TECO INVERTER

SPEECON

7200MA

INSTRUCTION MANUAL

220V Class	1φ/3φ	1~ 3HP
220V Class	3φ	5~20HP
440V Class	3φ	1~20HP

Please hand this manual to the end-users. It will be of great help for their daily operation, maintenance, inspection and troubleshooting.

NOTE FOR SAFE OPERATION

Read this instruction manual thoroughly before installation, operation, maintenance or inspection of the inverter. And only authorized personnel should be permitted to perform maintenance, inspections or parts replacement.

In this manual, notes for safe operation are classified as "WARNING" or "CAUTION".

⚡ WARNING : Indicates a potentially hazardous situation which, if not heeded, could possibly result in death or serious injury.

⚠ CAUTION : Indicates a potentially hazardous situation which, if not heeded, may result in moderate or minor injury and damage to the product or faulty operation.

"WARNING" or "CAUTION"

⚡ **WARNING**

Always turn off the input power supply before wiring terminals.
After turning OFF the main circuit power supply, do not touch the circuit components until the "CHARGE" LED off.
Never connect the main circuit terminals U/T1, V/T2, W/T3 to AC main power supply.

⚠ **CAUTION**

When mounting units in an enclosure, install a fan or other cooling device to keep the intake air temperature below 45ºC.
Do not perform a withstand voltage test to the inverter.
All the parameters of the inverter have been preset at the factory. Do not change the settings unnecessarily.

This inverter has gone thorough all the demanding tests at the factory before shipment. After unpacking, check for the following:

1. Verify the model numbers with the purchase order sheet and/or packing slip.
2. Do not install any inverter that is damaged in any way or missing parts.
3. Do not install or operate any inverter that has no QC marking.
   Contact our representative, if you find any irregularities mentioned above.

Thank you for adopting the TECO multi-function sensorless vector IGBT inverter **Speecon 7200MA** (hereafter referred as 7200MA).

This manual firstly describes the correct application of handling, wiring, operating, specification, and maintenance/inspection. Then, the manual explains the digital operator performance, parameter setting, operation, troubleshooting, etc. Before using the 7200MA, a thorough understanding of this manual is recommended for daily maintenance, troubleshooting and inspection. Please keep this manual in a secure and convenient place for any future reference.

Contents

1. 7200 MA Handling Description

1.1 Inspection Procedure upon Receiving

Before delivery, Every 7200 MA inverter has been properly adjusted and passed the demanding function test. After receiving the inverter, the customer should take it out and follow the below procedure:

Verify that the Type No. of the inverter you've received is the same as the Type No. listed on your purchase order. (Please read the Nameplate)

Observe the condition of the shipping container and report any damage immediately to the commercial carrier that have delivered your inverter.

Inverter nameplate:

MODEL	JNTMBGBB0001AZS - 1	← INVERTER MODEL
INPUT	440V CLASS INVERTER AC 3PH 380-460V 50/60Hz	← INPUT SPECIFICATION
OUTPUT	AC 3PH 0-460V 2.2KVA 2.6A	← OUTPUT SPECIFICATION
SER. NO.		← SERIES NO.

CE

Inverter model number

JNTMBGBB0001AZS-1

7200MA SERIES

ENCLOSURE AND MOUNTING
BB:ENCLOSED,WALL-MOUNTED
   TYPE (NEMA-1)

MAX. APPLICABLE MOTOR
CAPACITY(HP)
0001   1HP
 ₹   ₹
7R50   7.5HP
 ₹   ₹
0020   20HP

ENGLISH DISPLAY
AND MANUAL

UL INFORMATION
   :STANDARD TYPE
 U :UL/CUL STANDARD

HARDWARE INFORMATION
    :STANDARD TYPE
 S :220V/440V, 1/2HP COMPACT SIZE TYPE
 A :220V/440V 7.5/10HP VER 2 TYPE

RATED VOLTAGE
 JK :200 ~ 230V
 AZ:380 ~ 460V

1.2 Installation

When installing the inverter, always provide the following space to allow normal heat dissipation.

(a) Space in Side   (b) Space in Top/bottom
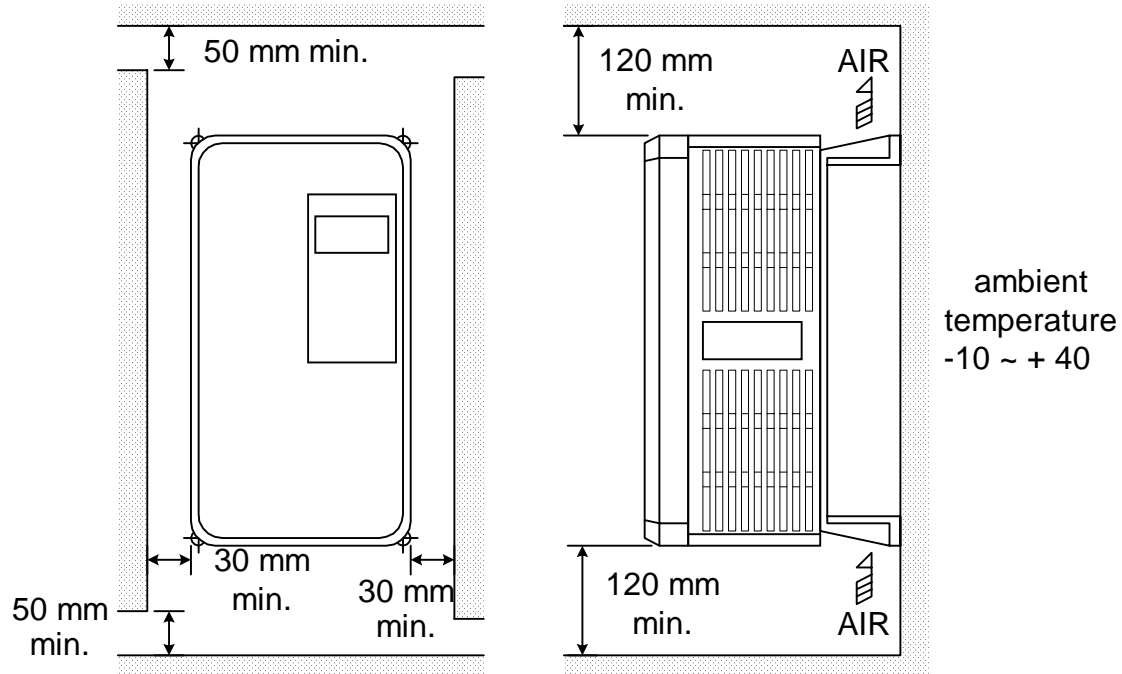
Fig. 1   Air clearance for 7200MA wall mounting

⚠ CAUTION
Location of equipment is important to achieve proper performance and normal operating life. The 7200MA-model unit should be installed in area where the following conditions exist. Ambient temperature : -10°C $+40^{\circ}$C Install 7200MA in a location free from rain, moisture and not in direct sunlight. Install 7200MA in a location free from harmful mist, gases, liquids, dusts and metallic powder. Install 7200MA in a location without excessive oscillation and electromagnetic noise. If more than 1 inverter are installed in a box, be sure to add a cooling fan or air conditioner to maintain the air temperature below $+45^{\circ}$C.

1.3 Removing/Attaching the Digital Operator and Front cover

> ⚠️ **Caution**
>
> 1. Do not remove or attach the LCD digital operator, mount or remove the front cover using methods other than those described above, otherwise the inverter may break or malfunction due to imperfect contact.
> 2. Never hang the front cover on side of the inverter with the LCD digital operator attached to the front cover, otherwise imperfect contact may result.

(A) For Compact Size Type 220V : 1-2HP, 440V : 1-2HP

| JNTMBGBB | JKS 1 | JNTMBGBB | AZS 1 |
| JNTMBGBB | JKSU1 | JNTMBGBB | AZSU1 |

Removing the digital operator :
Take off the two screws of the front cover in the place a and b. Remove the front cover and take off the screws in the place c and d.
Disconnect the RS-232 cable connector on the back side of the LCD digital operator. And then lift the digital operator upwards.

Mounting the front cover and digital operator :
Connect the RS-232 cable connector on the back of the LCD digital operator.

Attach the digital operator and tighten the screws in the place c and d. Insert the tabs of the upper part of front cover into the groove of the inverter and tighten the screws in the place a and b.
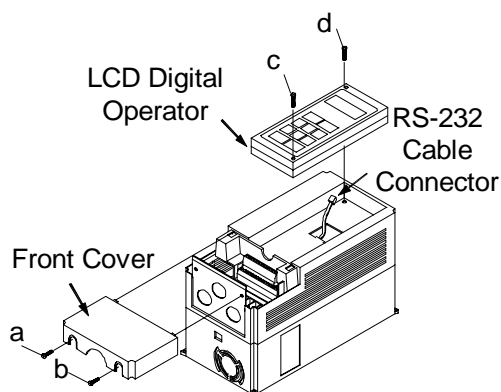
(B) For Standard Type 220V : 3-10HP, 440V : 3-10HP

| JNTMBGBB | JK 1 | JNTMBGBB | AZ 1 |
JNTMBGBB	JK U1	JNTMBGBB	AZ U1
JNTMBGBB	JKA 1	JNTMBGBB	AZA 1
JNTMBGBB	JKAU1	JNTMBGBB	AZAU1

Removing the digital operator
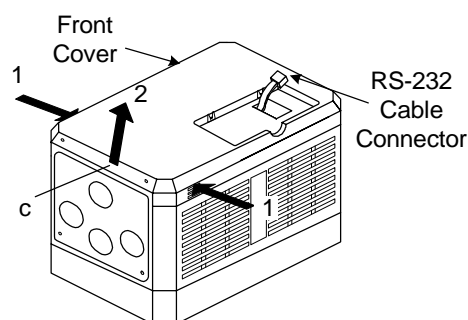
Take off the screws in the place a and b.

Press the lever on the side of the digital operator in the direction of arrow 1 to unlock the digital operator.

Disconnect the RS-232 cable connector on the back side of the LCD digital operator. Lift the digital operator in the direction of arrow 2 to remove the digital operator.

5
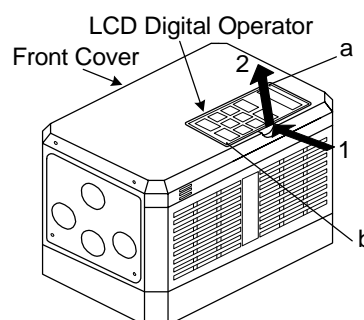
Removing the front cover

Press the left and right sides of the front cover in the directions of arrow 1 and lift the bottom of the cover in the direction of arrow 2 to remove the front cover.

Mounting the front cover and digital operator

Insert the tab of the upper part of front cover into the groove of the inverter and press the lower part of the front cover onto the inverter until the front cover snaps shut.

Connecting the RS-232 cable connector on the back side of the LCD digital operator and hook the digital operator at a on the front cover in the direction of arrow 1.

Press the digital operator in the direction of arrow 2 until it snaps in the place b and then tighten the screws in the place c and d. (on the front cover)

(C) For 220V 15,20HP and 440V 15,20HP Series

JNTMBGBB	JK	1	JNTMBGBB	AZ	1
JNTMBGBB	JK	U1	JNTMBGBB	AZ	U1

Removing the digital operator :
Take off the screws in the place a and b. Disconnect the RS-232 cable connector on the back side of the LCD digital operator and then lift the digital operator upwards.

Removing the front cover :
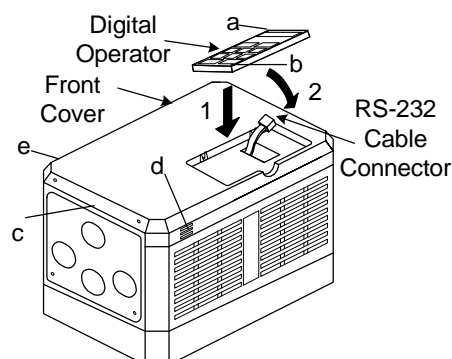Loosen the two screws of the front cover in the place c and d. And lift the bottom of the front cover to remove the front cover.

Mounting the front cover and digital operator :
Insert the tab of the upper part of front cover into the groove of the inverter and tighten the screws in the place c and d.
Connect the RS-232 cable connector on the back of the LCD digital operator.
Attach the digital operator and tighten the screws in the place a and b.

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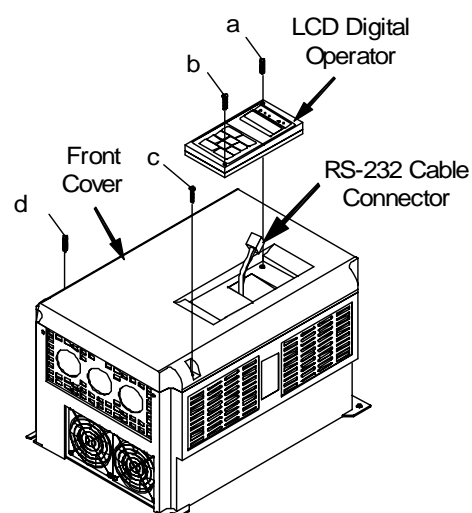
1.4 Wiring between Inverter and Peripheral devices and notice

⚠ Caution

1. After turning OFF the main circuit power supply, do not touch the circuit components or change any circuit components before the "CHARGE" lamps extinguished. (It indicates that there is still some charge in the capacitor).
2. Never do wiring work or take apart the connectors in the inverter while the power is still on.
3. Never connect the inverter output U/T1, V/T2, W/T3 to the AC source.
4. Always connect the ground lead E to ground.
5. Never apply high voltage test directly to the components within the inverter. (The semiconductor devices are vulnerable to high voltage shock.)
6. The CMOS IC on the control board is vulnerable to ESD. Do not try to touch the control board.
7. If Sn-03 is 7,9,11 (2-wire mode) or is 8,10,12 (3-wire mode), except parameter settings of Sn-01 and Sn-02, the other parameter settings will return to their initial settings at factory. If the inverter is initially operated in 3-wire mode (Sn-03= 8,10,12), the motor will rotate in CCW sense after setting changed to 2-wire mode. (Sn-03= 7,9,11). Be sure that the terminals 1 and 2 are OPEN so as not to harmful to personal or cause any potential damage to machines.

⚠ Caution

1. Determine the wire size for the main circuit so that the line voltage drop is within 2% of the rated voltage. If there is the possibility of excessive voltage drop due to wire length, use a larger wire (larger diameter) suitable to the required length

$$\text{Line voltage drop(V)} = \sqrt{3} \times \text{wire resistance}(\Omega/\text{km}) \times \text{wire length(m)} \times \text{current(A)} \times 10^{-3}$$

2. If the length of the cable wire between the inverter and the motor exceeds 30m, use a lower carrier frequency for PWM (adjust the parameter Cn-34). Refer to Page 56.

