SAVCH ELECTRIC

S5100 Series Inverter

High performance vector (Synchronous)

User manual

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SAVCH

User manual

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SAVCH electric provide a full range of technical support for our customers. All users could contact with the nearest SAVCH office or service center, also could contact with our headquarters directly.

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PREFACE

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 semi-conductor 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.

1.1 Safety precaution

Application precaution

⚠ Danger
●S5100 series inverter is used to drive permanent magnet synchronous motor and three-three asynchronous motor; it cannot be used for single-phase motors or other purposes. **Otherwise, Fire or an accident could happen.** ●S5100 series of inverters cannot be used for a life-support system or other purposes directly related to the human safety. ●The product is produced under strict quality control; install safety devices for applications where serious accidents or property damages are foreseen in relation to the failure of it. **Otherwise, An accident could happen.**

Installation precaution

⚠ 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 ℃ to prevent over-heating or fire. ●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. ●Inverters with a capacity of 30 KW or above, whose protective structure is IP00, involve a possibility that a human body may touch the live conductors of the main circuit terminal block. Inverters to which an optional DC reactor is connected also involve the same. Install such inverters in an inaccessible place **Otherwise, electric shock or injuries could happen.**

⚠ Caution
●Prevent lint, paper fibers, sawdust, dust, metallic chips, or other foreign materials from getting into the inverter or from accumulating on the cooler. ●When changing the positions of the top and bottom mounting bases, use only the specified screws. **Otherwise, it may cause a fire, or an accident.** ●Do not install or operate an inverter that is damaged or lacking external or internal parts. **Otherwise, it may cause a fire, an accident or injury**

Wiring Precaution

⚠ Danger
●When wiring the inverter to the power source, insert a recommended molded case circuit breaker (MCCB) or residual-current-operated protective device (RCD)/earth leakage circuit breaker (ELCB) (with over-current protection) in the path of each pair of power lines to inverters. Use the recommended devices within the recommended current capacity. ●Make sure to use the specified wire. ●Tighten terminals with specified torque. ●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. ●Do not connect a surge killer to the inverter's output (secondary) circuit. ●Be sure to connect an optional DC reactor (DCR) when the capacity of the power supply transformer exceeds 500 kVA and is 10 times or more the inverter rated capacity(accessories) **Otherwise, it may cause a fire,** ●Ground the inverter in compliance with the national or local electric code (China is C). ●Be sure to ground the inverter's grounding terminals ⏚G. **Otherwise, it may cause an electric shock, a fire .** ●Make sure to perform wiring after turning the power OFF. **Otherwise, it may cause an electric shock.** ●Do not connect the power supply wires to output terminals (U, V, and W). ●Do not connect to terminals other than terminals P (+)and DB ,when connecting the DC brake resistor. **Otherwise, it may cause a fire ,an accident.** ●Make sure that the control signal wires will not come into contact with live conductors of the main circuit. **Otherwise, it may cause an accident or an electric shock**

⚠ Caution
●The inverter, motor and wiring generate electric noise, and sometimes this may cause the malfunction of nearby sensors and devices. To prevent malfunction, take measures to prevent implement noise. **Otherwise it may cause an accident**

Operation Precaution

⚠ Danger
●Make sure to mount the front cover before turning the power ON; Do not remove the cover when the inverter power is ON. ●Do not operate switches with wet hands. **Otherwise, it may cause an electric shock** ●If the auto-reset function has been selected, the inverter may automatically restart and drive the motor depending on the cause of tripping. Design the machinery or equipment so that human safety is ensured at the time of restarting. ●If select the stall prevention function (current limit), automatic deceleration or anti-regenerative control and overload prevention control have been selected, it may operate with the acceleration/deceleration or frequency different from the commanded ones . Design the machine so that safety is ensured even in such cases. ●If any of the protective functions have been activated, first remove the cause. Then, after checking that the all run commands are set to OFF, release the alarm. If the alarm is released while any run commands are set to ON, the inverter may supply the power to the motor, running the motor. **Otherwise it may cause an accident.**

⚠ Danger
●If you enable the "Restart mode after momentary power failure", then the inverter automatically restarts running the motor when the power is recovered. Design the machinery or equipment so that human safety is ensured after restarting. ●If the user configures the function codes wrongly without completely understanding this Instruction Manual and this User's Manual, the motor may rotate with a torque or at a speed not permitted for the machine. **Otherwise, it may cause an accident or injury** ●Even if the inverter has interrupted power to the motor, if the voltage is applied to the main circuit input terminals L1/R, L2/S and L3/T, voltage may be output to inverter output terminals U, V, and W. ●Even if the motor is stopped due to DC braking or preliminary excitation, voltage is output to inverter output terminals U, V, and W. **Otherwise, it may cause an electric shock.** ●The inverter can easily accept high-speed operation. When changing the speed setting, carefully check the specifications of motors or equipment beforehand. **Otherwise it may result in injury accident**

⚠ Caution
●Do not touch the cooler and braking resistor because they become very hot. **Otherwise, it may cause burns.** ●The DC brake function of the inverter does not provide any holding mechanism. **Otherwise, it may cause an injury accident.**

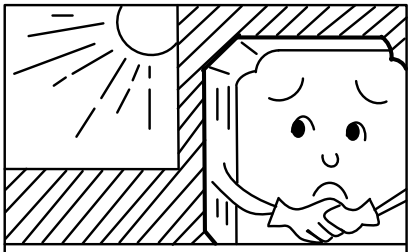
Maintenance and Parts Replacement Precaution

⚠Danger
●Before proceeding to the maintenance/inspection jobs, 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) **Otherwise, it may cause an electric shock** ●Maintenance and parts replacement should be made only by qualified persons. ●Take off the metallic objects (watch, rings) before starting work. ●Use insulated tools . ●Never modify the inverter. **Otherwise,it may cause an electric shock or injury**

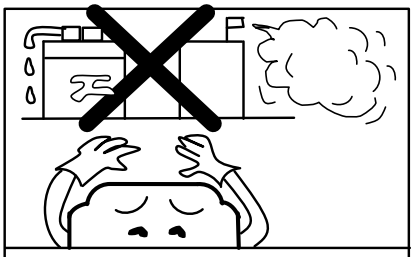
Disposal Precaution

⚠ Caution
●Treat the inverter (S5100) as an industrial waste when disposing of it. **Otherwise,It may cause an injury accident**

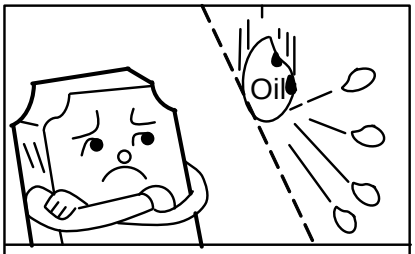
1.2 Notes for Operation Environment



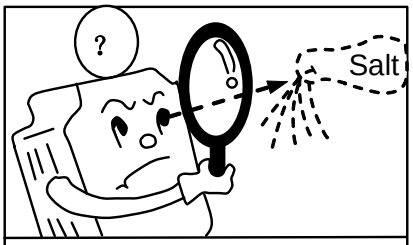
Direct sunlight



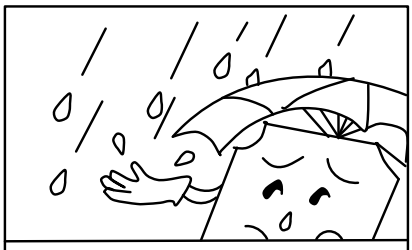
Corrosive gas or fluids



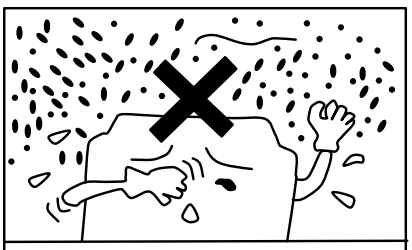
Oil



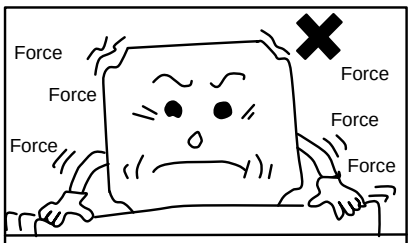
Salt or saline



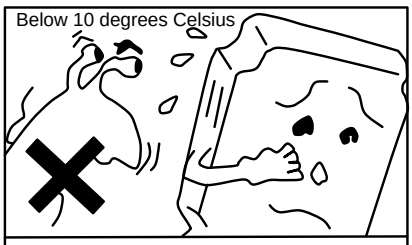
Rain, moisture



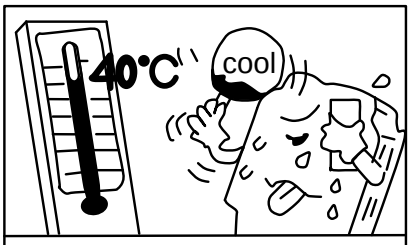
Iron chips and dust



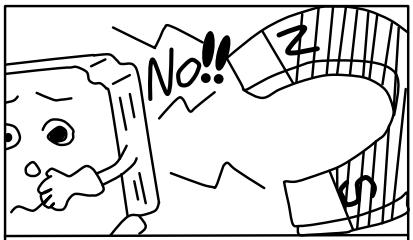
Large impelling



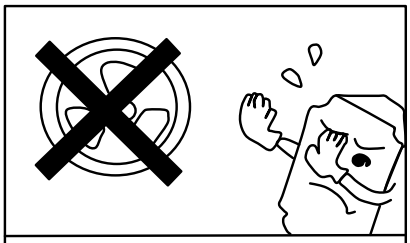
Extreme low temperatures



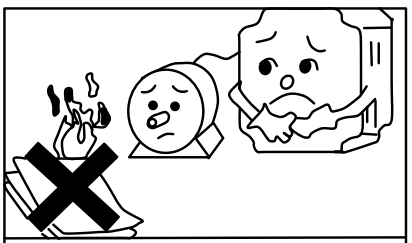
Extreme high ambient temperatures (Above 40℃)



Electromagnetic waves and ultra high-angle rays (For example：locations of welding machines and etc.)



Radioactive materials



Locations of inflammable materials

2.1 Operational Environment

Installation environment has a direct impact on the normal function of and life span of the inverter, so install S5100 series of inverters in an environment that satisfies the requirements listed in Table 2.1:

Table 2.1 Operational Environmental Requirements

Items	Specifications
Ambient temperature	-10 to+50℃; When inverters (22kW or below) are mounted side-by-side without any clearance between them, the surrounding temperature should be within the range from -10 to +40°C (14 to 104°F)
Relative humidity	No condensation below 90%
Environment Atmosphere	The inverter must not be exposed to dust, direct sunlight, corrosive, gases, flammable gases, oil mist, lint and small metal filings,vapor,electromagnetic interference (welding machines, power machines) , water drops, or vibration (punch). Keep away from radioactive materials and flammable object. Install antivibration pads to reduce vibration if vibration cannot be avoided
Altitude	1,000 m or less (Note 1)
Atmospheric pressure	86~106kPa
Vibration	3mm (max. amplitude) within 2 ~ 9 Hz 9.8 m/s^2 within 9 ~ 20 Hz 2 m/s^2 within 20 ~ 55 Hz 1 m/s^2 within 55 ~ 200 Hz

(Note 1) If you use the inverter in an altitude above 1000 m (3300 ft), you should apply an output current derating factor as listed in Table 2.2.

Table 2.2 The output Current Derating Factor in Relation to Altitude

Altitude	Output current derating factor
1,000 m (3300 ft)or lower	1
1,000~1,500m	0.97
1,500~2,000m	0.95
2,000~2,500m	0.91
2,500~3,000m	0.88

2.2 Installation matters

(1) Installing base

Install the inverter on a base made of metal or other non-combustible; do not mount it upside down, obliquely or horizontally.

⚠ Warning
Install the inverter on a base made of metal or other non-combustible. **Otherwise ,it may cause a fire.**

(2) Installation Clearance

Make sure that the minimum clearances indicated in Figure 2.1 and Table 2.3 are maintained at all times. When mounting the inverter in the panel of your system, take extra care with ventilation inside the panel as the surrounding temperature easily rises. Do not mount the inverter in a small panel with poor ventilation, it's easy to cause failure due to the inverter overheating.

Figure 2.1 Installation diagrammatic drawing

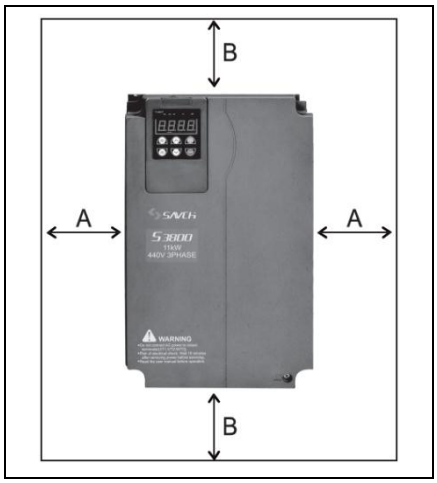
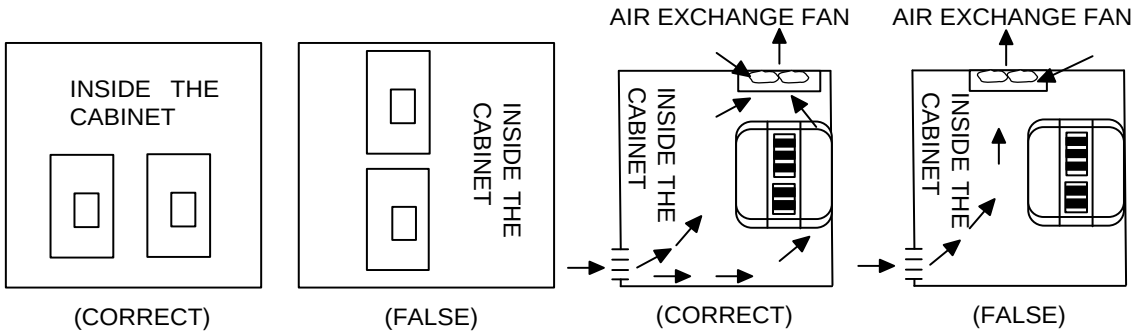


Table 2.3 Installation Clearance (mm)

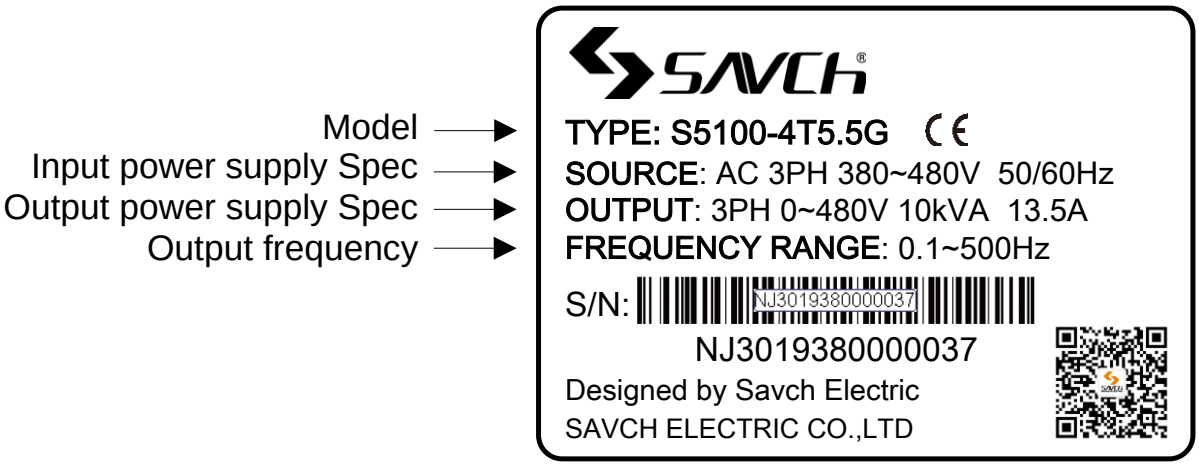
Inverter capacity	A	B
5.5~22kW	10	100
30~75 kW	50	

(3) Installing two or more inverters

When installing several inverters in the same unit or panel, install them side by side. When one must be installed above the other, be sure to separate them with a partition plate, or the like, so that any heat radiating from an inverter will not affect the one/s above. and pay attention to put the position for cooling , must install cooling fans on the case, to make the inverter surrounding temperature below 50 ℃ for the principle.As long as the surrounding temperature is 40°C(104°F) or lower, inverters of 22kW or below can be mounted side by side without any clearance between them.



2.3 Model Description



S	5100	-	4T	5.5	G
SAVCH	Product series name		Input power source: 4T: 3 ph 440V	Applicable motor rating 5.5：5.5kW 7.5：7.5kW . . . . . . 22：22kW . . . . . . 200：200kW	G: General

2.4 Inverter Specifications

2.4.1 Standard Specifications

(5.5 to 110kW) HD (Heavy Duty) spec for heavy duty

Item		Specifications									
Type(S5100-4T***G)		5.5	7.5	11	15	18.5	22	30	37	45	55
Nominal applied motor[kW](*1)(rated output)		5.5	7.5	11	15	18.5	22	30	37	45	55
Rated output	Rated power [kVA] (*2)	10	14	18	24	29	34	45	57	69	85
	Voltage [V]	3 ph 380~480V(With AVR function)									
	Rated current [A]	13.5	18.5	24.5	32	39	45	60	75	91	112
	Overload capability	150%-1min,200%-3.0s									
Input power	Voltage, frequency	380~480V,50Hz /60Hz									
	Voltage, frequency variations	Voltage:+10~15%(Interphase unbalance rate is within 2%, frequency:+5~-5%)									
	Required power supply capacity(with DCR) [kVA] (*3)	7.4	10	15	20	25	30	40	48	58	71
	Rated input current (without DCR) [A]	17.3	23.2	33	43.8	52.3	60.6	—			
	Rated input current (with DCR) [A]	—						62	76	91	105
Braking torque [%]		100%		20%				10~15%			
Braking transistor		Standard built-in						—			
DC reactor(DCR)		Optional (*4)						Standard built-in			
Enclosure		IP20 closed type						IP00			
Cooling method		Fan cooling									

Item		Specifications			
Type (S5100-4T***G)		75	90	110	132~200kW on the way
Nominal applied motor[kW](*1)(rated output)		75	90	110	
Rated output	Rated power [kVA] (*2)	114	134	160	
	Voltage [V]	3 ph 380~480V(With AVR function)			
	Rated current [A]	150	176	210	
	Overload capability	150%-1min,200%-3.0s			
Input power	Voltage, frequency	380~480V,50Hz /60Hz			
	Voltage, frequency variations	Voltage:+10~15%(Interphase unbalance rate is within 2%, frequency:+5~-5%)			
	Required power supply capacity (with DCR) [kVA] (*3)	96	114	140	
	Rated input current (without DCR) [A]	—			
	Rated input current (with DCR) [A]	140	160	210	
Braking torque [%]		10~15%			
Braking transistor		—			
DC reactor (DCR)		Optional (*4)			
Enclosure		IP00			
Cooling method		Fan cooling			

(5.5 to 110kW) ND (Normal Duty) spec for light duty

Item		Specifications												
Type(S5100-4T***G)		5.5	7.5	11	15	18.5	22	30	37	45	55	75	90	110
Nominal applied motor[kW](*1)(rated output)		7.5	11	15	18.5	22	30	37	45	55	75	90	110	132
Rated output	Rated power [kVA] (*2)	12	17	22	28	33	45	57	69	85	114	134	160	192
	Voltage [V]	3 ph 380~480V(With AVR function)												
	Rated current [A]	16.5	23	30.5	37	45	60							
	Overload capability	120%-1min												
Input power	Voltage, frequency	380~480V,50Hz /60Hz												
	Voltage, frequency variations	Voltage:+10~15%(Interphase unbalance rate is within 2%, frequency:+5~-5%)												
	Required power supply capacity(with DCR) [kVA] (*3)	10	15	20	25	30	40	48	58	71	96	114	140	165
	Rated input current (without DCR) [A]	23.2	33	43.8	52.3	60.6	77.9	—						
	Rated input current (with DCR) [A]	—						76	91	105	140	160	210	240
Braking torque [%]		70%		15%				7~12%						
Braking transistor		Standard built-in						—						
DC reactor(DCR)		Optional (*4)						Standard built-in				Optional (*4)		
Enclosure		IP20 closed type						IP00						
Cooling method		Fan cooling												

(*1) Suitable 6-pole standard motor.

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

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

(*4)DC reactor (DCR) is optional part, inverter of 75KW or above must use together with the DC reactor (DCR).

2.4.2 Common specifications

Item		Explanation
Output frequency	Max. frequency	25~500Hz
	Base frequency	25~500Hz (in conjunction with the maximum frequency)
	Starting frequency	0.1~60.0Hz
	Carrier frequency	·2 to 15 kHz (HD mode:5.5 to 45 kW, ND mode:5.5 to 18.5 kW). ·2~10kHz(HD mode：55~200kW,ND mode：22~45kW) ·2~6kHz(ND mode：55~200kW) Note: The carrier frequency may automatically drop depending upon the surrounding temperature or output current to protect the servo drive. (The automatic drop function can be disabled)
	Frequency output accuracy	• Analog setting: ±0.2% of maximum frequency (at 25 ±10℃) • Keypad setting: ±0.01% of maximum frequency (at -10 to +50℃)
	Setting resolution	• Analog setting: 1/3000 of maximum frequency (1/1500 for AUI input) • Keypad setting: 0.01 Hz (99.99 Hz or less), 0.1 Hz (100.0 to 500.0 Hz) • Link operation setting: 1/20000 of maximum frequency or 0.01 Hz (fixed)
Control	Control method	• Vector control without sensor • Vector control with sensor (optional PG card)
	Starting torque	• HD mode: more than 150%, ND mode:: more than 100%
	Start/stop operation	• Keypad (RUN/STOP keys), external signals (run forward (run reverse) run/stop command etc.),Communications link (RS-485).
	Frequency Setting	• Keypad (Can use UP/DOWN keys to set) • Analog input:DC0 to ±10V/0 to ±100%(terminal AVI、AUI) :DC 4 to 20mA/0 to 100% (terminal AVI) • UP/DOWN operation: Multi-frequency (16 steps), 16-bit parallel • Pulse train input (standard): Pulse input = MI7 terminal, Rotational direction = general terminals • Communications link • Reference frequency switching, Remote/local mode switching, Auxiliary frequency setting, Proportional operation setting, and Inverse operation.
	Acceleration/ deceleration time	0.00 to 6000 s，Linear/S-curve/curvilinear, Acceleration/deceleration time settings 1 to 4 switchable.
	Stop control	• Running continued at the stop frequency, coast-to-stop, or force to stop
	Auto-restart after momentary power failure	• Trip immediately, trip after recovery from power failure, trip after deceleration to stop. • Continue to run, restart after searching for idling motor speed.
	Torque limiter	• Torque limit value ±200% • Torque limiter 1/2, analog torque limit value.
	Control functions	• Analog input adjustment (gain/offset/filter time constant), frequency limiter (high and low), bias frequency, jump frequency, frequent star running, jogging operation, cooling fan ON/OFF control, select motor 2 to 4, protect motor from dew condensation, universal DI, universal DO,universal AO, rotational direction limitation. • Overload prevention control, Overvoltage Automatic deceleration (Anti-regenerative control), PID process control, PID dancer control. • Auto-tuning (Operating modes: motor load, do not connect the mechanical transmission parts.) • Light alarm, retstar, command loss detection.

Item		Explanation
	Digital input	Run/stop forward and reverse command, select multi-frequency , select ACC/DEC time,3-wire operation stop command , Coast-to-stop command,reset alarm, enable external alarm trip, ready for jogging, select frequency command 2/1, select motor 1 to 4, enable DC braking, select torque limiter level, UP/DOWN command, enable data change with keypad, cancel PID control, switch normal/inverse operation, interlock,cancel torque limiter, enable communications link via RS-485,universal DI, force to stop, pre-excitation, reset PID integral and differential components, hold PID integral component, External terminal command control /control switch operation panel, pulse train input, pulse train sign
	Transistor output	Servo drive running, frequency arrival signal 1/3, frequency detected (3 points), under voltage detected (inverter stopped),torque polarity detected, inverter output limiting, auto-restarting after momentary power failure, motor overload early warning, keypad operation, servo drive ready to run, select the AX terminal function (primary side MC), servo drive output limiting with delay, cooling fan in operation, auto-resetting, universal DO, heat sink overheat early warning, service lifetime alarm, reference loss detected, inverter operating, overload prevention control, current detected (3 points), low level current detected, PID alarm, under PID control, PID control stopped due to slow flow water, low output torque detected, torque detected (2 points),switched to motor 1 to 4, run forward signal, run reverse signal, inverter in remote operation, PTC status detection enabled, brake signal, analog frequency reference loss on the terminal [ACI], inverter keeping speed output, speed arrived, PG error detected, maintenance timer, light alarm, alarm relay contact output (for any fault), braking resistor broken, the end of the pole position detection
	Analog output	• Terminals AFM: Output a selected signal with DC voltage (0 to +10 V) or DC current (4 to 20 mA) • Terminals DFM:Output a selected signal with pulse (25 to 6000p/s log voltage (0 to +10 V) ＜Selectable output signals＞ Output frequency (command value、the estimated value、detected value), output current, output voltage, output torque, load factor, input power, PID feedback amount, speed detected value / speed estimated value, DC link bus voltage, universal AO, motor output, calibration, PID command , PID output.
Indication	Run /stop	Speed monitor (reference frequency (Hz), output frequency, motor speed, load shaft speed, line speed, speed in %). Output current, output voltage, torque calculation value, input power, PID command value, PID feedback amount, PID output, load factor, motor output, torque current, flux command, analog signal input monitor, cumulative inverter run time, cumulative motor run time, input watt-hour, number of startups, I/O checking, energy-saving monitor.
	Alarm information	Alarm history: Saves and displays the last 4 alarm code and their detailed description
Others	Communications	RS-485 COM port 1 (for keypad connection), RS-485 COM port 2 (on terminal block)

2.5 Precautions for Using Inverters

The precautions for installation environment, power supply lines, wiring, and connection to peripheral equipment. Be sure to observe those precautions.

■Storage environment

Store it to follow the special environments listed below the table.

< Storage and transport environment>

Items	Specifications
Storage environment temperature	-25 ~ +70 ℃ (shorter storage temperature during transportation, etc.)
Relative humidity	below 90% (No condensation)
Environment	The inverter must not be exposed to dust, direct sunlight, corrosive gas, flammable gas, oil mist, steam, water drops, and vibration.The atmosphere can contain a small amount of salt. (0.01 mg/cm2 or less per year)
Atmospheric pressure	86 ~ 106kPa (Storage)
	70 ~ 106 kPa (transportation)

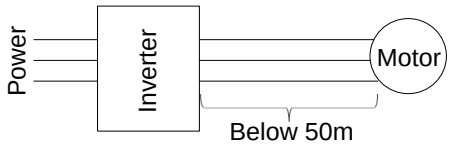
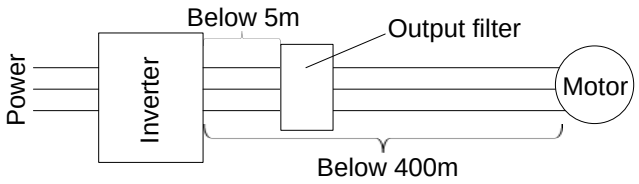
■Wiring Precaution

(1) Route the wiring of the control circuit terminals as far fromthe wiring of the main circuit as possible. Otherwise electric noise may cause malfunctions.

(2) Fix the control circuit wires inside the inverter to keep them away from the live parts of the main circuit (such as the terminal block of the main circuit).

(3) One inverter can not control multiple units of PM motor

(4) The wiring length from the inverter to the motor should not be too long, since a high-frequency current may be generated by stray capacitance between the cables and result in an over-current trip of the inverter, an increase in leakage current, or a reduction in current indication precision. Therefore, when the motor is driven by a inverter, the cable length is kept under 50m, If use longer cable ,it's more than 50m, especially in the case of connecting shielded cable with large capacitance toward ground, reduce the use of carrier frequency or use output filter. -

Condition without output filter	Condition with output filter
	

When there is an output filter, please ensure that the total length of wiring is within 400m (within 100m when vector controls)

(5) Precaution of surge voltage when the inverter drives (especially 440V class common motor)

When the inverter drives motor through the PWM way, the surge voltage generated by the inverter elements switching and output voltage overlap and are applied on the motor terminals. Especially when the motor wiring is longer, the surge voltage may cause insulation deterioration of the motor. Please conduct any countermeasures as follows.

- Use well-insulated motor.
- Connect output filter to the output side of inverter (secondary side).
- Try to shorten the length of wiring between the inverter and motor.

■ Precautions of connecting peripheral devices

(1) When the supply of power transformer is above 500kVA or the power transformer switches a phase capacitor, it's easy to cause internal failure or damage of the inverter due to too large surge voltage input to the inverter. Use AC reactor in the inverter's input circuit of (accessories) to avoid this situation.

(2) Precautions of power system (applicable for DC reactor and AC reactor)

When the supply of power transformer is above 500kVA and is 10 times more than the rated power of the inverter with semiconductor switching elements load in the same power system, use the DC reactor (accessories), otherwise % reactance of power will turn small; the harmonic components in the current flowing into the inverter will increase; the value of wave height will increase.

May cause damage to the rectifier bridge, main circuit capacitors and other components of the inverter as well as the capacity reduction of capacitor and so on.

(3) Improvement of input power factor (the reduction of higher harmonic) (applicable to DC reactor)

In order to improve the input power factor (reduce higher harmonic), use DC reactor (accessories), and then the power reactors will turn large; high harmonic currents will be suppressed; the power factor of inverter will be improved.

(4)Moulded Case Circuit Breaker (MCCB)

Install the recommended Moulded Case Circuit Breaker (MCCB) or earth leakage circuit breaker (ELCB) (with over-current protection) for the wiring protection in the inverter's input (primary) circuit. Use recommended circuit breaker within the recommended current capacity to ensure the protection.

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

<table>
<tr><th rowspan="3">Supplyvoltage</th><th rowspan="3">Applicable standard motor(kW)</th><th rowspan="3">Type of inverter</th><th rowspan="3">Specification</th><th colspan="2">Rated Current (A) of MCCB, ELCB</th></tr>
<tr><th colspan="2">DC reactor</th></tr>
<tr><th>Yes</th><th>No</th></tr>
<tr><td rowspan="28">3-phase 440V</td><td>5.5</td><td rowspan="2">S5100-4T5.5G</td><td>HD</td><td>15</td><td>30</td></tr>
<tr><td rowspan="2">7.5</td><td>ND</td><td rowspan="2">20</td><td rowspan="2">40</td></tr>
<tr><td rowspan="2">S5100-4T7.5G</td><td>HD</td></tr>
<tr><td rowspan="2">11</td><td>ND</td><td rowspan="2">30</td><td rowspan="2">50</td></tr>
<tr><td rowspan="2">S5100-4T11G</td><td>HD</td></tr>
<tr><td rowspan="2">15</td><td>ND</td><td rowspan="4">40</td><td rowspan="2">60</td></tr>
<tr><td rowspan="2">S5100-4T15G</td><td>HD</td></tr>
<tr><td rowspan="2">18.5</td><td>ND</td><td rowspan="2">75</td></tr>
<tr><td rowspan="2">S5100-4T18.5G</td><td>HD</td></tr>
<tr><td rowspan="2">22</td><td>ND</td><td rowspan="2">50</td><td rowspan="2">100</td></tr>
<tr><td rowspan="2">S5100-4T22G</td><td>HD</td></tr>
<tr><td rowspan="2">30</td><td>ND</td><td rowspan="2">75</td><td rowspan="3">125</td></tr>
<tr><td rowspan="2">S5100-4T30G</td><td>HD</td></tr>
<tr><td rowspan="2">37</td><td>ND</td><td rowspan="4">100</td></tr>
<tr><td rowspan="2">S5100-4T37G</td><td>HD</td></tr>
<tr><td rowspan="2">45</td><td>ND</td><td rowspan="2">150</td></tr>
<tr><td rowspan="2">S5100-4T45G</td><td>HD</td></tr>
<tr><td rowspan="2">55</td><td>ND</td><td rowspan="2">125</td><td rowspan="2">200</td></tr>
<tr><td rowspan="2">S5100-4T55G</td><td>HD</td></tr>
<tr><td rowspan="2">75</td><td>ND</td><td rowspan="2">175</td><td rowspan="8">-</td></tr>
<tr><td rowspan="2">S5100-4T75G</td><td>HD</td></tr>
<tr><td rowspan="2">90</td><td>ND</td><td rowspan="2">200</td></tr>
<tr><td rowspan="2">S5100-4T90G</td><td>HD</td></tr>
<tr><td rowspan="2">110</td><td>ND</td><td rowspan="2">250</td></tr>
<tr><td rowspan="2">S5100-4T110G</td><td>HD</td></tr>
<tr><td rowspan="2">132</td><td>ND</td><td>300</td></tr>
<tr><td></td><td></td><td></td><td></td></tr>
</table>

Note: In order to avoid the residual current circuit-breaker error, please choice the induction current with 200mA or above, and operation time with 0.1s or above.

(5) Magnetic contactor (MC):the inverter's input (primary) circuit

Switching magnetic contactor once can run / stop the inverter, but it's easy to cause failure due to frequent switching; the number of run / stop should be no more than once per hour at most. Do not use magnetic contactor as the power switch of the inverter, which could reduce the life of the inverter.

Tips •It's recommended that the timing sequence of magnetic contactor in the input side be disconnected by the fault alarm signal of the inverter for safety. In the event of damage to the inverter, 2 times of damage can be limited to the minimum scope. In this case, connect control power auxiliary input from the primary side of magnetic contactor, and then the running condition when an alarm occurs can be confirmed from thekeypad of the inverter.

•Damage to braking unit or the wrong connection of external braking resistor may cause damage to the internal machine of the inverter (charging resistors, etc.). If the magnetic contactor fails to output DC bus voltage or establish signal within 3 seconds after switched on, damage to braking unit or wrong connection of external braking resistor may be caused. In this case, the damage in a failure cannot be expanded via the timing sequence of the circuit breaker magnetic contactor. In the built-in models of braking transistor, output the abnormality detection signal of braking transistor and cut off the magnetic contactor in input side according to the signal.

(6) Magnetic contactor (MC):the inverter's output (secondary)

When setting the magnetic contactor in the inverter's output (secondary) for switching to commercial power, switch after both the inverter and the motor are OFF in order to prevent the roughness of contacts caused by the arcing of magnetic contactor. Do not install the main circuit surge absorber on the magnetic contactor.

(7) Connecting surge absorber and surge killer in the inverter output (secondary) circuit is prohibited.

■ PM Motor using Precautions

(1)One inverter can not control multiple units of PM motor

(2)PM motor can not run when connecting with power frequency, the motor may damage if running.

(3)When there is a brake, release the brake, then restart the motor.

(4)PM motor does not apply to the vertical transport use, such as lift machine etc.

2.6 Wiring

Perform wiring in accordance with the following steps. (Make instruction when the inverter has been installed).

2.6.1 Removal and installation of the cover and cable lead-in plate

(1) Below the capacity of 22kW:

① Loosen the cover screws; support the cover around the ends by hand; slide below and incline forward; remove upwards.

② Push the cable lead-in plate up, slide forward and remove it simultaneously before performing wiring.

③ Install the wiring lead-in plate and the surface casing in the reverse order of the above steps after performing wiring.

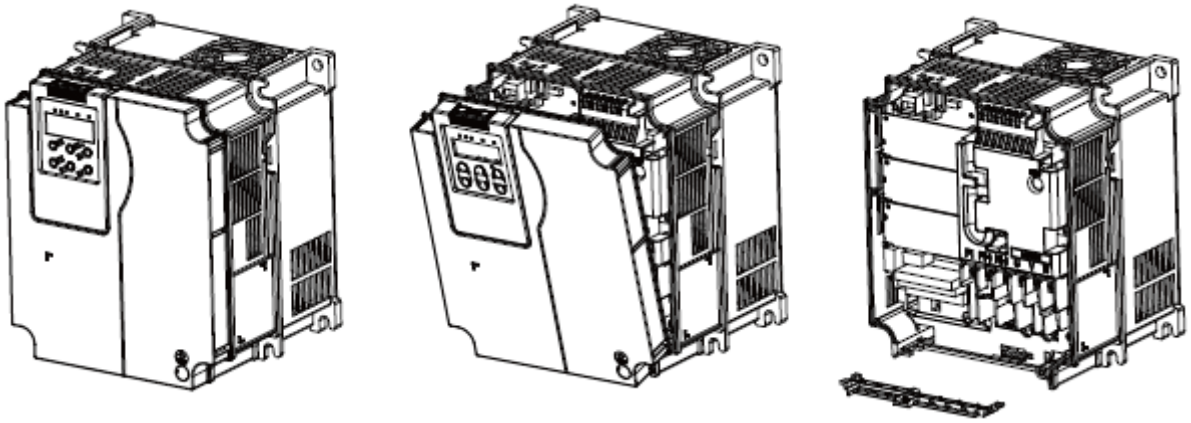


Figure 2.2 Removal of surface cover and cable lead-in plate (case of S5100-4T5.5G ~ 22G)

2.6.2 Screw specification and recommended wire specification

(1) Main circuit terminals

Screw specification and wire specification used on the main circuit wiring are as follows. The terminal position configurations are different due to different inverter powers. In Figure 2 there is no difference between the output side and input side of the ground terminal "⏚G".

Select products with the insulating layer or processed by insulated pipes for crimp terminals used for the main circuit. Recommended wire specification is to use a single strand of HIV wires at the ambient temperature condition of 50 ℃(maximum allowable temperature is 75 ℃).

Table 2.4 Screw Speciation

Supply voltage	Type of inverter	Screw Speciation						Reference
		Main circuit		Grounding		Control power auxiliary input [R1, T1]		
		Screw Size	Torque (N·m)	Screw Size	Torque (N·m)	Screw Size	Torque (N·m)	
3 phase 440V	S5100-4T5.5G	M5	3.5	M5	3.5	M3.5	1.2	Figure A
	S5100-4T7.5G							
	S5100-4T11G							
	S5100-4T15G	M6	5.8	M6	5.8			Figure B
	S5100-4T18.5G							
	S5100-4T22G							
	S5100-4T30G	M6	5.8	M6	5.8	M4	1.8	Figure C
	S5100-4T37G	M8	13.5	M8	13.5			Figure D
	S5100-4T45G							
	S5100-4T55G							
	S5100-4T75G	M10	27	M10	27			Figure E
	S5100-4T90G							
	S5100-4T110G							

⚠ Danger
The following terminals have high-voltage when set to ON. Main circuits:L1 / R, L2 / S, L3 / T, P1, P (+), N (-), DB, U, V, W, R1, T1, auxiliary contacts (RA, RB, RC, MRA , MRC) Insulation values Main circuit - Housing:basic insulation (overvoltage category Ⅲ, pollution degree Ⅱ) Main circuit - Control circuit:reinforced insulation (overvoltage category Ⅲ, pollution degree Ⅱ) Contact output - Control circuit:reinforced insulation (overvoltage category Ⅱ, pollution degree Ⅱ) **Otherwise an electric shock could happen.**

Figure A

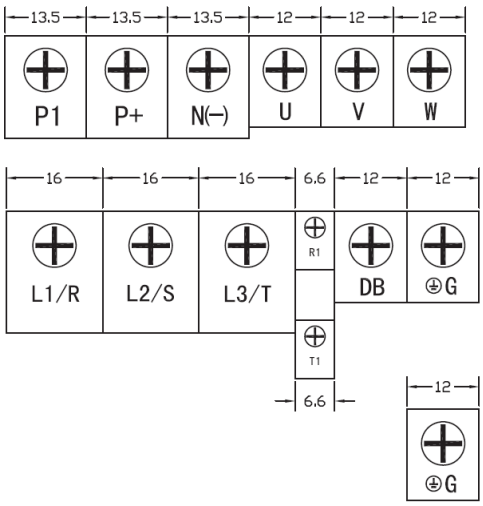


Figure B

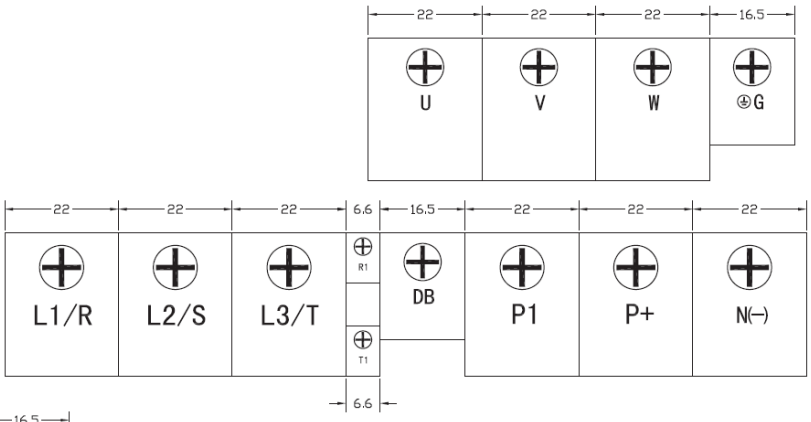


Figure C

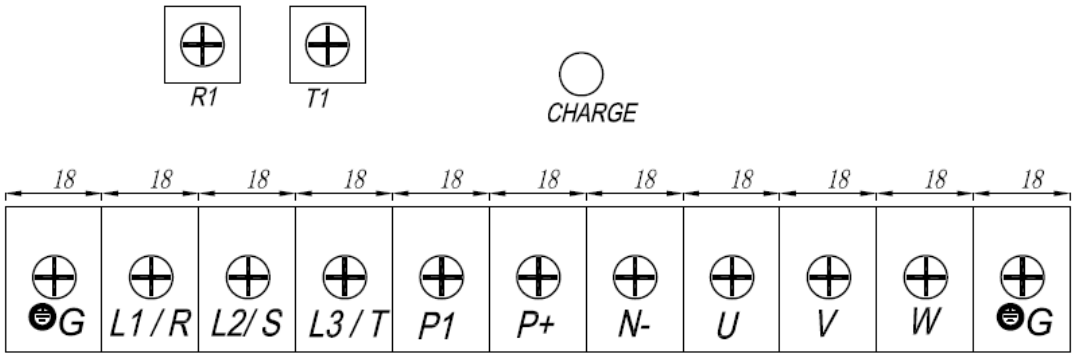


Figure D

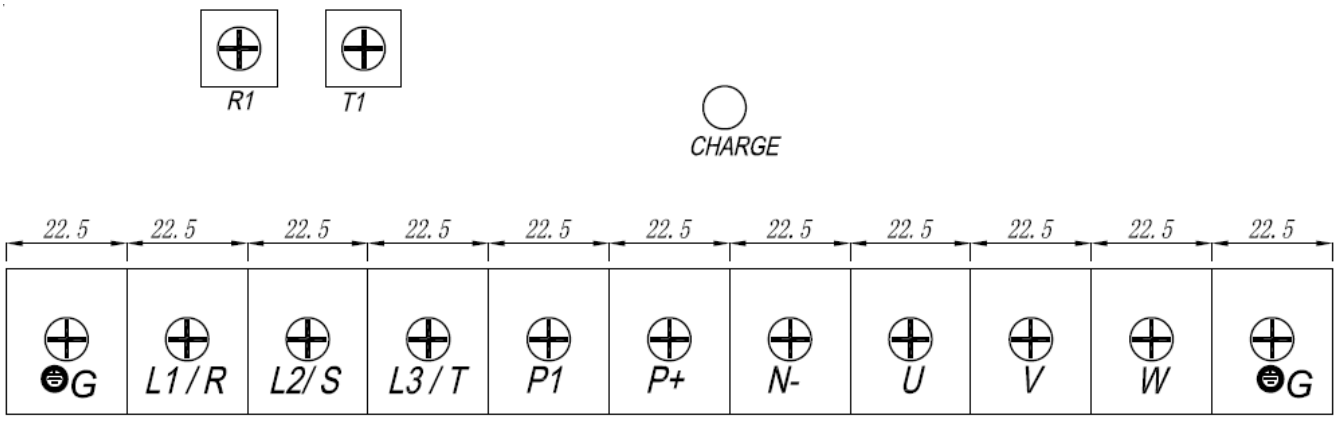


Figure E

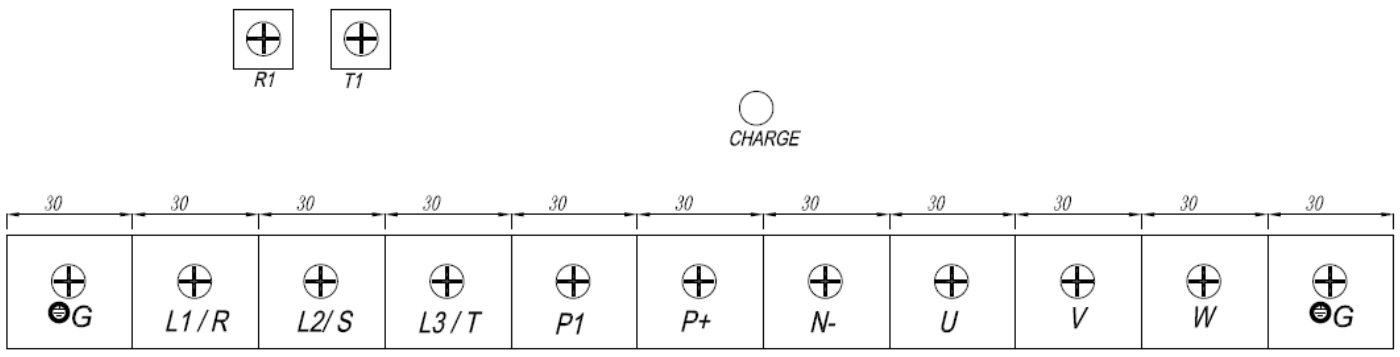
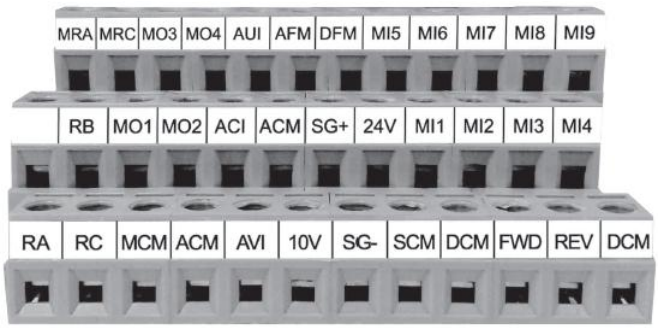


Table 2.5 Recommended wire specification

Supply voltage	Applicable standard motor(kW) (kW)	Type of inverter	Specification	Recommended wire specification (mm^2)				
				Main circuit output [L1/R,L2/S,L3/T]		Ground terminal [G]	Inverter output[U,V,W]	DC reactor connection [P1,P(+)]	Braking resistor connection [P(+),DB]
				DC reactor					
				Yes	No				
3 phase 440V	5.5	S5100-4T5.5G	HD	2.0	2.0	2.0	2.0	2.0	2.0
	7.5		ND			3.5			
		S5100-4T7.5G	HD						
	11		ND		3.5			3.5	
		S5100-4T11G	HD				3.5		
	15		ND	3.5	5.5			5.5	
		S5100-4T15G	HD						
	18.5		ND	5.5	8.0	5.5	5.5		
		S5100-4T18.5G	HD						
	22		ND		14		8.0	8.0	
		S5100-4T22G	HD						
	30		ND	14	22	8.0	14	14	-
		S5100-4T30G	HD						
	37		ND		-			22	
		S5100-4T37G	HD						
	45		ND	22			22		
		S5100-4T45G	HD						
	55		ND			14	38	38	
		S5100-4T55G	HD						
	75		ND	38			60	60	
		S5100-4T75G	HD						
	90		ND	60				100	
		S5100-4T90G	HD						
	110		ND	100		22	100		
		S5100-4T110G	HD						
	132		ND					150	

Terminal	Recommended wire specification(mm^2)
Control power auxiliary input terminals R1,T1	2.0

(2)Control terminals (applicable for all models)



Screws specification and wire specification used on control circuit wiring are shown as follows

Table 2.6 Recommended control circuit wiring specifications

Terminal	Screw Speciation		Recommended wire specification (mm^2)
	Screw Size	Torque (N·m)	
Control terminals	M3	0.7	0.75

2.6.3 Wiring Precautions

Note the following contents for wiring:

(1) Supplyvoltage should be within the input voltage range recorded in the nameplate.

(2) The power supply wires should be connected to the main power input terminals L1 / R, L2 / S, L3 / T (3 -phase) of the inverter. (Wrong connection to the other terminals will cause damage to the inverter when the power is ON)

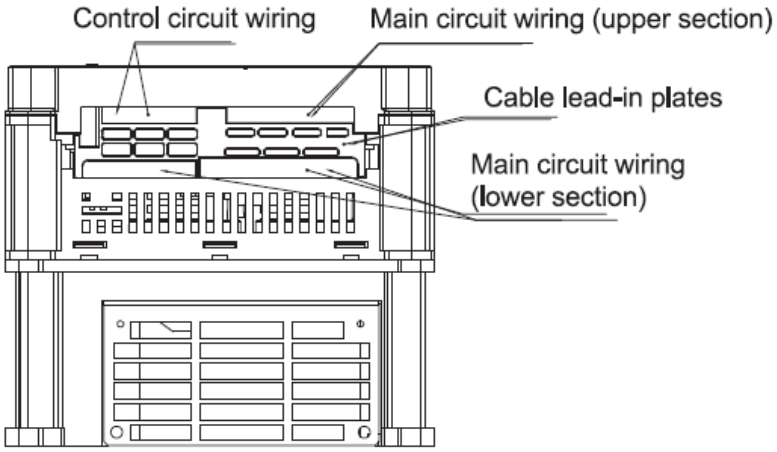
(3) Perform ground wires to prevent electric shock and fire hazards and reduce noise.

(4) Use crimp terminals with reliably-connected insulated bush in the main circuit terminal cables.

(5) Separate the cable connecting main circuit terminal input (primary) and output (secondary) from the control terminal cable respectively.

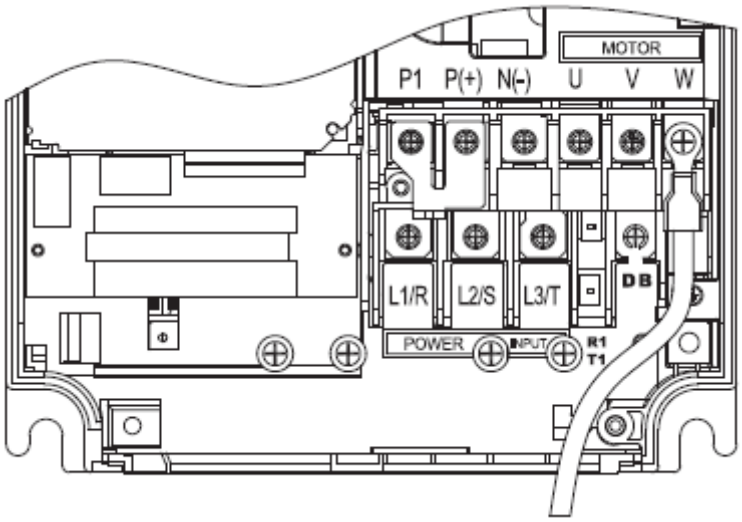
(6) When removing the screws used in main circuit terminals, tighten the screws to the original look even there is no cable.

(7) Cable lead-in plates are used for separating the main circuit wiring from the control circuit wiring. In the inverter below a capacity of 3.7kW, the main circuit wiring and control circuit wiring can be separated; between 5.5kW and 22kW, the main circuit wiring (lower section), the main circuit wiring (upper section) and the control circuit wiring can be separated. Note the sequence of each wiring.



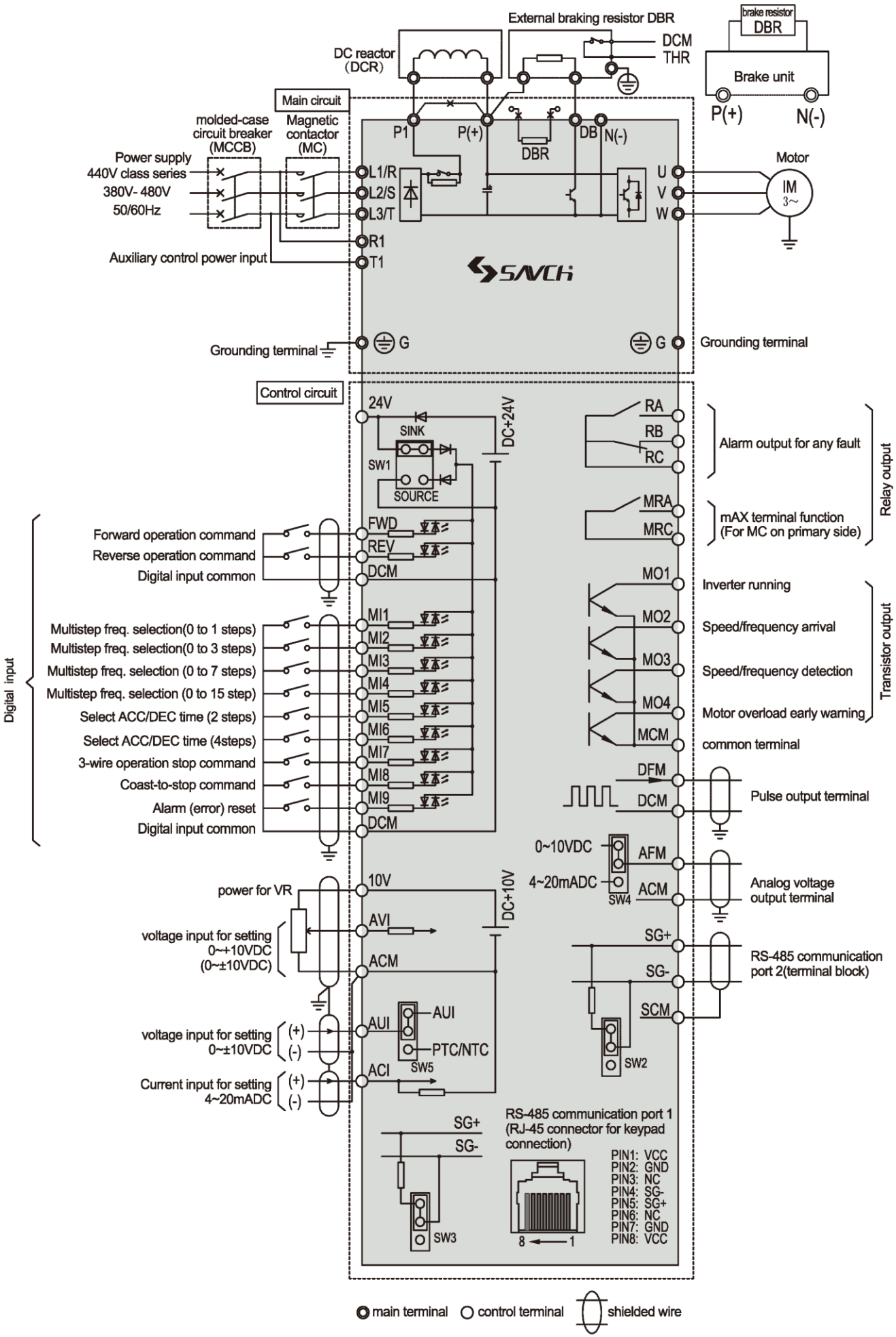
S5100-4T5.5G~4T22G

(8) Follow the chart below when the wiring cannot be made straight from the main circuit terminal according to the power of the inverter.



