00%</b>	Unit	0.01%

<b>02. 35</b>	Analog input adjustment for polarity selection (AVI terminal)		Factory default	<b>1</b>
	Setting Range	0: Bipolar 1: unipolar		

☞ For the parameters (02. 31~02. 35) above, Refer to 00. 01 for frequency setting.

<b>02. 36</b>	Analog input adjustment for offset (ACI terminals)	⊗	Factory default	<b>0.00</b>
	Setting Range	-5.0~5.0%		Unit 0.1%
<b>02. 37</b>	Analog input adjustment for gain (ACI terminals)	⊗	Factory default	<b>100.00</b>
	Setting Range	0.00~400.00%		Unit 0.01%
<b>02. 38</b>	Analog input adjustment for filter time constant (ACI terminals)	⚡	Factory default	<b>0.05</b>
	Setting Range	0.00~5.00s		Unit 0.01s
<b>02. 39</b>	Analog input adjustment for gain base point (ACI terminals)	⊗	Factory default	<b>100.00</b>
	Setting Range	0.00~100.00%		Unit 0.01%

☞ For the parameters (02. 36~02. 39) above, Refer to 00. 01 for frequency setting.

<b>02. 41</b>	Analog input adjustment for offset (AUI terminals)	⊗	Factory default	<b>0.00</b>
	Setting Range	-5.0~5.0%		Unit 0.1%
<b>02. 42</b>	Analog input adjustment for gain (AUI terminals)	⊗	Factory default	<b>100.00</b>
	Setting Range	0.00~400.00%		Unit 0.01%
<b>02. 43</b>	Analog input adjustment for filter time constant (AUI terminals)	⚡	Factory default	<b>0.05</b>
	Setting Range	0.00~5.00s		Unit 0.01s
<b>02. 44</b>	Analog input adjustment for gain base point (AUI terminals)	⊗	Factory default	<b>100.00</b>
	Setting Range	0.00~100.00%		Unit 0.01%
<b>02. 45</b>	Analog input adjustment for polarity selection (AUI terminal)		Factory default	<b>1</b>
	Setting Range	0: Positive and negative polarity 1: Positive polarity		

☞ For the parameters (02. 41~02. 45) above, Refer to 00. 01 for frequency setting.

Setting up a reference frequency by Analog Input

You can adjust the gain, polarity, filter time constant, and offset which are applied to analog inputs (voltage inputs to terminals AVI and AUI, and current input to terminal ACI).

## Adjustable items for analog inputs

Input Terminal	Input range	Gain		Polarity Selection	Filter time	Compensation
		Gain	Base point			
AVI	0~+10V, -10~+10V	02. 32	02. 34	02. 35	02. 33	02. 31
ACI	4~20mA	02. 37	02. 39	-	02. 38	02. 36
AUI	0~+10V, -10~+10V	02. 42	02. 44	02. 45	02. 43	02. 41

### ■ Compensation (02. 31, 02. 36, 02. 41)

Configures an offset for an analog voltage/current input. The offset also applies to signals sent from the external equipment.

### ■ Filtering Time constant (02. 33, 02. 38, 02. 43)

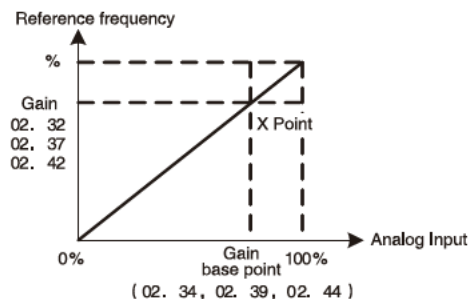
Configures a filter time constant for an analog voltage/current input. The larger the time constant, the slower the response. Specify the proper filter time constant taking into account the response speed of the machine (load). If the input voltage fluctuates due to line noises, increase the time constant.

### ■ Polarity Selection (02. 35, 02. 45)

Configure the input range for analog input voltage.

02. 35, 02. 45 Setting value	Specification of Input Terminal
0	-10~+10V
1	0~+10V (A minus component of the input will be regarded as 0V)

### ■ Gain




Note: To input bipolar analog voltage (DC0 to  $\pm 10V$ ) to terminals AVI and AUI, set 02. 35 and 02. 45 data to "0". Setting 02. 35 and 02. 45 data to "1" enables the voltage range from DC0 to +10V and interprets the negative polarity input from DC0 to -10V as 0V.

<b>02. 50</b>	Bias base point (Dominant frequency 1) (refer to 00. 01)		Factory default	<b>0.00</b>
	Setting Range	0.00~100.00%		Unit 0.01%
<b>02. 51</b>	Bias value (PID command 1)		Factory default	<b>0.00</b>
	Setting Range	-100.00~100.00(%)		Unit 0.01%
<b>02. 52</b>	Bias base point (PID command 1)		Factory default	<b>0.00</b>
	Setting Range	0.00~100.00(%)		Unit 0.01%



 Specify the gain and bias of the analog PID command 1, enabling it to define arbitrary relationship between the analog input and PID commands.

Note: Gain-related parameters 02. 32, 02. 34, 02. 37, 02. 39, 02. 42 and 02. 44 are shared by frequency commands.


<b>02. 53</b>	Normal/Inverse action selection (Dominant frequency 1) (refer to 01.01~01.09)		Factory default	<b>0.00</b>
	Setting Range	0: Normal operation 1: Inverse operation		

### 03 Motor 1 Parameters

To specify the motor parameters correctly, specify the motor rated capacity with(03. 02) and then initialize the motor parameters with (04. 03). This procedure also applies when the inverter is switched to the ND/HD mode and a motor with one or two ranks lower capacity is used. When switching the motor between the 1st to 4th motors, specify the corresponding function parameters. (Refer to the parameter 05.42)

The motor parameters to be specified in 03. 13~03. 56 (iron loss and magnetic saturation factors, etc.) are usually not shown on the motor nameplate or in the test report. If auto-tuning (03. 04 = 2 or 3) is not performed, it is not necessary to change the motor parameters from the ones for a standard motor.

<b>03. 01</b>	Motor 1 (No. of poles)	Factory default	<b>4</b>
	Setting Range	<b>2~22 poles</b>	

 Specifies the number of poles of the motor. Enter the value given on the nameplate of the motor. This setting is used to monitor the motor speed and control the speed. The following expression is used for the conversion.

$$\text{Motor speed (r/min)} = 120 / \text{number of poles} \times \text{frequency (Hz)}$$

<b>03. 02</b>	Motor 1 rated capacity	Factory default	Type Setting
	Setting Range	<b>0.01~1000kW</b>	Unit 0.01kW

 Specifies the rated capacity of the motor. Enter the rated value given on the nameplate of the motor.

<b>03. 03</b>	Motor 1 rated current	Factory default	Type Setting
	Setting Range	<b>0.00~2000A</b>	Unit 0.01A

<b>03. 04</b>	Motor 1 auto-tuning	Factory default	<b>0</b>
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There are 3 types of auto-tuning as below . Select the appropriate one considering the limitations in your equipment.

03. 04 Setting value	Auto-tuning	Action	Motor parameters to be tuned
0	Invalid	—	—
1	Tune while the motor stops	The inverter performs tuning while the motor is stopped.	Primary resistance %R1 (03. 07) Leakage reactance %X (03. 08) Rated Slip frequency (03. 12) %X correction factor 1, 2 (03. 53, 03. 54)

03. 04 Setting value	Auto-tuning	Action	Motor parameters to be tuned
2	Tune while the motor is rotating under V/f control	After tuning while the motor is stopped, the inverter performs tuning again, with the motor running at 50% of the base frequency.	No-load current (03. 06) Primary resistance %R1 (03. 07) Leakage reactance %X (03. 08) Rated Slip frequency (03. 12) Magnetic saturation factors 1~5 (03. 16~03. 20) Magnetic saturation expansion factors a~c (03. 21~03. 23) %X correction factor 1, 2 (03. 53, 03. 54)
3	Tune while the motor is rotating under vector control	After tuning while the motor is stopped, the inverter performs tuning, with the motor running at 50% of the base frequency twice.	No-load current (03. 06) Primary resistance %R1 (03. 07) Leakage reactance %X (03. 08) Rated Slip frequency (03. 12) Magnetic saturation factors 1~5 (03. 16~03. 20) Magnetic saturation expansion factors a~c (03. 21~03. 23) %X correction factor 1, 2 (03. 53, 03. 54)

For details of auto-tuning, refer to Chapter 4, Section 4.1 "Test Run".

Notes: • In any of the following cases, perform auto-tuning since the motor parameters are different from those of standard motors so that the best performance cannot be obtained under some controls.

- Cabling between the motor and the inverter is long. (Generally, 20m longer)
- A reactor is inserted between the motor and the inverter.

03. 05	Motor 1 (Online tuning)	⚡	Factory default	0
	Setting Range	0: Invalid 1: Action		
	Related parameters	05. 19 Motor 2 (Online tuning) 06. 19 Motor 3 (Online tuning) 07. 19 Motor 4 (Online tuning)		

📖 Long run under "Dynamic torque vector control" or "Slip compensation control" causes motor temperature change, varying the motor parameters.

This changes the motor speed compensation amount, resulting in motor speed deviation from the initial rpm.

Enabling online tuning identifies motor parameters covering the motor temperature change to decrease the motor speed fluctuation.

For use of online tuning, set 03. 04 (Auto-tuning) to "2".

Note: Online tuning can be performed only when 00. 42 = 1 (Dynamic torque vector control) or when 00. 42 = 2 (V/f control with slip compensation active) and 00. 37 = 2 or 5 (Auto torque boost).

03. 06	Motor 1 no-load current		Factory default	Type Setting	
	Setting Range	0.00~2000A	Unit	0.01A	
03. 07	Motor 1 %R1		⚡	Factory default	Type Setting
03. 08	Motor 1 %X		⚡	Factory default	Type Setting
	Setting Range	0.00~50.00%	Unit	0.01%	

Specify no-load current, %R1 and %X, respectively. Obtain the appropriate values from the test report of the motor or by calling the manufacturer of the motor.

- No-load current: Enter the value obtained from the motor manufacturer.
- %R1: Enter the value calculated by the following expression.

$$\%R1 = \frac{R1 + \text{Cable R1}}{V / (\sqrt{3} \times I)} \times 100 (\%)$$

R1: Primary resistance of motor ( $\Omega$ )

Cable R1: Resistance of the output cable ( $\Omega$ )

V: Rated voltage of motor (V)

I: Rated current of motor (A)

- %X: Enter the value calculated by the following expression.

$$\%X = \frac{X1 + X2 + XM (X2 + XM) + \text{Cable X}}{V / (\sqrt{3} \times I)} \times 100 (\%)$$

X1: Primary leakage reactance of motor ( $\Omega$ )

X2: Secondary leakage reactance of motor (converted to primary) ( $\Omega$ )

XM: Excitation reactance ( $\Omega$ ) of motor

Cable X: Reactance of cable at the side of output.

V: Rated voltage of motor (V)

I: Rated current of motor (A)

Note: For reactance, use the value at the base frequency (00.04)

<b>03.09</b>	Motor 1 Slip compensation gain for (driving)		Factory default	<b>100.0</b>
	Setting Range	<b>0.0~200.0%</b>	Unit	0.1%
<b>03.10</b>	Motor 1 slip compensation response time		Factory default	<b>0.12</b>
	Setting Range	<b>0.01~10.00s</b>	Unit	0.01s
<b>03.11</b>	Motor 1 slip compensation gain for (braking)		Factory default	<b>100.0</b>
	Setting Range	<b>0.0~200.0%</b>	Unit	0.1%

03.09 and 03.11 determine the slip compensation amount in % for driving and braking individually and adjust the slip amount from internal calculation. Specification of 100% fully compensates for the rated slip of the motor. Excessive compensation (03.09, 03.11 >100%) may cause hunting (undesirable oscillation of the system), so carefully check the operation on the actual machine.

In the constant of motor specially used for vector control, in order to improve the accuracy of torque, adjust the slip for drive/braking mode by 03.09 / 03.11.


03.10 determines the response time for slip compensation. Basically, there is no need to modify the default setting.

Parameter	Function	Operation (Slip compensation)
03.09	Motor 1 Slip compensation gain for (driving)	Adjust the slip compensation for driving, Slip compensation amount for driving = Rated slip $\times$ Slip compensation gain for driving
03.11	Motor 1 slip compensation gain for (braking)	Adjust the slip compensation amount for braking, Slip compensation amount for braking = Rated slip $\times$ Slip compensation gain for braking

Parameter	Function	Operation (Slip compensation)
03. 10	Motor 1 slip compensation response time	Specify the slip compensation response time. Basically, there is no need to modify the default setting.

Refer to the parameter 00. 42 for the slip compensation control.

<b>03. 12</b>	Motor 1 rated slip frequency	Factory default	Type Setting
	Setting Range	<b>0.00~15.00Hz</b>	Unit 0.01

 Specifies rated slip frequency. Obtain the appropriate values from the test report of the motor or by calling the manufacturer of the motor, Performing auto-tuning automatically sets these parameters.

• Rated slip frequency: Convert the value obtained from the motor manufacturer to Hz using the following expression and enter the converted value (The motor rating given on the nameplate sometimes shows a larger value).

$$\text{Rated slip frequency (Hz)} = \frac{\text{Synchronous speed} - \text{Rated speed}}{\text{Synchronous speed}} \times \text{Base frequency}$$


Refer to the parameter 00. 42 for the slip compensation control.

<b>03. 13</b>	Motor 1 iron loss factor 1	↗	Factory default	Type Setting
<b>03. 14</b>	Motor 1 iron loss factor 2	↗	Factory default	<b>0.00</b>
<b>03. 15</b>	Motor 1 iron loss factor 3	↗	Factory default	<b>0.00</b>
	Setting Range	<b>0.00~20.00%</b>	Unit	0.01%

 Iron loss factors1~3(03. 13~03. 15), Basically, there is no need to modify the setting.

<b>03. 16</b>	Motor 1 magnetic saturation factor 1	↗	Factory default	Type Setting
<b>03. 17</b>	Motor 1 magnetic saturation factor 2	↗	Factory default	Type Setting
<b>03. 18</b>	Motor 1 magnetic saturation factor 3	↗	Factory default	Type Setting
<b>03. 19</b>	Motor 1 magnetic saturation factor 4	↗	Factory default	Type Setting
<b>03. 20</b>	Motor 1 magnetic saturation factor 5	↗	Factory default	Type Setting
	Setting Range	<b>0.0~300.0%</b>	Unit	0.1%

<b>03. 21</b>	Motor 1 magnetic saturation expansion factor a	↗	Factory default	Type Setting
<b>03. 22</b>	Motor 1 magnetic saturation expansion factor b	↗	Factory default	Type Setting
<b>03. 23</b>	Motor 1 magnetic saturation expansion factor c	↗	Factory default	Type Setting
	Setting Range	<b>0.0~300.0%</b>	Unit	0.1%

 Input the exciting current to generate magnetic flux inside the motor and the characteristics of the magnetic flux generated. Performing auto-tuning while the motor is rotating (03. 04 = 2 or 3) specifies these factors automatically.

<b>03. 53</b>	Motor 1% X correction factor 1	↗	Factory default	<b>100</b>
<b>03. 54</b>	Motor 1% X correction factor 2	↗	Factory default	<b>100</b>
	Setting Range	<b>0~300%</b>	Unit	1%

☞ %X correction factors 1 and 2 are specified the factors to correct fluctuations of leakage reactance (%X). Basically, there is no need to modify the setting.

<b>03. 55</b>	Motor 1 torque current under vector control		Factory default	Type Setting
	Setting Range	<b>0.00~2000A</b>	Unit	0.01A

☞ Specifies the rated torque current under vector control without speed sensor. Basically, there is no need to modify the setting.

<b>03. 56</b>	Motor 1 induced voltage factor under vector control		Factory default	<b>85%</b>
	Setting Range	<b>50~100%</b>	Unit	1%

☞ The factory default is 90% in case of the motor capacity of 132kW above.  
Specifies the induced voltage factor under vector control without speed sensor. Basically, there is no need to modify the setting.

## 04 High Performance Functions Parameters

<b>04. 03</b>	Data initialization		Factory default	<b>0</b>
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☞ Initializes the current function parameter data to the factory defaults or initializes the motor parameters.

To change the parameter 04. 03 data, it is necessary to press the (STOP) + (▲) keys or (STOP) + (▼) keys simultaneously.

04. 03 Setting value	Function Description
0	Disable initialization (Settings manually made by the user will be retained.)
1	Initial value (Initialize all function parameter data to the factory defaults)
2	Initialize motor 1 parameters
3	Initialize motor 2 parameters
4	Initialize motor 3 parameters
5	Initialize motor 4 parameters

\* After pushing the (STOP) key to complete the initialization, the data of parameter 04. 03 will automatically change to "0" (factory default value).

Notes: When accessing function parameter 03. 02 with the keypad, take into account that 03. 02 data automatically updates data of function parameters 03. 03, 03. 06 to 03. 23, 03. 53 to 03. 56 and 04. 46. Similarly, when accessing function parameters 05. 16, 06. 16 and 07. 16 of the second~fourth motor, data of related function parameters for each are automatically updated.

<b>04. 04</b>	Auto-reset Times	↗	Factory default	<b>0</b>
	Setting Range	0: Invalid; 1-10 reset times		Unit
				1

#### 📖 Auto Reset (Times and Reset interval)

Specify the auto-reset function that makes the inverter automatically attempt to reset the tripped state and restart without issuing an alarm output (for any alarm) even if any protective function subject to reset is activated and the inverter enters the forced-to-stop state (tripped state). If the protective function is activated in excess of the times specified, the inverter will issue an alarm output (for any alarm) and not attempt to auto-reset the tripped state.

Listed below are the protective functions subject to auto-reset.

Protective function	LED monitor displays	Protective functions name	LED monitor displays
Overcurrent Protection	OC1, OC2, OC3	Motor overheating	OH4
Overvoltage Protection	OU1, OU2, OU3	Braking resistor overheat	dbH
Cooler Overheat	OH1	Motor overload	OL1~OL4
Inverter internal overheat	OH3	Inverter overload	OLU

### ⚠ Caution

When the alarm is stopped while the retry function is selected, the motor will run after the alarm is automatically restarted. For this reason, it is necessary to design a responsive machine that will ensure the safety of the human body and its surroundings even if it is re-run.

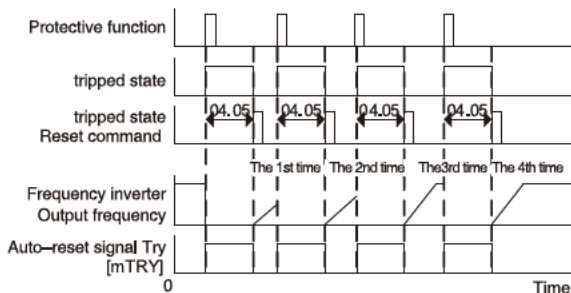
**An accident may be caused!**

<b>04. 05</b>	Auto-reset (Reset interval time)	↗	Factory default	<b>5.0</b>
	Setting Range	0.5~20.0(s)		Unit
				0.1s

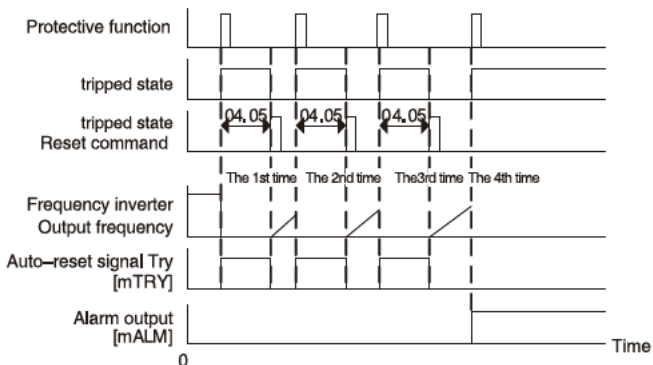
📖 Specifies the reset interval time between the time when the inverter enters the tripped state and the time when it issues the reset command to attempt to auto-reset the state. Refer to the timing scheme diagrams below.

<Operation figure >

- In the figure below, normal operation restarts in the 4th retry.



- Under the circumstance of output alarm when it is restarted for more than 3 times (04. 04=3)



- Auto-resetting – [mTRY] (parameter 01. 20–01. 24, 01. 27 data=26)

This output signal comes ON when auto-resetting (resetting alarms automatically) is in progress.

<b>04. 06</b>	Cooling fan ON-OFF control	↗	Factory default	<b>1</b>
	Setting Range	0: Invalid (always in operation)		
		1: Valid action (ON / OFF controllable)		

To prolong the service life of the cooling fan and reduce fan noise during running, the cooling fan stops when the temperature inside the inverter drops below a certain level while the inverter stops. However, since frequent switching of the cooling fan shortens its service life, the cooling fan keeps running for 10 minutes once started.

04. 06 specifies whether to keep running the cooling fan all the time or to control its ON/OFF.

- ON-OFF control of fan [mFAN] (parameter 01. 20–01. 24, 01. 27 data=25)

With the cooling fan ON/OFF control enabled (04. 06= 1), this output signal is ON when the cooling fan is in operation, and OFF when it is stopped. This signal can be used to make the cooling system of peripheral equipment interlocked for an ON/OFF control.

<b>04. 07</b>	Acceleration/Deceleration Pattern (refer to 00. 07)	↗	Factory default	<b>0</b>
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<b>04. 08</b>	Rotation direction Limitation		Factory default	<b>0</b>
	Setting Range	0: Invalid		
		1: Valid Action (Reverse rotation inhibited)		
		2: Valid Action (Forward rotation inhibited)		

Avoids the motor from running in an unexpected rotational direction due to miss-operation of run commands, miss-polarization of frequency commands, or other mistakes, etc.

Under vector control, some restrictions apply to the speed command. Under vector control without speed sensor, a speed estimation error caused by a motor constant error or other errors may slightly rotate the motor in the direction other than the specified one.

<b>04. 11</b>	Deceleration mode		Factory default	<b>0</b>
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Specifies the deceleration mode to be applied when a run command is turned OFF.

04. 11 Setting value	Function
0	Normal deceleration
1	Coast-to-stop (The inverter immediately shuts down its output, so the motor stops according to the inertia of the motor and machinery (load) and their kinetic energy losses.)

Note: When reducing the reference frequency, the inverter decelerates the motor according to the deceleration commands even if 04. 11 = 1 (Coast-to-stop). speed shall be cut according to setting of deceleration time when frequency setting is decreased.

<b>04. 12</b>	Instantaneous overcurrent limiting mode selection (refer to 00.43)		Factory default	<b>1</b>
	Setting Range	0: Invalid 1: Valid Action		

<b>04. 13</b>	Restart mode after momentary power failure (restart time) (refer to 00. 14)		Factory default	Type Setting
	Setting Range	<b>0.1~20.0 s</b>	Unit	0.1s
<b>04. 14</b>	Restart mode after momentary power failure (frequency fall rate) (refer to 00. 14)		Factory default	<b>999</b>
	Setting Range	0,00: deceleration time selected, 0,01 ~ 100,00Hz / s, 999 (according to the current limit command)	Unit	0.01Hz/s
<b>04. 15</b>	Restart mode after momentary power failure (continuous running level) (refer to 00. 14)		Factory default	<b>470</b>
	Setting Range	<b>440~600V</b>	Unit	1V
<b>04. 16</b>	Restart mode after momentary power failure (allowable momentary power failure time) (refer to 00. 14)		Factory default	<b>999</b>
	Setting Range	0.0~30.0s.999 (the inverter can determine automatically)	Unit	0.1s

<b>04. 26</b>	Thermistor (for motor) action selection		Factory default	<b>0</b>
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04. 26 and 04. 27 specify the PTC (Positive Temperature Coefficient)/NTC (Negative Temperature Coefficient) thermistor embedded in the motor. The thermistor is used to protect the motor from overheating or output an alarm signal.



Selects the function operation mode (protection or alarm) for the PTC/NTC thermistor as shown below.

04. 26 Setting value	Operation
0	Invalid
1	When the voltage sensed by PTC thermistor exceeds the detection level, motor protective function (alarm OH4) is triggered, causing the inverter to enter an alarm stop state.
2	When the voltage sensed by the PTC thermistor exceeds the detection level, a motor alarm signal is output but the inverter continues running. You need to assign the "Motor overheat detected by thermistor" signal[mTHM] (PTC) (parameter 01. 20~01. 24, 01. 27 data=56)
3	When the inverter is connected with the NTC thermistor built into the motor exclusively designed for vector control, the inverter senses the motor temperature and uses the information for control. If the motor overheats and the temperature exceeds the protection level, the inverter issues the Motor protection alarm OH4 and stops the motor.

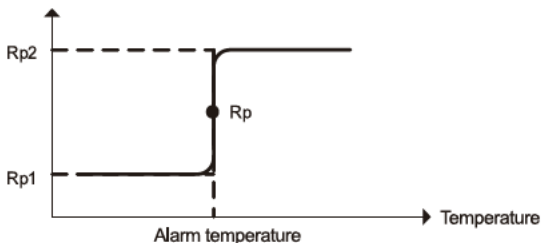
If 04. 26 data is set to "1" or "2" (PTC thermistor), the inverter monitors the voltage sensed by PTC thermistor and protect the motor even when any of the 2nd to 4th motors is selected. If 04. 26 data is set to "3" (NTC thermistor) and any of the 2nd to 4th motors is selected, the inverter does not perform these functions.

<b>04. 27</b>	Thermistor (for motor) action value	↗	Factory default	<b>0.35</b>
	Setting Range	<b>0.00~5.00V</b>	Unit	0.01V

#### ☞ Thermistor (for motor) (Level)

The alarm temperature at which the overheat protection becomes activated depends on the characteristics of the PTC thermistor. The internal resistance of the thermistor will significantly change at the alarm temperature. The detection level (voltage) is specified based on the change of the internal resistance.

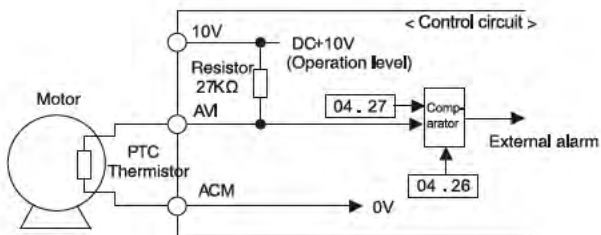
PTC thermistor internal resistance



Suppose that the internal resistance of the PTC thermistor at the alarm temperature is Rp, the detection level (voltage)  $V_{V2}$  is calculated by the expression below. Set the result  $V_{V2}$  to function parameter 04. 27.

$$V_{V2} = \frac{RP}{27000 + RP} \times 10.5 \text{ (V)}$$

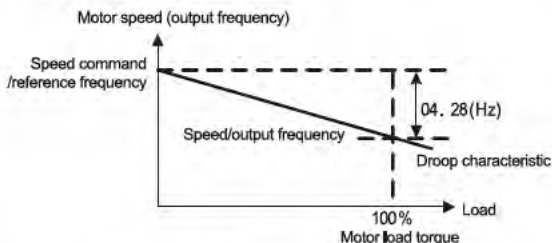
Suppose that the internal resistance of the PTC thermistor at the alarm temperature is Rp, the detection level (voltage)  $V_{V2}$  is calculated by the expression below. Set the result  $V_{V2}$  to function parameter 04. 27.



Note: When using the terminal AUI for PTC/NTC thermistor input, also turn SW5 on the control board to the PTC/NTC side.

<b>04.28</b>	Droop control		Factory default	<b>0.0</b>
	Setting Range	-60.0~0.0Hz(Droop control is invalid at 0.0)	Unit	-0.1Hz


In a system in which two or more motors drive single machinery, any speed gap between inverter-driven motors results in some load unbalance between motors. The droop control allows each inverter to drive the motor with the speed droop characteristics for increasing its load, eliminating such kind of load unbalance.