Example of connection between the 7200MA and typical peripheral devices are shown as below.

Power supply

Power supply switch(NFB) and earth leakage breaker

Electromagnetic contactor

AC reactor

Input noise filter

7200MA inverter

Zero phase core

Induction motor
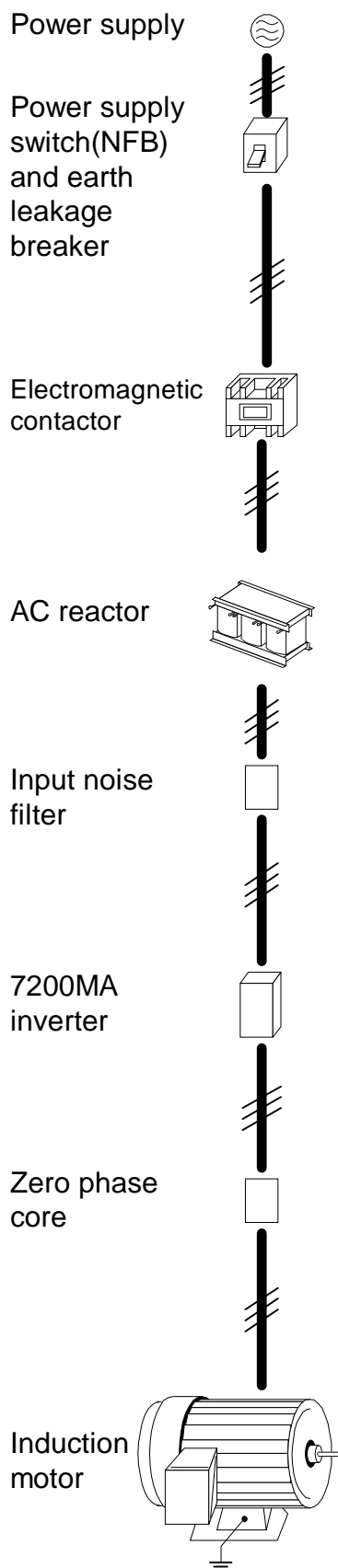
Power supply switch(NFB) and earth leakage breaker
Choose the power supply switch(NFB) of proper current rating.
Do not use the power supply switch(NFB) as the switch that the inverter is used to control the running or stop of motor.
When the earth leakage breaker installed to protect the leakage current fault, be sure that the earth leakage breaker has the sensitivity amperage 200mA per inverter and operation time 0.1 sec to avoid false-triggering.

Electromagnetic contactor
In normal operation, you don't need an electromagnetic contactor. However, you need to install an electro-magnetic contactor while in the case of sequence control through the external device or automatically re-start after power outage.
Do not use the electromagnetic contactor as the switch that control the operation of running or stop.

AC reactor
The AC-side reactor on the input AC side can improve the power factor and suppress the surge current.

Input noise filter
7200MA will comply with the EN55011 class A regulation if an input noise filter (specified by TECO) is used.
Please refer to the selection guide "1.9 Peripheral device" on page 24.

7200MA inverter
Input power supply can be connected to any terminal R/L1, S/L2, T/L3 on the terminal block. The phase sequence of input power supply is irrelevant to phase sequence.
Please connect the ground terminal E to the site ground securely.

Zero phase core
Install the zero phase corer to eliminate noise transmitted between the power line and the inverter.
Please refer to the selection guide "1.9 Peripheral device" on page 25

Induction Motor
If one inverter is to drive more than one motors, the inverter's rated current should be much greater than the sum of total current of motors while in operation.
The inverter and the motor should connect to the ground separately.

Standard Connection Diagram

The standard connection diagram of 7200MA is shown in Fig. 2. The sign indicates the main circuit terminal and the sign indicates control circuit terminal. The terminal function and arrangement are summarized in Table 1 and Table 2. There are three types of control board, the terminal arrangement is shown as below.

(A) For Compact Size Type 220V : 1-2HP, 440V : 1-2HP

JNTMBGBB	JKS 1	JNTMBGBB	AZS 1
JNTMBGBB	JKSU1	JNTMBGBB	AZSU1
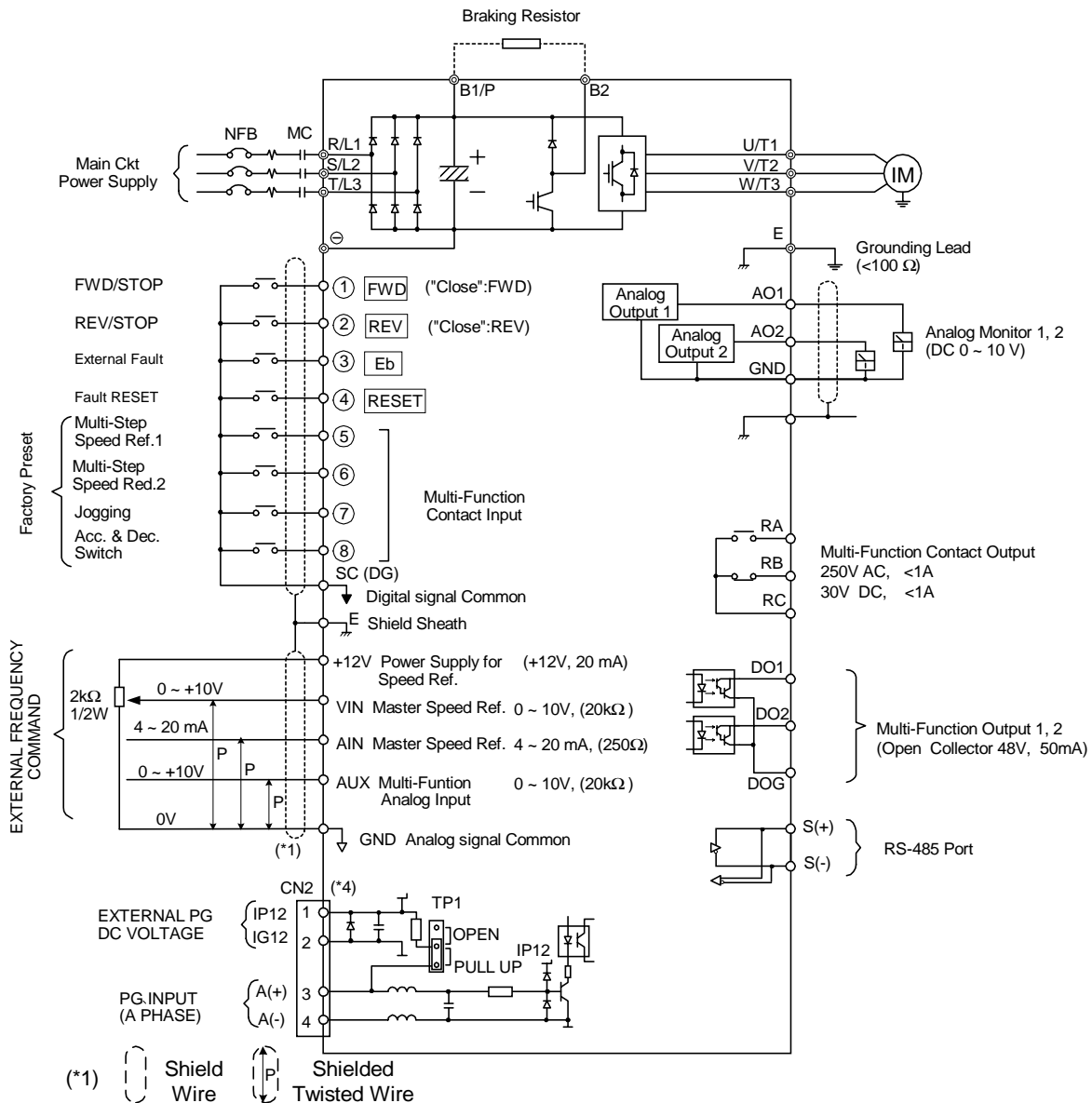
(*1) Shield Wire   Shielded Twisted Wire

(*2) The terminal arrangement

SC	1	3	5	7		VIN	AIN	AUX	DO1	DO2	DOG	S(-)				
E	2	4	6	8	+12V	GND	GND	AO1	AO2	S(+)	E		RA	RB	RC	

(*3) The control board code No. : 4P101C0040001

(*4) The CN2 wire code No. : 4H339D0250001

Fig. 2-a   Standard connection diagram

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(B) For Standard Type   220V : 3-20HP, 440V : 3-20HP

| JNTMBGBB | JK | 1 | JNTMBGBB | AZ | 1 |
| JNTMBGBB | JKA | 1 | JNTMBGBB | AZA | 1 |

Braking Resistor

B1/P   B2

NFB MC R/L1
Main Ckt   S/L2
Power Supply   T/L3

U/T1
V/T2
W/T3
IM

E   Grounding Lead (<100 Ω)

FWD/STOP   ① FWD ("Close":FWD)
REV/STOP   ② REV ("Close":REV)
External Fault ③ Eb
Fault RESET   ④ RESET

Analog Output 1   AO1
Analog Output 2   AO2
GND   Analog Monitor 1, 2 (DC 0 ~ 10 V)

Multi-Step Speed Ref.1   ⑤
Multi-Step Speed Red.2   ⑥
Jogging   ⑦
Acc. & Dec. Switch   ⑧

Factory Preset

Multi-Function Contact Input

SC   Digital signal Common

E Shield Sheath

RA
RB
RC
Multi-Function Contact Output
250V AC, <1A
30V DC,   <1A

2kΩ, 1/2W

+15V Power Supply for Speed Ref. (+15V, 20 mA)

2kΩ 1/2W   0 ~ +10V   VIN Master Speed Ref. 0 ~ 10V, (20kΩ)

4 ~ 20 mA   AIN Master Speed Ref. 4 ~ 20 mA, (250Ω)

0 ~ +10V   P   AUX Multi-Funtion Analog Input   0 ~ 10V, (20kΩ)

0V

EXTERNAL FREQUENCY COMMAND

GND Analog signal Common

(*1)

DO1
DO2
DOG
Multi-Function Output 1, 2
(Open Collector 48V, 50mA)

S(+)
S(-)
RS-485 Port

EXTERNAL PG DC VOLTAGE   IP12
                          IG12
TP1 OPEN
PULL UP
IP12

PG INPUT (A PHASE)   A(+)
                     A(-)

(*1) ⎡⎤ Shield Wire   ⎡P⎤ Shielded Twisted Wire

(*2) The terminal arrangement

| SC | 1 | 3 | 5 | 7 | VIN | AIN | AUX | DO1 | DO2 | DOG | IP12 | A(+) | A(-) | | RA | RB | RC |
| E | 2 | 4 | 6 | 8 | +15V | GND | GND | AO1 | AO2 | E | IG12 | S(+) | S(-) | | | | |

(*3) The control board code No.   3P101C0380003

Fig. 2-b Standard connection diagram

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(C) For UL(CUL) Standard Type   220V : 3-20HP, 440V : 3-20HP

| JNTMBGBB | JK U1 | JNTMBGBB | AZ U1 |
| JNTMBGBB | JKAU1 | JNTMBGBB | AZAU1 |

Braking Resistor

Main Ckt Power Supply

FWD/STOP ① FWD ("Close":FWD)
REV/STOP ② REV ("Close":REV)
External Fault ③ Eb
Fault RESET ④ RESET

Factory Preset
Multi-Step Speed Ref.1 ⑤
Multi-Step Speed Red.2 ⑥
Jogging ⑦
Acc. & Dec. Switch ⑧

Multi-Function Contact Input

24VG (Sink Common)
24V (Source Common)
(* 2)
TP2 : SOURCE
TP2 : SINK

E Shield Sheath
+12V Power Supply for Speed Ref.   (+12V, 20 mA)

EXTERNAL FREQUENCY COMMAND

2kΩ 1/2W   0 ~ +10V
VIN Master Speed Ref. 0 ~ 10V, (20kΩ)
4 ~ 20 mA
AIN Master Speed Ref. 4 ~ 20 mA, (250Ω)
0 ~ +10V
AUX Multi-Funtion Analog Input   0 ~ 10V, (20kΩ)
0V
(*1)   GND Analog signal Common

EXTERNAL PG DC VOLTAGE IP12 / IG12
TP1
OPEN
IP12
PULL UP

PG INPUT (A PHASE) A(+) / A(-)

Grounding Lead (<100 Ω)
Analog Output 1   AO1
Analog Output 2   AO2
GND
Analog Monitor 1, 2 (DC 0 ~ 10 V)

R1A
R1B
R1C
R2A
R2C
Multi-Function Contact Output 250V AC, <1A 30V DC, <1A

DO1
DOG
Multi-Function Output 1 (Open Collector 48V, 50mA)

S(+)
S(-)
RS-485 Port

NFB MC R/L1 S/L2 T/L3
B1/P B2
U/T1 V/T2 W/T3
IM
E

(*1) [Shield Wire]   [P Shielded Twisted Wire]

(*2) The terminal ① ~ ⑧ can be set as SINK or SOURCE type input interface, when setting ① ~ ⑧ as sink type input, the short jumper of TP2 must be set to SINK position, and set to SOURCE position for source type input.