2.6.4 Wiring of main circuit terminal and grounding terminal

Wiring dianram



(Note 1) When retaining the alarm signal (for any fault) or the keypad for display after the main power of inverter is disconnected, connect the terminals R1 and T1 to the power supply. The inverter can still run if the power supply is not input to the terminals.

(Note 2) Remove the shorting chip between terminal P1 - P(+) before connecting if it's used to connect DC reactor (DCR) (accessories). Inverter of 75KW or above must use DC reactor (DCR).

(Note 3) Built-in braking resistor is connected between terminals P (+) – DB in the inverter below a capacity of 3.7kW. Make sure to remove the connection to the built-in braking resistor when connecting external braking resistor (accessories).

(Note 4) The motor operations are set by a variety of transfer switches on the electric panel. For details, see "Transfer of various switches in 6.6".

(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) 440V series use special ground according to the technical standards for electrical equipment.

2) Ground wiring should connect the coarse wire with large surface area as short as possible.

Table 2.7 Equipment Ground Specified in Electrical Equipment Technical Standards

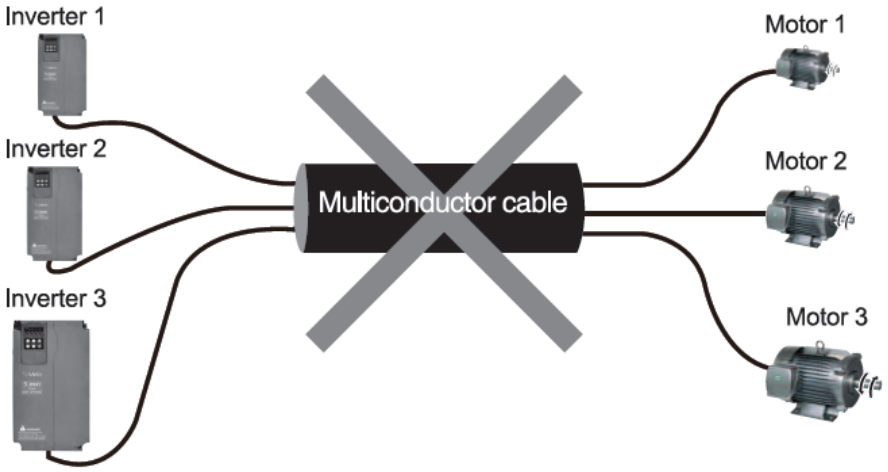
Supply voltage	Types of ground	Ground resistance
3 phase 440V	Special ground way	Below 10Ω

(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.

⚠Caution
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 (below a capacity of 22kW)

Power (kW)	Braking transistor	Built-in braking resistor	Connecting accessories	Steps
1.5~3.7	Built-in	Built-in	Braking resistor (power rises)	1),2),3)
5.5~22	Built-in	Not installed	Braking resistor	2),3)

Please refer to the following steps:

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.**

(5)Control power auxiliary input terminals R1, T1

The inverter can still run if power is not input to control power auxiliary input terminals. If the main power of the inverter is cut off and control power gradually depletes, various output signals and keypad will no longer display.

When retaining the alarm signal (for any fault) or thekeypad for display after the main power of inverter is disconnected, connect the terminals R1 and T1 to the power supply. Perform wiring from the input side (primary) of the magnetic contactor (MC) if there is a magnetic contactor (MC) in the input side of the inverter. Rated terminals are AC380 ~ 480V, 50/60Hz; the maximum current is 0.5A.

Note:Connect terminals T1 and R1 in the output side of earth leakage circuit breaker when turning the power ON. Earth leakage circuit breaker will malfunction if the terminals are connected in the input side for the input of the inverter is a three-phase and the terminals R1 and T1 are single-phases. Be sure to connect the terminals R1 and T1 from the input side to auxiliary B contact of insulation transformer or magnetic contactor in compliance with the location shown in the figure below.

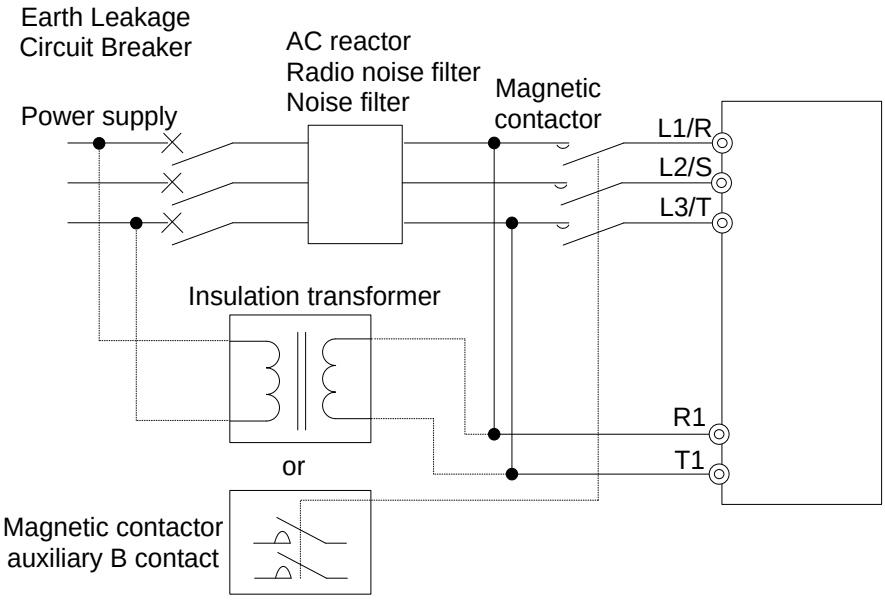


Figure 2.3 Connection of Earth Leakage Circuit Breaker

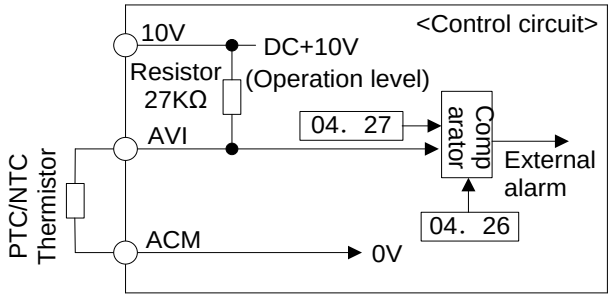
2.6.5 Control terminal wiring

Functions of control terminals are listed in Table 2.8. 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.

Table 2.8 Function of Control Terminals

Cate gory	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),DC±10~0V/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. (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,
	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) * The maximum possible input DC 30mA. Apply DC20mA when it exceeds DC20mA.
	AUI	Analog voltage input setting	(1) Analog voltage inputs the command value for frequency setting DC0~±10V/0~±100 (%)(positive running),DC±10~0V/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 02.35 as "0" when inputting the analog voltage of positive and negative (DC0 ~ ± 10V) via terminal AUI.

Category	Terminal symbol	Terminal name	Functions
	AUI	PTC/NTC Thermistor input	(1) PTC / NTC thermistor used to protect the motor can be connected. Switch SW5 (refer to 6.6) on the board to the PTC / NTC side. The internal circuitry of switching SW5 (switch of terminal AUI) to the PTC / NTC side is shown in the right figure. Refer to "Transfer of various switches in 6.6" for the details of SW5. Change function parameter 04.26 accordingly when switching SW5 to the PTC / NTC side.  Figure 2.4 The internal circuitry when SW5 is switched to the PTC / NTC side
	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.

Note: ◆Use shielded cable and shorten the wiring as much as possible (below 20m) for the connection of weak analog signal is susceptible to external noise. Ground the periphery cable of shielded cable; but connecting to the terminal ACM may reduce noise by the external sensor disturbances. As shown in Figure 2.5, be sure to ground one side to improve the shielding effect

◆Use the double-fork contact for weak signal and do not use contact control in terminal ACM when setting contacts in the analog input signal wiring.

◆The circuit of the analog signal output device may malfunction due to the noise by the inverter when connecting external analog signal output device. In such situation, connect to a ferrite core on the analog signal output terminals or connect the capacitor with strong harmonic characteristics between the control signal wires as shown in Figure 2.6.

◆Do not apply over DC +7.5V voltage to the terminal ACI which may cause damage to the internal circuitry.

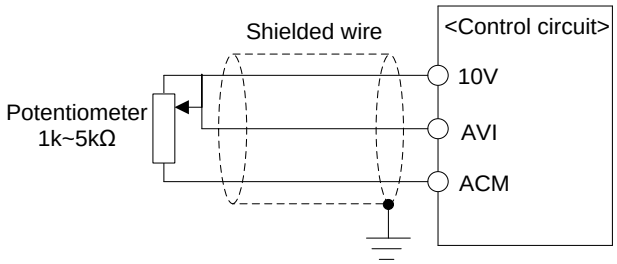
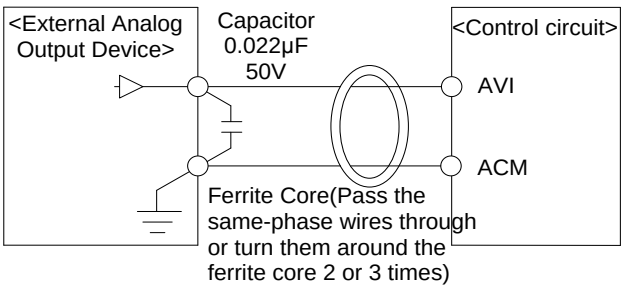
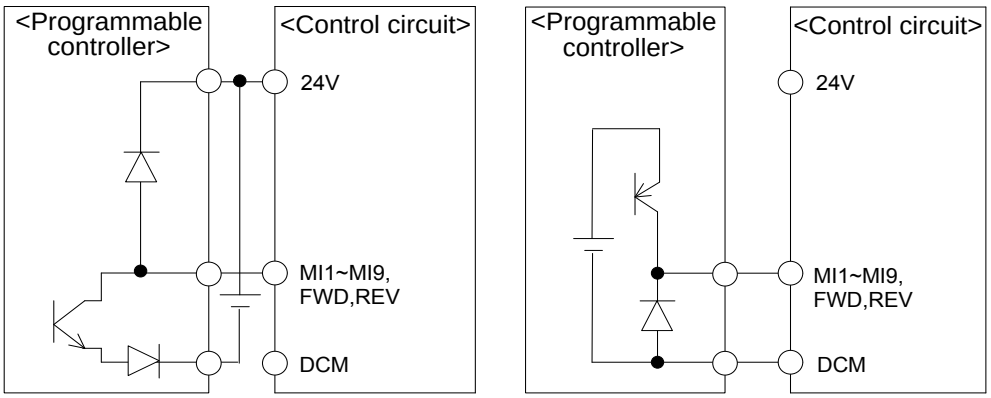


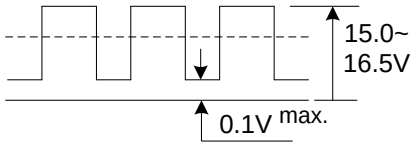
Figure 2.5 Shielded cable connection figure

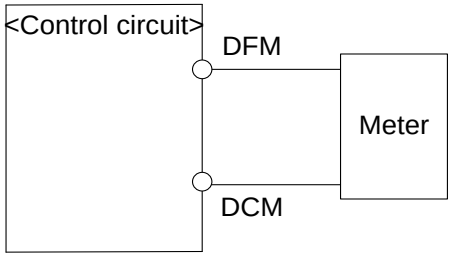


<table>
<tr><th>Cate gory</th><th>Terminal symbol</th><th>Terminal name</th><th>Functions</th></tr>
<tr><td></td><td colspan="3">Figure 2.6 Interference countermeasures example</td></tr>
<tr><td rowspan="13">Digital input</td><td>MI1</td><td>Digital input 1</td><td rowspan="10">(1) Set various signals towards function parameters
01．01~01．09,01．98,01．99.
(2) Apply SW1 input modes: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.

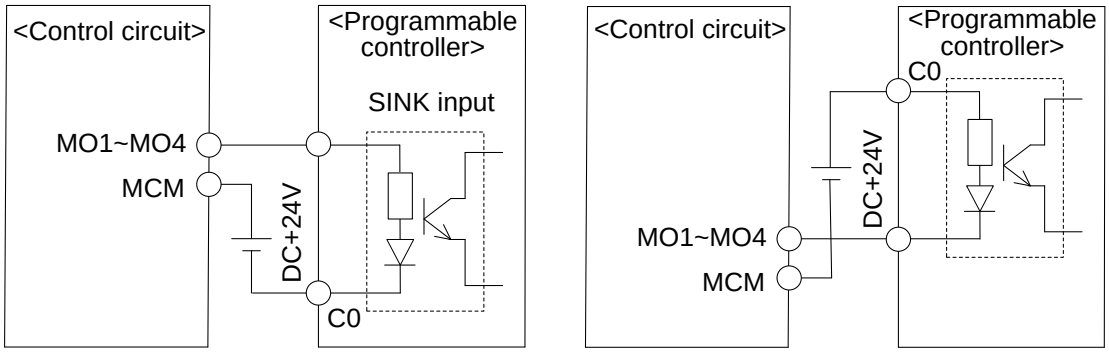
< Digital input circuit specifications >
<table><tr><th colspan="2">Item</th><th>Minimum</th><th>Maximum</th></tr><tr><td rowspan="2">Operating voltage(SINK)</td><td>ON Value</td><td>0V</td><td>2V</td></tr><tr><td>OFF Value</td><td>22V</td><td>27V</td></tr><tr><td rowspan="2">Operating voltage(SOURCE)</td><td>ON Value</td><td>22V</td><td>27V</td></tr><tr><td>OFF Value</td><td>0V</td><td>2V</td></tr><tr><td colspan="2">Operating current when ON
(Input voltage OV)
(Input terminal MI7)</td><td>2.5mA
(4.8mA)</td><td>5mA
(8mA)</td></tr><tr><td colspan="2">Allowable leakage current when OFF</td><td>—</td><td>0.5mA</td></tr></table></td></tr>
<tr><td>MI2</td><td>Digital input 2</td></tr>
<tr><td>MI3</td><td>Digital input 3</td></tr>
<tr><td>MI4</td><td>Digital input 4</td></tr>
<tr><td>MI5</td><td>Digital input 5</td></tr>
<tr><td>MI6</td><td>Digital input 6</td></tr>
<tr><td>MI7</td><td>Digital input 7</td></tr>
<tr><td>MI8</td><td>Digital input 8</td></tr>
<tr><td>MI9</td><td>Digital input 9</td></tr>
<tr><td>FWD</td><td>Forward running • Stop command input</td></tr>
<tr><td>REV</td><td>Reverse running • Stop command input</td></tr>
<tr><td>24V</td><td>Auxiliary control power</td><td>(1) Connect output signal power of programmable controller.
(Rated voltage DC +24 V (supply voltage range:DC +22 ~ +27 V) Maximum 100mA)
(2) Use as load power for transistor output.</td></tr>
<tr><td>DCM</td><td>Digital common terminal</td><td>Common terminals for digital input signal are absolutely insulated for ACM. MCM terminals.</td></tr>
<tr><td colspan="3">Tips ◆Use programmable controller for ON / OFF of terminals MI1 ~ MI9, FWD, REV
Circuit example using the programmable controller is shown in Figure 2.7.
In circuit (a), perform short / open circuit through open collector transistor outputs of programmable controller by an external power supply; perform ON / OFF operation toward terminals MI1 ~ MI9, FWD, REV with the operation below:
• Connect+ side terminal 24V of the insulated external power supply of programmable controller.
• Do not connect the inverter’s terminal DCM to the common terminal of programmable controller.</td></tr>
</table>

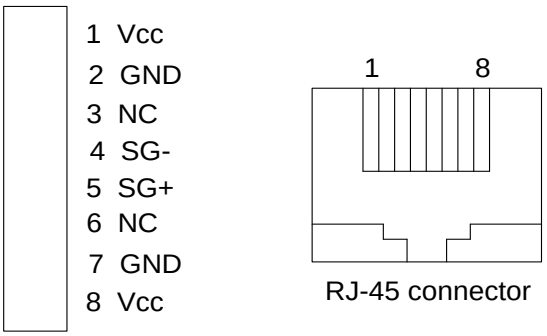
Category	Terminal symbol	Terminal name	Functions
			 (a)Switch at the drain side (b)Switch at the source side Figure 2.7 Programmable controller circuit ■ Precautions of terminal MI7 pulse input Terminal MI7 cannot correctly identify the input pulse due to the wiring's stray capacitance when being connected to the pulse generator of open collector output. Solution:Connect the pull-up resistor between the open collector output signals (terminal MI7) and power (terminals 24V) when switching at the drain side. Connect pull-down resistor between open collector output signals (terminal MI7) and digital common (terminal DCM) when switching at the source side. 1kΩ 2W resistor is recommended. The stray capacitance of wiring differs a lot due to different line type and laying methods, so confirm whether the input pulse can be correctly identified.
Analog output	AFM	Analog monitor	Output the monitor signal of current voltage DC0 ~ 10V or current voltage DC4 ~ 20mA. Output specification (VO / IO) switches through SW4 and functional parameters 00.29 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 • speed (PG feedback value) • DC bus voltage • Universal AO • Motor output • Analog output test • 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.

<table>
<tr><th>Cate gory</th><th>Terminal symbol</th><th>Terminal name</th><th>Functions</th></tr>
<tr><td rowspan="2">Pulse output</td><td>DFM</td><td>Pulse monitor DFM function</td><td>Output pulse signal. Content of the signal can be chosen from the same function as the AFM through the setting of function parameters 00.35.
* Impedance can be connected:Min 5kΩ
(Up to two analog voltmeter (DC0 ~ 10V can be connected, the input impedance is 10kΩ).
* Pulse working state:about 50%　Pulse rate:25 ~ 6000p / s (full scale)
• Pulse output waveform
 

• DFM output circuit example
 
</td></tr>
<tr><td>DCM</td><td>Digital common terminals</td><td>Common terminals for analog input signals and terminal DFM output are insulated for ACM, MCM terminals.</td></tr>
<tr><td rowspan="6">Transistors Output</td><td>MO1</td><td>Transistors Output 1</td><td rowspan="5">(1) Output various signals set by 01.20 - 01.24 parameters
(2) Switch from "signal output ON" to "signal output OFF" of the operation mode between the transistor output terminal MO1 ~ MO4 and the terminal MCM.

<Transistor output circuit specifications>
<table><tr><th colspan="2">Items</th><th>Maximum</th></tr><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></table>
Note ◆Connect a surge-absorbing diode at both ends of the field coil when connecting control relay.
◆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.</td></tr>
<tr><td>MO2</td><td>Transistors Output 2</td></tr>
<tr><td>MO3</td><td>Transistors Output 3</td></tr>
<tr><td>MO4</td><td>Transistors Output 4</td></tr>
<tr><td>MCM</td><td>Transistor outputs common terminal</td><td>Common terminals output by the transistor are relatively insulated to the terminals DCM, ACM.</td></tr>
</table>

<table>
<tr><td>Transistors Output</td><td colspan="3">Tip ◆Connect the programmable controller to terminals MO1 ~ MO4
Circuits of transistor outputs of connecting the inverter on programmable controller are as shown in Figure 2.8.
 

(a)Diagram of connection with the drain input programmable controller
(b) Diagram of connection with the source input programmable controller
Figure 2.8 circuit example of connecting the programmable controller</td></tr>
<tr><td rowspan="2">Contact output</td><td>MRA-MRC</td><td>Relay contact output</td><td>(1) Select and output various signals the same as terminals MO1 ~ MO4 as multi-function relay output.
Contact capacity:AC250V 0.3A cosφ = 0.3, DC48V 0.5A
(2) Switch from “ON signal output” when turned on between terminals MRA-MRC to “ON signal output” when turned off between terminals MRA-MRC.</td></tr>
<tr><td>RA-RB-RC</td><td>Relay contact output</td><td>(1) Perform output through relay contacts (1C) when the inverter alarm stops.
Contact capacity:AC250V 0.3A cosφ = 0.3, DC48V 0.5A
(2) Select and output various signals the same as terminals MO1 ~ MO4.
(3) Switch from “ON signal output” when turned on between terminals RA-RC to “ON signal output” when turned off between terminals RA-RC</td></tr>
<tr><td rowspan="2">communication</td><td>SG+/ SG-/SCM</td><td>RS-485 communication terminal</td><td>Connect input and output terminals of computers and programmable controllers via RS-485 communication. (Refer to 6.6 for terminal resistor)</td></tr>
<tr><td>RJ-45 connector for connection with keypad</td><td>RS-485 communications port 1 (for connection with keypad)</td><td>(1) Connect keypad use.
(2) Remove keypad and connectors used for communication between RS-485, computers and programmable controllers.
(Refer to 6.6 for terminal resistor)
 

RJ-45 connector</td></tr>
</table>

			Figure 2.9 Pin definition of RJ-45 connector • 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.

2.6.6 Transfer of various switches

⚠Danger
Before proceeding to the transfer of various switches, 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) **Otherwise an electric shock could happen.**

Change the specification of the input and output terminals by switching various jumpers on the board (refer to Figure 2.10).

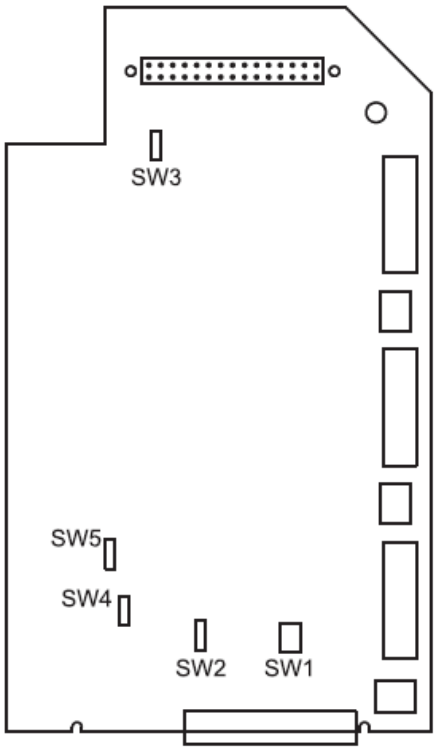
Functions of various switches are shown in Table 2.9

Table 2.9 Functions of various switches

<table>
<tr><th>Switch symbol</th><th>Functions</th></tr>
<tr><td>SW1</td><td>< Digital input terminals drain / source switch >
• For the digital input terminals MI1 ~ MI9, FWD, REV drain / source switches for jumper selection.
• The factory state is SINK side.</td></tr>
<tr><td>SW2</td><td><RS-485 Communication termination resistors switch (RS-485 Communicate Port 2 (Terminal block))>
• Set shorted cap to ON for RS-485 communication when connecting the inverter to the terminal.</td></tr>
<tr><td>SW3</td><td><RS-485 Communication termination resistors switch (RS-485 Communicate Port 1 (for connection with the keypad))>
Set it to OFF (Factory state) when connecting keypad,
•Set shorted cap to ON for RS-485 communication when connecting the inverter to the terminal.</td></tr>
<tr><td>SW4</td><td>< 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>
<tr><th>Output specifications</th><th>SW4</th><th>00．29 data</th></tr>
<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>
</table>
</td></tr>
</table>

<table>
<tr>
<td>SW5</td>
<td>
< 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>
<tr><th>Input specifications</th><th>SW5</th><th>04.26 data</th></tr>
<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>
</table>
</td>
</tr>
</table>

The locations of various switches on control circuit board are shown as follows.



Switches and factory settings of various SW

	SW1	SW2	SW3	SW4	SW5
Factory state	SINK	OFF			
—	SOURCE				

Figure 2.10 The locations of various switches on control circuit board

2.6.7 Installation and connection of the keypad

Keypad can be installed in the disc for operation.

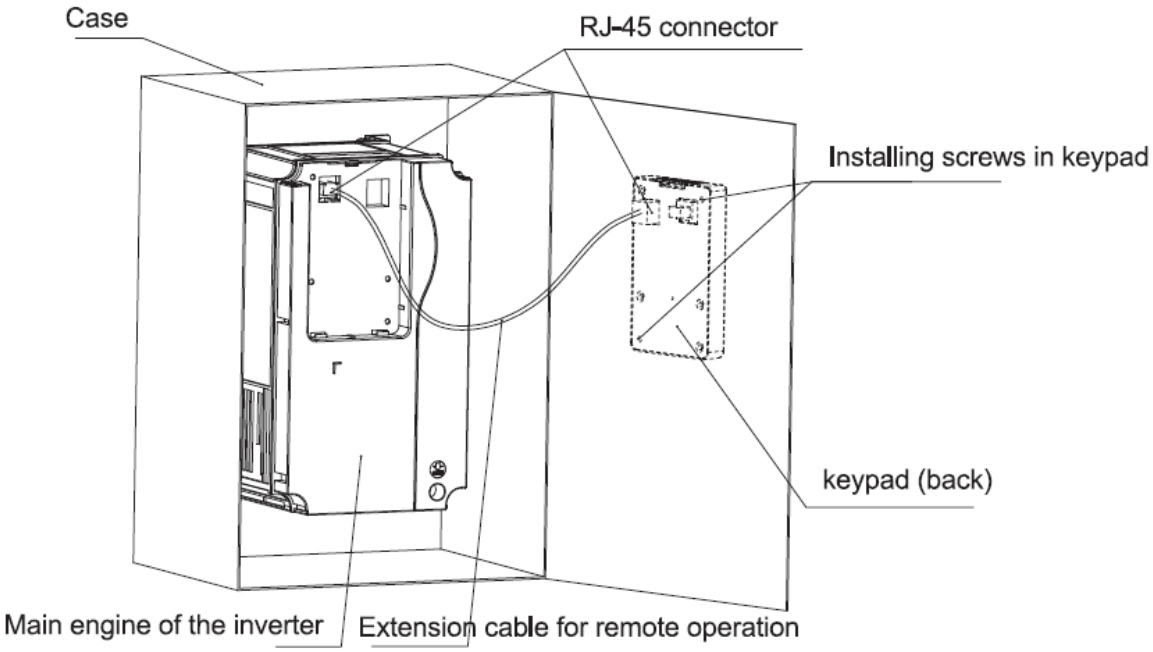


Figure 2.11 Install keypad in the disc

Keypad can be installed in the disc with following accessories.

Accessory Name	Type	Notes
Extension cable (Note 1)	3m,2m,1m	There are three kinds of length of the extension cable (3m,2m,1m)。
Installing screw	M3 ×□ (Note 2)	2 (Supplied by users)

(Note 1) Use network cable sold on the market.

(Note 2) Use the screws with proper length according to the thickness of the disc. (The depth of the screw hole in the keypad is 10mm)

■ Removal and installation methods of keypad

Remove the keypad by pressing on the hook on the keypad and pulling in front. Installation step is the opposite.

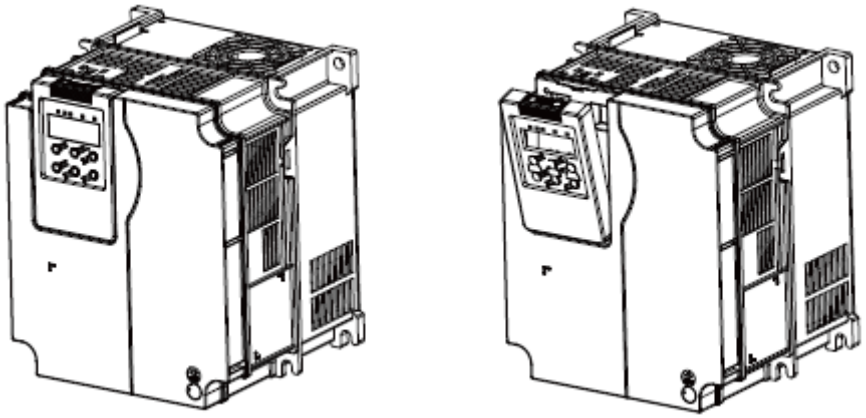


Figure 2.12 Removal of keypad

2.7 External Dimensions

2.7.1 External Dimensions

Inverter type	Figure	External Dimensions(mm)								
		W	W1	H	H1	D	D1	D2	M	N
S5100-4T5.5G	A	220	196	260	238	195.7	99.5	96.2	2*Φ10	10
S5100-4T7.5G										
S5100-4T11G										
S5100-4T15G	B	250	226	400	378					
S5100-4T18.5G										
S5100-4T22G										
S5100-4T30G	C	298	176	470	454.5	215	-	-	2*Φ6.5	6.5
S5100-4T37G	D	383	115	580	564	270	-	-	3*Φ10.5	10.5
S5100-4T45G										
S5100-4T55G										
S5100-4T75G	E	468	160	778	745	330	-	-	3*Φ12.5	12.5
S5100-4T90G										
S5100-4T110G										

(Unit：mm)

2.7.2 Inverter Main body figure

Inverter main body Unit:mm

Figure A(S5100-4T5.5G~4T11G)

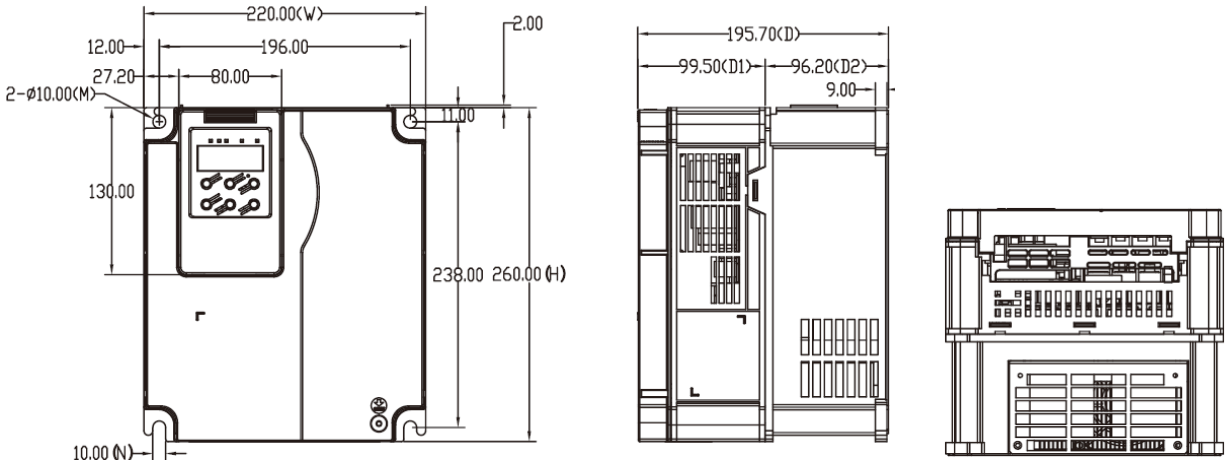


Figure B(S5100-4T15G~4T22G)

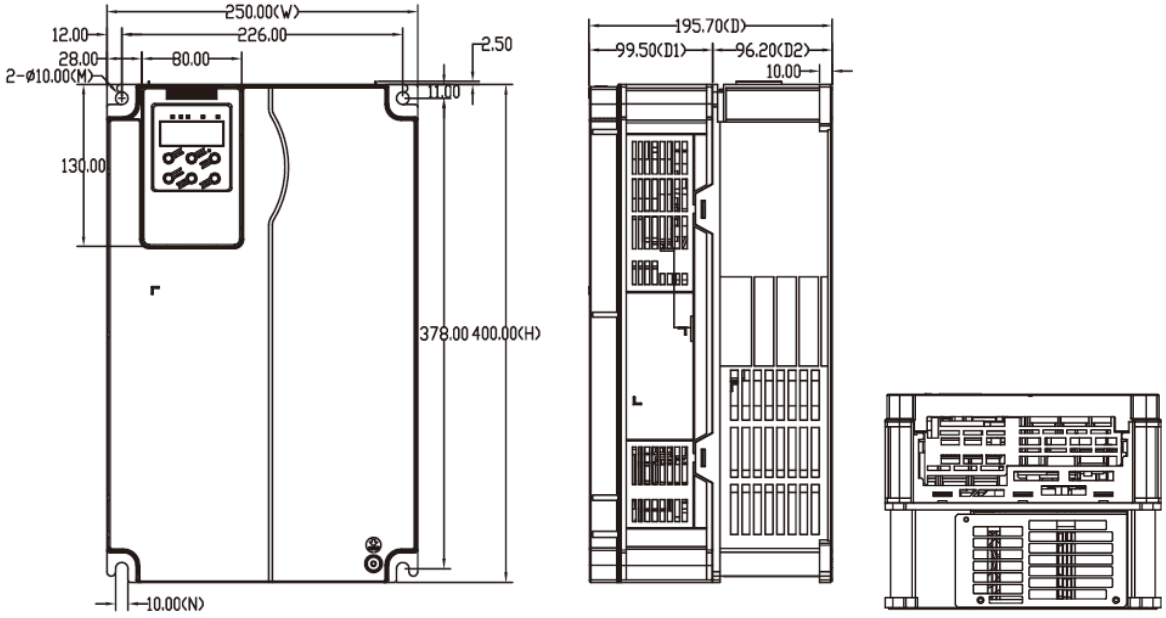


Figure C(S5100-4T30G)

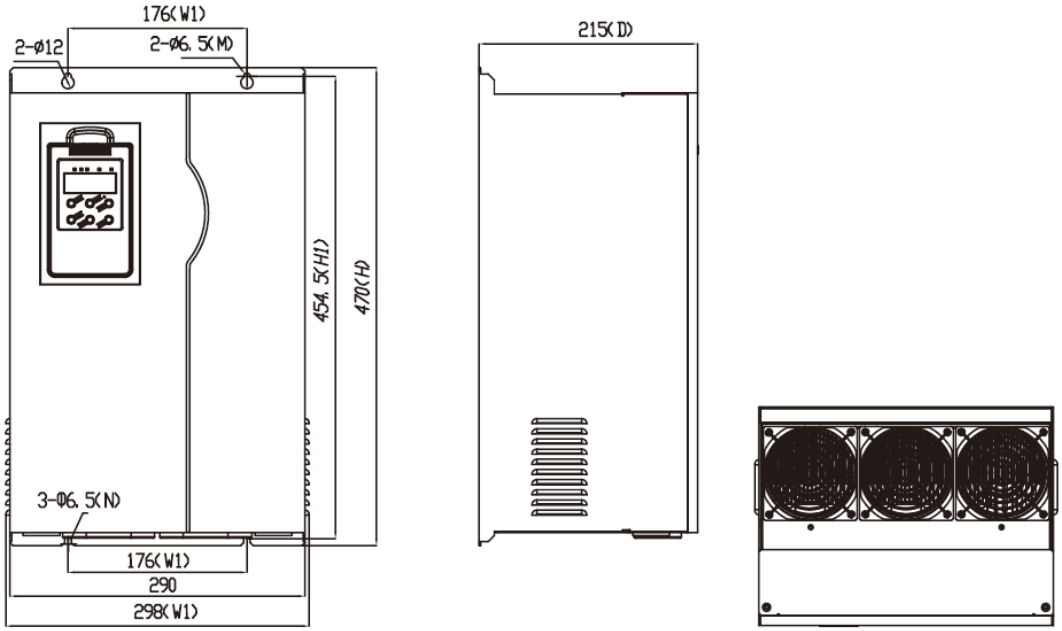


Figure D(S5100-4T37G~4T55G)

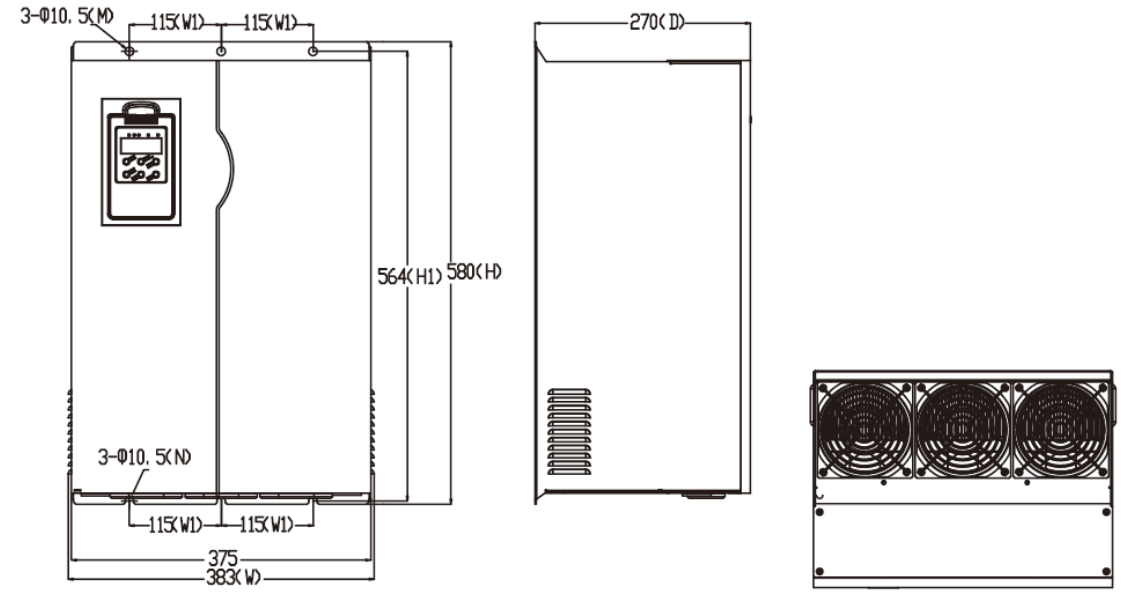
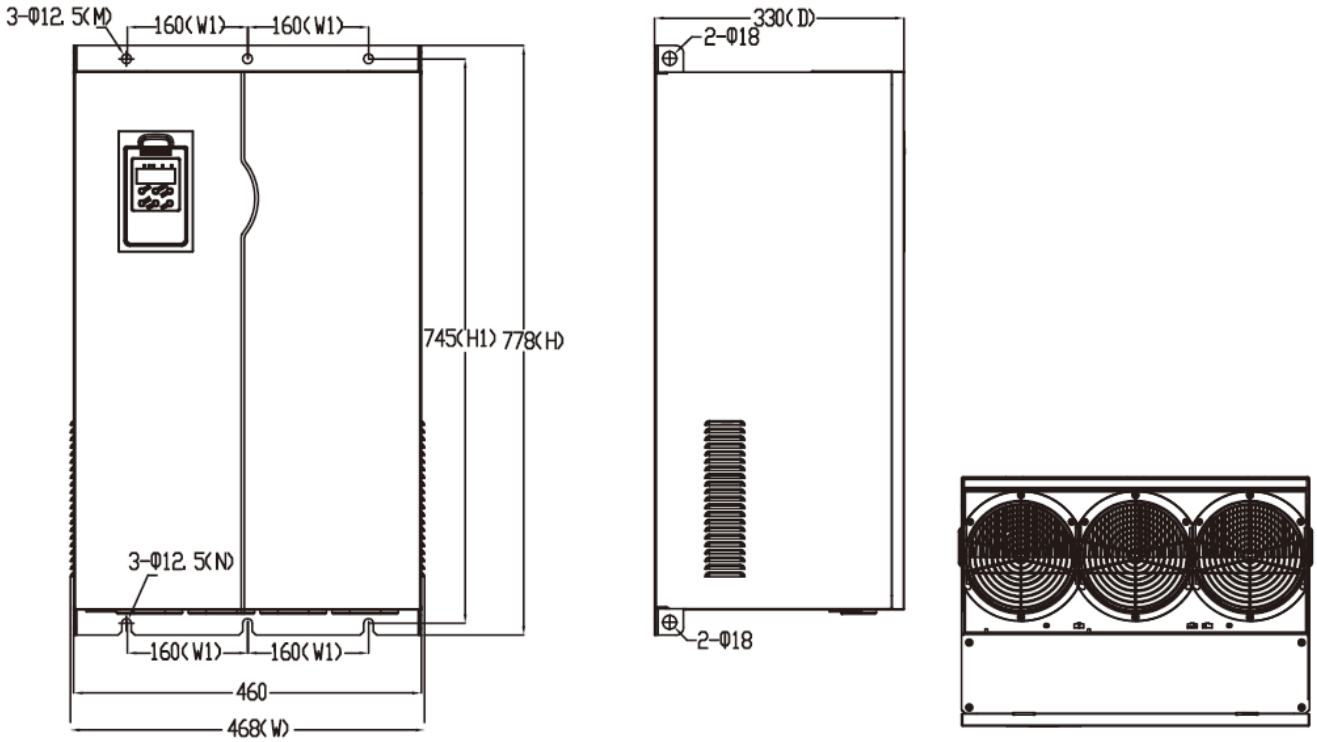


Figure E(S5100-4T75G~4T110G)



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.

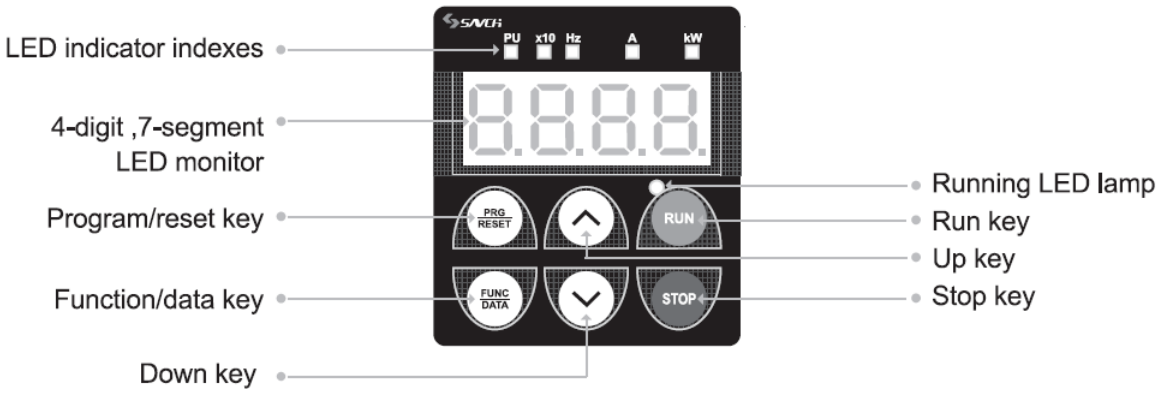


Table 3-1 Overview of Keypad Functions

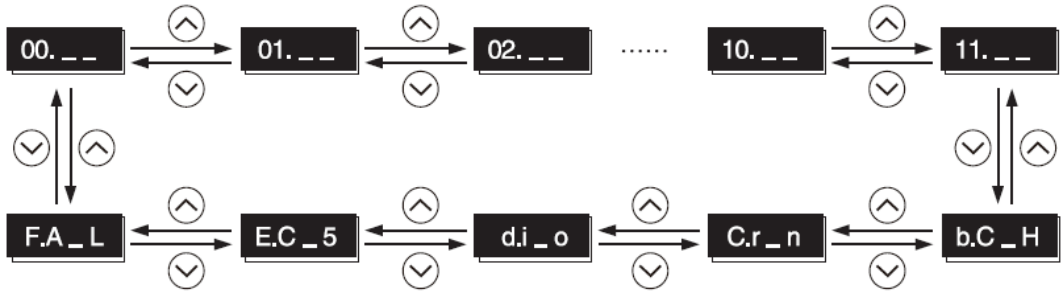
Monitors and Key	Functions Overview
60.00	Displays output frequency, current, voltage and other Running status information Function parameters and data, Alarm codes
PRG RESET	Switches the operation modes of inverter:Running mode, Programming mode and Alarm mode When alarm codes appears, pressing this key to clear the alarming information.
FUNC DATA	Switches the monitoring item of running status. Displays the functional parameter and establishes the newly entered data Switches to display the alarm information.
RUN	Run key
STOP	Stop Key
∧ \ ∨	Selects the setting items or change the function parameter data.
RUNNING LED lamp	The indicator lamp is on when it has run command status.
PU LED	When the RUN key of keypad as run command is valid, the indicator is on. In the programming mode and alarming mode, it cannot take RUN 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.

Operation using the Keypad

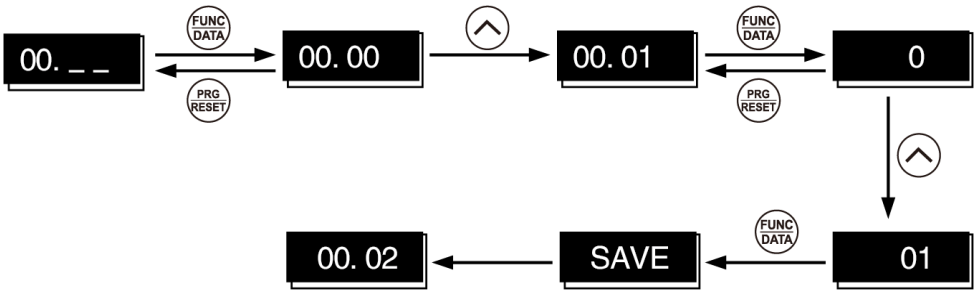
Operation Modes Selection

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 PRG 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 S5100 features the following three operation modes

Table 3.2 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.
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 DATA key in Running mode switches between monitor items in the sequence shown in Table 3.3

Table 3.3 Monitored Items

Monitored Items		Example	LED Display	Unit	Description of Display Value	01.43 Function parameter
Speed Monitor	Function parameter 01.48 specifies what to be displayed.					0
	Output Frequency 1 (command value)	*50.00*	■Hz □A □kW	Hz	Display value = Output frequency (Hz)	(01．48＝0)
	Output Frequency 2 (estimated/detected value)	*50.00*	■Hz □A □kW	Hz	Display value = Output frequency (Hz)	(01．48＝1) (01．48＝2)
	Setting Frequency	*50.00*	■Hz □A □kW	Hz	Display value = Setting frequency (Hz)	(01．48＝3)
	Motor Speed	*1500*	■Hz ■A □kW	r/min	$\text{Display value} = \text{Output frequency} \times \frac{120}{03.01}$	(01．48＝4)
	Load shaft speed	*200.0*	■Hz ■A □kW	r/min	Display value = Output frequency (Hz) × 01．50	(01．48＝5) (01．48＝7)
	Line Speed	*200.0*	□Hz ■A ■kW	m/min	Display value = Output frequency (Hz) × 01．50	
	Speed (%)	*60.0*	□Hz □A □kW	%	$\text{Display value} = \frac{\text{Output frequency}}{\text{Max. frequency}} \times 100$	
Output Current		*13.50*	□Hz ■A □kW	A	Current output from the inverter in RMS	3
Output Voltage		*380U*	□Hz □A □kW	V	Voltage output from the inverter in RMS	4
Output Torque		*50*	□Hz □A □kW	%	Calculated output torque	8
Input power		*8.60*	□Hz □A ■kW	kW	Input power to the inverter	9

Monitored Items	Example	LED Display	Unit	Description of Display Value	01.43 Function parameter
PID command	*10.00.*	□Hz □A □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.*	□Hz □A □kW	—		12
PID Output	*100.0.*	□Hz □A □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	*50L*	□Hz □A □kW	%	Load factor of the motor in % as the rated output being at 100%	15
Motor output power	*9.85*	□Hz □A ■kW	kW	Motor output in kW, LED blinks	16
Analog Input	*90.00*	□Hz □A □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).	17
Torque Current	*48*	□Hz □A □kW	%	Torque current command value When it is in magnetic pole position auto search and V/f control, it displays 0 (zero)	23
Magnetic flux command	*50*	□Hz □A □kW	%	Magnetic flux command value (Available only under vector control) When it is in magnetic pole position auto search and V/f control, it displays 0 (zero)	24
Input watt-hour	*100.0*	□Hz □A □kW	kWh	$\text{Display value} = \frac{\text{Input watt hour(kWh)}}{100}$	25

■ON □OFF

3.3.2 Monitoring light alarms on keypad

Inverter failure is divided into Alarm, and Light alarm. If the former occurs, which appears the inverter immediately trips, 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 PRG/RESET 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 Maintainance 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.

3.4 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. Table 3.4 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.

Table 3.4 Program Mode Menu

No.	Menu	LED Display on keypad	Main Functions	
1	Data Setting	*00.__*	00 Group Parameters (Basic Function)	Display/change the data of the selectable function code.
		01.__	01 Group Parameters(External Terminal Function)	
		02.__	02 Group Parameters(Control Function)	
		03.__	03 Group Parameters(PM Motor 1 Parameter)	
		04.__	04 Group Parameters(Advanced Function)	
		05.__	05 Group Parameters(PM Motor 2 Parameter)	
		06.__	06 Group Parameters(PM Motor 3 Parameter)	
		07.__	07 Group Parameters(Three-phase asynchronous Motor 4 Parameter)	
		08.__	08 Group Parameters(Application Function 1)	
		09.__	09 Group Parameters(Application Function 2)	
		11.__	11 Group Parameters(Serial Communication Function)	
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.	

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 3.5.

Table 3.5 “Drive Monitoring Items”

Keypad Display	Item	Unit	Description
C_00	Output Frequency	Hz	Output frequency (command value)
C_01	Output Frequency	Hz	Output frequency (estimated /detection value)
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 “----”.
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	-	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	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	-	—
C_21	PID Output Value	%	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	%	It displays Flux command value in %.

Keypad Display	Item	Unit	Description
C_23	Running Status 2	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	℃	Temperature detected by the NTC thermistor built in the motor. When it is not connected NTC thermistor setting, it displays "----".
C_25	Reserved	-	—
C_26	Reserved	-	—

■ 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 in Table 3.6 and Table 3.7, it distributes the run status into 0-15 bits. The relation of run status distribution and display in keypad is as in Table 3.8.

Table 3.9 is a table on converting 4-bit binary system number into hexadecimal number system of monitor.

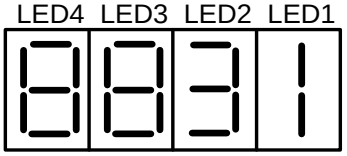
Table 3.6 Bit Distribution of Run Status (C_07)

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(Enable V/f control for three-phase asynchronous motor)..
9	mACC	Speed accelerating is 1.	1	mREV	Reverse rotation is 1.
8	mIL	Current in limiting is 1(Enable V/f control for three-phase asynchronous motor).	0	mFWD	Forward rotation is 1.

Table 3.7 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(PM Motor) 01：Motor 2(PM Motor) 10：Motor 3(PM Motor) 11：Motor 4(Three-phase asynchronous motor)
11			3	-	Control Method
10			2	-	0000: Three-phase asynchronous motor under V/f control
9			1	-	0101: PM Motor Vector control without speed sensor
8			0	-	0110: PM Motor Vector control with speed sensor 1011: PM motor under vector control with speed sensor(enable torque control)

Table 3.8 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	mIL	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	LED4 LED3 LED2 LED1 															

■ Hexadecimal conversion table

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

Table 3.9 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.

Table 3.10 “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 AVI input current. Unit:mA
d_04	Terminal AFM Output Voltage	Display terminal AFM output voltage. Unit:V
d_05	Terminal DFM Output Voltage	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	Display terminal AFM output current. Unit:mA

Keypad Display	Item	Description
d_10	Reserved	—
d_11	Terminal MI7 Pulse Input Monitor	Display pulse count of input terminal MI7 pulse train signal.
d_15	PG Detection Pulse rate (Instruction Side AB Phase)	Pulse rate of the A/B phase signal feedback from the reference PG (1000p/s is displayed as 1.00.)
d_16	PG Detection Pulse rate (Instruction Side Z Phase)	Pulse rate (p/s) of the Z phase signal feedback from the reference PG (p/s).
d_17	PG Detection Pulse rate (feedback Side AB Phase)	Pulse rate of the A/B phase signal feedback from the slave PG (1000p/s is displayed as 1.00.)
d_18	PG Detection Pulse rate (feedback Side Z Phase)	Pulse rate (p/s) of the Z phase signal feedback from the slave PG (p/s).
d_19	Reserved	—
d_20	Reserved	—
d_21	Reserved	—
d_22	Reserved	—
d_23	Reserved	—

■ 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 Table 3.11 and the following Fig, the segments a~dp of LED1 and LED2 are on when the digital output terminals (FWD,REV,MI1~MI9) are on, and off when OFF. The segments a~e of LED 3 are on when output terminals MO1~MO4-MCM and MRA-MRC 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("----").

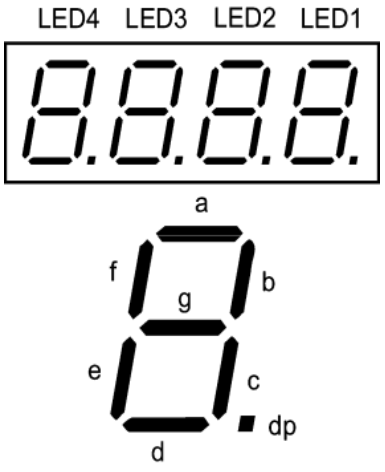


Table 3.11 Segment Displays of External Signal Information

Segment	LED4	LED3	LED2	LED1
a	RA/RB/RC	MO1-MCM	MI7	FWD
b	—	MO2-MCM	MI8	REV
c	—	MO3-MCM	MI9	MI1
d	—	MO4-MCM	—	MI2
e	—	MRA-MRC	—	MI3
f	—	—	—	MI4
g	—	—	—	MI5
dp	—	—	—	MI6

●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).