■ Select droop control [mDROOP] (parameter 01. 01~01. 09 data=76)  
The terminal command mDROOP switches droop control ON and OFF.

[mDROOP]	Droop control
ON	Valid
OFF	Invalid

Note: To use droop control, be sure to auto-tune the inverter for the motor beforehand.  
Under V/f control, to prevent the inverter from alarm even at an abrupt change in load, droop control applies the acceleration/deceleration time to the frequency obtained as a result of droop control. This may delay reflection of the frequency compensated during droop control on the motor speed, thereby running the inverter as if droop control is disabled. By contrast, under vector control without speed sensor, the current control system works so that the inverter does not alarm even at an abrupt change in load. No acceleration/deceleration time is applied to the frequency obtained as a result of droop control. It is, therefore, possible to eliminate load unbalance even during acceleration/deceleration.

<b>04. 30</b>	Communication link mode selection		Factory default	<b>0</b>
	Related parameters	11. 98 Communication function (mode selection)		

 Using the RS485 communications link (standard/option) or allows you to issue frequency commands and run commands from a computer or PLC at a remote location, as well as monitor the inverter running information and the function parameter data. Use 04. 30 and 11. 98 to specify the sources of those commands.

Command sources selectable

Command sources	Description
Inverter itself	Sources: RS485 communications link
	Frequency command source: Specified by 00. 01/02. 30, or multi-step frequency command. Run command source: Via the keypad or digital input terminals selected by 00. 02
RS485 communications link port 1	Via the standard RJ-45 port used for connecting a keypad
RS485 communications link port 2	Via the terminals (SG+, SG-, SCM) on the control PCB

Command sources specified by 04. 30 (Communications link function, Mode selection)

04. 30 Setting value	Frequency command	Running command
0	Inverter itself (00. 01 / 02. 30)	Inverter itself (00. 02)
1	RS485 communications link (port 1)	Inverter itself (00. 02)
2	Inverter itself (00. 01 / 02. 30)	RS485 communications link (port 1)
3	RS485 communications link (port 1)	RS485 communications link (port 1)
4	RS485 communications link (port 2)	Inverter itself (00. 02)
5	RS485 communications link (port 2)	RS485 communications link (port 1)
6	Inverter itself (00. 01 / 02. 30)	RS485 communications link (port 2)
7	RS485 communications link (port 1)	RS485 communications link (port 2)
8	RS485 communications link (port 2)	RS485 communications link (port 2)


Auxiliary Command sources specified by 11. 98 (Bus link function, Mode selection)


11. 98 Setting value	Frequency command	Running command
0	Follow 04. 30 data to set	Follow 04. 30 data to set


Combination of command sources specified by 04. 30 and 11. 98

		Frequency Instruction			
		Inverter itself	RS485 communications link port 1	RS485 communications link port 2	Via fieldbus (option)
Running command	Inverter itself	04. 30=0 11. 98=0	04. 30=1 11. 98=0	04. 30=4 11. 98=0	04. 30=0(1, 4) 11. 98=1
	RS485 communications link port 1	04. 30=2 11. 98=0	04. 30=3 11. 98=0	04. 30=5 11. 98=0	04. 30=2(3, 5) 11. 98=1
	RS485 communications link port 2	04. 30=6 11. 98=0	04. 30=7 11. 98=0	04. 30=8 11. 98=0	04. 30=6(7, 8) 11. 98=1

When the terminal command [mLE] ("Enable communications link via RS485 or fieldbus") is assigned to a digital input terminal, turning [mLE] ON makes the settings of 04. 30 and 11. 98 enabled. When [mLE] is OFF, those settings are disabled so that both frequency commands and run commands specified from the inverter itself take control.(parameter 01. 01~09 data=24)  
No [mLE] assignment is functionally equivalent to the [mLE] being ON.

<b>04. 43</b>	Cumulative running time for cooling fan		Factory default	—
	Setting Range	0~9999		Unit
				1

<b>04. 44</b>	Startup Counter for Motor 1		Factory default	—
	Setting Range	For adjustment in replacement (0000 ~ FFFF (hexadecimal))		
	Related parameters	04. 78 Maintenance Interval setting (M1) 04. 79 Preset Startup Count for Maintenance(M1) 04. 94 Cumulative motor run time 1		

 Counts the number of inverter startups and displays it. Check the displayed number on the maintenance screen of the keypad, and use it as a guide for maintenance timing for parts such as belts. To start the counting over again, e.g. after a belt replacement, set the data to "0000".

#### ■ Cumulative motor run time 1(04. 94)

Operating the keypad can display the cumulative run time of the 1st motor. This feature is useful for management and maintenance of the machinery. Using 04. 94 can modify the cumulative run time to the desired value to be used as an arbitrary initial data on which the replacement timing of machine parts or inverter is based. Specifying "0" clears the cumulative run time of the motor. Even when a motor is driven by commercial power, not by the inverter, it is possible to count the cumulative run time of the motor by detecting the ON/OFF state of the auxiliary contact of the magnetic contactor for switching to the commercial power line. To enable this function, assign [mCRUN-M1] (Commercial power driving status of motor 1, function parameter data = 72) to one of the digital input terminals.

Note: • Data of 04. 94 is displayed in hexadecimal number (HEX). Operating the keypad can check the cumulative run time of the 1st motor.  
• Cumulative motor run time 2 through 4 can also be counted.

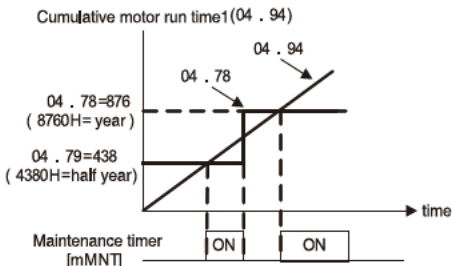
(Commercial power driving status of motor 2 to 4, function parameter data = 73 to 75 ) [mCRUN-M2 / M3 / M4] (parameter data=73 / 74 / 75)

#### ■ Maintenance timer [mMNT]

1) Maintenance interval (M1) specifies the maintenance interval. When the cumulative motor run time(04. 78)reaches the setting specified by 04. 78 (Maintenance interval (M1)), the inverter outputs the maintenance timer signal 1(04. 94) reaches the specified value by maintenance setting time (04. 78), signal [mMNT] to remind the user of the need of the maintenance of the machinery. Setting unit is time unit of 10 hours, with the Max.setting of 9999×10 hours.

• Data setting range: 0 invalid ), 1~9999 (unit of 10 hours)

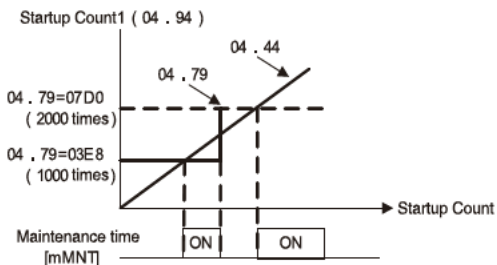
<Biannual maintenance>



2) (Preset startup count for maintenance (M1)) 04 . 79 specifies the number of inverter startup times to determine the next maintenance timing. When the count of the startup counter for motor 1 (04 . 44) reaches the number specified by 04 . 79 (Preset startup count for maintenance (M1)), the inverter outputs the maintenance timer signal [mMNT] to remind the user of the need of system maintenance. Setting shall be specified in hexadecimal number. The Max. setting is the FFFF=65,535.

- Data setting range: 0000 (invalid), 0001~FFFF (displaying in hexadecimal number)

<Biannual maintenance>



To enable this function, assign the maintenance timer signal [mMNT] to one of the digital output terminals (function parameter data = 84).

- Note:
- If the maintenance interval counter reaches the specified value, set a new value for the next maintenance in 04 . 78 and press the  $\odot$  key to reset the output signal and restart counting. This function is exclusively applied to the 1st motor.
  - If the startup counter reaches the specified value, set a new value for the next maintenance in 04 . 79 and press the  $\odot$  key to reset the output signal and restart counting. This function is exclusively applied to the 1st motor.



<b>04. 45</b>	Mock Alarm	$\blacktriangle$	Factory default	<b>0</b>
	Setting Range	0: Invalid		
		1: Trigger a mock alarm		
	Related parameters	04. 97 Clear alarm data		

Causes the inverter to generate a mock alarm in order to check whether external sequences function correctly at the time of machine setup. Setting the 04 . 45 data to "1" displays mock alarm Err on the LED monitor. It also issues alarm output (for any alarm).

(When data of function parameter 04 . 45 are modified, press the  $\odot$  key +  $\wedge$  key simultaneously.) After the mock error happens, data of function parameter 04 . 45 automatically reverts to "0", and allowing you to reset the alarm.




Just as data (alarm history and relevant information) of those alarms that could happen in running the inverter, the inverter saves mock alarm data, enabling you to confirm the mock alarm status.





To clear the mock alarm data, use 04. 97. (Accessing the 04. 97 data requires keying of  key +  key simultaneously.) 04. 97 data automatically returns to "0" after clearing the alarm data.

A mock alarm can be issued also by simultaneous keying of  key +  on the keypad for 5 seconds or more.


<b>04. 50</b>	Non-linear V/f Pattern 1 (Frequency) (refer to 00. 04)		Factory default	Type Setting
	Setting Range	0.0(canceled), 0.1~500.0Hz	Unit	0.1Hz
<b>04. 51</b>	Non-linear V/f Pattern 1 (Voltage) (refer to 00. 04)		Factory default	Type Setting
	Setting Range	0~500V: AVR action (440V series)	Unit	1V

<b>04. 52</b>	Non-linear V/f Pattern 2 (Frequency) (refer to 00. 04)		Factory default	<b>0.0</b>
	Setting Range	0.0(canceled), 0.1~500.0Hz	Unit	0.1Hz
<b>04. 53</b>	Non-linear V/f Pattern 2 (Voltage) (refer to 00. 04)		Factory default	<b>0</b>
	Setting Range	0~500V: AVR action (440V series)	Unit	1V

<b>04. 54</b>	Jogging acceleration time (refer to 00. 07)		Factory default	Type Setting
<b>04. 55</b>	Jogging deceleration time (refer to 00. 07)		Factory default	Type Setting
<b>04. 56</b>	Deceleration time for forced stop (refer to 00. 07)		Factory default	Type Setting
	Setting Range	<b>0.00~6000s</b>	Unit	0.01s

<b>04. 57</b>	1st S-curve acceleration range(Leading edge) (refer to 00. 07)		Factory default	<b>10</b>
<b>04. 58</b>	2nd S-curve acceleration range(Trailing edge) (refer to 00. 07)		Factory default	<b>10</b>
<b>04. 59</b>	1st S-curve deceleration range(Leading edge) (refer to 00. 07)		Factory default	<b>10</b>
<b>04. 60</b>	2nd S-curve deceleration range(Trailing edge) (refer to 00. 07)		Factory default	<b>10</b>
	Setting Range	<b>0~100%</b>	Unit	1%

<b>04. 61</b>	UP / DOWN control initial frequency setting selection (refer to 00. 01)		Factory default	<b>1</b>
	Setting Range	0: Take 0.00Hz as the initial frequency. 1: Take the final frequency command value as the initial frequency in the last UP / DOWN control		

<b>04. 63</b>	Frequency lower limiter action selection (refer to 00. 15)			Factory default	<b>0</b>
	Setting Range	0: limit by 00.16 (Frequency limiter: Low) and continue to run 1: If the output frequency lowers below the one limited by 00.16 (Frequency limiter: Low), decelerate to stop the motor.			

<b>04. 64</b>	Frequency lower limiter lower action value	↗	Factory default	<b>1.6</b>
	Setting Range	0,0: Depends on 00.16 (Frequency limiter, Low) 0,1 to 60Hz.		Unit 0.1Hz

 Specifies the lower limit of frequency to be applied when the current limiter, torque limiter, anti-regenerative control, or overload prevention control is activated. Normally, it is not necessary to change this data.


<b>04. 65</b>	Non-linear V/f Pattern 3 (Frequency) (refer to 00.04)	Factory default	<b>0,0</b>
	Setting Range	0,0(canceled), 0,1~500,0Hz	

<b>04. 66</b>	Non-linear V/f Pattern 3 (Voltage) (refer to 00.04)	Factory default	<b>0</b>
	Setting Range	0~500V: AVR action (440V series)	

<b>04. 67</b>	Automatic energy saving operation mode selection (refer to 00.37)	↗	Factory default	<b>0</b>
	Setting Range	0: Valid <b>only</b> at constant speed running 1: Valid in <b>all</b> modes		

<b>04. 68</b>	Slip compensation 1 Operating conditions selection (refer to 00.42)	Factory default	<b>0</b>	
	Setting Range	0: Valid in acceleration and deceleration ;valid at base frequency or above 1: Invalid in acceleration and deceleration; valid at base frequency or above 2: Valid in acceleration and deceleration; invalid at base frequency or above 3: Invalid in acceleration and deceleration; invalid at base frequency or above		

<b>04. 69</b>	Overvoltage Automatic Deceleration action selection	↗	Factory default	<b>3</b>
	Related parameters	04.76 Torque Limiter : Frequency increment limit for braking		

 It is enables or disables the anti-regenerative control. In the inverter not equipped with a braking unit, if the regenerative energy returned exceeds the inverter's braking capability, an overvoltage trip happens. To avoid such an overvoltage trip, enable the anti-regenerative control and the inverter controls the output frequency to keep the braking torque around "0" in both the deceleration and constant speed running phases.

Control mode	Control process	Operation Mode	Feature
Torque limit control(04. 69 =2, 4)	Controls the output frequency to keep the braking torque around "0".	It is invalid during acceleration, running at the constant speed, and deceleration.	Quick response. Causes less overvoltage trip with heavy impact load.
DC link bus voltage control (04. 69=3, 5)	Control the output frequency to lower the DC link bus voltage if the voltage exceeds the limiting level.	It is invalid during deceleration. Disabled during running at the constant speed.	Shorter deceleration time by making good use of the inverter's regenerative capability.

In addition, during deceleration triggered by turning the run command OFF, the anti-regenerative control increases the output frequency so that the inverter may not stop the load depending on the load state (huge moment of inertia, for example). To avoid that, 04. 69 provides a choice of cancellation of the anti-regenerative control to apply when three times the specified deceleration time is elapsed, thus decelerating the motor forcibly.


04. 69 Setting value	Function	
	Control mode	Force-to-stop with actual deceleration time exceeding three times the specified one.
0	Invalid automatic deceleration	—
2	Torque limit Control	Valid
3	DC link bus voltage control	Valid
4	Torque limit Control	Invalid
5	DC link bus voltage control	Invalid


■ Torque Limiter (Frequency increment limit for braking) (04. 76) Data Setting range: 0.0~500.0 (Hz).

Since increasing the output frequency too much in the torque limit control mode is dangerous, the inverter has a torque limiter (Frequency increment limit for braking) that can be specified by 04. 76. The torque limiter limits the inverter's output frequency to less than "Reference frequency + 04. 76 setting." But that the torque limiter activated restrains the anti-regenerative control, resulting in an overvoltage trip in some cases. Increasing the 04. 76 data improves the anti-regenerative control capability.

Notes: • Enabling the automatic deceleration (anti-regenerative control) may automatically increase the deceleration time

- When a braking unit is connected, disable anti-regenerative control. Automatic deceleration control may be activated at the same time when a braking unit starts operation, which may make the deceleration time fluctuate.
- If the set deceleration time is too short, the DC link bus voltage of the inverter rises quickly and consequently, the automatic deceleration may not follow the voltage rise. In such a case, specify a longer deceleration time.

04. 70	Overload prevention control		Factory default	999
	Setting Range	0.00 : Follow the deceleration time selected, 0.01 ~ 100.00 Hz / s, 999(cancel)	Unit	0.01

 Specifies the decelerating rate of the output frequency to prevent a trip from occurring due to an overload. This control decreases the output frequency of the inverter before the inverter trips due to a cooler overheat or inverter overload (with an alarm indication of OH1 or OLu, respectively). It is useful for equipment such as pumps where a decrease in the output frequency leads to a decrease in the load and it is necessary to keep the motor running even when the output frequency drops.

04. 70 Setting value	Function
0	Decelerate the motor by deceleration time 2 00. 08 or 01. 11
0.01~100.0	Decelerate the motor by deceleration rate from 0.01 to 100. (Hz/s).
999	Cancel overload prevention control.

■ Overload prevention control [mOLP] (parameters of 01.20~01.24, 01.27 data=36). This output signal comes ON when the overload prevention control is activated and the output frequency changed. [mOLP]. (Min.width of the output signal: 100ms).

Note: In equipment where a decrease in the output frequency does not lead to a decrease in the load, the overload prevention control is of no use and should not be enabled.



<b>04. 71</b>	Deceleration characteristics	↗	Factory default	<b>0</b>
	Setting Range	0: Invalid 1: Valid action		

**[i]** Setting the parameter data to enable forced brake control. If regenerative energy produced during the deceleration of the motor and returned to the inverter exceeds the inverter's braking capability, an overvoltage trip will occur. The forced brake control increases the motor energy loss during deceleration, increasing the deceleration torque.

Note: This function is aimed at controlling the torque during deceleration; it has no effect if there is a braking load. Enabling the automatic deceleration(anti-regenerative control, 04. 69 = 2 or 4) in the torque limit control mode disables the deceleration characteristics specified by parameter.

<b>04. 72</b>	Main Power Down Detection (Mode selection)	↗	Factory default	<b>1</b>
	Setting Range	0: Invalid, there is no main power down detection. 1: Valid, there is main power down detection.		

**[i]** In cases where the power is supplied via a PWM the inverter is connected via the DC link bus, there is no alternate-current input.

In such cases, set 04. 72 data to "0", otherwise the inverter cannot operate.

<b>04. 73</b>	Torque Limiter operating conditions selection (refer to 00. 40)		Factory default	<b>0</b>
	Setting Range	0: Valid in acceleration and deceleration, valid at constant speed 1: Invalid in acceleration and deceleration, valid at constant speed 2: Valid in acceleration and deceleration, invalid at constant speed		

<b>04. 76</b>	Torque Limiter: Frequency increment limit for braking (refer to 00. 40, 04. 69)	↗	Factory default	<b>5</b>
	Setting Range	<b>0,0~500,0Hzz</b>	Unit	0.1Hz

<b>04. 77</b>	Service Life of DC link bus capacitor (remaining time)	↗	Factory default	<b>—</b>
	Setting Range	0~8760 (10 hours as a unit)	Unit	1


**[i]** Displays the remaining time before the service life of DC link bus capacitor expires. (in 10 hours).



At the time of a PCB replacement, transfer the service life data of the DC link bus capacitor to the new board.


<b>04. 78</b>	Maintenance Interval setting (M1) (refer to 04. 44)	↗	Factory default	<b>8760</b>
	Setting Range	0(Invalid); 1 to 9999 (10 hours as a unit)		

<b>04. 79</b>	Preset Startup Count for Maintenance(M1) (refer to 04. 44)	↗	Factory default	<b>0</b>
	Setting Range	0000(Invalid); 0001 ~ FFFF (hexadecimal)		

<b>04. 80</b>	Output Current Fluctuation Damping Gain for Motor 1	↗	Factory default	<b>0,20</b>
	Setting Range	<b>0,00~1,00</b>	Unit	0.01

 The inverter output current driving the motor may fluctuate due to the motor characteristics and/or backlash in the machinery (load). Modifying the 04.80 data adjusts the controls in order to suppress such fluctuation. However, as incorrect setting of this gain may cause larger current fluctuation, do not modify the Factory default setting unless it is necessary.

<b>04. 81</b>	Light alarm selection 1		Factory default	<b>0</b>
<b>04. 82</b>	Light alarm selection 2		Factory default	<b>0</b>
	Setting Range	0000~FFFF (hexadecimal)		Unit
				1

 If the inverter detects a minor abnormal state "light alarm", it can continue the current operation without tripping while displaying the "light alarm" indication L-AL on the LED monitor. In addition to the indication L-AL, the PU LED lamp is blinking and inverter outputs the "light alarm" signal [mL-ALM] to a digital output terminal (To use the [mL-ALM], it is necessary to assign the signal to any of the digital output terminals by setting any of function parameters 01.20~01.24, 01.27). (data=98)

Select the desired items to be regarded as a light alarm from the following table.

Code	Name	Description
OH1	Cooler Overheat	Cooler temperature increased to the trip level.
OH2	External alarm	An error that has occurred in peripheral equipment turned the external alarm signal [mTHR]
OH3	Inverter internal overheat	The temperature inside the inverter has increased abnormally.
dbh	Braking resistor overheat	Estimated temperature of the coil in the braking resistor exceeded the allowable level.
OL1~OL4	Overload of motor 1~4	Motor temperature calculated with the inverter output current reached the trip level.
Er8 Erp	RS485 communications error (COM ports 1 and 2)	RS485 communication error between COM ports 1 and 2
ErE	Speed mismatch or excessive speed deviation	The deviation of the automatic speed regulator (between the reference speed and the detected one) is out of the specified range (09.21) for the period specified by 09.22).
OL	Motor overload early warning	Early warning before a motor overload
OH	Cooler overheat early warning	Early warning before a cooler overheat trip
LIF	Lifetime alarm	It is judged that the service life of any one of the capacitors (DC link bus capacitors and electrolytic capacitors on the PCB) and cooling fan has expired.
REF	Reference command loss detected	Analog frequency command was lost.
PID	PID alarm output	Warning related to PID control (absolute-value alarm or deviation alarm)
uTI	Low torque detected	Output torque drops below the low torque detection level for the specified period.
pTc	Thermistor activated (PTC)	The PTC thermistor on the motor detected a temperature.
rTe	Inverter life (Motor cumulative run time)	The motor cumulative run time reached the specified level.
cnT	Inverter life (Number of startups)	Number of startups reached the specified level.
CoF	PID feedback wire break	The PID feedback signal wire(s) is broken.

Set data for selecting "light alarms" in hexadecimal. For details on how to select the codes, refer to the next page.

#### ■ Selecting light alarm factors

To set and display the light alarm factors in hexadecimal format, each light alarm factor has been assigned to bits 0 to 15 as shown in below table. Set the bit that corresponds to the desired light alarm factor to "1".

Light Alarm Selection 1 (04. 81), Bit Assignment of Selectable Factors


Bit	Code	Contents	Bit	Code	Contents
15	—	—	7	OL3	Overload of motor 3
14	—	—	6	OL2	Overload of motor 2
13	Erp	RS485 communications error (COM port 2)	5	OL1	Overload of motor 1
12	Er8	RS485 communications error (COM port 1)	4	dbh	Braking resistor overheated
11	—	—	3	—	—
10	—	—	2	OH3	Inverter internal overheat
9	—	—	1	OH2	External alarm
8	OL4	Overload of motor 4	0	OH1	Cooler Overheat

Light Alarm Selection 1 (04. 82), Bit Assignment of Selectable Factors

Bit	Code	Contents	Bit	Code	Contents
15	—	—	7	LIF	Lifetime alarm
14	—	—	6	OH	Cooler overheat early warning
13	CnT	Inverter life (Number of startups)	5	OL	Motor overload early warning
12	rTE	Inverter life (Motor cumulative run time)	4	—	—
11	pTC	Thermistor activated (PTC)	3	CoF	PID feedback wire break
10	uTI	Low torque detected	2	—	—
9	Pid	PID alarm output	1	—	—
8	rEF	Reference command loss detected	0	ErE	Speed mismatch or excessive speed deviation

#### Display of Light Alarm Factor

(e.g.) Light alarm factors "RS485 communications error (COM port2)", "RS485 communications error (COM port 1)", "Option communications error", "Overload of motor 1" and "Cooler overheat" are selected by 04. 81.

LED No.	LED4				LED3				LED2				LED1				
Bit	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0	
Code	—	—	Erp	Er8	Er5	Er4	—	OL4	OL3	OL2	OL1	dbh	—	OH3	OH2	OH1	
Display Example	Binary	0	0	1	1	0	1	0	0	0	0	1	0	0	0	0	1
	Hexadecimal	3				4				2				1			
	Hexadecimal LED monitor on keypad	<div style="display: flex; justify-content: space-around; align-items: center;"> <span>LED4</span> <span>LED3</span> <span>LED2</span> <span>LED1</span> </div> 															

Note: With the 04. 26 data being set to "1" (PTC (The inverter immediately alarm with OH4 displayed)), if the PTC thermistor is activated, the inverter does not perform light alarm processing but stops its output, regardless of the assignment of bit 11 (PTC thermistor activated) by 04. 82 (Light Alarm Selection 2).

■ Light alarm [mL-ALM] (parameters 01. 20~01. 24 and 01. 27, data = 98 )

This output signal comes ON when a light alarm happens.

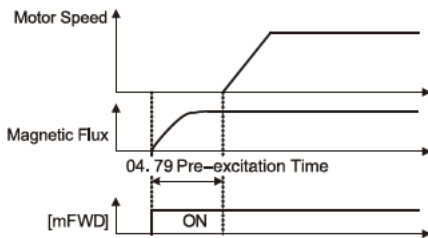
<b>04. 84</b>	Pre-excitation initial value	↗	Factory default	<b>100</b>
	Setting Range	100~400%(Ratio to the motor's no-load current)		Unit
			Unit	1%

☞ This parameter specifies the forcing function for the pre-excitation. It is used to shorten the pre-excitation time. Basically, there is no need to modify the default setting.

A motor generates torque with magnetic flux and torque current. Lag elements of the rising edge of magnetic flux causes a phenomenon in which enough torque is not generated at the moment of the motor start. To obtain enough torque even at the moment of motor start, enable to specify the pre-excitation by parameters so that magnetic flux is established before a motor start.

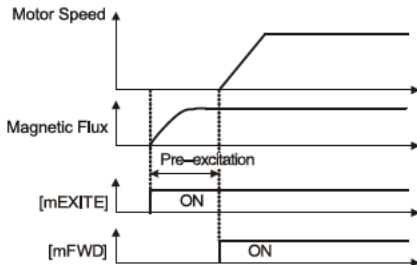
<b>04. 85</b>	Pre-excitation time	↗	Factory default	<b>0.00</b>
	Setting Range	0.00(Invalid), 0.01~30.00s		Unit
			Unit	0.01s

☞ Specifies the pre-excitation time before starting operation. When a run command is inputted, the pre-excitation starts. After the pre-excitation time specified by 04. 85 has elapsed, the inverter judges magnetic flux to have been established and starts acceleration. Specify 04. 85 data so that enough time is secured for establishing magnetic flux. The appropriate value for 04. 85 data depends on the motor capacity. Use the default setting value of the parameter 04. 13.



■ Pre-excitation [mEXITE] (parameters 01. 01~01. 09, data = 32)

Turning this input signal [mEXITE] ON starts pre-excitation. After the delay time for establishing magnetic flux has elapsed, a run command is inputted. Inputting the run command terminates pre-excitation and starts acceleration. Use an external sequence to control the time for establishing magnetic flux.








Note: Under V/f control (including auto torque boost and torque vector), pre-excitation is disabled, so use DC braking or hold the starting frequency instead.


A transient phenomenon, which may occur when the amount of mechanical loss is small, may rotate the motor during pre-excitation. If a motor rotation during pre-excitation is not allowed in your system, install a mechanical brake or other mechanism to stop the motor.


 **Warning**


Even if the motor stops due to pre-excitation, voltage is output to inverter's output terminals U, V, and W.



**Otherwise, an electric shock can occur!**

<b>04. 86</b>	For Manufacturer to use		Factory default	<b>0</b>
	Setting Range	<b>0~2</b>		
<b>04. 87</b>	For Manufacturer to use		Factory default	<b>25.0</b>
	Setting Range	<b>25.0~500.0Hz</b>		Unit 0.1Hz
<b>04. 88</b>	For Manufacturer to use		Factory default	<b>0</b>
	Setting Range	<b>0~3; 999</b>		
<b>04. 89</b>	For Manufacturer to use		Factory default	<b>0</b>
<b>04. 90</b>	For Manufacturer to use		Factory default	<b>0</b>
	Setting Range	<b>0, 1</b>		


 Function Parameters 04. 86~04. 90 appear on the LED monitor, but they are reserved for particular manufacturers. Unless otherwise specified, do not access them.