(*3) The terminal arrangement

| 24VG | 1 | 3 | 5 | 7 | 24V | VIN | AIN | AUX | DO1 | DOG | IP12 | A(+) | A(-) | | R2A | R2C | R1A | R1B | R1C |
| E | 2 | 4 | 6 | 8 | +12V | GND | GND | AO1 | AO2 | E | IG12 | S(+) | S(-) | | | | | | |

(*4) The control board code No. : 4P101C0060002
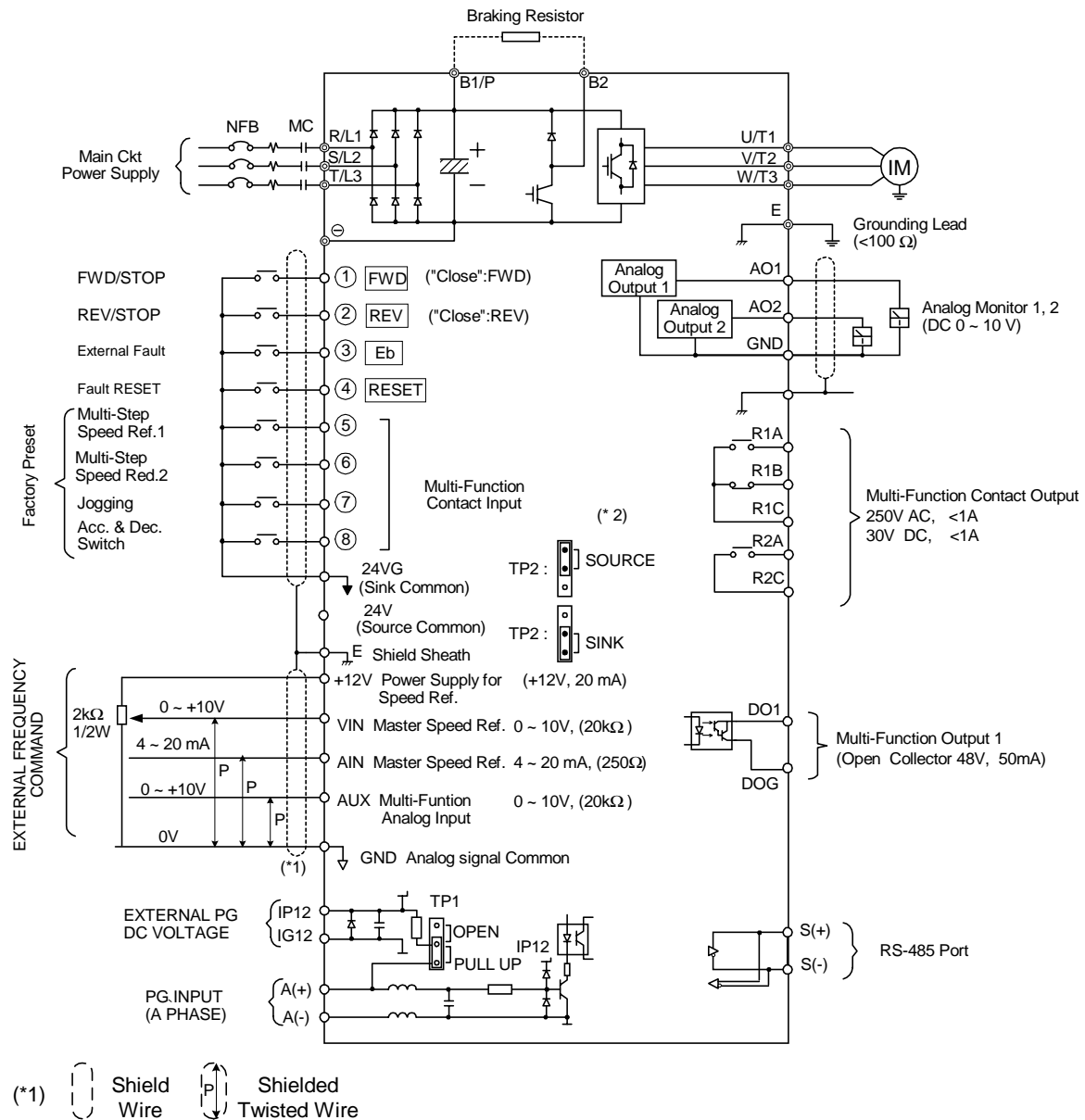
Fig. 2-c   Standard connection diagram

1.5 Description of terminal function

Table 1 Main circuit terminals

Terminal	Terminal Function
R/L1	Main circuit input power supply
S/L2	(For single phase power supply, please use R/L1, S/L2 as input terminal)
T/L3	
B1/P	B1/P, B2: External braking resistor
B2/R	B1/P, : DC power supply input
B2	
U/T1	
V/T2	Inverter output
W/T3	
E	Grounding lead (3rd type grounding)

Terminal block configuration
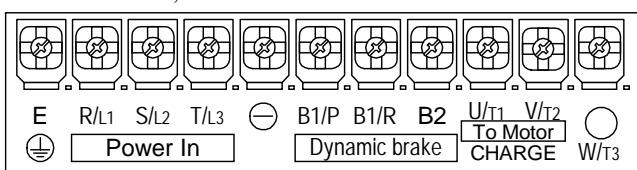
For Compact Size Type 220V : 1-2HP, 440V : 1-2HP

JNTMBGBB	JKS 1	JNTMBGBB	AZS 1
JNTMBGBB	JKSU1	JNTMBGBB	AZSU1

R/L1 S/L2 T/L3 B1/P ⊖ B2 U/T1 V/T2 W/T3
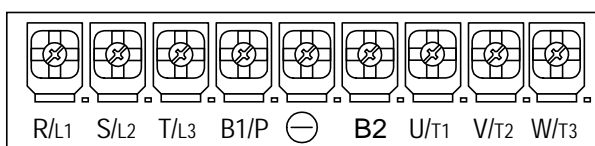
For Standard type and UL(CUL) Type Series

JNTMBGBB	JK 1	JNTMBGBB	AZ 1
JNTMBGBB	JK U1	JNTMBGBB	AZ U1
JNTMBGBB	JKA 1	JNTMBGBB	AZA 1
JNTMBGBB	JKAU1	JNTMBGBB	AZAU1

220V : 3 ~ 5 HP, 440V : 3 ~ 5 HP

E R/L1 S/L2 T/L3 ⊖ B1/P B1/R B2 U/T1 V/T2 W/T3
⊕   Power In   Dynamic brake   To Motor
                                     CHARGE

220V : 7.5 ~ 10 HP, 440V : 7.5 ~ 10 HP

E R/L1 S/L2 T/L3 ⊖ B1/P B1/R B2 U/T1 V/T2 W/T3 E
⊕   Power In   Dynamic brake   To Motor   ⊕
                                     CHARGE

220V : 15 ~ 20 HP, 440V : 15 ~ 20 HP

R/L1 S/L2 T/L3 ⊖ B1/P B2 U/T1 V/T2 W/T3
Power In   Dynamic brake   To Motor

Table 2 Control circuit terminals

Terminal	Functions	
1(DI1)	Forward Operation – Stop Signal	
2(DI2)	Reverse Operation – Stop Signal	
3(DI3)	External Fault Input	
4(DI4)	Fault Reset	
5(DI5) 6(DI6) 7(DI7) 8(DI8)	Multifunction Input Terminal: 3-Wire Operation, Load/Remote Control, Multi-Speed Select, FWD/REV Select, ACC/DEC Choice, ACC/DEC Halting, Base Block, Overheat Warn, PID Control, DC Braking, Speed Search, Up/Down Function, PG Feedback Control, External Fault, Timer function, Multifunction Analog Input Setting	
SC(DG) (24VG)	Digital Signal Ground Sink Common Point (Locate the short jumper of TP2 in SINK position)	
24V^{*1}	Source Common Point (Locate the short jumper of TP2 in SOURCE position)	
E	Connection to Shield Signal Lead (Frame Ground)	
+15V(+12V^{*2})	DC voltage for External Device	
VIN	Master speed Voltage Reference (0~10V)	
AIN	Master speed Current Reference (4~20mA)	
AUX	Auxiliary Analog Input: Auxiliary frequency Command, Frequency Gain, Frequency Bias, Overtorque Detection, Output Voltage Bias, ACC/DEC Ramp, DC-Brake Current, Stall Prevention Current Level during Running Mode, PID Control, Lower-Bound of Frequency Command, Frequency-Jump-4, etc	
GND	Analog Signal Common	
IP12 IG12	External Power Source For PG Feedback Use	
A(+) A(-)	Phase-A Signal Input of PG	
AO1 AO2	Analog Multifunction Output Port: Frequency Commend, Output Frequency, Output Current, Output Voltage, DC Voltage, PID Controlled Value, Analog Command Input of VIN, AIN or AUX.	
GND	Common Lead for Analog Port	
RA(R1A)	Relay Contact Output A	Same function as terminal DO1, DO2
RB(R1B)	Relay Contact Output B	
RC(R1C)	Relay Contact Common	
DO1 DO2 $\left(\begin{smallmatrix}R2A\\R2B\end{smallmatrix}\right)$	Digital Multi-Function (Open Collector) Output "1", "2" Terminals: During-Running, Zero-speed, Agreed-frequency, Agree-frequency-setting, Frequency-Output, Inverter-Operation-Ready, Undervoltage-Detection, Base-Block Output, Run Source, Frequency command, Overtorque Detection, Frequency Command Invalid, Fault, Undervoltage, Overheat, Motor Overload, Inverter Overload, During-Retry, Communication-Fault, Timer-Function-Output	
DOG	Common Terminal (of Open Collector Transistor)	
S(+) S(-)	RS-485 Port	

(*1) Only UL(CUL) Standard Type has 24V terminal.

(*2) Only UL(CUL) and compact type size.

> ⚠ Caution
>
> Use the control circuit terminals VIN, AIN according the setting of Sn-24.
> The MAX. Output current at terminal (+15V or +12V) is 20mA.
> The multi-function analog output terminals AO1, AO2 is a dedicated output for a frequency meter, ammeter, etc. Do not use these 2 analog outputs for feedback control or any other control purpose.

1.6 Wiring main circuit and notice

Main circuit wiring

The non-fusible-breaker (NFB) should be installed between the AC source and the R/L1-S/L2-T/L3 input terminal of 7200MA inverter. The user can make his own decision of installing electromagnetic contactor block (MCB) or not. To protect against the false triggering of leakage-current, the user should install a leakage current breaker with amperage sensitivity 200mA and operation time 0.1 sec.

Table 3　220V and 440V class applicable wire size and connector

| Power supply | 7200MA model | | | Wire size (mm^2) | | | NFB[*4] | MCB[*4] |
	Applicable Power Rating (HP)[*1]	Rated KVA	Rated current (A)	Main circuit[*2]	Ground connection wire E (G)	Control wire[*3]		
220V 1φ 3φ	1HP	2	4.8	2　5.5	2　5.5	0.5　2	TO-50EC(15A)	CN-11
	2HP	2.7	6.4	2　5.5	3.5　5.5	0.5　2	TO-50EC(20A)	CN-11
	3HP	4	9.6	3.5　5.5	3.5　5.5	0.5　2	TO-50EC(20A)	CN-11
220V 3φ	5.4HP	7.5	17.5	5.5	5.5	0.5　2	TO-50EC(30A)	CN-16
	7.5HP	10.1	24	8	5.5　8	0.5　2	TO-100S(50A)	CN-18
	10HP	13.7	32	8	5.5　8	0.5　2	TO-100S(60A)	CN-25
	15HP	20.6	48	22	8	0.5　2	TO-100S(100A)	CN-50
	20HP	27.4	64	30	8	0.5　2	TO-100S(100A)	CN-65
440V 3φ	1HP	2.2	2.6	2　5.5	2　5.5	0.5　2	TO-50EC(15A)	CN-11
	2HP	3.4	4	2　5.5	3.5　5.5	0.5　2	TO-50EC(15A)	CN-11
	3HP	4.1	4.8	2　5.5	3.5　5.5	0.5　2	TO-50EC(15A)	CN-11
	5.4HP	7.5	8.7	2　5.5	3.5　5.5	0.5　2	TO-50EC(15A)	CN-18
	7.5HP	10.3	12	3　5.5	3.5　5.5	0.5　2	TO-50EC(20A)	CN-18
	10HP	12.3	15	5.5	5.5	0.5　2	TO-50EC(30A)	CN-25
	15HP	20.6	24	8　14	8	0.5　2	TO-50EC(30A)	CN-25
	20HP	27.4	32	8　14	8	0.5　2	TO-100S(50A)	CN-35

*1 : It is assumed constant torque load.

*2 : The main circuit has terminals of R/L1, S/L2, T/L3, U/T1, V/T2, W/T3, B1/P, B2/R, B2, .

*3 : The control wire is the wire led to the pin terminals of control board.

*4 : In Table 3, the specified Part No. of NFB and MC are the item No. of the products of Taian. The customer can use the same rating of similar products from other sources. To decrease the noise interference, be sure to add R-C surge suppressor (R: 10Ω/5W, C: 0.1μF/1000VDC) at the 2 terminals of coils of electromagnetic contactor.

External circuit wiring precaution:

(A) Control circuit wiring:
  (1) Separate the control circuit wiring from main circuit wiring (R/L1, S/L2, T/L3, U/T1, V/T2, W/T3) and other high-power lines to avoid noise interruption.
  (2) Separate the wiring for control circuit terminals RA-RB-RC (R1A-R2B-R2C) (contact output) from wiring for terminals ①　⑧, A01, A02, GND, DO1, DO2 (R2A-R2C), DOG and 15V, VIN, AIN, AUX, GND, IP12, IG12, A (+), A (-).
  (3) Use the twisted-pair or shielded twisted-pair cables for control circuits to prevent operating faults. Process the cable ends as shown in Fig. 3. The max. wiring distance should not exceed 50 meter.
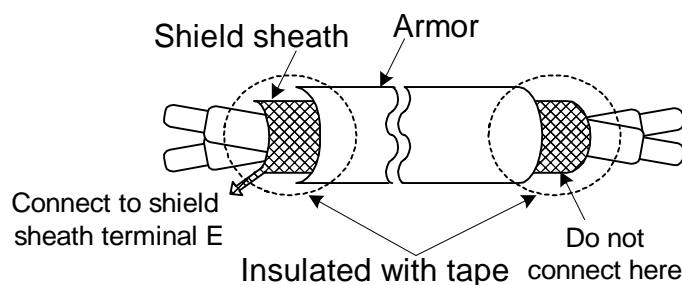
Fig. 3　Processing the ends of twisted-pair cables

When the digital multi-function output terminals connect serially to an external relay, an anti-parallel freewheeling diode should be applied at both ends of relay, as shown below.
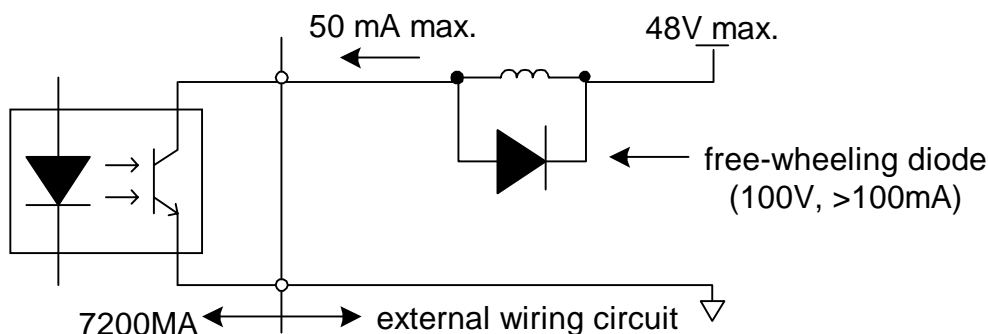

Fig. 4　The Optical-couplers connect to external inductive load

(B) Wiring the main circuit terminals:
  (1) Input power supply can be connected to any terminal R/L1, S/L2 or T/L3 on the terminal block. The phase sequence of input power supply is irrelevant to the phase sequence.
  (2) Never connect the AC power source to the output terminals U/T1, V/T2 and. W/T3.
  (3) Connect the output terminals U/T1, V/T2, W/T3 to motor lead wires U/T1, V/T2, and W/T3, respectively.
  (4) Check that the motor rotates forward with the forward run source. Switch over any 2 of the output terminals to each other and reconnect if the motor rotates in reverse with the forward run source.
  (5) Never connect a phase advancing capacitor or LC/RC noise filter to an output circuit.