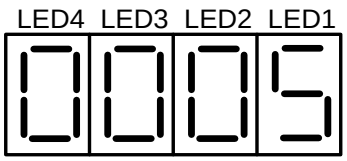
Digital input terminals FWD and REV are distributed to bit 0 and bit 1. MI1~MI9 are distributed to bits 2~10. In all bits, when all input terminals are ON, it I set as “1”, and it is set as ‘0” when OFF. E.g., when terminals FWD and MI1 are ON and the rest are OFF, the display of LED4~LED1 is 0005.

Digital output terminals MO1~MO4 are distributed to 0-3. When output terminals MO1~MO4-MCM are ON (short circuit), it is set as “1”. When OFF (disconnected), it is set as “0”.

The status of contact output terminals MRA/MRC is distributed to bit 4. When the output terminals MRA-MRC are closed, it is set as “1”. 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~MO4 is OFF, MRA~MRC is disconnected and 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.

Table 3.12 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		—	—	—	—	—	MI9	MI8	MI7	MI6	MI5	MI4	MI3	MI2	MI1	REV	FWD
Output terminal		—	—	—	—	—	—	—	RA/ RB/ RC	—	—	—	MRA/ MRC	MO 4	MO 3	MO2	MO1
Display Example(Input terminal)	Binary System	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1
	LED keypad In hexadecimal																

3.4.4 Reading maintenance Information

Menu code E” Maintenance Information:E.C_S” of program mode displays necessary information in inverter maintenance.

Table 3.13 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.

Keypad Display	Item	Display Contents
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	Displays the max temperature –inside of the inverter for per hour. Unit:℃ (it displays 20 ℃ when it is below 20 ℃.)
E_03	Max. Temperature of cooler	Displays the max temperature of –cooler for per hour. Unit:℃ (it displays 20 ℃ when it is below 20 ℃.)
E_04	Max. effective current	Displays the maximum current in RMS for per hour. Unit:A
E_05	Capacitance of -DC link bus capacitor	Reserved
E_06	Cumulative power-on time of electrolytic capacitors on the PCB	Displays the content of the cumulative time counter of voltage application to the electrolytic capacitor on the PCB, Which is calculated by multiplying by the cumulative time count by the coefficient based on the surrounding temperature condition. Measurement Range: 0~99,990 h Display:0~9999 ×10 LED on (cumulative running time of electrolytic capacitor on the PCB= Display × 10 h) If it is beyond 99,990 h, it stops cumulation action. The display is maintained at 9999.
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 1st 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.
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".

Keypad Display	Item	Display Contents
E_11	RS-485 error times (communication port 1)	Cumulated error times in RS-485 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	RS-485 error content (communication port 1)	Latest error appears in RS-485 communication (communication port 1). It displays in decimal system code form.
E_13	Reserved	—
E_14	Inverter ROM version	The ROM version of inverter is displayed in 4 bits form.
E_16	Keypad ROM version	The ROM version of keypad is displayed in 4 bits form.
E_17	RS-485 error times (communication port 2)	Accumulated error times in RS-485 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	RS-485 error content (communication port 2)	Latest error appears in RS-485 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	Displays the -current temperature inside the inverter. Unit:℃
E_25	Temperature value of the cooler	Displays the current temperature of cooler inside the inverter. Unit:℃
E_26	Reserved	—
E_27	Reserved	—
E_30	Cumulative running time of motor 4	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	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/)
E_34	Number of startups for the 4th motor	Displays cumulative starting times of the 4th motor. Display method is the same with E_08
E_35	Remaining startup times before the next maintenance for the 1st motor	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

Keypad Display	Item	Display Contents
E_36	Latest Light alarm	Displays Latest Light alarm content as an alarm code.
E_37	Last Light alarm	Displays the last light alarm as an alarm code. For the details, refer to **"Chapter 7 Failure Indication and Countermeasures"**
E_38	2nd Last Light alarm	Displays the 2nd last light alarm as an alarm code. For the details, refer to **"Chapter 7 Failure Indication and Countermeasures"**
E_39	3rd Last Light alarm	Displays the 3rd last light alarm as an alarm code. For the details, refer to **"Chapter 7 Failure Indication and Countermeasures"**
E_40	Reserved	—
E_41	Reserved	—
E_42	Reserved	—
E_43	Reserved	—
E_44	Reserved	—

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 3.14.

Table 3.14 Alarm Information items

Keypad Display	Display Content	Description
F_00	Output frequency	Output frequency(command value)
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) and Display Method of Running Status 2(C_23) of "4.2 Run Status Monitoring Item" on detailed information.
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.

Keypad Display	Display Content	Description
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	Displays the temperature inside inverter. Unit:℃
F_11	Max. temperature of cooler	Displays the max. temperature of the cooler. Unit:℃
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 "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 1st alarm codes simultaneously (it displays " --- " when there is no alarm has appeared.)
F_17	Multiple alarm 2	Appear the 2ndalarm 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	Displays the run status 2 in 4-bit in hexadecimal. Refer to ■Run Status (C_07) and Display Method of Run Status 2(C_23) of "4.2 Run Status Monitoring Item" on detailed information.
F_23	Speed detection value	Displays speed estimated / detection value.

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 PRG RESET 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 ∧ / ∨ keyswhen the current(latest) one is dispalyed.

■Display of running status information at the time of alarm

When displaying alarm code, press FUNC DATA 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 PRG RESET 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 STOP key + PRG RESET 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 conetct 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.

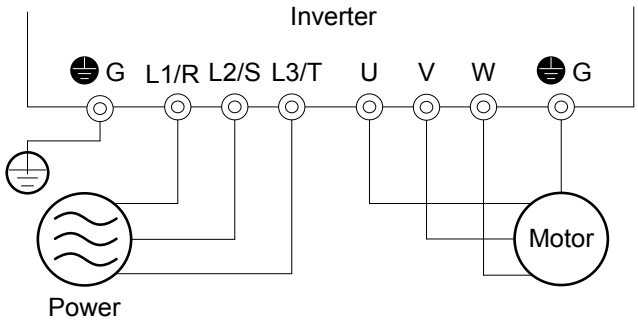


Fig 4.1 Connection Diagram of Main Circuit Terminals

4.1.2 Switching between HD and ND drive modes

It can switch heavy load used HD specification and light load used ND specification.

00．80 Data	Drive mode	Application	Continuous Rated Current Level	Overload Capability	Max.Output Frequency
0	HD (Heavy Duty) Specification	Heavy load	It can drive motor whose capacity is the same as the inverter's one.	150% 1min,200% 3s	500Hz
1	ND(Normal Duty) Specification	Light load	It can drive motor one rank to two ranks larger than the inverter's capacity.	120% 1min	120Hz

When PM motor is under vector control with speed sensor, please limit the max. output frequency beyond 200Hz.

When three-phase asynchronous motor is under V/F control, please limit the max. output frequency beyond 120Hz.

Under ND mode, rated current is one rank to two ranks larger continuously, but the overload withstanding capacity is reduced in percentage. see "Chapter 2 Hardware Description and Installation" on current value.

Under ND mode, it is restricted by the following function parameters and internal processing.

Function parameter	Name	HD mode	ND mode	Notes
00．26	Carrier Frequency	Setting range 2~15kHz (5.5~45kW) 2~10kHz(55~200kW)	Setting range 2~15kHz (5.5~18.5kW) 2~10kHz(22~45kW) 2~ 6kHz(55~200kW)	Under ND mode, a value out of the range, if specified, automatically changes to the max. value allowable in the ND mode.
00．44	Current limiter level	Initial value 160%	Initial value 130%	Enable the V/f control for three-phase asynchronous motor .When 00．80 is changed, it is initialized to the value specified at left.
07．01	Max. output frequency(Three-phase asynchronous 4)	Setting range 25~500Hz Upper limit 500Hz	Setting range 25~500Hz Upper limit 120Hz	Enable the V/f control for three-phase asynchronous motor .Under ND mode when the max. output frequency is beyond 120Hz, the actual output frequency is internally limited to120Hz.
—	Current indication and output	Based on the rated current level for HD mode	Based on the rated current level for ND mode	

The motor rated capacity (03．02*) will not be upgraded automatically. configure the data to match the applied motor rating as required.

4.1.3 Selection for a desired Motor drived Control

In S5100, it can select the following motor drive control

00．42 Data	Control Method	Basic Control	Speed Feedback	Control Method	Speed Control
	Three-phase asynchronous motor under V/f control	V/f Control	Disable	V/f	Frequency Control
15	PM motor Vector control without speed sensor	Vector Control	Estimated speed	Without PG	Speed control with automatic speed regulator (ASR)
16	PM motor Vector control with speed sensor		Enable	PG	

■Three-phase asynchronous motor under V/f control

No matter how to set the parameter data 00．42, When parameter data 01．90=4, it enables to switch to three-phase asynchronous motor driving.

Under this control, the inverter controls a motor with the voltage and frequency according to the V/f pattern specified by function parameters. This control disables all automatically controlled features such as the slip compensation, so no unpredictable output fluctuation results, enabling stable operation with constant output frequency.

■PM motor 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).

■PM motor Vector control with speed sensor

This control requires an optional PG (pulse generator) and an optional PG interface card to be mounted on a motor shaft and an inverter, respectively. The inverter detects the motor's rotational position and speed from PG feedback signals and uses them for speed control. In addition, it decomposes the motor drive current into the exciting and torque current components, and controlseach of components in vector.

The desired response can be obtained by adjusting the control constants (PI constants) and using the speed regulator (PI controller).

Note:When the PM motor is under vector control without speed sensor/with speed sensor, use the parameter of the motor constant to calculate. 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.

·Under HD mode, please set the capacity of the motor to be the same to that of the inverter, current detection’s resolvability and control will get worse. Under ND mode,the inverter can drive control the motor with 1~2 pole capacity.

·The wiring distance between the inverter and motor should be 50 m (or164ft) 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 50 m (or164 ft). In that case, make the wiring length as short as possible or use a wire with small stray capacitance to minimize the stray capacitance.

·When the output frequency is set more than 120HZ, please set the carrier frequency 00．26 to be more than 5kHz.

4.1.4 Basic Function parameters Setting of PM motor Vector Control without Sensor <2>

If no sensor control (00．42 = 15) is adopted, 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)	90Hz
00．05	Rated voltage at base frequency 1		Rated voltage of motor
03．01	Motor 1 (No. of poles)		6 poles
03．02	Motor 1 (Rated capacity)		Nominal applied motor capacity
03．03	Motor 1 (Rated current)		Rated current of nominal applied motor

Function parameter	Function	Data	Factory default
03．30	Selection of pole position polar detection	Motor type	1：IPM
03．90	Overcurrent protection level	Demagnetize limit current of the motor	0.00A(Invalid)
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	90Hz
00．15	Upper limit of output frequency		90Hz
00．07	Acceleration time 1		Below 22kW:9.00s Above 30kW:30.00s
00．08	Deceleration time 1		

4.1.5 Basic function parameters Setting of PM motor Vector Control with Sensor

If use the sensor control(00．42 = 16), 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 1	Motor ratings (printed on the nameplate of the motor)	90Hz
00．05	Rated voltage at base frequency 1		Rated voltage of motor
03．01	Motor 1 (No. of poles)		6 poles
03．02	Motor 1 (Rated capacity)		Nominal applied motor capacity
03．03	Motor 1 (Rated current)		Rated current of nominal applied motor
03．30	Magnetic pole position polar detection selection	Motor type	1：IPM
03．90	Overcurrent protection level	Demagnetized limit current of the motor	0.00A(Invalid)
09．01	Speed control 1 Speed command filter	Characteristic of Speed controller, In factory default, the appropriate value of the PM motor under vector control without speed sensor	0.2S
09．02	Speed control 1 Speed detection filter		0.025S
09．03	Speed control 1 P item (gain)		2.0
09．04	Speed control 1 I item (integral time)		0.6S
09．14	Feedback Input (Pulse input format)	Control object motor encoder type	4:A,B phase quadrature phase difference UVW signal
09．15	Feedback Input: Encoder pulse resolution	Control object motor encoder pulse resolution	0400H(1024)

Function parameter	Function	Data	Factory default
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	90Hz
00．15	Upper limit of output frequency		90Hz
00．07	Acceleration time 1		Below 22kW：9.00s Above 30kW：30.00s
00．08	Deceleration time 1		

■ Auto-tuning procedure

(1) Selection of tuning type

Perform auto-tuning while the motor is running (03．04* = 2，4) and stopped (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 o actual running direction of mechanical equipments.

03．04 Data	Auto-Tuning type	Motor parameters subjected to tuning	Tuning Action	Selection Condition of Auto-tunning type
1	Tune while the motor stops	Armature resistance (03．60) d axis inductance (03．61) q axis inductance (03．62)	Tuning with the motor stopped	Cannot rotate the motor.
2	Tune while the motor is rotating	Armature resistance(03．60) d axis inductance (03．61) q axis inductance (03．62) Induced voltage(03．63) Pole position sensor compensation(03．95)	The armature resistance, d/q axis inductance when the motor stops. Induced voltage when the motor is rotating (50% speed of base frequency) Tuning of pole position sensor compensation when the motor is rotating (base on speed set by parameter 09．80)	Motor Rotating
4	Tune while the motor is rotating	Pole position sensor compensation(03．95)	Tuning of pole position sensor compensation when the motor is rotating(base on speed set by parameter 09．80)	Motor Rotating Use PM motor sensor vector control, 00．42=16

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 execution procedures

① Set “1” or “2”in function parameter 03．04 and press PRG/DATA key.

② Enter a run command. (press RUN 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. 5 to 40 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 + 10 s + Deceleration time)

⑤ Automatically turn the run command OFF to complete tuning.

4.1. 6 Three-phase asynchronous motor v/f control basic function parameter setting

When the motor is under V/F control(01．90 = 4), 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
07．02	Base frequency 4	Motor ratings (printed on the nameplate of the motor)	50Hz
07．03	Rated voltage at base frequency 4		Rated voltage of motor
07．15	Motor 4 (No. of poles)		4 poles
07．16	Motor 1 (Rated capacity)		Motor capacity
07．17	Motor 1 (Rated current)		Rated current of motor
07．01	Max. output frequency 4	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.	60Hz
00．15	Upper limit of output frequency		90Hz
00．07	Acceleration time 1		Below 22kW：9.00s Above 30kW ：30.00s
00．08	Deceleration time 1		

Auto-tuning procedure

(1) Selection of auto-tuning type

Select "tuning with the motor stopped (07．18 = 1)" or "tuning with the motor running (07．18 = 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.

07．18 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 (07．21) Leakage reactance %X (07．22) Rated Slip (07．26)	Tuning with the motor stopped	Cannot rotate the motor.
2	Tune while the motor is rotating under V/f control	No-load current (07．20) Primary resistance %R1 (07．21) Leakage reactance %X (07．22) Rated Slip (07．26) Magnetic saturation factors 1~5 Magnetic saturation expansion factors a~c (07．30~07．37)	Tuning the %R1 and %X, with the motor stopped.Tuning the no-load current and magnetic saturation factor, with the motor runningat 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 07．18, auto-tuning data is saved in the Function parameter of motor 1*.

(2) Preparation Mechanical System

Take dismantling for motor gearing

(3) Auto-tuning execution procedures

① Set "1" or "2"in function parameter 07．18 and press FUNC DATA key.

② Enter a run command. (press RUN 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 80s.

④ When function parameter 07．18 = 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 75 s + 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 80 s.)

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 receivedas so on.
Tunning frequency error	When output frequency is limited by the max. output frequency(upper)
Parameter setting error	Rated impedance, Rated inductance is invalid
Pole position calculation is disabled	When parameter data 03.30=1 or 3, Inductance salient pole of the motor is too small When parameter data 03.30=2, the motor is without magnetic saturation characteristic
Magnetic saturation deficiency	The pole position can not be identied due to the too small magnetic saturation characteristic of the motor
Magnetic saturation excess	The magnetic saturation characteristic is too large, the flow current may be too big when the pole position is being identied.
PG signal error	There is a error of the signal sent by speed/pole position sensor
Errors appears	An undervoltage or any other alarm has occurred.

4.1.7 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) S Set a low reference frequency such as 5 Hz, using ⌃ / ⌄ keys on keypad.

(2) After pressing RUN key, the inverter starts forward running.

(3) Press 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※

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	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 trip occurs due to a short deceleration time, prolong the deceleration time	○	○	○
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.	○	×	×
04．07	Acceleration/Deceleration Pattern	When stall preventing function of the current limitation own to the acceleration and deceleration is enabled, the motor is modified to the direction where the action value is increased.	○	×	×
07．05	Torque boost 4	When the starting torque is insufficient, the motor is modified from the direction where the torque boost is increased. When the no-load is over excite, the motor is modified from the direction where the torque boost is decreased.	○	×	×
07．41	Output Current Fluctuation Damping Gain for Motor 4	When motor current is vibrational, increase the vibration inhibition coefficient.	○	×	×
09．01	Speed control 1 Speed command filter	If compared with the reference speed, the change overrun is too large, increase filter time.	×	○	○
09．02	Speed control 1 Speed detection filter	When there is fluctuation in speed detection, the gain of the speed control can not be improved, enlarge the constant of the filter to increase the gain.	×	○	○
09．03	Speed control 1 P item (gain)	Reduce the proportion coefficient when there is a speed viabration. Enlarge the proportion coefficient when the response is slow.	×	○	○
09．04	Speed control 1 I item (integral time)	Shorten the integral time when the response is slow.	×	○	○

○：Valid ×：Invalid

4.1.8 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 + FUNC DATA key ” on the keypad for 5 s 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 unction 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 + ⌃ key" simultaneously. After displaying jogging frequency for 1 s 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 + ⌃ 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 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 + ⌃ key" simultaneously

4.2.2 External Terminal Command Control / Keypad Command Control Switching

In normal operation, it takes external terminal command control run of inverter. It can be switched to keypad command control to take all operations by keypad.

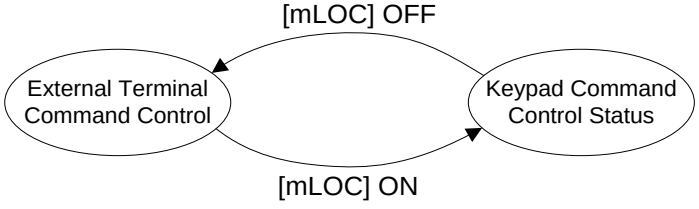
● External terminal command control:Inverter run command setting and frequency setting are controlled by external terminals.

● Keypad command control:Inverter run command setting and frequency setting are controlled by keypad .

Switching of External Terminal Command Control / Keypad Command Control is taken via external digital input signal. It needs assign data 35 keypad command selection [mLOC] to one digital input terminal of function parameters 01．01~01．09, 01．98, 01．99.

When External Terminal Command Control is switched to Keypad Command Control, the frequency setting will be maintained at frequency setting of External Terminal Command automatically. It is at run status when taking switching. Run command of keypad is ON automatically, so that the run status can be maintained continuously. When it is conflict with keypad setting, the inverter operation will be stopped.

Select [mLOC] signal combination according to the External Terminal Command Control / Keypad Command Control and keypad command. Please refer to the following illustrated status switching drawing on status switching.

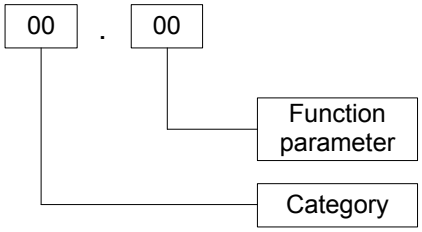


External terminal command control / keypad command control status switching drawing

5.1 Function Parameters List

Users can set the function parameter values to control and apply various functions of S5100 series inverter.

Before starting to narrate this chapter, first describe function parameter format as follows:



Then function parameters are classified as follows:

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

■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 following table shows the symbolic meaning of "change when running" column in the function parameter list after the next page.

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 FUNC/DATA key. If you press the RESET key without pressing the FUNC/DATA 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 FUNC/DATA 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, 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 data	Action
10	When [mJOG] is ON, select Jog (physical ON ⇔ timing sequence OFF)
1010	When [mJOG] is OFF, select Jog (physical OFF ⇔ timing sequence ON)

■The relationship between function parameters and control modes

S5100 series inverter can help users achieve the following drive controls. Depending on different control modes, the effective range of individual function parameter is different as well. The range of each function parameter classified according to different control modes is shown in the "control mode" column of the function parameters list below. ○ represents effective and × represents invalid.

Control mode column of parameters list	Control target (04．18)	Control mode selection 1	
		00．42 Setting value	Other condition
No PG	PM motor under vector control without speed sensor	15	Parameter data 01.90=0 and terminal “mM4” is turned OFF or no assingment of the terminal
PG	PM motor under vector control with speed sensor	16	
V/f	Three-phase asynchronous motor under V/f control	Unlimited	Parameter 01.90=4 or terminal “mM4” is turned ON

00: Basic functions parameters

	Parameter	Parameter Functions	Setting Range	Factory Default	Control Method		
					Without PG	PG	IM/ V/f
✓	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	○	○	○
	00．01	Dominant frequency 1 source selection	0:keypad (⌃ / ⌄ key) 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 8:keypad (⌃ / ⌄ key) (balanceless-bumpless switching available) 10:Simple PLC input 11:Digital input (optional card) 12:Pulse train input	0	○	○	×

00: Basic functions parameters

	Parameter	Parameter Functions	Setting Range	Factory Default	Control Method		
					Without PG	PG	IM/ V/f
	00．02	Operation command source selection	0:keypad command mode (Now the running direction is set by external terminal) 1:External terminal command mode 2:keypad forward command mode 3:keypad reverse command mode	2	○	○	○
	00．03	Maximum output frequency 1	25.0~500.0Hz	90.0	○	○	×
	00．04	Base frequency 1	25.0~500.0Hz	90.0	○	○	×
	00．05	Rated Voltage at Base Frequency 1	160 ~ 500V:AVR action (440V series)	370	○	○	×
	00．06	Maximum output voltage 1	160 ~ 500V: Limitionof output voltage (440V series) 999: No limitaion of output voltage	370	○	○	×
↗	00．07	Acceleration time 1	0.00 ~ 6000s ※ 0.00 Entering 0.00 cancels the acceleration time, requiring external soft-start.	Type Setting	○	○	○
↗	00．08	Deceleration time 1			○	○	○
↗	00．10	Electronic Thermal Overload (Protection for Motor)1 Select motor characteristics	1:PM motor with shaft-driven cooling fan(Enclosed exterior fan) 2:PM motor with external cooling fan(Entire enclosed external ventilation)	1	○	○	×
↗	00．11	Electronic Thermal Overload (Protection for Motor)1 Detection level	0.00 (invalid); 1% to 135% of the rated current (allowable continuous drive current) of the motor	Type Setting	○	○	×
↗	00．12	Electronic Thermal Overload (Protection for Motor)1 Thermal time constant	0.5~75.0min	Type Setting	○	○	×
↗	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 3:Continue to run (for heavy inertia or general loads) 4:Restart at the frequency at which the power failure occurred (for general load) 5:Restart at the starting frequency	1	○	○	○
↗	00．15	Upper limit of output frequency	0.0~500.0Hz	90.0	○	○	○
↗	00．16	Lower limit of output frequency	0.0~500.0Hz	0.0	○	○	○
	00．18	Dominant frequency 1 bias setting	–100.00~100.00%	0.00	○	○	○
↗	00．23	Starting frequency 1	0.0~60.0Hz	1.0	○	○	×

00: Basic functions parameters

	Parameter	Parameter Functions	Setting Range	Factory Default	Control Method		
					Without PG	PG	IM/ V/f
↗	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)	2~15kHz (HD Specifications:5.5~45kW, ND Specifications:5.5~18.5kW) 2~10kHz (HDSpecifications:55~200kW, ND Specifications:22~45kW) 2~6kHz (ND Specifications:55~200kW)	Type Setting	○	○	○
↗	00．29	AFM terminal action selection	0:Voltage output (DC0 ~ +10 V) 1:Current output (DC4 ~ 20mA) 2:Current output (DC0 ~ 20mA)	0	○	○	○
⊛	00．30	AFM terminal output gain (Voltage adjustment)	0~300%	100	○	○	○
↗	00．31	AFM terminal function selection	0:Output frequency 1 (command value) 1:Output frequency 2 (estimated/detected value) 2:Output Current 3:Output Voltage 4:Output torque 5:Load factor 6:Input power 7:PID feedback amount 8:PG feedback amount 9:DC link bus voltage 10:Universal AO 13:Motor output power 14:Analog output calibration (+) 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 (Voltage adjustment)	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	0:Output frequency 1 (command value) 1:Output frequency 2 (estimated/detected value) 2:Output Current 3:Output Voltage 4:Output torque 5:Load factor 6:Input power	0	○	○	○

00: Basic functions parameters							
	Parameter	Parameter Functions	Setting Range	Factory Default	Control Method		
					Without PG	PG	IM/ V/f
			7:PID feedback amount 8:PG feedback amount 9:DC link bus voltage 10:Universal AO 13:Motor output power 14:Analog output calibration (+) 15:PID command value (SV) 16:PID output value (MV)				
	00．38	Stop frequency detection mode	0:detected speed value 1:reference speed value	0	×	○	×
↗	00．39	Stop frequency holding time	0.00~10.00s	0.00	○	○	×
↗	00．40	Torque limiter level 1-1	20~200%; 999(invalid)	200	○	○	○
↗	00．41	Torque limiter level 1-2	20~200%; 999(invalid)	200	○	○	○
	00．42	Drive Control mode selection 1	0: V/f control 15:PM motor under vector control without speed sensor 16: PM motor under vector control with speed sensor	15	○	○	×
↗	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)	OFF (canceled)	Type Setting	○	○	○
↗	00．51	Electronic Thermal Overload Allowable average loss (protection for braking resistor)	0.001~99.99kW	0.001	○	○	○
↗	00．52	Electronic Thermal Overload braking resistance (protection for braking resistor)	0.01~999Ω	0.01	○	○	○
	00．80	HD / ND switching	0:HD Specifications 1:ND Specifications	0	○	○	○

01: External terminal function parameters

	Parameter	Parameter Functions	Setting Range	Factory Default	Control Method		
					Without PG	PG	IM/ V/f
	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	○	○	○
	01．05	MI5 terminal function selection	4(1004):Select ACC/DEC time (2 steps) [mRT1]	4	○	○	○
	01．06	MI6 terminal function selection	5(1005):Select ACC/DEC time (4 steps) [mRT2]	5	○	○	○
	01．07	MI7 terminal function selection	6(1006):Enable 3-wire operation [mHLD]	6	○	○	○
	01．08	MI8 terminal function selection	7(1007):Coast to a stop [mBX]	7	○	○	○
	01．09	MI9 terminal function selection	8(1008):Reset alarm (abnormal) [mRST]	8	○	○	○
			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]		○	○	×
			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]		○	○	○
			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]		○	○	×
			22(1022):Interlock [mIL]		○	○	○
			23(1023):Cancel Torque control[mHz/TRQ]		×	○	×
			24(1024):Communication link via selection (RS-485) [mLE]		○	○	○
			25(1025):Universal DI [mU-DI]		○	○	○
			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]		○	○	○
			35(1035):Select local (keypad) operation [mLOC]		○	○	○
			36(1036):Motor 3 selection [mM3]		○	○	×
			37(1037):Motor 4 selection [mM4]		○	○	○

01: External terminal function parameters

	Parameter	Parameter Functions	Setting Range	Factory Default	Control Method		
					Without PG	PG	IM/ V/f
			48:Pulse train input (available only for terminal MI7 (01．07)) [mPIN]		○	○	○
			49(1049):Pulse train symbol [mSIGN] (available for terminals except MI7(01．01~01．06, 01．08, 01．09))		○	○	○
			※ Setting the value in parentheses()shown above assigns a negative logic output to a terminal.(True if OFF)				
↗	01．10	Acceleration time 2	0.00~6000s ※ 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			○	○	○
↗	01．13	Deceleration time 3			○	○	○
↗	01．14	Acceleration time 4			○	○	○
↗	01．15	Deceleration time 4			○	○	○
↗	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	○	○	○
	01．22	MO3 terminal function selection	2(1002):Frequency (speed) detection [mFDT]	2	○	○	○
	01．23	MO4 terminal function selection	3(1003):Undervoltage detected (When Inverter stopped)[mLU]	7	○	○	○
	01．24	MRA/MRC terminal function selection	4(1004):Torque polarity detection[mB/D]	15	○	○	○
	01．27	RA/RB/RC terminal function selection	5(1005):Inverter output limiting[mIOL]	99	○	○	○
			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]		○	○	○
			27(1027):Universal DO [mU-DO]		○	○	○
			28(1028):Cooler overheat early warning [mOH]		○	○	○
			30(1030):Lifetime alarm [mLIFE]		○	○	○

01: External terminal function parameters

	Parameter	Parameter Functions	Setting Range	Factory Default	Control Method		
					Without PG	PG	IM/ V/f
	01．27	RA/RB/RC terminal function selection	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 [mID3]		○	○	○
			41(1041):Low current detected [mIDL]		○	○	○
			42(1042):PID alarm output [mPID-ALM]		○	○	○
			43(1043):In PID control [mPID-CTL]		○	○	○
			44(1044):Motor stopped due to slow flowrate under PID control[mPID-STP]		○	○	○
			45(1045):Low output torque detection [mU-TL]		○	○	○
			46(1046):Torque detection 1 [mTD1]		○	○	○
			47(1047):Torque detection 2 [mTD2]		○	○	○
			48(1048):Motor 1 selected [mSWM1]		○	○	×
			49(1049):Motor 2 selected [mSWM2]		○	○	×
			50(1050):Motor 3selected [mSWM3]		○	○	×
			51(1051):Motor 4 (Three-phase asynchronous motor)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]		○	○	○
			57(1057):Brake signal [mBRKS]		×	○*12	×
			58(1058):Frequency (speed) detection 3 [mFDT3]		○	○	○
			59(1059):ACI terminal wire break detected [mACIOFF]		○	○	○
			70(1070):Speed valid [mDNZS]		○	○	×
			71(1071):Speed agreement [mDSAG]		○	○*12	×
			72(1072):Frequency (speed) arrival signal 3 [mFAR3]		○	○*12	○
			76(1076):P G error detected[mPG-ERR]		○	○*12	×
			84(1084):Maintenance timer[mMNT]		○	○	○
			89(1089)：Magnetic pole position detection completed ［mPID］		×	○	×
			98(1098):Light alarm [mL-ALM]		○	○	○
			99(1099):Alarm output (for any alarm) [mALM]		○	○	○
			105(1105):Braking transistor broken[mDBAL]		○	○	○
			※ 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	Control Method		
					Without PG	PG	IM/ V/f
↗	01．30	Frequency Arrival (Hysteresis width)	0.0~10.0Hz	2.5	○	○	○
↗	01．31	Frequency detection value	0.0~500.0Hz	90.0	○	○	○
↗	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	90.0	○	○	○
↗	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 23:Torque current (%) 24:Magnetic flux command (%) 25:Input watt-hour	0	○	○	○
↗	01．44	Display when stopped	0:Specified value 1:Display output value	0	○	○	○
↗	01．48	Speed monitoring selection	0:Output frequency 1 (command value) 1:Output frequency 2 (estimated/detected value) 2:Reference frequency 3:Motor speed 4:Load shaft speed 5:Line speed 7:Display speed (%)	0	○	○	○
↗	01．50	Coefficient for Speed Indication	0.01~200.00	20.00	○	○	○

01: External terminal function parameters

	Parameter	Parameter Functions	Setting Range	Factory Default	Control Method		
					Without PG	PG	IM/ V/f
↗	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	90.0	○	○	○
↗	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 2:Auxiliary frequency 2 3:PID command 1 5:PID feedback amount 6:Ratio setting 7:Analog torque limit value A 8:Analog torque limit value B 10:Torque command 11:Torque current command 17:Forward (FWD) speed limit value 18:Reverse (REV) speed limit value 20:Analog input monitor	0	○	○	○
	01．62	Terminal ACI extension function selection		0	○	○	○
	01．63	Terminal AUIextension function selection		0	○	○	○
↗	01．64	Saving of digital reference frequency	0:Auto-saving (when the main power is turned off) 1:Press the FUNC/DATA key to save	1	○	○	○
↗	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	10.00	○	○	○
↗	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	○	○	○
	01．90	Motor selection	0: According to M* terminal function 'mM2' 'mM3' 'mM4' 4: Motor 4(Three-phase asynchronous motor) selection(equal to “mM4” ON)	0	○	○	○
	01．98	FWD terminal function selection	0(1000):Multi-step speed command 1(0-1 step) [mSS1]	98	○	○	○
	01．99	REV terminal function selection	1(1001):Multi-step speed command 2(0-3 steps) [mSS2]	99	○	○	○
			2(1002):Multi-step speed command 3 (0-7 steps) [mSS4]		○	○	○
			3(1003):Multi-step speed command 4 (0-15 steps) [mSS8]		○	○	○
			4(1004):Select ACC/DEC time (2 steps) [mRT1]		○	○	○

01: External terminal function parameters

Parameter	Parameter Functions	Setting Range	Factory Default	Control Method		
				Without PG	PG	IM/ V/f
		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]		○	○	○
		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]		○	○	○
		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]		○	○	○
		22(1022):Interlock [mIL]		○	○	○
		23(1023):Cancel Torque control [mHz/TRQ]		×	○	×
		24(1024):Communication link via selection (RS-485,BUS option) [mLE]		○	○	○
		25(1025):Universal DI [mU-DI]		○	○	○
		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]		○	○	○
		35(1035):Select local (keypad) operation[mLOC]		○	○	○
		36(1036):Motor 3 selection [mM3]		○	○	×
		37(1037):Motor 4 (Three-phase asynchronous motor)selection [mM4]		○	○	○
		49(1049):Pulse train symbol [mSIGN]		○	○	○
		98:Run forward [mFWD]		○	○	○
		99:Run reverse [mREV]		○	○	○
		※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	Control Method		
					Without PG	PG	IM/ V/f
↗	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	0.00~500.00Hz	0.00	○	○	○
	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 8:Enable (⌃/⌄)keys on the keypad (balanceless-bumpless switching available) 10:Simple PLC input 11:Digital input interface card (option) 12:Pulse train input	2	○	○	○
⊛	02．31	Analog input adjustment for offset (AVI terminals)	–5.0~5.0%	0.0	○	○	○

02: Control functions parameters

	Parameter	Parameter Functions	Setting Range	Factory Default	Control Method		
					Without PG	PG	IM/ V/f
◎	02．32	Analog input adjustment for gain (AVI terminals)	0.00~400.00%	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: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)	0.00~400.00%	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)	0.00~400.00%	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	○	○	○
◎	02．50	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	Normal/Inverse action selection (Dominant frequency 1)	0:Normal operation 1:Inverse operation	0	○	○	○

03: Motor 1 parameters

	Parameter	Parameter Functions	Setting Range	Factory Default	Control Method		
					Without PG	PG	IM/ V/f
	03．01	Motor 1 (No. of poles)	2 to 22 poles	6	○	○	×
	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	1: Stop setting (armature resistance, inductance) 2: Running setting (armature resistance, inductance, induction voltage, pole position sensor compensation) 4: Running setting (pole position sensor compensation)	0	○	○	×
	03．30	Motor 1 Pole position detection selection	0: Current auto search 1: For IPM(Embeded) motor 2: For SPM(surface) motor 3: Current auto search for IPM motor	0	○	○	×
	03．60	Motor 1 Armature resistance	0.000~50.000Ω	Type Setting	○	○	×
	03．61	Motor 1 Shaft inductance	0.00~500.00mH		○	○	×
	03．62	Motor 1 axis inductance	0.00~500.00mH		○	○	×
	03．63	Motor 1 Induction voltage (basic speed)	160~500V(440V series)		○	○	×
	03．64	Motor 1 Iron loss (basic speed)	0.0~20.0%(Motor capacity as a standard level)		○	○	×
	03．65	Motor 1 q axis inductance magnetic saturation correction	0.0~100.0%(100.0% = no magnetic saturation) 999(Factory adjustment value)	999	○	○	×
	03．74	Motor 1 Current command value at startup	10~200%(Motor rated current as a standard level)	80	○	○	×
	03．84	For manufacturer	0.0~100.0, 999	999	—	—	—
	03．85	Motor 1 Reference value of flux	50.0~150.0%，999(Factory adjusted value)	999	○	○	×
	03．86	For manufacturer	Specialized for monitor	—	—	—	—
	03．87	Motor 1 NS check current command value	0~200%(Motor rated current as a standard level)	Type Setting	○	○	×
	03．88	For Manufacturer to use	0~100, 999	999	—	—	—
	03．89	For Manufacturer to use	0, 1~100	0	—	—	—
	03．90	Motor 1 overcurrent protection value	0.00(Invalid)，0.01~2000A	Type Setting	○	○	×
	03．95	Motor 1 Magnetic pole position sensor compensation	0.0~359.9°，999 (No adjustment of compensation)	999	×	○	×

04: Advanced functions Parameters

	Parameter	Parameter Functions	Setting Range	Factory Default	Control Method		
					Without PG	PG	IM/ V/f
	04．03	Data initialization	0:Manual settings 1:Initialize all function parameters data (factory setting) 2:Initialize Motor 1 constant parameters(PM motor) 5:Initialize Motor 4 constant parameters(Three-phase asynchronous motor)	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)	0	○	○	○
✓	04．07	Acceleration/Deceleration Pattern	0:Inactive (linear acceleration and deceleration) 1:S curve acceleration and deceleration (weak) 2:S curve acceleration and deceleration (arbitrary:based on 04.57 ~ 04.60) 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	○	○	○
	04．09	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)	0.1~20.0s	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)	400~600V:(440V series)	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	○	○	○
	04．18	Torque control action selection	0:Invalid (speed control) 2:Valid Action (torque current command) 3:Valid Action (torque command)	0	×	○	×

04: Advanced functions Parameters

	Parameter	Parameter Functions	Setting Range	Factory Default	Control Method		
					Without PG	PG	IM/ V/f
↗	04．26	Thermistor (for motor) action selection	0:Invalid 1:PTC:The inverter immediately trips 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	○	○	○
↗	04．30	Communication link mode selection	Frequency command Run command 0:00．01 00．02 1:RS-485 communications (port 1) 00．02 2:00．01 RS-485 communications (port 1) 3:RS-485 communications (port 1) RS-485 communications (port 1) 4:RS-485 communications (port 2) 00．02 5:RS-485 communications (port 2) RS-485 communications (port 1) 6:00．01 RS-485 communications (port 2) 7:RS-485 communications (port 1) RS-485 communications (port 2) 8:RS-485 communications (port 2) RS-485 communications (port 2)	0	○	○	○
↗	04．42	Capacitance of Main circuit (DC link bus) capacitor	Reserved	—	○	○	○
↗	04．43	Cumulative running time for cooling fan	Indication of cumulative run time of cooling 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 (Changeable,resettable) in replacement (In 10 hours)	—	○	○	○
	04．50	Non-linear V/f Pattern 1 (Frequency)	0.0(canceled),0.1~500.0Hz	Type Setting	×	×	○
	04．51	Non-linear V/f Pattern 1 (Voltage)	0 ~ 500V:AVR action (440V series)		×	×	○
	04．52	Non-linear V/f Pattern 2 (Frequency)	0.0(canceled),0.1~500.0Hz	0.0	×	×	○
	04．53	Non-linear V/f Pattern 2 (Voltage)	0 ~ 500V:AVR action (440V series)	0	×	×	○

04: Advanced functions Parameters

	Parameter	Parameter Functions	Setting Range	Factory Default	Control Method		
					Without PG	PG	IM/ V/f
↗	04．54	Jogging acceleration time	0.00~6000s	Type Setting	○	○	○
↗	04．55	Jogging deceleration time			○	○	○
↗	04．56	Deceleration time for forced stop			○	○	○
↗	04．57	1st S-curve acceleration range (Leading edge)	0~100%	10	○	○	○
↗	04．58	2nd S-curve acceleration range (Trailing edge)		10	○	○	○
↗	04．59	1st S-curve deceleration range (Leading edge)		10	○	○	○
↗	04．60	2nd 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	○	○	○
↗	04．64	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(canceled),0.1~500.0Hz	0.0	×	×	○
	04．66	Non-linear V/f Pattern 3 (Voltage)	0 ~ 500V:AVR action (440V series)	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 4:Torque limit control:with Force-to-stop invalid.	0	○	○	○
↗	04．70	Overload prevention control	0.00:Follow the deceleration time selected,0.01~100.00 Hz/s, 999(cancel)	999	○	○	○
↗	04．72	Main power failure detection mode selection	0:Invalid 1:valid action	1	○	○	○
	04．74	Torque Limiter:torque control target	0:Motor-generating torque limit 1:Torque current limit 2:Output power limit	1	○	○	○
↗	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)	0000	○	○	×

04: Advanced functions Parameters

	Parameter	Parameter Functions	Setting Range	Factory Default	Control Method		
					Without PG	PG	IM/ V/f
↗	04．81	Light alarm selection 1	0000~FFFF (hexadecimal)	0000	○	○	○
↗	04．82	Light alarm selection 2	0000~FFFF (hexadecimal)	0000	○	○	○
↗	04．86	For Manufacturer to use	0~2	0	—	—	—
↗	04．87		25.0~500.0Hz	25.0	—	—	—
↗	04．88		0~3; 999	0	—	—	—
↗	04．89		0,1	0	—	—	—
↗	04．90		0,1	0	—	—	—
↗	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)	—	○	○	○
↗	04．96	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)	0051H (hexadecimal)			
			Bit 0: Lower the carrier frequency automatically (0: invalid; 1: valid)	1	×	×	○
			Bit 1: Input phase loss protection (0: invalid; 1: valid)	1	○	○	○
			Bit 2: Output phase loss protection (0: invalid; 1: valid)	0	○	○	○
			Bit 3: Reserve	0	○	○	○
			Bit 4: Reserve-	1	○	○	○
			Bit 5: Detect DC fan locked (0: valid; 1: invalid)	0	○	○	○
			Bit 6: Detect braking transistor error (For 22kW or below) (0:invalid; 1: valid)	1	○	○	○
			Bit 7: Switch IP20/IP40 enclosure (0: IP20; 1: IP40)	0	○	○	○

05: Motor 2 parameters

	Parameter	Parameter Functions	Setting Range	Factory Default	Control Method		
					Without PG	PG	IM/ V/f
↗	05．43	Speed control 2 speed command filter	0.000~5.000s	0.020	○	○	×
⊛	05．44	Speed control 2 speed detection filter	0.000~0.100s	0.005	○	○	×
⊛	05．45	Speed control 2 P item (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	○	○	×
↗	05．48	Speed control 2 output filter	0.000~0.100s	0.000	○	○	×

06: Motor 3 parameters

	Parameter	Parameter Functions	Setting Range	Factory Default	Control Method		
					Without PG	PG	IM/ V/f
↗	06．43	Speed control 3 speed command filter	0.000~5.000s	0.020	○	○	×
⊛	06．44	Speed control 3 speed detection filter	0.000~0.100s	0.005	○	○	×
⊛	06．45	Speed control 3 P item (gain)	0.1~200.0 times	10.0	○	○	×
⊛	06．46	Speed control 3 I item (integral time)	0.001~9.999s； 999:Integral action is invalid	0.100	○	○	×
↗	06．48	Speed control 3 output filter	0.000~0.100s	0.000	○	○	×

07: Motor 4 parameters

	Parameter	Parameter Functions	Setting Range	Factory Default	Control Method		
					Without PG	PG	IM/ V/f
	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) 160~500V:AVR action (440V series)	380	×	×	○
	07．04	Maximum output voltage 4	160~500V:AVR action (440V series)	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: Motor 4 parameters

	Parameter	Parameter Functions	Setting Range	Factory Default	Control Method		
					Without PG	PG	IM/ V/f
↗	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	0~100%(HD specification), 0~80%(ND specification)	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:Common V / f control with slip compensation inactive(Fixed setting value)	0	×	×	○
	07．15	Motor 4 (No. of poles)	2 to 22 poles	4	×	×	○
	07．16	Motor 4 rated capacity	0.01 ~ 1000kW	Type Setting	×	×	○
	07．17	Motor 4 rated current	0.00~2000A		×	×	○
	07．18	Motor 4auto-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)	0	×	×	○
	07．20	Motor 4 no-load current	0.00~2000A	Type Setting	×	×	○
↗	07．21	Motor 4 %R1	0.00~50.00%		×	×	○
↗	07．22	Motor 4 %X	0.00~50.00%		×	×	○
	07．26	Motor 4 rated slip frequency	0.00~15.00Hz		×	×	○

07: Motor 4 parameters

	Parameter	Parameter Functions	Setting Range	Factory Default	Control Method		
					Without PG	PG	IM/ V/f
↗	07．27	Motor 4 iron loss factor 1	0.00~20.00%	Type Setting	×	×	○
↗	07．28	Motor 4 iron loss factor 2		0.00	×	×	○
↗	07．29	Motor 4 iron loss factor 3		0.00	×	×	○
↗	07．30	Motor 4 magnetic saturation factor 1	0.0~300.0%	Type Setting	×	×	○
↗	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	Reserved	0	×	×	○
↗	07．41	Output Current Fluctuation Damping Gain for Motor 4	0.00~1.00	0.20	×	×	○
	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))	—	×	×	○
↗	07．60	Motor 4 Speed display coefficient	0.01~200.00	30.00			
	07．98	Motor 4 Function selection	0000~FFFF(hexadecimal)	00FF			
			Bit 0: Current limiter (00．43、00．44) (0: disable；1: enable)	1	×	×	○
			Bit 1: Running direction limiter(04．08) (0: disable,1: enable)	1	×	×	○
			Bit 2: variable torque V/f pattern (04．50~04．53, 04．65, 04．66) (0: disable；1: enable)	1	×	×	○
			Bit 3: PID contorl (08．01~08．62, 04．91) (0: disable；1: enable)	1	×	×	○
			Bit 4~7: Available space	1	×	×	○
			Bit 8~15: Available space	0	×	×	○

08: Application function 1 parameters

	Parameter	Parameter Functions	Setting Range	Factory Default	Control Method		
					Without PG	PG	IM/ V/f
	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, AUI) 3:UP / DOWN 4:Command via communications link	0	○	○	○
✓	08．03	PID control P item (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: Application function 1 parameters

	Parameter	Parameter Functions	Setting Range	Factory Default	Control Method		
					Without PG	PG	IM/ V/f
↗	08．56	PID control speed command filter	0.00~5.00s	0.10	○	○	○
↗	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 item (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 D item (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	○	○	×
↗	08．70	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	0			
			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;1:operation command OFF is valid, Only when a run command is OFF)		×	○	×

09: Application function 2 parameters

	Parameter	Parameter Functions	Setting Range	Factory Default	Control Method		
					Without PG	PG	IM/ V/f
↗	09．01	Speed control 1 Speed command filter	0.000~5.000s	0.200	○	○	×
⊛	09．02	Speed control 1 Speed detection filter	0.000~0.100s	0.025	○	○	×
⊛	09．03	Speed control 1 P item (gain)	0.1~200.0 times	20	○	○	×
⊛	09．04	Speed control 1 I item (integral time)	0.001~9.999s 999:Integral action is invalid	0.600	○	○	×
↗	09．06	Speed control 1 output filter	0.000~0.100s	0.000	○	○	×
↗	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)I 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	0.000	×	×	×
	09．14	Feedback Input (Pulse input format)	2: Orthogonal phase difference B, A phase pulse, Z phase 4: Orthogonal phase difference B, A phase pulse, UVW signal	2	×	○	×
	09．15	Feedback Input:Encoder pulse resolution	0014 ~ EA60 (hexadecimal) (20 to 60000 pulses)	0400H (1024)	×	○	×
↗	09．21	Speed Agreement/PG Error Hysteresis width	0.0~50.0%	10.0	○	○	×
↗	09．22	Speed Agreement/PG Error Detection timer	0.00~10.00s	0.50	○	○	×
	09．23	PG Error Processing	0:Continue to run 1:Stop running with alarm 1 2:Stop running with alarm 2	0	○	○	×
	09．24	Zero speed control	0:Zero speed control is invalid when it's at startup 1:Zero speed control is valid when it's at startup	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	○	○	×
	09．51	For Manufacturer to use	0~500	Type Setting	—	—	—
	09．54				—	—	—
	09．55		0000~00FF (displayed in hex.)	0000H	—	—	—

09: Application function 2 parameters

	Parameter	Parameter Functions	Setting Range	Factory Default	Control Method		
					Without PG	PG	IM/ V/f
	09．59	Command (Pulse Rate Input)	0:Pulse train sign/Pulse train input 1:Forward rotation pulse/Reverse rotation pulse 2:A/B phase with 90 degree phase shift	0	○	○	○
↗	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	○	○	○
↗	09．80	Magnetic pole position auto search frequency	0.1~10.0Hz	1.0	×	○	×
	09．92	For Manufacturer to use	0.00~3.00	0.00	-	-	-
↗	09．93	For Manufacturer to use	0.00~10.00, 999	999	—	—	—
↗	09．94	For Manufacturer to use	0.00~10.00, 999	999	—	—	—
↗	09．95	For Manufacturer to use	0.00~10.00, 999	999	—	—	—
↗	09．96	For Manufacturer to use	-50.0~50.0, 999	999	—	—	—
↗	09．97	For Manufacturer to use	-50.0~50.0, 999	999	—	—	—
	09．98	For Manufacturer to use	0000~FFFF (hexadecimal)	0000	—	—	—

11: Serial communication function Parameter

	Parameter	Parameter Functions	Setting Range	Factory Default	Control Method		
					Without PG	PG	IM/ V/f
	11．01	RS-485 communication 1 communication Station address	1~255	1	○	○	○
↗	11．02	RS-485 communication 1:Communications error processing	0:Immediately trip with alarm Er8 1:Trip with alarm Er8after running for the period specified by timer 2:Retry during the period specified by timer. If the retry fails, trip with alarm Er8 3:Continue to run	0	○	○	○
↗	11．03	RS-485 communication 1:timer	0.0~60.0s	2.0	○	○	○
↗	11．04	RS-485 communication 1:baud rate	0:2400bps 1:4800bps 2:9600bps 3:19200bps 4:38400bps	2	○	○	○
↗	11．05	RS-485communication1:data length selection	0:8 Bit 1:7 Bit	0	○	○	○

11: Serial communication function Parameter

	Parameter	Parameter Functions	Setting Range	Factory Default	Control Method		
					Without PG	PG	IM/ V/f
↗	11．06	RS-485 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	RS-485 communication 1:stop bit selection	0:2 bit 1:1 bit	0	○	○	○
↗	11．08	RS-485 communication 1:No-response error detection time	0:No detection 1~60s	0	○	○	○
↗	11．09	RS-485 communication 1 response interval	0.00~1.00s	0.01	○	○	○
↗	11．10	RS-485 communication 1 protocol selection	0:Modbus RTU protocol	0	○	○	○
	11．11	RS-485 communication 2 communication Station address	1~255	1	○	○	○
↗	11．12	RS-485 communication 2:Communications error processing	0:Immediately trip with alarm Erp 1:Trip with alarm Erp after running for the period specified by timer 2:Retry during the period specified by timer. If the retry fails, trip with alarm Erp 3:Continue to run	0	○	○	○
↗	11．13	RS-485 communication 2:timer	0.0~60.0s	2.0	○	○	○
↗	11．14	RS-485 communication 2:baud rate	0:2400bps 1:4800bps 2:9600bps 3:19200bps 4:38400bps	2	○	○	○
↗	11．15	RS-485 communication 2:data length selection	0:8 Bit 1:7 Bit	0	○	○	○
↗	11．16	RS-485 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	○	○	○
↗	11．17	RS-485 communication 2:stop bit selection	0:2 bit 1:1 bit	0	○	○	○
↗	11．18	RS-485 communication 2:No-response error detection time	0:No detection 1~60s	0	○	○	○
↗	11．19	RS-485 communication 2 response interval	0.00~1.00s	0.01	○	○	○
↗	11．20	RS-485 communication 2 protocol selection	0:Modbus RTU protocol	0	○	○	○

11: Serial communication function Parameter

	Parameter	Parameter Functions	Setting Range	Factory Default	Control Method		
					Without PG	PG	IM/ V/f
↗	11．50	Function switch bit(Hexadecimal)	Bit 0: Panel is wire broken and stop in control operation(0: valid; 1: invalid) Bit 1: Panel with potentiometer use up/down button to give the frequency (0: valid; 1: invalid)	0000	○	○	○
↗	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 0:Follow 04．30 Running command Follow 04．30	0	○	○	○
↗	11．99	Auxiliary communication function (mode selection)	Frequency command 0: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.

11 parameter groups are as the following:

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

00 Basic Functional Parameters

00．00	Setting Data protection	↯	Factory default	0

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 " “ STOP key + ⌃key " (from 0 to 1) or " STOP 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 01．01~01．09,data = 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.

00．01	Dominant frequency 1 source selection	Factory default	0
	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	Enable ⌃ / ⌄ keys on the keypad to set.	[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).	
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 MI9. For details, See parameters 01．01~01．09 on detailed information.	[3]
8	Enable ⌃/ ⌄keys on the keypad to set. (Balanceless-bumpless switching available).	[1]
10	Simple PLC operation. For details, See parameter 02．21 (simple PLC operation selection) on detailed information.	
11	Enable a digital input interface card to set. (option). (For details, See Instruction for Use of optional on detailed information.)	—
12	Enable the Pulse train input [mPIN] command assigned to digital input terminal or a PG interface card to set (option)	[4]

＜Frequency Command＞

[1] Enable ⌃ / ⌄ keys on the keypad to set (0．01＝0(factory default), 8)

(1) Data of parameter 00．01 is set as “0” or “8”. Switch to running mode and set frequency by pressing ⌃ /⌄ keys.

(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. If to save the set frequency, press the FUNC DATA key. (01．64＝1:factory default) and save the frequency. It can start operation at the set frequency when the power is powered on next time.

Tips:·Besides the above saving method of frequency setting data, it also has automatic saving method (parameter 01．64＝0).

·Under the status of setting parameter 00．01 data as “0”or “8”, When other frequency setting method beside main frequency 1 source selection (main frequency 2 source selection, communication, and multispeed frequency) as frequency setting, it cannot change the set frequency through ⌃ / ⌄ key even the keypad is set as running mode.