<b>04. 91</b>	PID Feedback Wire Break Detection		Factory default	<b>0</b>
	Setting Range	<b>0.0(Invalid alarm detection); 0.1~60.0s</b>		Unit 0.1s

 Using the terminal ACI (current input) for PID feedback signal enables wire break detection and alarm (CoF) issuance. 04. 91 specifies whether the wire break detection is enabled, or the duration of detection. (The inverter judges an input current to the terminal ACI (below 2mA as a wire break.)

<b>04. 92</b>	Continuity of Running (P) (refer to 00. 14)		Factory default	<b>999</b>
	Setting Range	<b>0.000~10.000 times; 999</b>		Unit 0,001
<b>04. 93</b>	Continuity of Running (I) (refer to 00. 14)		Factory default	<b>999</b>
	Setting Range	<b>0,010~10,000s; 999</b>		Unit 0,001s

<b>04. 94</b>	Cumulative motor run time 1 (refer to 04. 44)		Factory default	<b>—</b>
	Setting Range	<b>0~9999 The cumulative run time can be modified or reset(resettable). (10 hours as a unit)</b>		Unit 1

<b>04. 95</b>	DC braking characteristics selection (Braking response mode) (refer to 00. 20~00. 22)		Factory default	<b>1</b>
	Setting Range	<b>0: Slow response 1: Quick response</b>		

<b>04. 96</b>	Stop key Priority/ Start Check function	↗	Factory default	<b>0</b>
	Setting Range	0: STOP key priority is invalid, Start Check function is valid		
		1: STOP key priority is valid, Start Check function is valid		
		2: STOP key priority is invalid, Start Check function is invalid		
		3: STOP key priority is valid, Start Check function is invalid		

The precedence function and effectiveness/voidness of the running command during power up of the combined key can be selected.

#### ■ STOP Key Priority Function

Even if Even when run commands are entered from the digital input terminals or via the RS485 communications link (link operation), pressing the key forces the inverter to decelerate and stop the motor. After that, Er6 appears on the LED monitor.

#### ■ Start check function

For safety, this function checks whether any run command has been turned ON or not in each of the following situations. If one has been turned ON, the inverter does not start up but displays alarm code Er6 on the LED monitor.

•When the power to the inverter is turned ON.

•When the key is pressed to release an alarm status or when the digital input terminal command [mRST] ("Reset alarm") is turned ON.

•When the run command source is switched by a digital input terminal command such as [mLE] "Enable communications link via RS485 " or [mLOC] "Select local (keypad) operation".

<b>04. 97</b>	Clear alarm data	↗	Factory default	<b>0</b>
	Setting Range	0: Invalid		
		1: Setting "1" clears alarm data and then returns to "0".		
	Related parameters	04. 45 Mock Alarm		

Clears alarm data (alarm history and relevant information) stored in the inverter.

To clear alarm data, simultaneous keying of + keys is required.

<b>04. 98</b>	Protection/Maintenance Function (Mode selection)(refer to 00. 26 and 04. 42)	↗	Factory default	<b>0057H</b>
	Setting Range		Unit	<b>1</b>

Specifies whether to enable or disable automatic lowering of carrier frequency, input phase loss protection, output phase loss protection, judgment threshold on the life of DC link bus capacitor, judgment on the life of DC link bus capacitor, DC fan lock detection, braking transistor error detection, and IP20/IP40 switching, in combination .

#### Automatic lowering of carrier frequency (bit 0) (Under V/f control only)

This function should be used for important machinery that requires keeping the inverter running. Even if a cooler overheat or overload happens due to excessive load, abnormal surrounding temperature, or cooling system failure, enabling this function lowers the carrier frequency to avoid tripping (OH1, OH3, OLU). Note that enabling this function results in increased motor noise.

#### Input Phase Loss Protection (Lin) (bit 1)

Upon detection of an excessive stress inflicted on the apparatus connected to the main circuit due to phase loss or line-to-line voltage unbalance in the three-phase power supplied to the inverter, this feature stops the inverter and displays an alarm Lin is displayed.

Note: In configurations where only a light load is driven or a DC reactor is connected, phase loss or line-to-line voltage unbalance may not be detected because of the relatively small stress on the apparatus connected to the main circuit.

Output Phase Loss Protection action (OPL: Output Phase Loss) (bit 2)

Upon detection of phase loss in the output while the inverter is running, this feature stops the inverter and displays an alarm OPL.

Note: Where a magnetic contactor is installed in the inverter output circuit, if the magnetic contactor goes OFF during operation, all the phases will be lost. In such a case, this protection feature does not work.

To set data of function parameter 04. 98, assign the setting of each function to each bit of binary and then set the data in the form of hexadecimal number. Refer to the assignment of each function to each bit and a conversion example below.

Bit	Function	Bit Data=0	Bit Data=1	Factory default
Bit 0	Lower the carrier frequency automatically	Invalid	Valid	1: Valid
Bit 1	Detect input phase loss	Continue to run	Enter alarm processing	1: Alarm
Bit 2	Detect input phase loss	Continue to run	Enter alarm processing	1: Alarm
Bit 6	Reserved	Reserved	Reserved	0
Bit 7	Reserved	Reserved	Reserved	0

An example of conversion from binary to decimal (for the number configured by the factory default setting shown above)

$$\begin{aligned}
 \text{Decimal} &= \text{Digit } 7 \times 2^7 + \text{Digit } 6 \times 2^6 + \text{Digit } 5 \times 2^5 + \text{Digit } 4 \times 2^4 + \text{Digit } 3 \times 2^3 + \text{Digit } 2 \times 2^2 + \text{Digit } 1 \times 2^1 \\
 &\quad + \text{Digit } 0 \times 2^0 \\
 &= \text{Digit } 7 \times 128 + \text{Digit } 6 \times 64 + \text{Digit } 5 \times 32 + \text{Digit } 4 \times 16 + \text{Digit } 3 \times 8 + \text{Digit } 2 \times 4 + \text{Digit } 1 \times 2 \\
 &\quad + \text{Digit } 0 \times 1 \\
 &= 0 \times 128 + 0 \times 64 + 0 \times 32 + 1 \times 16 + 0 \times 8 + 1 \times 4 + 1 \times 2 + 1 \times 1 \\
 &= 16 + 4 + 2 + 1 \\
 &= 23 \quad (\text{eg.: Factory default})
 \end{aligned}$$

i.e. hexadecimal value is 17H.

## 05 Motor 2 Parameters, 06 Motor 3 Parameters, 07 Motor 4 Parameters

Inverter can switch control parameters even when it is running so that a single inverter can drive four motors by switching them or turn the energy saving operation ON or OFF for the setup change (e.g., gear switching) that causes the moment of inertia of the machinery to change.

Parameters	Type	Remarks
00/01/03 group parameters etc	Motor 1	Including function parameters commonly applied to motors 1 to 4.
05 group parameters	Motor 2	
06 group parameters	Motor 3	
07 group parameters	Motor 4	

Note: This manual describes function codes applied to motor 1 only. For ones applied to motor/Parameter Switching 2 to 4 except (05. 42, 06. 42, 07. 42), refer to the corresponding function codes prepared for motor 1 in "parameters to switch" table on the next page.

<b>05. 42</b>	Motor/Parameter Switching 2 (Mode selection)	Factory default	<b>0</b>
	Setting Range	0: Motor switch (switch to the 2nd motor) 1: Parameter switch ( switch to particular 05)	
<b>06. 42</b>	Motor/Parameter Switching 3 (Mode selection)	Factory default	<b>0</b>
	Setting Range	0: Motor switch (switch to the 3rd motor) 1: Parameter switch ( switch to particular 06)	
<b>07. 42</b>	Motor/Parameter Switching 4 (Mode selection)	Factory default	<b>0</b>
	Setting Range	0: Motor switch (switch to the 4nd motor) 1: Parameter switch ( switch to particular 07)	
	Related parameters	09. 25 Automatic speed regulator switching time	

Motor/Parameter Switching 2, 3, and 4 (Mode selection) [mM2], [mM3], [mM4] The combination of digital input terminal commands [mM2], [mM3], [mM4] select motor 2, 3 and 4 and switches between the 1st, 2nd, 3rd and 4th motors as listed below, (parameter 01. 01~09 data = 12, 36, 37) When the motor is switched, the function parameter group with which the inverter drives the motor is also switched to the corresponding one. At the same time, the inverter outputs the corresponding signal from the "Motor 1 selected" signal [mSWM1] to the "Motor 4 selected" signal [mSWM4] (Function parameter 01. 20~01. 27 data = 48, 49, 50, or 51) in order to switch the external switch to that selected motor.

Input terminal command: 01. 01~01. 09			Inverter-driven motor selected (Function parameter group enabled)	Output terminal command: 01. 20~01. 25			
[mM2]	[mM3]	[mM4]		[mSWM1]	[mSWM2]	[mSWM3]	[mSWM4]
OFF	OFF	OFF	Motor 1 (Default)	ON	OFF	OFF	OFF
ON	—	—	Motor 2 (05 group parameters valid)	OFF	ON	OFF	OFF
OFF	ON	—	Motor 3 (06 group parameters valid)	OFF	OFF	ON	OFF
OFF	OFF	ON	Motor 4 (07 group parameters valid)	OFF	OFF	OFF	ON

Parameters 05. 42, 06. 42, or 07. 42 selects whether the combination of terminal commands [mM2], [mM3], and [mM4] switches the actual motors (to the 2nd, 3rd, and 4th motors) (05. 06. or 07 group parameters)



05. 42/06. 42/ 07. 42 Setting value	Parameter function	Switching is possible
0	Motor (Switch to the 2nd, 3rd or 4th motor)	Only when the inverter is stopped (all run commands are OFF).
1	Switch parameters: Switch to particular 05, 06, or 07 group parameters for energy-saving operation ON/OFF and PI change of speed control system on a same motor	Even when the inverter is running.

Note: From the point of view of signal timing, a combination of [mM2]–[mM4] must be determined at least 2 ms before the signal of a run command is established.

<b>05. 46</b>	Speed control 2 I item (integral time)	☑	Factory default	<b>0.1</b>
<b>06. 46</b>	Speed control 3 I item (integral time)	☑	Factory default	<b>0.1</b>
<b>07. 46</b>	Speed control 4 I item (integral time)	☑	Factory default	<b>0.1</b>
	Setting Range	0.001–9.999s, 999: Integral action is invalid	Unit	0.001s

☑ Confirm the parameters of Automatic Speed Regulator (ASR).

Select PI regulator or P regulator.

Set these parameters as "999" when P regulator is selected.

The parameters in the "Switch Parameters" table are switched when the motor switching is set. In addition, the parameters shown in the table "Neglected function from the 2nd motor" are the first motor only, and the second motor below is neglected.

In the case of parameter switching, the parameters of the object's "0" mark are switched on. For parameters other than objects, the parameters of the first motor are kept valid and there are no parameters that have been cancelled from the second motor.

Switch Parameters

Name	Parameter				Object of parameter switching
	1st Motor	2nd Motor	3rd Motor	4th Motor	
Maximum output frequency	00. 03	05. 01	06. 01	07. 01	
Base frequency	00. 04	05. 02	06. 02	07. 02	
Rated Voltage at Base frequency voltage	00. 05	05. 03	06. 03	07. 03	
Maximum output voltage	00. 06	05. 04	06. 04	07. 04	
Torque boost	00. 09	05. 05	06. 05	07. 05	
Electronic Thermal Overload (Protection for Motor) Select motor characteristics	00. 10	05. 06	06. 06	07. 06	
Electronic Thermal Overload (Protection for Motor) Detection level	00. 11	05. 07	06. 07	07. 07	
Electronic Thermal Overload(Protection for Motor) Thermal time constant	00. 12	05. 08	06. 08	07. 08	
DC braking starting frequency	00. 20	05. 09	06. 09	07. 09	
DC braking braking level	00. 21	05. 10	06. 10	07. 10	
DC braking braking time	00. 22	05. 11	06. 11	07. 11	
Starting frequency	00. 23	05. 12	06. 12	07. 12	
Load Selection / Auto Torque Boost / Auto Energy Saving Operation 3	00. 37	05. 13	06. 13	07. 13	○
Drive Control mode selection	00. 42	05. 14	06. 14	07. 14	
Motor (No. of poles)	03. 01	05. 15	06. 15	07. 15	
Motor rated capacity	03. 02	05. 16	06. 16	07. 16	

### Switch Parameters

Name	Parameter				Object of parameter switching
	1st Motor	2nd Motor	3rd Motor	4th Motor	
Motor rated current	03. 03	05. 17	06. 17	07. 17	
Motor auto-tuning	03. 04	05. 18	06. 18	07. 18	
Motor no-load current	03. 06	05. 20	06. 20	07. 20	
Motor %R1	03. 07	05. 21	06. 21	07. 21	
Motor %X	03. 08	05. 22	06. 22	07. 22	
Motor Slip compensation gain for (driving)	03. 09	05. 23	06. 23	07. 23	○
Motor slip compensation response time	03. 10	05. 24	06. 24	07. 24	○
Motor slip compensation gain for (braking)	03. 11	05. 25	06. 25	07. 25	○
Motor rated slip frequency	03. 12	05. 26	06. 26	07. 26	
Motor iron loss factor 1	03. 13	05. 27	06. 27	07. 27	
Motor iron loss factor 2	03. 14	05. 28	06. 28	07. 28	
Motor iron loss factor 3	03. 15	05. 29	06. 29	07. 29	
Motor magnetic saturation factor 1	03. 16	05. 30	06. 30	07. 30	
Motor magnetic saturation factor 2	03. 17	05. 31	06. 31	07. 31	
Motor magnetic saturation factor 3	03. 18	05. 32	06. 32	07. 32	
Motor magnetic saturation factor 4	03. 19	05. 33	06. 33	07. 33	
Motor magnetic saturation factor 5	03. 20	05. 34	06. 34	07. 34	
Motor magnetic saturation expansion factor a	03. 21	05. 35	06. 35	07. 35	
Motor magnetic saturation expansion factor b	03. 22	05. 36	06. 36	07. 36	
Motor magnetic saturation expansion factor c	03. 23	05. 37	06. 37	07. 37	
Slip Compensation (Operating conditions)	04. 68	05. 40	06. 40	07. 40	○
Output Current Fluctuation Damping Gain	04. 80	05. 41	06. 41	07. 41	○
Speed control (speed command filter)	09. 01	05. 43	06. 43	07. 43	○
Speed control (speed detection filter)	09. 02	05. 44	06. 44	07. 44	○
Speed control P term (gain)	09. 03	05. 45	06. 45	07. 45	○
Speed control I item (integral time )	09. 04	05. 46	06. 46	07. 46	○
Speed control output filter	09. 06	05. 48	06. 48	07. 48	○
Speed control(notch filter resonance frequency)	09. 07	05. 49	06. 49	07. 49	
Speed control (notch filter attenuation level)	09. 08	05. 50	06. 50	07. 50	
For Manufacturer to use	09. 51	09. 52	09. 53	09. 54	
Cumulative Motor run time	04. 94	05. 51	06. 51	07. 51	
Startup Counter	04. 44	05. 52	06. 52	07. 52	
Motor % X correction factor 1	03. 53	05. 53	06. 53	07. 53	
Motor % X correction factor 2	03. 54	05. 54	06. 54	07. 54	
Motor torque current under vector control	03. 55	05. 55	06. 55	07. 55	
Motor induced voltage factor under vector control	03. 56	05. 56	06. 56	07. 56	
For Manufacturer to use	03. 57	05. 57	06. 57	07. 57	

Function Codes Unavailable for the 2nd to 4th Motors

Contents	Parameter	Operation in 2nd to 4th motors
Non-linear V/f pattern	04. 50-04. 53, 04. 65, 04. 66	Invalid
Starting frequency 1 (Holding time)	00. 24	Invalid
Stop frequency (Holding time)	00. 39	Invalid
Overload early warning/Current detection	01. 34, 01. 35	Invalid
Droop control	04. 28	Invalid
UP/DOWN control(Initial frequency setting)	04. 61	Fixed at the initial setting (0 Hz)
PID control	08. 01-08. 06, 08. 08-08. 13, 08. 15-08. 19, 08. 56-08. 62, 01. 40, 01. 41, 04. 91	Invalid
Dew condensation prevention	08. 21, 00. 21, 00. 22	Invalid
Brake signal	08. 68-08. 72, 08. 95, 08. 96	Invalid
Current limiter	00. 43, 00. 44	Invalid
Rotational direction limitation	04. 08	Invalid
Pre-excitation	04. 84, 04. 85	Invalid
Maintenance Interval/ Preset Startup Count for Maintenance	04. 78, 04. 79	Invalid
NTC thermistor	04. 26, 04. 27	Invalid

■ ASR Switching Time (09. 25) data setting range: 0,000~1,000(s)


Parameter switching is possible even during operation. For example, speed control P(Gain) and I (Integral time) listed in "Switch Parameters" table can be switched.

Switching these parameters during operation may cause an abrupt change of torque and result in a mechanical shock, depending on the driving condition of the load.

To reduce such a mechanical shock, the inverter decreases the abrupt torque change using the ramp function of ASR Switching Time(09. 25).

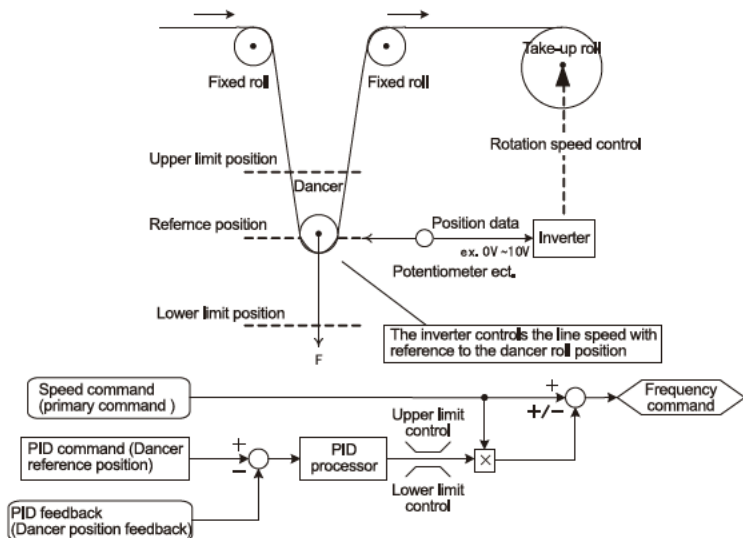
## 08 Application Function 1 Parameters

08. 01	PID control action	Factory default	0
	Setting Range	0: Invalid	
		1: PID output is normal characteristics, Process control	
		2: PID output is inverse characteristics, Process control	
		3: Speed control (Dancer control)	

 PID control, Under PID control, the inverter detects the state of a control target object with a sensor or the similar device and compares it with the commanded value. If there is any deviation between them, the PID control operates so as to minimize it. That is, it is a closed loop feedback system that matches controlled variable (feedback amount).

The PID control expands the application area of the inverter to the process control (e.g., flow control, pressure control, and temperature control) and the speed control (e.g., dancer control). If PID control is enabled (08. 01=1~3), the frequency control of the inverter is switched from the drive frequency command generator block to the PID command generator block.

<PID dancer control block diagram>



Using this parameter enables switching between normal and inverse operations against the PID control output, so you can specify an increase/decrease of the motor rotating speed to the difference or error component ( between the commanded (input) and feedback amounts), making it possible to apply the inverter to air conditioners.

Moreover, the terminal command ( [mIVS] ) can also switch operation between normal and inverse. For details about the switching of normal/inverse operation, refer to the description of Switch normal/inverse operation, refer to Parameter 01. 01~01. 09 [mIVS](data=21)

<b>08. 02</b>	<b>PID control command</b>	Factory default	<b>0</b>
---------------	----------------------------	-----------------	----------

Select the mode to set the command values for PID control.

08. 02 Setting value	Functions
0	Specify the PID command using the $\wedge$ / $\vee$ keys on the keypad.
1	PID command 1 (Analog input: terminals AVI, ACI, AUI) Voltage input to the terminal AVI (DC0~±10V, PID100% command/DC±10V) Current input to the terminal ACI (DC4~20mA, PID100% command/DC20mA) Voltage input to the terminal AUI (DC0~±10V, PID100% command/DC±10V)
3	PID Terminal command according to UP/DOWN command Using the UP or DOWN command in conjunction with PID display coefficients (specified by 01. 40 and 01. 41) with which the command value is transformed to virtual physical value etc., you can specify 0 to 100% of the PID command (±100% for PID dancer control).
4	Command via communications link Communication code (site: 0E0DH): sending the transmission data 20000d is equal to 100% of PID command.

[ 1 ] PID command with the  $\odot$ / $\ominus$  keys on the keypad (08. 02=0(factory default)  
 Using the  $\odot$ / $\ominus$  keys on the keypad in conjunction with PID display coefficients (specified by 01. 40 and 01. 41), you can specify 0 to 100% of the PID process command ( $\pm$ 100% of the PID dancer position command) in an easy-to-understand converted command format.

[ 2 ] PID command by analog inputs (08. 02 = 1)  
 When any analog input (voltage input to terminals AVI and AUI, or current input to terminal ACI) for PID command 1 (08. 02 = 1) is used, it is possible to arbitrary specify the PID command by multiplying the gain and adding the bias. The polarity can be selected and the filter time constant and offset can be adjusted. In addition to 08. 02 setting, it is necessary to select PID command 1 for analog input (specified by any of 01. 61~01. 63). For details, refer to the descriptions of 01. 61~01. 63.

Adjustable elements of PID command

Input terminal	Input range	Bias		Gain		Polarity Selection	Filter time	Compensation
		Bias	Base point	Bias	Base point			
AVI	0~+10V, -10~-+10V	02. 51	02. 52	02. 32	02. 34	02. 35	02. 33	02. 31
ACI	4~20mA			02. 37	02. 39			
AUI	0~+10V, -10~-+10V			02. 42	02. 44	02. 45	02. 43	02. 41

■ Compensation (02. 31, 02. 36, 02. 41)  
 Configures an offset for an analog voltage/current input. The offset also applies to signals sent from the external equipment.

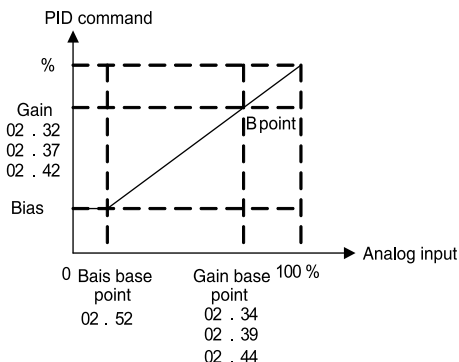
■ Filtering Time constant (02. 33, 02. 38, 02. 43)  
 Provide the filter time constants for the voltage and current of the analog input. Choose appropriate values for the time constants considering the response speed of the machinery system, as large time constants slow down the response. If the input voltage fluctuates because of noise, specify large time constants.

■ Polarity Selection (02. 35, 02. 45)  
 Specifies the input range for analog input voltage.

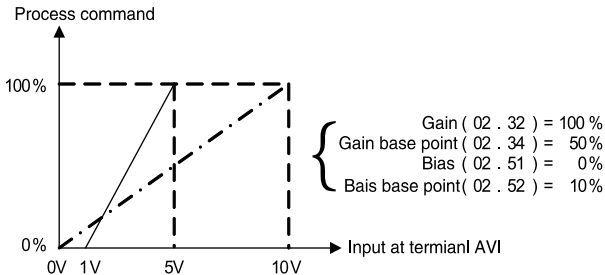
02. 35, 02. 45 Setting value	Terminal input specifications
0	-10~+10V
1	0~+10V (negative value of voltage is regarded as 0V)

Note: negative voltage input signal is only supported in 18.5kW and above power range!

■ Gain and bias



eg. The graphics of 0~100% set at 1~5V from terminal AVI



[ 3 ] PID command with UP/DOWN control (08. 02=3)

When the UP/DOWN control is selected as a PID command, turning the terminal command [mUP] or [mDOWN] ON causes the PID command to change within the range from 0 to 100%. The PID command can be specified in mnemonic physical quantities with the PID display coefficients.

To select the UP/DOWN control as a PID command, the [mUP] and [mDOWN] should be assigned to the digital input terminals. (01. 01 to 01. 09, data = 17, 18)

[mUP]	[mDOWN]	Function
data=17	data=17	
OFF	OFF	Retain PID command value.
ON	OFF	Increase PID command value at a rate between 0.1%/0.1s and 1%/0.1s.
OFF	ON	Decrease PID command value at a rate between 0.1%/0.1s and 1%/0.1s.
ON	ON	Retain PID command value.

Note: The inverter internally holds the PID command value set by the UP/DOWN control and applies the held value at the next restart (including powering ON).

[ 4 ] PID command via communications link (08. 02=4)

Communication code(site: 0E0DH): The transmission data of 20000 (decimal) is equal to 100% (maximum frequency) of the PID command.

Note: Other than the remote command selection by 08. 02, the multi-frequency 4, 8 or 12 (specified by 02. 08, 02. 12 or 02. 16, respectively) specified by terminal commands [mSS4] and [mSS8] can also be selected as a preset value for the PID command. Calculate the setting data of the PID command using the expression below.

$$\text{PID command data(\%)} = \frac{\text{Preset multi-frequency}}{\text{Max. output frequency}} \times 100$$

In dancer control (08. 01 = 3), the setting from the keypad interlocks with data of 08. 57 (PID control: Dancer reference position), and is saved as function code data.

Selecting Feedback Terminals

For feedback control, determine the connection terminal according to the type of the sensor output.

- If the sensor is a current output type, use the current input terminal ACI of the inverter.
- If the sensor is a voltage output type, use the voltage input terminal AUI of the inverter, or switch over the terminal AVI to the voltage input terminal and use it.

For details, refer to parameters 01. 61, 01. 62, 01. 63.

### PID display coefficient and monitoring

To monitor the PID command and its feedback value, set the display coefficient to convert the values into easy-to-understand mnemonic physical quantities, such as temperature.

For details, refer to function Parameters 01. 40、01. 41 on display coefficients, and to 01. 43 on monitoring.

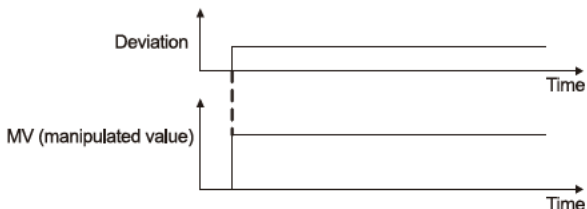
<b>08. 03</b>	PID control P term (gain)	↗	Factory default	<b>0.100</b>
	Setting Range	0.000~30.000 times	Unit	0.001

 Specifies the gain for the PID processor.

#### P(Proportional) action

An operation in which the MV (manipulated value: output frequency) is proportional to the deviation is called P action, which outputs the MV in proportion to deviation. However, the MV alone cannot eliminate deviation.

Gain is data that determines the system response level against the deviation in P action. An increase in gain speeds up response, but an excessive gain may oscillate the inverter output. A decrease in gain delays response, but it stabilizes the inverter output.



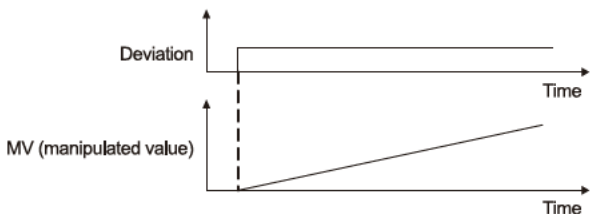
<b>08. 04</b>	PID control I item (integral time)	↗	Factory default	<b>0.5</b>
	Setting Range	0.0~3600.0s (0.0 means integral term is invalid)	Unit	0.1s

 Specifies the integral time for the PID processor.