(C) GROUNDING
   (1) Always use the ground terminal (E) with a ground resistance of less than 100Ω.
   (2) Do not share the ground wire with other devices, such as welding machines or power tools.
   (3) Always use a ground wire that complies with the technical standards on electrical equipment and minimize the length of ground wire.
   (4) When using more than one inverter, be careful not to loop the ground wire, as shown below.

        (a) OK   (b) OK   (c) NO
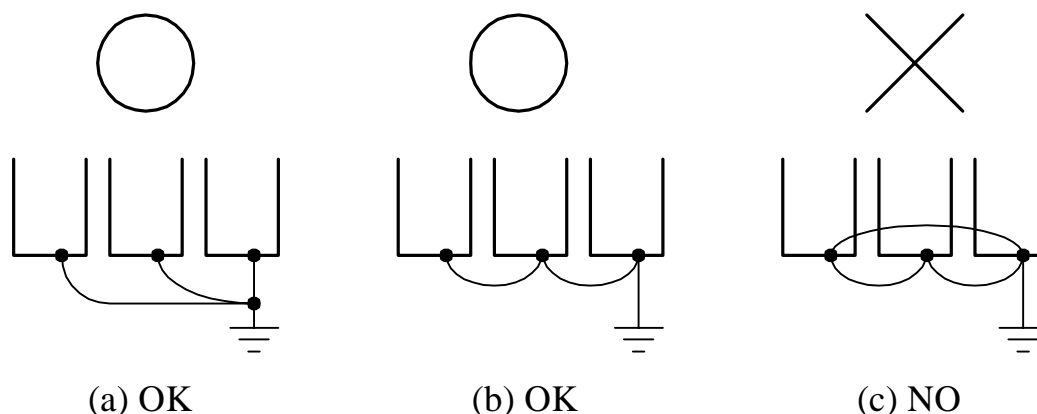
Fig. 5   7200MA ground winding

Determine the wire size for the main circuit so that the line voltage drop is within 2% of the rated voltage. (If there is the possibility of excessive voltage drop, use a larger wire suitable to the required length)

Installing an AC reactor
If the inverter is connected to a large-capacity power source (600kVA or more), install an optional AC reactor on the input side of the inverter. This also improves the power factor on the power supply side.

If the cable between the inverter and the motor is long, the high-frequency leakage current will increase, causing the inverter output current to increase as well. This may affect peripheral devices. To prevent this, adjust the carrier frequency, as shown below:

Cable length	< 30m	30m ~50m	50m ~100m	100m
Carrier frequency (Cn-34)	15kHz max (Cn-34=6)	10kHz max (Cn-34=4)	5kHz max (Cn-34=2)	2.5kHz (Cn-34=1)

1.7 Inverter Specifications

Input Voltage Class			220V CLASS							440V CLASS							
			1 /3-Phase		3-Phase					3 Phase							
MODEL			JNTMBGBB				JK			JNTMBGBB						AZ	
			0001	0002	0003	0005	7R50	0010	0015	0020	0001	0002	0003	0005	7R50	0010	0015	0020
Max. Applicable Motor Output	HP		1	2	3	5.4	7.5	10	15	20	1	2	3	5.4	7.5	10	15	20
	kW		0.75	1.5	2.2	4	5.5	7.5	11	15	0.75	1.5	2.2	4	5.5	7.5	11	15
Output Power	Rated Output Capacity (KVA)		2	2.7	4	7.5	10.1	13.7	20.6	27.4	2.2	3.4	4.1	7.5	10.3	12.3	20.6	27.4
	Rated Output Current* (A)		4.8	6.4	9.6	17.5	24	32	48	64	2.6	4	4.8	8.7	12	15	24	32
	Max. Output Voltage (V)		3 Phase 200~230 V								3 Phase 380~460 V							
	Max. Output Frequency (Hz)		Through Parameter Setting (0Hz to 400Hz)															
Power Source	Rated Voltage· Frequency		1- / 3-Phase 200~230V 50/60Hz		3-Phase 200~230V 50/60Hz						3 Phase 380~460V 50/60Hz							
	Allowable Voltage Fluctuation		-15% ~ +10%															
	Allowable Frequency Fluctuation		±5%															
Control Characteristics	Operation Mode		Graphic LCD Panel (English and Chinese) with parameters copying															
	Control Mode		Sinusoidal PWM															
	Frequency Control Range		0.5Hz ~ 400Hz															
	Frequency Accuracy (varied with temperature)		Digital Command: ±0.01% (-10 ~ +40ºC), Analog Command: ±0.1% (25ºC±10ºC),															
	Speed Control Accuracy		±0.1 (V/F with PG feedback), ±0.5 (Sensorless Vector Contorl)															
	Frequency Command Resolution		Digital Command: 0.01Hz Analog Command: 0.06Hz/60Hz															
	Frequency Output Resolution		0.01Hz															
	Overload Resistibility		150% Rated Current for 1 Min															
	Frequency Setting Signal		DC 0~+10V / 4~20 mA															
	Acc./Dec. Time		0.0~6000.0 sec (Accel/Decel Time Can Be Set Independently)															
	Voltage–Frequency Characteristics		V/F Curve Can Be Set Through Parameter Setting															
	Regeneration Torque		Approx. 20%															

*: The rated output current while in continuous operation

Input Voltage Class			220V CLASS				440V CLASS		
			1 /3-Phase	3-Phase			3 Phase		
MODEL			JNTMBGBB JK				JNTMBGBB AZ		
			0001 0002 0003 0005 7R50 0010 0015 0020				0001 0002 0003 0005 7R50 0010 0015 0020		
Control Characteristics	Basic Control Function		Restart After Momentary Power Loss, PID Control, Auto Torque Boost, Slip Compensation, RS_485 Communication, Speed Feedback Control, Simple PLC function, 2 Analog Output Port						
	Extra Function		Cumulative Power on & Operation Hour memory, Energy Saving, Up/Down Operation, 4 Different sets of Fault Status Record (Including Latest one), MODBUS Communication, Multiple-Pulse Output Ports, etc.						
Protection Function	Stall Prevention		During Acceleration/Deceleration and constant Speed Running (Current Level Can Be Selected During Acceleration and Constant Speed Running. During Deceleration, Stall Prevention Can Be Enabled or Disabled)						
	Instantaneous Overcurrent		Stopped if above 200% Rated Current						
	Motor Overload Protection		Electronic Overload Curve Protection						
	Inverter Overload Protection		Stopped if above 150% Rated Current for 1 Min.						
	Overvoltage		Stop if VDC 410V (220 Class) or VDC 820V (440 Class)						
	Undervoltage		Stop if VDC 200V (220 Class) or VDC 400V (440 Class)						
	Momentary Power Loss Ride-Through time		15ms, stop otherwise						
	Overheat Protection		Protected by Thermistor						
	Grounding Protection		Protection by DC Current Sensor						
	Charge Indication (LED)		Lit when the DC Bus Voltage Above 50V						
Mechanical Construction			Enclosed, Wall-Mounted Type (NEMA-1)						
Cooling			Forced[*1]	Forced			Forced[*1]	Forced	
Weight (kg)			2.29^{*1} 2.29^{*1} 4.25 4.25 5.73 5.73 10.5 10.5				2.29^{*1} 2.29^{*1} 4.25 4.25 5.73 5.73 10.5 10.5		
Environmental Condition	Application Site		Indoor (No Corrosive Gas And Dust Present)						
	Ambient Temperature		-10ºC ~ +40ºC (Not Frozen)						
	Storage Temperature		-20ºC ~ +60ºC						
	Ambient Humidity		Below 90%RH (Non-Condensing)						
	Height, Vibration		Below 1000M, 5.9m/S^2 (0.6G), (JISC0911 Standard)						
Communication Function			RS-485 Installed (MODBUS Protocol)						
EMI			Meet EN50081-2 (1994) With Specified EMI Filter						
EMC Compatibility			Meet Pr EN 50082-2						
Option			PROFIBUS Card						

*1 : The standard type (JNTMBGBB   JK/AZ   ) use self cooling. Its weight is 4.12kg.
      The compact type (JNTMBGBB   JK/AZ S   ) use forced cooling. Its weight is 2.29kg.

1.8 Dimensions

(A) For Compact Size Type 220V : 1-2HP, 440V : 1-2HP
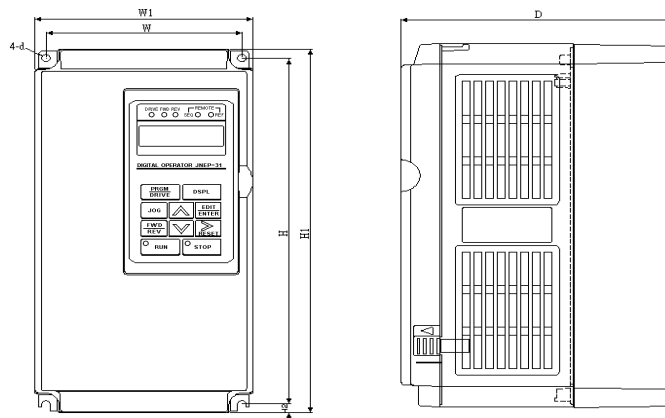
JNTMBGBB	JKS 1
JNTMBGBB	AZS 1
JNTMBGBB	JKSU1
JNTMBGBB	AZSU1

Voltage	Max. applicable motor output (HP)	Mounting Dimension (mm)				External Dimension (mm)			Approx. mass N.W. (kg)
		W	H	H2	d	W1	H1	D	
220V 1φ/3φ	1	122	207	5	M5	132	217	143.5	2.29
	2								
440V 3φ	1	122	207	5	M5	132	217	143.5	2.29
	2								

(B) For Standard Type 220V : 3-10HP, 440V : 3-10HP

JNTMBGBB	JK 1
JNTMBGBB	AZ 1
JNTMBGBB	JK U1
JNTMBGBB	AZ U1
JNTMBGBB	JKA 1
JNTMBGBB	AZA 1
JNTMBGBB	JKAU1
JNTMBGBB	AZAU1

Voltage	Max. applicable motor output (HP)	Mounting Dimension (mm)				External Dimension (mm)			Approx. mass N.W. (kg)
		W	H	H2	d	W1	H1	D	
220V 1φ/3φ	3	126	266	6.8	M6	140	279.5	176.5	4.25
220V 3φ	5.4	192	286	7	M6	211.2	300	215	5.73
	7.5								
	10								
440V 3φ	3	126	266	6.8	M6	140	279.5	176.5	4.25
	5.4								
	7.5	192	286	7	M6	211.2	300	215	5.73
	10								

(C) For 220V/440V 15,20HP Series

JNTMBGBB	JK	1	JNTMBGBB	AZ	1
JNTMBGBB	JK	U1	JNTMBGBB	AZ	U1

Voltage	Max. applicable motor output (HP)	Mounting Dimension (mm)				External Dimension (mm)			Approx. mass N.W. (kg)
		W	H	H2	d	W1	H1	D	
220V 3ϕ	15	245	340	10	M6	265	360	225	10.5
	20								
440V 3ϕ	15	245	340	10	M6	265	360	225	10.5
	20								

1.9 Peripheral Units

Braking resistors

All 7200MA model have built-in braking transistor as standard. If more braking capacity is needed, the external braking resistor will be used.

The 7200MA (1-5HP standard type, except compact size type) can have an external braking resistor attached on the back of heat sink of inverter.

Braking resistor

B1/P   B1/R   B2
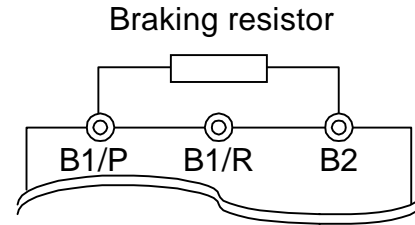
Fig. 6 Wiring diagram for external brake resistor

Table 4   Brake resistor list

Model		External brake resistor		
V	HP	Code number	Resistor specification	Approx. braking torque
220V 1φ /3φ	1	4H333D0010007	150W/200	125%, 3%ED
	2	4H333D0020002	150W/100	125%, 3%ED
	3	4H333D0030008	150W/70	120%, 3%ED
220V 3φ	5.4	4H333D0040003	150W/62	100%, 3%ED
	7.5	4H333D0120007	600W/35	100%, 10%ED
	10	4H333D0130002	800W/25	100%, 10%ED
	15	4H333D0140008	2400W/17	100%, 10%ED
	20	4H333D0150003	3000W/13	100%, 10%ED
440V 3φ	1	4H333D0070000	150W/750	130%, 3%ED
	2	4H333D0080005	150W/400	125%, 3%ED
	3	4H333D0090001	150W/300	115%, 3%ED
	5.4	4H333D0010007	150W/200	110%, 3%ED
	7.5	4H333D0160009	600W/130	105%, 10%ED
	10	4H333D0170004	800W/100	100%, 10%ED
	15	4H333D0180000	1000W/68	100%, 10%ED
	20	4H333D0190005	1600W/50	100%, 10%ED

AC reactor

An AC reactor can be added on the power supply side if the inverter is connected to a much larger capacity power supply system, or the inverter is within short distance (<10m) from power supply systems, or to increase the power factor on the power supply side.

Choose the proper AC reactor according to the below list.

Table 5　AC reactor list

Inverter Model			AC reactor	
V	HP	Rated current	Code No.	Specification (mH/A)
220V 1φ/3φ	1	4.8A	3M200D1610021	2.1mH/5A
	2	6.5A	3M200D1610030	1.1mH/10A
	3	9.6A	3M200D1610048	0.71mH/15A
220V 3φ	5.4	17.5A	3M200D1610056	0.53mH/20A
	7.5	24A	3M200D1610064	0.35mH/30A
	10	32A	3M200D1610072	0.265mH/40A
	15	48A	3M200D1610081	0.18mH/60A
	20	64A	3M200D1610099	0.13mH/80A
440V 3φ	1	2.6A	3M200D1610137	8.4mH/3A
	2	4A	3M200D1610145	4.2mH/5A
	3	4.8A	3M200D1610153	3.6mH/7.5A
	5.4	8.7A	3M200D1610161	2.2mH/10A
	7.5	12A	3M200D1610170	1.42mH/15A
	10	15A	3M200D1610188	1.06mH/20A
	15	24A	3M200D1610196	0.7mH/30A
	20	32A	3M200D1610200	0.53mH/40A

Note: The AC reactors are applied only to input side. Do not apply it to output side.