·When frequency setting is set through ⌃ / ⌄ key, displayed final digit will flash. The data starting from the final digit appears changes, and the changing position moves forward one by one.

·To set frequency, press ⌃ / ⌄ key once. After the final digit is flashing, press PRG/FEED key continuously for more than 1 s. It can move flashing position in this way, thus it can take large data modification. The operation is named as cursor movement.

· If the parameter 00．01 data is set as “8”, the non-impact and smooth transition function becomes effective. When the frequency setting method except through keypad is switched to frequency setting through keypad , the initial value through keypad after being switched will inherit the frequency setting before switching. It can also achieve no shock running even frequency setting switching is taken through the function.

[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, –10~+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, –10~+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, –10~+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)

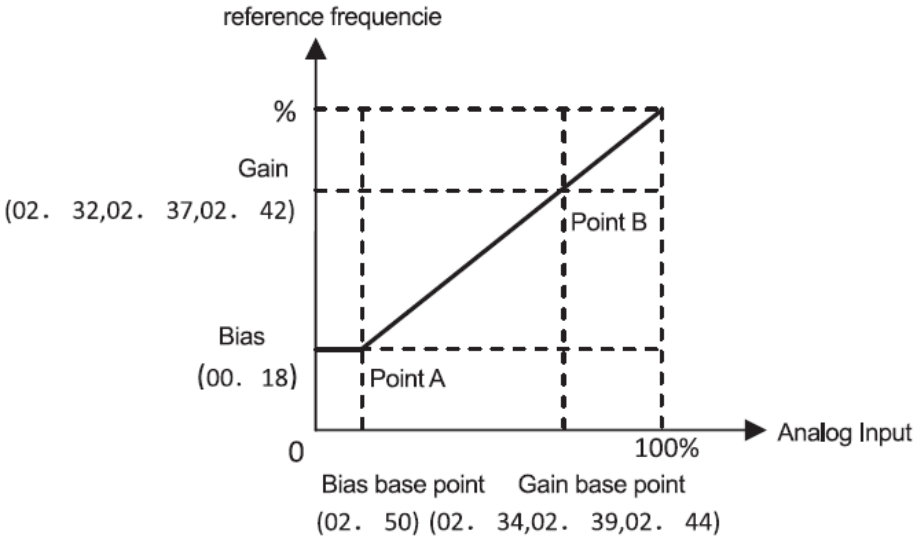
Specifies a filter time constant for analog input voltage or current. Choose an appropriate value for the time constant taking into account the response speed of the machinery system since a large time constant slows down the response. When the input voltage fluctuates dueto noise, specify a larger time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

■ Polarity Selection (02．35,02．45)

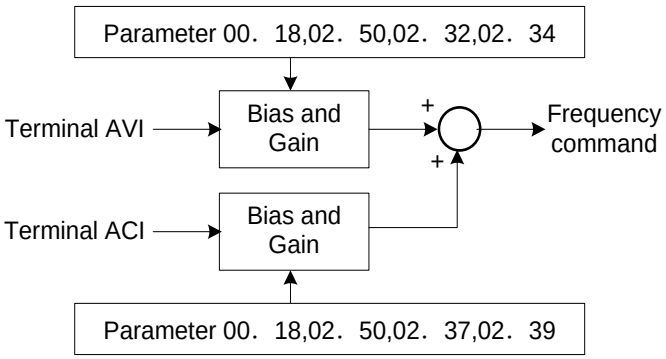
Specifies the input range for analog input voltage.

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

■ 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.



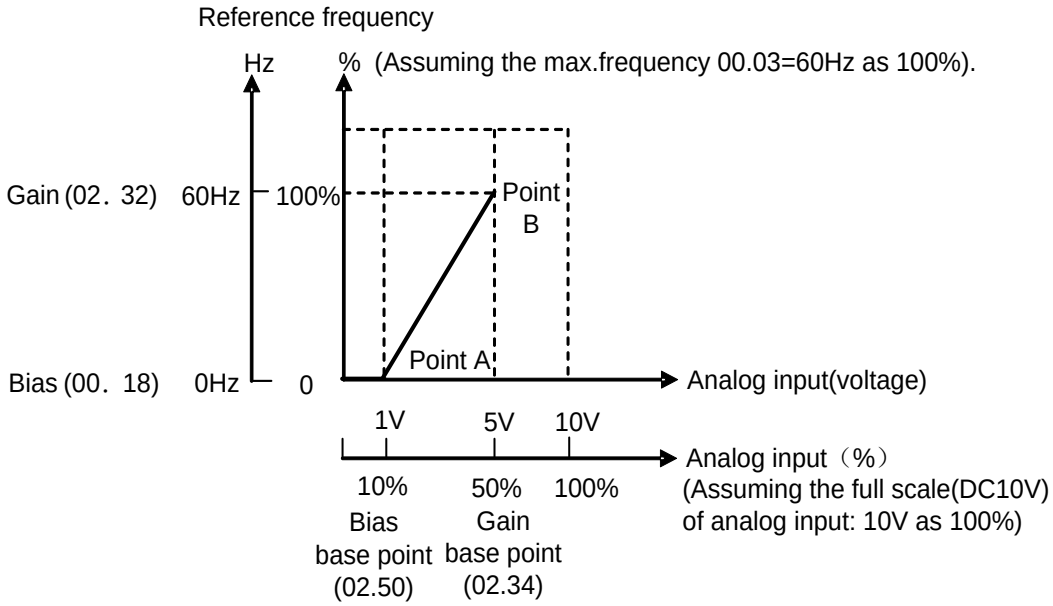
In the case of unipolar input (terminal AVI(with 02.35 = 1, terminal ACI, terminal AUI with 0.245 = 1)

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. 32and 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 (02.50) and gain base point (02.34, 02.39 or 02.44), assuming the full scale (10 VDC or 20 mA DC) 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 0 Hz.

Example:Setting the bias, gain and their base points when the reference frequency 0 to 60 Hz follows the analog input of 1 to 5 VDC 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 to10% of 10V (full scale of terminal AVI, set the bias base point to 10% (02.50 = 10).

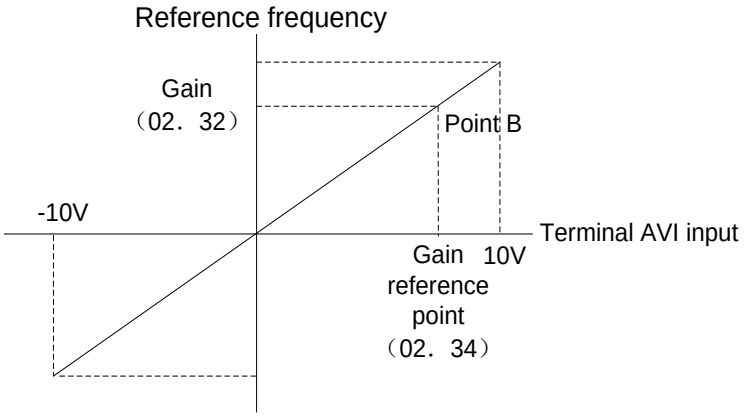
(Point B)

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

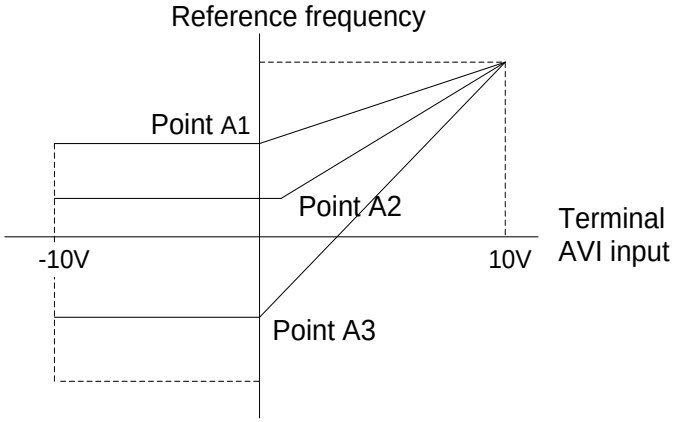
In the case of bipolar input (terminal AVI with (02．35＝0) and terminal AUI with (02．45＝0)

Setting 02.35 and 02.45 data to "0" enables terminal AVI ,to be used for bipolar input (-10 V to +10 V) 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 to5, 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)

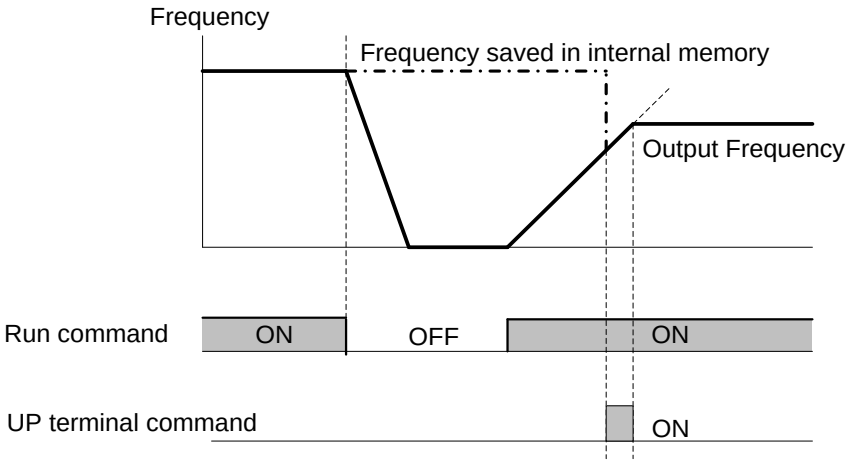
Input signal [mUP]	Output signal [mDOWN]	Action
data＝17	data＝18	
OFF	OFF	Keep the current output frequency.
ON	OFF	Increase the output frequency with the acceleration time currently specified.
OFF	ON	Decrease the output frequency with the deceleration time currently specified.
ON	ON	Keep the current 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 RS-485 or other way		

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

■ Selecting the pulse train input format (09．59)

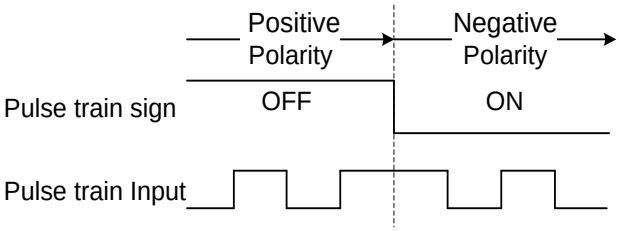
A pulse train in the format selected by the function parameter 09．59 can give a frequency command to the inverter. Three types of formats are available; the pulse train sign/pulse train input, the forward rotation pulse/reverse rotation pulse, and the A and B phases with 90 degree phase difference. If no optional PG interface card is mounted, the inverter ignores the setting of the function parameter 09．59 and accepts only the pulse train sign/pulse train input.

The table below lists pulse train formats and their operations:

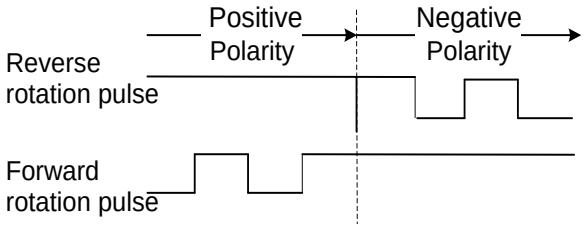
09．59 Setting value	Pulse train formats	Operation overview
0	Positive and Negative Sign / Pulse	Frequency/speed command according to the pulse train rate is given to the inverter. The pulse train sign specifies the polarity of the frequency/speed command . • For the inverter without an optional PG interface card (option) Pulse train input:mPIN assigned to the digital terminal [mPIN] on terminal MI7 (data=48) Pulse train sign:mSIGN assigned to a digital terminal other than MI7 (data=49) If no mSIGN is assigned, polarity of any pulse train input is positive.
1	Forward rotation pulse/Reverse rotation pulse	Frequency/speed command according to the pulse train rate is given to the inverter. The forward rotation pulse gives a frequency/speed command with positive polarity, and a reverse rotation pulse, with negative polarity.

09．59 Setting value	Pulse train formats	Operation overview
2	Phase A and B of 90 Degree Phase Difference	Pulse trains generated by A and B phases with 90 degree phase difference give a frequency/speed command based on their pulse rate and the phase difference to an inverter.

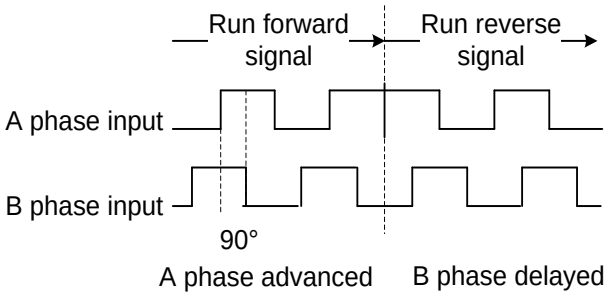
For details of operations using the optional PG interface card, refer to the Instruction Manual for it.



Positive and Negative Sign / Pulse



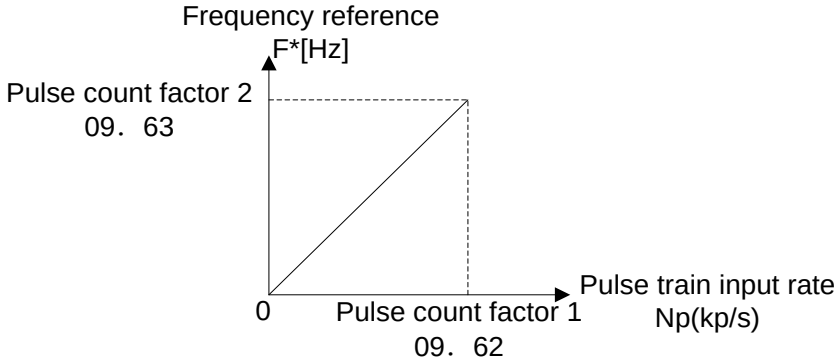
Forward rotation pulse/Reverse rotation pulse



Phase A and B of 90 Degree Phase Difference

■ 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.

$$f^*\,[Hz] = Np\,[kp/s] \times \frac{\text{Pulse count factor 2（09.63）}}{\text{Pulse count factor 1（09.62）}}$$

f* [Hz] : Frequency reference

Np [kp/s]: Input pulse rate

In the case of A and B phases with 90 degree phase difference, note that the pulse train rate is not the one 4-multiplied.

The pulse train sign, forward/reverse rotation pulse, and A/B phase difference define the polarity of the pulse train input. 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

Note: Mounting an optional PG interface card automatically switches the pulse train input source to the card and disables the input from the terminal l MI7.

■ 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 the reference frequency fluctuates due to small number of pulses, specify a larger 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

00．02	Operation command source selection	Factory default	2

Selects the source that specifies a run command.

00．02 Setting value	Function	Description	
		Run/Stop	Run direction instruction
0	keypad command (running direction commands must be assigned to external terminals)	RUN / STOP key	[mFWD],[mREV]
1	Terminal command FWD or REV	[mFWD],[mREV]	
2	keypad :Forward rotation	RUN / STOP key	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	RUN / STOP key	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.

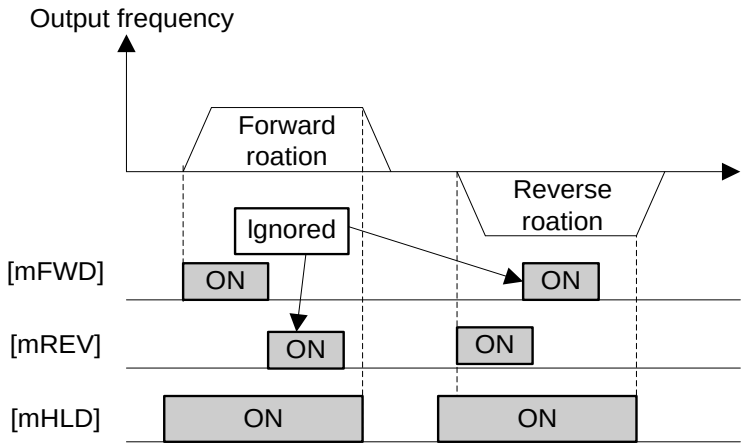
Note ·When 00．02 = 1, the "Run forward" FWD and "Run reverse" REV terminal commands must be assigned to terminals [mFWD] and [mREV], respectively.

·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 REVwith 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	25.0~500.0(Hz)	Unit	0.1Hz

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.

Under vector control with speed sensor, set the maximum frequency at 200 Hz or below.

Under vector control without speed sensor or HD specification is under V/f control, set the maximum frequency at 500 Hz or below.

ND specification is under V/f control, set the maximum frequency at 200 Hz or below.

Note ·If a setting exceeding the maximum setting value is made, The actual output frequency will be internally limited, the reference speed and analog output will be based on the full scale/reference value. (e.g., the setting value 500 Hz is inputted, the reference speed and analog output (AFM) will be the input/output specification of full scale (FS)/setting value(10V／500Hz))

·Modifying (00．03) data to allow a higher reference frequency requires also changing (00．15) data specifying a frequency limiter (high).

00．04	Base frequency 1		Factory default	50.0
	Setting Range	25.0~500.0(Hz)	Unit	0.1Hz
	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.

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

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

00．06	Maximum output voltage 1	↗	Factory default	380
	Setting Range	160~500V: Limited action of output voltage (440V series) 999: No limited action of output voltage(440V series)	Unit	1V

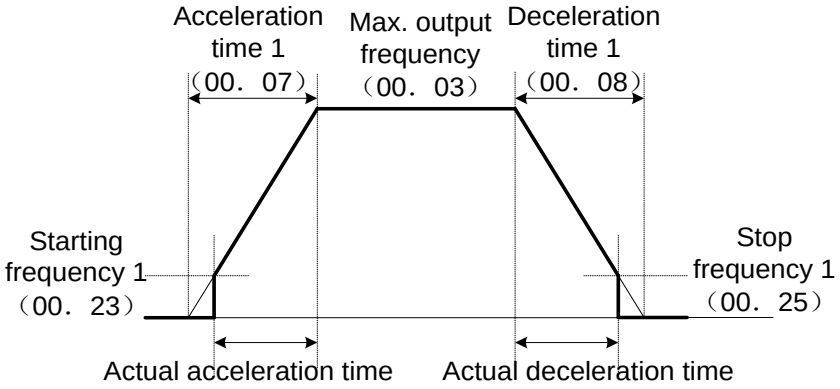
Generally,there is no need to change this value.When the motor rotation is unstable due to the input power voltage being too low and unstable, setting the value of the parameter 00. 06 to be lower than the input power voltage may avoid this happen.

Note: The voltage can be outputted from the inverter is equal to the inverter's input voltage.Please carry out the appropriate setting in accordance with the motor's specification.

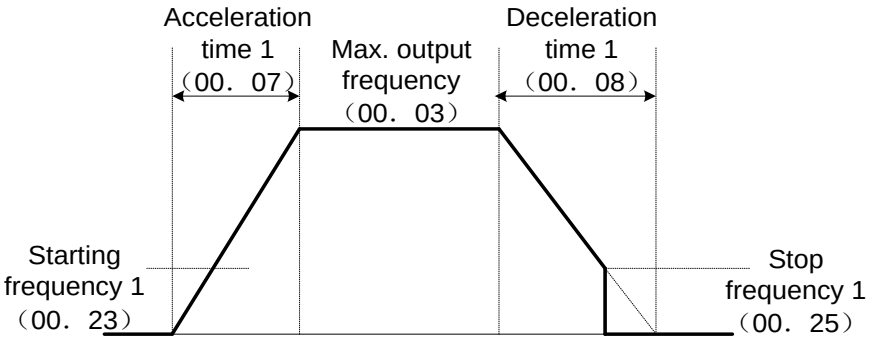
00．07	Acceleration time 1	↗	Factory default	Type Setting
00．08	Deceleration time 1	↗	Factory default	
	Setting Range	0.00~6000(s)	Unit	0．01S
	Related parameters	01．10,01．12,01．14 Acceleration time 2,3,4 01．11,01．13,01．15 Deceleration time 2,3,4 04．07 Acceleration/Deceleration Pattern 04．54,04．55 Acceleration 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 0 Hz.

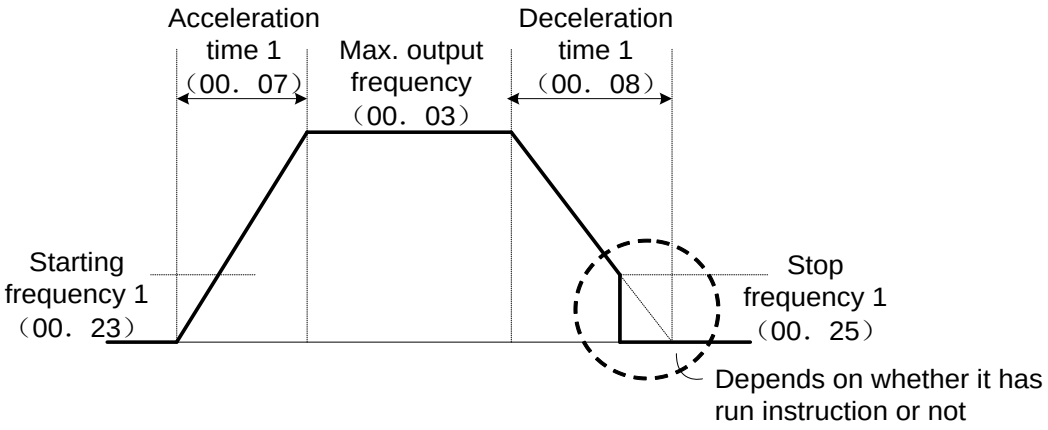
V/f Control Condition



Under vector control without speed sensor



Under vector control with speed sensor



■Acceleration and deceleration time

<table>
<tr><td rowspan="2">Acceleration and deceleration time type</td><td colspan="2">Parameter</td><td colspan="3" rowspan="2">Switching factor of Acceleration and deceleration time (parameters 01．01~01．09)</td></tr>
<tr><td>Acceleration time</td><td>Deceleration time</td></tr>
<tr><td rowspan="2">Acceleration and deceleration time 1</td><td rowspan="2">00．07</td><td rowspan="2">00．08</td><td>[mRT2]</td><td>[mRT1]</td><td rowspan="5">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.</td></tr>
<tr><td>OFF</td><td>OFF</td></tr>
<tr><td>Acceleration and deceleration time 2</td><td>01．10</td><td>01．11</td><td>OFF</td><td>ON</td></tr>
<tr><td>Acceleration and deceleration time 3</td><td>01．12</td><td>01．13</td><td>ON</td><td>OFF</td></tr>
<tr><td>Acceleration and deceleration time 4</td><td>01．14</td><td>01．15</td><td>ON</td><td>ON</td></tr>
<tr><td>At jogging operation</td><td>04．54</td><td>04．55</td><td colspan="3">When the terminal command [mJOG] is On, jogging operation is possible. (data=10) (Parameter 02．20)</td></tr>
<tr><td>At forced stop</td><td>—</td><td>04．56</td><td colspan="3">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)</td></tr>
</table>

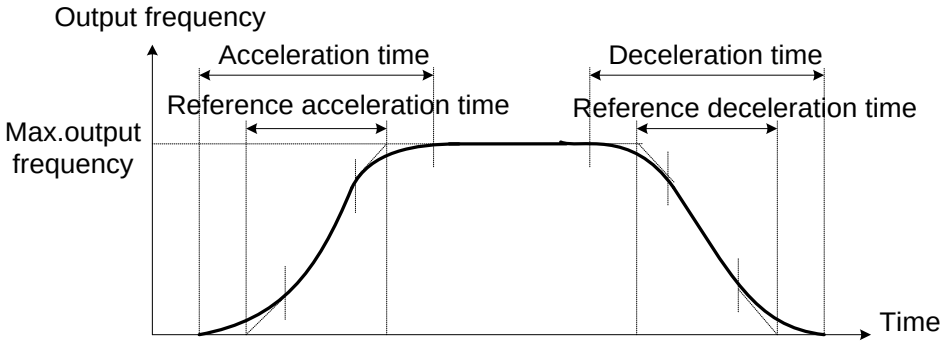
■**Acceleration/Deceleration pattern** (04．07)

Specifies the acceleration and deceleration patterns (patterns 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 (Arbitrary)		Arbitrary:The acceleration /deceleration rate can be arbitrarily specified for each of the four inflection zones.	04．57,04．58 04．59,04．60
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, and specifying arbitrary rate for each of the four zones with function parameter 04．57~04．60. The reference acceleration/deceleration time determines the duration of acceleration/deceleration in the linear period; hence, the actual acceleration/deceleration time is longer than the reference acceleration/ deceleration time.



	Acceleration Starting zone	Acceleration Ending zone	Deceleration Starting zone	Deceleration Ending zone
S Curve (Weak)	5%	5%	5%	5%
S Curve (Arbitrary) Setting Range:0~100%	04．57 Acceleration rate for the 1st S-curve (Leading edge)	04．58 Acceleration rate for the 2nd S-curve (Trailing edge)	04．59 Deceleration rate for the 1st S-curve (Leading edge)	04．60 Deceleration rate for the 2nd S-curve (Trailing edge)

Acceleration and Deceleration Time

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

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

× reference acceleration or deceleration time

=1.1× reference acceleration or deceleration time

＜S-curve acceleration/deceleration (arbitrary):when the frequency change is 30% or more of the maximum frequency--10% at the leading edge and 20% at the trailing edge＞

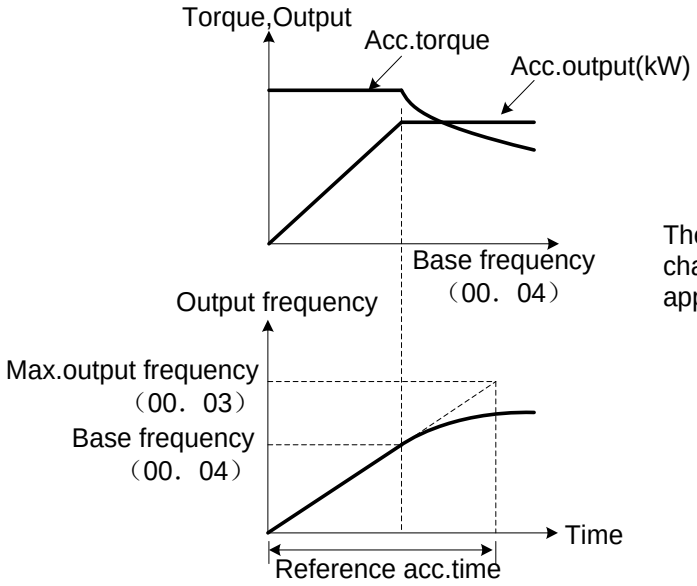
$$\text{Acceleration and Deceleration Time (S)}=(2\times\frac{10}{100}+\frac{70}{100}+2\times\frac{20}{100})$$

×reference acceleration or deceleration time

= 1.3×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.



The figures at left show the acceleration characteristics.Similar characteristics apply to the deceleration.

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.

00．10	Electronic Thermal Overload (Protection for Motor)1 Select motor characteristics		↗	Factory default	1
	Setting Range	1：Motor with shaft-driven cooling fan(Enclosed exterior fan)			
		2：Motor with external cooling fan(Entire enclosed external ventilation)			

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.

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

00．10 Setting value	Function
1	The cooling capability of the motor with shaft-driven cooling fan(Enclosed exterior fan)will become lower when it is being low frequency operation
2	PM motor with external cooling fan(Entire enclosed external ventilation)(The cooling capability keeps stable without depending on output frequency)

00．11	Electronic Thermal Overload (Protection for Motor)1 Detection level		↗	Factory default	Type Setting
	Setting Range	0.00(invalid)； 1% to 135% of the rated current (allowable continuous drive current) of the motor		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).

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

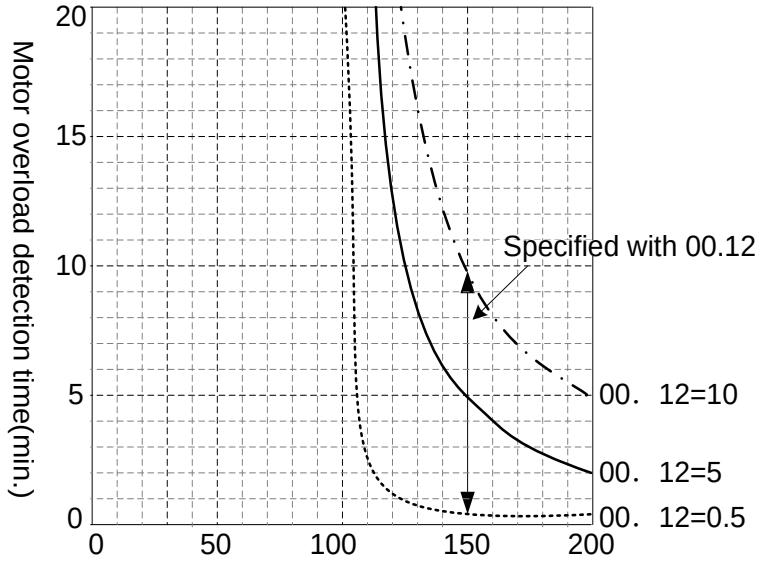
The parameter specifies the thermal time constant of the motor. the current of 150% of the overload detection level specified by 00．11 flows for the time specified by 00．12 the electronic thermal overload protection becomes activated to detect the motor overload. The thermal time constant for general-purpose 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＞



(Actual output current value/Overlead detection level) X 100%

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)		
		5：Restart at the starting frequency		
	Related parameters	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)

00．14 action setting	Description
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 together so that the motor enters a coast-to-stop state.
1: alarm LU after recovery from power failure	If the inverter immediately turns off during operation and the DC bus voltage of the inverter is detected with low voltage, immediately shut down the inverter output so that the motor coasts to a stop. The moment the power is restored, an undervoltage alarm luis issued, while the motor remains in a coast-to-stop state.

00．14 action setting	Description
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-shop 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	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 momentof 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.
4: Restart at the frequency at which the power failure occurred	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.
5: Restart at the starting frequency	

Control mode	The action of entering the running command when recovery
The three-phase asynchronous motor is under V/f control and auto search is disabled 04.09=0	When parameter data 00.14=3,4,restart from the frequency when the low voltage is detected. When parameter data 00.14=5, restart from the starting frequency 07.12 .
The three-phase asynchronous motor is under V/f control and auto search is enabled 04.09=1,2	Check the motor speed via the auto search and restart from this frequency
Under vector control without speed sensor	
Under vector control with speed sensor	Detect the motor speed via speed sensor and restart from this frequency

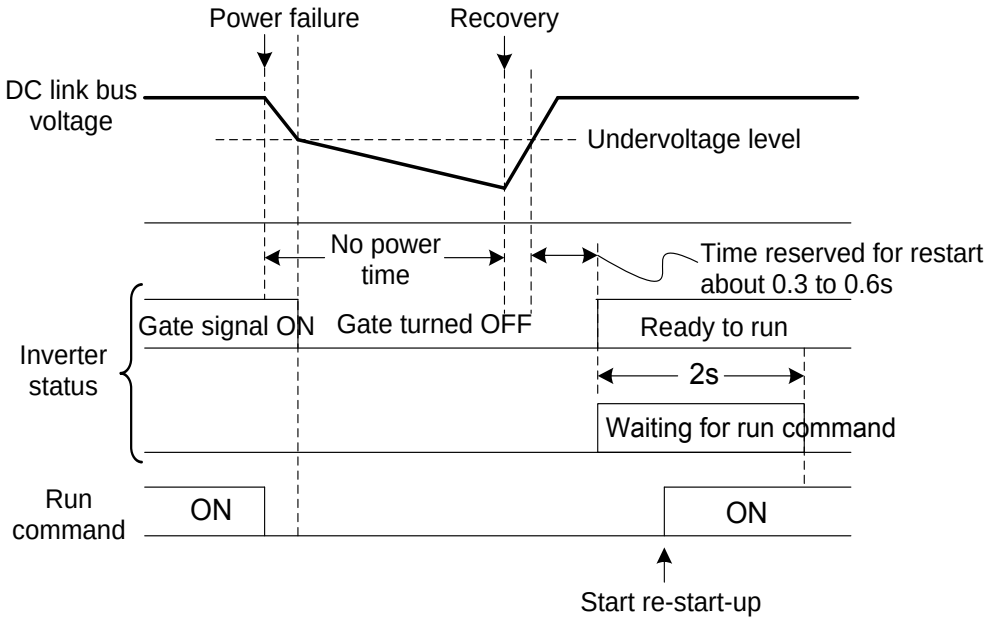
⚠ Warning
If you enable the "Restart mode after momentary power failure" (00．14＝3~5), the inverter automatically restarts the motor running when the power is recovered. Design the machinery or equipment so that human safety is ensured after restarting. **It may cause an accident.**

■Restart mode after momentary power failure (Basic operation with auto search disabled)

The inverter recognizes a momentary power failure upon detecting the condition that DC link bus voltage goes below the undervoltage detection level, while the inverter is running. If the load of the motor is light and the duration of the momentary power failure is extremely short, the voltage drop may not be great enough for a momentary power failure to be recognized, and the motor may continue to run uninterrupted.

Upon recognizing a momentary power failure, the inverter enters the restart mode (after a recovery from momentary power failure) and prepares for restart. When power is restored, the inverter goes through an initial charging stage and enters the ready-to-run state. When a momentary power failure occurs, the power supply voltage for external circuits such as relay sequence circuits may also drop so as to turn the run command OFF. In consideration of such a situation, the inverter waits 2 seconds for a run command input after the inverter enters a ready-to-run state. If a run command is received within 2 seconds, the inverter begins the restart processing in accordance with the 00．14 data (Mode selection). If no run command has been received within 2-second wait period, the inverter cancels the restart mode (after a recovery from momentary power failure) and needs to be started again from the ordinary starting frequency. Therefore, ensure that a run command is entered within 2 seconds after a recovery of power, or install a mechanical latch relay.

When run commands are entered via the keypad, the above operation is also necessary for the mode (00．02＝0) in which the rotational direction is determined by the terminal command, In the modes where the rotational direction is fixed (00．02＝2,3), it is retained inside the inverter so that the restart will begin as soon as the inverter enters the ready-to-run state.



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.

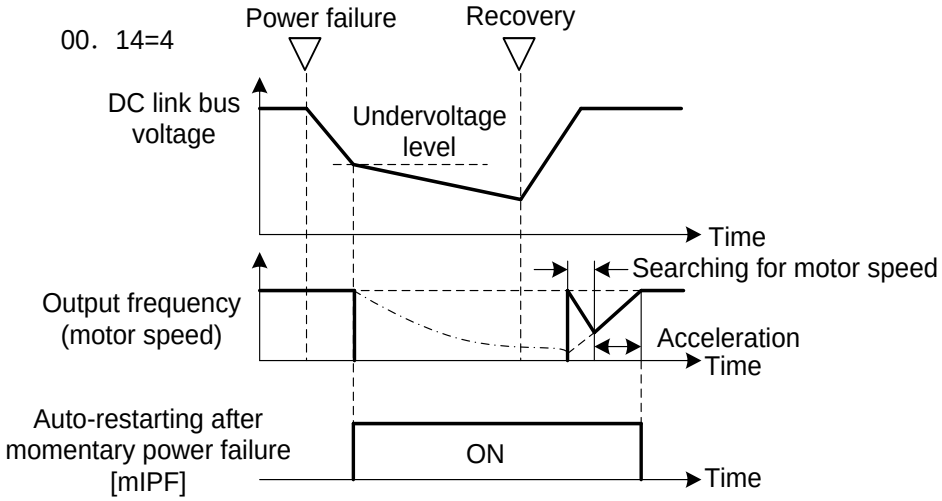
·If the "Coast to a stop" terminal command [mBX] is entered during the power failure, the inverter gets out of the restart mode and enters the normal running mode. If a run command is entered with power supply applied, the inverter will start from the normal starting frequency.

·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.

Parameters 01．01~01．09 Data＝22

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

During a momentary power failure, the motor slows down. After power is restored, the inverter restarts at the frequency just before the momentary power failure. Then, the current limiting function works and the output frequency of the inverter automatically decreases. When the output frequency matches the motor speed, the motor accelerates up to the original output frequency. See the figure below. In this case, the instantaneous overcurrent limiting must be valid (04．12＝1).



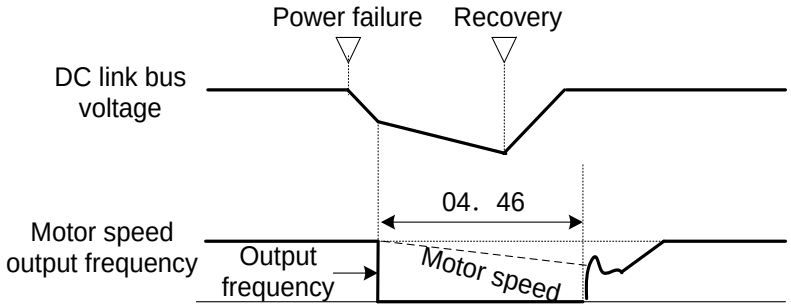
■Auto-restarting after momentary power failure [mIPF]

This output signal is ON during the period after the occurrence of momentary power failure until the completion of restart (the output has reached the reference frequency). When the [mIPF] is ON, the motor slows down, so perform necessary operations. (parameters 01．20~01．24, 01．27 data＝6).

■Restart mode after momentary power failure (Basic operation with auto search enabled)

Auto search for idling motor speed will become unsuccessful if it is done while the motor retains residual voltage. It is, therefore, necessary to leave the motor for the time (auto search delay time) enough to discharge the residual voltage.

For restart mode after momentary power failure, The delay time is specified by the parameter 04．46 (Starting Mode (Auto search delay time 2)) The inverter will not start unless the time specified by 04．46 has elapsed, even if the starting conditions are satisfied. (Parameters 04．09,09．67).



Notes:·To use auto search for idling motor speed, it is necessary to tune the inverter beforehand.

·When the estimated speed exceeds the maximum frequency or the upper limit frequency, the inverter disables auto search and starts running the motor with the maximum frequency or the upper limit frequency, whichever is lower.

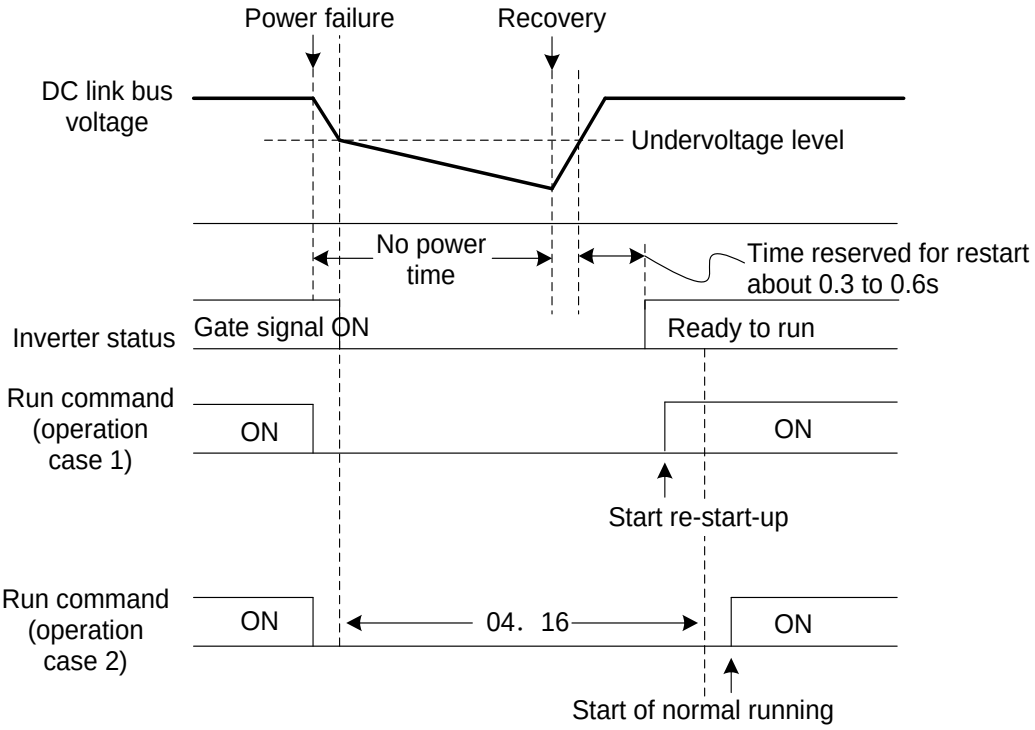
·During auto search, if an overcurrent or overvoltage trip occurs, the inverter restarts the suspended auto search.

·Perform auto search at 60 Hz or below.

·Note that auto search may not fully provide the performance depending on load conditions, motor parameters,wiring length, and other external factors.

■Restart mode after momentary power failure (Allowable momentary power failure time) (04．16)

Specifies the maximum allowable duration (0.0 to 30.0 seconds) from an occurrence of a momentary power failure (undervoltage) until the inverter is to be restarted. Specify the coast-to-stop time which the machine system and facility can tolerate. If the power is restored within the specified duration, the inverter restarts in the restart mode specified by 00．14. If not, the inverter recognizes that the power has been shut down so that the inverter does not apply the restart mode and starts normal running.



If 04．16 (Allowable momentary power failure time) is set to "999," restart will take place until the DC link bus voltage drops down to the allowable voltage for restart after a momentary power failure (50 V for 230 V series and 100 V for 400 V series). If the DC link bus voltage drops below the allowable voltage, the inverter recognizes that the power has been shut down so that it does not restart but starts (normal starting)

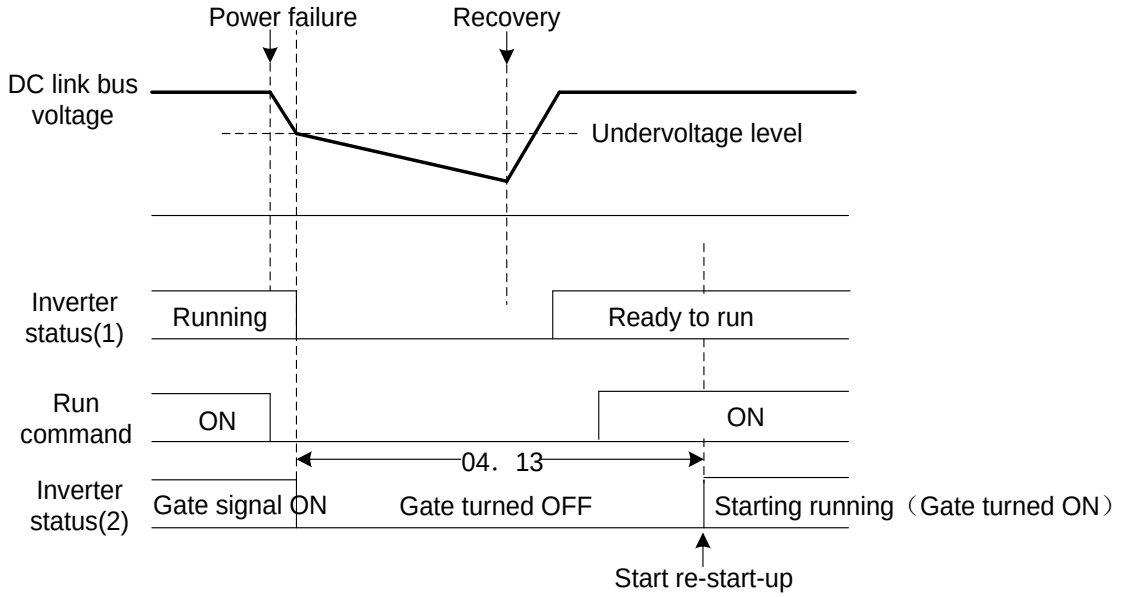
Power supply	Allowed voltage for restart after
440V	100V

Note: The time required from when the DC link bus voltage drops from the threshold of undervoltage until it reaches the allowable voltage for restart after a momentary power failure, greatly varies depending on the inverter capacity, the presence of options, and other factors.

■Restart mode after momentary power failure (Restart time) (04．13) (Specialized for the three-phase asynchronous motor under V/f control)

04．13 specifies the time period from momentary power failure occurrence until the inverter reacts for restarting process. (With auto search,using parameter 04．46 speed sensor to track the start holding time).

If the inverter starts the motor while motor's residual voltage is still in a high level, a large inrush current may flow or an overvoltage alarm may occur due to an occurrence of temporary regeneration. For safety, therefore, it is advisable to set 04．13 to a certain level so that the restart will take place only after the residual voltage has dropped to a low level. Note that even when power is restored, restart will not take place until the restart time (04．13) has elapsed.



Note:04．13 (Restart mode after momentary power failure -- Restart time) also applies to the switching operation between line and inverter (Parameters 01．01~01．09).

■Restart mode after momentary power failure (Frequency fall rate) (04．14)

During restart after a momentary power failure, if the inverter output frequency and the idling motor speed cannot be harmonized with each other, an overcurrent will flow, activating the overcurrent limiter. If it happens, the inverter automatically reduces the output frequency to match the idling motor speed according to the reduction rate (Frequency fall rate:Hz/s) specified by 04．14 .

04．14 Setting value	Inverter's action for the output frequency fall
0.00	Follow the deceleration time specified
0.01~100.00(Hz/s)	Follow data specified by 04．14
999	Follow the setting of the PI controller in the current limiter. (PI constant is a fixed value inside of inverter.)

Note:If the frequency fall rate is too high, regeneration may take place at the moment the motor rotation matches the inverter output frequency, causing an overvoltage trip. On the contrary, if the frequency fall rate is too low, the time required for the output frequency to match the motor speed (duration of current limiting action) may be prolonged, triggering the inverter overload prevention control.

■Continuous running value for re-start of interrupt power-supply(04．15)

Continuity of running (P and I) (04．92,04．93).

·Trip after decelerate-to-stop

If a momentary power failure occurs when 00.14 is set to "2"(alarm LU), the inverter enters the control sequence of the decelerate-to-stop when the DC link bus voltage drops below the continuous running level.

Use 04．15 to specify for DC link bus voltage starting for deceleration to stop control.

Under the decelerate-to-stop control, the inverter decelerates its output frequency keeping the DC link bus voltage constant using the PI processor.

P (proportional) and I (integral) components of the PI processor are specified by 04．92 and 04．93 respectively.

For normal inverter operation, it is not necessary to modify data of 04．15, 04．92 and 04．93 .

·Continue to run

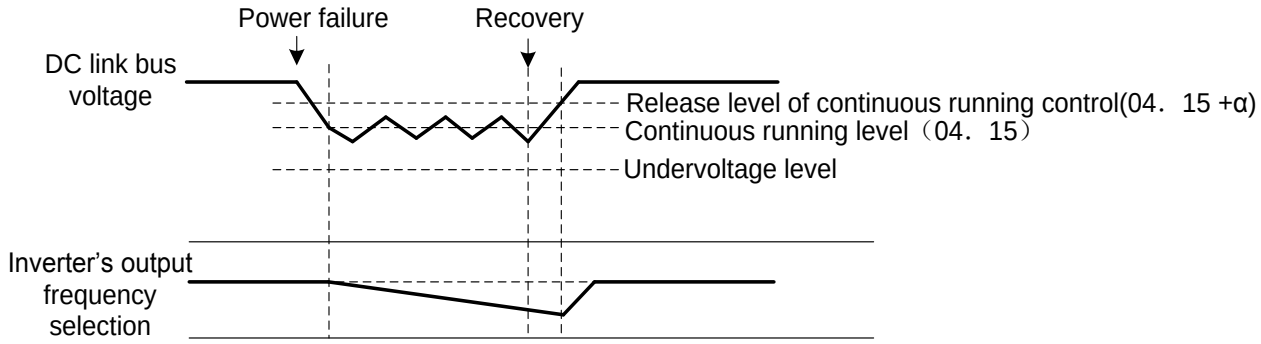
If a momentary power failure occurs when 00．14is set to "3" (Continue to run),the inverter enters the control sequence of the continuous running when the DC link bus voltage drops below the continuous running level.

Use 04．15 to specify the continuous running level starting for continuous running control.

Under the continuous running control, the inverter continues to run keeping the DC link bus voltage constant using the PI processor.

P (proportional) and I (integral) components of the PI processor are specified by 04．92 and 04,93 respectively.

For normal inverter operation, it is not necessary to modify data of 04．15, 04．92 and 04．93.



Power supply voltage	α	
	Below 22 kW	30Kw or below
440V	10V	20V

Notes: Even if you select "Trip after decelerate-to-stop" or "Continue to run," the inverter may not be able to do so when the load's inertia is small or the load is heavy, due to undervoltage caused by a control delay. In such a case, when "Trip after decelerate-to-stop" is selected, the inverter allows the motor to coast to a stop; when "Continue to run" is selected, the inverter saves the output frequency being applied when the undervoltage alarm occurred and restarts at the saved frequency after a recovery from the momentary power failure.

When the input power voltage for the inverter is high, setting the continuous running level high makes the control more stable even if the load's inertia is relatively small. Raising the continuous running level too high, however, might cause the continuous running control activated even during normal operation.

When the input power voltage for the inverter is extremely low, continuous running control might be activated even during normal operation, at the beginning of acceleration or at an abrupt change in load. To avoid this, lower the continuous running level. Lowering it too low, however, might cause undervoltage that results from voltage drop due to a control delay.

Before you change the continuous running level, make sure that the continuous running control will be performed properly, by considering the fluctuations of the load and the input voltage.

00．15	Upper limit of output frequency		↗	Factory default	70.0
00．16	Lower limit of output frequency		↗	Factory default	0.0
	Setting Range	0.0~500.0(Hz)		Unit	0.1 Hz
	Related parameters	04．63 Frequency lower limiter action selection			

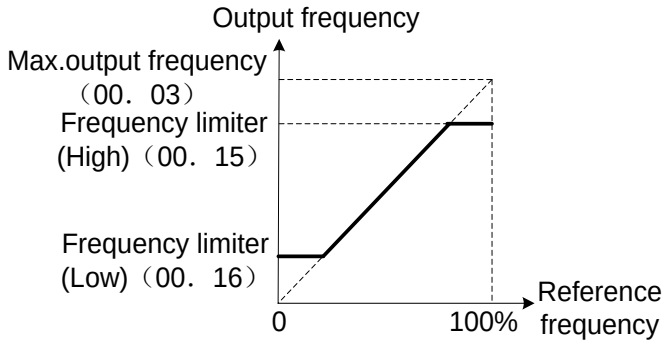
04．15 and 04．16 specify the upper and lower limits of the output frequency or reference frequency, respectively. The object to which the limit is applied differs depending on the control system.

0 frequency limiter		Object to which the limit is applied
Fequency Limiter (High)	00．15	Reference speed (reference frequency)
Frequency Limiter (Low)	00．16	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.		

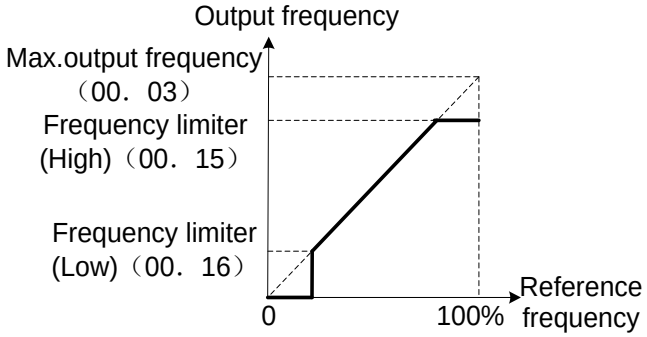
■Low Limiter (Mode selection) (04．63)

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.

00．18	Dominant frequency 1 bias setting (refer to 00．01)		Factory default	0.00
	Setting Range	–100.00~100.00%	Unit	0.01%

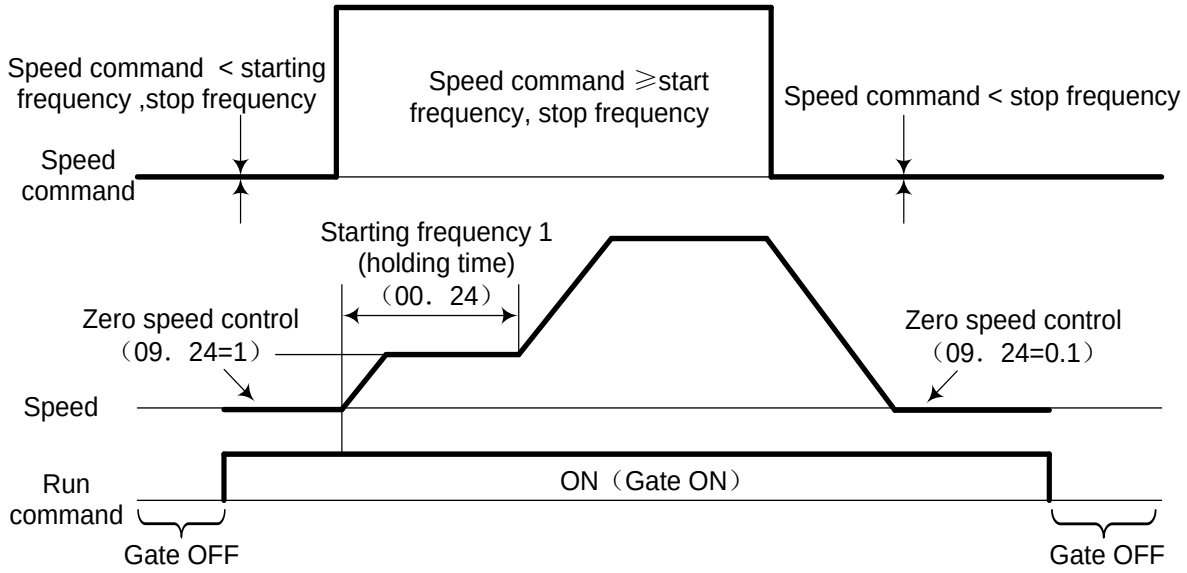
00．23	Starting frequency 1		↗	Factory default	0.5
	Setting Range	0.0~60.0(Hz)		Unit	0.1Hz
	Related parameters	00．38 Stop frequency detection mode 00．39 Stop frequency holding time 04．92 Continuity of Running (P) 04．93 Continuity of Running (I) 07．12 Starting frequency 4 09．24 Zero speed control			
00．24	Starting frequency 1 holding time		↗	Factory default	0.00
	Setting Range	0.00~10.00(s)		Unit	0.01s
00．25	Stop frequency		↗	Factory default	0.2
	Setting Range	0.0~60.0(Hz)		Unit	0.1Hz

Parameter	Description
00．23, 07．12	Specifies the starting frequency at the startup of an inverter. PM motor under vector control without speed sensor, induction motor under V/f control, it is enabled by 0.1Hz when 0.0Hz is set.
00．24	Specifies the holding time for the starting frequency
00．25	Specifies the stop frequency at the stop of the inverter. PM motor under vector control without speed sensor, induction motor under V/f control, it is enabled by 0.1Hz when 0.0Hz is set.
00．39	Specifies the holding time for the stop frequency.