#### I (Integral) action

An operation in which the change rate of the MV (manipulated value: output frequency) is proportional to the integral value of deviation is called I action, which outputs the MV that integrates the deviation. Therefore, I action is effective in bringing the feedback amount close to the commanded value. For the system whose deviation rapidly changes, however, this action cannot make it react quickly.

The effectiveness of I action is expressed by integral time as parameter, that is 08. 04 data. The longer the integral time, the slower the response. The reaction to the external disturbance also becomes slow. The shorter the integral time, the faster the response. Setting too short integral time, however, makes the inverter output tend to oscillate against the external disturbance.



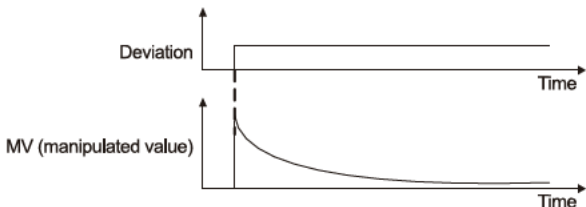
<b>08. 05</b>	PID control item D (differential time)	↗	Factory default	<b>0.00</b>
	Setting Range	0.00~600.00s (0.0 means differential term is invalid)		Unit
				0.01s

 Specifies the differential time for the PID processor.

#### D (Differential) Action

An operation in which the MV (manipulated value: output frequency) is proportional to the differential value of the deviation is called D action, which outputs the MV that differentiates the deviation. D action makes the inverter quickly react to a rapid change of deviation.

The effectiveness of D action is expressed by differential time as parameter, that is 08. 05 data. Setting a long differential time will quickly suppress oscillation caused by P action when a deviation occurs. Too long differential time makes the inverter output oscillation more. Setting short differential time will weaken the suppression effect when the deviation happens.



The combined uses of P, I, and D actions are described below.

#### (1) PI Control

PI control, which is a combination of P and I actions, is generally used to minimize the remaining deviation caused by P action. PI control always acts to minimize the deviation even if a commanded value changes or external disturbance steadily occurs. However, the longer the integral time, the slower the system response to quick-changed control. P action can be used alone for loads with very large part of integral components.

#### (2) PD Control

In PD control, the moment that a deviation occurs, the control rapidly generates greater MV (manipulated value) than that generated by D action alone, to suppress the deviation increase. When the deviation becomes small, the behavior of P action becomes small. A load including the integral component in the controlled system may oscillate due to the action of the integral component if P action alone is applied. In such a case, use PD control to reduce the oscillation caused by P action, for keeping the system stable. That is, PD control is applied to a system that does not contain any damping actions in its process.

#### (3) PID Control

PID control is implemented by combining P action with the deviation suppression of I action and the oscillation suppression of D action. PID control features minimal control deviation, high precision and high stability. In particular, PID control is effective to a system that has a long response time to the occurrence of deviation.

Follow the procedure below to set data to PID control function parameters.

It is highly recommended that you adjust the PID control value while monitoring the system response waveform with an oscilloscope or equivalent. Repeat the following procedure to determine the optimal solution for each system.

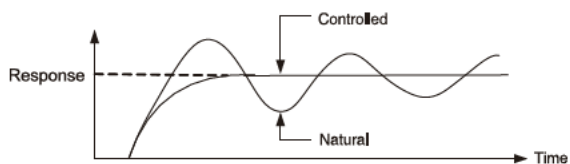
- Increase the data of 08. 03 (PID control P (Gain)) within the range where the feedback signal does not oscillate.
- Decrease the data of 08. 04 (PID control I (Integral time)) within the range where the feedback signal does not oscillate.
- Increase the data of 08. 05 (PID control D (Differential time)) within the range where the feedback signal does not oscillate.



Refining the system response waveforms is shown below.

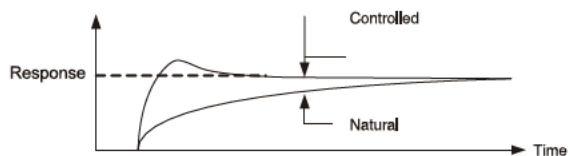
1) Suppressing overshoot

Increase the data of 08. 04 (Integral time) and decrease that of 08. 05 (Differential time).



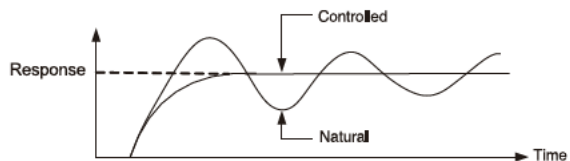
2) Quick stabilizing (moderate overshoot allowable)

Decrease the data of 08. 03 (Gain) and increase that of 08. 05 (Differential time).



3) Suppressing oscillation whose period is longer than the integral time specified by 08. 04,

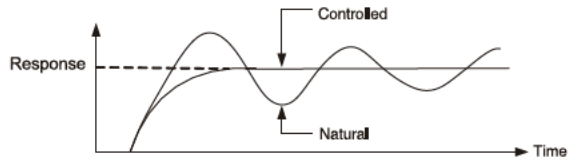
Increase the data of 08. 04 (Integral time).



4) Suppressing oscillation whose period is approximately the same as the time specified by 08. 05 (Differential time)

Decrease the data of 08. 05 (Differential time).

Decrease the data of 08. 03 (Gain), if the oscillation cannot be suppressed even though the differential time is set at 0s.



<b>08. 06</b>	PID control feedback signal filter		Factory default	<b>0.5</b>
	Setting Range	<b>0.0~900.0s</b>	Unit	0.1s

Set filtering time as constant against feedback signal of PID control. (With stable PID control role. However, it is set too large, the response will be slow.)

Note: when tension is in control, in case of needing detailed setting of constant of filtering time, please use analog input filtering time (02. 33, 02. 38 and 02. 43).

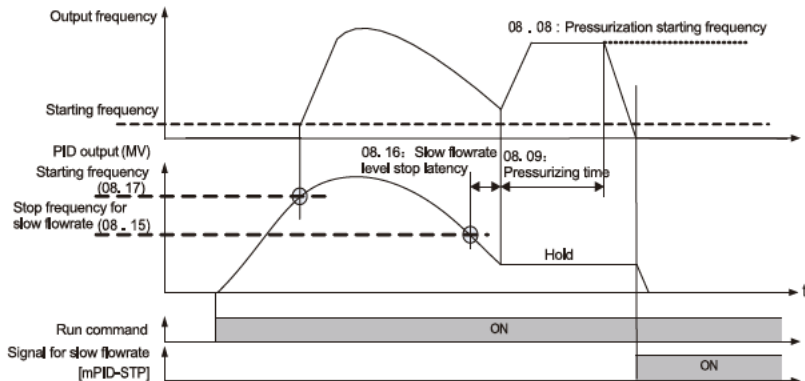
<b>08.08</b>	PID control:Pressurization starting frequency	↗	Factory default	<b>0.0</b>
	Setting Range	<b>0.0(Invalid), 1.0~500.0(Hz)</b>		Unit
				0.1Hz
<b>08.09</b>	PID control Pressurizing time	↗	Factory default	<b>0</b>
	Setting Range	<b>0~60s</b>		Unit
				1s
	Related parameters	08.15(Control Stop frequency for slow flowrate) 08.16(Control Slow flowrate level stop latency) 08.17(Control starting frequency)		

#### Pressurization before slow flowrate stopping (08.08 and 08.09)

Specifying 08.08 (Pressurization starting frequency) and 08.09 (Pressurizing time) enables pressurization control when the frequency drops below the level specified by 08.15 (Stop frequency for slow flowrate) for the period specified by 08.16. During the pressurization, the PID control is in the hold state.

This function prolongs the stopping time of equipment with a bladder tank by pressurizing immediately before the frequency drops below the level at which the inverter stops the motor, thus enabling energy saving operation. Because the pressurization starting frequency (08.08) can be specified with a parameter, pressurization setting suitable for the equipment is possible.

For the pressurization control, see the chart below.



#### Slow flowrate stopping function (08.15~08.17)

Parameter 08.15~08.17 configure the **slow flowrate stopping function** in pump control, a function that stops the inverter when the discharge pressure rises, causing the volume of water to decrease.

When the discharge pressure has increased, decreasing the reference frequency (output of the PID processor) below the stop frequency for slow flowrate level (08.15) for the period of slow flowrate level stop latency (08.16), the inverter decelerates to stop, while PID control itself continues to operate. When the discharge pressure decreases, increasing the reference frequency (output of the PID processor) above the starting frequency (08.17), the inverter resumes operation.

■ PID control (Stop frequency for slow flowrate)( 08.15) data setting range: 0.0 (Invalid), 1.0~500.0(Hz)

Specifies the frequency which triggers slow flowrate stop of inverter.

■ PID control (Slow flowrate level stop latency) (08.16) data setting range:0~60(s)

Specifies the period from when the PID output drops below the frequency specified by 08.15 until the inverter starts deceleration to stop.

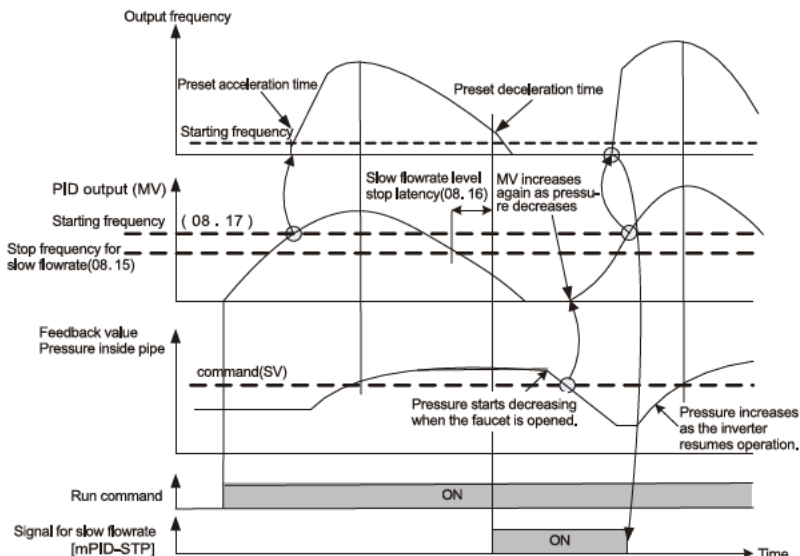
■ **PID control (Starting frequency) (08.17)** data setting range: 0.0~500.0(Hz)

Specifies the starting frequency. Set 08.17 to a frequency higher than the stop frequency for slow flowrate (08.15). If the specified starting frequency is lower than the stop frequency for slow flowrate, the latter stop frequency is ignored; the slow flowrate stopping function is triggered when the output of the PID processor drops below the specified starting frequency.

■ **Assignment of [mPID-STP] ("Motor stopped due to slow flowrate under PID control")** (parameter 01.20~01.24, 01.27 data=44)

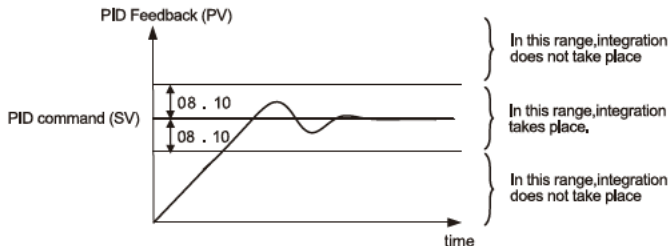
Assigning the digital output signal [mPID-STP] to any of the programmable, output terminals with any of 01.20 to 01.24 and 01.27 (data=44) enables the signal to output when the inverter stops due to the slow flowrate stopping function under PID control.

For the slow flowrate stopping function, see the chart below.




<b>08.10</b>	<b>PID control anti-integral windup level</b>		Factory default	<b>200</b>
	Setting Range	<b>0~200%</b>	Unit	<b>1%</b>

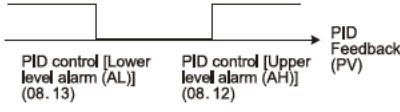
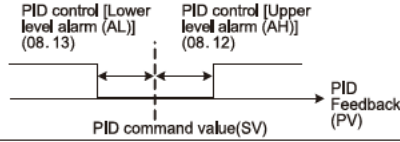
Suppresses overshoot in control with the PID processor. As long as the deviation between the feedback and the PID command is beyond the preset range, the integrator holds its value and does not perform integration operation.




<b>08. 11</b>	PID control Select alarm output	↗	Factory default	<b>0</b>
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 The inverter can output two types of alarm signals (absolute-value and deviation alarms) associated with PID control if the digital output signal [mPID-ALM] is assigned to any of the programmable, output terminals with any of 01. 20 to 01. 24 and 01. 27 (data = 42).


This parameter specifies the alarm output types, one of the following alarms available.

08. 11 Setting value	Alarm	Description
0	Absolute-value alarm	<p>[mPID-ALM] is ON , When <math>PV &lt; AL</math> or <math>AH &lt; PV</math></p>  <p>PID control [Lower level alarm (AL)] (08. 13)      PID control [Upper level alarm (AH)] (08. 12)      PID Feedback (PV)</p>
1	Absolute-value alarm (with Hold )	Same as above (with Hold )
2	Absolute-value alarm (with Latch)	Same as above (with Latch)
3	Absolute value alarm(with Hold and Latch)	Same as above (with Hold and Latch)
4	Deviation alarm	<p>[mPID-ALM] is ON, when <math>PV &lt; SV-AL</math> or <math>SV+AH &lt; PV</math></p>  <p>PID control [Lower level alarm (AL)] (08. 13)      PID control [Upper level alarm (AH)] (08. 12)      PID Feedback (PV)</p> <p>PID command value(SV)</p>
5	deviation alarm(with Hold)	Same as above (with Hold )
6	deviation alarm(with Latch)	Same as above (with Latch)
7	deviation alarm (with Hold n and Latch)	Same as above (with Hold and Latch)

**Hold:** During the power-on sequence, the alarm output is kept OFF (disabled) even when the monitored quantity is within the alarm range. Once it goes out of the alarm range, and comes into the alarm range again, the alarm is enabled.

**Latch:** Once the monitored quantity comes into the alarm range and the alarm is turned ON, the alarm will remain ON even if it goes out of the alarm range. To release the latch, perform a reset by using the  key or turning the terminal command [mRST]. Resetting can be done by the same way as resetting an alarm.

<b>08. 12</b>	PID control Upper level alarm (AH)	↗	Factory default	<b>100</b>
<b>08. 13</b>	PID control Lower level alarm (AL)	↗	Factory default	<b>0</b>
	Setting Range	-100%~100%	Unit	1%

 Specifies the upper limit of the alarm (AH) and lower limit of the alarm (AL) in percentage (%) of the feedback amount.

**Note:** The value displayed (%) is the ratio of the upper/lower limit to the full scale (10V or 20 mA) of the feedback amount (in the case of a gain of 100%).

Upper level alarm (AH) and lower level alarm (AL) also apply to the following alarms:

Alarm	Description	Methods	
		Select alarm output (08.11)	Parameter setting
Upper limit(absolute)	ON if AH<PV	Absolute-value alarm	AL = 0
Lower limit(absolute)	ON if PV<AL		AH = 100%
Upper limit (deviation)	ON if SV+AH<PV	Deviation alarm	AL = 100%
Lower limit (deviation)	ON if PV<SV-AL		AH = 100%
Upper/lower limit (deviation)	ON if  SV-PV >AL		AL = AH
Upper/lower range limit (deviation)	ON if SV-AL<PV<SV+AH	Deviation alarm	A negative logic signal should be assigned to [mPID-ALM]
Upper/lower range limit (absolute)	ON if AL<PV<AH	Absolute-value alarm	
Upper/lower range limit (deviation)	ON if SV-AL<PV<SV+AH	Deviation alarm	

<b>08.15</b>	PID control Stop frequency for slow flowrate (refer to 08.08)	↗	Factory default	<b>0.0</b>
	Setting Range	0.0(Invalid); 1.0~500.0Hz	Unit	0.1Hz
<b>08.16</b>	PID control Slow flowrate level stop latency (refer to 08.08)	↗	Factory default	<b>30</b>
	Setting Range	<b>0~60s</b>	Unit	1s
<b>08.17</b>	PID control starting frequency (refer to 08.08)	↗	Factory default	<b>0.0</b>
	Setting Range	<b>0.0~500.0Hz</b>	Unit	0.1Hz

<b>08.18</b>	PID control: Upper limit of PID process output	↗	Factory default	<b>999</b>
<b>08.19</b>	PID control: Lower limit of PID process output	↗	Factory default	<b>999</b>
	Setting Range	-150%~150%; 999(Depends on setting of 00.15)	Unit	1%

☞ Specifies the upper limit of the PID processor output limiter in %. If you specify "999", the setting of the frequency limiter (High) (00.15) and limiter (Low) (00.16) will serve as the upper and lower limit.

The upper and lower limiters can be specified to the PID output, exclusively used for PID control. The settings are ignored when PID cancel is enabled and the inverter is operated at the reference frequency previously specified. (parameter 01.01-01.09 data=20)

<b>08.21</b>	Dew Condensation Prevention ( duty cycle )	↗	Factory default	<b>1</b>
	Setting Range	<b>1~50%</b>		

☞ When the inverter is stopped, dew condensation on the motor can be prevented, by feeding DC power to the motor at regular intervals to keep the temperature of the motor above a certain level.

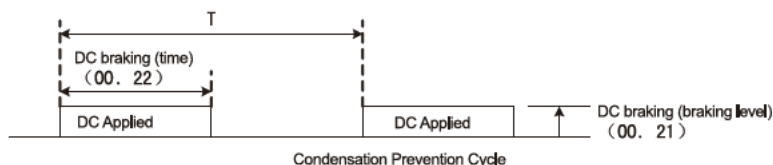
#### ■ Enabling Dew Condensation Prevention

To utilize this feature, you need to assign the terminal command [mDWP] ("Protect motor from dew condensation") to one of the general-purpose digital input terminals. (Parameter 01.01-01.09 data = 39)

#### ■ Dew Condensation Prevention (Duty) (08. 21)

The magnitude of the DC power applied to the motor is the same as the setting of 00. 21 (DC braking 1, Braking level) and its duration of each interval is the same as the setting of 00. 22 (DC braking 1, Braking time). Interval T is determined so that the ratio of the duration of the DC power to T is the value (Duty) set for 08. 21.

$$\text{Duty for condensation prevention}(08. 21) = \frac{\text{DC braking (time)}(00. 22)}{T} \times 100\%$$



<b>08. 22</b>	Commercial Power Switching Sequence (refer to 01. 01-01. 09)	Factory default	<b>0</b>
	Setting Range	0: Keep inverter operation (Stop due to alarm) 1: Automatically switch to commercial-power operation	

<b>08. 56</b>	PID control speed command filter		Factory default	<b>0.10</b>
	Setting Range	<b>0.00~5.00s</b>	Unit	0.01s

<b>08. 57</b>	PID control Dancer reference position		Factory default	<b>0</b>
	Setting Range	<b>-100~0~100%</b>	Unit	1%

Specifies the dancer reference position in the range of -100% to +100% for dancer control. If 08. 02 = 0 (keypad), this function parameter is enabled as the dancer reference position. It is also possible to modify the PID command with the  $\odot$  /  $\ominus$  keys. If it is modified, the new command value is saved as 08. 57 data.

<b>08. 58</b>	PID control Detection width of dancer position deviation		Factory default	<b>0</b>
	Setting Range	0: invalid PID constant switching 1~100%: Manual set value	Unit	1%

Specifies the bandwidth in the range of 1 to 100%. Specifying "0" does not switch PID constants.

The moment the feedback value of dancer roll position comes into the range of "the dancer reference position  $\pm$  detection width of dancer position deviation (08. 58)", the inverter switches PID constants from the combination of 08. 03, 08. 04 and 08. 05 to that of 08. 59, 08. 60 and 08. 61, respectively in its PID processor. Giving a boost to the system response by raising the P gain may improve the system performance in the dancer roll positioning accuracy.

<b>08. 59</b>	PID control P term (gain) 2 (refer to 08. 03~08. 05)		Factory default	<b>0.100</b>
	Setting Range	<b>0.000~30.000 times</b>	Unit	0.001

<b>08. 60</b>	PID control I item (integral time) 2 (refer to 08. 03-08. 05)	↗	Factory default	<b>0.00</b>
	Setting Range	0.00~3600.0s		Unit
				0.1s
<b>08. 61</b>	PID control item D (differential time) 2 (refer to 08. 03-08. 05)	↗	Factory default	<b>0.00</b>
	Setting Range	0.00~600.00s		Unit
				0.01s


📖 Descriptions for 08. 59, 08. 60, and 08. 61 are the same as those of PID control P (Gain) (08. 03), I(Integral time) (08. 04), and D(Differential time) (08. 05), respectively.

<b>08. 62</b>	PID control block selection	Factory default	<b>0</b>
	Setting Range	0~3	
		Bit 0: PID output polarity; 0 = plus(add); 1 = minus(subtract)	
		Bit 1: Select compensation factor for PID output 0 = Ratio (relative to the main setting) 1 = Speed command (relative to maximum frequency)	

📖 08. 62 allows you to select either adding or subtracting the PID dancer processor output to or from the primary speed command. Also, it allows you to select either controlling the PID dancer processor output by the ratio (%) against the primary speed command or compensating the primary speed command by the absolute value (Hz).

08. 62 Data			Control function	
10 Decimal	Bit 1	Bit 0	Control value type	Operation for the primary speed command
0	0	0	Absolute value (Hz)	Addition
1	0	1	Absolute value (Hz)	Subtraction
2	1	0	Ratio (%)	Addition
3	1	1	Ratio (%)	Subtraction

<b>08. 68</b>	Brake signal Brake-OFF current	↗	Factory default	<b>100</b>
	Setting Range	0~300%		Unit
<b>08. 69</b>	Brake signal Brake-OFF frequency/speed	↗	Factory default	<b>1.0</b>
	Setting Range	0.0~25.0Hz		Unit
				0.1Hz
<b>08. 70</b>	Brake signal Brake-OFF timer	↗	Factory default	<b>1.0</b>
	Setting Range	0.0~5.0s		Unit
				0.1s
<b>08. 71</b>	Brake signal Brake-ON frequency/speed	↗	Factory default	<b>1.0</b>
	Setting Range	0.0~25.0Hz		Unit
				0.1Hz
<b>08. 72</b>	Brake signal Brake-ON timer	↗	Factory default	<b>1.0</b>
	Setting Range	0.0~5.0s		Unit
				0.1s
<b>08. 95</b>	Brake signal Brake-OFF torque	↗	Factory default	<b>100</b>
	Setting Range	0~300%		Unit
				1%

<b>08. 96</b>	Brake signal Speed condition selection		Factory default	<b>0</b>
	Setting Range	0~31		
		Bit 0: Criterion speed for brake-ON (0: speed detection value 1: reference speed)		
		Bit 1: Reserved		
		Bit 2: Response for brake-OFF current (0: Slow response 1: Quick response )		
		Bit 3: Criterion frequency for brake-ON (0: Stop frequency 1: Brake-ON frequency )		
	Bit 4: Output condition of brake signal(0: operation command OFF is invalid, Independent of a run command ON/OFF)			

These function parameters are for the brake releasing/turning-on signals of vertical carrier machines.

It is possible to set the conditions of the brake releasing/turning-on signals (current, frequency or torque) so that a hoisted load does not fall down at the start or stop of the operation, or so that the load applied to the brake is reduced.

■ Brake signal [mBRKS] (parameter 01. 20~01. 24, 01. 27 Data = 57)

This signal outputs a brake control command that releases or activates the brake.

Releasing the Brake

When any of the inverter output current, output frequency, or torque command value exceeds the specified level of the brake signal (08. 68/08. 69/08. 95) for the period specified by 08. 70 (Brake signal (Brake-OFF timer)), the inverter judges that required motor torque is generated and turns the signal [mBRKS] for releasing the brake.

This prevents a hoisted load from falling down due to an insufficient torque when the brake is released.

Parameter	Name	Setting Range	Remark
08. 68	Brake-OFF current	0~300%: Set it putting the inverter rated current at 100%.	Refer to Note below.
08. 69	Brake-OFF frequency/speed	0.0~25.0Hz	Available only under V/f control.
08. 70	Brake-OFF timer	0.0~5.0s	
08. 95	Brake-OFF torque	0~300%	Available only under vector control.
08. 96	Speed condition selection	Response for brake-OFF current (Bit 2) 0: Slow response (default) 1: Quick response	Specifies the response type for brake-OFF current detection. Selecting slow response inserts a detection filter into the current detection circuit so that the brake-OFF timing will be slightly behind the rising edge of the actual current. If the delay is not negligible with adjustments, select quick response.

Note: The inverter rated current differs depending upon the drive mode selected (G/P).

Turning the Brake ON

When the run command is OFF and the output frequency drops below the level specified by 08. 71 (Brake signal (Brake-ON frequency/speed) ) and stays below the level for the period specified by 08. 72 (Brake signal (Brake-ON timer) ), the inverter judges that the motor rotation is below a certain level and turns the signal [mBRKS] OFF for activating the brake.

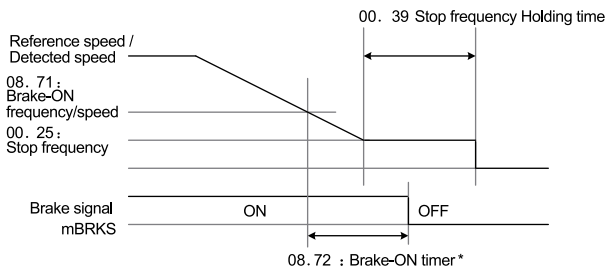
Under vector control, when the reference speed or the detected one drops below the level of the brake-ON frequency (specified by bit 3 of 08. 96) and stays below the level for the period specified by 08. 72 (Brake signal (Brake-ON timer)), the inverter judges that the motor rotation is below a certain level and turns the signal [mBRKS] OFF for activating the brake.

By this operation, it can reduce the burden of the brake in running, and be valid to extend the effective life of the brake.



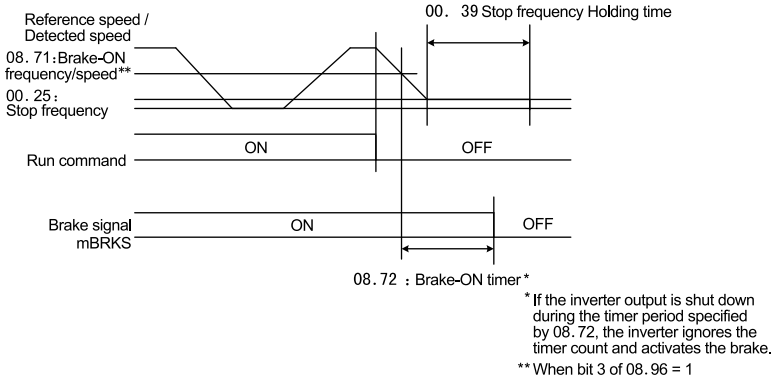
Parameter	Name	Setting Range	Remark
08. 71	Brake-ON frequency/speed	0.0~5.0s	Available when using V/f control
08. 72	Brake-ON timer	0.0~25.0Hz	
08. 96	Speed condition selection	Criteria of speed condition for brake-ON (Bit 0) 0: Detected speed 1: Reference speed	Available when using vector control. Specifies the criteria of speed to be used for brake-ON condition. When "Vector control without speedsensor" is selected, specify "Reference speed" (Bit 0 = 1).
		Criteria of frequency for brake-ON (Bit 3) 0: Stop frequency (00. 25) 1: Brake-ON frequency (08. 71)	Available when using vector control. Specifies the criteria of frequency to be used for brake-ON timing. If "Detected speed" and "Stop frequency" are selected (Bit 0 = 0 and Bit 3 = 0) to determine brake-ON timing, the brake may be applied after running at the stop frequency (00. 25) due to a speed error. If it is required that brake is applied during running at the stop frequency, select "Brake-ON frequency" (Bit 3 = 1) as criteria of frequency. When jogging or inching the motor for vertical conveyance, use 08. 71 as brake-ON frequency.
		Turn-on condition of brake signal (Bit 4) 0: Independent of a run command ON/OFF 1: Only when a run command is OFF	Available when using vector control. Specifies whether to turn on a brake signal independent of a run command ON/OFF or only when a run command is OFF. When normal and reverse operations are switched, brake-ON conditions may be met in the vicinity of zero speed. For such a case, select "Only when a run command is OFF" (Bit 4 = 1).