Noise filter

A. INPUT SIDE NOISE FILTER

Installing a noise filter on power supply side to eliminate noise transmitted between the power line and the inverter

7200MA has its specified noise filter to meet the EN55011 class A specification

Table 6   Noise filter on the input side

Inverter Model			Noise filter			
V	HP	Rated current	ϕ	Code	Rated current	Dimension
220V 1ϕ/3ϕ	1	4.8A	1ϕ	JUNF12015S-MA	15 A	fig. (a)
			3ϕ	JUNF32012S-MA	12 A	fig. (a)
	2	6.5A	1ϕ	JUNF12015S-MA	15 A	fig. (a)
			3ϕ	JUNF32012S-MA	12 A	fig. (a)
	3	9.6A	1ϕ	JUNF12020S-MA	20 A	fig. (a)
			3ϕ	JUNF32024S-MA	24 A	fig. (a)
220V 3ϕ	5.4	17.5A	3ϕ	JUNF32024S-MA	24 A	fig. (a)
	7.5	24A	3ϕ	JUNF32048S-MA	48 A	fig. (b)
	10	32A	3ϕ	JUNF32048S-MA	48 A	fig. (b)
	15	48A	3ϕ	JUNF32070S-MA	70 A	fig. (b)
	20	64A	3ϕ	JUNF32070S-MA	70 A	fig. (b)
440V 3ϕ	1	2.6A	3ϕ	JUNF34008S-MA	8 A	fig. (a)
	2	4A	3ϕ	JUNF34008S-MA	8 A	fig. (a)
	3	4.8A	3ϕ	JUNF34012S-MA	12 A	fig. (a)
	5.4	8.7A	3ϕ	JUNF34012S-MA	12 A	fig. (a)
	7.5	12A	3ϕ	JUNF34024S-MA	24 A	fig. (b)
	10	15A	3ϕ	JUNF34024S-MA	24 A	fig. (b)
	15	24A	3ϕ	JUNF34048S-MA	48 A	fig. (b)
	20	32A	3ϕ	JUNF34048S-MA	48 A	fig. (b)

Dimension : (unit : mm)
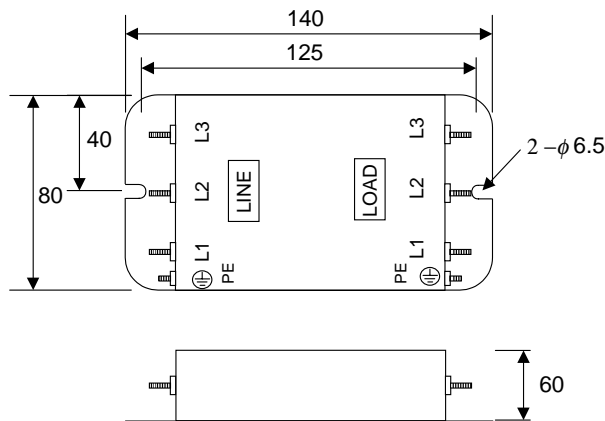
fig. 7(a)
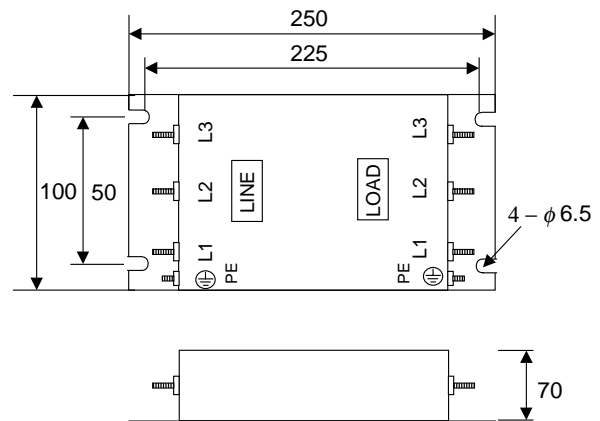
fig. 7(b)

B. EMI SUPPRESSION ZERO PHASE CORE

Model : JUNFOC046S

Code No. : 4H000D0250001

According to the required power rating and wire size, select the matched ferrite core to suppress EMI noise.

The ferrite core can attenuate the frequency response at high frequency range (from 100KHz to 50MHz, as shown below). It should be able to attenuate the RFI from inverter to outside.

The zero-sequence noise ferrite core can be installed either on the input side or on the output side. The wire around the core for each phase should be winded by following the same convention and one direction. The more winding turns the better attenuation effect. (Without saturation). If the wire size is too big to be winded, all the wire can be grouped and go through these several cores together in one direction.

Frequency attenuation characteristics (10 windings case)
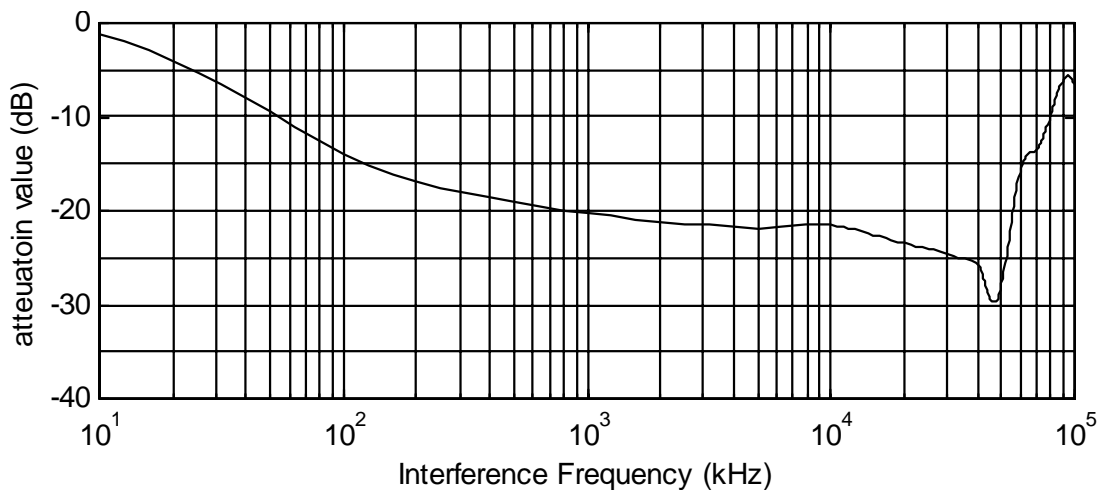
Example: EMI suppression zero phase core application example
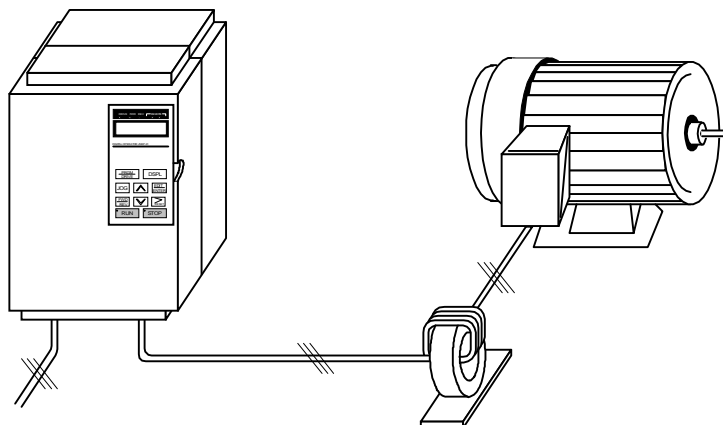
Note: All the line wire of U/T1, V/T2, W/T3 phase must pass through the same zero-phase core in the same winding sense.

LCD operator with extension wire

When used for remote control purpose, the LCD operator can have different extension wires based upon the applications. Some extension wires are listed below.
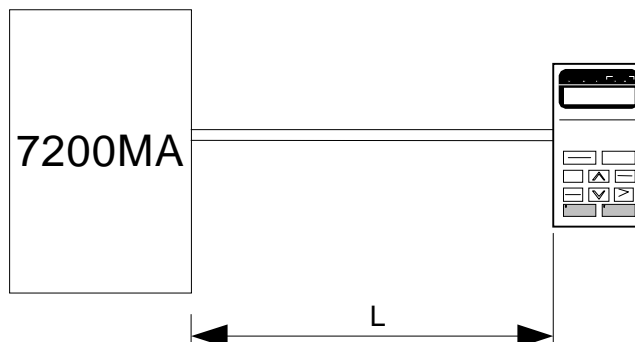
Cable Length	Extension Cable Set *1	Extension Cable *2	Blank Cover *3
1m	4H332D0010000	4H314C0010003	4H300D1120000
2m	4H332D0030001	4H314C0030004	
3m	4H332D0020005	4H314C0020009	
5m	4H332D0040006	4H314C0040000	

*1   Including special cable for LCD digital operator, blank cover, fixed use screws and installation manual.
*2   One special cable for LCD digital operator.
*3   A blank cover to protect against external dusts, metallic powder, etc.

The physical dimension of LCD digital operator is drawn below.
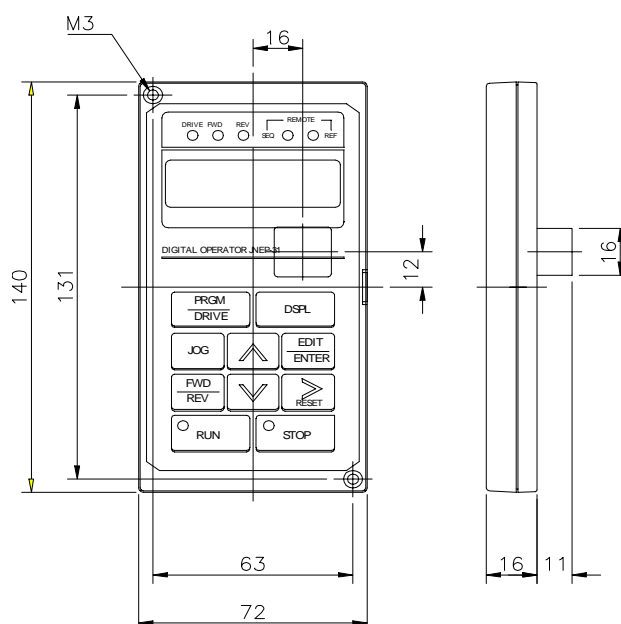
Fig. 8 LCD Digital Operator Dimension

Analog operator

All 7200MA have the digital LCD digital operator. Moreover, an analog operator as JNEP-16 (shown in fig. 9) is also available and can be connected through wire as a portable operator. The wiring diagram is shown below.
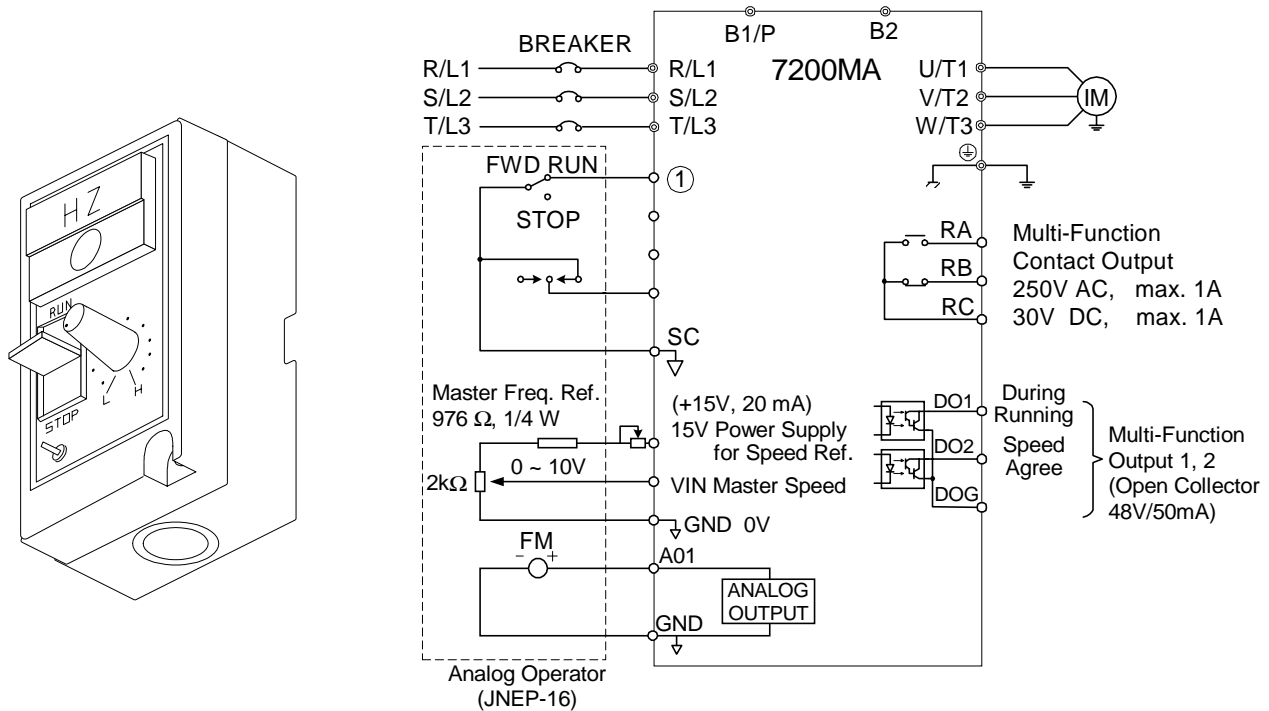
Fig. 9 Analog Operator

PROFIBUS Communication Card

Code No. : 4H300D0290009

Please refer to the appendix D and "7200MA PROFIBUS-DP Communication Application manual" for communication interface.