■Zero Speed Control (09．24)

To enable zero speed control under vector control with speed sensor, it is necessary to set the speed command (frequency command) at below the starting and stop frequencies. If the starting and stop frequencies are 0.0 Hz, however, the zero speed control is enabled only when the speed command is 0.00 Hz. 09．24 specifies the operation for the zero speed control at the startup of the inverter.

09．24 Setting value	Zero speed control in start	Action description
0	Not allowed at startup	Even setting the speed command at below the starting and stop frequencies and turning a run command ON does not enable the zero speed control. To enable the zero speed control, set the speed command at above the starting frequency and then start up the inverter again.
1	Allowed at startup	Setting the speed command at below the starting and stop frequencies and turning a run command ON enables the zero speed control.



■Stop Frequency Detection mode (00．38)

When the inverter stops, check if the inverter output should be shut down in accordance with the detected speed value or reference speed value

00．38 Setting value	checkout for output shut down
0	Detected speed value
1	Reference speed value

Note: Generally, it is checked via detected speed value, however, when the inverter is influenced by a too large external load (over the inverter's capability), sometimes it is not able to make the motor decelerate to stop, as a result, the detected speed value will not up to the stop frequency. In this case, the inverter will not stop, therefore, please select reference speed value to ensure the safety.

If checking in accordance with reference speed value, it will be available to stop the inverter and shut down the inverter output.

00．26	Carrier frequency setting (Motor Sound)		Factory default	2
	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	2 ~ 15kHz	5.5~45kW (HD specification) 5.5~18.5kW (ND specification)
	2 ~10kHz	55~200kW (HD specification) 22~45kW (ND specification)
	2 ~ 6kHz	55~200kW (ND specification)
Motor noise	High ↔ low	
Motor temperature (due to harmonics components)	High(more) ↔ low (less)	

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.

Besides, due to the fluctuation of the output current waveform, it is easily protected by the overcurrent of the inverter.

- If the PM motor rotates by low carrier frequency, it will lead to the overheat of permanent magnet caused by output current higher harmonics, then casuing the demagnetize.When reducing the settin value of carrier frequency, please ensure the allowable carrier frequency of the motor.

Please reduce the setting value of the carrier frequency when using standard PM motor as rated load.

Increasing carrier frequency will reduce the output current higher harmonics, the inverter output current value when it is available to continue to run will reduced.

When changing the setting value of the carrier frequency, please refer to “the 2nd chapter Specification” to check the inverter output current value when it is available to continue to run.

- Under vector control without speed sensor/with speed sensor, when output frequency is set to be 120Hz or above, suggest to set the carrier frequency 00.26 to be 5kHz or above.

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

Above parameters can allow output terminals AFM to output monitored data such as the output frequency and the output current in an analog DC voltage or current. The magnitude of such analog voltage or current is adjustable.

■Action Selection (00．29)

Select the output specification of terminal AFM. Meanwhile, it shall set the slide switch SW4 on the control printed circuit board (control PCB).

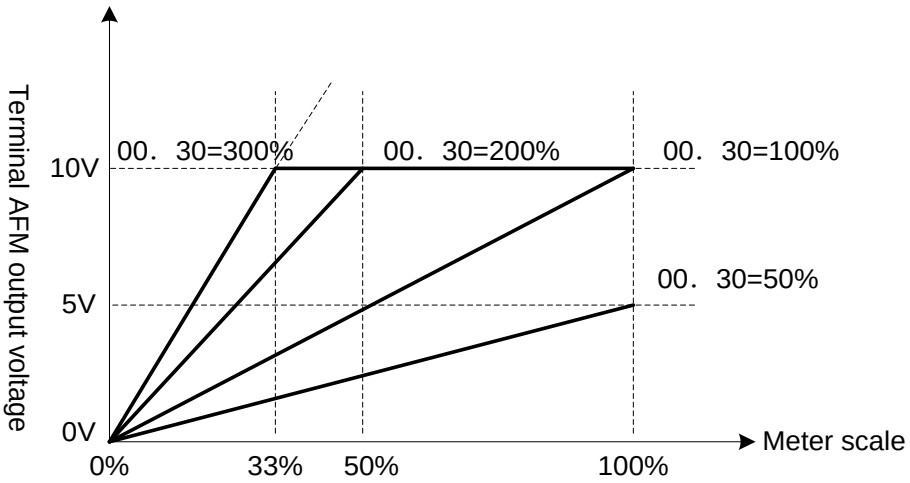
00．29 Setting value	Output form of terminal AFM	Position of slide switch (SW4) on Control board
0	Voltage output (DC0~10V)	VO side
1	Current output (DC4~20mA)	IO side
2	Current output (DC 0~+20mA)	IO side

Note: The output current is not isolated from analog input, and does not have an isolated power supply.

Therefore, if an electrical potential relationship between the inverter and peripheral equipment has been established, e.g., by connecting an analog, cascade connection of a current output device is not available.

■Output Voltage adjustment (00．30)

Allows you to adjust the output voltage within the range of 0 to 300%.(It is the output current value when parameter 00.29=1)



■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 (command value)	Output frequency of the inverter	Max.output frequency (00．03)
1	Output Frequency 2 (estimated/detected value)	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
8	PID Feedback amount(speed)	Speed detected through the PG interface, or estimated speed under vector control without speed sensor	Max.speed (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

00．31 Setting value	Monitoring items	Contents	Meter scale (Full scale at 100%)
16	PID Output value(MV)	Output level of the PID controller under PID control (Frequency command)	Max.output frequency (00．03)
17	Positional deviation in synchronous running	Positional deviation in synchronous running	Monitoring amount:0% to 50% to 100%, representing -180° to 0° to +180° of the deviation

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(%).

00．33	DFM terminal pulse rate			Factory default	1440
	Setting Range	25 ~ 6000p / s (100% of pulse count)		Unit	1
00．34	DFM terminal output gain(Voltage adjustment)			Factory default	0
	Setting Range	0%:Pulse frequency output (50% of fixed amplitude); 1 ~ 300%:Output voltage adjustment (2000p / s fixed pulse amplitude adjustment)		Unit	1%

Combining parameter 00．33 with specification of connected counter, specify the monitoring output as pulse count in 100%.

It can output the output frequency or output current on DFM terminal and other monitored data through pulse signal. Additionally, as mean voltage output, it can also drive analog meter in mean voltage of pulse signal.

It can set the specification of output pulses respectively.

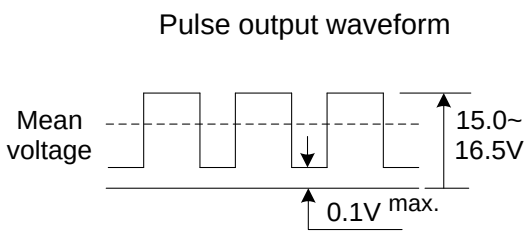
When it is used as pulse output, please set parameter 00．33 and use 00．34＝0.

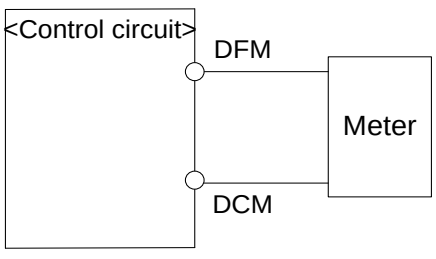
When it is used as mean voltage output, and set 00．34＝1~300%. Additionally, 00．33 setting data shall be ignored.

Output form	00．33 data	00．34 data	Pulse action status	Pulse county
Pulse output	25~6000p/s	0	Constant as about 50%	variable
Mean voltage output	—	1~300%	variable	Constant as about 2000p/s

■Output Voltage adjustment (00．34)

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





00．35	DFM terminal function selection (refer to 00．31)	↗	Factory default	0

The parameter selects monitoring objects output to terminal DFM. Monitoring objects are the same with parameter 00．31.

00．38	Stop frequency detection mode (refer to 00．23)		Factory default	0
	Setting Range	0：Detected speed value		
		1：Reference speed value		
00．39	Stop frequency holding time (refer to 00．23)	↗	Factory default	0.00
	Setting Range	0.00~10.00s	Unit	0.01 s

00．40	Torque limiter level 1-1	↗	Factory default	200
00．41	Torque limiter level 1-2	↗	Factory default	200
	Setting Range	20-200(%)；999(invalid)	Unit	1%
	Related parameters	01．16 Torque limiter level 2-1　　01．17 Torque limiter level 2-2 04．74 Torque Limiter:torque control target		

If the inverter's output torque is over the torque reference value, the limited current command will make output torque within the torque reference value.

Torque limiter and current limiter (specialized for induction motor under V/f control) is similar control function. If they are both activated, it may cause competition, leading to the vibration etc. Please avoid to using them together.

Torque limter, as a function, it not only corresponds torque limiter base on the parameter setting of 00．40,00．41,01．16,01．17, but also corresponds to the limiter base on analog command and the limiter from the communication.

Under vector control without speed sensor/with speed sensor, it is able to select either one from the torque current limiter, torque limiter.

When the induction motor is under V/f control, only torque current limiter can be used.

■ Torque Limiter (Control target) (04．74)

Under vector control without speed sensor/with speed sensor, it is able to select torque limited object from the torque current, torque.

When the induction motor is under V/f control, no matter how to set the parameter, it can be the way to limit the torque current.

According to the torque limiter object, the limiter can be devided into below different modes:

■ Torque limiters level (00．40，00．41，01．16，01．17) Data setting range：20~200%、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: Max torque limiter is 200%, however it will limit with the torque internally decided by overload current which is according to unit. Therefore, even the setting value is 200%, actually it will be auto-limited by a lower value.

Tips: Through the torque limiter 2/limiter 1 'mTL2/TL1' switch torque limiter value 1 and torque limiter value 2 assigned to the digital input terminal.

■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.

00．42	Drive Control mode selection 1		Factory default	15
	Related parameters	04．68 Slip compensation 1 Operating conditions selection	Unit	1

Drive Control of motor Selection.

For details,See Chapter 4 “Running Item 3 Selection for a desired Motor drived Control” .

00．43	Current limiter action selection (Specialized for three-phase asynchronous motor)		↗	Factory default	2
	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.

00．44	Current limiter action level		↗	Factory default	160
	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.

Note:The inverter's rated current differs depending upon the HD /ND mode selected.

When the output current of the inverter exceeds the level specified by the current limiter (00．44), the inverter automatically manages its output frequency to prevent a stall and limits the output current. The Factory default setting of the current limiter is 160% and 130% for HD and ND -mode inverters, respectively. (Once the HD/ ND mode is selected by parameter 00．80, the current limit for each mode is automatically specified).

If overload current, 160% (130%) or more of the current limit level, flows instantaneously so that an output frequency decrease problem arises due to the current limiter, consider increasing the current limit level.

■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 trip 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 trip 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 trip 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 trip. 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.

00．50	Electronic Thermal Overload Discharging capability (Protection for Braking Resistor)		↗	Factory default	Type Setting
00．51	Electronic Thermal Overload Allowable average loss (protection for braking resistor)		↗	Factory default	0.001
	Setting Range	0.001~99.99kW		Unit	0.001
00．52	Electronic Thermal Overload braking resistance (protection for braking resistor)		↗	Factory default	0.01
	Setting Range	0.01~999Ω		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.

Record the standard braking resistor and 10% ED products. When braking resistor outside of the company, please confirm corresponding constant with resistor manufacturers and take corresponding setting.

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~MI9, FWD or REV, and connect that terminal its common terminal to braking resistor's terminals 2 and 1.

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

＜Applying braking load during deceleration ＞

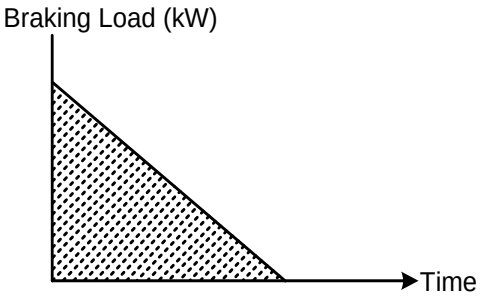
In usual deceleration, the braking load decreases as the speed slows down.In the deceleration with constant torque, the braking load decreases in proportion to the speed.

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

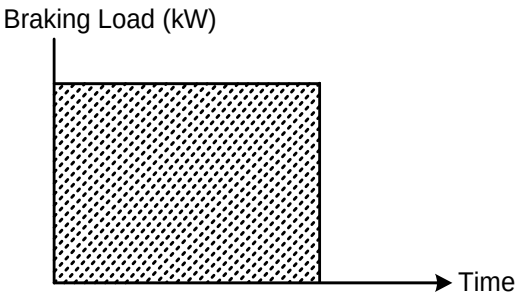
＜Applying braking load during running at a constant speed ＞

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.



Applying braking load during deceleration



Applying braking load during running at constant speed

Discharge capability (00．50) refers to kWs 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
1~9000	1~9000(kWs)
OFF	Disable the electronic thermal overload protection

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

Discharge capability (kWs) = braking time (S) ×motor rated capacity (kW) (2)

Tips:When the 00．50 data is set to "0" (To be applied to the braking resistor built-in type), no specification of the discharging capability is required.

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	HD / ND switching		Factory default	0
	Setting Range	0:HD Specifications 1:ND Specifications	Unit	1

Specifies whether to drive the inverter in the high duty (HD) or Normal duty(ND) mode.

When parameter 00．80 data is changed, it is necessary to press the (STOP key＋▲ / ▼key) simultaneously. See Chapter 4 “Running Item 2 Switching between HD and ND drive modes” on detailed function description.

01 External Terminal Function Parameters

01．01	MI1 terminal function selection	Factory default	0
01．02	MI2 terminal function selection	Factory default	1
01．03	MI3 terminal function selection	Factory default	2
01．04	MI4 terminal function selection	Factory default	3
01．05	MI5 terminal function selection	Factory default	4
01．06	MI6 terminal function selection	Factory default	5
01．07	MI7 terminal function selection	Factory default	6
01．08	MI8 terminal function selection	Factory default	7
01．09	MI9 terminal function selection	Factory default	8
	Related parameters	01．98 FWD terminal function selection 01．99 REV terminal function selection	

01．01 to 01．09,01．98 and 01．99 assign commands (listed below) to general-purpose, programming, digital input terminals MI1~MI9, 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~MI9, FWD and REV in normal logic system. They 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 corresponding parameters when related parameter column displays related parameter.

Additionally, on S5100 series inverter runs under "V/f control," "dynamic torque vector control," "V/f control with speed sensor," "dynamic torque vector control with speed sensor," "vector control without speed sensor," or "vector control with speed sensor." Some terminal commands assigned apply exclusively to the specific drive control. which is indicated by letters “○:(Applicable)” or “×:(Not applicable)” in the "Drive control" column in the table given below.

⚠ 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	Control Method			Related parameters
Active ON	Active OFF			Without PG	PG	IM/ V/f	
0	1000	Multi-step speed command (0-15 steps)	[mSS1]	○	●	○	02．05~02．19
1	1001		[mSS2]	○	●	○	
2	1002		[mSS4]	○	●	○	
3	1003		[mSS8]	○	●	○	

Data		Function	Signal name	Control Method			Related parameters
Active ON	Active OFF			Without PG	PG	IM/ V/f	
4	1004	Select ACC/DEC time (2 steps)	[mRT1]	○	●	○	00．07,00．08, 01．10~01．15
5	1005	Select ACC/DEC time (4 steps)	[mRT2]	○	●	○	
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]	○	○	○	—
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 parameters
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	[mIVS]	○	●	○	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 (RS-485)	[mLE]	○	○	○	04．30,11．98
25	1025	Universal DI	[mU-DI]	○	○	○	—
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]	×	●	×	05，06 parameters
37	1037	Motor 4 selection	[mM4]	○	○	○	07 parameters
48	—	Pulse train input (available only for terminal MI7 (01．07))	[mPIN]	○	○	○	00．01,02．30
49	1049	Pulse train symbol(available for terminals except MI7)	[mSIGN]	○	○	○	
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]	○	○	○	

○：enable， ●：disable in torque limiter(04．18 ≠ 0) ×：Disable

Notes:Some negative logic (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

■ Select ACC/DEC time [mRT1], [mRT2] (parameter data= “4”, “5”)

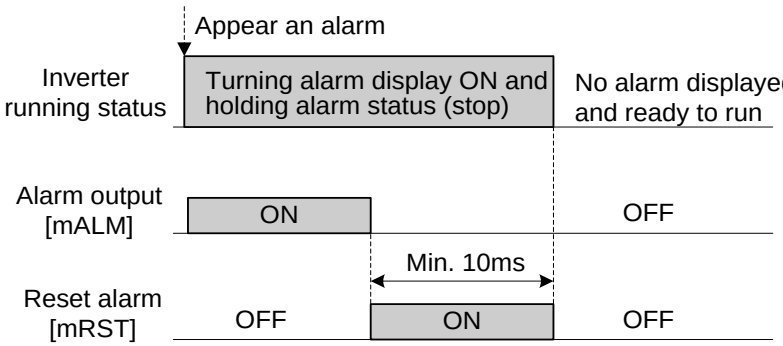
The external digital input signal can switch the ACC/DEC time 1~4 (00．07,00．08,01．10~01．15). (Parameters 00．07, 00．08)

■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.

■ Motor 2~4 selection [mM2]、[mM3]、[mM4](parameter data = 12,36,37)

When driving the PM motor, use the external digital input signal ([mM2], [mM3]) to swith the function parameter of the 1st motor to 3rd motor (parameter of speed control system(ASR))

Besides, switch PM motor driving (Motor 1~3) and three-phase asynchronous motor driving (Motor 4) by signal [mM4].

■ Torque limiter level2 / torque limiter level 1 [mTL2/TL1](parameter data = 14)

Switch torque limiter level 1(00．40,00．41)and Torque limiter level 2 (01．16,01．17) by the external digital input signal

No assignment is functionally enable the torque limiter level 1(00．40,00．41).

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

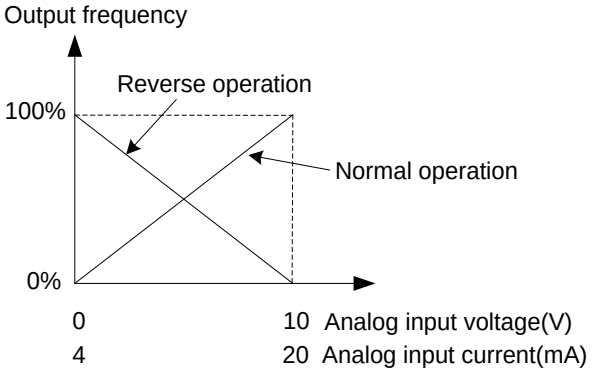
Turning this terminal command [mHz/PID] ON invalid the PID control. If the PID control is invalid with this command, the inverter runs the motor with the reference frequency manually set (by any of the multi-step frequency, keypad, analog input, etc).

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 normal/inverse operation (parameter data=21)

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



Tips:The normal/inverse 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 normal/inverse 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 normal/inverse 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:Normal operation	OFF	Normal operation
0:Normal 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 normal/inverse 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 normal/inverse 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	Normal operation
	ON	Reverse operation

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

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

Forward / reverse action selection (main frequency source selection) (02．53)	Input signal [mIVS]	Action
0:Forward direction	—	Normal 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 normal and inverse, and has no effect on any normal/inverse operation selection of the manual frequency setting.

(Parameters 08．01~08．19,08．56~08．62)

■ Interlock [mIL](parameter data = 22)

In the structure of setting the magnetic contactor in the inverter's output (secondary), sometimes only by the internal momentary power failure detection function can not correctly detect momentary power failure detection. In this case, using the interlock signal and input digital signal can make the momentary power failure and restart smoothly.(Parameter 00．14)

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

■ Cancel Torque control [mHz/ TRQ](parameter data = 23)

When the torque control is enabled(04．18 = 2,3), switch speed control and torque control by using the external digital input signal.

Input signal [mHz/TRQ]	Description
OFF	Enable torque control
ON	Cancel torque control (Enable speed control)

■ Communication link via selection (RS-485) [mLE](parameter data = 24)

Turning this terminal command 'mLE' ON runs the motor according to the frequency command or run commands received via the communication link selected with function parameter 04．30 and 11．98(RS-485 and CAN).

No [mLE] assignment is functionally equivalent to the [mLE] being ON. (Parameters 04．30,11．98)

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

Using [mU-DI] enables the inverter to monitor digital signals sent from the peripheral equipment via an RS-485 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. (parameter 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)

■ Select local (keypad) operation [mLOC](parameter data = 35)

By using the external digital input signal can switch the remote / local of the setting method of the run commands and frequency setting.

■ Pulse train input [mPIN](available only for terminal MI7)and Pulse train symbol [mSIGN](available for terminals except MI7)(parameter data = 48,49)

The terminal MI7 set the input frequency base on pulse train.It requires to assingn pulse train input “PIN” to the terminal MI7. Besides, assign the symbol [mSIGN] to the pulse train (enabled other than for terminal MI7), the pulse train symbol can determined the polar of the frequency setting.

In the input of the pulse train, set the relationship between the input pulse frequency and frequency setting value by the parameter 09.62(command(pulse train input) pulse augmenting factor 1) and 09.63(command(pulse train input) pulse augmenting factor 2)(Parameter 00．01)

According the types of the installed PG optional parts, pulse train input will switch automatically to the input from the optional parts side and terminal MI7 is ignored.

Please refer to the user manual of each optional part for more detail.

■Run forward and stop command [mFWD] (parameter data=98)

Turning this terminal command [mFWD] ON runs the motor in the forward direction; turning it OFF decelerates it to stop.

Tip:This terminal command [mFWD] can be assigned only by 01．98,01．99 .

■ Run reverse and stop command [mREV] (parameter data=99)

Turning this terminal command [mREV] ON runs the motor in the reverse direction; turning it OFF decelerates it to stop.

Tip:This terminal command [mREV] can be assigned only by 01．98,01．99 .

01．10	Acceleration time 2 (refer to 00．07)		↗	Factory default	Type Setting
01．11	Deceleration time 2 (refer to 00．07)		↗	Factory default	
01．12	Acceleration time 3 (refer to 00．07)		↗	Factory default	
01．13	Deceleration time 3 (refer to 00．07)		↗	Factory default	
01．14	Acceleration time 4 (refer to 00．07)		↗	Factory default	
01．15	Deceleration time 4 (refer to 00．07)		↗	Factory default	
	Setting Range	0.00~6000s ※ Enter 0.00 cancels the ACC/DEC. time (requiring external soft-start and -stop)		Unit	0.01s

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

01．20	MO1 terminal function selection	Factory default	0
01．21	MO2 terminal function selection	Factory default	1
01．22	MO3 terminal function selection	Factory default	2
01．23	MO4 terminal function selection	Factory default	7
01．24	MRA/MRC terminal function selection	Factory default	15
01．27	RA/RB/RC terminal function selection	Factory default	99

Terminals MO1,MO2,MO3,MO4,MRA／MRC,RA／RB／RC are assigned by 01．20~01．24,01．27,it's a output signals to general-purpose, programmable output terminals.it can also switch the logic system between normal and negative 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,MO3,MO4 are transistor output, and terminals MRA ／MRC,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 negative logic, 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 negative logic 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 MRA／MRC,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~MO4 instead.

The table below lists functions that can be assigned to terminals MO1,MO2,MO3,MO4,MRA／MRC,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	Control Method			Related parameters ／Related signal (data)
Active ON	Active OFF			Without PG	PG	IM/ V/f	
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

Data		Function	Signal name	Control Method			Related parameters / Related signal (data)
Active ON	Active OFF			Without PG	PG	IM/ V/f	
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]	○	○	○	[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]	○	○	○	—
30	1030	Lifetime alarm	[mLIFE]	○	○	○	
31	1031	Frequency (speed) detection 2	[mFDT2]	○	○	○	01．32,01．36
33	1033	Reference loss detected	[mREF OFF]	○	○	○	01．65
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]	○	●	○	08．11~08．13
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]	○	○	○	01．78~01．81
46	1046	Torque detection 1	[mTD1]	○	○	○	
47	1047	Torque detection 2	[mTD2]	○	○	○	
48	1048	Motor 1 selected	[mSWM1]	○	○	×	—
49	1049	Motor 2 selected	[mSWM2]	○	○	×	—
50	1050	Motor 3 selected	[mSWM3]	○	○	×	—
51	1051	Motor 4 selected	[mSWM4]	○	○	○	01．90,07 parameter
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

Data		Function	Signal name	Control Method			Related parameters / Related signal (data)
Active ON	Active OFF			Without PG	PG	IM/ V/f	
76	1076	PG error detected	[mPG-ERR]	●	○	×	09．21~09．23
84	1084	Maintenance timer	[mMNT]	○	○	×	04．44,04．78, 04．79, 04．94
89	1089	Magnetic pole position detection completed	[mPID]	×	○	×	
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

○: enable，●: disable in torque limiter (04．18 ≠ 0), ×: disable

Note:Any negative logic (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	Operating condition 1	Operating condition 2
[mRUN]	If the output frequency exceeds the starting frequency, the signal turns ON, otherwise, it turns OFF	It turns ON under zero speed control
[mRUN2]		It turns ON under zero speed control,magnetic pole postion detection,DC brake(Only for three-phase asynchronous motor)

■ Frequency (speed) arrival signal [mFAR] and Frequency (speed) arrival signal 3 [mFAR3](parameter data = 1,72)

When the gap between output frequency (speed detected value) and setting frequency (reference speed) is within the frequency detection level (parameter 01. 30), frequency (speed) arrival signal turns ON. (parameter 01．30)

■ Frequency detection [mFDT]、Frequency detection 2 [mFDT2]、Frequency detection 3 [mFDT3](parameter data = 2,31,58)

When the output frequency(speed detected value) exceeds the frequency detection level specified by function parameter (01．31, 01．36, 01．54), the frequency detection signal comes ON; When it drops below the speed detection level minus Hysteresis width specified by 01．32," it goes OFF.

■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 torqueor 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-and Max. internal value)

· Current limiting by software (00．43, 00．44) (Only for three-phase asynchronous motor under V/f control)

· Instantaneous overcurrent limiting by hardware (04．12＝1) (Only for three-phase asynchronous motor under V/f control)

·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.

■ Auto-restarting after momentary power failure [mIPF](parameter data = 6)

The signal [mIPF] turns ON when the inverter continues running due to the momentary power failure, or in the period from when the low voltage is detected and output is shut down and wait to recovery to the restart mode completed(frequency arrival).(parameter 00．14)

■ Motor overload early warning [mOL](parameter data = 7)

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). (parameter 01．34)

■Keypad operation enabled (parameter data =8)

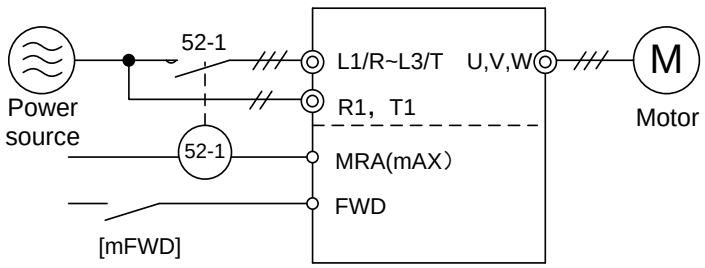
This output signal comes ON when the keypad is specified as a run (RUN and STOP key) command source.

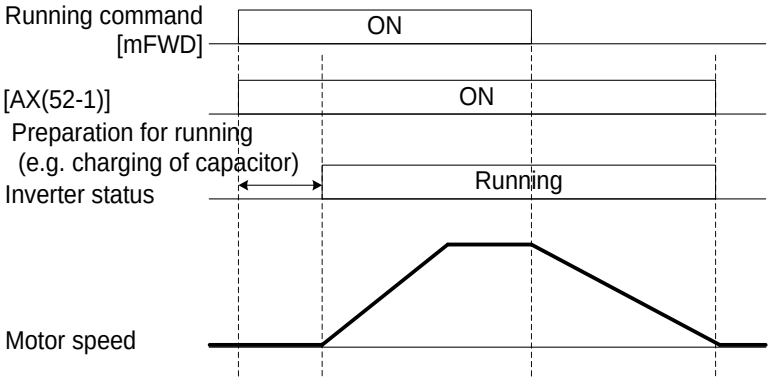
■Inverter ready to run [mRDY] (parameter data =10)

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





■ ON-OFF control of cooling fan [m FAN](parameter 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

■ Auto-resetting [mTRY](parameter data = 26)

This output signal comes ON in the resetting (Alarm's auto-reset).(parameters 04．04,04．05)

■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 RS-485 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 trip OH1 actually happens.

This signal comes ON when the temperature of the cooler exceeds the "overheat trip temperature minus 5°C,"

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

■Lifetime alarm (parameter data=30)

This output signal comes ON when it is judged that the service life of any one of capacitors (DC link bus capacitors and electrolytic capacitors on the printed circuit boards) and cooling fan has expired .This signal should be used as a guide for replacement of the capacitors and cooling fan. If this signal comes ON, use the specified maintenance procedure to check the service life of these parts and determine whether the parts should be replaced or not.

■ Reference loss detected [mREF OFF](parameter data = 33)

As reference frequency, use the analog input, and when this analog input loss (reference loss) is detected, this output signal comes ON. If it returns back to the formal reference frequency, this output signal comes OFF. (parameter 01．65)

■ Overload prevention control [mOLP](parameter data = 36)

This output signal comes ON if it is under overload prevention control. (The minimum ON-duration is 100 ms.)(parameter 04．70)

■ Current detected [mID],Current detected 2 [mID2] and Current detected 3 [mID3](parameter data = 37,38,39)

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], [mID2or [mID3] turns OFF. (The minimum ON-duration is 100 ms.)

■ Low current detected [mIDL](parameter data = 41)

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 100 ms.)

■ PID alarm output [mPID-ALM](parameter data = 42)

As PID alarm, this signal can output absolute value alarm, deviation alarm.(parameters 08．11~08．13)

■ 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.

■ Assignment of [mPID-STP] ("Motor stopped due to slow flowrate under PID control")(parameter data = 44)

This output signal comes ON when the inverter stops due to little water stop function in the PID control.(parameters 08．15~08．17)

■ Low torque detection [mU-TL](parameter data = 45)

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) (01．80)) for the period specified (Low torque detection (Timer) (01．81)). 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 100 ms. (parameters 01．80, 01．81)

Note: In below control mode, some of the zones do not perform low torque detection in low speed operation.

The signal when the inverter is in the zones keeps the same results of the judgment as before entering the zones.

·PM motor under vector control without speed sensor: No detection when the value is not over 10% of the base frequency(00．04).

·Induction motor under V/f control: No detection when the value is not over 20% of the base frequency(07．02).

Besides, low torque detection [mU-TL] turns OFF when the inverter is in stop operation.

■Torque detection 1 [mTD1] and Torque detection 2[mTD2](parameter data = 46,47)

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) (01．78、01．80)) for the period specified (Torque detection (Timer) (01．79、01．81)), 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. (parameter 01．78~01．81)

■ Motor 1~4 selected [mSWM1]、[mSWM2]、[mSWM3]、[mSWM4](parameter data = 48,49,50,51)

The motor switched by the motor selected signal [mSWM1],[mSWM2],[mSWM3],[mSWM4] or the signal that the parameter is corresponding to is turned ON.

Besides, when the induction motor is under V/f control and enabled by setting parameter 01．90 = 4, 'mSWM4' turns ON. (parameter 01．90)

■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.

■ Motor overheat detected by thermistor [mTHM](parameter data = 56)

In the PTC thermistor on the motor detected a temperature, the alarm signal OH4 is not required and output alarm signal [mTHM], then continues running. (parameter 04．26 = 2)。(parameters 04．26,04．27)

■ Brake signal [mBRKS](parameter daxlta = 57)

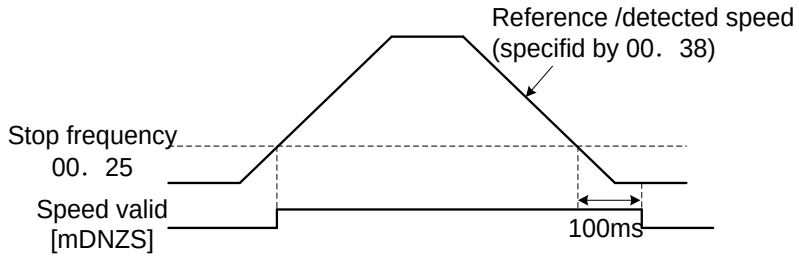
This signal outputs a brake control command that releases or activates the brake.(parameters 08．68~08．72)

■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 2 mA interpreting it as the terminal ACI wire broken.

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

This output signal comes ON when the reference speed value/ detected speed value exceeds the stop speed specified by stop frequency, it goes OFF when the speed is below the stop frequency for 100 ms or longer. When PM motor is under vector control without speed sensor, use reference speed value to check (parameter 00．25，00．38)



■ Speed agreement signal [mDSAG](parameter data = 71)

As the reference speed output from acceleration and deceleration counter, If the speed regulator's deviation (between the reference speed and detected one) is within the specified range, the signal [mDSAG] turns ON, If the deviation is out of the specified range, the signal turns OFF.

When PM is under vector control without speed sensor, use detected speed value to check. (parameters 09．21,09．22)

■ PG error detected [mPG-ERR](parameter data = 76)

When the inverter is set to continue running by the PG error selection (09．23) and the PG error is detected, the inverter will not output the PG error alarm and continues running, but this output signal comes ON.(parameters 09．21~09．23)

■ Maintenance timer [mMNT](parameter data = 84)

When the cumulative operation time of the motor exceeds the pre-set time or starting times of the motor 1 exceeds that of preset, this output signal comes ON.(parameters 04．78,04．79)

■ Magnetic pole position detection completed[mPTD](parameter data = 89)

When PM motor starts and the magnetic pole position is detected, this output signal comes ON.

■ Light alarm [mL-ALM](parameter data = 98)

This output signal comes ON when there is a light alarm occurred.

For more detail information, please refer to parameter 04．81,04．82, " 3.3.2 Monitoring light alarms on keypad " in Chapter 3 Keypad Description, Chapter 7 Failure Indication and Countermeasures.

■Alarm [mALM] (parameter data =99)

When any alarm appears, ON signal is output.

■Braking transistor broken [mDBAL] (parameter data=105)

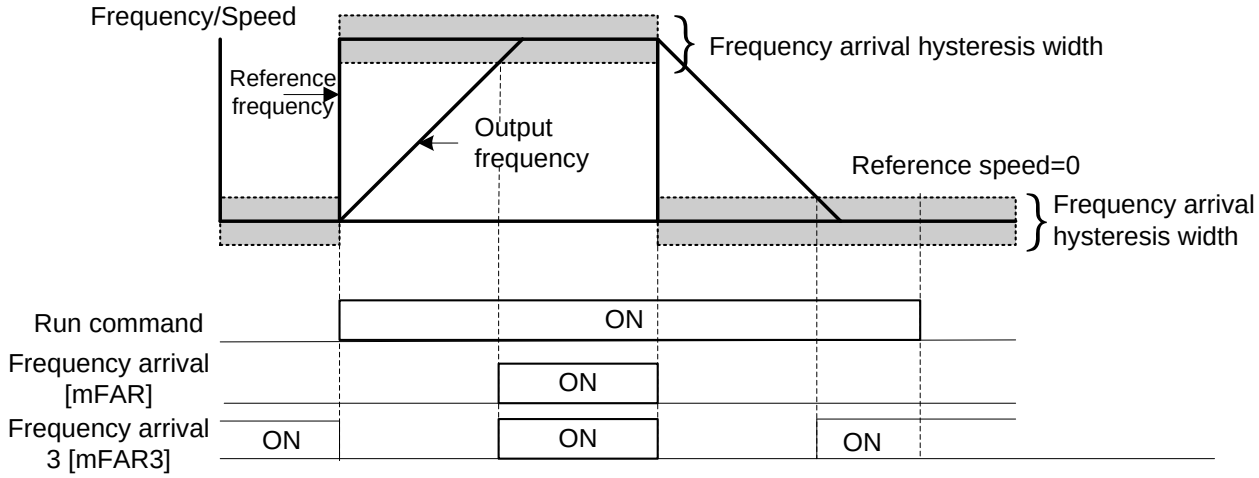
If the inverter detects a breakdown of the braking transistor, it issues the braking transistor alarm (dba) and also the output signal [mDBAL]. Detection of braking transistor broken can be cancelled by 04.98 (below 22KW for 400 series). (parameter 04.98)

Note:When brake transistor is damaged, it may result in brake resistor damage or internal damage of inverter. Check whether the built-in brake transistor is abnormal to prevent expansion of damage. Hence, please set electromagnetic contactor on input side of inverter as OFF through abnormal signal of brake transistor [mDBAL].

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

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 by01.30, output signal is ON.

The operation timings of each signal are shown below.

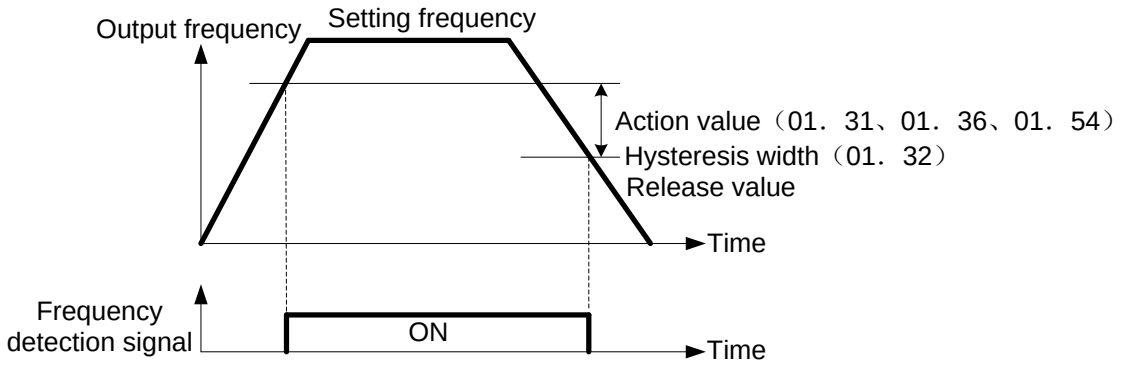


01．31	Frequency detection value		Factory default	90.0
01．32	Frequency detection hysteresis width		Factory default	1.0
	Setting Range	0.0~500.0Hz	Unit	0.1Hz
	Related parameters	01．36,01．54 Frequency detection 2,3 value		

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	



01．34	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)		

01．35	Overload Early Warning / current detection timer		Factory default	10.00
	Setting Range	0.01~600.00s	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)

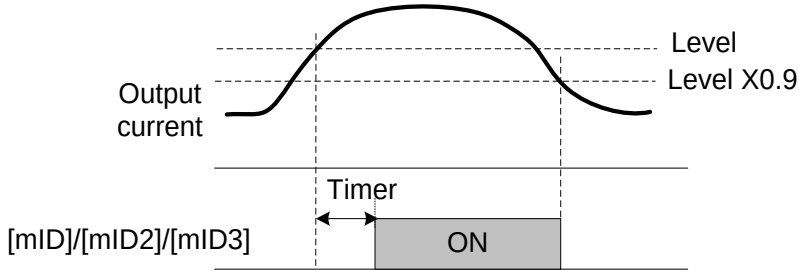
2:Enable (For an inverter-driven motor, non-ventilated motor, or motor with separately powered)

■ 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).

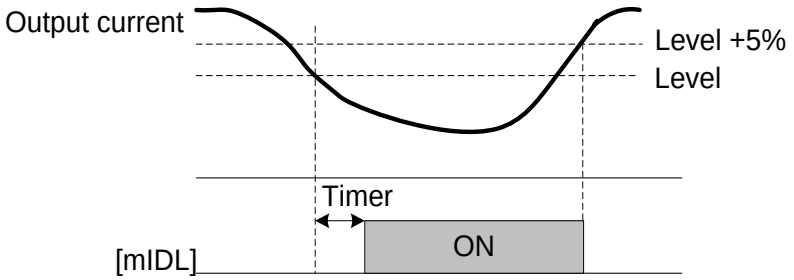
■ Current detected [mID], Current detected 2 [mID2]and Current detected 3[mID3]

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], [mID2or [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 100 ms.)



01．36	Frequency detection 2 value (refer to 01．31)		↗	Factory default	90.0
	Setting Range	0.0~500.0Hz		Unit	0.1Hz

01．37	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%
01．38	Current detection 2 / Low current detection timer (refer to 01．34)		↗	Factory default	10.00
	Setting Range	0.01~600.00s		Unit	0.01s

01．40	PID display coefficient A		↗	Factory default	100
01．41	PID display coefficient B		↗	Factory default	0
	Setting Range	–999~0.00~9990		Unit	0.01

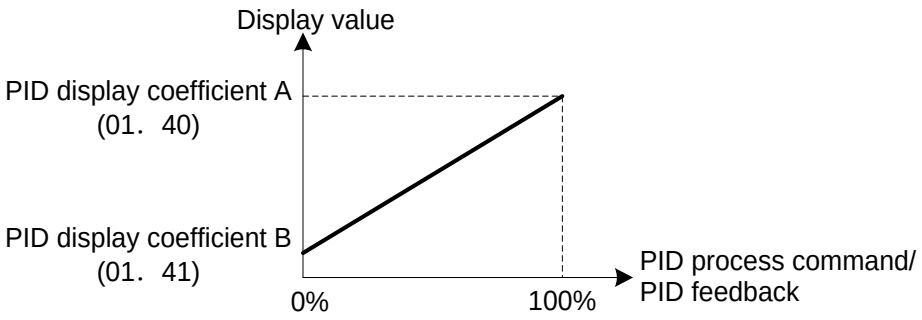
These function parameters PID display coefficients A and B to convert a PID command (process command or dancer position command) and its feedback into mnemonic physical quantities to display.

■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

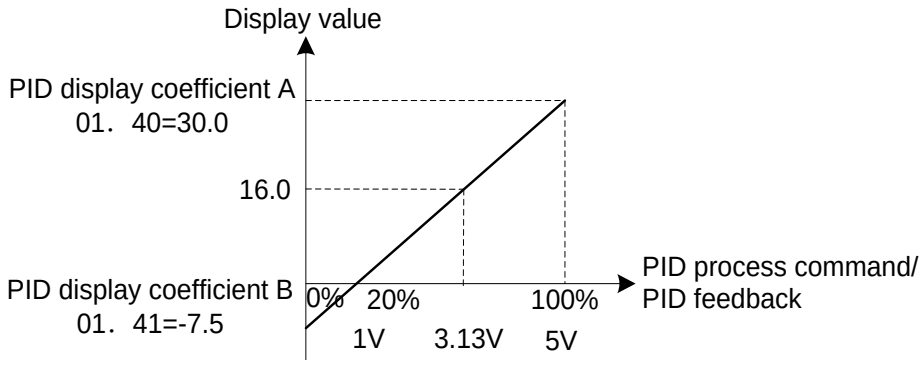


For example:Maintaining the pressure around 16 kPa (sensor voltage 3.13 V) while the pressure sensor can detect 0 to 30 kPa over the output voltage range of 1 to 5 V,Select terminal AVI as a feedback terminal and set the gain to 200% so that 5 V corresponds to 100%.

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

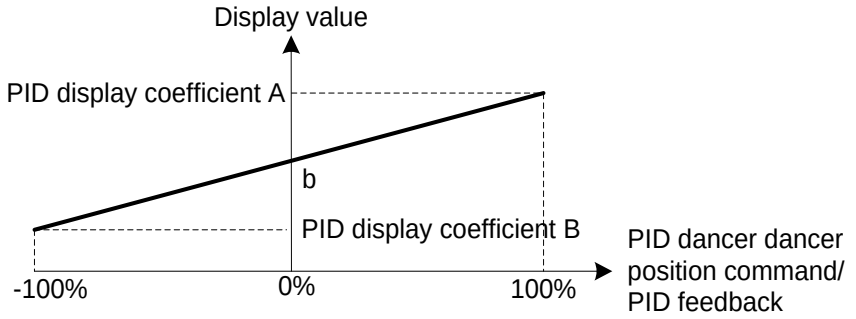
That determines the display value at 0% of PID process command or its feedback, PID display coefficient B (E41) = -7.5

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.

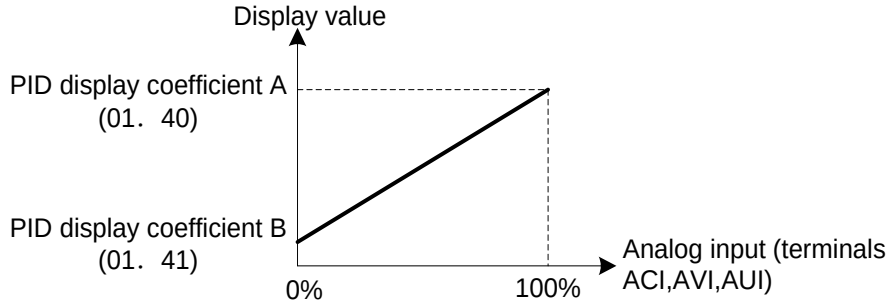
That is, suppose "b" = "Display value at 0%," then:Display coefficient B = 2b - A

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.

01．42	Display filter time constant		↗	Factory default	0.5
	Setting Range	0.0~5.0 s		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.

When speed monitoring parameter 01. 43=0, display filter is disabled.

01．43	Keypad display selection		↗	Factory default	0
	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".

01．44	Display when stopped		↗	Factory default	0
	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 1 (command value)	Setting frequency	Output frequency 1 (command value)
1	Output frequency 2(estimated/detected value)	Setting frequency	Output frequency 2(estimated/detected value)
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

01．48	Speed monitoring selection (refer to 01．43)	↗	Factory default	0

01．50	Coefficient for Speed Indication		↗	Factory default	20.00
	Setting Range	0.01~200.00		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)

Tips: When three-phase asynchronous motor is under V/f control, use parameter 07．60(Motor 4 speed display coefficient)

01．51	Display Coefficient for Input Watt-hour Data		↗	Factory default	0.010
	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.

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

01．55	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
01．56	Current detection 3 timer (refer to 01．34)		↗	Factory default	10
	Setting Range	0.01~600.00s		Unit	0.01s

01．61	Terminal AVI extension function selection	Factory default	0
01．62	Terminal ACI extension function selection	Factory default	0
01．63	Terminal AUI extension function selection	Factory default	0

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).
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: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

01．64	Saving of digital reference frequency	↗	Factory default	1

Specifies how to save the reference frequency specified in digital formats by the ⌃ / ⌄ keys on the keypad as shown below.

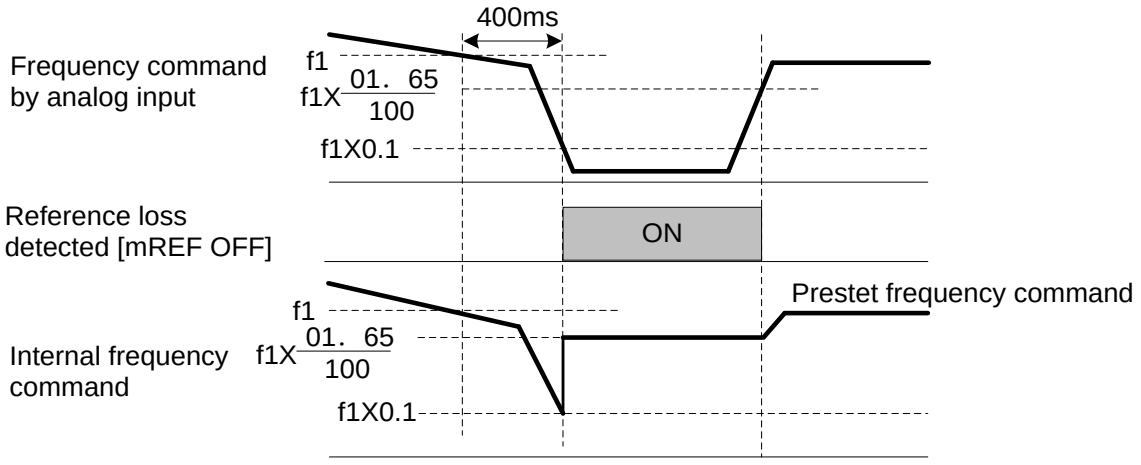
01．64 Setting value	Function
0	Automatic saving when the main power is turned OFF,The reference frequency will be automatically saved when the main power is turned OFF. At the next power-on, the reference frequency at the time of the previous power-off applies.
1	Saving by pressing FUNC DATA key. Pressing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

01．65	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, f1 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).

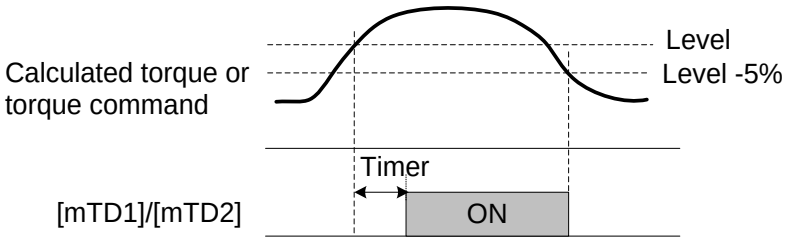
01．78	Torque detection 1 level		↗	Factory default	100
	Setting Range	0~300%		Unit	1%
01．79	Torque detection 1 timer		↗	Factory default	10.00
	Setting Range	0.01~600.00s		Unit	0.01s
01．80	Torque detection 2 / low torque detection level		↗	Factory default	20
	Setting Range	0~300%		Unit	1%
01．81	Torque detection 2 / low torque detection timer		↗	Factory default	20.00
	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

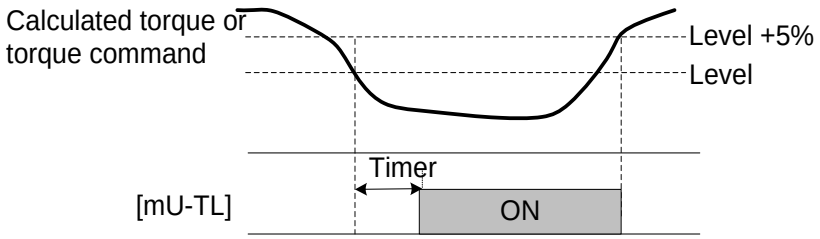
■ Torque detection 1 [mTD1], Torque detection 2 [mTD2]

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 100 ms.



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.)

01．90	Motor selection	Factory default	0

Specifies to select the switch types of the PM motor driving and induction motor driving.

01．90 Setting Value	Motor switch type
0	Switch motor/parameter in accordance with the input signal [mM2], [mM3], [mM4]
4	Fix to motor 4 (induction motor).(Normally signal [mM4] is equal to ON)

01．98	FWD terminal function selection (refer to 01．01~01．09)	Factory default	98
01．99	REV terminal function selection (refer to 01．01~01．09)	Factory default	99

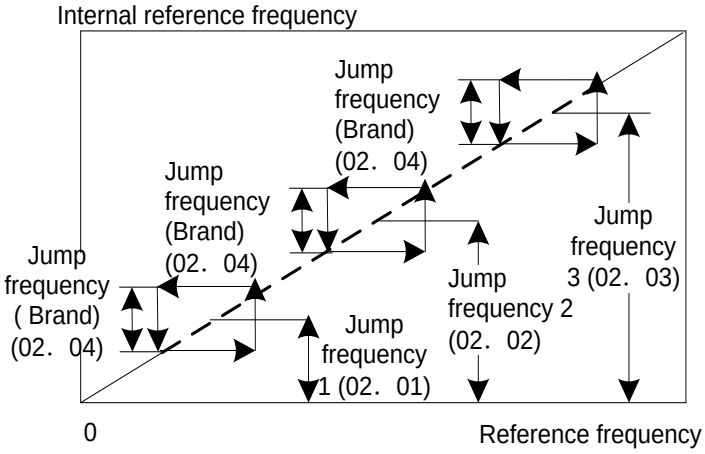
02 Control Function Parameters

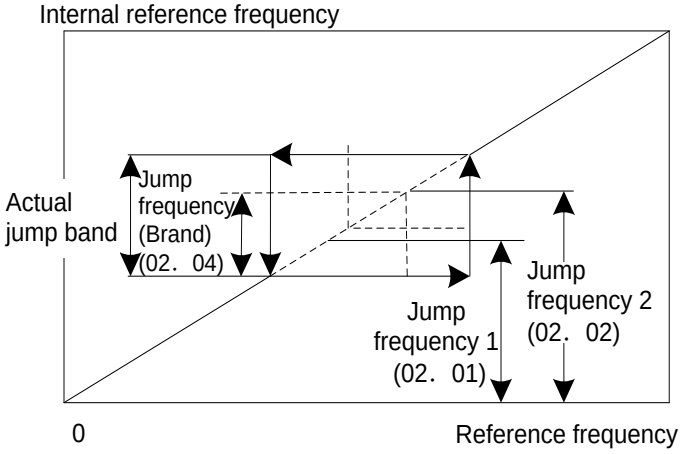
02．01	Jump frequency 1		↗	Factory default	0.0
02．02	Jump frequency 2		↗	Factory default	0.0
02．03	Jump frequency 3		↗	Factory default	0.0
	Setting Range	0.0~500.0 Hz,(Setting to 0.0 results in no jump frequency band.)		Unit	0.1 Hz
02．04	Jump frequency range		↗	Factory default	3.0
	Setting Range	0.0~30.0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

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.