- Operation time chart when Criteria of frequency for brake-ON (Bit 3) = 1 (Brake-ON frequency)



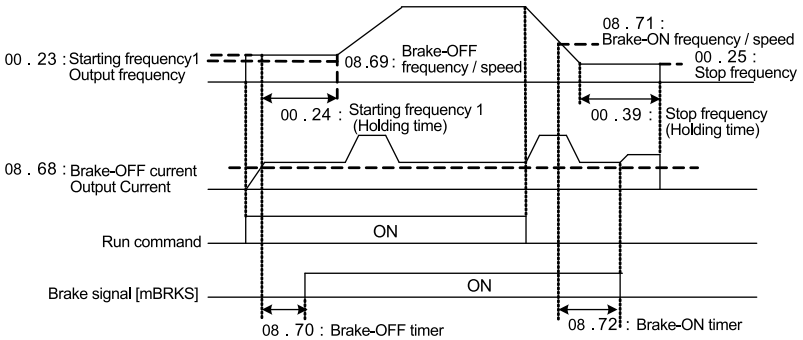
\* If the inverter output is shut down during the timer period specified by 08. 72, the inverter ignores the timer count and activates the brake.

- Operation time chart when Turn-on condition of brake signal (Bit 4) = 1 (Only when a run command is OFF)



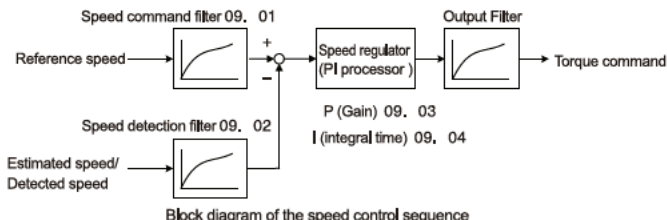
- Note:
- The brake signal control is only applicable to the 1st motor. If the motor switching function selects any of the 2nd to 4th motors, the brake signal remains ON.
  - If the inverter is shut down due to an occurrence of alarm state or by the command ("Coast to a stop"), the brake signal is immediately turned ON.

- Operation time chart



## 09 Application Function 2 Parameters

These function parameters control the speed control sequence for normal operations. For application of each function parameters of 09.01, 09.02, 09.03, 09.04 and 09.06, refer to the diagram below and the subsequent descriptions.



<b>09.01</b>	Speed control 1 Speed command filter		Factory default	<b>0.020</b>
	Setting Range	<b>0.000~5.000s</b>	Unit	0.001s

- Specifies a time constant determining the first order delay of the speed command filter. Modify this data when an excessive overshoot occurs against the change of the reference speed. Increasing the filter time constant stabilizes the reference speed and reduces overshoot against the change of the reference speed, but it slows the response speed of the inverter.

<b>09.02</b>	Speed control 1 Speed detection filter		Factory default	<b>0.005</b>
	Setting Range	<b>0.000~0.100s</b>	Unit	0.001s

- Specifies a time constant determining the first order delay of the speed detection filter. Modify this data when the control target (machinery) is oscillatory due to deflection of a drive belt or other causes so that ripples (oscillatory components) are superimposed on the detected speed, causing hunting (undesirable oscillation of the system) and blocking the PI processor gain from increasing (resulting in a slow response speed of the inverter). In addition, if the lower encoder resolution makes the system oscillatory, try to modify this data. Increasing the time constant stabilizes the detected speed and raises the PI processor gain even with ripples superimposed on the detected speed. However, the speed detection itself delays, resulting in a slower speed response, larger overshoot, or hunting.

<b>09.03</b>	Speed control 1 P item (gain)		Factory default	<b>10.0</b>
	Setting Range	<b>0.1~200.0 times</b>	Unit	0.1
<b>09.04</b>	Speed control 1 I item (integral time)		Factory default	<b>0.100</b>
	Setting Range	0.001~9.999s, 999: Integral action is invalid	Unit	0.001s

- Specify the gain and integral time of the speed regulator (PI processor), respectively. To determine the parameters for automatic speed regulator (ASR). Any one of PI processor and P regulator can be selected. When P regulator is selected, set the parameters to be "999".

### ◇ P gain

Definition of "P gain = 1.0" is that the torque command is 100% (100% torque output of each inverter capacity) when the speed deviation (reference speed – detected speed) is 100% (equivalent to the maximum speed).

Determine the P gain according to moment of inertia of machinery loaded to the motor output shaft. Larger moment of inertia needs larger P gain to keep the flat response in whole operations. Specifying a larger P gain improves the quickness of control response, but may cause a motor speed overshooting or hunting (undesirable oscillation of the system). Moreover, mechanical resonance or vibration sound on the machine or motor could happen due to excessively amplified noises. If it happens, decreasing P gain will reduce the amplitude of the resonance/vibration. A too small P gain results in a slow inverter response and a speed fluctuation in low frequency, which may prolong the time required for stabilizing the motor speed.

◇ Integral time



Specifying a shorter integral time shortens the time needed to compensate the speed deviation, resulting in quick response in speed. Specify a short integral time if quick arrival to the target speed is necessary and a slight overshooting in the control is allowed; specify a long time if any overshooting is not allowed and taking longer time is allowed.


If a mechanical resonance happens and the motor or gears sound abnormally, setting a longer integral time can transfer the resonance point to the low frequency zone and suppress the resonance in the high frequency zone.

<b>09.06</b>	Speed control 1 output filter		Factory default	<b>0.002</b>
	Setting Range	<b>0.000~0.100s</b>	Unit	0.001s

 Specifies the time constant for the first order delay of the speed controller output filter.

Use 09.06 when even adjusting the P gain or integral time cannot suppress mechanical resonance such as hunting or vibration. Generally, setting a larger value to the time constant of the output filter decreases the amplitude of resonance; however, a too large time constant may make the system unstable.

<b>09.07</b>	Speed control 1 notch filter resonance frequency		Factory default	<b>200</b>
	Setting Range	<b>1~200Hz</b>	Unit	1Hz
	Related parameters	05. 49, 06. 49, 07. 49 Speed control 2~4 (notch filter resonance frequency)		
<b>09.08</b>	Speed control 1 notch filter attenuation level		Factory default	<b>0</b>
	Setting Range	<b>0~20dB</b>	Unit	1dB
	Related parameters	05. 50, 06. 50, 07. 50 Speed control 2~4 (notch filter attenuation level)		

 The notch filters make it possible to decrease the speed loop gain only in the vicinity of the predetermined resonance points, suppressing the mechanical resonance.

The notch filters are available only under "vector control with speed sensor".

Setting the speed loop gain at a high level in order to obtain quicker speed response may cause mechanical resonance.

If it happens, decreasing the speed loop gain is required to slow the speed response as a whole. In such a case, using the notch filters makes it possible to decrease the speed loop gain only in the vicinity of the predetermined resonance points and set the speed loop gain at a high level in other resonance points, enabling a quicker speed response as a whole.

The following four types of notch filters can be specified.




	Parameter	Name	Setting Range	Unit	Default setting
Notch filter time 1	09. 07	Speed control 1 (Notch filter resonance frequency)	1~200	Hz	200
	09. 08	Speed control 1(Notch filter attenuation level)	0~20	dB	0(Invalid)



The following four types of notch filters can be specified.


	Parameter	Name	Setting Range	Unit	Default setting
Notch filter time 2	05. 49	Speed control 2 (Notch filter resonance frequency)	1~200	Hz	200
	05. 50	Speed control 2(Notch filter attenuation level)	0~20	dB	0(Invalid)
Notch filter time 3	06. 49	Speed control 3 (Notch filter resonance frequency)	1~200	Hz	200
	06. 50	Speed control 3(Notch filter attenuation level)	0~20	dB	0(Invalid)
Notch filter time 4	07. 49	Speed control 4 (Notch filter resonance frequency)	1~200	Hz	200
	07. 50	Speed control 4(Notch filter attenuation level)	0~20	dB	0(Invalid)

Setting the notch filter attenuation level to "0" (dB) disables the corresponding notch filter. (dB). It is possible to apply all of the four notch filters to the 1st motor or apply each notch filter to each of the 1st to 4th motors.

Requisite for use of notch filters	Notch filter time1	Notch filter time2	Notch filter time3	Notch filter time4
		09. 07. 09. 08	05. 49. 05. 50	06. 49. 06. 50
[mM2],[mM3], and [mM4] ("Select motor 2, 3, and 4") are not in use. (01. 01~01. 09, 01. 98, 01. 99≠12, 36, 37)	All of the four notch filters apply to the 1st motor.			
All of the three "Motor/Parameter Switching" items are set to "Parameters." (05. 42. 06. 42, 07. 42=1)	All of the four notch filters apply to the 1st motor.			
Other than the above	1st Motor	2nd Motor	3rd Motor	4th Motor

<b>09. 09</b>	Speed control (JOG) Speed command filter (refer to 09. 01)		Factory default	<b>0.002</b>
	Setting Range	<b>0.000~5.000s</b>	Unit	0.001s
<b>09. 10</b>	Speed control (JOG) Speed detection filter (refer to 09. 01)		Factory default	<b>0.005</b>
	Setting Range	<b>0.000~0.100s</b>	Unit	0.001s
<b>09. 11</b>	Speed control (JOG) P item (gain) (refer to 09. 01)			<b>10.0</b>
	Setting Range	<b>0.1~200.0 times</b>	Unit	0.1

<b>09. 12</b>	Speed control (JOG) I item (integral time) (refer to 09. 01)		Factory default	<b>0.100</b>
	Setting Range	0.001~9.999s, 999: Integral action is invalid	Unit	0.001s
<b>09. 13</b>	Speed control (JOG) output filter (refer to 09. 01)		Factory default	<b>0.002</b>
	Setting Range	<b>0.000~0.100s</b>	Unit	0.001s



 To determine the parameters for automatic speed regulator (ASR). Any one of PI processor and P regulator can be selected.

When P regulator is selected, set the parameters to be "999" . Control the speed control sequence for jogging operations.

The block diagrams and function codes related to jogging operations are the same as for normal operations.

Since this speed control sequence is exclusive to jogging operations, specify these function codes to obtain higher speed response than that of normal operations for smooth jogging operations.

For details, refer to the corresponding descriptions (parameter 09. 01~09. 04, 09. 06) about the speed control sequence for normal operations.

<b>09. 21</b>	Speed Agreement (Hysteresis width and Detection timer)		Factory default	<b>10.0</b>
	Setting Range	0.0~50.0%, Maximum speed / 100%		Unit
				0.1%
<b>09. 22</b>	Speed Agreement Detection timer (refer to 00. 14)		Factory default	<b>0.50</b>
	Setting Range	0.00~10.00s		Unit
				0.01s
<b>09. 23</b>	Speed Error Processing (refer to 00. 14)			<b>2</b>
	Setting Range	0: Continue to run		
		1: Stop running with alarm 1		
		2: Stop running with alarm 2		
		3: Continue to run 2		
		4: Stop running with alarm 3		
		5: Stop running with alarm 4		

Note: this application features, only for vector control mode of the 18.5kW and above power range.

 Specify the detection levels of the speed agreement signal [mDSAG].

Speed agreement signal [mDSAG] (parameter 01. 20~01. 24, 01. 27 data=71)

If the speed regulator's deviation (between the reference speed and detected one) is within the specified range (09. 21), the signal [mDSAG] turns ON. If the deviation is out of the specified range (09. 21) for the specified period (09. 22), the signal turns OFF. This signal allows the user to check whether the speed regulator works properly or not.

Speed error detected signal [mPG-ERR] (parameter 01. 20~01. 24, 01. 27 data=76)

If the speed regulator's deviation (between the reference speed and detected one) is out of the specified range (09. 21) for the specified period (09. 22), the inverter judges it as a speed error. 09. 23 defines the detection condition (and exception), processing after error detection, and hysteresis width as listed below.

09. 23 Setting value	Detection condition (and exception)	Processing after error detection	Speed command >00. 04 Hysteresis width for error detection
0	When the inverter cannot follow the reference speed (even after soft-starting) due to a heavy overload or similar, so that the detected speed is less than the reference speed, the inverter does not interpret this situation as a speed error.	The inverter outputs the speed error detected signal [mPG-ERR] and continues to run.	If the speed command is below the base frequency (00. 04), detection width = 09. 21, which is constant. If it is above the base frequency, detection width = 09. 21 * Speed command / Base frequency (00. 04)
1		The inverter initiates a motor coast to stop, with the ErE alarm.	
2	No exception.		
3	When the inverter cannot follow the reference speed (even after soft-starting) due to a heavy overload or similar, so that the detected speed is less than the reference speed, the inverter does not interpret this situation as a speed error.	The inverter outputs the speed error detected signal [mPG-ERR] and continues to run.	
4		The inverter initiates a motor coast to stop, with the ErE alarm.	
5	No exception.		

Note: Enabling an operation limiting function such as the torque limit and droop control will increase the deviation caused by a huge gap between the reference speed and detected one. In this case, the inverter may alarm interpreting this situation as a speed error, depending on the running state. To avoid this incident, set the 09. 23 data to "0" (continue to run) to prevent the inverter from alarm even if any of those limiting functions is activated.

<b>09. 25</b>	Automatic speed regulator switching time (refer to 05. 42)	↗	Factory default	<b>0,000</b>
	Setting Range	0,000~1,000s		Unit
			Unit	0,001s

<b>09. 32</b>	Torque control speed limit 1 (refer to 04. 18)	↗	Factory default	<b>100</b>
<b>09. 33</b>	Torque control speed limit 2 (refer to 04. 18)	↗	Factory default	<b>100</b>
	Setting Range	0~110%		Unit
			Unit	1%

<b>09. 35</b>	Overspeed detection level	↗	Factory default	<b>999</b>
	Setting Range	0~120% 999: based on 09. 33 to 09. 32 or parameter values		Unit
			Unit	1%

09.35 Specifies the overspeed detection level under torque control by percentage of the max. frequency. Set according to the corresponding percentage of the Max. output frequency (00. 03, 05. 01, 06. 01, 07. 01).

If the following condition is satisfied, the inverter detects an overspeed state and issues an overspeed alarm OS.

Motor speed  $\geq$  Max. frequency (00. 03/05. 01/06. 01/07. 01)  $\times$  09. 35

Setting d35 data to "999" causes the inverter to issue an overspeed alarm OS if either of the following conventional conditions is satisfied.

Motor speed  $\geq$  Max. frequency (00. 03/05. 01/06. 01/07. 01)  $\times$  (09. 32 or 09. 33)  $\times$  1.2

Or

Motor speed  $\geq$  120Hz (vector control without speed sensor)  $\times$  (09. 32 or 09. 33)  $\times$  1.2

Note: Torque/Torque current command

It is possible to command torque/torque current from an analog voltage input (terminal (AVI) or AUI) or analog current input terminals (ACI).

To use the analog voltage/current input, function parameters 01. 61 (terminal AVI), 01. 62 (terminal ACI) and 01. 63 (terminal AUI) should be set to 10 or 11 as shown in the table below.)


Input	Command form	Parameter	Setting specifications (Factory default)
Terminal[AVI] (-10V~10V)	Torque command	01. 61=10	Motor rated torque $\pm$ 100%/ $\pm$ 10V
	Torque current command	01. 61=11	Motor rated torque current $\pm$ 100%/ $\pm$ 10V
Terminal[AUI] (-10V~10V)	Torque command	01. 63=10	Motor rated torque $\pm$ 100%/ $\pm$ 10V
	Torque current command	01. 63=11	Motor rated torque current $\pm$ 100%/ $\pm$ 10V
Terminal[ACI] 0,4~20mA	Torque command	01. 62=10	Motor rated torque 100%/ $\pm$ 20mA
	Torque current command	01. 62=11	Motor rated torque current 100%/ $\pm$ 20mA

Function parameters 02. 31 to 02. 45 (Analog input adjustment) are applied to these analog inputs.

Speed limiter

The response of the speed limiter can be adjusted by using P gain and Integral time of the speed control as listed below.

Selected motor	Parameter	
	P gain	Integral time
M1	09. 03	09. 04
M2	05. 45	05. 46
M3	06. 45	06. 46
M4	07. 45	07. 46

<b>09. 61</b>	Command filter time constant (refer to 00. 01)		Factory default	<b>0.005</b>
	Setting Range	<b>00.000~5.000s</b>	Unit	0.001s
<b>09. 62</b>	Command pulse count factor 1 (refer to 00. 01)		Factory default	<b>1</b>
<b>09. 63</b>	Command pulse count factor 2(refer to 00. 01)		Factory default	<b>1</b>
	Setting Range	<b>1~9999</b>	Unit	1
<b>09. 67</b>	Starting Auto search Mode (refer to 04. 09)		Factory default	<b>0</b>
	Setting Range	0: Invalid		
		1: Action (At restart after momentary power failure)		
		2: Action (At restart after momentary power failure and at normal start)		

Note: this application features, only for vector control mode of the 18.5kW and above power range.

## 10 Application Function 3 Parameters

The customizable logic function allows the user to form a logic circuit for digital input/output signals, customize those signals arbitrarily, and configure a simple relay sequence inside the inverter. In a customizable logic, one step (component) is composed of "2 inputs and 1 output + logical operation (including timer) " and a total of ten steps can be used to configure a sequence.

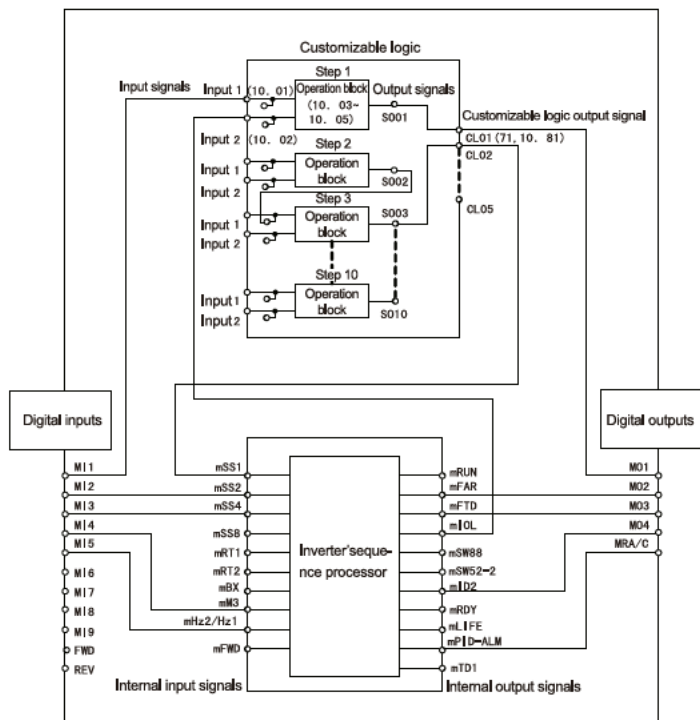
The setting values of parameters 10. 06~10. 50 are the same as that of 10. 01, 10. 02, 10. 03, 10. 04 and 10. 05.

### ■ Specifications

Item	Specifications
Input signal	Input 2
Operation block	Logical operation, counter, etc.: 13 types ,Timer: 5 types
Output signal	Output 1
Number of steps	Ten steps
Customizable logic output signal	Output 5
Customizable logic processing time	2ms

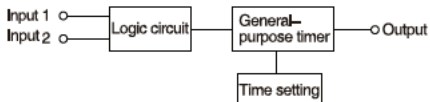


## ■ Block diagram



## ■ Customizable Logic (Setting) (10. 01~10. 50)

In a customizable logic, one step is composed of the components shown in the following block diagram.



Configuration of function parameters for each step

Step No.	Input 1	Input 2	Logic circuit	General-purpose timer	Time setting	Output
Step 1	10. 01	10. 02	10. 03	10. 04	10. 05	[mSO01]
Step 2	10. 06	10. 07	10. 08	10. 09	10. 10	[mSO02]
Step 3	10. 11	10. 12	10. 13	10. 14	10. 15	[mSO03]
Step 4	10. 16	10. 17	10. 18	10. 19	10. 20	[mSO04]
Step 5	10. 21	10. 22	10. 23	10. 24	10. 25	[mSO05]

Configuration of function parameters for each step

Step No.	Input 1	Input 2	Logic circuit	General-purpose timer	Time setting	Output
Step 6	10. 26	10. 27	10. 28	10. 29	10. 30	[mSO06]
Step 7	10. 31	10. 32	10. 33	10. 34	10. 35	[mSO07]
Step 8	10. 36	10. 37	10. 38	10. 39	10. 40	[mSO08]
Step 9	10. 41	10. 42	10. 43	10. 44	10. 45	[mSO09]
Step 10	10. 46	10. 47	10. 48	10. 49	10. 50	[mSO10]

<b>10. 00</b>	Customizable Logic (Mode selection)		Factory default	<b>0</b>
	Setting Range	0: Invalid 1: Valid Action (Customizable logic operation)		Unit

 Specifies whether to enable the sequence configured with the customizable logic function.

<b>10. 01</b>	Customizable Logic: (Input 1) step 1	Factory default	<b>0</b>
<b>10. 02</b>	Customizable Logic: (Input 2) step 1	Factory default	<b>0</b>

The following signals are available as input signals.

Data	Selectable Signals
0000 (1000) ~ 0105(1105)	General-purpose output signals (same as the ones specified by 01.20,[mRUN] (Inverter running), [mFAR] frequency (Frequency (speed) arrival signal), [mFDT] (frequency (speed) detected), [mLU] (Undervoltage detected (Inverter stopped)), [mB/D] (torque polarity detected) etc.) Note: 27 [Universal DO] is not available, cannot be selected.
2001(3001)	Output of step 1[mSO01]
2002(3002)	Output of step 2[mSO02]
2003(3003)	Output of step 3[mSO03]
2004(3004)	Output of step 4[mSO04]
2005(3005)	Output of step 5[mSO05]
2006(3006)	Output of step 6[mSO06]
2007(3007)	Output of step 7[mSO07]
2008(3008)	Output of step 8[mSO08]
2009(3009)	Output of step 9[mSO09]
2010(3010)	Output of step 10[mSO10]
4001(5001)	MI1 terminal input signal[mMI1]
4002(5002)	MI2 terminal input signal[mMI2]
4003(5003)	MI3 terminal input signal[mMI3]
4004(5004)	MI4 terminal input signal[mMI4]
4005(5005)	MI5 terminal input signal[mMI5]
4006(5006)	MI6 terminal input signal[mMI6]
4007(5007)	MI7 terminal input signal[mMI7]
4008(5008)	MI8 terminal input signal[mMI8]
4009(5009)	MI9 terminal input signal[mMI9]
4010(5010)	FWD terminal input signal[mFWD]

Data	Selectable Signals
4011(5011)	REV terminal input signal [ mREV ]
6000(7000)	Final run command [ mFL_RUN ]: (ON when "frequency command ≠ 0" and a run command is given)
6001(7001)	Final FWD run command [ mFL_FWD ]: (ON when "frequency command ≠ 0" and a run forward command is given)
6002(7002)	Final REV run command [ mFL_REV ]: (ON when "frequency command ≠ 0" and a run reverse command is given)
6003(7003)	During acceleration [ mDACC ]: (ON during acceleration)
6004(7004)	During deceleration [ mDDEC ]: (ON during deceleration)
6005(7005)	Under anti-regenerative control [ mREGA ]: (ON under anti-regenerative control)
6006(7006)	Within dancer reference position [ mDR_REF ]: (ON when the dancer roll position is within the reference range)
6007(7007)	Alarm factor presence [ mALM_ACT ]: (ON when there is no alarm factor)

<b>10. 03</b>	User sequence: step 1 sequential circuit	Factory default	0
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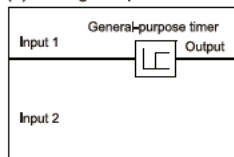
For Logic circuit (with general-purpose timer), the following functions are selectable as a logic circuit:

Setting value	Function	Description
0	No function assigned	Output is always OFF.
1	Through output + general-purpose timer	Only a general-purpose timer. No logic circuit exists.
2	Logic and (ANDing) + general-purpose timer	AND circuit with 2 inputs and 1 output, plus general-purpose timer.
3	Logic or (ORing) + general-purpose timer	OR circuit with 2 inputs and 1 output, plus general-purpose timer.
4	Logical XOR (XORing) + general-purpose timer	XOR circuit with 2 inputs and 1 output, plus general-purpose timer.
5	Set priority flip-flop + general-purpose timer	Set priority flip-flop with 2 inputs and 1 output, plus general-purpose timer.
6	Reset priority flip-flop + general-purpose timer	Reset priority flip-flop with 2 inputs and 1 output, plus general-purpose timer.
7	Rising edge detector + general-purpose timer	Rising edge detector with 1 input and 1 output, plus general-purpose timer. This detects the rising edge of an input signal and outputs the ON signal for 2ms.
8	Falling edge detector + general-purpose timer	Falling edge detector with 1 input and 1 output, plus general-purpose timer. This detects the falling edge of an input signal and outputs the ON signal for 2ms.
9	Rising and falling edge detector + general-purpose timer	Rising and falling edges detector with 1 input and 1 output, plus general-purpose timer. This detects both the falling and rising edges of an input signal and outputs the ON signal for 2ms.
10	Input hold + general-purpose timer	Hold function of previous values of 2 inputs and 1 output, plus general-purpose timer. If the hold control signal is OFF, the logic circuit outputs input signals; if it is ON, the logic circuit retains the previous values of input signals.

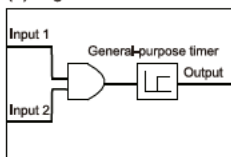
Setting value	Function	Description
11	Increment counter	Increment counter with reset input. By the rising edge of an input signal, the logic circuit increments the counter value by one. When the counter value reaches the target one, the output signal turns ON. Turning the reset signal ON resets the counter to zero.
12	Decrement counter	Decrement counter with reset input. By the rising edge of an input signal, the logic circuit decrements the counter value by one. When the counter value reaches zero, the output signal turns ON. Turning the reset signal ON resets the counter to the initial value.
13	Timer with reset input	Timer output with reset input. If an input signal turns ON, the output signal turns ON and the timer starts. When the period specified by the timer has elapsed, the output signal turns OFF, regardless of the input signal state. Turning the reset signal ON resets the current timer value to zero and turns the output OFF.

The block diagrams for individual functions are given below.