2. Using LCD Digital Operator

Functions of LCD digital operator

JNEP-31 LCD digital operator has 2 modes: DRIVE mode and PRGM mode. When the inverter is stopped, DRIVE mode or PRGM mode can be selected by pressing the key $\boxed{\frac{PRGM}{DRIVE}}$. In DRIVE mode, the operation is enabled. Instead, in the PRGM mode, the parameter settings for operation can be changed but the operation is not enabled. The component names and function are shown as below:
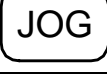

operation mode indicators
DRIVE   lit when in DRIVE mode
FWD   lit when there is a forward run command input
REV   lit when there is a reverse run command input
SEQ   lit when the run command is enabled from the control circuit terminal or RS-485 port (REMOTE mode)
REF   lit when the frequency reference from the control circuit terminals (VIN or AIN) or RS-485 port is enabled (REMOTE mode)

LCD Display
Chinese Display : 2-line by 8-character
English Display: 2-line by 20-character
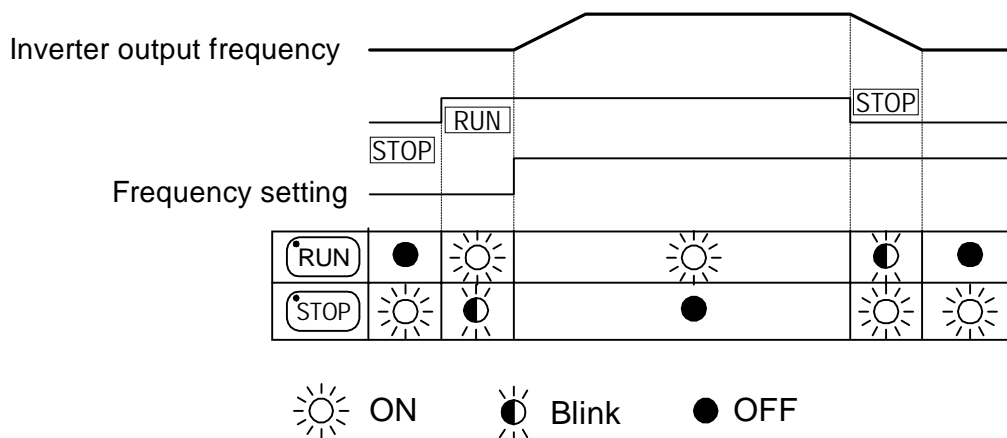
Keys (Key functions are defined in Table 7)

Fig. 10   LCD Digital operator

Table 7 Key's functions

Key	Name	Function
PRGM/DRIVE	PRGM/DRIVE key	Switches over between program mode (PRGM) and drive mode (DRIVE).
DSPL	DSPL key	Display operation status
JOG	JOG key	Enable jog operation from LCD digital operator in operation (DRIVE).
FWD/REV	FWD/REV key	Select the rotation direction from LCD digital operator.
>/RESET	RESET key	Set the number of digital for user constant settings. Also It acts as the reset key when a fault has occurred.
∧	INCREMENT key	Select the menu items, groups, functions, and user constant name, and increment set values.
∨	DECREMENT key	Select the menu items, groups, functions, and user constant name, and decrement set values.
EDIT/ENTER	EDIT/ENTER key	Select the menu items, groups, functions, and user constants name, and set values (EDIT). After finishing the above action, press the key (ENTER).
RUN	RUN key	Start inverter operation in (DRIVE) mode when the digital operator is used. The LED will light.
STOP	STOP key	Stop 7200MA operation from LCD digital operator. The STOP key can be enabled or disabled by setting the parameter Sn-07 when operating from the control circuit terminal.

RUN STOP indicator lights or blinks to indicate the 3 operating status:

☀ ON   ◐ Blink   ● OFF

Display contents in DRIVE mode and PRGM mode

Power on

PRGM mode ← [PRGM/DRIVE] → DRIVE mode *1

PRGM mode branch:

[DSPL]

An-　　monitor　set

[DSPL]

Bn-　　monitor　set

[DSPL]

Sn-　　monitor　set

[DSPL]

Cn-　　monitor　set

DRIVE mode branch:

[DSPL]

Frequency reference value displayed

[DSPL]

display monitor　set item

[DSPL] *2

Un-　　monitor

[DSPL]

An-　　monitor　set

[DSPL]

Bn-　　monitor　set

[DSPL]

[DSPL] + [> RESET] *3

Sn-　　monitor

[DSPL]
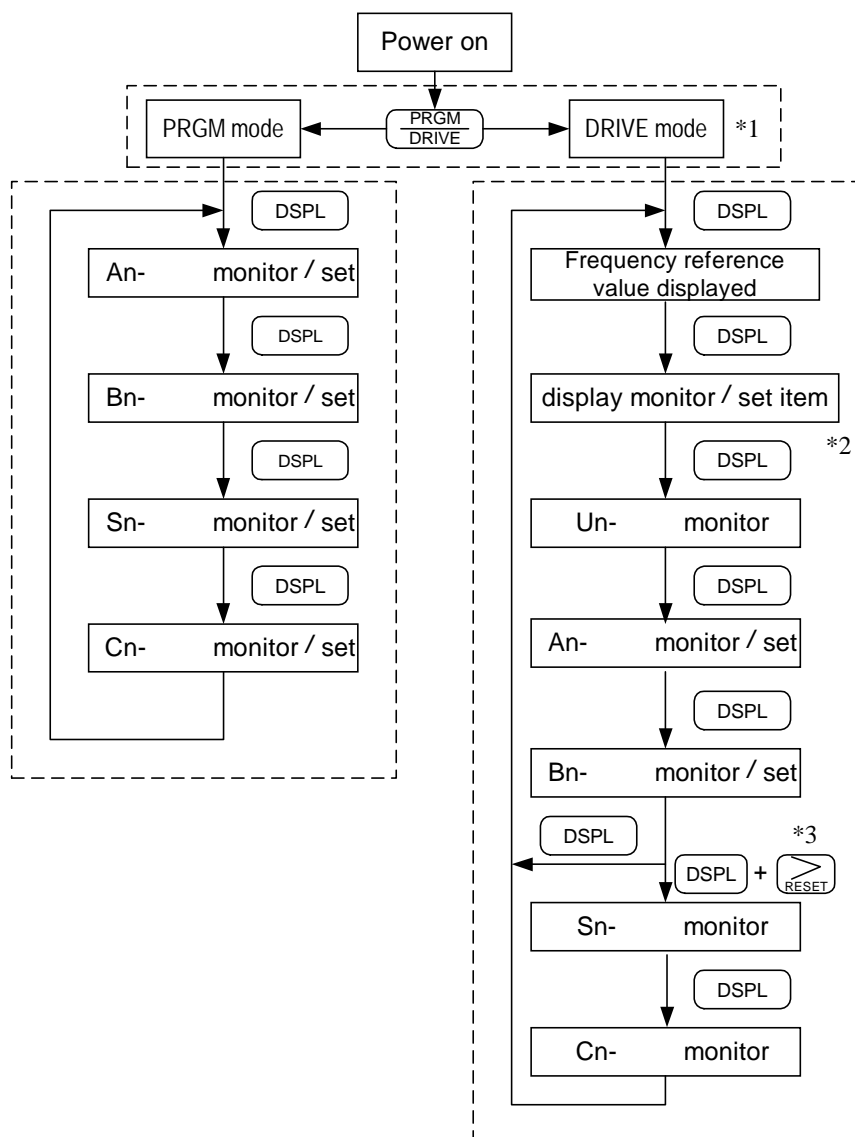
Cn-　　monitor

*1 When the inverter is powered up, the inverter system immediately enters into DRIVE mode. Press the [PRGM/DRIVE] key, the system will switch into PRGM mode. If the fault occurs, press the [PRGM/DRIVE] key and enter into DRIVE mode to monitor the corresponding Un-　　contents. If a fault occurs in the DRIVE mode, the corresponding fault will be displayed. Press the [> RESET] key and reset the fault.

*2 The monitored items will be displayed according to the settings of Bn-12 and Bn-13.

*3 When in the DRIVE mode, press the [DSPL] key and [> RESET] key, the setting values of Sn- and Cn-　　will only be displayed for monitoring but not for changing or setting.

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Parameter description

The 7200MA has 4 groups of user parameters:

Parameters	Description
An-	Frequency command
Bn-	Parameter groups can be changed during running
Sn-	System parameter groups (can be changes only after stop)
Cn-	Control parameter groups (can be changed only after stop)

The parameter setting of Sn-03 (operation status) will determine if the setting value of different parameter groups are allowed to be changed or only to be monitored, as shown below:

Sn-03	DRIVE mode		PRGM mode	
	To be set	To be monitored	To be set	To be monitored
0^{*1}	An,Bn	Sn,Cn	An,Bn,Sn,Cn	
1	An	Bn,(Sn,Cn) ^{*2}	An	Bn,Sn,Cn

*1   Factory setting

*2   When in DRIVE mode, the parameter group Sn-, Cn- can only be monitored if the $\boxed{\overset{>}{\text{RESET}}}$ key and the $\boxed{\text{DSPL}}$ key are to be pressed simultaneously.

After a few trial and adjustment, the setting value Sn-03 is set to be "1" so as not be modified again.
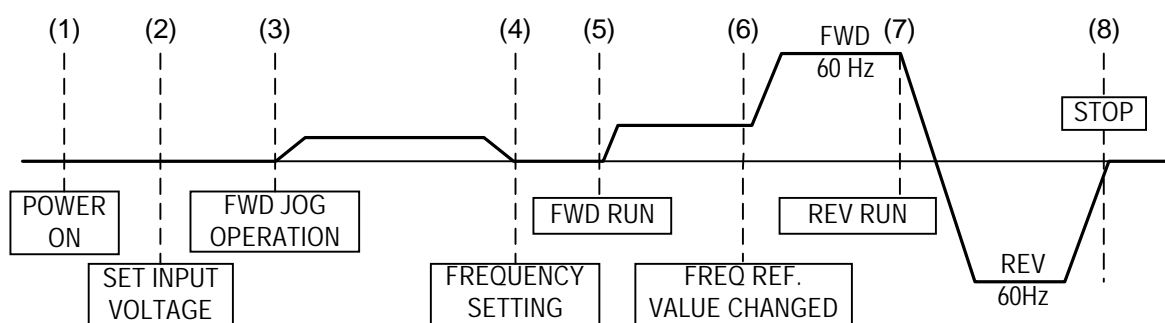
Example of using LCD digital operator

> Note
>
> Before operation: Control parameter Cn-01 value must be set as the input AC voltage value. For example, Cn-01=380 if AC input voltage is 380.

This example will explain the operating of 7200MA according to the following time chart.

OPERATION MODE

Example of operation

Description		Key Sequence	Digital Operator Display	Remark
(1)	When Power on — Select frequency reference value displayed		Freq. Cmd.000.00Hz TECO	
		Select PRGM mode	PRGM / DRIVE	An -01 Freq. Cmd. 1	LED DRIVE OFF
(2)	Input voltage setting (e.g. AC input voltage is 380V)	Select CONTROL PARAMETER	DSPL press 3 times	Cn -01- Input Voltage	
			EDIT / ENTER	Cn-01 = 440.0V Input Voltage	
		Display Cn-01 setting Input Voltage 380V	>/RESET ∧ ∨	Cn-01 = 380.0V Input Voltage	Display for 0.5 sec
	(continued)		EDIT / ENTER	Entry Accepted	

32

Description		Key Sequence	Digital Operator Display	Remark
(continued)				
(3) FWD JOG	Select DRIVE mode	PRGM/DRIVE	Freq. Cmd.000.00Hz TECO	LED DRIVE ON
	Select output frequency displayed	DSPL	Freq. Cmd.0.00 Hz O/P Freq. 0.00 Hz	LED FWD ON
	Select direction of rotation (When power on, initially defaulted FWD)			
	Jog operation	JOG	O/P Freq. 6.00 Hz Freq. Cmd. 6.00 Hz	
(4) Frequency setting	Select frequency cmd displayed	DSPL press 4 times	Freq. Cmd.000.00Hz TECO	
15 Hz	Change frequency cmd	>/RESET ∧ ∨	Freq. Cmd.015.00Hz TECO	
	Set new frequency cmd	EDIT/ENTER	Freq. Cmd.015.00Hz TECO	
			Entry Accepted	Displayed for 0.5sec Confirm the display.
	Select O/P frequency displayed	DSPL	O/P Freq. 0.00 Hz Freq. Cmd. 15.00 Hz	
(5) FWD run	Running operation	RUN	O/P Freq. 15.00 Hz Freq. Cmd. 15.00 Hz	LED RUN ON
(6) Frequency command change	Select frequency cmd displayed	DSPL press 4 times	Freq. Cmd.015.00Hz TECO	
60 Hz	Change reference value	>/RESET ∧ ∨	Freq. Cmd.060.00Hz TECO	
	Enter new frequency cmd setting	EDIT/ENTER	Freq. Cmd.060.00Hz TECO	
			Entry Accepted	Displayed for 0.5sec Confirm the display.
	Select frequency cmd displayed	DSPL	O/P Freq. 60.00 Hz Freq. Cmd. 60.00 Hz	
(7) REV RUN	Change to REV	FWD/REV	O/P Freq. 60.00 Hz Freq. Cmd. 60.00 Hz	LED REV ON
(8) STOP	Decrement to STOP	STOP	O/P Freq. 0.00 Hz Freq. Cmd. 60.00 Hz	LED STOP ON (Blinking while decel.) RUN

Example of display (use $\wedge$ and $\vee$ keys to display monitored items/contents)

Description	Key Sequence	Digital Operator Display	Remark
Display Frequency Command		Freq. Cmd. 60.00Hz TECO	
Display Moniter Contents *1	DSPL	Freq. Cmd. 60.00 Hz O/P Freq. 60.00 Hz	
Display Output Current	$\wedge$	Freq. Cmd. 60.00 Hz O/P I 12.5 A	
Display Output Voltage	$\wedge$	Freq. Cmd. 60.00 Hz O/P Volt. 220.0 V	
Display DC Voltage	$\wedge$	Freq. Cmd. 60.00 Hz DC Volt. 310.0 V	
Display Output Voltage	$\vee$	Freq. Cmd. 60.00 Hz O/P Volt. 220.0 V	
Display Output Current	$\vee$	Freq. Cmd. 60.00 Hz O/P I 12.5 A	

*1 The monitor contents can be selected by the setting of Bn-12 and Bn-13

3. Parameter Setting

3.1 Frequency command (in Multi-speed operation)   An[*1]-

Under the DRIVE mode, the user can monitor the parameters and set their values.