02．05	Multi-speed frequency 1	↗	Factory default	0.00
02．06	Multi-speed frequency 2	↗	Factory default	0.00
02．07	Multi-speed frequency 3	↗	Factory default	0.00
02．08	Multi-speed frequency 4	↗	Factory default	0.00
02．09	Multi-speed frequency 5	↗	Factory default	0.00
02．10	Multi-speed frequency 6	↗	Factory default	0.00
02．11	Multi-speed frequency 7	↗	Factory default	0.00
02．12	Multi-speed frequency 8	↗	Factory default	0.00
02．13	Multi-speed frequency 9	↗	Factory default	0.00
02．14	Multi-speed frequency 10	↗	Factory default	0.00
02．15	Multi-speed frequency 11	↗	Factory default	0.00
02．16	Multi-speed frequency 12	↗	Factory default	0.00
02．17	Multi-speed frequency 13	↗	Factory default	0.00

02．18	Multi-speed frequency 14		↗	Factory default	0.00
02．19	Multi-speed frequency 15		↗	Factory default	0.00
	Setting Range	0.00~500.00 Hz		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 01．09) (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)
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.

·PID command

[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 1 Hz. The following gives the conversion formula between the PID command value and the data to be specified.

Specified data = Max. output frequency (00．03) of PID command (%)/100

$$\text{PID command} = \frac{\text{Specified data (02.08、02.12、02.16)}}{\text{Max. output frequency}} \times 100$$

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	0.01Hz
	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 ＋ 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 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

02．30	Dominant frequency 2 source selection (refer to 00．01)	Factory default	2

02．31	Analog input adjustment for offset (AVI terminals)		Factory default	0.00
	Setting Range	–5.0~5.0%	Unit	0.1%

02．32	Analog input adjustment for gain (AVI terminals)	⊙	Factory default	100.00
	Setting Range	0.00~400.00%	Unit	0.01%
02．33	Analog input adjustment for filter time constant (AVI terminals)	↗	Factory default	0.05
	Setting Range	0.00~5.00s	Unit	0.01s
02．34	Analog input adjustment for gain base point (AVI terminals)	⊙	Factory default	100.00
	Setting Range	0.00~100.00%	Unit	0.01%
02．35	Analog input adjustment for polarity selection (AVI terminal)		Factory default	1
	Setting Range	0：Bipolar		
		1： unipolar		

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

02．36	Analog input adjustment for offset (ACI terminals)	⊙	Factory default	0.00
	Setting Range	–5.0~5.0%	Unit	0.1%
02．37	Analog input adjustment for gain (ACI terminals)	⊙	Factory default	100.00
	Setting Range	0.00~400.00%	Unit	0.01%
02．38	Analog input adjustment for filter time constant (ACI terminals)	↗	Factory default	0.05
	Setting Range	0.00~5.00s	Unit	0.01s
02．39	Analog input adjustment for gain base point (ACI terminals)	⊙	Factory default	100.00
	Setting Range	0.00~100.00%	Unit	0.01%

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

02．40	ACI terminal range selection	Factory default	0
	Setting Range	0：4~20mA	
		1：0~20mA	

02．41	Analog input adjustment for offset (AUI terminals)	⊙	Factory default	0.00
	Setting Range	–5.0~5.0%	Unit	0.1%
02．42	Analog input adjustment for gain (AUI terminals)	⊙	Factory default	100.00
	Setting Range	0.00~400.00%	Unit	0.01%
02．43	Analog input adjustment for filter time constant (AUI terminals)	↗	Factory default	0.05
	Setting Range	0.00~5.00s	Unit	0.01s
02．44	Analog input adjustment for gain base point (AUI terminals)	⊙	Factory default	100.00
	Setting Range	0.00~100.00%	Unit	0.01%

02．45	Analog input adjustment for polarity selection (AUI terminal)		Factory default	1
	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)

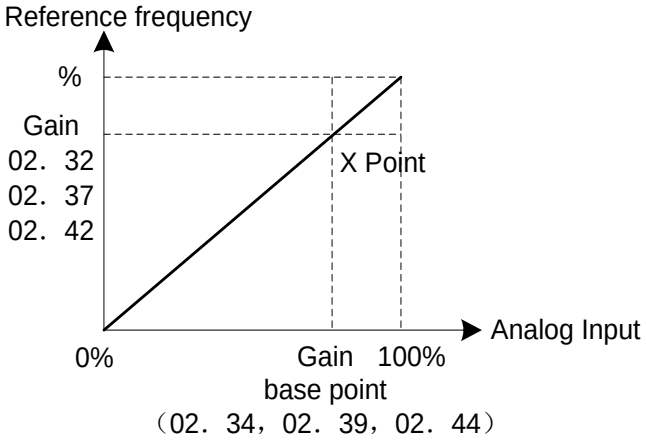
Configures a filter time constant for an analog voltage/current input. The larger the time constant,the slower the response. Specify the proper filter time constant taking into account the response speed of the machine (load). If the input voltage fluctuates due to line noises, increase the time constant.

■ Polarity Selection (02．35,02．45)

Configure the input range for analog input voltage.

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

■Gain



（02．34，02．39，02．44）

Note:To input bipolar analog voltage (0 to ±10 DC) to terminals AVI and AUI, set 02．35 and02．45 data to "0." Setting 02．35 and 02．45 data to "1" enables the voltage range from DC 0 to +10 VDC and interprets the negative polarity input from DC0 to -10 V as 0 V.

02．50	Bias base point (Dominant frequency 1) (refer to 00．01)		Factory default	0.00
	Setting Range	0.00~100.00%	Unit	0.01%

02．51	Bias value (PID command 1)		Factory default	0.00
	Setting Range	–100.00~100.00(%)	Unit	0.01%
02．52	Bias base point (PID command 1)		Factory default	0.00
	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.

The actual setting is the same as that of 00．18. For details, refer to 00．18 given in the description of 00．01.

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

02．53	Normal/Inverse action selection (Dominant frequency 1) (refer to 01．01~01．09)		Factory default	0.00
	Setting Range	0：Normal operation		
		1：Inverse operation		

03 Motor 1 Parameters (For PM motor)

For Series S5100, in order to build a motor model internal the inverter to realized vector control, the proper motor parameters is required. Not only rated capacity and current of the motor, but also correctly specifying the parameters.

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

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.

Motor speed (r/min) ＝ 120／ number of poles × frequency (Hz)

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

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

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

03．04	Motor 1auto-tuning	Factory default	0

Automatically check the motor parameters and save as motor parameters.For details of auto-tuning, refer to Chapter 4,Section 4.1 "Test Run."

03．30	Motor 1(Magnetic pole position detection mode)	↗	Factory default	1
	Related parameters	03．74 motor 1(current command value at startup) 03．87motor 1(NS to check current command value) 09．80 pole position auto search frequency		

Select magnetic pole position detection mode. Please specify the mode that is suitable for your using PM motor type.

03．30 Setting	Function	Remark
0:Current auto search	No magnetic pole position detection. When the motor starts, make the current that is fit for current command value (03．74) at startup flow and inject the magnetic pole position. Under this mode, when starting the motor, the motor will rotate partly in the opposite direction of the running direction in accordance with the position of the motor axis.	The function is disabled when parameter 03. 04=1(stop tuning)
1: Mode for IPM(embedded magnet) motor	Select the suitable magnetic pole position detection for embedded magnet type PM motor and start the motor. Specifiy the current value by the parameter 03. 87 when in magnetic pole position detection. Generally, There is no need to modify the fatory default.	—
2: Mode for SPM (exterior magnet) motor	Select the suitable magnetic pole position detection for exterior magnet type PM motor and start the motor	—

03．30 Setting	Function	Remark
3: Current auto search mode for IPM motor	Select the suitable magnetic pole position detection for embedded magnet type PM motor that is unable to magnetic saturation and start the motor. Under this mode, when starting the motor, the motor will rotate partly in the opposite direction of the running direction in accordance with the position of the motor axis.Select this mode, when there is setting error Er7(error subcode is 5056) occurred in the rotating tuning when parameter 03. 04=2. When the PM motor is under vector control without speed sensor, please increase starting frequency holding time(00．24) in accordance with the time from 0.5~5.0s and set it to the value that can start the motor smoothly. Regarding the check of the error subcode, please refer to the Chapter 3 for "3.4.5 Reading Alarm Information".	This function is disabled when parameter 03. 04=1(stop tuning)

Note: Specifiy the current value by the parameter 03. 87 when in magnetic pole position detection.Generally, there is no need to modify the fatory defaut.

When PM motor is under vector control with speed sensor, the parameters and starting action shown as below:

00．42 data	09．14 data	03．95 data	03．30 data	Action taken at startup
16: PM motor with speed sensor	2:A,B phase quadrature phase difference,Z phase	999(Compensation without adjustment)	0: Current auto search 3: Current auto search mode for IPM motor	<Startup is disabled> the inverter can not start when there is erc alarm. Pls adjust parameter 03. 95
Vector control			1: For IPM motor 2: For SPM motor	< Start magnetic pole position detection > Start from 0Hz after magnetic pole position detection.
		0.0~359.9°(compensation adjustment completed)	0, 3	<Start magnetic pole position auto search> Perform magnetic pole position auto search with the frequency specified by parameter 09. 80 only when it is the first time for the inverter to connect the power supply. When the magnetic pole position auto search is completed, accelerate to the reference speed. From the next time, start from 0Hz(Normal startup) Besides, the longest time of the magnetic pole position auto search needs the motor to take one rotation at mechanical angle.(Parameter 09. 80)
			1, 2	<Start magnetic pole position detection> Start from 0Hz after magnetic pole position detection.
	4: A,B phase quadrature phase	999(Compensation without adjustment)	0, 3	<Startup is disabled> The inverter can not start when there is erc alarm. Pls adjust parameter 03. 95

00．42 data	09．14 data	03．95 data	03．30 data	Action taken at startup
	difference, UVW signal		1, 2	<Start magnetic pole position detection> Start from 0Hz after magnetic pole position detection.
		0.0~359.9°(compensation adjustment completed)	No limit	<Normal starting> Start from 0Hz

Note:Magnetic pole position auto search and magnetic pole position detection can not produce the complete torque. When it applies to the application software that needs torque at startup, use brake signal 'BRKS' and magnetic pole position detection completed signal 'PTD', please do not brake off unitil the magnetic pole position auto search and magnetic pole position detection is completed.(Parameter 01. 20)

03．60	Motor 1 (Armature resistance)			Factory default	Type Setting
	Setting Range	0.000~50.000Ω		Unit	
03．61	Motor 1 (d axis inductance)			Factory default	Type Setting
03．62	Motor 1 (q axis inductance)				
	Setting Range	0.00~500.00mH		Unit	
03．63	Motor 1 (induction voltage (base speed))			Factory default	Type Setting
	Setting Range	160~500V(440V series)		Unit	
03．64	Motor 1 (iron loss (base speed))		↗	Factory default	Type Setting
	Setting Range	0.0~20.0%(Motor's capacity as a standard level)		Unit	

Specifies the motor's armature inductance, d axis inductance, q axis inductance, induction voltage (base speed), iron loss (base speed). Please specify by getting the motor's test report or contact the motor's manufacturer.

Besides, if the inverter perform auto-tuning, the parameter 03．60~03．63 will be set automatically.

03．65	Motor 1 (q axis inductance saturation correction)		↗	Factory default	999
	Setting Range	0.0~100.0%(100.0% = No inductance saturation) 999(factory adjustment)		Unit	

Specifies the control parameter for the motor. Generally, no need to change.

03．74	Motor 1 (Current command value at startup)(refer to 03．30)		↗	Factory default	80
	Setting Range	10~200% (Motor's rated current as a standard level)		Unit	

03．84	For Manufacturer to use		Factory default	999
	Setting Range	0.0~100.0, 999	Unit	

This parameter is reserved for particular manufacturers. Unless otherwise specified, do not access it.

03．85	Motor 1 (Flux limiter)	↗	Factory default	999
	Setting Range	50.0~150.0%，999(Factory adjustment)	Unit	

Specifies the control parameter for the motor. Generally, no need to change.

03．86	For Manufacturer to use		Factory default	—
	Setting Range	For monitor	Unit	

This parameter is reserved for particular manufacturers. Unless otherwise specified, do not access it.

03．87	Motor 1 NS check current command value (refer to 03．30)		Factory default	Type Setting
	Setting Range	0~200% (Motor's rated current as a standard level)	Unit	

03．88	For Manufacturer to use		Factory default	999
	Setting Range	0~100, 999	Unit	
03．89	For Manufacturer to use		Factory default	0
	Setting Range	0, 1~100	Unit	

Function Parameters 03．88~03．89 appear on the LED monitor, but they are reserved for particular manufacturers. Unless otherwise specified, do not access them.

03．90	Motor 1 overcurrent protection level		Factory default	Type Setting
	Setting Range	0.00(Invalid)，0.01~2000A	Unit	

PM motor has the allowable current value to prevent demagnetization of the permanent magnet. If there is current exceeding the allowable current value flowing, the magnetic force of the permanent magnet will be weaker and can not get the expected motor characterics.

When there is current which exceeds the current value specified by parameter 03. 90 flowing, the inverter will output the overcurrent protection alarm OC1 ,OC2 ,OC3 to protect the motor.

Note: Pay attention that the rated current of the inverter will be different from the HD/ND specification.

03．95	Motor 1 magnetic pole position speed sensor compensation		Factory default	999
	Setting Range	0.0~359.9°，999(Compensation without adjustment)	Unit	

Do the adjustment to compensation between the magnetic pole position of the PM motor with magnetic pole position speed sensor and detection pthe osition base on the magnetic pole position speed sensor.

The motor can adjust automatically by the auto-tuning.

Please rfer to the Chapter 4“4.1 Test Run” for more detailed procedure of the auto-tuning.

04．03	Data initialization	Factory default	0

Initializes the current function parameter data to the factory defaults or initializes the motor parameters.

To change the parameter04．03 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(Specialized for PM motor)
5	Initialize motor 4 parameters(Specialized for three-phase asynchronous motor)

·Upon completion of the initialization, the 04．03 data reverts to "0" (factory default).

04．04	Auto-reset Times		Factory default	0
	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
Inverter internal overheat	OH3	Inverter overload	OLU
Loss of synchronism protection	Erd		

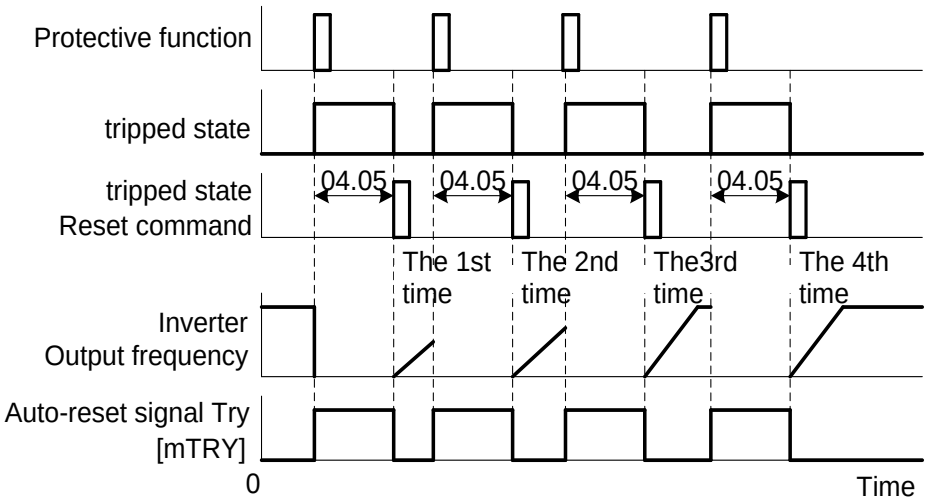
⚠ Caution
If the "auto-reset" function has been specified, the inverter may automatically restart and run the motor stopped due to a trip fault, depending on the cause of the tripping. Design the machinery so that human body and peripheral equipment safety is ensured even when the auto-resetting succeeds. **An accident may be caused.**

04．05	Auto-reset (Reset interval time)		Factory default	5.0
	Setting Range	0.5~20.0(s)	Unit	0.1s

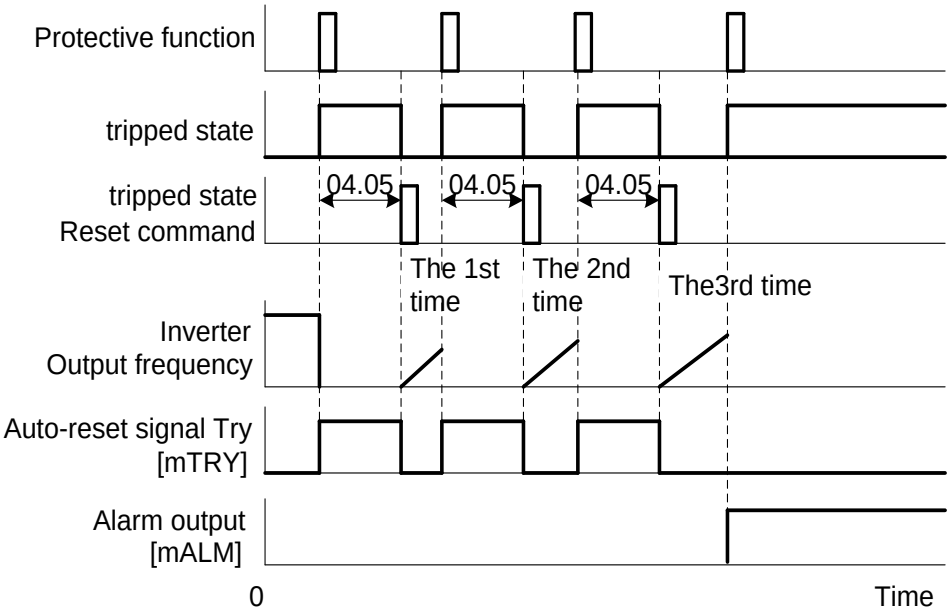
Specifies the reset interval time between the time when the inverter enters the tripped state and the time when it issues the reset command to attempt to auto-reset the state. Refer to the timing scheme diagrams below.

<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.

04．06	Cooling fan ON-OFF control		Factory default	0
	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

04．07	Acceleration/Deceleration Pattern (refer to 00．07)	↗	Factory default	0

04．08	Rotation direction Limitation		Factory default	0
	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..

04．09	Starting Auto search Mode		Factory default	0
	Setting Range	None		
	Related parameters	04．46 Starting Mode Auto search delay time 2		

When the induction motor is under V/f control,specifies the starting mode--whether to enable the auto search for idling motor speed to run the idling motor without stopping it.The auto search can apply to the restart of the inverter after a momentary power failure and the normal startup of the inverter individually.

When driing the PM motor, the auto search is always enabled no matter how to set the parameter.

■Starting mode, auto search (04．09／09．67) and terminal command [mSTM] ("Enable auto search for idling motor speed at starting")

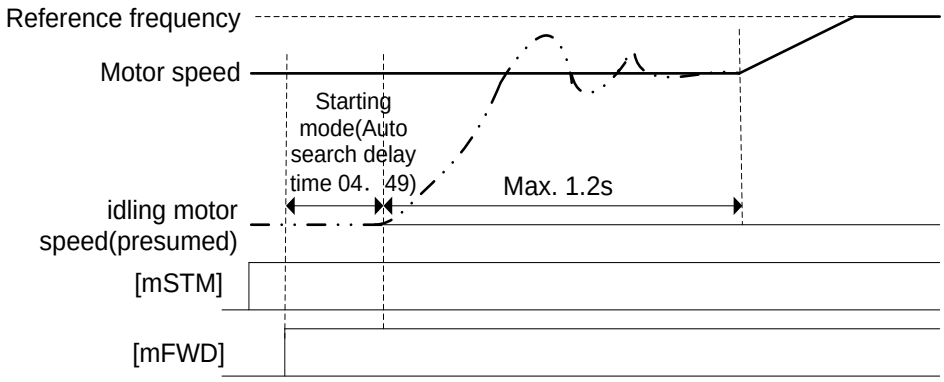
The combination of 04．09/09．67 data Starting mode, auto search and the [mSTM] status determines whether to perform the auto search as listed below.

Parameter	Drive control	Factory default
04．09	V/f control (00．42＝0~2)	0：Auto search is disable
09．67	Vector control without speed sensor (00．42＝5)	2：Auto search is enable

04．09 Setting	Auto search for idling motor speed at starting	
	For restart after momentary power failure (00．14＝3~5)	Normal Starting
0：Invalid	Auto search is disable	Auto search is disable
1：Operation	Auto search is enable	Auto search is disable
2：Operation	Auto search is enable	Auto search is enable

Auto search for idling motor speed

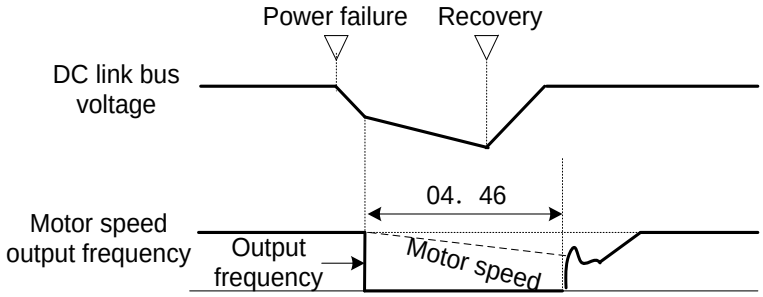
Starting the inverter with [mSTM] being ON searches for the idling motor speed for a maximum of 1.2 seconds to run the idling motor without stopping it. After completion of the auto search, the inverter accelerates the motor up to the reference frequency according to the frequency command and the preset acceleration time.



Auto search for idling motor speed to follow

■Starting Mode (Auto search delay time 2) (04．46) Data setting range:0.1~20.0(s)

At the restart after a momentary power failure, at the start by turning the terminal command [mBX] ("Coast to a stop") OFF and ON, or at the restart by auto-reset, the inverter applies the delay time specified by 04．46. The inverter will not start unless the time specified by H46 has elapsed, even if the starting conditions are satisfied.



Under auto search control, the inverter searches the motor speed with the voltage applied at the motor start and the current flowing in the motor, based on the model built with the motor parameters. When the inverter searches the speed of the induction motor, due to the strong influence of the motor's residual voltage,at factory shipment, 04．46 data is preset to a correct value according to the motor capacity for the general purpose Induction motor, It can perform shorten setting to the parameter 04. 46 when not driving the induction motor.

However, Depending on the Induction motor characteristics, however, it may take time for residual voltage to disappear (due to the secondary thermal time constant of the motor). In such a case, the inverter starts the motor with the residual voltage remaining, which will cause an error in the speed search and may result in occurrence of an inrush current or an overvoltage alarm.

If it happens, increase the value of 04．46 data and remove the influence of residual voltage.

(If possible, it is recommended to set the value around two times as large as the factory default value allowing a margin.)

Note ·Make sure to auto-tune the inverter preceding the start of auto search for the idling motor speed.

·When the estimated speed exceeds the maximum frequency or the upper limit frequency, the inverter disables auto search and starts running the motor with the maximum frequency or the upper limit frequency, whichever is lower.

·During auto search, if an overcurrent or overvoltage trip occurs, the inverter restarts the suspended auto search.

·Perform auto search at 60 Hz or below.

·Note that auto search may not fully provide the performance depending on load conditions, motor parameters, wiring length, and other external factors.

Tips: When the PM motor is under vector control without speed sensor/vector control with speed sensor, no matter how to set the parameter, the auto search is always enabled.

Since there is no need to wait clearing the residual voltage, so during the auto search waiting operation, you can perform shorten setting of the parameter 04. 46 to prevent the motor rotation speed from dropping.

04．11	Deceleration mode	↗	Factory default	0

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.

04．12	Instantaneous overcurrent limiting mode selection (refer to 00．43，00．44)		↗	Factory default	1
	Setting Range	0：Invalid			
		1：Valid Action			

04．13	Restart mode after momentary power failure (restart time) (refer to 00．14)		↗	Factory default	Type Setting
	Setting Range	0.1~20.0 s		Unit	0.1s
04．14	Restart mode after momentary power failure (frequency fall rate) (refer to 00．14)		↗	Factory default	999
	Setting Range	0.00:deceleration time selected, 0.01 ~ 100.00Hz / s, 999 (according to the current limit command)		Unit	0.01 Hz/s
04．15	Restart mode after momentary power failure (continuous running level) (refer to 00．14)		↗	Factory default	470
	Setting Range	400~600V		Unit	1V
04．16	Restart mode after momentary power failure (allowable momentary power failure time) (refer to 00．14)		↗	Factory default	999
	Setting Range	0.0~30.0s,999 (the inverter can determine automatically)		Unit	0.1s

04．18	Torque control action selection		Factory default	0
	Setting Range	0：Invalid (speed control)		
		2：Valid Action (torque current command)		
		3：Valid Action (torque command)		
	Related parameters	09．32,09．33 Torque control (speed limit 1,2)		

When vector control with speed sensor is selected, the inverter can control the motor-generating torque according to a torque command sent from external sources.

04．18 specifies whether to enable or disable the torque control.Enabling the torque control offers two choices:with torque current command and with torque command.

■Torque Commands

Torque commands can be given as analog voltage input (via terminals AVI and AUI) or analog current input (via terminal ACI) To use analog voltage/current inputs, it is necessary to set parameter 01．61 (AVI terminal),, 01．62(ACI terminal) or 01．63(AUI terminal) data to "10" or "11.".

Input	Command form	Function Parameter Setting	Specifications
AVI terminal (–10V~10V)	Torque command	01．61=10	Motor rated torque ±100% / ±10V
	Torque current command	01．61=11	Motor rated torque current ±100% / ±10V
AUI terminal (–10V~10V)	Torque command	01．63=10	Motor rated torque ±100% / ±10V
	Torque current command	01．63=11	Motor rated torque current ±100% / ±10V
ACI terminal (4~20mA)	Torque command	01．62=10	Motor rated torque ±100% / ±10V
	Torque current command	01．62=11	Motor rated torque current ±100% / ±10V

■Polarity of torque commands

The polarity of a torque command switches according to the combination of the polarity of an external torque command and a run command on terminal [FWD] or [REV], as listed below.

Polarity of Torque command	Running command	Torque Polarity
Positive	［mFWD］ON	Positive torque (forward driving/Reverse braking)
	［mREV］ON	Negative torque (forward braking/ Reverse driving)
Negative	［mFWD］ON	Negative torque (forward braking/ Reverse driving)
	［mREV］ON	Positive torque (forward driving/Reverse braking)

■Cancel torque control［mHz/TRQ］(parameter 01．01~01．09 data=23)

When torque control is enabled (04．18 = 2 or 3), assigning the terminal command ［mHz/TRQ］("Cancel torque control") to any of the general-purpose digital input terminals (data = 23) enables switching between speed control and torque control.

Cancel torque control signal［mHz/TRQ］	Operation
ON	Cancel torque control (Enable speed control)
OFF	Enable torque control

■Torque Control (Speed limits 1 and 2) (09．32,09．33)

Torque control controls the motor-generating torque, not the speed. The speed is determined secondarily by torque of the load, inertia of the machinery, and other factors. To prevent a dangerous situation, therefore, the speed limit functions (d32 and d33) are provided inside the inverter. (09．32,09．33).

Tips: Speed limited function(09．32, 09．33) and torque control(04．18) is separated. However, V/f control of the induction motor is disabled.(Parameter 09．32、09．33)

Note:Due to parameter setting error etc.,then the motor may rotate at an unintended high speed. To protect the mechanical system, we can set the maximum speed arbitrarily.

·Forward overspeed level = Max. output frequency (00．03) × speed limit 1 (09．32)×120(%)

·Reverse overspeed level = Max. output frequency (00．03) × speed limit 2 (09．33)×120(%)

·If motor speed (estimated/detected speed) exceeds the above value, the inverter outputs OS alarm and stop.

Note:Running/stopping the motor

Under torque control, the inverter does not control the speed, so it does not perform acceleration or deceleration by soft-start and stop (acceleration/deceleration time) at the time of startup and stop. Turning ON a run command starts the inverter to run and output the commanded torque. Turning it OFF stops the inverter so that the motor coasts to a stop.

04．26	Thermistor (for motor) action selection	↗	Factory default	0

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.

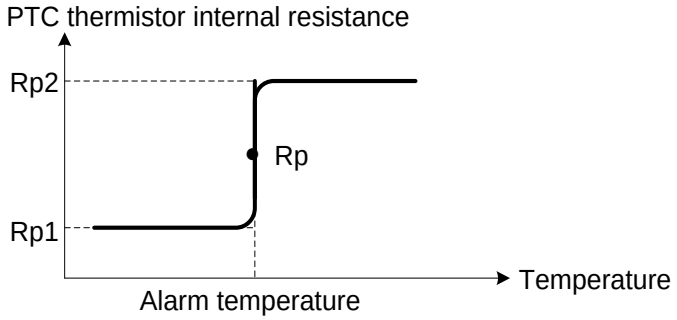
Selects the function operation mode (protection or alarm) for the PTC/NTC thermistor as shown below.

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 PM motor exclusively designed for with speed sensor.If the motor overheats and the temperature exceeds the protection level, the inverter issues the Motor protection alarm OH4 and stops the motor.

04．27	Thermistor (for motor) action value		↗	Factory default	0.35
	Setting Range	0.00~5.00V		Unit	0.01V

Thermistor (for motor) (Level)

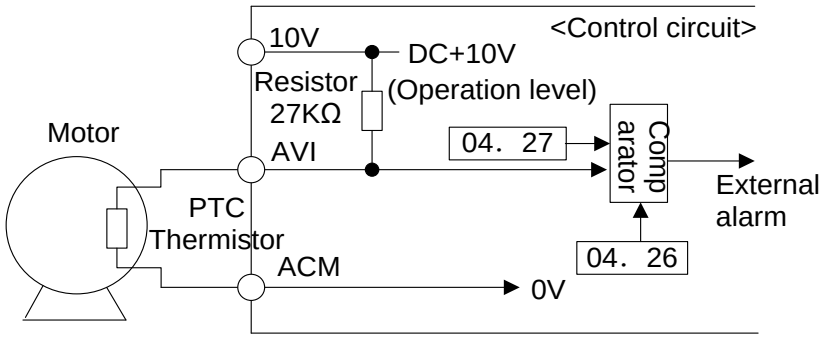
The alarm temperature at which the overheat protection becomes activated depends on the characteristics of the PTC thermistor. The internal resistance of the thermistor will significantly change at the alarm temperature. The detection level (voltage) is specified based on the change of the internal resistance.



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.

$$V_{V2} = \frac{RP}{27000 + RP} \times 10.5\ (V)$$

Connect the PTC thermistor as shown below. The voltage obtained by dividing the input voltage on terminal AUI with a set of internal resistors is compared with the detection level voltage specified by 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.

04．30	Communication link mode selection	↗	Factory default	0
	Related parameters	11．98 Communication function (mode selection)		

Using the RS-485 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:RS-485 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
RS-485 communications link port 1	Via the standard RJ-45 port used for connecting a keypad
RS-485 communications link port 2	Via the terminals (SG+,SG–,SCM) on the control PCB

Command sources specified by 04．30 (Communications link, mode selection)

04．30 Setting value	Frequency command	Running command
0	Inverter itself (00．01／02．30)	Inverter itself (00．02)
1	RS-485 communications link (port 1)	Inverter itself (00．02)
2	Inverter itself (00．01／02．30)	RS-485 communications link (port 1)
3	RS-485 communications link (port 1)	RS-485 communications link (port 1)
4	RS-485 communications link (port 2)	Inverter itself (00．02)
5	RS-485 communications link (port 2)	RS-485 communications link (port 1)
6	Inverter itself (00．01／02．30)	RS-485 communications link (port 2)
7	RS-485 communications link (port 1)	RS-485 communications link (port 2)
8	RS-485 communications link (port 2)	RS-485 communications link (port 2)

Command sources specified by 11．98 (Communications 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	RS-485 communications link port 1	RS-485 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
	RS-485 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
	RS-485 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 RS-485 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.

04．42	Capacitance of Main circuit(DC link bus) capacitor		↗	Factory default	—
	Setting Range	For adjustment in replacement (0000 ~ FFFF (hexadecimal))			
	Related parameters	04．47 Initial Capacitance of Main circuit (DC Link Bus) capacitor 04．48 Cumulative run time of capacitors on PCB 04．98 Protection/Maintenance Function (Mode selection)			
04．43	Cumulative running time for cooling fan		↗	Factory default	—
	Setting Range	0~9999		Unit	1

■Life prediction function

The inverter has the life prediction function for some parts which measures the discharging time or counts the voltage applied time, etc. The function allows you to monitor the current lifetime state on the LED monitor and judge whether those parts are approaching the end of their service life. (The life prediction function can also issue early warning signals if the lifetime alarm command[mLIFE]is assigned to any of the digital output terminals by any of 01．20~01．24 and 01．27)

Parameter	Function	Description
04．42	Capacitance of Main circuit(DC link bus) capacitor	Displays the measured value of capacitance for DC link bus capacitor. ·Start of initial capacitance measuring mode under ordinary operating conditions (0000) ·Measurement failure (0001)
04．43	Cumulative running time for cooling fan	Displays the accumulative run time of fan (hours). ·Setting Range：0~9999

Parameter	Function	Description
04．47	Initial Capacitance of Main circuit (DC Link Bus) capacitor	Displays the initial capacitance for DC link bus capacitor. ·Start of initial capacitance measuring mode under ordinary operating conditions 0000) · Measurement failure (0001)
04．48	Cumulative run time of capacitors on PCB	Displays the cumulative run time of capacitor on the PCB (10 hours). ·Setting Range：0~9999

When replacing the cooling fan or capacitors on printed circuit boards, it is necessary to clear or modify the data of the function parameters listed above.

04．44	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.

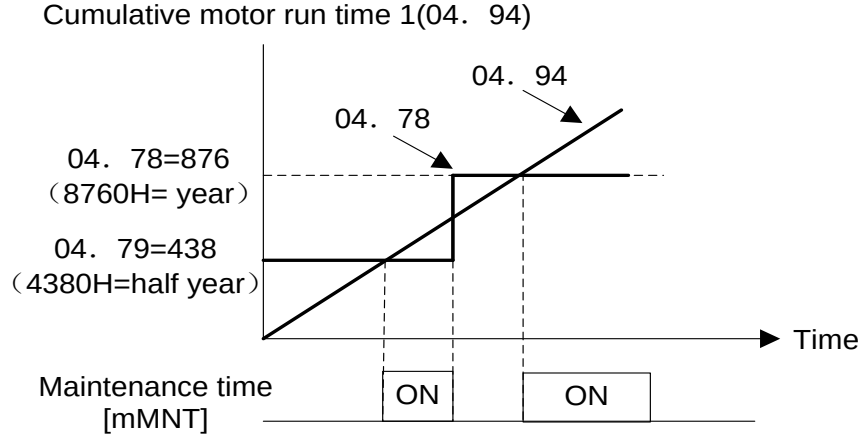
■Maintenance timer [mMNT]

1) Maintenance interval (M1)) specifies the maintenance interval. When the cumulative motor run time 1) (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＞

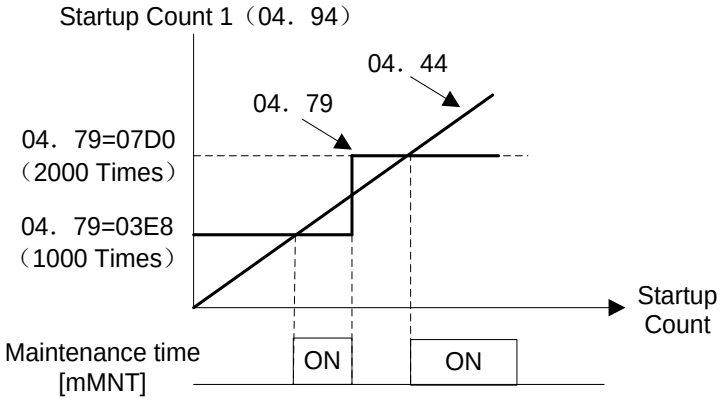


2)(Preset startup count for maintenance (M1)) 04．79 specifies the number of inverter startup times to determine the next maintenance timing. When the count of the startup counter for motor 1 (04．44) reaches the number specified by 04．79 (Preset startup count for maintenance (M1)), the inverter outputs 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)

＜Maintenance every 1,000 times of startups＞



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 FUNC/DATA key to reset the output signal and restart counting. This function is exclusively applied to the1st motor.

·If the startup counter reaches the specified value, set a new value for the next maintenance in 04．79 and press the FUNC/DATA key to reset the output signal and restart counting.

04．45	Mock Alarm		Factory default	0
	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 STOP key + ∧ 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 STOP 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 STOP key + FUNC/DATA on the keypad for 5 seconds or more.

04．46	Starting Mode Auto search delay time 2 (refer to 04．09)		Factory default	Type Setting
	Setting Range	0.1~20.0s	Unit	0.1s

04．47	Initial Capacitance of Main circuit (DC Link Bus) capacitor (refer to 04．42)		✓	Factory default	—
	Setting Range	For adjustment in replacement (0000 ~ FFFF (hexadecimal)		Unit	1
04．48	Cumulative run time of capacitors on PCB (refer to 04．42)		✓	Factory default	—
	Setting Range	0~9999		Unit	1

04．50	Non-linear V/f Pattern 1 (Frequency) (refer to 07．02)		Factory default	Type Setting
	Setting Range	0.0(canceled),0.1~500.0Hz	Unit	0.1Hz
04．51	Non-linear V/f Pattern 1 (Voltage) (refer to 07．02)		Factory default	Type Setting
	Setting Range	0~500V：AVR action (440V series)	Unit	1V

04．52	Non-linear V/f Pattern 2 (Frequency) (refer to 07．02)		Factory default	0.0
	Setting Range	0.0(canceled),0.1~500.0Hz	Unit	0.1Hz
04．53	Non-linear V/f Pattern 2 (Voltage) (refer to 07．02)		Factory default	0
	Setting Range	0~500V：AVR action (440V series)	Unit	1V

04．54	Jogging acceleration time (refer to 00．07)	✓	Factory default	Type Setting
04．55	Jogging deceleration time (refer to 00．07)	✓	Factory default	
04．56	Deceleration time for forced stop (refer to 00．07)	✓	Factory default	
	Setting Range	0.00~6000s	Unit	0.01s

04．57	1st S-curve acceleration range(Leading edge) (refer to 00．07)	✓	Factory default	10
04．58	2nd S-curve acceleration range(Trailing edge) (refer to 00．07)	✓	Factory default	10
04．59	1st S-curve deceleration range(Leading edge) (refer to 00．07)	✓	Factory default	10
04．60	2nd S-curve deceleration range(Trailing edge) (refer to 00．07)	✓	Factory default	10
	Setting Range	0~100%	Unit	1%

04．61	UP / DOWN control initial frequency setting selection (refer to 00．01)	Factory default 1
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	

04．63	Frequency lower limiter action selection (refer to 00．15)	✓	Factory default	0
Setting Range	0：limit by 00.16 (Frequency limiter:Low) and continus to run			
	1：If the output frequency lowers below the one limited by 00.16(Frequency limiter:Low), decelerate to stop the motor.			

04．64	Frequency lower limiter lower action value		↗	Factory default	1.6
	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.

04．65	Non-linear V/f Pattern 3 (Frequency) (refer to 07．02)		Factory default	0.0
	Setting Range	0.0(canceled),0.1~500.0Hz	Unit	0.1Hz

04．66	Non-linear V/f Pattern 3 (Voltage) (refer to 07．02)		Factory default	0
	Setting Range	0~500V ：AVR action (440V series)	Unit	1V

04．69	Overvoltage Automatic Deceleration action selection		↗	Factory default	0
	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.

S3800 series of inverters have two braking control modes; torque limit control and DC link bus voltage control.

S5100 adopts torque limit control mode (anti-regenerative control)

Please learn about the specification and select the appropriate mode.

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.

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
4	Torque limit 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, internal overheat and or inverter overload (with an alarm indication of OH1,OH2,OH3, 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:100 ms).

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.

04．72	Main Power Down Detection (Mode selection)		↗	Factory default	1
	Setting Range	0：Invalid, there is no main power down detection.			
		1：Valid, there is main power down detection.			

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.

04．74	Torque Limiter:torque control target (refer to 00．40)		Factory default	1
	Setting Range	0：Motor-generating torque limit		
		1：Torque current limit		
		2：Output power limit		

04．76	Torque Limiter:Frequency increment limit for braking (refer to 00．40,04．69)		↗	Factory default	5
	Setting Range	0.0~500.0Hz		Unit	0.1Hz

04．77	Service Life of DC link bus capacitor remaining time)		↗	Factory default	—
	Setting Range	0~8760 (10 hours as a unit)		Unit	1

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.

04．78	Maintenance Interval setting (M1) (refer to 04．44)		↗	Factory default	8760
	Setting Range	0(Invalid)；		Unit	1
		1 to 9999 (10 hours as a unit))			
04．79	Preset Startup Count for Maintenance(M1) (refer to 04．44)		↗	Factory default	0
	Setting Range	0000(Invalid)；		Unit	1
		0001 ~ FFFF (hexadecimal)			

04．81	Light alarm selection 1		↗	Factory default	0
04．82	Light alarm selection 2		↗	Factory default	0
	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.
Er4	Option communications error	Communications error between the inverter and an option.
Er5	Option error	An option judged that an error happened.
Er8 Erp	RS-485 communications error (COM ports 1 and 2)	RS-485 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. Or, failure of the air circulation DC fan inside the inverter. (440V series:above 75kW).

Code	Name	Description
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)
uTl	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.

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 listed in Tables 6.1 and 6.2. Set the bit that corresponds to the desired light alarm factor to "1." Table 6.3 shows the relationship between each of the light alarm factor assignments and the LED monitor display. (in the hexadecimal number).

Refer to ”Table 3.9 Conversion of Binary and Hexadecimal”

Table 6.1 Light Alarm Selection 1 (04．81), Bit Assignment of Selectable Factors

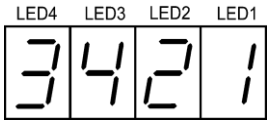
Bit	Code	Contents	Bit	Code	Contents
15	—	—	7	OL3	Overload of motor 3
14	—	—	6	OL2	Overload of motor 2
13	Erp	RS-485 communications error(COM port 2)	5	OL1	Overload of motor 1
12	Er8	RS-485 communications error (COM port 1)	4	dbh	Braking resistor overheated
11	Er5	Option error	3	—	—
10	Er4	Option communications error	2	OH3	Inverter internal overheat
9	—	—	1	OH2	External alarm
8	OL4	Overload of motor 4	0	OH1	Cooler Overheat

Table 6.2 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	uTl	Low torque detected	2	—	—
9	Pid	PID alarm output	1	—	—
8	rEF	Reference command loss detected	0	ErE	Speed mismatch or excessive speed deviation

Table 6.3 Display of Light Alarm Factor

(e.g.) Light alarm factors "RS-485 communications error (COM port2)," "RS-485 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 (refer to Table 3.9)	3				4				2				1			
	Hexadecimal LED monitor on keypad																

Note:With the 04．26 data being set to "1" (PTC (The inverter immediately trips with 0h4displayed)), if the PTC thermistor is activated, the inverter does not perform light alarm processing but stops its output, regardless of theassignment of bit 11 (PTC thermistor activated) by 04．82 (Light Alarm Selection 2).

■Light alarm [mL-ALM] (parameters01．20~01．24 and 01．27, data = 98)

This output signal comes ON when a light alarm happens.

04．86	For Manufacturer to use		↗	Factory default	0
	Setting Range	0~2			
04．87	For Manufacturer to use		↗	Factory default	25.0
	Setting Range	25.0~500.0Hz		Unit	0.1Hz
04．88	For Manufacturer to use		↗	Factory default	0
	Setting Range	0~3; 999			
04．89	For Manufacturer to use		↗	Factory default	0
04．90	For Manufacturer to use		↗	Factory default	0
	Setting Range	0,1			

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.

04．91	PID Feedback Wire Break Detection		↗	Factory default	0
	Setting Range	0.0(Invalid alarm detection)；0.1~60.0s		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 2 mA as a wire break.)

04．92	Continuity of Running (P) (refer to 00．14)		↗	Factory default	999
	Setting Range	0.000~10.000 times；999		Unit	0.001
04．93	Continuity of Running (I) (refer to 00．14)		↗	Factory default	999
	Setting Range	0.010~10.000s; 999		Unit	0.001s

04．94	Cumulative motor run time 1 (refer to 04．44)		Factory default	—
	Setting Range	0~9999 The cumulative run time can be modified or reset(resettable). (10 hours as a unit)	Unit	1

04．96	Stop key Priority/ Start Check function		Factory default	0
	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 STOP key can be selected.

■STOP Key Priority Function

Even t Even when run commands are entered from the digital input terminals or via the RS-485 communications link (link operation), pressing the STOP 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 PRG/RESET 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 RS-485 " or [mLOC] "Select local (keypad) operation".

04．97	Clear alarm data		Factory default	0
	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 STOP + ∧ keys is required.

04．98	Protection/Maintenance Function (Mode selection)(refer to 00．26 and 04．42)		Factory default	0051H
	Setting Range		Unit	1

Specifies whether to enable or disable automatic lowering of carrier frequency, input phase loss protection,output phase loss protection, DC fan lock detection, braking transistor error detection, and IP20/IP40 switching, in combination .

Note: Decreasing the carrier frequency may increase the motor noise and overheat.

When the PM motor is under vector control without speed sensor/with speed sensor, the carrier frequency may automatically decrease (disable)

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.

Braking transistor error detection (Bit 6) dbA (22kW or below) (bit 6)

Upon detection of a built-in braking transistor error, this feature stops the inverter and displays an alarm dba. Set data of this bit to "0" when the inverter does not use a braking transistor and there is no need of entering an alarm state.

Switch IP20/IP40 enclosure (Bit 7)

Mounting an IP40 option to inverters of 22kW or below enables them to conform to IP40. In such a case, It need to switch the enclosure grade which is suitable for IP40 for the protection coordination. 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	0
Bit 1	Detect input phase loss	Continue to run	Enter alarm processing	0：Continue to run
Bit 2	Detect input phase loss	Continue to run	Enter alarm processing	0：Continue to run
Bit 6	Detect braking transistor error	Continue to run	Enter alarm processing	1：Enter alarm processing

An example of conversion from binary to decimal (for the number configured by the factory default setting shown above)

Decimal ＝ Digit 7×2^7＋Digit 6×2^6＋Digit 5×2^5＋Digit 4×2^4＋Digit 3×2^3＋Digit 2×2^2＋Digit 1×2^1＋Digit 0×2^0

＝ Digit 7×128＋Digit 6×64＋Digit 5×32＋Digit 4×16＋Digit 3×8＋Digit 2×4＋Digit 1×2＋Digit 0×1

＝ 0×128＋1×64＋0×32＋1×16＋0×8＋0×4＋0×2＋1×1

＝ 64＋16＋1

＝ 81 (eg.:Factory default)

i.e. hexadecimal value is 51H.

05 Motor 2 Parameters (For PM motor),06 Motor 3 Parameters (For PM motor)

07 Motor 4 Parameters (For three-phase asynchronous motor)

The S5100 series inverter not only can switch the PM motor and three-phase asynchronous motor to run but also to switch the control parameter corresponding to the moment of inertia of the machinery when it is driving the PM motor.

The motor switching/parameter swithcing base on [mM2],[mM3], [mM4] should be determined by the Combination, priority.

Input terminal command：01．01~01．09			Switching	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	No	Motor 1 (Default)	ON	OFF	OFF	OFF
ON	—		Parameter Switching(ASR Constant Switching)	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 Swithchig(Three-phase asynchronous motor driving)	Motor 4 (07 group parameters valid)	OFF	OFF	OFF	ON

The tables describes no matter that the input terminal command is turned ON or OFF, when the control mode is “V/f control”, select the 4th motor(Three-phase aynchronous motor)

Note: The parameter switching is enabled even the inverter is running, but the motor switching from PM motor driving to three-phase asynchronous motor driving is enabled only when the inverter is stopped. At this time, from the point of view of signal timing, a combination of [mM4] must be determined at least 2 ms before the signal of a run command is established.

Tips: When the parameter 01. 90=4, no matter that input terminal command [mM2]~[mM4] is turned ON or OFF, the V/f control of induction is valid(Norally, [mM4] is equatl to O). Parameter (01．90)

05．43	Speed control 2 speed command filter		Factory default	0.020
06．43	Speed control 3 speed command filter		Factory default	0.020
	Setting Range	0.000~5.000s	Unit	0.001s
05．44	Speed control 2 speed detection filter		Factory default	0.005
06．44	Speed control 3 speed detection filter		Factory default	0.005
	Setting Range	0.000~0.100s	Unit	0.001s
05．45	Speed control 2 P item (gain)		Factory default	10.0
06．45	Speed control 3 P item (gain)		Factory default	10.0
	Setting Range	0.1~200.0 times	Unit	0.1
05．46	Speed control 2 I item (integral time)		Factory default	0.100
06．46	Speed control 3 I item (integral time)		Factory default	0.100
	Setting Range	0.001~9.999s	Unit	0.001s

05．48	Speed control 2 output filter		Factory default	0.000
06．48	Speed control 3 output filter		Factory default	0.000
	Setting Range	0.000~0.100s	Unit	0.001s
	Related parameters	09．25 Automatic speed regulator switching time		

When the inverter is driving the PM motor, it can run after swithching the PI constant of the speed control system. Please use the machinery whose moment of inertia of the load is changeable.

Table 6.4 Parameter Switching

Name	Parameter		
	1st Motor	2nd Motor	3rd Motor
Speed control (speed command filter)	09．01	05．43	06．43
Speed control (speed detection filter)	09．02	05．44	06．44
Speed control P item (gain)	09．03	05．45	06．45
Speed control I item (integral time)	09．04	05．46	06．46
Speed control output filter	09．06	05．48	06．48

■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 able 6.4 can be switched.

Switching these parameters during operation may cause an abruptchange 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)

07．01	Maximum output frequency 4 (refer to 00．03)		Factory default	50.0
	Setting Range	25.0~500.0Hz	Unit	0.1Hz

07．02	Base frequency 4		Factory default	50.0
	Setting Range	25.0~500.0Hz	Unit	0.1Hz
07．03	Rated Voltage at Base Frequency 4		Factory default	380
	Setting Range	0: AVR invalid (Output a voltage in proportion to input voltage) 160 ~ 500V: AVR action (440V series)	Unit	1V
07．04	Maximum output voltage 4		Factory default	380
	Setting Range	160~500V ： AVR action (440V series)	Unit	1V
	Related parameters	04．50 Non-linear V/f Pattern 1 (Frequency)； 04．51 Non-linear V/f Pattern 1 (Voltage)； 04．52 Non-linear V/f Pattern 2 (Frequency) 04．53 Non-linear V/f Pattern 2 (Voltage)； 04．65 Non-linear V/f Pattern 3 (Frequency)； 04．66 Non-linear V/f Pattern 3 (Voltage)；		

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 codes 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 07．04 (Maximum Output Voltage 4) 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	07．01	07．04	The setting of the maximum output voltage is disabled when the auto torque boost is selected.
Base frequency	07．02	07．03	
Non-linear V/f 3	04．65	04．66	It is invalid when the auto torque boost is selected.
Non-linear V/f 2	04．52	04．53	
Non-linear V/f 1	04．50	04．51	

■Specify the parameter 07. 02, 07. 03 accroding to the motor's rated frequency and voltage (rated voltage printed on the nameplate labeled on the motor)

·When the data is set as "0", base frequency voltage is equal to the inverter input voltage and the inverter automatically keeps the output voltage constant in line with the setting.

·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.

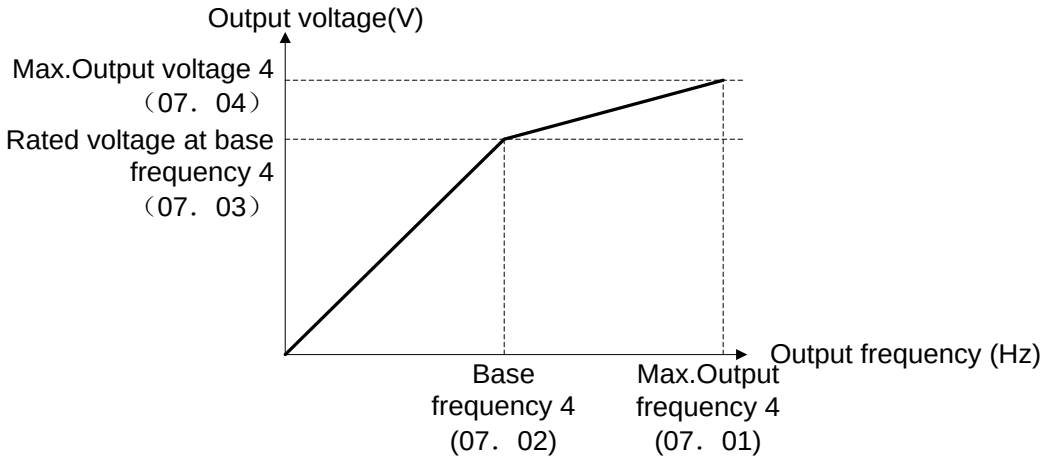
Note: The voltage the inverter can output is at the same level as the inverter input voltage. Configure these voltages correctly in accordance with the motor specifications.

■ Parameter 07．04 set the voltage for the maximum frequency 1 (00．03).