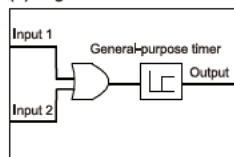
(1) Through output



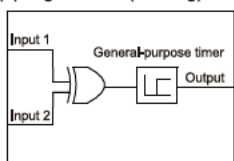
(2) Logic AND



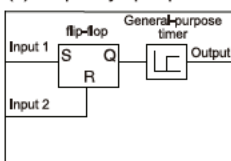
(3) Logic OR



(4) Logical XOR (XORing)

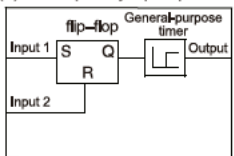


(5) Set priority flip-flop



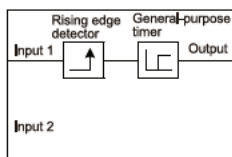
Input1	Input2	Last output	Output	Remarks
OFF	OFF	OFF	OFF	Hold previous value
	ON	ON	ON	
ON	ON	—	OFF	Set priority
	—	—	ON	

(6) Reset priority flip-flop

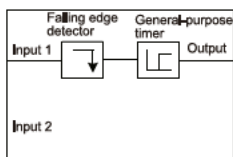


Input1	Input2	Last output	Output	Remarks
OFF	OFF	OFF	OFF	Hold previous value
	ON	ON	ON	
ON	ON	—	OFF	Reset priority
	—	—	ON	

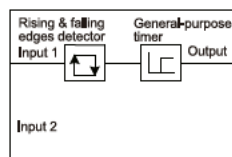
(7) Rising edge detector



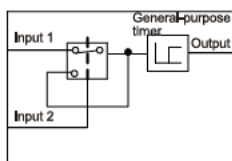
(8) Falling edge detector



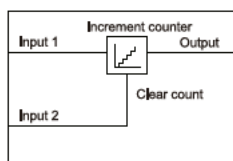
(9) Rising &amp; falling edges detector



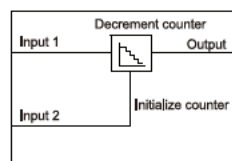
(10) Hold



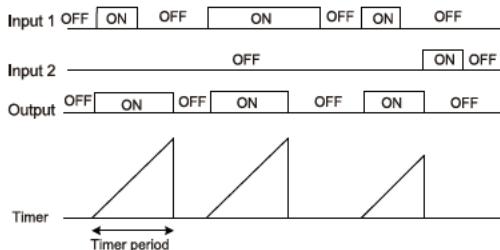
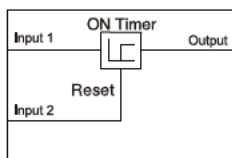
(11) Increment counter



(12) Decrement counter



(13) Timer with reset input

**10.04** Customizable Logic: Step 1 Type of timer

Factory default

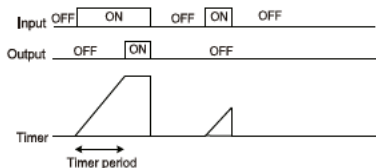
**0**

For General-purpose timer, the following is a function list:

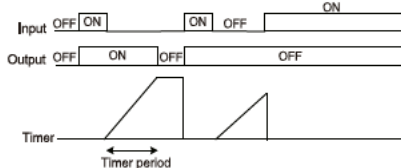
Setting Value	Function	Description
0	No timer	
1	On-delay timer	Turning an input signal ON starts the on-delay timer. When the period specified by the timer has elapsed, an output signal turns ON. Turning the input signal OFF turns the output signal OFF.
2	Off-delay timer	Turning an input signal ON turns an output signal ON. Turning the input signal OFF starts the off-delay timer. When the period specified by the timer has elapsed, the output signal turns OFF.
3	One-shot pulse output	Turning an input signal ON issues a one-shot pulse whose length is specified by the timer.
4	Retriggerable timer	Turning an input signal ON issues a one-shot pulse whose length is specified by the timer. If an input signal is turned ON again during the preceding one-shot pulse length, however, the logic circuit issues another one-shot pulse.
5	Pulse train output	If an input signal turns ON, the logic circuit issues ON and OFF pulses (whose lengths are specified by the timer) alternately and repeatedly. This function is used to flash a luminescent device.

The operation schemes for individual timers are shown below.

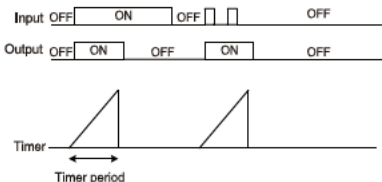
(1) On-delay timer



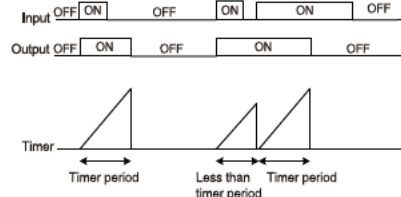
(2) Off-delay timer



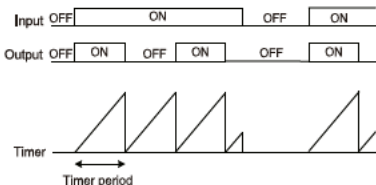
(3) One-shot pulse output



(4) Retriggerable timer



(5) Pulse train output



<b>10.05</b>	Customizable Logic: Step 1 time setting	Factory default	<b>0.00</b>
	Setting Range	<b>0.00~600.00</b>	Unit
			0.01

This function parameter and other related function parameter specify the general-purpose timer period or the increment/decrement counter value.

Setting Value	Function	Description
<b>0.00~600.00</b>	Timer period	The period is specified by seconds.
	Counter value	The specified value is multiplied by 100 times. (If 0,01 is specified, it is converted to 1.)

<b>10.71</b>	Customizable Logic output signal 1 output selection	Factory default	<b>0</b>
<b>10.72</b>	Customizable Logic output signal 2 output selection	Factory default	<b>0</b>
<b>10.73</b>	Customizable Logic output signal 3 output selection	Factory default	<b>0</b>
<b>10.74</b>	Customizable Logic output signal 4 output selection	Factory default	<b>0</b>
<b>10.75</b>	Customizable Logic output signal 5 output selection	Factory default	<b>0</b>

<b>10. 81</b>	Customizable Logic Output Signal 1 function selection	Factory default	<b>100</b>
<b>10. 82</b>	Customizable Logic Output Signal 2 function selection	Factory default	<b>100</b>
<b>10. 83</b>	Customizable Logic Output Signal 3 function selection	Factory default	<b>100</b>
<b>10. 84</b>	Customizable Logic Output Signal 4 function selection	Factory default	<b>100</b>
<b>10. 85</b>	Customizable Logic Output Signal 5 function selection	Factory default	<b>100</b>

#### ■ Output signal

In a customizable logic, outputs from steps 1 to 10 are issued to mSO01 to mSO10, respectively, mSO01~mSO10 differ in configuration depending upon the connection destination, as listed below. (To relay those outputs to any function other than the customizable logic, route them via customizable logic outputs (mCLO1 to mCLO5).

If the connection destination is:	Configuration	Parameters
Customizable logic input	Select one of the internal step output signals [mSO01] to [mSO10] in customizable logic input setting.	10. 01, 10. 02, etc.
Input to the inverter's sequence processor ("Select multi-step frequency" [mSS1] "Run forward" FWD [mSS1] and operation command [mFWD], etc.)	Select one of the internal step output signals [mSO01] to [mSO10] to be connected to customizable logic output signals 1 to 5 ([mCLO1] to [mCLO5])	10. 71~10. 75
	Select an inverter's sequence processor input function to which one of the customizable logic output signals 1 to 5 ([mCLO1] to [mCLO5]) is to be connected, (Same as in 01. 01)	10. 81~10. 85
General-purpose digital output (MO* terminals)	Select one of the internal step output signals [mSO01] to [mSO10] to be connected to customizable logic output signals 1 to 5 ([mCLO1] to [mCLO5]).	10. 71~10. 75
	To specify a general-purpose digital output function (on MO* terminals) to which one of the customizable logic output signals 1 to 5 ([mCLO1] to [mCLO5]) is to be connected, select one of [mCLO1] to [mCLO5] by specifying the general-purpose digital output function on any MO* terminal.	01. 20~01. 24, 01. 27

Note: General-purpose digital outputs (on MO\* terminals) are updated every 5 ms. To securely output a customizable logic signal via MO terminals, include on- or off-delay timers in the customizable logic. Otherwise, short ON or OFF signals may not be reflected on those terminals.

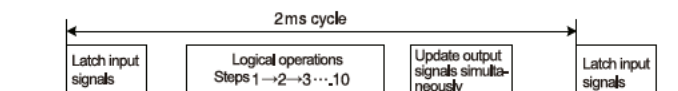
Parameter	Name	Data Setting range	Factory default
10. 71	Customizable Logic output signal 1 output selection	0: Invalid 1: Step 1 Output [mSO01]	0
10. 72	Customizable Logic output signal 2 output selection	2: Step 2 Output [mSO02] 3: Step 3 Output [mSO03]	0
10. 73	Customizable Logic output signal 3 output selection	4: Step 4 Output [mSO04] 5: Step 5 Output [mSO05] 6: Step 6 Output [mSO06]	0
10. 74	Customizable Logic output signal 4 output selection	7: Step 7 Output [mSO07] 8: Step 8 Output [mSO08]	0
10. 75	Customizable Logic output signal 5 output selection	9: Step 9 Output [mSO09] 10: Step 10 Output [mSO10]	0

Parameter	Name	Data Setting range	Factory default
10. 81	Customizable Logic Output Signal 1 function selection	0 to 100, 1000 to 1081 (Same as data of 01. 98 and 01. 99) But ,except the following, 19(1019): Enable data change with keypad (data can be modified) 80(1080): Cancel customizable logic	100
10. 82	Customizable Logic Output Signal 2 function selection		100
10. 83	Customizable Logic Output Signal 3 function selection		100
10. 84	Customizable Logic Output Signal 4 function selection		100
10. 85	Customizable Logic Output Signal 5 function selection		100

■ Notes for using a customizable logic

A customizable logic performs processing every 2ms in the following sequence.

- (1) At the start of processing, the customizable logic latches all of the external input signals entered to steps 1 to 10 to ensure simultaneity.
- (2) Logical operations are performed in the order of steps 1 to 10.
- (3) If an output of a particular step applies to an input at the next step, the output of the step having processing priority can be used in the same processing.
- (4) The customizable logic updates all of the five output signals at the same time.



When configuring a logic circuit, take into account the processing order of the customizable logic. Otherwise, a delay in processing of logical operation leads to a signal delay problem, resulting in no expected output, slow processing, or a hazard signal issued.

**Warning**

Ensure safety before modifying customizable logic related function code settings (related 10 group function parameters) or turning ON the "Cancel customizable logic" terminal command [mCLC], depending upon the settings, such modification or cancellation of the customizable logic may change the operation sequence to cause a sudden motor start or an unexpected motor operation.

**Otherwise, it may cause accident or injury!**

<b>10. 91</b>	Customizable logic timer monitor (Step selection)	Factory default	<b>0</b>
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The contents of the timer in a customizable logic can be monitored using the monitor-related function code or the keypad.

Selecting a timer to be monitored

Parameter	Function
10. 91	1 to 10 : 10. 91 specifies the step number whose timer or counter is to be monitored

Selecting a timer to be monitored

Monitoring method	Related function parameter and LED monitor display on Keypad	Monitored item
Communications link on the Keypad	Customizable logic (Timer monitor) <u>d</u> 24	Timer or counter value specified by 10. 91 (dedicated to monitoring)



- Cancel customizable logic [mCLC] (parameter 01. 01-01. 09 data = 80)

This terminal command disables the customizable logic temporarily. Use it to run the inverter without using the customizable logic circuit or timers for maintenance or other purposes.

[mCLC]	Function
OFF	It's valid for customizable logic (Depends on the 10. 00 setting)
ON	It's invalid for customizable logic

Note: Before changing the setting of [mCLC] ensure safety. Turning [mCLC] ON disables the sequence of the customizable logic, causing a sudden motor start depending upon the settings.

- Zero all timers of user sequence [mCLTC] (parameter 01. 01-01. 09 data = 81)

Assigning mCLTC terminal function to any of the general-purpose digital input terminals and turning it ON resets all of the general-purpose timers and counters in the customizable logic. Use this command when the timings between the external sequence and the internal customizable logic do not match due to a momentary power failure or other reasons so that resetting and restarting the system is required.

[mCLTC]	Function
OFF	Ordinary operation
ON	Reset all of the general-purpose timers and counters in the customizable logic. (To operate the timers and counters again, revert CLTC to OFF.)

## 11 Serial Communication Parameters

### 1. Communication Protocol

For S3100 series inverter, the communication interface of RS485 is provided, and the international standard ModBus communication protocol is used for host-subordinate communication. The user can realize the centralized control by PC/PLC, controlling the upper computer (setting the control command, running frequency of inverter, and edit function parameters of inverter, inverter's running status and alarm information, etc.) to suit the specific applied requirements.

### 2. Protocol Contents

Such Modbus serial communication protocol defines the framing content and application format of asynchronous transmission in serial communication including: poll and broadcast frame of host equipment, format of subordinate device response frame; Organized the framing content by host equipment, which includes host polling and broadcast frames. subordinate equipment address (or broadcast address), executive command, data and error correction, etc. The response of subordinate equipment is also in the same structure with the content including: confirm the action, return data and error correction, etc. In case that some errors occurred when the subordinate device received the frames, or can't complete the required action by the host equipment, it will organize a fault frame as the response and give a feedback to the host equipment.

### 3. Application Mode

The inverter can be accessed into the "Single-host, Multi-Subordinate" control network with RS485 bus.

### 4. Bus Structure

#### (1) Interface Mode

RS485 hardware interface

#### (2) Transmission Mode

Asynchronous serial, half-duplex transmission mode. At the same time, one sends data and the other receives data for the host equipment and subordinate device. The data is sent frame by frame at the form of message in the process of serial asynchronous communication.

#### (3) Topological Structure

Single-host multi-subordinate system. The set range of subordinate address is 1-247, and 0 is the address for broadcasting and communication. Each address of subordinate in the network has the uniqueness, which is the base to ensure the serial communication of ModBus.

## 5. Protocol Specification

The communication protocol for inverter is an asynchronous serial host-subordinate ModBus communication protocol. In the network, only an equipment (host equipment) can establish the protocol (called as "query/command"). Other equipments (subordinate device) can respond to the "query/command" of host equipment only through providing data, or perform the responsive action according to the "query/command" of host. The host equipment herein refers to personal computer, industrial control equipment or Programmable Logic Commander (PLC), etc., and subordinate device refers to inverter or other control equipments with the same communication protocol. The host equipment can not only carry out the communication to some subordinate device alone, but also send the broadcast message to all subordinates. For the "query/command" of host equipment visited separately, all subordinate devices shall return a message (called as response). For the broadcast information sent by the host equipment, the subordinate device doesn't respond to the host equipment.

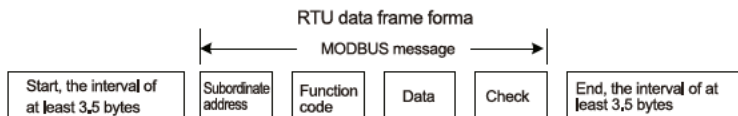
## 6. Communication Frame Structure

The data format of ModBus communication protocol is RTU (remote terminal unit) mode.

In the mode of RTU, the format of each byte is as follows:

Coding system: 8-binary, every 8-bit frames field includes two hexadecimal characters, hexadecimal system 0-9, A-F.

In the mode of RTU, new frame is always to deem the transmission time of 3,5 bytes at least as the start silently. On the network where the transmission rate is calculated at the Baud rate, the transmission time of 3,5 bytes can be grasped easily. The following data area for transmission successively is: subordinate address, operation command code, data and CRC check word. The bytes at each area all are hexadecimal 0...9, A...F. The equipment of network always monitors the activities of communication bus. When the first area (address information) is received, each network equipment shall check such byte. As the transmission for last byte is completed, there is also an interval similar to the transmission time of 3,5 bytes to present the end of this frame. Afterwards, the transmission of new frame will be started.



The information of a frame must be transmitted by a continuous data flow. If there is interval time more than 1,5 bytes exists before the end of whole frames transmission, the receiving equipment will clear such incomplete information and treat mistakenly the following byte as the address field part of new frame. Similarly, if the interval time between the start of a new frame and the previous frame is less than the time of 3,5 bytes, the receiving equipment will treat it as the continuation of the previous frame. The final check value of CRC is not correct due to the disorder of frame, causing the fault of communication.

Standard Structure of RTU Frame:

Frame Header START	T1-T2-T3-T4 (transmission time of 3,5 bytes)
Subordinate address zone ADDR	Communication address: 0-247 (decimal system) (0= the broadcast address)
Functional Zone CMD	03H: reads subordinate parameters; 06H: writes subordinate parameters
Data Zone DATA(N-1) ... DATA(0)	Data of 2*N bytes; this part is the main content of communication and the core of data exchange in communication.
CRC CHK lower bite	Test value: Check value of CRC (16 BIT)
CRC CHK upper bite	
Ending-frame END	T1-T2-T3-T4(transmission time of 3,5 bytes)

## G, Description of Command Code and Communication Data

Command code: 03H (0000 0011), read N words (can sequentially read 50 words at most)

E.g. from the inverter whose subordinate address is 01H, the start address of internal memory is 0004, read 2 words sequentially, the structure of this frame is described as follows.

RTU host command information:

START	T1-T2-T3-T4
ADDR	01H
CMD	03H
Start address upper bit	00H
Start address lower bit	04H
Date number upper bit	00H
Date number lower bit	02H
CRC CHK lower bit	85H
CRC CHK upper bit	CAH
END	T1-T2-T3-T4

RTU subordinate response information

START	T1-T2-T3-T4
ADDR	01H
CMD	03H
Byte number	04H
Date address 0004H upper bit	13H
Date address 0004H lower bit	88H
Date address 0005H upper bit	13H
Date address 0005H lower bit	88H
CRC CHK lower bit	73H
CRC CHK upper bit	CBH
END	T1-T2-T3-T4

Command code: 06H (0000 0110), write one word

E.g. 5000 (1388H) is written to 0008H address of subordinate address 02H inverter.

RTU host command information:

START	T1-T2-T3-T4
ADDR	02H
CMD	06H
Write data address upper bit	00H
Write data address lower bit	03H
Date content upper bit	13H
Date content lower bit	88H
CRC CHK lower bit	74H
CRC CHK upper bit	AFH
END	T1-T2-T3-T4

RTU subordinate response information:

START	T1-T2-T3-T4
ADDR	02H
CMD	06H
Write data address upper bit	00H
Write data address lower bit	03H
Date content upper bit	13H
Date content lower bit	88H
CRC CHK lower bit	74H
CRC CHK upper bit	AFH
END	T1-T2-T3-T4

## 7. Communication Frame Error-checking Method

The error-checking method of frame mainly includes two parts: bit checking of byte (odd/even parity) and whole data checking of frame (CRC checking and LRC checking).

### 8. Byte Checking

Users can choose different byte checking method as required, and also can choose no checking, which will affect the checking bit setting of every byte.

Even parity checking: add an even parity bit before data transmission to express the number of "1" in transmission data is an odd or even. If it is an even, the checking bit is "0", otherwise set it "1" to keep the parity data constant.

Odd parity checking: add an odd parity bit before data transmission to express the number of "1" in transmission data is an odd or even. If it is an odd, the checking bit is "0", otherwise set it "1" to keep the parity data constant.

For example, it's necessary to transfer "11001110", the data containing 5 "1"s. If even checking is adopted, the even parity checking bit is "1"; if the odd checking is adopted, the odd parity checking bit is "0". When transferring data, the parity bit is put on checking bit of frame by calculation.

The receiving devices also need parity checking, if the parity of received data is different from the preset situation, it will be considered a communication error had occurred.

## 9. CRC(Cyclical Redundancy Checking):

To use RTU frame format which includes a frame error detection zone based on CRC calculation method. CRC zone checks contents of the whole frame. CRC zone is two bytes, containing a 16-bit binary value. It joins in the frame after being calculated by the transfer device. Receiving device recalculates and receives the CRC of the frame and compares with the received value of CRC zone, if the two CRC values are not equal, it indicates there are transmission errors.

In CRC checking mode, it first stores in 0xFFFF, and then calls a procedure and processes the continuous more than 6 bytes in the frame and value in the current register. Only 8Bit data in each character is valid for CRC, while start and stop bits, and parity bits are invalid.

During CRC generation process, each 8-bit character is different or (XOR) from register contents individually, and the result moves to the direction of the least significant bit, while the most significant bit is filled with 0. LSB is picked up to detect, if LSB is 1, register is different from the preset value individually or, if LSB is 0, no processing. The whole process will repeat eight times. After the last one (Bit 8) is completed, the next 8-bit byte is exclusive OR with the current value of the register individually. The final register value is the CRC value after the execution of all bytes in the frame.

This calculation method of CRC uses the international standard CRC checking rule. While users are editing the CRC algorithm, they can refer to the relative standard CRC algorithm, and edit a CRC calculation program meeting the requirements actually.

Now offers a simple function of CRC calculation for users to refer (using C language programming):

```
unsigned int crc_cal_val( unsigned char *data_val, unsigned char data_length)
{
    int i;
    unsigned int crc_val=0xffff;
    while(data_length-->0)
    {
        crc_val^=*data_val++;
        for(i=0;i<8;i++)
        {
            if(crc_val&0x0001)
                crc_val=(crc_val>>1)^0xa001;
            else
                crc_val=crc_val>>1;
        }
    }
    return(crc_val);
}
```

In ladder logic, CKSM calculates CRC value according to the frame contents, adopts look-up table method, which possesses simple procedure and fast speed, but the program occupies a large space of ROM program, use with caution on the occasion with requirements for space.

## 10. Definition of communication data address

It is the definition of communication data address, and used to control inverter, obtain the status information of the transducer and set the relative function parameters of the inverter.

(1) Presentation rule of function code parameter address

Take parameter set+ function number as the register address of corresponding parameters, but it should be converted to hexadecimal, for example as for addresses of 05-05 and 09-12, the function code addresses are 0505H and 090CH with hexadecimal.

## (2) Address description of other function s:

Function Description	Address Definition	Description	R / W Characteristics
Reset command of reserved alarm	0E0EH	Write 1 to do RST action of alarm reset	W
Communication control command	0E06H	BIT0: mFWD forward run BIT1: mREV reverse run	W/R
Inverter status	0F0EH	BIT0: mFWD in forward run	R
		BIT1: mREV in reverse run	
		BIT2: mEXT DC braking	
		BIT3: mINT output open circuit of transducer	
		BIT4: mBRK braking	
		BIT5: mNUV busbar voltage in the normal range	
		BIT6: mTL torque limit	
		BIT7: mVL voltage limit	
		BIT8: mL current limit	
		BIT9: mACC acceleration	
		BIT10: mDEC deceleration	
		BIT11: mALM alarm occurs	
BIT12: mRL communicate valid (communication controls operation, set the frequency command )			
BIT15: mBUSY parameter data is being written			
Communication set data address	0E01H	Pay attention to communication setting range (0 to 20000): When set as the frequency source, the opposite is the max. frequency values (00-03); When set as the torque, the opposite is the upper limit value of torque. When set or feedback as PID, the opposite is the max. value of PID.	W/R
Run / Stop parameter address description	0F01H	Setting frequency (-20000~20000 corresponding to the max. output frequency)	R
	0F06H	Operating frequency (-20000~20000 corresponding to the max. output frequency)	R
	0F15H	Busbar voltage (0~1000V)	R
	0F0CH	Output voltage (0.0 ~ 1000.0V)	R
	0F0BH	Output current ( 0.00 ~399.99%, the rating is 100% )	R
	1008H	The speed of the motor (0.00~99990 r/min)note1	R
	1016H	Output power (0.00~9999kW) note1	R
	1007H	Output torque (-999~999%)	R
	100BH	PID set value (999~9990)	R
	100CH	PID feedback amount (999~9990)	R
	1028H	Terminal input status (b0:FWD, b1:REV, b2:MI1, b3:MI2, b4:MI3, b5::MI4, b8:MI7)	R
	0F0FH	Terminal output status(b0:MO1,b1: MO2,b8:RAC)	R
	0F31H	AVI analog value ( -20000~ 20000 corresponding to 10V)	R
	0F32H	ACI analog value ( 0 ~ 20000 corresponding to 20mA)	R
	0F36H	AUI analog value ( -20000 ~ 20000 corresponds to 10V)	R
Fault address of inverter	1100H	The latest code value of fault information represents information described in the table below.	R

Note: the mapping table between the latest fault code value read from the 1100H and actual fault is as below:

Value	Fault Type
0	No fault
1	Overcurrent occurred during acceleration (OC1)
2	Overcurrent occurred during deceleration (OC2)
3	Overcurrent occurred during running at a constant speed (OC3)
4	Reserved
5	Reserved
6	Overvoltage occurred during acceleration (OU1)
7	Overvoltage occurred during deceleration (OU2)
8	Overvoltage occurred during running at constant speed (OU3)
9	Reserved
10	Undervoltage fault (LU)
11	Input phase loss (Lin)
12	Reserved
13	Reserved
14	Reserved
15	Reserved
16	Reserved
17	Cooler Overheat (OH1)
18	External alarm (OH2)
19	Inverter internal overheat (OH3)
20	Motor overheating (PTC/NTC detection) (OH4)
21	Reserved
22	Braking resistor overheated (dbH)
23	Overload of motor 1 (OL1)
24	Overload of motor 2 (OL2)
25	Inverter overload (OLU)
26	Reserved
27	Overspeed (OS)
28	Reserved
29	NTC wire break error (nrB)
30	Reserved

Value	Fault Type
31	Memory error (Er1)
32	Keypad communications error (Er2)
33	CPU error (Er3)
34	Reserved
35	Reserved
36	Operation error (Er6)
37	Auto-tuning error (Er7)
38	RS485 communications error (COM port 1) (Er8)
39	Reserved
40	Reserved
41	Reserved
42	Reserved
43	Reserved
44	Overload of motor 3 (OL3)
45	Overload of motor 4 (OL4)
46	Output phase loss (OPL)
47	Speed mismatch or excessive speed deviation (ErE)
48	Reserved
49	Reserved
50	Reserved
51	Data saving error during undervoltage(ErF)
52	Reserved
53	RS485 communications error(COM port 2) (ErP)
55	Reserved
56	Reserved
57	Reserved
58	PID feedback wire break (CoF)
59	Reserved
60	Reserved

Note 1:

Floating-point data (eg: the speed of the motor)

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Exponent		Mantissa													

Exponent: 0~3

Mantissa: 1~9999

Value represented by this form = mantissa × square of 10 (exponent -2)

Value	Mantissa	Exponent	Mantissa × square(exponent -2) of 10
0.01~99.99	1~9999	0	0.01
100.0~999.9	1000~9999	1	0.1
1000~9999	1000~9999	2	1
10000~99990	1000~9999	3	10

#### 11. Response of Error Information

When responding from the device, it uses parameters and fault address to indicate a normal response (errorless) or occurrence of some kind of error (called response of objection). For normal response, responsive parameters, data addresses or sub-function codes respond from the device. For response of objection, a code equivalent to the normal code returns from the device with logical 1 in the first place.

For example: a message from the host device to the subordinate equipment requires reading a set of data address of transducer function code, which will generate the following parameters:

00000011 (hexadecimal 03H)

For normal response, the same function code responds from the device. For objection response, it returns:

10000011 (hexadecimal 83H)

After receiving the objection response from the host application, the typical process is resending message, or modifying a command for the responsive fault.

Up to two ports of RS485 communications link are available as listed below.

Port	Connection Route	Parameter	The machine can be connected
1	RS485 communications link (COM 1)(via the RJ-45 connector prepared for keypad connection)	11.01~11.10	Keypad
2	RS485 communications link (COM 2)(via terminals SG+, SG-, on the control PCB)	11.11~11.20	Host equipment

To connect any of the applicable devices, follow the procedures shown below.

##### (1) Keypad

The keypad allows you to run and monitor the inverter. It can be used independent of the 11 group function parameters setting.


##### (2) Host equipment


The inverter can be managed and monitored by connecting host equipment such as a PC and PLC to the inverter. Modbus RTU and SAVCH Electric general-purpose inverter protocol are available for communications protocols.

<b>11.01</b>	RS485 communication 1 communication Station address		Factory default	1
	Setting Range	1~255		
	Related parameters	11.11 RS485 communication 2 communication Station address		


 Specifies the station address for the RS485 communications link.


Protocol	Station address
Modbus RTU	1~255


<b>11. 02</b>	RS485 communication 1: Communications error processing		Factory default	<b>2</b>
	Setting Range	0: Immediate Er8 alarm 1: Er8 alarm after timer operation 2: Retry start when timer is running, when communication is not resumed: Er8 Alarm, when communication resumes: Continue running. 3: Continue to run		
	Related parameters	11. 12 RS485 communication 2: Communications error processing		


 Specifies the error processing to be performed if an RS485 communications error happens. RS485 communications errors include logical errors (such as address error, parity error, framing error), transmission protocol error, and physical errors (such as no-response error specified by 11. 08 and 11. 18). The inverter can recognize such an error only when it is configured with a run or frequency command sourced through the RS485 communications link and it is running. If none of run and frequency commands is sourced through the RS485 communications link or the inverter is not running, the inverter does not recognize any error occurrence.