Parameter No.	Name	LCD Display (English)	Setting Range		Setting[*2] Unit	Factory Setting	Ref. Page
An-01	Frequency Command 1	An-01= 000.00Hz Freq. Cmd. 1	0.00	400.00Hz	0.01Hz	0.00Hz	
An-02	Frequency Command 2	An-02= 000.00Hz Freq. Cmd. 2	0.00	400.00Hz	0.01Hz	0.00Hz	
An-03	Frequency Command 3	An-03= 000.00Hz Freq. Cmd. 3	0.00	400.00Hz	0.01Hz	0.00Hz	
An-04	Frequency Command 4	An-04= 000.00Hz Freq. Cmd. 4	0.00	400.00Hz	0.01Hz	0.00Hz	
An-05	Frequency Command 5	An-05= 000.00Hz Freq. Cmd. 5	0.00	400.00Hz	0.01Hz	0.00Hz	
An-06	Frequency Command 6	An-06= 000.00Hz Freq. Cmd. 6	0.00	400.00Hz	0.01Hz	0.00Hz	
An-07	Frequency Command 7	An-07= 000.00Hz Freq. Cmd. 7	0.00	400.00Hz	0.01Hz	0.00Hz	
An-08	Frequency Command 8	An-08= 000.00Hz Freq. Cmd. 8	0.00	400.00Hz	0.01Hz	0.00Hz	82,97, 98
An-09	Frequency Command 9	An-09= 000.00Hz Freq. Cmd. 9	0.00	400.00Hz	0.01Hz	0.00Hz	
An-10	Frequency Command 10	An-10= 000.00Hz Freq. Cmd. 10	0.00	400.00Hz	0.01Hz	0.00Hz	
An-11	Frequency Command 11	An-11= 000.00Hz Freq. Cmd. 11	0.00	400.00Hz	0.01Hz	0.00Hz	
An-12	Frequency Command 12	An-12= 000.00Hz Freq. Cmd. 12	0.00	400.00Hz	0.01Hz	0.00Hz	
An-13	Frequency Command 13	An-13= 000.00Hz Freq. Cmd. 13	0.00	400.00Hz	0.01Hz	0.00Hz	
An-14	Frequency Command 14	An-14= 000.00Hz Freq. Cmd. 14	0.00	400.00Hz	0.01Hz	0.00Hz	
An-15	Frequency Command 15	An-15= 000.00Hz Freq. Cmd. 15	0.00	400.00Hz	0.01Hz	0.00Hz	
An-16	Frequency Command 16	An-16= 000.00Hz Freq. Cmd. 16	0.00	400.00Hz	0.01Hz	0.00Hz	
An-17	Jog Frequency Command	An-17= 000.00Hz Jog Freq. Cmd.	0.00	400.00Hz	0.01Hz	6.00Hz	84

*1. At factory setting, the value of "Setting Unit" is 0.01Hz.

*2. The displayed "Setting Unit" can be changed through the parameter Cn-28.

3.2 Parameters Groups Can Be Changed during Running Bn-

Under the DRIVE mode, the Parameter group can be monitored and set by the users.

Function	Parameter No.	Name	LCD display (English)	Setting range		Setting Unit	Factory Setting	Ref. Page
Acc/Dec time	Bn-01	Acceleration Time 1	Bn-01= 0010.0s Acc. Time 1	0.0	6000.0s	0.1s	10.0s	39
	Bn-02	Deceleration Time 1	Bn-02= 0010.0s Dec. Time 1	0.0	6000.0s	0.1s	10.0s	
	Bn-03	Acceleration Time 2	Bn-03= 0010.0s Acc. Time 2	0.0	6000.0s	0.1s	10.0s	
	Bn-04	Deceleration Time 2	Bn-04= 0010.0s Dec. Time 2	0.0	6000.0s	0.1s	10.0s	
Analog Frequency	Bn-05	Analog Frequency Cmd. Gain (Voltage)	Bn-05= 0100.0% Voltage Cmd. Gain	0.0	1000.0%	0.1%	100.0%	39
	Bn-06	Analog Frequency Cmd. Bias (Voltage)	Bn-06= 000.0 Voltage Cmd. Bias	-100.0%	100.0%	0.1%	0.0%	
	Bn-07	Analog Frequency Cmd Gain. (Current)	Bn-07= 0100.0 Current Cmd. Gain	0.0	1000.0%	0.1%	100.0%	
	Bn-08	Analog Frequency Cmd Bias (Current)	Bn-08= 000.0 Current Cmd. Bias	-100.0%	100.0%	0.1%	0.0%	
Multi-Function Analog Input	Bn-09	Multi-Function Analog Input Gain	Bn-09= 0100.0 Multi_Fun. ~Gain	0.0	1000.0%	0.1%	100.0%	39
	Bn-10	Multi-Function Analog Input Bias	Bn-10= 000.0 Multi_Fun. ~Bias	-100.0%	100.0%	0.1%	0.0%	
Torque Boost	Bn-11	Auto Torque Boost Gain	Bn-11= 0.5 Auto_Boost Gain	0.0	2.0	0.1	0.5	40
Monitor	Bn-12	Monitor 1	Bn-12= 01 Display: Freq.Cmd.	1	18	1	1	41
	Bn-13	Monitor 2	Bn-13= 02 Display: O/P Freq.	1	18	1	2	
Multi-Function Analog Output	Bn-14	Multi-Function Analog Output AO1 Gain	Bn-14= 1.00 ~Output AO1 Gain	0.01	2.55	0.01	1.00	42
	Bn-15	Multi-Function Analog Output AO2 Gain	Bn-15= 1.00 ~Output AO2 Gain	0.01	2.55	0.01	1.00	
PID Control	Bn-16	PID Detection Gain	Bn-16= 01.00 PID Cmd. Gain	0.01	10.00	0.01	1.00	42
	Bn-17	PID Proportional Gain	Bn-17= 01.00 PID P_gain	0.01	10.00	0.01	1.00	
	Bn-18	PID integral time	Bn-18= 10.00s PID I_Time	0.00	100.00s	0.01s	10.00s	

Function	Parameter No.	Name	LCD display (English)	Setting range		Setting Unit	Factory Setting	Ref. Page
PID Control	Bn-19	PID Differential Time	Bn-19= 0.00s PID D_Time	0	1.00s	0.01s	0.00s	42
	Bn-20	PID Bias	Bn-20= 0 PID Bias	0	109%	1%	0%	
Auto_Run Time Function	Bn-21	1st_Step Time Under Auto_Run Mode	Bn-21= 0000.0s Time 1	0.0	6000.0s	0.1s	0.0s	82 97, 98
	Bn-22	2nd_Step Time Under Auto_Run Mode	Bn-22= 0000.0s Time 2	0.0	6000.0s	0.1s	0.0s	
	Bn-23	3rd_Step Time Under Auto_Run Mode	Bn-23= 0000.0s Time 3	0.0	6000.0s	0.1s	0.0s	
	Bn-24	4th_Step Time Under Auto_Run Mode	Bn-24= 0000.0s Time 4	0.0	6000.0s	0.1s	0.0s	
	Bn-25	5th_Step Time Under Auto_Run Mode	Bn-25= 0000.0s Time 5	0.0	6000.0s	0.1s	0.0s	
	Bn-26	6th_Step Time Under Auto_Run Mode	Bn-26= 0000.0s Time 6	0.0	6000.0s	0.1s	0.0s	
	Bn-27	7th_Step Time Under Auto_Run Mode	Bn-27= 0000.0s Time 7	0.0	6000.0s	0.1s	0.0s	
	Bn-28	8th_Step Time Under Auto_Run Mode	Bn-28= 0000.0s Time 8	0.0	6000.0s	0.1s	0.0s	
	Bn-29	9th_Step Time Under Auto_Run Mode	Bn-29= 0000.0s Time 9	0.0	6000.0s	0.1s	0.0s	
	Bn-30	10th_Step Time Under Auto_Run Mode	Bn-30= 0000.0s Time 10	0.0	6000.0s	0.1s	0.0s	
	Bn-31	11th_Step Time Under Auto_Run Mode	Bn-31= 0000.0s Time 11	0.0	6000.0s	0.1s	0.0s	
	Bn-32	12th_Step Time Under Auto_Run Mode	Bn-32= 0000.0s Time 12	0.0	6000.0s	0.1s	0.0s	
	Bn-33	13th_Step Time Under Auto_Run Mode	Bn-33= 0000.0s Time 13	0.0	6000.0s	0.1s	0.0s	
	Bn-34	14th_Step Time Under Auto_Run Mode	Bn-34= 0000.0s Time 14	0.0	6000.0s	0.1s	0.0s	
	Bn-35	15th_Step Time Under Auto_Run Mode	Bn-35= 0000.0s Time 15	0.0	6000.0s	0.1s	0.0s	
	Bn-36	16th_Step Time Under Auto_Run Mode	Bn-36= 0000.0s Time 16	0.0	6000.0s	0.1s	0.0s	
Timer Function	Bn-37	Timer Function On_Delay Time	Bn-37= 0000.0s ON_delay Setting	0.0	6000.0s	0.1s	0.0s	44
	Bn-38	Timer Function Off_Delay Time	Bn-38= 0000.0s OFF_delay Setting	0.0	6000.0s	0.1s	0.0s	
Energy Saving	Bn-39	Energy_Saving Gain	Bn-39= 100 Eg.Saving Gain	50	150	1	100%	44

(1) Acceleration Time 1 (Bn-01)
(2) Deceleration Time 1 (Bn-02)
(3) Acceleration Time 2 (Bn-03)
(4) Deceleration Time 2 (Bn-04)

Set individual Acceleration/Deceleration times

Acceleration time   the time required to go from 0% to 100% of the maximum output frequency

Deceleration time   the time required to go from 100% to 0% of the maximum output frequency

If the acceleration/deceleration time sectors 1 and 2 are input via the multi-function inputs terminal ⑤~⑧, the acceleration/Deceleration can be switched between 2 sectors even in the running status.

Output frequency

Cn-02

Control circuit terminals ⑤~⑧
Open : select the 1st sector Acc./Dec. time
(Parameters Bn-01, Bn-02 set)
Close : select the 2nd sector ACC/DEC time
(Parameters Bn-03, Bn-04 set)

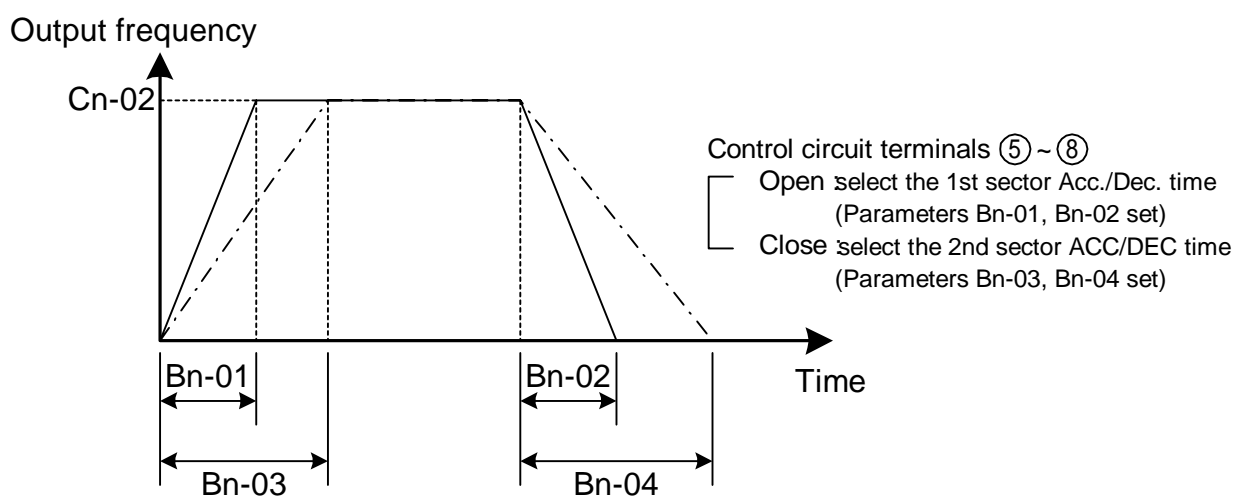Bn-01   Bn-02   Time

Bn-03   Bn-04

Fig. 11 Acceleration and Deceleration time

Note :

  1. To set the S-curve characteristics function, please refer to page 59.
  2. The S-curve characteristic times can be set respectively for beginning-accel. end-accel., beginning-decel., and end-decel. through the parameters setting of Cn-41   Cn-44.

(5)   Analog Frequency Command Gain (Voltage) (Bn-05)
(6)   Analog Frequency Command Bias (Voltage) (Bn-06)
(7)   Analog Frequency Command Gain (Current) (Bn-07)
(8)   Analog Frequency Command Bias (Current) (Bn-08)
(9)   Multi-function Analog Input Gain   (Bn-09)
(10) Multi-function Analog Input Bias   (Bn-10)

For every different analog frequency command (voltage or current) and multi-function analog inputs, their corresponding gain and bias should be specified respectively.
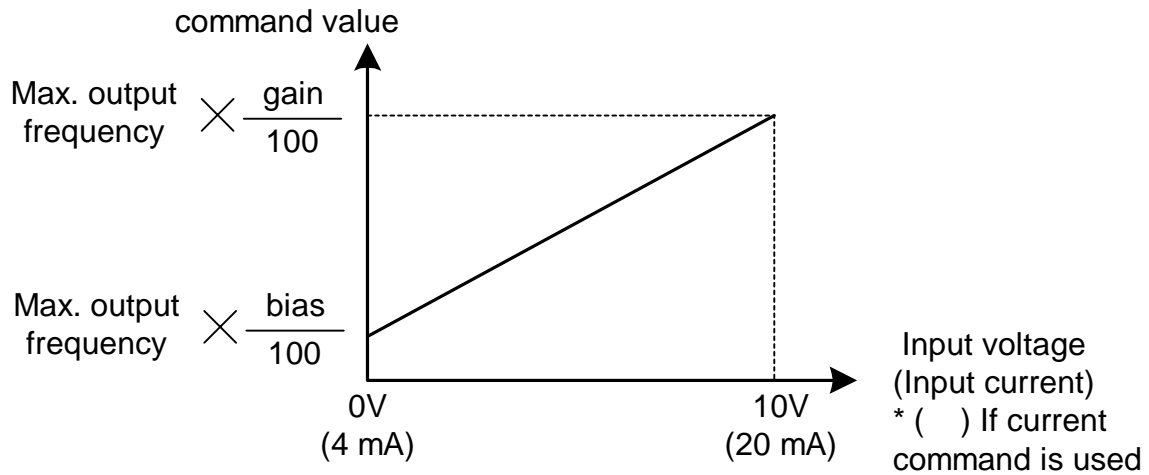
Fig. 12　Analog input gain and bias

(11) Auto Torque Boost Gain (Bn-11)

The inverter can increase the output torque to compensate the load increase automatically through the auto torque boost function. Then the output voltage will increase. As a result, the fault trip cases can be decreased. The energy efficiency is also improved. In the case that the wiring distance between the inverter and the motor is too long (e.g. more than 100m), the motor torque is a little short because of voltage drop. Increase the value of Bn-11 gradually and make sure the current will not increase too much. Normally, no adjustment is required.
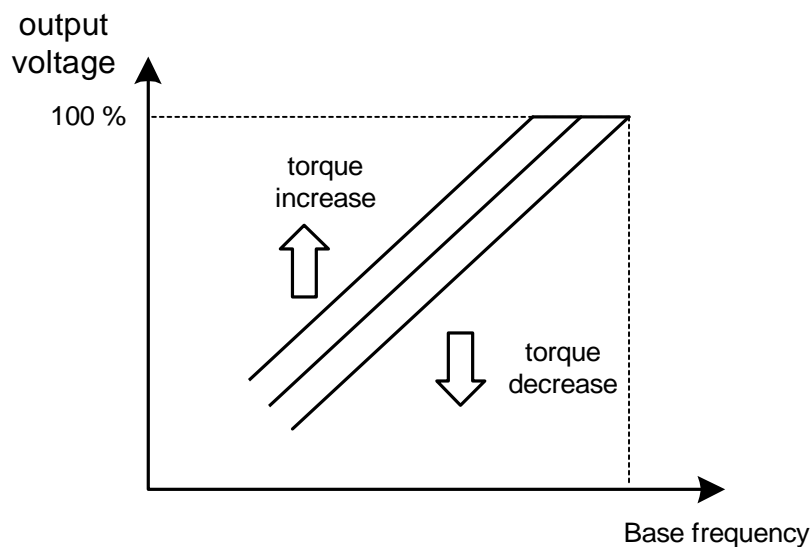

Fig. 13　Adjust the auto torque boost gain Bn-11 to increase the output torque.