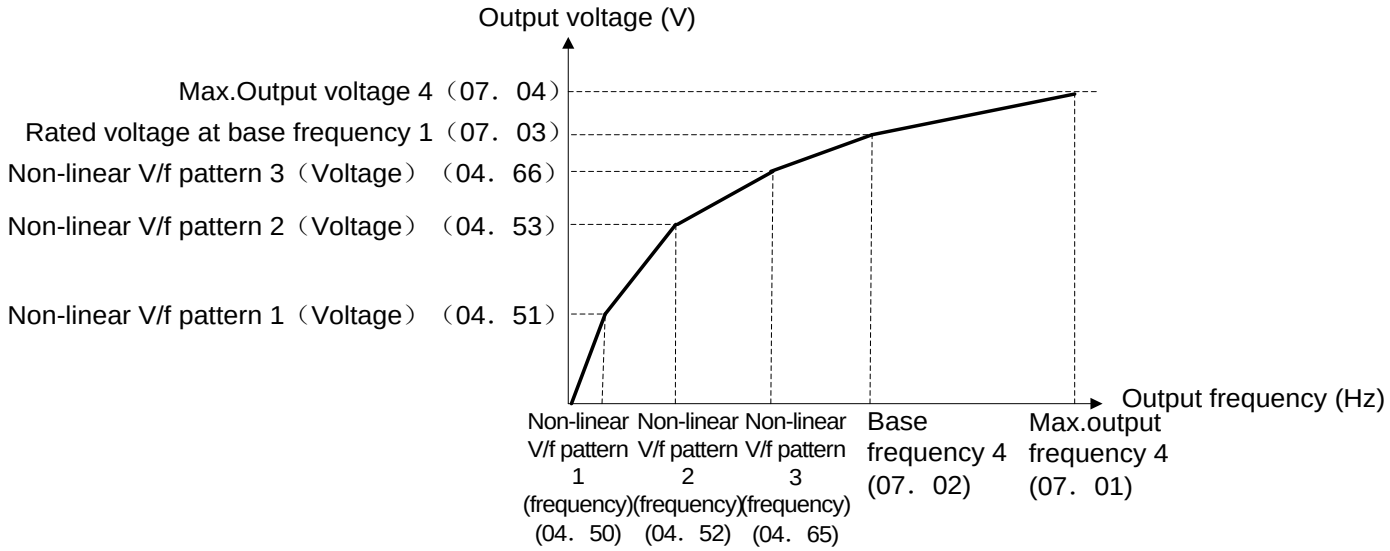
Note: If Rated Voltage at Base Frequency 4(07．03) is set to "0," settings of 04．50 through 04．53, 04．65, 04．66 and 07．04 do not take effect. (When the non-linear point is below the base frequency, the linear V/f pattern applies; when it is above, the output voltage is kept constant.)

<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 (440V series)

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

Note: 04．50、04．51 of the default values may vary according to the inverter power. See the following table.

Voltage	440V series	
Power	~30kW	37kW~
04．50	0.0	5.0 (Hz)
04．51	0	38 (V)

07．05	Torque boost 4 (refer to 07．13)	↗	Factory default	Type Setting
	Setting Range	0.0~20.0%(percentage with respect to rated voltage at base frequency 4)	Unit	0.1%

07．06	Electronic Thermal Overload (Protection for Motor) 4 Select motor characteristics (refer to 00．10~00．12)	↗	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,)		
07．07	Electronic Thermal Overload (Protection for Motor)4 Detection level (refer to 00．10~00．12)	↗	Factory default	Type Setting
	Setting Range	0.00 (invalid) ; 1% to 135% of the rated current of the motor	Unit	1%

07．08	Electronic Thermal Overload (Protection for Motor) 4 Thermal time constant (refer to 00．10~00．12)	↗	Factory default	Type Setting
	Setting Range	0.5~75.0min	Unit	0.1min

07．09	DC braking 4 starting frequency	↗	Factory default	0.0
	Setting Range	0.0~60.0Hz	Unit	0.1Hz

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

Note: When the three-phase asynchronous motor is under V/f control, specify the DC braking to be valid that prevents motor 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, durin g the braking time when the output frequency goes down to the DC braking starting frequency.

07．10	DC braking 4 braking level	↗	Factory default	0
	Setting Range	0~100%(HD model)，0~80%(ND model)	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 HD/ND and HD modes.

07．11	DC braking 4 braking time	↗	Factory default	0.00
	Setting Range	0.00(invalid); 0.01~30.00s	Unit	0.01s

Specifies the braking period that activates DC braking. Setting the braking time to "0.0" disables the DC braking.

⚠ CAUTION
The DC brake function of the inverter does not provide any holding mechanism. Injury Danger

07．12	Starting frequency 4 (refer to 00．23)	↗	Factory default	0.5
	Setting Range	0.0~60.0Hz	Unit	0.1Hz

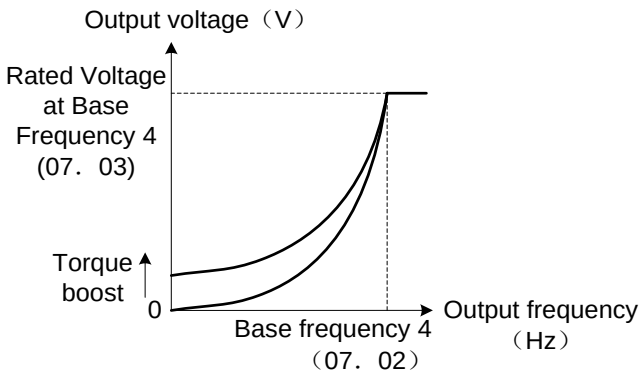
07．13	Load Selection / Auto Torque Boost / Auto Energy Saving Operation 4		Factory default	1
	Setting Range	0:Variable torque load (general fan and pump load)		
		1:constant torque load		
		2:Auto torque boost		
		3:Auto energy saving operation (general fan and pump load)		
		4:Auto energy saving operation (constant torque load)		
		5:Auto energy saving operation (automatic torque boost)		
	Related parameters	07．05 Torque boost 4		

07．13 Setting Value	V/f characteristics	Torque boots	Automatic energy saving	Applicable load
0	Variable torque V/f pattern	Manual torque boost 07．05	Invalid	Variable torque load (General-purpose fans and pumps)
1	Linear V/f pattern			Constant torque load
2		Automatic torque boost		Constant torque load (To be selected if a motor may be over-excited at no load.)
3	Variable torque V/f pattern	Manual torque boost 07．05	valid	Variable torque load (General-purpose fans and pumps)
4	Linear V/f pattern			Constant torque load
5		Automatic torque boost		Constant torque load (To be selected if a motor may be over-excited at no load.)

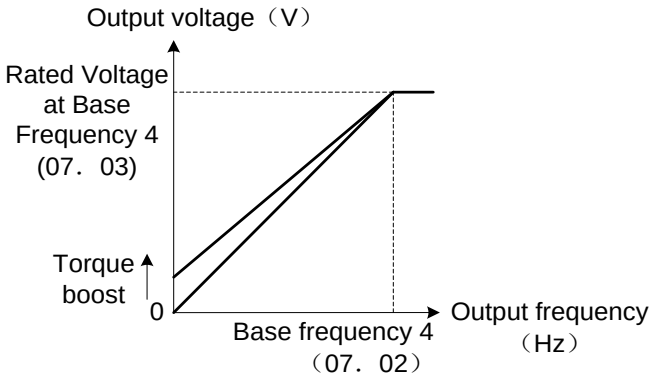
Note: If a required"load torque + acceleration toque" is more than 50% of the constant torque, it is recommended to select the linear V/f pattern (factory default).

■ 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 (07．13 = 0)



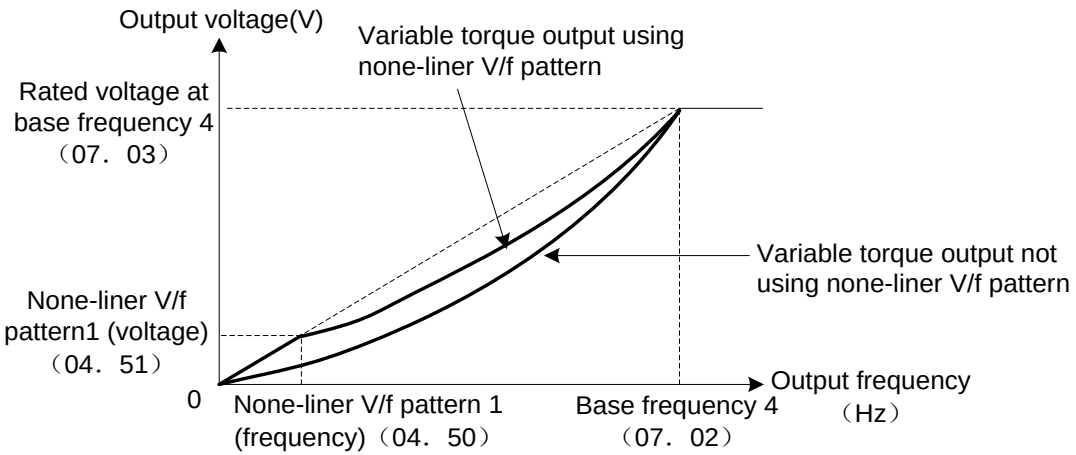
Linear V/f pattern (07．13 = 1)

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

Additonally, under V/f patterns, the bit 2 of the paratmeter 07. 98 should be set to “1”.(parameter 07．98)



■ Torque boost

• Torque boost based on 07．05 (manual adjustment) Data setting range 0.0~20.0%(100%/ reference frequency voltage)

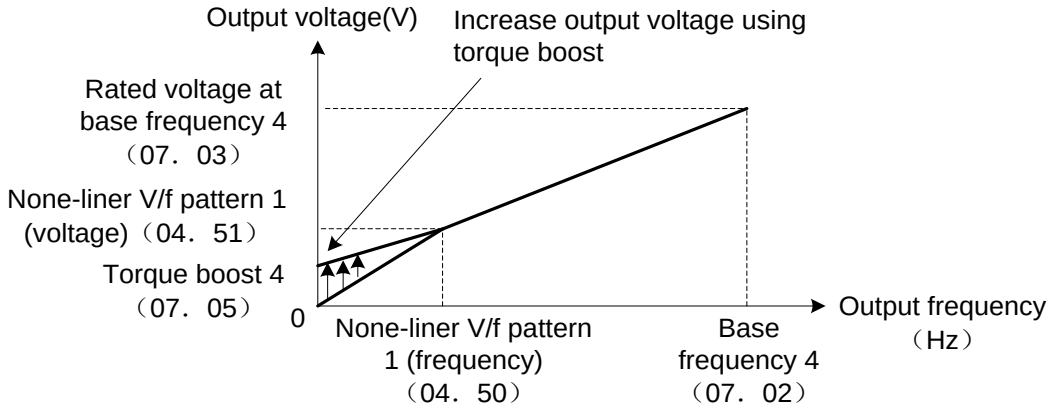
In torque boost using 07．05, constant voltage is added to the basic V/f pattern, regardless of the load. To secure a sufficient starting torque, manually adjust the output voltage to optimally match the motor and its load. Specify an appropriate level that guarantees smooth start-up and yet does not cause over-excitation at no or light load.

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

Specify the parameter 07．05 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 ofthe motor, set the base frequency 1(00．04), the rated voltage at base frequency 1 (00．05), and other pertinent motor parameters (03．01~03．03and 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 07．05 (07．13＝0 or 1).

07．14	Drive Control mode selection 4		Factory default	0
	Setting Range	0：Common V / f control with slip compensation inactive (Fixed setting vaule)		

Drive Control of motor Selection.

For details, see Chapter 4 "Running Item 3 Selection for a desired Motor drived Control" .

07．15	Motor 4 (No. of poles)		Factory default	4
	Setting Range	2~22 poles		

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.

Motor speed (r/min) ＝ 120／ number of poles × frequency (Hz)

For series S5100 drive inverter, it enables to switch and drive control PM motor and induction motor via motor swithching.

It enables to use the induction V/f control when drving the induction motor. Addtionally, to use the integrated automatic control functions such as auto torque boost, torque calculation monitoring, auto-energy saving operation, torque limiter, automatic deceleration (anti-regenerative control), auto search for idling motor speed, slip compensation, torque vector control, droop control, and overload stop, it is necessary to build a motor model in the inverter by specifying proper motor parameters, not only the motor capacity and rated current, but also correct setting of each motor parameters.

Pls refer to Chapter 4, Section 4.1 "Test Run” for the setting.

For series 5100 drive inverter to drive three-phase asynchronous motor, there is no need to set the motor’s constant. In any of the following cases when cabling between the motor and the inverter is long. (Generally, 20 m longer) or a reactor is inserted between the motor and the inverter, please perform auto-tuning since the motor parameters are different from those of standard motors.

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

To specify the three-phase motor parameters correctly, select the motor type by motor 4 selection(07．39) and specify the motor rated capacity with(07．16) and then initialize the motor 4 parameters with (04．03=5),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.

Pleaase refer to parameter 04. 03 for initialized parameter of the motor 4 parameters.

07．16	Motor 4 rated capacity		Factory default	Type Setting
	Setting Range	0.01~1000kW	Unit	0.01kW
07．17	Motor 4 rated current		Factory default	Type Setting
	Setting Range	0.00~2000A	Unit	0.01A

Specifies the rated capacity and current of the motor and enter the rated value given on the nameplate of the motor.

07．18	Motor 4 auto-tuning		Factory default	0
	Setting Range	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)		

Automatically check the motor parameters and save as the parameters for the three-phase asynchronous motor.

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

07．20	Motor 4 no-load current			Factory default	Type Setting
	Setting Range	0.00~2000A		Unit	0.01A
07．21	Motor 4 %R1		↗	Factory default	Type Setting
07．22	Motor 4 %X		↗	Factory default	
	Setting Range	0.00~50.00%		Unit	0.01%
07．26	Motor 4 rated slip frequency			Factory default	Type Setting
	Setting Range	0.00~15.00Hz		Unit	0.01Hz

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.

$$\%R1 = \frac{R1+\text{Cable X}}{V/(\sqrt{3} \times I)} \times 100\ (\%)$$

R1 ： Primary resistance of motor (Ω)

Cable R1: Resistance of the output cable (Ω)

V ： Rated voltage of motor (V)

I ： Rated current of motor (A)

- %X：Enter the value calculated by the following expression.

$$\%X = \frac{\dfrac{XM}{X1+X2+(X2+XM)} + \text{Cable X}}{V/(\sqrt{3} \times I)} \times 100\ (\%)$$

X1 ： Primary leakage reactance of motor (Ω)

X2 ： Secondary leakage reactance of motor (converted to primary) (Ω)

XM ： Excitation reactance (Ω) of motor

Cable X: Reactor of the cable between the inverter and the motor.

- 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).

$$\text{Rated slip frequency (Hz)} = \frac{\text{Synchronous speed- Rated speed}}{\text{Synchronous speed}} \times \text{Base frequency}$$

Note:For reactance, use the value at the base frequency（07．02）.

07．27	Motor 4 iron loss factor 1		↗	Factory default	Type Setting
07．28	Motor 4 iron loss factor 2		↗	Factory default	0.00
07．29	Motor 4 iron loss factor 3		↗	Factory default	0.00
	Setting Range	0.00~20.00%		Unit	0.01%

07．30	Motor 4 magnetic saturation factor 1		↗	Factory default	Type Setting
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		↗		
	Setting Range	0.0~300.0%		Unit	0.1%

Basically, there is no need to specify arbitrary rate for the motor parameters 07．27~07．37(Iron loss, magnetic saturation characteristics)

07．60	Motor 4 speed display coefficient (refer to 01．50)		↗	Factory default	30.00
	Setting Range	0.01~200.00		Unit	0.01

07．98	Motor 4 Function Selection		Factory default	00FF

When the three-phase motor is under V/f control, enable to select valid/invalid function according to the requirement.

When the function is selected as valid, it requires to specify arbitrary rate for each function parameters.

07．98 Bit	Object function		Related parameters
Bit 0	Current limiter	(0：Invalid，1：valid)	00．43, 00．44
Bit 1	operation direction	(0：Invalid，1：valid)	04．08
Bit 2	Non-linear V/f pattern	(0：Invalid，1：valid)	04．50~04．53, 04．65, 04．66
Bit 3	PID control	(0：Invalid，1：valid)	08．01~08．62, 04．91
Bit 4 After	(Being not in use)		—

Specify the entering in hexadecimal.

The 1st bit of the hexadecimal corresponds to the 4th bit of the binary as below:

LED No.		LED4				LED3				LED2				LED1			
Bit		15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Display Example	Binary System	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1
	LED monitor In hexadecimal	0				0				F				F			

08 Application Function 1 Parameters

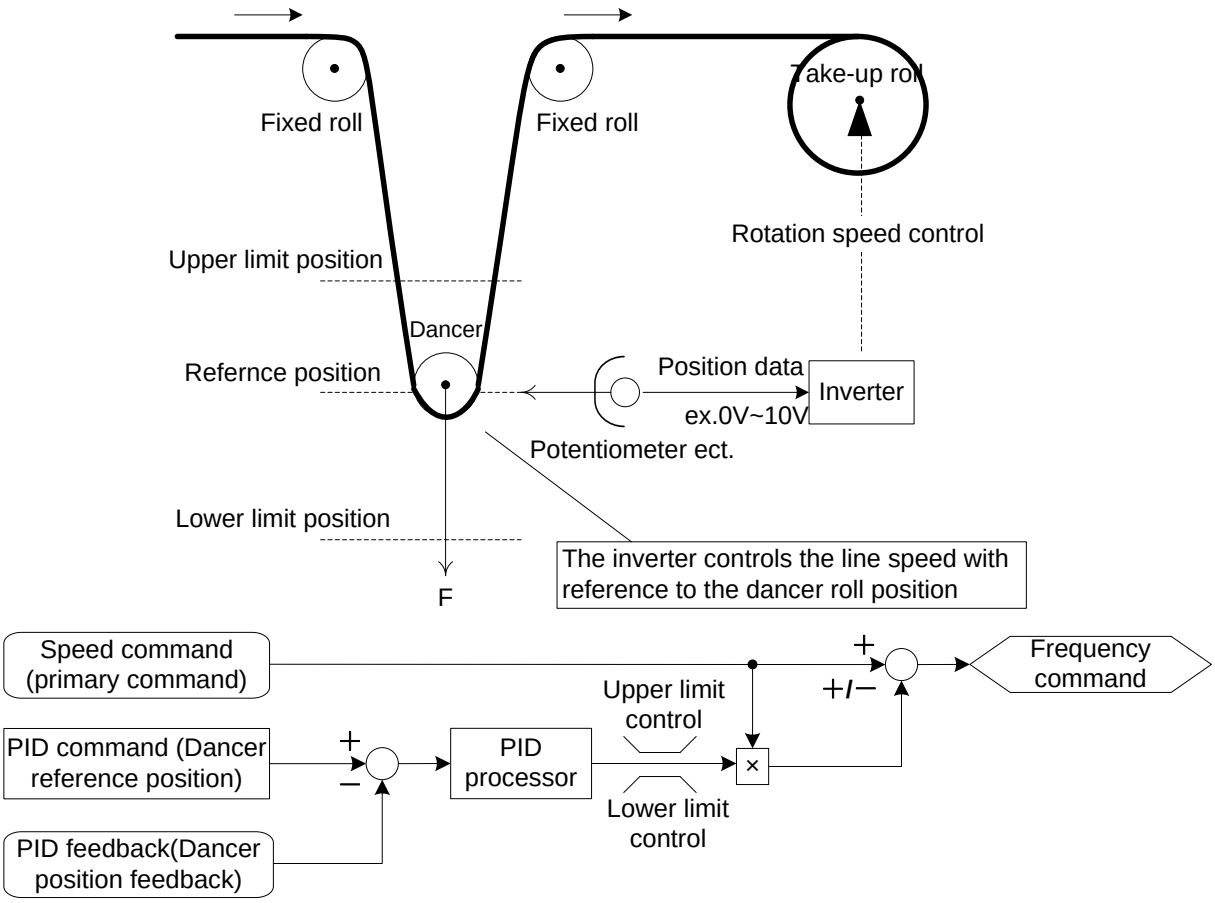
08．01	PID control action		Factory default	0
	Setting Range	0:Invalid		
		1:PID output is normal characteristics, Process control		
		2:PID output is inverse characteristics, Process control		
		3:Speed control (Dancer control)		

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)

08．02	PID control command	Factory default	0

Select the mode to set the command values for PID control.

08．02 Setting value	Functions
0	Specify the PID command using the ⌃ / ⌄ 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 01．4and01．41) 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 ⌃ / ⌄ keys on the keypad (08．02＝0(factory default))

Using the ⌃ / ⌄ keys on the keypad in conjunction with PID display coefficients (specified by 01．40 and01．41), you can specify 0 to 100% of the PID process command (±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	Compen sation
		Bias	Base point	Gain	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	—	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)

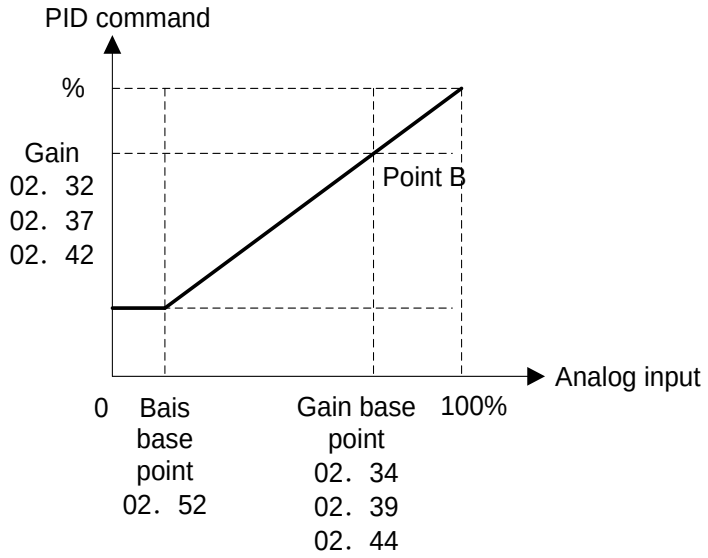
Provide the filter time constants for the voltage and current of the analog input. Choose appropriate values for the time constants considering the response speed of the machinery system, as large time constants slow down the response. If the input voltage fluctuates because of noise, specify large time constants.

■ Polarity Selection (02．35,02．45)

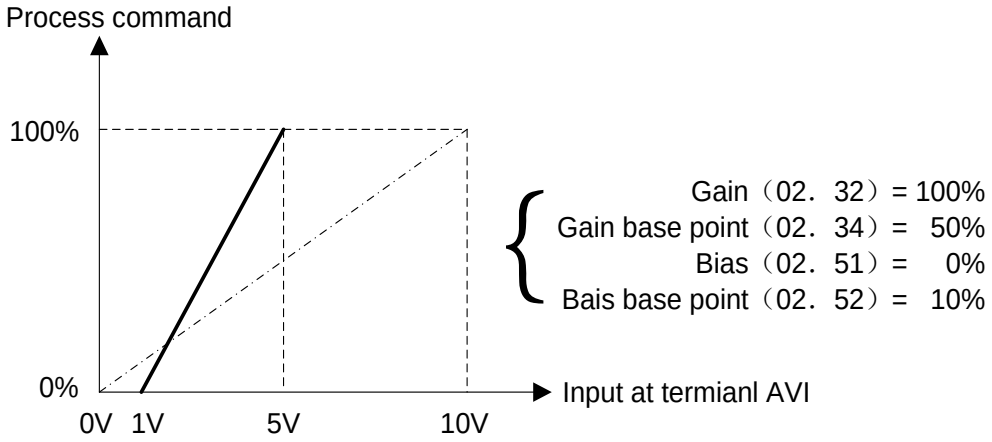
Specifies the input range for analog input voltage.

02．35,02．45 Setting value	Terminal input specifications
0	–10~+10V
1	0~+10V (negative value of voltage is regarded as 0 V)

■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＝18	
OFF	OFF	Retain PID command value.
ON	OFF	Increase PID command value at a rate between 0.1%/0.1 s and 1%/0.1 s
OFF	ON	Decrease PID command value at a rate between 0.1%/0.1 s and 1%/0.1 s.
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.

$$\text{PID command data(\%)} = \frac{\text{Preset multi-frequency}}{\text{Max. output freqency}} \times 100$$

·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.

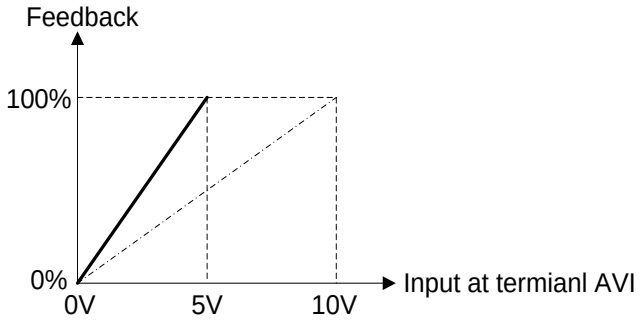
For details, refer to parameters 01．61,01．62,01．63 .

<Application example: Process Control> main application: Air conditioning equipment, fan, pump.

Action range of the PID process control is 0~100% internal control. As the feedback encoder, the control range is determined by the gain setting.

(Example) In cases that the output of external sensor is 1~5V output:

- connection terminal is voltage input, so please use terminal AVI.
- Since the max external sensor is set to be 100%(5v), so set the gain(02．32) to be 200%. When the voltage input is 0~10V, the input specification of the terminal AVI is 0/`100% and set to be 200% by the proportion of 10V/5V. (In the feedback, the bias setting is invalid)

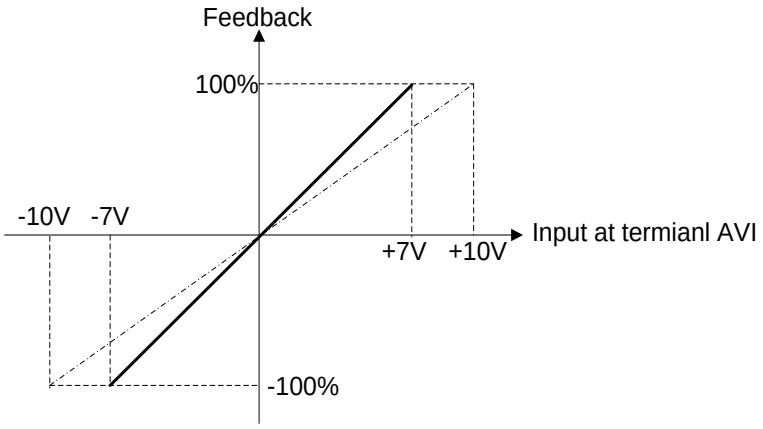


<Application example: Dancer Control> main application: Coiling machine.

(Example 1) In cases that the output of external sensor is ±7V:

- Voltage input is two poles, so please use terminal AVI.
- When input voltage is positive and negative poles, the output of the external sensor is controlled within the range of ±100%.

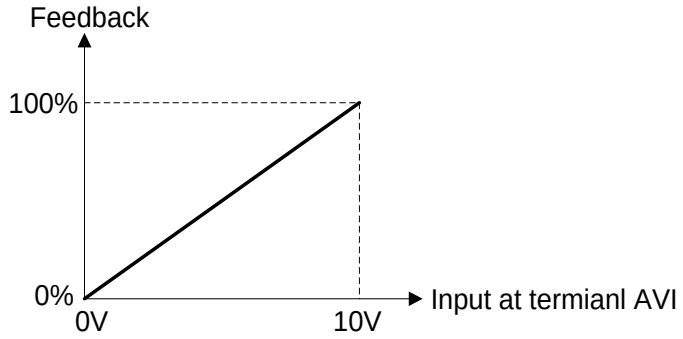
Since the ±7V of the external sensor is set to be ±100%, so the gain is set as below (02．32) $\frac{10V}{7V}$ ≈143%



(Example 2) In case that the output of external sensor is 0~10V,

· Since it is voltage input, AVI terminal is required.

·The output of the external sensor is controlled within the range of 0~100% when voltage input is monopole.



In this case, setting the basic postion of dancer roller to be 5V (50%) is recommended.

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.

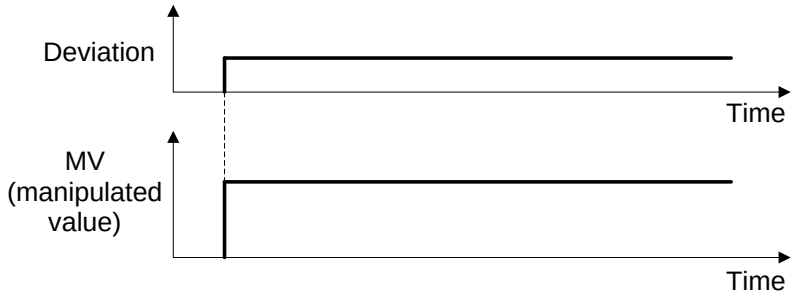
08．03	PID control P item (gain)		↗	Factory default	0.100
	Setting Range	0.000~30.000 times		Unit	0.001

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.



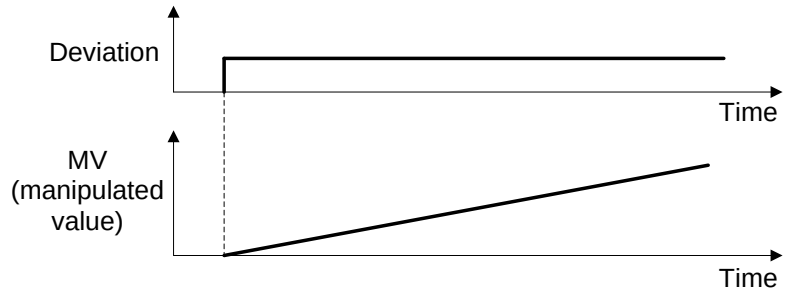
08．04	PID control I item (integral time)		↗	Factory default	0.0
	Setting Range	0.0~3600.0s (0.0 means integral term is invalid)		Unit	0.1s

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 is08．04 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.



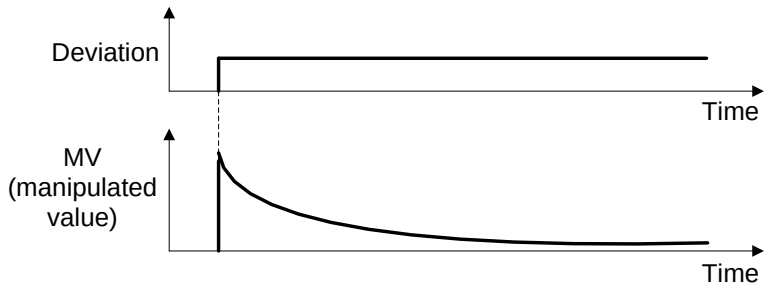
08．05	PID control item D (differential time)		↗	Factory default	0.00
	Setting Range	0.00~600.00s (0.0 means differential term is invalid)		Unit	0.01s

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 weakens 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.·

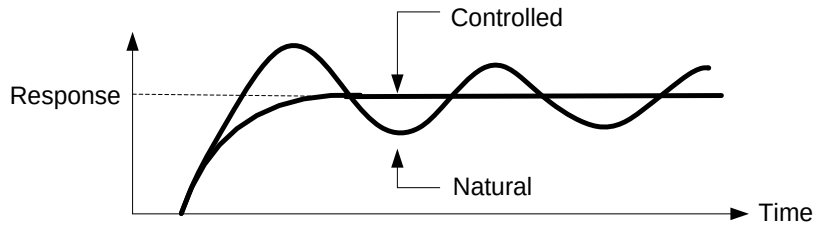
· Decrease the data of 08．04 (PID control I (Integral time)) within the range where the feedback signal does not oscillate.

· 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.

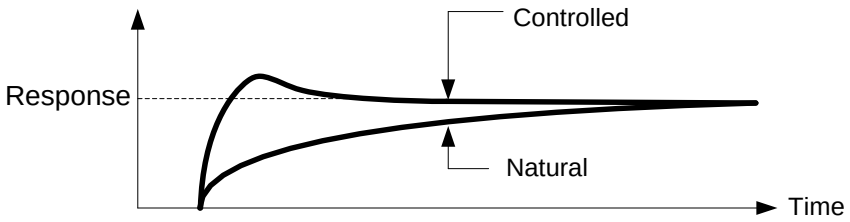
1) Suppressing overshoot

Increase the data of 08．04 (Integral time) and decrease that of 08．05 (Differential time.)



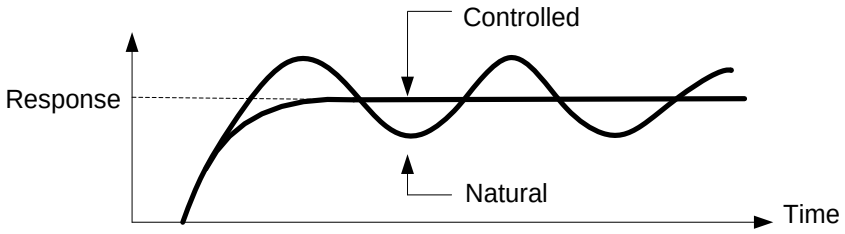
2) Quick stabilizing (moderate overshoot allowable)

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 ,

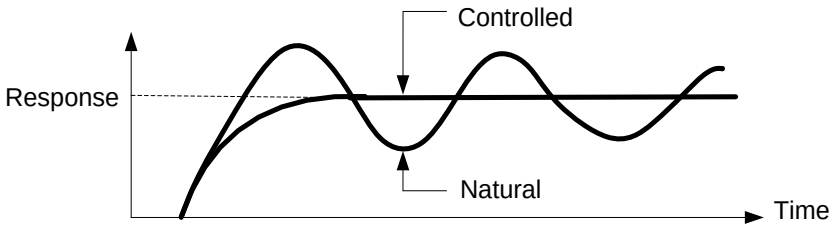
Increase the data of 08．04 (Integral time).



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 0 s.



08．06	PID control feedback signal filter		Factory default	0.5
	Setting Range	0.0~900.0s	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).

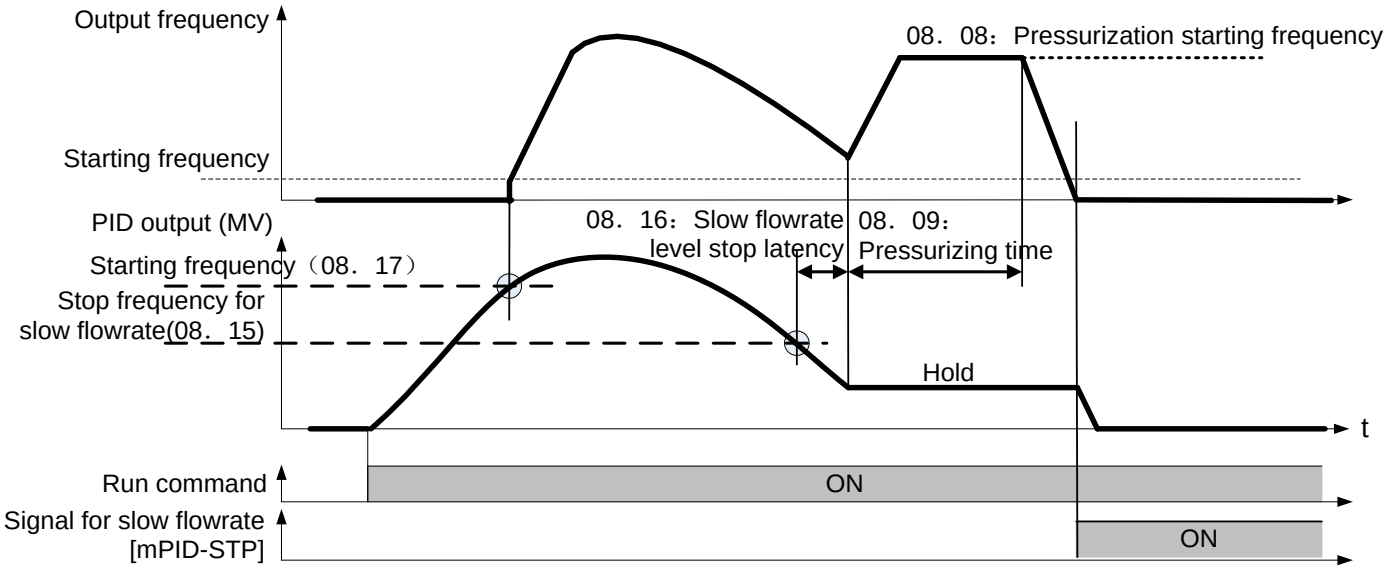
08．08	PID control:Pressurization starting frequency		Factory default	0.0
	Setting Range	0.0(Invalid),1.0~500.0(Hz)	Unit	0.1Hz
08．09	PID control Pressurizing time		Factory default	0
	Setting Range	0~60s	Unit	1s
	Related parameters	08．15(Control Stop frequency for slow flowrate) 08．16(Control Slow flowrate 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.

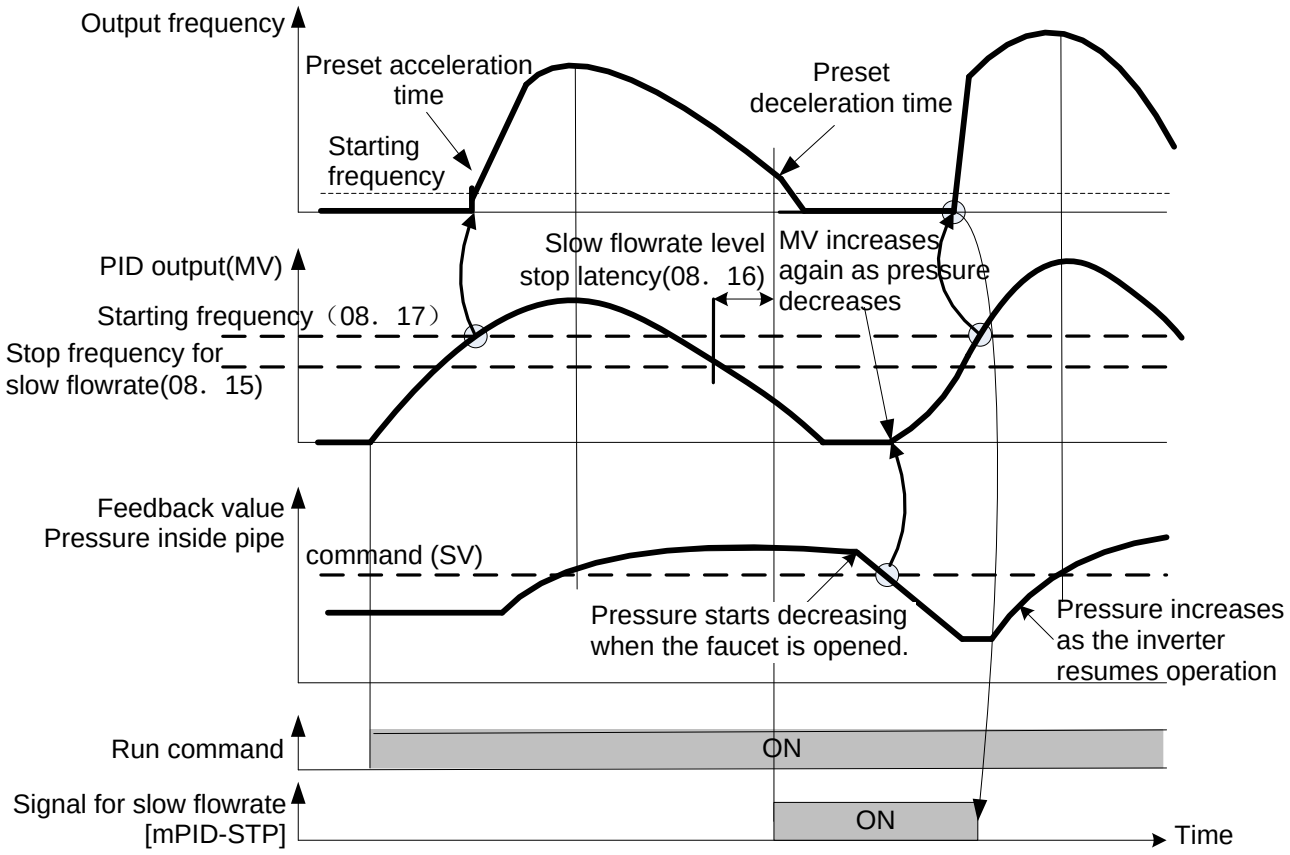
■PID control (Starting frequency) (08．17) data setting range:0.0-500.0 (Hz)

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)

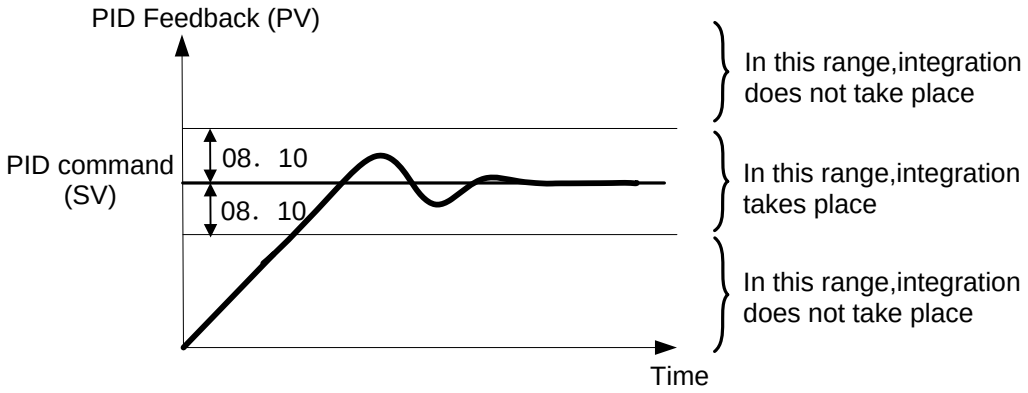
Assigning the digital output signal [mPID-STP] to any of the programmable, output terminals with any of 01．20 to 01．24 and 01.27 (data=44) enables the signal to output when the inverter stops due to the slow flowrate stopping function under PID control.

For the slow flowrate stopping function, see the chart below.



08．10	PID control anti- integral windup level		Factory default	200
	Setting Range	0~200%	Unit	1%

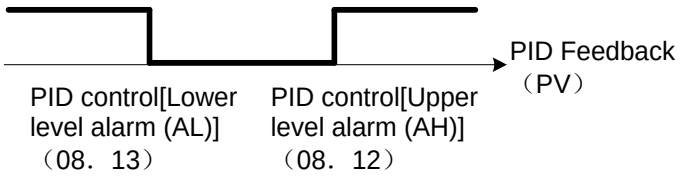
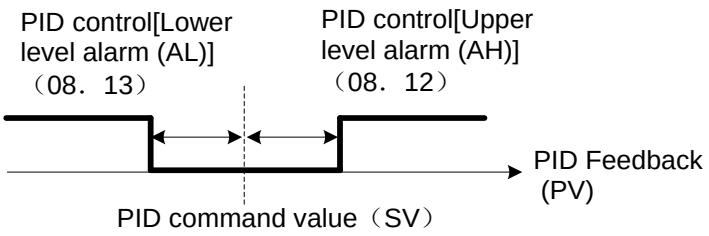
Suppresses overshoot in control with the PID processor. As long as the deviation between the feedback and the PID command is beyond the preset range, the integrator holds its value and does not perform integration operation.



08．11	PID control Select alarm output		Factory default	0

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	[mPID-ALM] is ON , When PV＜AL or AH＜PV 
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	[mPID-ALM] is ON, when PV＜SV-AL or SV+AH＜PV 
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 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.

08．12	PID control Upper level alarm (AH)		↗	Factory default	100
08．13	PID control Lower level alarm (AL)		↗	Factory default	0
	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 (10 V 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＋A	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	

08．15	PID control Stop frequency for slow flowrate (refer to 08．08)	↗	Factory default	0.0
	Setting Range: 0.0(Invalid)；1.0~500.0Hz		Unit	0.1Hz
08．16	PID control Slow flowrate level stop latency (refer to 08．08)	↗	Factory default	30
	Setting Range: 0~60s		Unit	1s
08．17	PID control starting frequency (refer to 08．08)	↗	Factory default	0.0
	Setting Range: 0.0~500.0Hz		Unit	0.1 Hz

08．18	PID control:Upper limit of PID process output	↗	Factory default	999
08．19	PID control:Lower limit of PID process output	↗	Factory default	999
	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)

08．56	PID control speed command filter	↗	Factory default	0.10
	Setting Range: 0.00~5.00s		Unit	0.01s

08．57	PID control Dancer reference position	↗	Factory default	0
	Setting Range: –100~0~100%		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 ⌃/⌄ keys. If it is modified, the new command value is saved as 08．57 data.

08．58	PID control Detection width of dancer position deviation		↗	Factory default	0
	Setting Range	0：invalid PID constant switching		Unit	1%
		1~100%：Manual set value			

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 ±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.

08．59	PID control P item (gain) 2 (refer to 08．03~08．05)		↗	Factory default	0.100
	Setting Range	0.000~30.000 times		Unit	0.001
08．60	PID control I item (integral time) 2 (refer to 08．03~08．05)		↗	Factory default	0.00
	Setting Range	0.0~3600.0s		Unit	0.1s
08．61	PID control item D (differential time) 2 (refer to 08．03~08．05)		↗	Factory default	0.00
	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.

08．62	PID control block selection	Factory default	0
	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	Ratio (%)	Addition
1	0	1	Ratio (%)	Subtraction
2	1	0	Absolute value (Hz)	Addition
3	1	1	Absolute value (Hz)	Subtraction

08．68	Brake signal Brake-OFF current		↗	Factory default	100
	Setting Range	0~300%		Unit	1%
08．70	Brake signal Brake-OFF timer		↗	Factory default	1.0
	Setting Range	0.0~5.0s		Unit	0.1s

08．71	Brake signal Brake-ON frequency/speed		↗	Factory default	1.0
	Setting Range	0.0~25.0Hz		Unit	0.1Hz
08．72	Brake signal Brake-ON timer		↗	Factory default	1.0
	Setting Range	0.0~5.0s		Unit	0.1s
08．95	Brake signal Brake-OFF torque		↗	Factory default	100
	Setting Range	0~300%		Unit	1%
08．96	Brake signal Speed condition selection		↗	Factory default	0
	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.

Note: When the motor is under vector control without speed sensor or the three-phase motor asynchronous motor is under V/f control, this function is disabled.

■Brake signal [mBRKS] (parameter 01.20~01.24, 01.27 Data =57)

When all of the following conditions are met, the inverter judges that the motor-generating torque is sufficient and turns the signal [mBRKS] for releasing the brake.

- The 1st motor selection (turn signal [mM4] OFF)
- When any of the inverter output current, output frequency(Reference value/detected value), reference torque exceed the specified level of the brake signal (08．68/08．95).
- Turn magnetic pole postion detection signal [mPTD] to be ON
- When any of the inverter outputcurrent, output frequency(Reference value/detected value), 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)).

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.
08．70	Brake-OFF timer	0.0~5.0s	
08．95	Brake-OFF torque	0~300%	Available only under vector control.

Note:The inverter rated current differs depending upon the drive mode selected (ND or HD).

Turning the Brake ON

When all of the following conditions are met, the inverter judges that the motor rotation is below a certain level and turns the signal [mBRKS] OFF for activating the brake.

- The 1st ~3rd motor(PM motor) selection (turn signal [mM4] OFF)
- (When 08．96 bit 3 = 0)From the time when the inverter starts operation, after that the output frequency(reference value/detected value) exceeds stopping frequency(00．25)+ frequency detection leve(01．30), the output frequency (reference value/detected value) is under the specified level of the stopping frequency(00．25).
- (When 08．96 bit 3 = 1)the output frequency (reference value/detected value) is under the specified level of the brake signal (08．71).
- (When 08．96 bit 4 = 1)the inverter operation command turns OFF.
- When all of the above conditions are met and any of the inverter output frequency(reference value/detected value) exceeds the period specified by 08．72(Brake signal(Brake-ON timer))

It can reduce the burden of the brake in running, and be valid to extend the effective life of the brake.

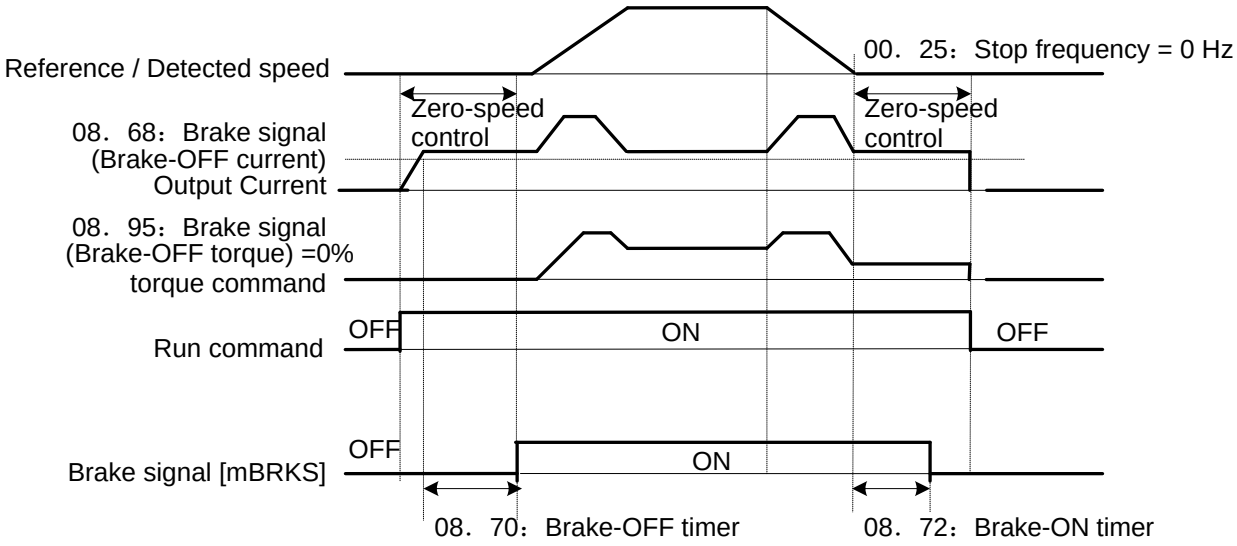
Additionally, even when any one of the following conditions is met, the inverter also judges it is abnormal state and truns the signal [mBRKS] OFF.

- No inverter output
- Under torque control
- Turn magnetic pole postion detection signal[mPTD] to be OFF
- The 4th motor (three-phase asynchronous motor) selection(Turn signal[mM4])

Parameter	Name	Setting Range	Remark
08．71	Brake-ON frequency/speed	0.0~25.0Hz	
08．72	Brake-ON timer	0.0~5.0s	
08．96	Speed condition selection	0-31	According to below bit combination and set the value in decimal.
		Criteria of speed condition for brake-ON (Bit 0) 0:Detected speed 1:Reference speed	Select criteria of speed condition for brake-ON
		Response for brake-OFF current (Bit 2) 0：Slow response 1：Quick response	Select response speed for brake-OFF current
		Criteria of frequency for brake-ON (Bit 3) 0:Stop frequency (00．25) 1:Brake-ON frequency (08．71)	Select criteria of frequency for brake-ON
		Turn-on condition of brake signal (Bit 4) 0:Independent of a run command ON/OFF 1:Only when a run command is OFF	Select if the run command OFF is included in turn-on condition of brake signal

Note: After that the inverter output is shut down via the output alarm or coast-to-stop command, the brake signal turns turn-on condition.

·Operation time chart

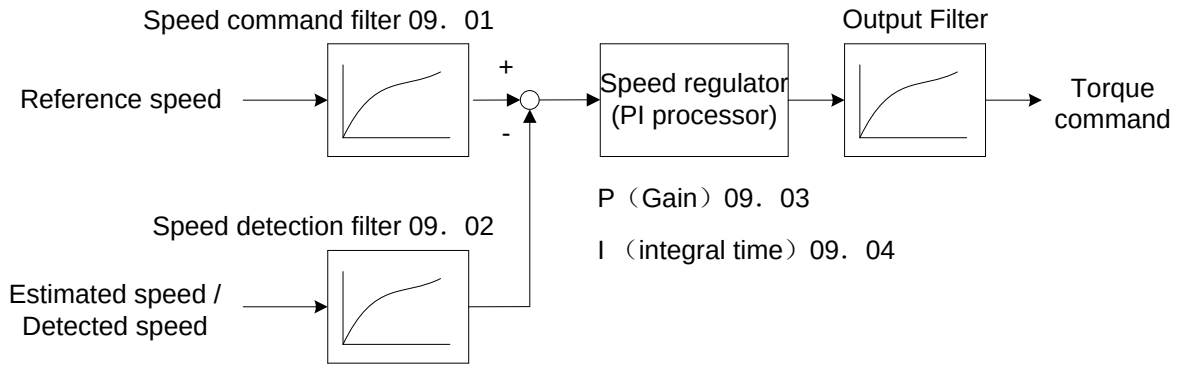


Note ·If the zero speed control is enabled, set 08．95 (Brake-OFF torque) at 0%.

·After releasing the brake ([mBRKS]ON), operating for a while, and then activating the brake ([mBRKS]OFF) to stop the motor, if you want to release the brake ([mBRKS]ON) , turn the inverter's run command OFF and then ON。

09 Application Function 2 Parameters

These function parameters control the speed control system 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.



Block diagram of the speed control sequence

09．01	Speed control 1 Speed command filter		Factory default	0.200
	Setting Range	0.000~5.000s	Unit	0.001s
	Related parameters	05．43 Speed control 2 speed command filter 05．44 Speed control 2 speed detection filter 05．45 Speed control 2 P item (gain) 05．46 Speed control 2 I item (integral time) 05．48 Speed control 2 output filter 06．43 Speed control 3 speed command filter 06．44 Speed control 3 speed detection filter 06．45 Speed control 3 P item (gain) 06．46 Speed control 3 I item (integral time) 06．48 Speed control 3 output filter		

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.

09．02	Speed control 1 Speed detection filter		Factory default	0.025
	Setting Range	0.000~0.100s	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.

09．03	Speed control 1 P item (gain)		⊙	Factory default	2.0
	Setting Range	0.1~200.0 times		Unit	0.1
09．04	Speed control 1 I item (integral time)		⊙	Factory default	0.600
	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.

09．06	Speed control 1 output signal filter		↗	Factory default	0.000
	Setting Range	0.000~0.100s		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.

09．09	Speed control (JOG) Speed command filter (refer to 09．01)		↗	Factory default	0.020
	Setting Range	0.000~5.000s		Unit	0.001s
09．10	Speed control (JOG) Speed detection filter (refer to 09．01)		⊙	Factory default	0.005
	Setting Range	0.000~0.100s		Unit	0.001s
09．11	Speed control (JOG) P item (gain) (refer to 09．01)		⊙	Factory default	10.0
	Setting Range	0.1~200.0 times		Unit	0.1
09．12	Speed control(JOG)I item (integral time) (refer to 09．01)		⊙	Factory default	0.100
	Setting Range	0.001~9.999s,999：Integral action is invalid		Unit	0.001s

09．13	Speed control (JOG) output filter (refer to 09．01)		Factory default	0.002
	Setting Range	0.000~0.100s	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.