11. 02, 11. 12 Setting value	Function
0	Immediately alarm, displaying an RS485 communications error ( Er8 for 11. 02 and Erp for 11. 12). The inverter stops (with alarm issue).
1	Run during the period specified by the error processing timer (11. 03, 11. 13), display an RS485 communications error (Er8 for 11. 02 and Erp for 11. 12), and then stop operation. The inverter stops (with alarm issue).
2	Retry communication during the period specified by the error processing timer (11. 03, 11. 13). If a communications link is recovered, continue operation. Otherwise, display an RS485 communications error (Er8 for 11. 02 and Erp for 11. 12) and stop operation. The inverter stops (with alarm issue).
3	Continue to run even when a communication error happens.

<b>11. 03</b>	RS485 communication 1: timer		Factory default	<b>2.0</b>
	Setting Range	0,0~60,0s		
	Related parameters	11. 13 RS485 communication 2: timer		

 Timer (parameter 11. 03, 11. 13): specifies an error processing timer. If the timer count has elapsed due to no response from the other end when a query has been issued, the inverter interprets it as an error occurrence. See the "No-response error detection time (11. 08, 11. 18)" given on the next page.

<b>11. 04</b>	RS485 communication 1: baud rate		Factory default	<b>3</b>
	Setting Range	0: 2400bp s 1: 4800bps 2: 9600bps 3: 19200bps 4: 38400bps		
	Related parameters	11. 14 RS485 communication 2: baud rate		

 Baud rate: specifies the transmission speed for RS485 communication, parameters of 11. 14 and 11. 04 with the same setting.



<b>11.05</b>	RS485 communication1:data length selection		Factory default	<b>0</b>
	Setting Range	0: 8 Bit		
		1: 7 Bit		
	Related parameters	11. 15 RS485 communication2: data length selection		

Data length: specifies the character length for RS485 communication, parameters 11. 15 and 11. 05 with the same setting.

<b>11.06</b>	RS485 communication 1: parity check selection		Factory default	<b>0</b>
	Setting Range	0: No ( Stop bit : 2 )		
		1: Even parity ( Stop bit: 1 )		
		2: Odd parity ( Stop bit: 1 )		
		3: No ( Stop bit : 1 )		
	Related parameters	11.16 RS485 communication 2: parity check selection		

Parity check: specifies the property of the parity bit.

11. 06, 11. 16 Setting value	Function
0	None (2 stop bits for Modbus RTU)
1	Even parity (1 stop bit for Modbus RTU)
2	Odd parity (1 stop bit for Modbus RTU)
3	None (1 stop bit for Modbus RTU)

<b>11.07</b>	RS485 communication 1: stop bit selection		Factory default	<b>0</b>
	Setting Range	0: 2 Bit		
		1: 1 Bit		
	Related parameters	11.17 RS485 communication 2: stop bit selection		

Stop bits: specifies the number of stop bits, parameters 11. 17 and 11. 07 with the same setting.

<b>11.08</b>	RS485 communication 1: No-response error detection time		Factory default	<b>0</b>
	Setting Range	0: No detection		
		1~60s		
	Related parameters	11.18 RS485 communication 2: No-response error detection time		

■ No-response error detection time(11. 08, 11. 18)

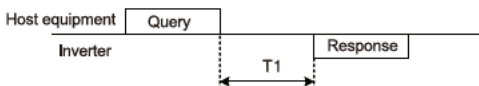
Specifies the timeout period for receiving a response from the host equipment (such as a computer or PLC) in RS485 communication, in order to detect network breaks. This applies to the machinery that accesses the host equipment at the predetermined intervals. If the response timeout occurs, the inverter starts communications error processing.

11. 08, 11. 18 Setting value	Function
0	No detection
1~60	1 to 60s

<b>11. 09</b>	RS485 communication 1 response interval	⚡	Factory default	<b>0.01</b>
	Setting Range	0.00~1.00s		
	Related parameters	11. 19 RS485 communication 2 response interval		

■ Response interval(11. 09 for port 1 and 11. 19 for port 2), parameters 11. 19 and 11. 09 with the same setting

Specifies the latency time after the end of receiving a query sent from the host equipment (such as a computer or PLC) until the start of sending the response. This enables the inverter to control the response timing to match the host equipment that is slow in processing.



$T1 = \text{response interval} + \alpha$

$\alpha$  where  $\alpha$  is the processing time inside the inverter.  $\alpha$  may vary depending on the processing status and the command processed in the inverter.

<b>11. 10</b>	RS485 communication 1 protocol selection	⚡	Factory default	<b>1</b>
	Setting Range	0: Modbus RTU protocol 1: PC software SavchSoft_INV protocol 5: Modbus ASCII protocol		
	Related parameters	11. 20 RS485 communication 2 protocol selection		

📖 Protocol selection (11. 10 for port 1, 11. 20 for port 2); Parameters 11. 20 and 11. 10 have the same selection.

<b>11. 97</b>	Communication Data Storage Selection	⚡	Factory default	<b>0</b>
	Setting Range	0: Save into nonvolatile storage (Rewritable times limited) 1: Write into temporary storage (Rewritable times unlimited) 2: Save all data from RAM storage to EEPROM(After saving data, the 11. 97 data automatically returns to "1". )		

📖 A nonvolatile storage (EEPROM) in the inverter has a limited number of rewritable times (100,000 to 1,000,000 times). Saving data into the storage so many times unnecessarily will no longer allow the storage to save data, causing memory errors. For frequent data writing via the communications link, therefore, a temporary storage is provided instead of the nonvolatile storage (EEPROM). To use the temporary storage, set the 11. 97 data at "1". Using the temporary storage reduces the number of data writing times into the nonvolatile storage (EEPROM), preventing memory errors.

Setting the 11. 97 data at "2" saves all data written in the temporary storage into the nonvolatile one.

Changing the 11. 97 data requires simultaneous keying of (STOP key + ⏪ / ⏩ key).

<b>11. 98</b>	Communication function (mode selection) (refer to 04. 30)		Factory default	<b>0</b>
---------------	--	--	-----------------	----------

<b>11. 99</b>	Auxiliary communication function (mode selection)		Factory default	<b>0</b>
---------------	---	---	-----------------	----------

Setting value	Function	
	Frequency command	Running command
0	04. 30, 11. 98	04. 30, 11. 98

## **7. Failure Indication and Countermeasures**

Inverter itself has various alarm data, like overvoltage, undervoltage, and over-current, as protective functions. the "alarm" detection function which, upon detection of an abnormal state, displays the alarm code on the LED monitor and causes the inverter to trip, the "light alarm" detection function which displays the alarm code but lets the inverter continue the current operation, Alarm history are stored in the memory of inverter, and can be read by the keypad. If any problem arises, understand the protective functions listed below table and onwards for troubleshooting.

Protection functions	Description	Related parameters
"Alarm" detection	This function detects an abnormal state, displays the corresponding alarm code, and causes the inverter to trip. The "alarm" codes are check-marked in the "Alarm" object column in Table 7.1. For details of each alarm code, see the corresponding item in the troubleshooting. The inverter retains the last four alarm codes and their factors together with their running information applied when the alarm occurred, so it can display them.	04.98
Light Alarm	This function detects an abnormal state categorized as a "light alarm" displays L-AL, and lets the inverter continue the current operation without tripping, without raising alarm. The "light alarm" codes are check-marked in the "Light alarm" object column in table below.	04.81 04.82
Stall prevention	When the output current exceeds the current limiter level (00.44) during acceleration/ deceleration or constant speed running, this function decreases the output frequency to avoid an overcurrent trip.	00.44
Overload prevention control	Before the inverter trips due to a heat sink overheat (OH1) or inverter overload (OLU), this function decreases the output frequency to reduce the load.	04.70
Automatic deceleration (Anti-regenerative control)	If regenerative energy returned exceeds the inverter's braking capability, this function automatically increases the deceleration time or controls the output frequency to avoid an overvoltage trip.	04.69
Deceleration characteristics (Excessive regenerative energy proof braking capability)	During deceleration, this function increases the motor energy loss and decreases the regenerative energy returned to avoid an overvoltage trip (OU).	04.71
Reference loss detection	This function detects a reference frequency loss (due to a broken wire, etc.), continues the inverter operation at the specified frequency, and issues the "Command loss detected" alarm signal.	01.65
Automatic lowering of carrier frequency	Before the inverter trips due to an abnormal surrounding temperature or output current, this function automatically lowers the carrier frequency to avoid a trip.	04.98
Dew condensation prevention	Even when the inverter is in stopped state, this function feeds DC current across the motor at certain intervals to raise the motor temperature for preventing dew condensation.	08.21
Motor overload early warning	When the inverter output current has exceeded the specified level protection, this function issues the "Motor overload early warning" signal by the thermal overload protection function before inverter raise alarm (This function exclusively applies to the 1st motor.)	01.34 01.35

Protection functions	Description	Related parameters
Auto-reset	When the inverter has stopped because of a trip, this function allows the inverter to automatically reset and restart itself, The number of retries and the latency between stop and reset can be specified.	04.04 04.05
Forced stop	Upon receipt of the "Force to stop" terminal command [mSTOP], this function interrupts the run and other commands currently applied in order to forcedly decelerate the inverter to a stop.	04.56

"Alarm" object

Code	Name	Code	Name
OOC1, OC2, OC3	overcurrent	OS	Overspeed
EF	Ground fault	Er1	Memory error
OU1, OU2, OU3	Overvoltage	Er2	Keypad communications error
LU	Undervoltage	Er3	CPU error
Lin	Input phase loss	Er6	Operation error
OPL	Output phase loss	Er7	Auto-tuning error
OH1	Cooler Overheat	Er8	RS485 communications error(COM port 1)
		Erp	RS485 communications error(COM port 2)
OH2	External alarm	ErF	Data saving error during undervoltage
OH3	Inverter internal overheat	ErE	Speed mismatch or excessive speed deviation
OH4	Motor protection (PTC/NTC thermistor)	nrb	NTC wire break error
dbH	Braking resistor overheated	Err	Mock alarm
OL1~OL4	Overload of motor 1~4	CoF	PID feedback wire break
OLU	Inverter overload		

"Light Alarm" Objects

Code	Name	Code	Name
OH1	Cooler Overheat	Er8	RS485 communications error(COM port 1)
		Erp	RS485 communications error(COM port 2)
OH2	External alarm	ErE	Speed mismatch or excessive speed deviation
OH3	Inverter internal overheat	Pid	PID alarm output
dbH	Braking resistor overheated	UTL	Low torque output
OL1~OL4	Overload of motor 1~4	PTC	PTC Thermistor activated
CoF	PID feedback wire break	rTE	Inverter life (Motor cumulative run time)
OL	Motor overload early warning	CnT	Inverter life (Number of startups)
OH	Cooler overheat early warning	LiF	Lifetime alarm
rEF	Reference command loss detected		

## 7.1 PROBLEMS AND TROUBLESHOOTING PROCEDURE

Code	Description for problem and Possible Causes	Checking	Suggested Measures
OC1 (Overcurrent occurred during acceleration.) OC2 (Overcurrent occurred during deceleration) OC3 (Overcurrent occurred during running at a constant speed)	(1)The inverter output lines were short-circuited.	Disconnect the wiring from the inverter output terminals ([U], [V] and [W]) and measure the interphase resistance of the motor wiring. Check if the resistance is too low	Remove the short-circuited part (including replacement of the wires, relay terminals and motor).
	(2)Ground faults have occurred at the inverter output lines.	Disconnect the wiring from the output terminals ([U], [V] and [W]) and perform a Megger test.	Remove the grounded parts (including replacement of the wires, relay terminals and motor).
	(3) Overload	Measure the motor current with a measuring device to trace the current trend. Then, use this data to judge if the trend is over the calculated load value for your system design.	If the load is too heavy, reduce it or increase the inverter capacity
		Trace the current trend and check if there are any sudden changes in the current	①If there are any sudden changes, make the load fluctuation smaller or increase the inverter capacity. ②Enable instantaneous overcurrent limiting (04. 12 = 1)
	(4) Excessive torque boost specified. (manual torque boost (when 00. 37=0. 1. 3. 4))	Check whether decreasing the torque boost (00. 09) decreases the output current but does not stall the motor.	If no stall occurs, decrease the torque boost 00. 09.
	(5)The acceleration/ deceleration time was too short	Check that the motor generates enough torque required during acceleration or deceleration. That torque is calculated from the moment of inertia for the load and the acceleration/deceleration time.	①Increase the acceleration /deceleration time( 00. 07. 00. 08. 01. 10~01. 15. 04. 56 ) ②Enable the current limiter ( 00. 43)and torque limiter( 00. 40. 00. 41 .01. 16. 01. 17 ) ③Increase the inverter capacity.
(6) Malfunction caused by noise.	Check if noise control measures are appropriate (e.g., correct grounding and routing of control and main circuit wires)	①Implement noise control measures. ②Enable the Auto-reset (04. 04). ③Connect a surge absorber to magnetic contactor's coils or other solenoids (if any) causing noise.	
EF (Ground fault)	Inverter output terminal(s) grounded (ground fault)	Disconnect the wiring from the output terminals ([U], [V], and [W]) and perform a Megger test.	Remove the grounded parts (including replacement of the wires, relay terminals and motor).
OU1 (Overvoltage occurred during acceleration) OU2 (Overvoltage occurred during deceleration)	(1) The power supply voltage exceeded the inverter's specification range	Measure the input voltage.	Decrease the voltage to within the specified range.
	(2) A surge current entered the input power supply	In the same power line, if a phase-advancing capacitor is turned ON/OFF or a thyristor converter is activated, a surge (momentary large increase in the voltage or current) may be caused in the input power	Install a DC reactor.

Code	Description for problem and Possible Causes	Checking	Suggested Measures
OU1 (Overvoltage occurred during acceleration) OU2 (Overvoltage occurred during deceleration) OU3 (Overvoltage occurred during running at constant speed)	(3) The deceleration time was too short for the moment of inertia for load	Recalculate the deceleration torque based on the moment of inertia for the load and the deceleration time.	① Increase the deceleration time (00.08.01.11.01.13.01.15.04.56). ② Enable the automatic deceleration (anti-regenerative control) (04.69), or deceleration characteristics (04.71). ③ Enable torque limiter (00.40.00.41.01.16.01.17.04.73). ④ Set the rated voltage (at base frequency) (00.05) to "0" to improve the braking capability. ⑤ Consider the use of a braking resistor.
	(4) The acceleration time was too short.	Check if the overvoltage alarm occurs after rapid acceleration.	① Increase the acceleration time (00.07.01.10.01.12.01.14). ② Select the S-curve pattern (04.07). ③ Consider the use of a braking resistor.
	(5) Braking load was too heavy.	Compare the braking torque of the load with that of the inverter.	① Set the rated voltage (at base frequency) (00.05) to "0" to improve the braking capability. ② Consider the use of a braking resistor.
	(6) Malfunction caused by noise	Check if the DC link bus voltage was below the protective level when the overvoltage alarm occurred.	① Implement noise control measures. ② Enable the auto-reset (04.04). ③ Connect a surge absorber to magnetic contactor's coils or other solenoids (if any) causing noise.
	(1) A momentary power failure occurred	① Release the alarm. ② If you want to restart running the motor without treating this condition as an alarm, set 00.14 to "3", "4", or "5", depending on the load type.	
LU (Undervoltage)	(2) The power to the inverter was switched back to ON too soon (when 00.14=1)	Check if the power to the inverter was switched back to ON while the control power was still alive. (Check whether the LEDs on the keypad light.)	Turn the power ON again after all LEDs on the keypad go off.
	(3) The power supply voltage did not reach the inverter's specification range	Measure the input voltage.	Increase the voltage to within the specified range.
	(4) Peripheral equipment for the power circuit malfunctioned, or the connection was incorrect.	Measure the input voltage to find which peripheral equipment malfunctioned or which connection is incorrect.	Replace any faulty peripheral equipment, or correct any incorrect connections.
	(5) Any other loads connected to the same power supply has required a large starting current, causing a temporary voltage drop.	Measure the input voltage and check the voltage fluctuation.	Reconsider the power supply system configuration.



Code	Description for problem and Possible Causes	Checking	Suggested Measures
LU (Undervoltage)	(6) Inverter's inrush current caused the power voltage drop because the power supply transformer capacity was insufficient.	Check if the alarm occurs when a molded case circuit breaker (MCCB), residual-current-operated protective device (RCD)/earth leakage circuit breaker (ELCB) (with overcurrent protection) or magnetic contactor (MC) is turned ON.	Reconsider the capacity of the power supply transformer.
Lin (Input phase loss)	(1) Breaks in wiring to the main power input terminals.	Measure the input voltage	Repair or replace the main circuit power input wires or input devices (MCCB, MC, etc.).
	(2) The screws on the main power input terminals are loosely tightened.	Check if the screws on the main power input terminals have become loose.	Tighten the terminal screws to the recommended torque.
	(3) Interphase voltage unbalance between three phases was too large	Measure the input voltage.	① Connect an AC reactor (ACR) to lower the voltage unbalance between input phases. ② Increase the inverter capacity.
	(4) Overload cyclically occurred	Measure the ripple wave of the DC link bus voltage.	If the ripple is large, increase the inverter capacity.
	(5) Single-phase voltage was input to the three-phase input inverter.	Check the inverter settings and service condition.	Correct inverter for single-phase use to meet the power supply( on single-phase input)
OPL (Output phase loss)	(1) Inverter output wires are broken	Measure the output current.	Replace the output wires.
	(2) The motor winding is broken	Measure the output current.	Replace the motor.
	(3) The terminal screws for inverter output were not tight enough	Check if any screws on the inverter output terminals have become loose.	Tighten the terminal screws to the recommended torque.
	(4) A single-phase motor has been connected		Single-phase motors cannot be used. Note that (S3100 inverter only drives 3-phase induction motors)
OH1 (Cooler Overheat)	(1) Temperature around the inverter exceeded the inverter's specification range.	Measure the temperature around the inverter.	E.g., ventilate the panel where the inverter is mounted, Lower the temperature around the inverter.
	(2) Ventilation path is blocked.	Check if there is sufficient clearance around the inverter.	Change the mounting place to ensure the clearance.
		Check if the cooler is not dogged.	Clean the cooler.
	(3) Cooling fan's airflow volume decreased due to the service life expired or failure.	Check the cumulative run time of the cooling fan.	Replace the cooling fan.
(4) Overload	Measure the output current.	① Reduce the load (use cooler's overheat early warning (01. 01~01. 09)/or overload early warning (01. 34) and reduce the load before the overload protection is activated). ② Decrease the motor sound (carrier frequency)(00. 26). ③ Enable the overload prevention control(04. 70).	






Code	Description for problem and Possible Causes	Checking	Suggested Measures
OH2 (External alarm)	(1) An alarm function of external equipment was activated	Check the operation of external equipment.	Remove the cause of the alarm that occurred.
	(2) Wrong connection or poor contact in external alarm signal wiring.	Check if the external alarm signal (d-ada= 9) wiring is correctly connected to the terminal to which the "Enable external alarm trip" terminal command has been assigned.	Connect the external alarm signal wire correctly.
	(3) Incorrect setting of function parameter data	Check whether the "Enable external alarm trip" terminal command has been assigned to an unavailable terminal 01. 01~01. 09, 01. 98, 01. 99. Check whether the logic (normal/negative) of the external signal matches that of the [mTHR] command specified by 01. 01~01. 09, 01. 98, 01. 99.	Correct the assignment. Ensure the matching of the normal/negative logic.
OH3 (Inverter internal overheat)	The surrounding temperature exceeded the inverter's specification limit.	Measure the surrounding temperature.	E.g., ventilate the panel where the inverter is mounted ,Lower the temperature around the inverter.
OH4 ( Motor protection (PTC/NTC thermistor))	(1) The temperature around the motor exceeded the motor's specification range.	Measure the temperature around the motor.	Lower the temperature.
	(2) Cooling system for the motor defective	Check if the cooling system of the motor is operating normally.	Repair or replace the cooling system of the motor.
	(3) Overload.	Measure the output current.	①Reduce the load (e.g. Use the overload early warning early/ 01. 34 )and reduce the load before the overload protection is activated.) (In winter, the load tends to increase.) ②Lower the temperature around the motor. ③Increase the motor sound (Carrier frequency) (00.26)
	(4) The activation level (04.27) of the PTC thermistor for motor overheat protection was set inadequately.	Check the PTC thermistor specifications and recalculate the detection voltage.	Modify the data of function parameter data.
	(5) Settings for the PTC/NTC thermistor are improper	Check the setting of the thermistor mode selection (04. 26) and the slider position of terminal AUI property switch SW5.	Change 04.26 to the setting which is appropriate for the thermistor used and switch the control board switch to PTC / NTC side.
	(6) Excessive torque boost specified. (00.09)	Check whether decreasing the torque boost (00. 09) does not stall the motor.	If no stall occurs, decrease the 00.09 data.
	(7) The V/f pattern did not match the motor	Check if the base frequency (00.04) and the rated voltage at base frequency (00.05) match the values on the motor's nameplate.	Match the function parameter data with the values on the motor's nameplate.
	(8) Incorrect setting of function parameter data.	Although no PTC/NTC thermistor is used, the thermistor mode is enabled (04. 26) is still in action.	Set the 04. 26 data to "0" (Disable)


Code	Description for problem and Possible Causes	Checking	Suggested Measures
dbH (Braking resistor overheated)	(1) Braking load is too heavy.	Reconsider the relationship between the braking load estimated and the real load.	① Lower the real braking load. ② Review the selection of the braking resistor and increase the braking capability. (Parameters (00. 50, 00. 51, 00. 52) data is also required to be modified)
	(2) Specified deceleration time is too short.	Recalculate the deceleration torque and time needed for the load currently applied, based on a moment of inertia for the load and the deceleration time.	① Increase the deceleration time (00. 08. 01, 11. 01, 13. 01, 15. 04, 56). ② Review the selection of the braking resistor and increase the braking capability. (Parameters (00. 50, 00. 51, 00. 52) data is also required to be modified)
	(3) Incorrect setting of function parameters (00. 50, 00. 51, 00. 52) data	Recheck the specifications of the braking resistor.	Review data of function parameters 00. 50, 00. 51, 00. 52, then modify it.
OH3 (Charger circuit fault)	(1) The control power was not supplied to the magnetic contactor intended for short-circuiting the charging resistor.	Check whether you quickly turned the circuit breaker ON and OFF to confirm safety after cabling/wiring.	Wait until the DC link bus voltage has dropped to a sufficiently low level and then release the current alarm. After that, turn ON the power again. (Do not turn the circuit breaker ON and OFF quickly.) (Turning ON the circuit breaker supplies power to the control circuit to the operation level (lighting the LEDs on the keypad) in a short period. Immediately turning it OFF even retains the control circuit power for a time, while it shuts down the power to the magnetic contactor intended for short-circuiting the charging resistor since the contactor is directly powered from the main power. Under such conditions, the control circuit can issue a turn-on command to the magnetic contactor, but the contactor not powered can produce nothing. This state is regarded as abnormal, causing an alarm.)
OL1~OL4 (Overload of motor 1~4)	(1) The electronic thermal characteristics do not match the motor overload characteristics.	Check the motor characteristics.	① Reconsider the data of function parameters (00. 10*, 00. 12* ). ② Use an external thermal relay.
	(2) Activation level for the electronic thermal protection was inadequate	Check the continuous allowable current of the motor.	Reconsider and change the data of function parameter (00. 11*), and make change accordingly.

Code	Description for problem and Possible Causes	Checking	Suggested Measures
OL1~OL4 (Overload of motor 1~4)	(3) The specified acceleration/ deceleration time was too short.	Recalculate the acceleration/deceleration torque and time needed for the load, based on the moment of inertia for the load and the acceleration/deceleration time.	Increase the acceleration/ deceleration time (00. 07. 00. 08. 01. 10~01. 15. 04. 56).
	(4) Overload	Measure the output current.	Reduce the load (e.g. Use the overload early warning (01. 34) and reduce the load before the overload protection is activated.). (In winter, the load tends to increase.)
	(5) Excessive torque boost specified (00. 09)	Check whether decreasing the torque boost (00. 09) does not stall the motor.	If no stall occurs, decrease the 00. 09* data.
OLU (Inverter overload)	(1) Temperature around the inverter exceeded the inverter's specification range.	Measure the temperature around the inverter.	E.g., ventilate the panel where the inverter is mounted, Lower the temperature.
	(2) Excessive torque boost specified (00.09)	Check whether decreasing the torque boost (00. 09) does not stall the motor.	If no stall occurs, decrease the 00. 09 data.
	(3) The specified acceleration/ deceleration time was too short.	Recalculate the acceleration/deceleration torque and time needed for the load, based on the moment of inertia for the load and the acceleration/deceleration time.	Increase the acceleration /deceleration time (00. 07, 00. 08, 01. 10~01. 15, 04. 56).
	(4) Overload	Measure the output current.	①Reduce the load (e.g., Use the overload early warning (01. 34) and reduce the load before the overload protection is activated.). (In winter, the load tends to increase.) ②Decrease the motor sound (Carrier frequency) (00. 26) ③Enable overload prevention control (04. 70).
	(5) Ventilation paths are blocked.	Check if there is sufficient clearance around the inverter.	Change the mounting place to ensure the clearance.
		Check if the cooler is not clogged.	Clean the cooler.
	(6) Cooling fan's airflow volume decreased due to the service life expired or failure.	Check the cumulative run time of the cooling fan.	Replace the cooling fan.
Visually check that the cooling fan rotates normally.		Replace the cooling fan.	
(7) The wires to the motor are too long, causing a large leakage current from them.	Measure the leakage current.	Insert an output circuit filter (OFL)	
OS (Overspeed)	(1)Incorrect setting of function parameter data.	Check the motor parameter "Number of poles" (03. 01).	Specify the 03. 01 data in accordance with the motor to be used. according to the motor used.
		Check the max. frequency setting (00. 03).	Specify the 00. 03 data in accordance with the output frequency.
		Check the setting of speed limit function (09. 32, 09. 33).	Disable the speed limit function (09. 32, 09. 33).

Code	Description for problem and Possible Causes	Checking	Suggested Measures
OS (Overspeed)	(2) Insufficient gain of the speed controller	Check whether the actual speed overshoots the commanded one in higher speed operation.	Increase the speed controller gain (09.03) (Depending on the situations, reconsider the setting of the filter constant or the integral time)
	(3) Noises superimposed on the PG wire.	Check whether appropriate noise control measures have been implemented (e.g., correct grounding and routing of signal wires and main circuit wires).	Implement noise control measures.
Er1 (Memory error)	(1) When writing data (especially initializing or copying data), the inverter was shut down so that the voltage to the control PCB has dropped	Initialize the function parameter data with (04.03); After initialization, check if pressing the  key releases the alarm .	Revert the initialized function code data to their previous settings, then restart the operation.
	(2) Inverter affected by strong electrical noise when writing data (especially initializing or copying data)	Check if appropriate noise control measures have been implemented (e.g., correct grounding and routing of control and main circuit wires). Also, perform the same check as described in (1) above.	Implement noise control measures. Revert the initialized function code data to their previous settings, then restart the operation.
	(3) The control PCB failed.	Initialize the function code data by setting (04.03) to "1", then reset the alarm by pressing the  key and check that the alarm goes on.	The control PCB (on which the CPU is mounted) is defective. Contact your SANCH Electric representative.
Er2 (Keypad communications error)	(1) Broken communications cable or poor contact.	Check continuity of the cable, contacts and connections.	① Re-insert the connector firmly ② Replace the cable.
	(2) Connecting many control wires hinders the front cover from being mounted, lifting the keypad.	Check the mounting condition of the front cover.	① Use wires of the recommended size (0.75mm <sup>2</sup> ) for wiring. ② Change the wiring layout inside the unit so that the front cover can be mounted firmly.
	(3) Inverter affected by strong electrical noise.	Check if appropriate noise control measures have been implemented (e.g., correct grounding and routing of communication cables and main circuit wires).	Implement noise control measures.
	(4) A keypad failure occurred	Replace the keypad with another one and check whether a keypad communications error (Er2) occurs.	Replace the keypad.
Er3 (CPU error)	(1) Inverter affected by strong electrical noise.	Check if appropriate noise control measures have been implemented (e.g. correct grounding and routing of signal wires, communications cables, and main circuit wires)	Implement noise control measures.