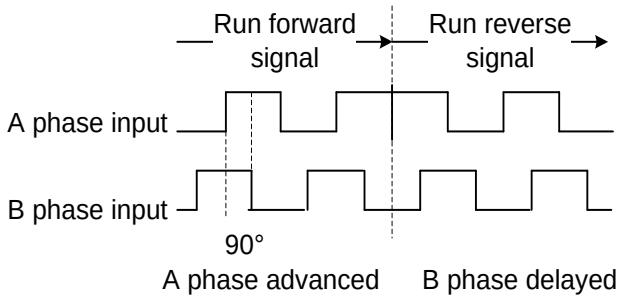
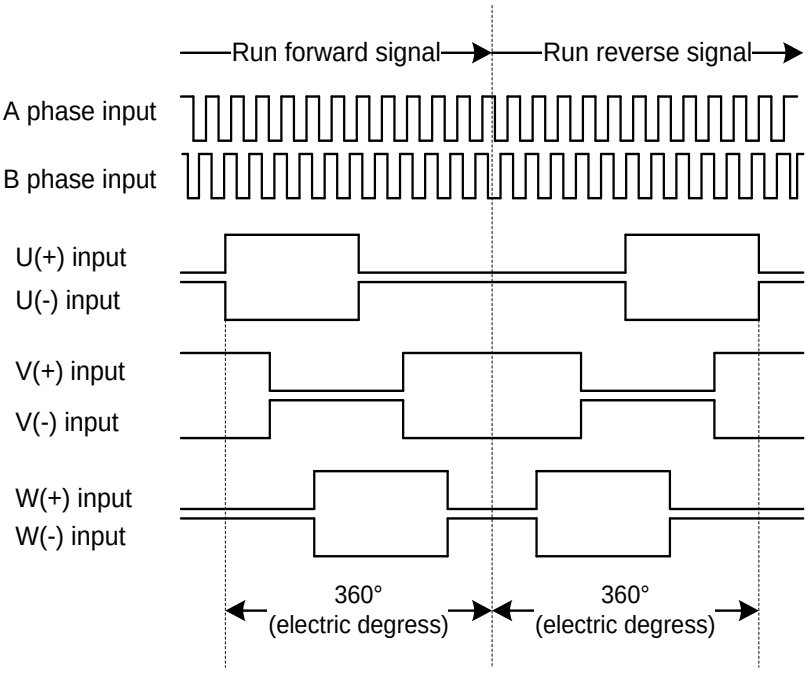
The block diagrams and function codes related to jogging operations are the same as for normal operations.

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.

09．14	Feedback Input (Pulse input format)	Factory default	2

Specify the speed feedback input under vector control with speed sensor.Select the signal waveform of the speed/magneti pole postion feedback input.

09．14 Setting value	Pulse input mode	Remark
2	A and B phases with 90 degree phase difference Z phase	
4	A and B phases with 90 degree phase difference ,UVW signal	

Note: When changing the setting of parameter 09．14, it requires to do a adjustment again for the magnetic pole postion sensor compensation (03．95). The inverter can adjust automatically via auto-tuning.

09．15	Feedback Input:Encoder pulse resolution		Factory default	0400H(1024)
	Setting Range	0014 ~ EA60 (hexadecimal)(20 to 60000 pulses)	Unit	1

Specifies the pulse resolution (P/R) of the speed feedback encoder.-When using the motor with speed sensor, please set “0400” (1024 P/R) .

Note: When PM motor is under vector control with speed sensor, please install the pulse encoder to the motor shaft or the shaft with equal rigidity. Sometimes, it can not perform correct control due to gap and flex.

09．21	Speed Agreement/PG Error (Hysteresis width and Detection timer)		↗	Factory default	10.0
	Setting Range	0.0~50.0%,Maximum speed／100%		Unit	0.1%
09．22	Speed Agreement/PG Error Detection timer (refer to 00．14)		↗	Factory default	0.50
	Setting Range	0.00~10.00s		Unit	0.01s
09．23	PG Error Processing (refer to 00．14)			Factory default	0
	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			

Specify the detection levels of the speed agreement signal [mDSAG] and PG Error detected signal [mPG-ERR]

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.

PG 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 PG error.

09．24	Zero speed control (refer to 00．23)		Factory default	0
	Setting Range	0：Zero speed control is invalid when it’s at startup		
		1：Zero speed control is valid when it’s at startup		

09．25	Automatic speed regulator switching time (refer to 05．42)		↗	Factory default	0.000
	Setting Range	0.000~1.000s		Unit	0.001s

09．32	Torque control speed limit 1 (refer to 04．18)		↗	Factory default	100
09．33	Torque control speed limit 2 (refer to 04．18)		↗	Factory default	100
	Setting Range	0~110%		Unit	1%

09．51	For Manufacturer to use		Factory default	Type Setting
09．54	For Manufacturer to use		Factory default	
	Setting Range	0~500	Unit	1
09．55	For Manufacturer to use		Factory default	0000
	Setting Range	0000~00FF(16 displayed in hex.)	Unit	1

Function Parameters 09．51~09．55 appear on the LED monitor, but they are reserved for particular manufacturers. Unless otherwise specified, do not access them.

09．59	Command (Pulse Rate Input) (refer to 00．01)		Factory default	0
	Setting Range	0：Pulse train sign/Pulse train input		
		1：Forward rotation pulse/Reverse rotation pulse		
		2：A/B phase with 90 degree phase shift		

09．61	Command filter time constant (refer to 00．01)	↗	Factory default	0.005
	Setting Range	0.000~5.000s	Unit	0.001s

09．62	Command pulse count factor 1 (refer to 00．01)	Factory default	1
09．63	Command pulse count factor 2(refer to 00．01)	Factory default	1
	Setting Range	1~9999	Unit	1

Synchronous operation could be realized using PG optional components.

09．80	Magnetic pole position auto search frequency	↗	Factory default	1.0
	Setting Range	0.1~10.0Hz	Unit	

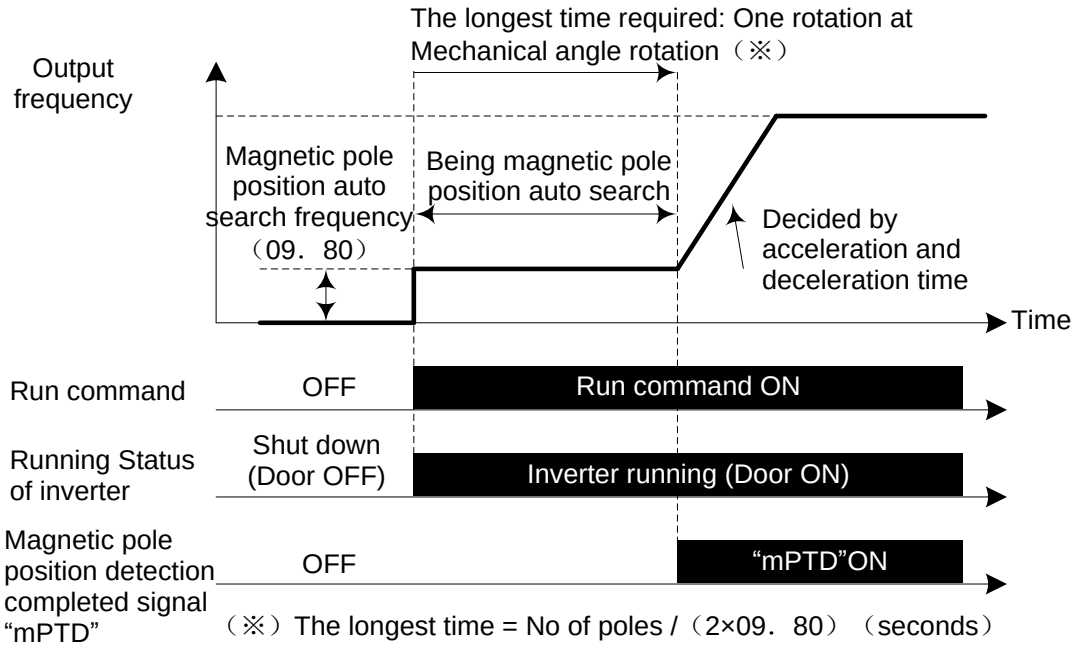
When starting the PM motor under vector control with speed sensor and magnetic pole position is unspecified, it need to auto search the magnetic pole position. Set the output frequency by parameter 09．80 when performing the magnetic pole position auto search.

(Note)Parameter 03．30 = 0 or 3 and 03．95 ≠ 999 ,09．14 = 2 (Generally, there is no need to modify the factory default of the parameter 03. 30)

Note: Performing magnetic pole position auto search can not generate sufficient starting torque. So it applies to the application software that needs torque when starting, use brake signal'BRKS' and magnetic pole position detection completed signal 'PTD', please do not release the brake until magnetic pole position auto search is completed. (Parameter 01．20)

Magnetic pole position auto search operation schemes

Operation schemes when the PM motor is under vector control with speed sensor and display with parameter 03．30 = 0 or 3, 03．95 ≠ 99, 09．14 = 2.



（※）The longest time = No of poles /（2×09．80）（seconds）

<09．80=1Hz（Factory default），State of 6 poles motor>
The longest time = 6/（2×1）=3（秒）

09．92	For Manufacturer to use		↗	Factory default	0.30
	Setting Range	0.00~10.00		Unit	

09．93	For Manufacturer to use		↗	Factory default	999
09．94	For Manufacturer to use		↗	Factory default	999
09．95	For Manufacturer to use		↗	Factory default	999
	Setting Range	0.00~10.00，999		Unit	
09．96	For Manufacturer to use		↗	Factory default	999
09．97	For Manufacturer to use		↗	Factory default	999
	Setting Range	-50.0~50.0，999		Unit	
09．98	For Manufacturer to use			Factory default	0000
	Setting Range	0000~FFFF(hexadecimal)		Unit	1

Function parameters 09．92~09．98 appear on the LED monitor, but they are reserved for particular manufacturers. Unless otherwise specified, do not access them.

11 Serial Communication Parameters

1. Communication Protocol

For S5100 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 Modubus 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 occured 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

S5100 series of frequency inverter can be accessed into the "Single-host, Multi-Subordinate " control network with RS 485 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 S5100 series frequency 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 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 S5100 series of frequency 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 subordinate s. 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.

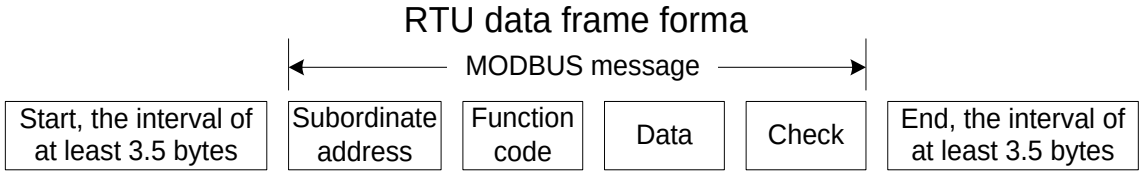
6. Communication Frame Structure

The data format of ModBus communication protocol for S5100 series of frequency inverter 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 zong 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_vaLue(unsigned char *data_vaLue,unsigned char data_length)
{
    int i;
    unsigned int crc_vaLue=0xffff;
    while(data_length--)
    {
            crc_vaLue^=*data_vaLue++;
        for(i=0;i<8;i++)
        {
            if(crc_vaLue&0x0001)
                crc_vaLue=(crc_vaLue>>1)^0xa001;
                                        else
                crc_vaLue=crc_vaLue>>1;
        }
       }
      return(crc_vaLue);
}
```

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 occusion 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 functions:

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	W/R
		BIT1：mREV reverse run	
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：mIL current limit	
		BIT9：mACC acceleration	
		BIT10：mDEC deceleration	
		BIT11：mALM alarm occurs	
		BIT12：mRL communicate valid (communication controls operation, set the frequency command)	
		BIT15：BUSY 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) (0.00~9999KW)note1	R

Function Description	Address Definition	Description	R / W Characteristics
	1007H	Output torque (-999~999%)	R
	100BH	PID set value (999~9990)	R
	100CH	PID feedback amount (999~9990)	R
	0F47H	Terminal input status (b0:FWD,b1:REV,b2:MI1,b3:MI2,b4:MI3,b5::MI4,b6:MI5,b7:MI6,b8:MI7,b9:MI8,b10:MI9)	R
	0F0FH	Terminal output status (b0:MO1,b1:MO2,b2:MO3,b3:MO4, b4:MRA/C, b8:RA/C)	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 code value of fault information represents information described in the table below.	R

Note:The comparasion table between figures read from 1100H with the actual fault:

Value	Fault Type	Value	Fault Type
0	No fault	31	Memory error (Er1)
1	Overcurrent occurred during acceleration (OC1)	32	Keypad communications error (Er2)
2	Overcurrent occurred during deceleration (OC2)	33	CPU error (Er3)
3	Overcurrent occurred during running at a constant speed (OC3)	34	Option communications error (Er4)
4	Reserved	35	Option error (Er5)
5	Reserved	36	Operation error (Er6)
6	Overvoltage occurred during acceleration (OU1)	37	Auto-tuning error (Er7)
7	Overvoltage occurred during deceleration (OU2)	38	RS-485 communications error(COM port 1) (Er8)
8	Overvoltage occurred during running at constant speed (OU3)	39	Reserved
9	Reserved	40	Reserved
10	Undervoltage fault (LU)	41	Reserved
11	Input phase loss (Lin)	42	Reserved
12	Reserved	43	Reserved
13	Reserved	44	Overload of motor 3 (OL3)
14	Reserved	45	Overload of motor 4 (OL4)
15	Reserved	46	Output phase loss (OPL)
16	Charger circuit fault (OH3)	47	Speed mismatch or excessive speed deviation (ErE)
17	Cooler Overheat (OH1)	48	Reserved
18	External alarm (OH2)	49	Reserved
19	Inverter internal overheat (OH3)	50	Reserved
20	Motor overheating (PTC/NTC detection) (OH4)	51	Data saving error during undervoltage (ErF)
21	Reserved	52	Reserved

Value	Fault Type	Value	Fault Type
22	Braking resistor overheated (dbH)	53	RS-485 communications error(COM port 2) (ErP)
23	Overload of motor 1 (OL1)	55	Reserved
24	Overload of motor 2 (OL2)	56	Positioning control error:Servo-lock (Ero)
25	Inverter overload (OLU)	57	Reserved
26	Reserved	58	PID feedback wire break (CoF)
27	Overspeed (OS)	59	Braking transistor error (dbA)
28	PG wire break (PG)	60	Reserved
29	NTC wire break error (nrb)		
30	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 1in 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 RS-485 communications link are available as listed below.

Port	Connection Route	Parameter	The machine can be connected
1	RS-485 communications link (COM 1)(via the RJ-45 connector prepared for keypad connection)	11．01~ 11．10	Keypad
2	RS-485 communications link (COM 2)(via terminals SG＋,SG–,and SCM 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.

11．01	RS-485 communication 1 communication Station address		Factory default	1
	Setting Range	1~255		
	Related parameters	11．11 RS-485 communication 2 communication Station address		

Specifies the station address for the RS-485 communications link.

Protocol	Station address
Modbus RTU	1~255

11．02	RS-485 communication 1:Communications error processing	↗	Factory default	0
	Setting Range	0：Immediately trip with alarm Er8		
		1：Trip with alarm Er8after running for the period specified by timer		
		2：Retry during the period specified by timer. If the retry fails, trip with alarm Er8		
		3：Continue to run		
	Related parameters	11．12 RS-485 communication 2:Communications error processing		

Specifies the error processing to be performed if an RS-485 communications error happens.

RS-485 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 RS-485 communications link and it is running. If none of run and frequency commands is sourced through the RS-485 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 trip, displaying an RS-485 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 RS-485 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 RS-485 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.

11．03	RS-485 communication 1:timer	↗	Factory default	2.0
	Setting Range	0.0~60.0s		
	Related parameters	11．13 RS-485 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.

11．04	RS-485 communication 1:baud rate	↗	Factory default	2
	Setting Range	0：2400bps		
		1：4800bps		
		2：9600bps		
		3：19200bps		
		4：38400bps		
	Related parameters	11．14 RS-485 communication 2:baud rate		

Baud rate: specifies the transmission speed for RS-485 communication. parameters of 11．14 and 11．04 with the same setting.

11．05	RS-485communication1:data length selection	↗	Factory default	0
	Setting Range	0：8 Bit		
		1：7 Bit		
	Related parameters	11．15 RS-485communication2:data length selection		

Data length: specifies the character length for RS-485 communication. parameters 11．15 and 11．05 with the same setting.

11．06	RS-485 communication 1:parity check selection	↗	Factory default	0
	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 RS-485 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)

11．07	RS-485 communication 1:stop bit selection		Factory default	0
	Setting Range	0：2 bit		
		1：1 bit		
	Related parameters	11．17 RS-485 communication 2:stop bit selection		

Stop bits:specifies the number of stop bits.parameters 11．17 and 11．07 with the same setting.

11．08	RS-485 communication 1:No-response error detection time		Factory default	0
	Setting Range	0： No detection		
		1~60s		
	Related parameters	11．18 RS-485 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 RS-485 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.

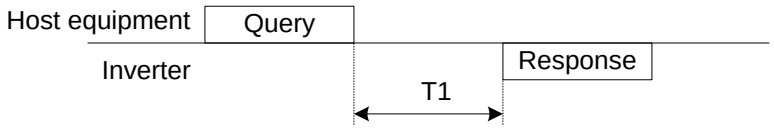
For the processing of communications errors, refer to 11．02 and 11．12.

11．08,11．18 Setting value	Function
0	No detection
1~60	1 to 60 s

11．09	RS-485 communication 1 response interval		Factory default	0.01
	Setting Range	0.00~1.00s		
	Related parameters	11．19 RS-485 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 = response interval + α

α：where α is the processing time inside the inverter. α may vary depending on the processing status and the command processed in the inverter.

11．10	RS-485 communication 1 protocol selection	↗	Factory default	0
	Setting Range	0：Modbus RTU protocol		
	Related parameters	11．20 RS-485 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.

11．97	Communication Data Storage Selection	↗	Factory default	0
	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).

11．98	Communication function (mode selection) (refer to 04．30)	↗	Factory default	0

11．99	Auxiliary communication function (mode selection)	↗	Factory default	0

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 7.2.	04．81 04．82
Overvoltage 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
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
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
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

Table 7.1 Abnormal States Detectable

Code	Name	Code	Name
OC1,OC2,OC3	Overcurrent	Er2	Keypad communications error
EF	Ground fault(30kW or above)	Er3	CPU error
OU1,OU2,OU3	Overvoltage	Er4	Option communications error
LU	Undervoltage	Er5	Option error
Lin	Input phase loss	Er6	Operation error
OPL	Output phase loss	Er7	Auto-tuning error
OH1	Cooler Overheat	Er8 Erp	RS-485 communications error(COM port 1) RS-485 communications error(COM port 2)
OH2	External alarm	ErF	Data saving error during undervoltage
OH3	Inverter internal overheat	Erc	Magnetic pole position detection error
OH4	Motor protection (PTC/NTC thermistor)	nrb	NTC wire break error
dbH	Braking resistor overheated (22 kW or below)	Err	Mock alarm
OH3	Charger circuit fault	CoF	PID feedback wire break
OL1 ~ OL4	Overload of motor 1~4	dbA	Braking transistor error
OLU	Inverter overload	Erd	Loss of synchronism detection/ starting magnetic pole position detection error
OS	Overspeed	ErE	Speed mismatch
Er1	Memory error		

Table 7.2 “Light Alarm" Objects

Code	Name	Code	Name
OH1	Cooler Overheat	Er4	Option communications error
OH2	External alarm	Er5	Option error
OH3	Inverter internal overheat	Er8 Erp	RS-485 communications error(COM port 1) RS-485 communications error(COM port 2)
dbH	Braking resistor overheated		
OL1 ~ OL4	Overload of motor 1~4	Pid	PID alarm output
CoF	PID feedback wire break	UTL	Low torque output
OL	Motor overload early warning	PTC	PTC Thermistor activated
OH	Cooler overheat early warning	rTE	Inverter life (Motor cumulative run time)
rEF	Reference command loss detected	CnT	Inverter life (Number of startups)
		LiF	Lifetime alarm

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	If there are any sudden changes, make the load fluctuation smaller or increase the inverter capacity.
	(4)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.
	(5) 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.
	(6)Insufficient adjustment of the speed controller	Adjust the speed controller according to the inertia torque of the load	Improv the gain of the speed controller(09．03)and shorten the integral time(09．04)
	(7)Current frequency value is large at startup	Check if speed 10% around has current protection in light load	Decrease the setting value of the motor 1(Current reference value at startup 03．74)
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
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.	①Increase the deceleration time (00．08,01．11,01．13,01．15,04．56). ②Enable the automatic deceleration (anti-regenerative control) (04．69) ③Enable torque limiter (00．40,00．41,01．16,01．17 ④Consider the use of a braking resistor.
	(4) The acceleration time was too short.	Check if the overvoltage alarm occurs after rapid acceleration.	①Increase the acceleration time (00．07,01．10,01．12,01．14). ②Select the S-curve pattern (04．07). ③Consider the use of a braking resistor.
	(5)Braking load was too heavy.	Compare the braking torque of the load with that of the inverter.	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.	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.
	(7)Insufficient adjustment of the speed controller	Check whether the actual speed overshoots the commanded one in higher speed operation.	①Reduce gain of the speed controller (09．03), increase integral time(09．04). ②Increase speed control(09．01).
LU (Undervoltage)	(1) A momentary power failure occurred	①Release the alarm. ②If 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.	
	(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
	(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.	①Connect an AC reactor (ACR) to lower the voltage unbalance between input phases. ②Increase 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 (S5100 inverter drives 3 phase permanent magnet synchronous motor)
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 clogged.	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.	①Reduce 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). ②Decrease the motor sound (carrier frequency) (00.26).

Code	Description for problem and Possible Causes	Checking	Suggested Measures
			③Enable the overload prevention control (04.70).
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 (data= 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.	Correct the assignment.
		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	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 the 04．26 data in accordance with the thermistor used and set the SW5 to the PTC/NTC position.
	(6)Incorrect setting of the motor's function parameter data	Check whether the data of 00．04, 00．05, 03．01, 03．02, 03．03, 03．60~64 match the parameters of the motor	Perform auto-tuning of the inverter

Code	Description for problem and Possible Causes	Checking	Suggested Measures
	(7) 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)
dbH (Braking resistor overheated)	(1) Braking load is too heavy.	Reconsider the relationship between the braking load estimated and the real load.	①Lower the real braking load. ②Review 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.	①Increase the deceleration time (00．08,01．11,01．13,01．15,04．56). ②Review 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.	①Reconsider the data of function parameters(00．10*,00．12*). ② Use an external thermal relay.

Code	Description for problem and Possible Causes	Checking	Suggested Measures
	(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.
	(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) Incorrect setting of the motor's function parameter data	Check whether the data of 00．04, 00．05, 03．01, 03．02, 03．03, 03．60~64 match the parameters of the motor	Perform auto-tuning of the inverter
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) 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).
	(3) 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).
	(4) 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.
	(5)Incorrect setting of the motor's function parameter data	Check whether the data of 00．04, 00．05, 03．01, 03．02, 03．03, 03．60~64 match the parameters of the motor	Perform auto-tuning of the inverter
	(6) 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.

Code	Description for problem and Possible Causes	Checking	Suggested Measures
		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).
	(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 PRG/RESET 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 PRG/RESET key and check that the alarm goes on.	The control PCB (on which the CPU is mounted) is defective.Contact your SAVCH Electric representative.
Er2 (Keypad communications error)	(1) Broken communications cable or poor contact.	Check continuity of the cable, contacts and connections.	①Re-insert the connector firmly.. ②Replace 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.	①Use wires of the recommended size (0.75mm²) for wiring. ②Change 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	Implement noise control measures.

Code	Description for problem and Possible Causes	Checking	Suggested Measures
		cables, and main circuit wires)	
Er4 (Option communications error)	(1) There was a problem with the connection between the option card and the inverter.	Check whether the connector on the option card is properly engaged with that of the inverter.	Reload the option card into the inverter.
	(2) Strong electrical noise.	Check whether 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.
Er5	Option error	An error detected by the option card. Refer to the instruction manual of the option card for details.	
Er6 (Operation error)	(1)The STOP key was pressed when (04.96 = 1, 3)	Check that the STOP 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) Incorrect setting of the motor's rated value	Check whether the data of (00．04，00．05，03．02，03．03) match the specification of the motor.	Check whether the data of (00．04，00．05，03．02，03．03) match the specification of the motor
	(3) Motor type	Check if you are using the PM motor without magnetic saturation	Set the parameter data of magnetic pole position detection mode to be 0 or 3 and set the time for the motor to run 1 rpm or above
	(4) The wiring length between the inverter and the motor was too long.	Check whether the wiring length between the inverter and the motor exceeds 164ft (50m). (Small capacity inverters are greatly affected by the wiring length.)	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.
	(5) 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.	①Replace the inverter with one with an appropriate capacity ②Manually specify the values for the motor parameter

Code	Description for problem and Possible Causes	Checking	Suggested Measures
	(6) A tuning operation involving motor rotation (03．04 = 2 or 3) was attempted while the brake was applied to the motor.		①Specify the tuning that does not involve the motor rotation (03.04 = 1). ②Release the brake before tuning that involves the motor rotation (03.04 = 2 or 3).
Er8 (RS-485 communications error(COM port 1)) Erp (RS-485 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 RS-485 converter did not operate due to incorrect connections and settings, or defective hardware.	Check the RS-485 converter (e.g., check for poor contact).	Change the various RS-485 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 RS-485 converter with a recommended insulated one.
	(7) Terminating resistor not properly configured.	Check that the inverter serves as a terminating device in the network.	Configure the terminating resistor switch(es) (SW2/SW3) for RS-485 communication correctly. (That is, turn the switch(es) to ON.)
ErC (Magnetic pole position detection error)	(1)Improper setting of the inverter	Check there is the motor and speed/magnetic pole position sensor,control mode, pulse input of the speed feedback encoder, the pulse resolution (P/R) of the speed feedback encoder	①Correct setting of parameter 00．42, 09．14, 09．15. ②Correct setting of parameter 03．95(enables auto-tuning).
	(2)Connection error of the Speed/Magnetic pole position sensor	Check if the output wire connection of the speed/magnetic pole position sensor is correct	Correctly connect the feedback input optional parts and speed/magnetic pole position sensor
	(3)The running	Check if the phase sequence of	Correctly connect the inverter with

Code	Description for problem and Possible Causes	Checking	Suggested Measures
	direction of the motor dismatches the sensor output	AB or UVW is correct	the motor
	(4)There was a problem with the connection between the option card and the inverter.	Check whether the connector on the option card is properly engaged with that of the inverter.	Reload the option card into the inverter.
	(5)Strong electrical noise.	Check whether appropriate noisecontrol measures have been implemented (e.g. correct grounding and routing of signal wires, communications cables, and main circuit wires).	Implement noise control measures.
Erd (Loss of synchronism detection/Magnetic pole position detection error at startup)	(1) Function parameter settings do not match the motor characteristics.	Check whether the data of 00．04, 00．05, 03．01~03．03, 03．60~03．64 match the parameters of the motor.	Perform auto-tuning of the inverter
	(2)Incorrect magnetic pole position detection	Check whether the magnetic pole position detection match the motor type	Make the magnetic pole position detection to match the motor type
	(3)Insufficient starting frequency(under vector control without speed sensor)	Set the magnetic pole position detection 03．30 to be 0 or 3, check whether the setting of starting frequency is proper	Set the time for the motor to run with 1 rpm or above
	(4) Insufficient starting torque	Check acceleration time(00．07, 01．10, 01．12, 01．14) and parameter data 03．74(current reference value)at startup	①Set the acceleration time that matchs the load ②Increase the current reference value at startup
	(5) Too small load	Check parameter data 03．74(current reference value)at startup	Reduce the current reference value at startup. Set the current reference value to be 80% or below when the motor is in monomer operation at test run
	(6) Unstable control system	Check motor rotor resistor 03．60, speed regulator proportional gain 09．03, integral time constant 09．04	Adjust the resistor of the motor rotor. Set the speed regulator proportional gain and integral time constant to match the Inertia moment of mechanical system
ErF (Data saving error during undervoltage)	(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 PRG/RESET 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.
	(2) Inverter operation affected by strong electrical noise when the power was turned	Check if appropriate noise control measures have been implemented (e.g., correct grounding and routing of control	Implement noise control measures. After pressing the PRG/RESET key and releasing the alarm, return the data of the relevant function codes

Code	Description for problem and Possible Causes	Checking	Suggested Measures
	OFF.	and main circuit wires).	(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) Incorrect setting of function parameter data	Check the motor (No. of poles) (03．01)	Specify data of function parameters 03．01 in accordance with the motor and PG.
	(2)overload	Measure the output current.	Reduce the load.
		Check whether any mechanical brake is working.	Release the mechanical brake.
	(3) Function parameter settings do not match the motor characteristics.	Check whether the data of 00．04,00．05,03．01~03．03,03．60~03．64 match the parameters of the motor.	Perform the auto-tuning of the inverter
	(4) 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
	(5)Insufficient adjustment of the speed controller	Check whether the speed in high speed operation exceeds the specified range.	Reduce the gain of the speed control 09．03
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.
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.

Code	Description for problem and Possible Causes	Checking	Suggested Measures
dbA (Braking transistor error)	(1) The braking transistor is broken.	Check whether resistance of the braking resistor is correct or there is a misconnection of the resistor.	Repair the inverter.

7.2 Common Abnormal motor operation

Description for problem	Possible Cause	CHECKING	Suggested Measures
The motor does not rotate.	(1) No power supplied to the inverter.	Check the input voltage and interphase voltage unbalance.	①Turn ON a molded case circuit breaker (MCCB), a residual-current- operated protective device (RCD)/earth leakage circuit breaker (ELCB) (with overcurrent protection) or a magnetic contactor (MC). ②Check for voltage drop, phase loss, poor connections, or poor contacts, and fix them if necessary. ③If only the auxiliary control power input is supplied, also supply the main power to the inverter.
	(2) No run forward/reverse command was inputted, or both the commands were inputted simultaneously (external signal operation).	Check the input status of the forward/reverse command with Menu "I/O Checking" using the keypad.	①Input a run command. ②Set either the forward or reverse run command off if both commands are being entered. ③Correct the run command source. (Set 00.02 data to "1.") ④Correct the assignment of commands FWD and REV with the function parameters (01.98, 01.99) ⑤Connect the external circuit wires to control circuit terminals [FWD] and [REV] correctly. ⑥Make sure that the sink/source slide switch (SW1) on the control PCB is properly configured.
	(3) No Enable input	Check the input status of the command of forward/reverse running direction with Menu I/O using the keypad.	Input command of running direction (00.02=0) or choose to run the fixed operation panel for running direction (00.02=2, or 3)
	(4) The inverter could not accept any run commands from the keypad since it was in Programming mode.	Check which operation mode the inverter is in, using the keypad.	Shift the operation mode to Running mode and enter a run command.
	(5) A run command with higher priority than the one attempted was active, and the run command was stopped.	Referring to the block diagram of the frequency command block,check the higher priority run command with Menu "Data Checking" and Menu "I/O Checking" using the keypad.	Correct any incorrect function code data settings (in 04．30, 11.98, etc.) or cancel the higher priority run command.
	(6) No analog frequency command input	Check whether the analog frequency command (reference frequency) is correctly inputted, using Menu "I/O Checking" on the keypad.	①Connect the external circuit wires to terminals 10V,AVI,ACM,ACI,AUI correctly. ②When terminal AUI is used, check the slider position of terminal

Description for problem	Possible Cause	CHECKING	Suggested Measures
			AUI property switch (SW5) and the setting of the thermistor mode selection (04.26).
	(7) The reference frequency was below the starting or stop frequency.	Check that a reference frequency has been entered correctly, using Menu"I/O Checking" on the keypad.	①Set the reference frequency at the same or higher than that of the starting and stop frequencies (00. 23 and 00.25). ②Reconsider the starting and stop frequencies (00.23 and 00.25), and if necessary, change them to the lower values. ③Inspect the external frequency command potentiometers, signal converters, switches, and relay contacts. Replace any ones that are faulty. ④Connect the external circuit wires to terminals 10V ,AVI,ACM,ACI,AUI correctly.
	(8) A frequency command with higher priority than the one attempted was active.	Check the higher priority run command with Menu"Data Checking" and Menu "I/O Checking" using the keypad, referring to the block diagram of the frequency command block	Correct any incorrect function parameter data.
	(9) The upper and lower frequencies for the frequency limiters were set incorrectly.	Check the data of function parameters 00.15 (Frequency limiter (High)) and 00.16 (Frequency limiter (Low)).	Change the settings of 00.15 and 00.16 to the correct ones.
	(10) The coast-to-stop command was effective	Check the data of function parameters 01．01~01．09,01．98,01．99 the input signal status, using Menu "I/O Checking" on the keypad.	Release the coast-to-stop command setting.
	(11) Broken wires, incorrect connection or poor contact with the motor.	Check the wiring (Measure the output current).	Repair the wires to the motor, or replace them.
	(12) overload	Measure the output current.	Reduce the load (In winter, the load tends to increase.)
		Check whether any mechanical brake is activated.	Release the mechanical brake, if any.
	(13) Torque generated by the motor was insufficient.	Check that the motor starts running if the value of torque boost (00.09) is increased.	Increase the value of torque boost (00．09) and try to run the motor.
		Check the data of function parameters 00．04,00．05,04．50,04．51,04．52,04．53,04．65,04．66.	Change the V/f pattern to match the motor's characteristics.
		Check that the motor switching signal (selecting motor 1, 2, 3 or 4) is correct and the data of function codes matches each motor.	①Correct the motor switching signal. ②Modify the function parameter data to match the connected motor.
		Check whether the reference frequency is below the slip-compensated frequency of the motor.	Change the reference frequency so that it becomes higher than the slip-compensated frequency of the motor.

Description for problem	Possible Cause	CHECKING	Suggested Measures
	(14) Wrong connection or poor contact of DC reactor (DCR)	Check the wiring. For the inverter of 75KW or above, the DC reactor (DCR) is optional. Without a DCR, these inverters cannot run.	Connect the DCR correctly. Repair or replace DCR wires.
The motor rotates, but the speed does not increase	(1) The Max. frequency currently specified was too low.	Check the data of function parameter 00.03 (Max. frequency).	Correct the 00．03 data.
	(2) The data of frequency limiter (High) currently specified was too low.	Check the data of function parameter 00.15 (Frequency limiter (High))	Correct the 00.15 data.
	(3) The reference frequency currently specified was too low.	Check that the reference frequency has been entered correctly, using Menu "I/O Checking" on the keypad.	①Increase the reference frequency. ②Inspect the external frequency command potentiometers, signal converters, switches, and relay contacts. Replace any ones that are faulty. ③Connect the external circuit wires to terminals 10V,AVI,ACM,ACI,AUI correctly.
	(4) A frequency command (e.g., multi-frequency or via communications) with higher priority than the one attempted was active and its reference frequency was too low.	Check the data of the relevant function parameters and what frequency commands are being received, through Menu "Data Setting," "Data Checking" and "I/O Checking," on the keypad by referring to the block diagram of the frequency command	Correct any incorrect data of function parameters (e.g. cancel the higher priority frequency command).
	(5) The acceleration time was too long or too short.	Check the data of function parameters 00．07,01．10, 01．12,01．14. (Acceleration time)	Change the acceleration time to match the load.
	(6) Overload	Measure the output current.	Reduce the load.
		Check whether any mechanical brake is activated.	Release the mechanical brake.
	(7) Function parameter settings do not agree with the motor characteristics.	If auto-torque boost or auto-energy saving operation is specified, check whether the data of 03.02,03．03,03．06, 03．07,03．08 agree with the parameters of the motor. matches the motor constant.	Perform auto-tuning of the inverter for the motor to be used.
	(8) The output frequency does not increase due to the current limiter operation.	Make sure that 00.43 (Current limiter (Mode selection)) is set to "2" and check the data of 00.44 (Current limiter (Level)).	Correct the 00.44 data. Or, if the current limiter operation is not needed, set 00.43 to "0" (disabled).
		Decrease the value of torque boost (00.09), then run the motor again and check if the speed increases.	Adjust the value of the torque boost 00.09.
		Check the data of function parameters 00．04,00．05, 04．50,04．51,04．52,04．53,04．65,04．66 to ensure that the V/f pattern setting is right.	Match the V/f pattern setting with the motor ratings.

Description for problem	Possible Cause	CHECKING	Suggested Measures
	(9) Bias and gain incorrectly specified.	Check the data of function parameters (00．18,02．50,02．32,02．34,02．37,02．39,02．42,02．44).	Readjust the bias and gain to appropriate values.
The motor runs in the opposite direction to the command..	(1) Wiring to the motor is incorrect.	Check the wiring to the motor.	Connect terminals U, V, and W of the inverter to the U, V, and W terminals of the motor, respectively.
	(2) Incorrect connection and settings for run commands and rotation direction commands FWD and REV..	Check the data of function parameters 01．98,01．99 and the connection to terminals [FWD] and [REV].	Correct the data of the function codes and the connection.
	(3) The rotation direction specification of the motor is opposite to that of the inverter.	Check the data of running and operation(00.02).	Change the data of 00.02 into 2 (forward running) or 3 (reverse running).
	(4) The specifications of motor is mismatch.	The rotation direction of IEC-compliant motors is opposite to that of incompliant motors	Switch the [mFWD] / [mREV] signal setting.
Speed fluctuation or current oscillation occurs during running at constant speed.	(1) The frequency command fluctuates.	Check the signals for the frequency command with Menu "I/O Checking" using the keypad.	Increase the filter constants (02．33,02．38,02．43) for the frequency command.
	(2) An external potentiometer is used for frequency setting.	Check that there is no noise in the control signal wires from external sources.	①Isolate the control signal wires from the main circuit wires as far as possible. ②Use shielded or twisted wires for control signals.
		Check whether the external frequency command potentiometer is malfunctioning due to noise from the inverter.	Connect a capacitor to the output terminal of the potentiometer or set a ferrite core on the signal wire. (refer to Chapter 2).
	(3) Frequency switching or multi-step frequency command was enabled.	Check whether the relay signal for switching the frequency command is chattering.	If the relay contact is defective, replace the relay.
	(4) The wiring length between the inverter and the motor is too long.	Check whether auto-torque boost, auto-energy saving operation, or dynamic torque vector control is enabled.	①Perform auto-tuning of the inverter for every motor to be used. ②Disable the automatic control systems by setting 00.37 to "1" (Constant torque load) and 00.42 to "0" (V/f control with slip compensation active), then check that the motor vibration stops. ③Make the output wires as short as possible.
	(5) The machinery is hunting due to vibration caused by low rigidity of the load. Or the current is irregularly oscillating due to special motor parameters.	Once disable all the automatic control systems such as auto torque boost, auto energy saving operation, overload prevention control, current limiter, torque limiter, automatic deceleration (anti-regenerative control), auto search for idling motor speed, slip compensation, dynamic torque vector control, droop control, overload stop function, speed control, tuning, notch filter, observer, and then check that the	①Disable the functions causing the vibration. ②Readjust the output current fluctuation damping gain (04.80). ③Readjust the speed control systems. (09.01~09.06)

Description for problem	Possible Cause	CHECKING	Suggested Measures
		motor vibration comes to a stop.	
		Check that the motor vibration is suppressed if you decrease the level of 00.26 (Motor sound (Carrier frequency)) or set 00.27 (Motor sound (Tone)) to "0."	Decrease the carrier frequency (00.26) or set the tone to "0" (00.27 = 0).
Grating sound is heard from the motor or the motor sound fluctuates.	(1) The specified carrier frequency is too low.	Check the data of function parameters 00.26 (Motor sound (Carrier frequency)) and 00.27 (Motor sound (Tone)).	①Increase the carrier frequency (00．26) ②Change the setting of 00.27 to appropriate value.
	(2) Resonance with the load	Check the machinery mounting accuracy or check whether there is resonance with the mounting base.	①Disconnect the motor from the machinery and run it alone, then find where the resonance comes from. Upon locating the cause, improve the characteristics of the source of the resonance. ②Adjust the settings of 02.01 (Jump frequency 1) to 02.04 (Jump frequency (Hysteresis width)) so as to avoid continuous running in the frequency range causing resonance. ③Enable the speed control (notch filter) (09.07, 09.08) and the observer (09．18,09．19,09．20) to suppress vibration.(Depending on the characteristics of the load, this may take no effect.)
The motor does not accelerate or decelerate within the specified time	(1) The inverter runs the motor with S-curve or curvilinear pattern.	Check the data of function parameter 04.07 (Acceleration/deceleration pattern).	①Select the linear pattern. (04.07 = 0) ②Shorten the acceleration/ deceleration time. (00．07,00．08,01．10~01．15)
	(2) The automatic deceleration (Anti-regenerative control) is enabled during deceleration.	Check the data of function parameter 04.69 (Automatic deceleration (Mode selection)).	Increase the deceleration time (00．08,01．11,01．13,01．15).
	(3)Overload	Measure the output current.	Reduce the load (For fans or pumps, decrease the frequency limiter value (00.15).) (In winter, the load tends to increase.)
	(4) An external potentiometer is used for frequency setting.	Check that there is no noise in the control signal wires from external sources.	①Isolate the control signal wires from the main circuit wires as far as possible. ②Use shielded or twisted wires for control signals. ③Connect a capacitor to the output terminal of the external frequency command potentiometer or set a ferrite core on the signal wire. (refer to Chapter 2).

Description for problem	Possible Cause	CHECKING	Suggested Measures
	(5) The output frequency is limited by the torque limiter.	Check whether data of torque limiter related function parameters (00．40,00．41,01．16,01．17) is correctly configured and the [mTL2/TL1]terminal command ("Select torque limiter level 2/1") is correct.	①Correct the data of 00．40,00．41,01．16,01．17,or reset them to the factory defaults. ②Set the [mTL2/TL1] correctly. ③Increase the acceleration/ deceleration time (00．07,00．08,01．10~01．15).
	(6) The specified acceleration or deceleration time was incorrect.	Check the terminal commands [mRT1] and [mRT2] for acceleration/deceleration times.	Correct the [mRT1] and [mRT2] settings
The motor does not restart even after the power recovers from a momentary power failure.	(1) The data of function parameter 00.14 is either "0," "1," or "2."	Check if an undervoltage trip (LU) occurs.	Change the data of function parameter 00.14 (Restart mode after momentary power failure (Mode selection)) to "3," "4," or "5" .
	(2) The run command remains OFF even after the power has been restored.	Check the input signal with Menu "I/O Checking" using the keypad.	Check the power recovery sequence with an external circuit. If necessary, consider the use of a relay that can keep the run command ON.
		In 3-wire operation, the power to the control printed circuit board (control PCB) has been shut down once because of a long momentary power failure time, or the "Enable 3-wire operation" signal [mHOLD]has been turned OFF once.	Change the design or the setting so that a run command can be issued again within 2 seconds after the power has been restored.
The motor abnormally heats up	(1) Continuous running in extremely slow speed.	Check the running speed of the inverter.	Change the speed setting or replace the motor with a motor exclusively designed for inverters.
	(2) Overload	Measure the inverter output current.	Reduce the load (For fans or pumps, decrease the frequency limiter value (00.15).) (In winter, the load tends to increase.)
The motor does not run as expected	(1)Incorrect setting of function parameter data.	Check that function codes are correctly configured and no unnecessary configuration has been done.	Configure all the function parameters correctly.
		Make a note of function code data currently configured and then initialize all function parameter data using 04.03 .	After the above process, reconfigure function parameters one by one, checking the running status of the motor.

7.3 Other abnormal conditions

Description for problem	Possible Cause	CHECKING	Suggested Measures
Nothing appears in the LED monitor on keypad	(1) No power (neither main power nor auxiliary control power) supplied to the inverter.	Check the input voltage and interphase voltage unbalance.	①Turn ON a molded case circuit breaker (MCCB), a residual-current- operated protective device (RCD)/earth leakage circuit breaker (ELCB) (with overcurrent protection) or a magnetic contactor (MC). ②Check for voltage drop, phase loss, poor connections, or poor contacts and fix them if necessary.
	(2) The power for the control PCB did not reach a sufficiently high level.	Check if the jumper bar has been removed between terminals P1 and P(+) or if there is a poor contact between the jumper bar and those terminals	Check if the jumper bar has been removed between terminals P1 and P(+) or if there is a poor contact between the jumper bar and those terminals.
	(3) The keypad was not properly connected to the inverter.	Check whether the keypad is properly connected to the inverter.	①Remove the keypad, put it back, and see whether the problem recurs. ②Replace the keypad with another one and check whether the problem recurs.
		When running the inverter remotely, ensure that the extension cable is securely connected both to the keypad and to the inverter.	①Disconnect the cable, reconnect it, and see whether the problem recurs. ②Replace the keypad with another one and check whether the problem per recurs.
Data of function codes cannot be changed.	(1) An attempt was made to change function code data that cannot be changed when the inverter is running.	Using operation panel to check whether or not running monitor of the sub-menu is in operation, and through parameter table, check whether or not the parameter needed to be change can be reset during running.	After running stops, modify parameter data.
	(2) The data of the function codes is protected.	Check the data of data protection (00.00).	Change the data of 00.00 from data protection state(1 or 3) to the state of enabling data modification(0 or 2).
	(3) The [mWE-KP] terminal command ("Enable data change with keypad") is not entered, though it has been assigned to a digital input terminal.	Check the data of function parameters 01．01~01．09, 01．98,01．99 and the input signal status with Menu "I/O Checking" using the keypad.	Input a [mWE-KP] command through a digital input terminal.
	(4) The FUNC DATA key was not pressed.	Check whether you have pressed the FUNC DATA key after changing the function parameter data.	①Press the FUNC DATA key after changing the function parameter data.. ②Check that “save” is displayed on the LED monitor.
	(5) The data of function parameters 00．02, 01．01~	Either one of the [mFWD], [mREV] terminal commands is	Turn OFF both [mFWD],[mREV].

Description for problem	Possible Cause	CHECKING	Suggested Measures
	01．09,01．98,01．99 cannot be changed.	turned ON.	
The lower right corner point will light up in LED Monitor on the keypad	(1) When PID control had been disabled (08.01 = 0), you changed 01.43 (LED Monitor (Item selection)) to 10 or 12. With the PID being enabled (08.01 = 1, 2, or 3), you disabled PID control (08.01 = 0) when the LED monitor had been set to display the PID command or PID feedback amount by pressing the FUNC DATA key.	Make sure that when you wish to view other monitor items, 01.43 is not set to "10:PID command" or "12:PID feedback amount".	Set 01.43 to a value other than "10" or "12."
		Make sure that when you wish to view a PID command or a PID feedback amount, 08.01 (PID control) is not set to "0:Disable."	Set 08.01 to "1:Enable (Process control normal operation)," "2:Enable (Process control inverse operation)," or "3:Enable (Dancer control).
	(2) The keypad was poorly connected.	Prior to proceed, check that pressing the FUNC DATA key does not change the display on the LED monitor. Check continuity of the extension cable for the keypad used in remote operation.	Replace the cable.
_ _ _(under bar) appears	(1) The voltage of the DC link bus was low.	Select E_01 under Menu "Maintenance Information" in Programming mode on the keypad, then check the DC link bus voltage which should be three-phase DC440 V or below.	Connect the inverter to a power supply that meets its input specifications.
	(2) The main power is not ON, while the auxiliary input power to the control circuit is supplied.	Check whether the main power is turned ON.	Turn the main power ON.
	(3) Although power is supplied not via the commercial power line but via the DC link bus, the main power down detection is enabled (04.72 = 1).	Check the connection to the main power and check if the 04.72 data is set to "1" (factory default).	Correct the 04.72 data.
Displayed as "[ ]"	(1) Inverter running on single-phase power	Check whether or not the arithmetic product of output frequency and display coefficient (01.50) is over 100,000.	Correct the 01.50 data.

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 8.1. Before performing periodic inspections, be sure to stop the motor and remove the front cover with the inverter power OFF.

Table 8.1 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.	1) Check visually or measure using apparatus. 2) Visual inspection	1) The standard specifications must be satisfied. 2) No foreign or dangerous objects are left.
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	The display can be read and there is no fault.
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	1), 2), 3), 4), 5) 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 or deterioration. 3) Check for contamination or accumulation of dust or dirt.	1) Retighten. 2), 3) Visual inspection	1), 2), 3) No abnormalities

Check part		Check item	Method of inspection	Evaluation criteria
	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	1), 2) No abnormalities
	Terminal blocks	Check that the terminal blocks are not damaged.	Visual inspection	No abnormalities
	Braking resistor	1) Check for abnormal odor or cracks in insulators caused by overheat. 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% of the resistance of the braking resistor.
	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 overheat.	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 indicatedin Table 8.2 when measuring with meters for commercial frequencies.

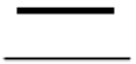
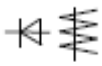
The power factor cannot be measured by a commercially available power-factor meter that measures the phase difference between

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

$$\text{Power factor} = \frac{\text{Electric power(W)}}{\sqrt{3} \times \text{voltage(V)} \times \text{current(A)}} \times 100\ (\%)$$

Table 8.2 Meters for Measurement of Main Circuit

Item	Input side (primary side)			Output side (secondary side)			DC link bus voltage (P(+)-N(-))
Wage 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.

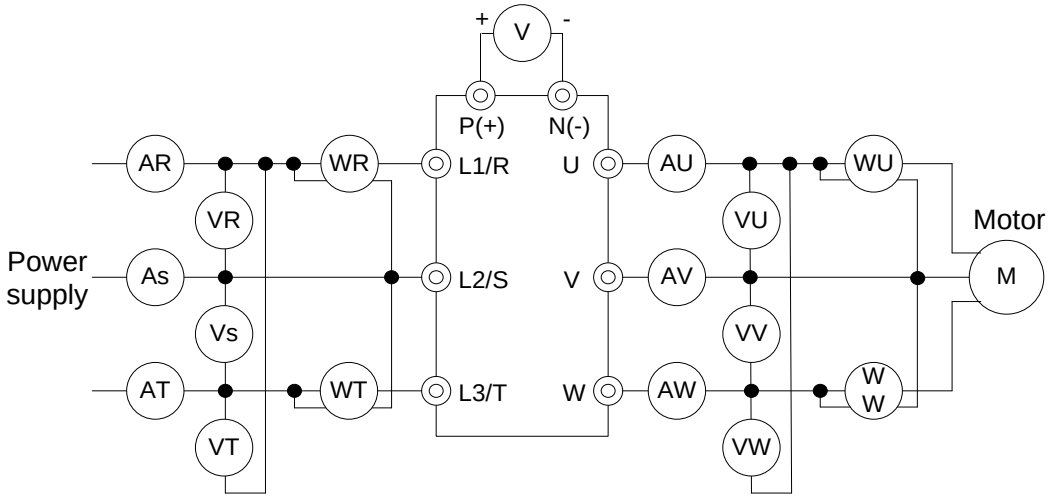


Figure 8.1 Wiring diagram of meters

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 DC 500 V 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 Figure 7.2.

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.)

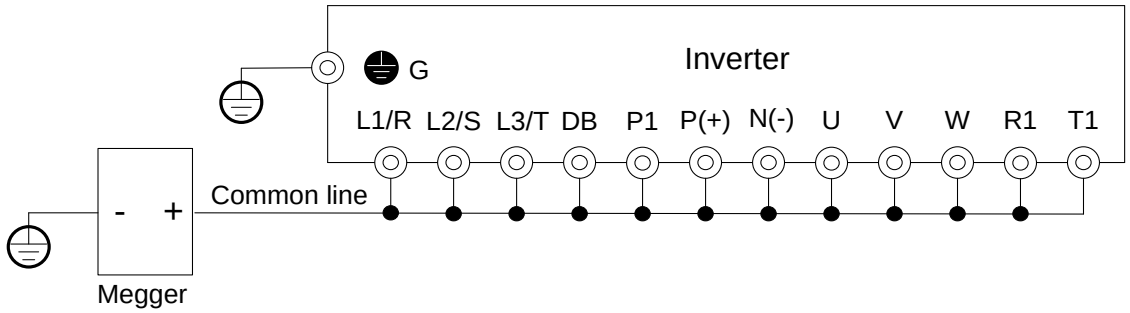


Figure 8.2 Wiring diagram of Main Circuit Terminal for Megger Test

(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 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	7.5	5.5	30.46	RXHG-500W-100R-J(500W 100Ω)	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-27R2-J(4800W 27.2Ω)	X	1	125	27.2Ω
	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			

9.2 Input/output AC/DC reactor specifications list for S5100 series inverter

Inverter model	Applied input AC reactor	Applied output AC reactor	Applied DC reactor
S5100-4T5.5G	ACL-0015-EISH-E1M0B	OCL-0015-EISC-EM47	×
S5100-4T7.5G	ACL-0020-EISH-EM75B	OCL-0020-EISC-EM35	×
S5100-4T11G	ACL-0030-EISH-EM60B	OCL-0030-EISC-EM23	×
S5100-4T15G	ACL-0040-EISH-EM42B	OCL-0040-EISC-EM18	×
S5100-4T18.5G	ACL-0050-EISH-EM35B	OCL-0050-EISC-EM14	×
S5100-4T22G	ACL-0060-EISH-EM28B	OCL-0060-EISC-EM12	×
S5100-4T30G	ACL-0080-EISC-EM19B	OCL-0080-EISC-E87U	Standard Built-in
S5100-4T37G	ACL-0090-EISC-EM19B	OCL-0090-EISC-E78U	Standard Built-in
S5100-4T45G	ACL-0120-EISH-EM13B	OCL-0120-EISC-E58U	Standard Built-in
S5100-4T55G	ACL-0150-EISH-EM11B	OCL-0150-EISH-E47U	Standard Built-in
S5100-4T75G	ACL-0200-EISH-E80UB	OCL-0200-EISH-E35U	DCL-0160-UIDH-EM36
S5100-4T90G	ACL-0250-EISH-E65UB	OCL-0250-EISH-E28U	DCL-0180-UIDH-EM33
S5100-4T110G	ACL-0250-EISH-E65UB	OCL-0250-EISH-E28U	DCL-0250-UIDH-EM26

■ Innovate for more | win forever

■ Industry intelligence | Energy saving | Green power

Savch wechat

Service Number

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Service Network

Website：www.savch.net

Qualification

Received ISO9001 and CE recognition

Sales service contact address