Code	Description for problem and Possible Causes	Checking	Suggested Measures
Er6 (Operation error)	(1) The  key was pressed when (04.96 = 1, 3)	Check that the  key was pressed when a run command had been entered from the input terminal or through the communications port.	If this was not intended, check the setting of 04.96.
	(2) The start check function was activated when 04.96 = 2, 3	Check that any of the following operations has been performed with a run command being entered. • Turning the power ON • Releasing the alarm	Review the running sequence to avoid input of a Run command when this error (Er6) occurs. If this was not intended, check the setting of 04.96 (Turn the run command OFF before releasing the alarm.)
	(3) The forced stop digital input [mSTOP] was turned OFF	OFF Check that turning the [mSTOP] OFF decelerated the inverter to stop.	If this was not intended, check the settings of 01.01~01.09 terminals MI1~MI9.
Er7 (Auto-tuning error)	(1) A phase was missing (There was a phase loss) in the connection between the inverter and the motor.		Properly connect the motor to the inverter.
	(2) V/f or the rated current of the motor was not properly set.	Check whether the data of function parameter (00.04.00.05.04.50.04.51.04.52.04.53.04.65.04.66.03.02.03.03) matches the motor specifications.	Check whether the data of function parameter (00.04.00.05.04.50.04.51.04.52.04.53.04.65.04.66.03.02.03.03) matches the motor specifications.
	(3) The wiring length between the inverter and the motor was too long.	Check whether the wiring length between the inverter and the motor exceeds 164 ft (50 m). (Small capacity inverters are greatly affected by the wiring length.)	① Review, and if necessary, change the layout of the inverter and the motor to shorten the connection wire. Alternatively, minimize the wiring length without changing the layout. ② Disable both auto-tuning and auto-torque boost (set as 00.37=1).
	(4) The rated capacity of the motor was significantly different from that of the inverter.	Check whether the rated capacity of the motor is three or more ranks lower, or two or more ranks higher than that of the inverter.	① Replace the inverter with one with an appropriate capacity ② Manually specify the values for the motor parameter (03.06.03.07.03.08). ③ Disable both auto-tuning and auto-torque boost (set as 00.37=1).
	(5) The motor was a special type such as a high-speed motor.		Disable both auto-tuning and auto-torque boost (set as 00.37=1).
	(6) A tuning operation involving motor rotation (03.04 = 2 or 3) was attempted while the brake was applied to the motor.		① Specify the tuning that does not involve the motor rotation (03.04 = 1). ② Release the brake before tuning that involves the motor rotation (03.04 = 2 or 3).

Code	Description for problem and Possible Causes	Checking	Suggested Measures
Er8 (RS485 communications error (COM port 1)) Erp (RS485 communications error (COM port 2))	(1) Communications conditions of the inverter do not match that of the host equipment.	Compare the settings of the 11. 01~11. 10/11. 11~11. 20 with those of the host equipment	Correct any settings that differ.
	(2) Even though no-response error detection time (11. 08, 11. 18) has been set, communications is not performed within the specified cycle.	Check the host equipment.	Change the settings of host equipment software or disable the no-response error detection (11.08/11.18 = 0).
	(3) The host equipment did not operate due to defective software, settings, or defective hardware.	Check the host equipment (e.g., PLCs and computers).	Remove the cause of the equipment error.
	(4) The RS485 converter did not operate due to incorrect connections and settings, or defective hardware.	Check the RS485 converter (e.g., check for poor contact).	Change the various RS485 converter settings, reconnect the wires, or replace hardware with recommended devices as appropriate.
	(5) Broken communications cable or poor contact.	Check the continuity of the cables, contacts and connections.	Replace the cable.
	(6) Inverter affected by strong electrical noise.	Check if appropriate noise control measures have been implemented (e.g., correct grounding and routing of communications cables and main circuit wires).	①Implement noise control measures. ②Implement noise reduction measures on the host side. ③Replace the RS485 converter with a recommended insulated one.
	(7) Terminating resistor or not properly configured.	Check that the inverter serves as a terminating device in the network.	Configure the terminating resistor switch(es) (SW2/SW3) for RS485 communication correctly. (That is, turn the switch(es) to ON.)
ErF (Data saving error during under-voltage)	(1) During data saving performed when the power was turned OFF, the voltage fed to the control PCB dropped in an abnormally short period due to the rapid discharge of the DC link bus.	Check how long it takes for the DC link bus voltage to drop to the preset voltage when the power is turned OFF.	Remove whatever is causing the rapid discharge of the DC link bus voltage. After pressing the  key and releasing the alarm, return the data of the relevant function parameters the frequency commands and PID commands (specified through the keypad) or the output frequencies modified by the [mUP]/[DOWN] terminal commands) back to the original values and then restart the operation.

Code	Description for problem and Possible Causes	Checking	Suggested Measures
ErF (Data saving error during under-voltage)	(2) Inverter operation affected by strong electrical noise when the power was turned OFF.	Check if appropriate noise control measures have been implemented (e.g., correct grounding and routing of control and main circuit wires).	Implement noise control measures. After pressing the  key and releasing the alarm, return the data of the relevant function codes (such as the frequency commands and PID commands (specified through the keypad) or the output frequencies modified by the [mUP]/[DOWN] terminal commands) back to the original values and then restart the operation.
	(3) The control circuit failed.	Check if ErF occurs each time the power is turned ON.	The control PCB (on which the CPU is mounted) is defective. Contact your SAVCH Electric representative.
ErE (Speed mismatch or excessive speed deviation)	(1) overload	Measure the output current.	Reduce the load.
		Check whether any mechanical brake is working.	Release the mechanical brake.
	(2) The motor speed does not rise due to the current limiter operation.	Check the data of function parameter (00.44) (Current limiter (Level)).	Change the 00.44 data correctly. Or, set the 00.43 data to "0" (Disable) if the current limiter operation is not needed.
		Check the data of function parameter 00.04, 00.05, 03.01~03.12 to ensure that the V/f pattern setting is right.	① Match the V/f pattern setting with the motor ratings. ② Change the function parameter data in accordance with the motor parameters.
	(3) Function parameter settings do not match the motor characteristics.	Check whether the data of 03.01, 03.02, 03.03, 03.06, 03.07, 03.08, 03.09, 03.10, 03.12 match the parameters of the motor.	Perform auto-tuning of the inverter, using the function parameter 03.04.
	(4) Wiring to the motor is incorrect.	Check the wiring to the motor.	Connect the inverter output terminals U, V, and W to the motor input terminals U, V, and W, respectively.
(5) The motor speed does not rise due to the torque limiter operation.	Check the data of Torque limiter (00.40).	Correct the 00.40 data. Or, set the 00.40 data to "999" (Disable) if the torque limiter operation is not needed.	
nrB (NTC wire break error)	(1) The NTC thermistor cable is broken.	Check whether the motor cable is broken.	Replace the motor cable.
	(2) The temperature around the motor is extremely low (lower than -30°C)	Measure the temperature around the motor.	Reconsider the use environment of the motor.
	(3) The NTC thermistor is broken.	Measure the resistance of the NTC thermistor.	Replace the motor.
Err (Mock alarm)	Set the function parameter 04.45 data to "1" for performing this alarm.		Press RESET key for recovery.

Code	Description for problem and Possible Causes	Checking	Suggested Measures
Cof (PID feedback wire break )	(1) The PID feedback signal wire is broken.	Check whether the PID feedback signal wires are connected correctly.	①Check whether the PID feedback signal wires are connected correctly. Or, tighten up the related terminal screws. ②Check whether any contact part bites the wire sheath.
	(2) PID feedback related circuit affected by strong electrical noise.	Check if appropriate noise control measures have been implemented (e.g., correct grounding and routing of signal wires, communication cables, and main circuit wires).	①Implement noise control measures. ②Separate the signal wires from the main power wires as far as possible.



## **8.MAINTENANCE AND INSPECTION**

Perform daily and periodic inspections to avoid trouble and keep the reliability of the inverter at its maximum.

### **8.1 DAILY INSPECTION**

Visually inspect the inverter for operation errors from the outside without removing the covers when the inverter is ON or operating.

- Check that the expected performance (satisfying the standard specification) is obtained.
- Check that the surrounding environment satisfies the requirements given in Chapter 2, Section 2.1 "Operating Environment".
- Check that the LED monitor on the keypad display normally.
- Check for abnormal noise, odor, or excessive vibration.
- Check for traces of overheat, discoloration and other defects.

### **8.2 PERIODIC INSPECTION**

Perform periodic inspections according to the items listed in Table below. Before performing periodic inspections, be sure to stop the motor and remove the front cover with the inverter power OFF.

List of Periodic Inspections

Check part	Check item	Method of inspection	Evaluation criteria	
Ambient environment	1) Check the surrounding temperature, humidity, vibration and atmosphere (dust, gas, oil mist, or water drops). 2) Check that tools or other foreign materials or dangerous objects are not left around the equipment.	Check visually or measure using apparatus.	The standard specifications must be satisfied.	
Input voltage	Check that the input voltages of main and control circuit are correct.	Measure the input voltages using a multimeter or the like.	The standard specifications must be satisfied.	
Keypad	1) Check that the display is clear. 2) Check that there is no missing part in the displayed characters.	Visual inspection	No abnormalities	
Structure such as frame and cover	Check for: 1) Abnormal noise or excessive vibration 2) Loose bolts (at clamp sections). 3) Deformation and breakage 4) Discoloration caused by overheat 5) Contamination and accumulation of dust or dirt	1) Visual or auditory inspection 2) Retighten. 3), 4), 5) Visual inspection	No abnormalities	
Main Circuit	Common	1) Check that bolts and screws are tight and not missing. 2) Check the devices and insulators for deformation, cracks, breakage and discoloration caused by overheat deterioration. 3) Check for contamination or accumulation of dust or dirt.	1) Retighten. 2), 3) Visual inspection	No abnormalities
	Conductor, wires	1) Check conductors for discoloration and distortion caused by overheat. 2) Check the sheath of the wires for cracks and discoloration.	1), 2) Visual inspection	No abnormalities
	Terminal blocks	Check that the terminal blocks are not damaged.	Visual inspection	No abnormalities

Check part		Check item	Method of inspection	Evaluation criteria
Main Circuit	Braking resistor	1) Check for abnormal odor or cracks in insulators caused by overheating. 2) Check for wire breakage.	1) Olfactory and visual inspection 2) Check the wires visually, or disconnect either wire and measure the conductivity with a multimeter.	1) No abnormalities 2) Within ±10% percentage of nominal resistance.
	DC link bus capacitor	1) Check for electrolyte leakage, discoloration, cracks and swelling of the casing. 2) Check that the safety valve does not protrude remarkably. 3) Measure the capacitance if necessary.	1), 2) Visual inspection 3) Auditory, visual, and olfactory inspection	1), 2) No abnormalities 3) The discharge time should not be shorter than the one specified by the replacement manual.
	Transformer, reactor	Check for abnormal roaring noise and odor.	Auditory, visual, and olfactory inspection	No abnormalities
	magnetic contactor, relay	1) Check for chatters during operation. 2) Check that contact surface is not rough.	1) Auditory inspection 2) Visual inspection	No abnormalities
Control circuit	PCB	1) Check for loose screws and connectors. 2) Check for odor and discoloration. 3) Check for cracks, breakage, deformation and remarkable rust. 4) Check the capacitors for electrolyte leaks and deformation.	1) Retighten. 2) Olfactory and visual inspection 3), 4) Visual inspection	No abnormalities
Cooling system	Cooling Fan	1) Check for abnormal noise and excessive vibration. 2) Check for loose bolts. 3) Check for discoloration caused by overheating.	1) Auditory and visual inspection, or turn manually (be sure to turn the power OFF). 2) Retighten. 3) Visual inspection	No abnormalities
	Ventilation path	Check the heat sink, intake and exhaust ports for clogging and foreign materials.	Visual inspection	No abnormalities

### 8.3 Measurement of Electrical Amounts in Main Circuit




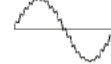
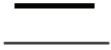







Because the voltage and current of the power supply (input, primary circuit) of the main circuit of the inverter and those of the motor (output, secondary circuit) contain harmonic components, the readings may vary with the type of the meter. Use meters indicated in Table below when measuring with meters for commercial frequencies.

The power factor cannot be measured by a commercially available power-factor meter that measures the phase difference between the voltage and current. To obtain the power factor, measure the power, voltage and current on each of the input and output sides and use the following formula.

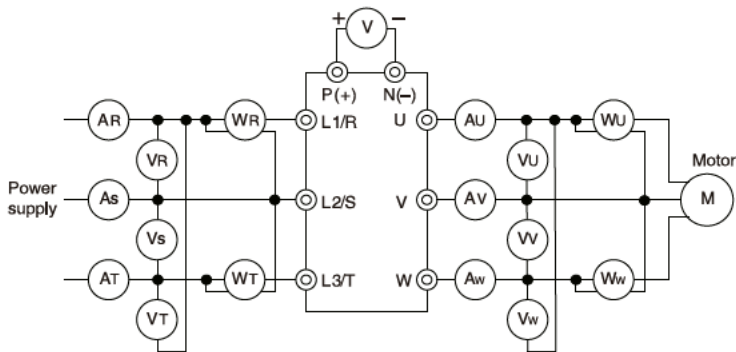
#### ■ 3-phase input

$$\text{Power factor} = \frac{\text{Electric power(W)}}{\sqrt{3} \times \text{voltage(V)} \times \text{current(A)}} \times 100 (\%)$$

### Meters for Measurement of Main Circuit

Item	Input side (primary side)			Output side (secondary side)			DC link bus voltage (P(+), N(-))
Wave form	voltage 	current 		voltage 	current 		
Meter name	Ammeter AR, AS, AT	Voltmeter VR, VS, VT	wattmeter WR, WT	Ammeter AU, AV, AW	Voltmeter VU, VV, VW	wattmeter WU, WW	DC voltmeter V
Meter type	Moving iron type	Rectifier or moving iron type	Digital AC power meter	Digital AC power meter	Digital AC power meter	Digital AC power meter	Moving coil type
Meter symbol							

Note: It is not recommended that meters other than a digital AC power meter be used for measuring the output voltage or output current since they may cause larger measurement errors or, in the worst case, they may be damaged.



Wiring diagram of meters

## 8.4 Insulation Test

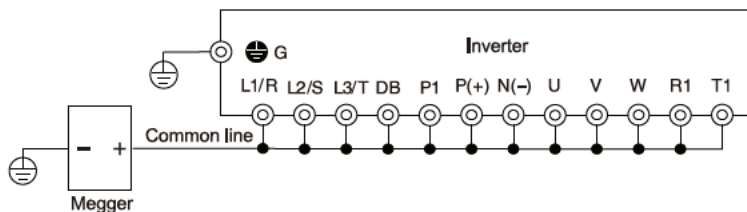
Since the inverter has undergone an insulation test before shipment, avoid making a Megger test at the customer's site.

If a Megger test is unavoidable for the main circuit, observe the following instructions; otherwise, the inverter may be damaged.

A withstand voltage test may also damage the inverter if the test procedure is wrong. When the withstand voltage test is necessary, consult your Fuji Electric representative.

### (1) Megger test of main circuit

- 1) Use a DC500V Megger and shut off the main power supply without fail before measurement.
- 2) If the test voltage leaks to the control circuit due to the wiring, disconnect all the wiring from the control circuit.
- 3) Connect the main circuit terminals with a common line as shown in below figure.
- 4) The Megger test must be limited to across the common line of the main circuit and the ground (⊕).
- 5) Value of 5 MΩ or more displayed on the Megger indicates a correct state. (The value is measured on an inverter alone.)



Wiring diagram of Main Circuit Terminal for Megger Test

### (2) Insulation test of control circuit

Do not make a Megger test or withstand voltage test for the control circuit. Use a high resistance range tester for the control circuit.

- 1) Disconnect all the external wiring from the control circuit terminals.
- 2) Perform a continuity test to the ground. One MΩ or a larger measurement indicates a correct state.

### (3) Insulation test of external main circuit and sequence control circuit

Disconnect all the wiring connected to the inverter so that the test voltage is not applied to the inverter.

## **9.1 Braking resistor selection guide**

The choice of braking resistor needs to be determined according to the power generated by the motor in the actual application system and has the relationship with the inertia of the system, the deceleration time, the energy that the bit can load, etc., and needs the customer to choose according to the actual situation. The larger the system inertia, the shorter the deceleration time required, the more frequent braking, the greater the braking resistance power to choose, the smaller the resistance, but not lower than the recommended minimum resistance.

(1) When braking, the regenerative energy of the motor is almost entirely consumed on the brake resistor.

The formula is:  $U \times U / R = P_b$

U - braking voltage with stable system brake (440V-class default is DC750V, 220V-class default is DC360V)

$P_b$  - braking power

(2) brake resistor power selection

The power of the brake resistor is theoretically the same to the braking power, but considering the derating is 70%.

The formula is:  $0.7 \times P_r = P_b \times ED$

$P_r$  - resistance power

ED - brake rate (brake process accounts for the proportion of the entire work process)

Common occasions	Elevator	Winding and unwinding	Centrifuge	General brake load
Brake rate (ED)	20~30%	20~30%	50~60%	5%~10%

(3) brake resistor selection calculation reference

① 380V5.5kW motor applications, for example, check the table below to get: 10% braking resistor resistance specifications: 500W100Ω, as applied to the lifting industry needs up to 30% of the braking rate, the formula between the resistance power and braking rate is in direct proportion.

Therefore, the choice of resistance specifications:  $500W \times (30\% / 10\%) = 1500W100\Omega$ .

② If the braking torque is not enough, the test will need to use 80Ω to ensure not jump OU (inverter over-voltage), the formula that the resistance is inversely proportional to the braking power.

Therefore, the new resistance specification at 10% ED is:  $500W \times (100\Omega / 80\Omega) = 625W80\Omega$ .

③ If the lifting load is heavy, also needs 80Ω resistor and 30% braking rate.

Then the new resistance specifications:  $625W \times (30\% / 10\%) = 1875W80\Omega$ .

## 9.2 Braking resistor list

S3100 220V braking resistor list

Voltage	Applicable motor		Full load output torque(Nm)	Applied resistor specification	Braking unit	Quantity	Braking torque 10%ED%	Min resistance
	HP	kW			Quantity			
220V Series	0.5	0.4	2.22	RXHG-80W-400R-J ( 80W 400Ω )	X	1	125	150Ω
	1	0.75	4.15	RXHG-80W-200R-J ( 80W 200Ω )	X	1	125	80Ω
	2	1.5	8.31	RXHG-300W-100R-J ( 300W 100Ω )	X	1	125	55Ω
	3	2.2	12.19	RXHG-300W-70R-J ( 300W 70Ω )	X	1	125	35Ω
	5.4	4.0	22.16	RXHG-400W-40R-J ( 400W 40Ω )	X	1	125	25Ω
	7.5	5.5	30.46	RXHG-1KW-20R-J ( 1000W 20Ω )	X	1	125	12Ω
	10	7.5	41.54	RXHG-1KW-20R-J ( 1000W 20Ω )	X	1	125	12Ω

S3100 440V braking resistor list

Voltage	Applicable motor		Full load output torque(Nm)	Applied resistor specification	Braking unit	Quantity	Braking torque 10%ED%	Min resistance
	HP	kW			Quantity			
440V Series	1	0.75	4.15	RXHG-80W-750R-J ( 80W 750Ω )	X	1	125	260
	2	1.5	8.31	RXHG-300W-400R-J ( 300W 400Ω )	X	1	125	190Ω
	3	2.2	12.19	RXHG-300W-250R-J ( 300W 250Ω )	X	1	125	145Ω
	5	4.0	22.16	RXHG-400W-150R-J ( 400W 150Ω )	X	1	125	95Ω
	7.5	5.5	30.46	RXHG-500W-100R-J ( 500W 10Ω )	X	1	125	60Ω
	10	7.5	41.54	RXHG-1KW-75R-J ( 1000W 75Ω )	X	1	125	50Ω
	15	11	60.93	RXHG-1KW-50R-J ( 1000W 50Ω )	X	1	125	40Ω
	20	15	83.09	RXHG-1.5KW-40R-J ( 1500W 40Ω )	X	1	125	40Ω
	25	18.5	102.47	BRU-4.8KW-32R-J ( 4800W 32Ω )	X	1	125	32Ω
	30	22	121.86	BRU-4.8KW-27R-J ( 4800W 27.2Ω )	X	1	125	27.2Ω

Voltage	Applicable motor		Full load output torque(Nm)	Applied resistor specification	Braking unit	Quantity	Braking torque 10%ED%	Min resistance
	HP	kW			Quantity			
440V Series	40	30	166.17	BRU-6KW-20R-J ( 6000W 20Ω )	DBU-4030	1	100	20Ω
					1			
	50	37	204.94	BRU-9.6KW-13R6-J (9600W 13.6Ω)	DBU-4045	1	100	13.6Ω
					1			
	60	45	249.26	BRU-9.6KW-13R6-J (9600W 13.6Ω)	DBU-4045	1	100	13.6Ω
					1			
	75	55	304.65	BRU-9.6KW-13R6-J (9600W 13.6Ω)	DBU-4045	1	100	13.6Ω
					2 (parallel connection)			
	100	75	415.43	BRU-9.6KW-13R6-J (9600W 13.6Ω)	DBU-4045	2 (parallel connection)	100	6.8Ω
					2 (parallel connection)			
	120	90	498.51	BRU-9.6KW-13R6-J (9600W 13.6Ω)	DBU-4045	2 (parallel connection)	100	6.8Ω
					2 (parallel connection)			
	150	110	609.29	BRU-9.6KW-13R6-J (9600W 13.6Ω)	DBU-4220	2 (parallel connection)	100	6.8Ω
					1			
	180	132	731.15	PRU-30KW-4R0-J (30000W 4Ω)	DBU-4220	1	100	4Ω
1								
215	160	886.24	PRU-30KW-4R0-J (30000W 4Ω)	DBU-4220	1	100	4Ω	
				1				
270	200	1107.08	PRU-30KW-4R0-J (30000W 4Ω)	DBU-4220	1	100	3Ω	
				1				
300	220	1218.58	PRU-30KW-4R0-J (30000W 4Ω)	DBU-4220	1	100	3Ω	
				1				
380	280	1550.92	PRU-60KW-2R0-J (60000W 2Ω)	DBU-4300	1	100	2Ω	
				1				
430	315	1744.79	PRU-60KW-2R0-J (60000W 2Ω)	DBU-4220	1	100	2Ω	
				2 (parallel connection)				

### 9.3 Input/output AC/DC reactor specifications list for S3100 series inverter

S3100 220V Input/output AC reactor and DC reactor specification list

Inverter model	Applied input AC reactor	Applied output AC reactor	Applied DC reactor
S3100-2T0.4G	ACL-0005-EISC-E2M8C	OCL-0005-EISC-E1M4C	×
S3100-2T0.75G	ACL-0005-EISC-E2M8C	OCL-0005-EISC-E1M4C	×
S3100-2T1.5G	ACL-0010-EISC-E1M4C	OCL-0010-EISC-EM70C	×
S3100-2T2.2G	ACL-0015-EISC-EM93C	OCL-0015-EISC-EM47C	×
S3100-2T4.0G	ACL-0020-EISC-EM70C	OCL-0020-EISC-EM35C	×
S3100-2T5.5G	ACL-0030-EISCL-EM47C	OCL-0030-EISCL-EM23C	×
S3100-2T7.5G	ACL-0040-EISCL-EM35C	OCL-0040-EISCL-EM18	×

S3100 440V Input/output AC reactor and DC reactor specification list

Inverter model	Applied input AC reactor	Applied output AC reactor	Applied DC reactor
S3100-4T0.75G/1.5P	ACL-0005-EISC-E2M8C	OCL-0005-EISC-E1M4C	×
S3100-4T1.5G/2.2P	ACL-0005-EISC-E2M8B	OCL-0005-EISC-E1M4C	×
S3100-4T2.2G/4.0P	ACL-0007-EISC-E2M0C	OCL-0007-EISC-E1M0C	×
S3100-4T4.0G/5.5P	ACL-0010-EISC-E1M4C	OCL-0010-EISC-EM70C	×
S3100-4T5.5G/7.5P	ACL-0015-EISC-EM93C	OCL-0015-EISC-EM47C	×
S3100-4T7.5G/11P	ACL-0020-EISC-EM70C	OCL-0020-EISC-EM35C	×
S3100-4T11G/15P	ACL-0030-EISCL-EM47C	OCL-0030-EISC-EM23C	×
S3100-4T15G/18.5P	ACL-0040-EISCL-EM35C	OCL-0040-EISC-EM18	×
S3100-4T18.5G/22P	ACL-0050-EISCL-EM28C	OCL-0050-EISC-EM14C	×
S3100-4T22G/30P	ACL-0060-EISCL-EM24C	OCL-0060-EISC-EM12C	×
S3100-4T30G/37P	ACL-0090-EISCL-EM16	OCL-0080-EISC-E87U	DCL-0065-EIDH-EM80
S3100-4T37G/45P	ACL-0090-EISCL-EM16	OCL-0090-EISC-E78U	DCL-0078-EIDH-EM70
S3100-4T45G/55P	ACL-0120-EISCL-EM12C	OCL-0120-EISC-E58U	DCL-0095-EIDH-EM54
S3100-4T55G/75P	ACL-0150-EISH-E95UC	OCL-0150-EISH-E47U	DCL-0115-EIDH-EM45
S3100-4T75G/90P	ACL-0200-EISH-E70UC	OCL-0200-EISH-E35U	DCL-0160-UIDH-EM36
S3100-4T90G/110P	ACL-0250-EISH-E56UC	OCL-0250-EISH-E28U	DCL-0180-UIDH-EM33
S3100-4T110G/132P	ACL-0250-EISH-E56UC	OCL-0250-EISH-E28U	DCL-0250-UIDH-EM26
S3100-4T132G/160P	ACL-0290-EISH-E48UC	OCL-0290-EISH-E24UC	DCL-0250-UIDH-EM26
S3100-4T160G/200P	ACL-0330-EISH-E42UC	OCL-0330-EISH-E21UC	DCL-0340-UIDH-EM17
S3100-4T200G/220P	ACL-0490-EISH-E28UC	OCL-0490-EISH-E14UC	DCL-0460-UIDH-EM09
S3100-4T220G/280P	ACL-0490-EISH-E28UC	OCL-0490-EISH-E14UC	DCL-0460-UIDH-EM09
S3100-4T280G/315P	ACL-0600-EISH-E23UC	OCL-0600-EISH-E12UC	DCL-0650-UIDH-E72U
S3100-4T315G/355P	ACL-0660-EISH-E25UC	OCL-0660-EISH-E11U	DCL-0650-UIDH-E72U

## Appendix:

### A: User manual upgrade record

Date	After upgrade	Upgrade content
2017-05	V1.0	1st version
2017-09	V1.1	1. Add the seventh chapter part of the abnormal occurrence and removal methods 2. to add some of the details of the chapter description
2018-03	V1.2	Add the content of the fourth chapter, the sixth chapter, the eighth chapter, the ninth chapter, synchronized with the chinese version of this manual detailed version.