If the driven motor capacity is less than the inverter capacity (Max. applicable motor capacity), raise the setting.

If the motor generates excessive oscillation, lower the setting.

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(12) Monitor 1   (Bn-12)

(13) Monitor 2   (Bn-13)

In the DRIVE mode, 2 inverter input/output statuses can be monitored at the same time. The specified items can be set through the setting of Bn-12 and Bn-13. For more details, refer to Table 8.

Example:

(1) Bn-12= 02   Display
     Bn-13= 01

| O/P Freq. | 15.00Hz |
| Freq.Cmd. | 15.00Hz |

(2) Bn-12= 03   Display
     Bn-13= 05

| O/P I | 21.0A |
| DC Volt | 311V |

(3) Bn-12= 11   Display
     Bn-13= 12

| I/P Term. | 00101010 |
| O/P Term. | 00010010 |

Note : While monitoring, use the $\boxed{\wedge}$ or $\boxed{\vee}$ key to show the next lower-row displayed. But the setting of Bn-12 and Bn-13 does not change.

Table 8

Setting	Monitoring contents	Setting	Monitoring contents
Bn-12= 01	Freq.Cmd.	Bn-13= 01	Freq.Cmd.
Bn-12= 02	O/P Freq.	Bn-13= 02	O/P Freq.
Bn-12= 03	O/P I	Bn-13= 03	O/P I
Bn-12= 04	O/P V	Bn-13= 04	O/P V
Bn-12= 05	DC Volt	Bn-13= 05	DC Volt
Bn-12= 06	Term. VIN	Bn-13= 06	Term. VIN
Bn-12= 07	Term. AIN	Bn-13= 07	Term. AIN
Bn-12= 08	Term. AUX	Bn-13= 08	Term. AUX
Bn-12= 09	~ Output(AO1)	Bn-13= 09	~ Output(AO1)
Bn-12= 10	~ Output(AO2)	Bn-13= 10	~ Output(AO1)
Bn-12= 11	I/P Term	Bn-13= 11	I/P Term
Bn-12= 12	O/P Term	Bn-13= 12	O/P Term
Bn-12= 13	Sp. FBK	Bn-13= 13	Sp. FBK
Bn-12= 14	Sp. Compen.	Bn-13= 14	Sp. Compen.
Bn-12= 15	PID I/P	Bn-13= 15	PID I/P
Bn-12= 16	PID O/P(Un-16)	Bn-13= 16	PID O/P(Un-16)
Bn-12= 17	PID O/P(Un-17)	Bn-13= 17	PID O/P(Un-17)
Bn-12= 18	Motor Sp.	Bn-13= 18	Motor Sp.

(14) Multi-function Analog Output AO1 Gain (Bn-14)

(15) Multi-function Analog Output AO1 Gain (Bn-15)

Multi-function analog output AO1 and AO2 can be set for their individual voltage level respectively.
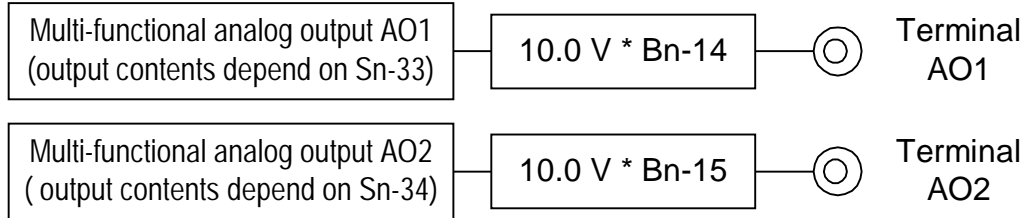
(16) PID Detection Gain   (Bn-16)

(17) PID Proportional Gain   (Bn-17)

(18) PID Integral Time   (Bn-18)

(19) PID Differential Time   (Bn-19)

(20) PID Bias   (Bn-20)

The PID control function is a control system that matches a feedback value (i.e., a detected value) to the set target value. Combining the proportional (P), integral (I) and derivative (D) control make the control possible to achieve required response with the constant setting and tuning procedure of proportional gain Bn-17, integral time Bn-18 and derivative time Bn-19.

See the appendix on page 110 for " PID Parameter Setting".

Fig. 14 is a Block diagram of the inverter's internal PID control.

If both the target value and feedback value are set to 0, adjust the inverter output frequency to zero.
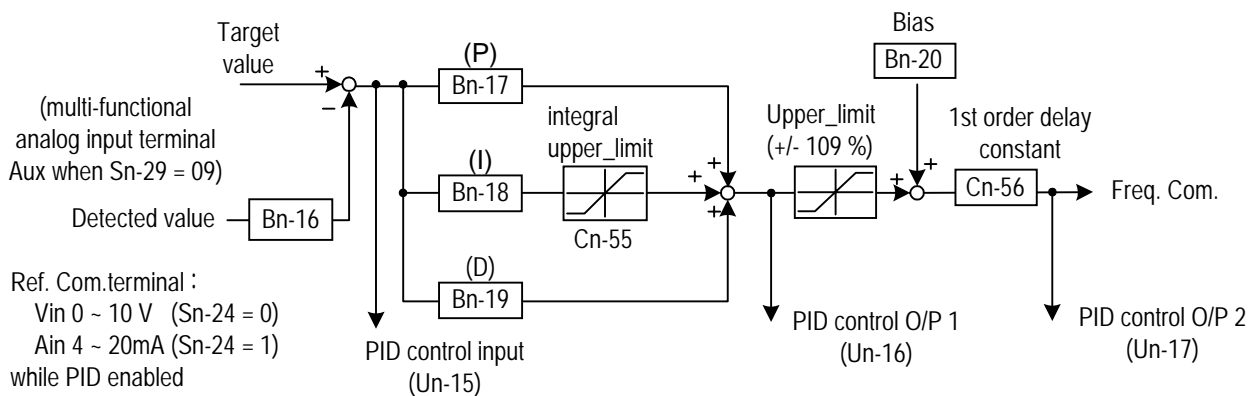

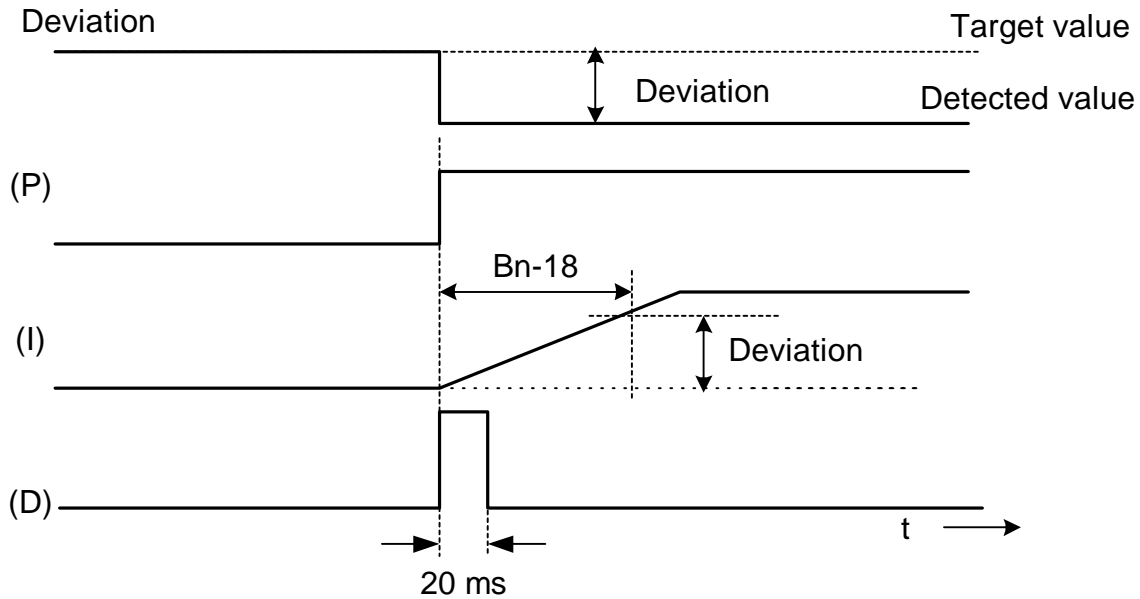Fig. 14   Block diagram for PID control in inverter

Fig. 15 Response of PID control for STEP-shape (deviation) input

Deviation = Target value Detected value × Bn-16.

P's control output = deviation × Bn-17.

I's control output will increase with time and the output will be equal to the deviation after time specified by parameter Bn-18

The parameter Cn-55 will prevent the calculated value of the integral control (with the integral time Bn-18) in the PID control from exceeding the fixed amount.

D's control output = difference $\times\,(\dfrac{\text{Bn-19}}{\text{5 m sec}})$

Note : The enable PID function, parameter Sn-64 must be set to 1

(21) Time Setting in Auto_Run Mode (Bn-21 Bn-36)

In Auto_Run mode, the time setting for individual step is described on page 97 "auto_run mode selection and enable (Sn-44~60)".

(22) Timer ON_Delay Time   (Bn-37)

(23) Timer OFF_Delay Time (Bn-38)

The timer function is enabled when the timer function input setting (Sn-25~28=19) and its timer function output setting (Sn-30~32=21) are set for the multi-function input and output respectively.

These inputs and outputs serve as general-purpose I/O . Setting ON/OFF delay time (Bn-37/38) for the timer can prevent chattering of sensors, switches and so on.

When the timer function input ON times is longer than the value set for Bn-37, the timer function output turns ON.

When the timer function input OFF time is longer than the value set for Bn-38, the timer function output turns OFF. An example is shown below.
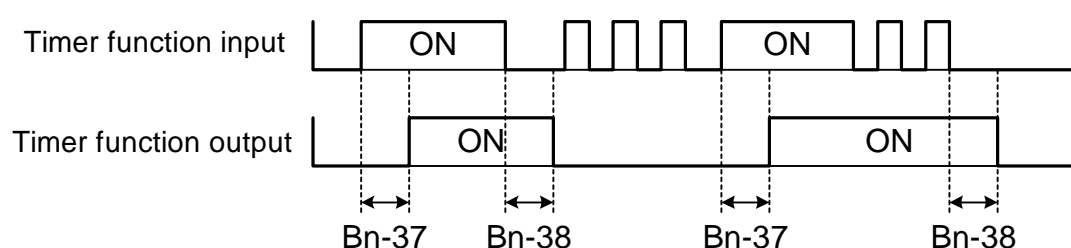

Fig. 16 An operation example of timer function

(24) Energy_Saving Gain (Bn-39)

Input the energy_saving command while a light load causes the inverter output voltage to be reduced and save energy. Set this value as a percentage of the V/F pattern. The setting range is 50~150%. The factory setting is 100% and the energy saving function is disabled. If the energy saving gain Bn-39 is not 100%, the energy saving function is enabled.

In energy saving mode (Bn-39 100), the output voltage will automatically decrease and be proportional to energy saving gain Bn-39. The Bn-39 setting should not be small so that the motor will not stall.

The energy saving function is disabled in the PID close-loop control and during acceleration and deceleration.
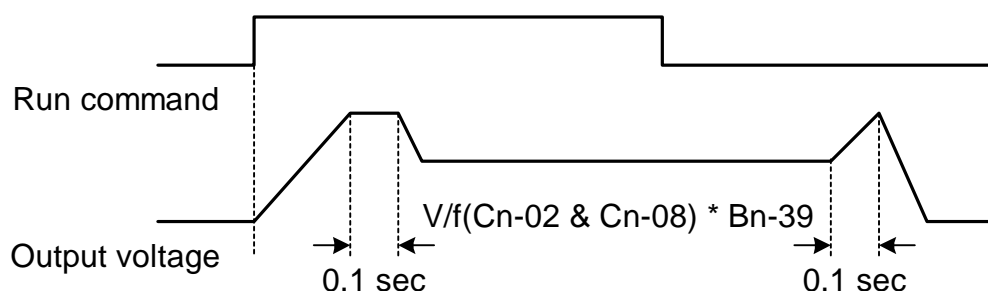

Fig. 17 Time chart for energy-saving operation

3.3 Control Parameters Cn-

Function	Parameter No.	Name	LCD display (English)	Setting range		Setting Unit	Factory Setting	Ref. Page
V/F Pattern Setting	Cn-01	Input Voltage	Cn-01= 220.0V Input Voltage	150.0	255.0V[*2]	0.1V	220.0V[*1]	48
	Cn-02	Max. Output Frequency	Cn-02= 060.0Hz Max. O/P Freq.	50.0	400.0Hz	0.1Hz	60.0Hz	48
	Cn-03	Max. Output Voltage	Cn-03= 220.0Hz Max. Voltage	0.1	255.0V[*2]	0.1V	220.0V[*1]	
	Cn-04	Max. Voltage Frequency	Cn-04= 060.0Hz Max. Volt Frequency	0.1	400.0Hz	0.1Hz	60.0Hz	
	Cn-05	Middle Output Frequency	Cn-05= 003.0Hz Middle O/P Freq.	0.1	400.0Hz	0.1Hz	3.0Hz	
	Cn-06	Voltage At Middle Output Frequency	Cn-06= 014.9V Middle Voltage	0.1	255.0V[*2]	0.1V	14.9V[*1]	
	Cn-07	Min Output Frequency	Cn-07= 001.5Hz Min O/P Freq.	0.1	400.0Hz	0.1Hz	1.5Hz	
	Cn-08	Voltage At Min. Output Frequency	Cn-08= 007.9V Min. Voltage	0.1	255.0V[*2]	0.1V	7.9V[*1]	
Motor Parameter	Cn-09	Motor Rated Current	Cn-09= 0003.3A Motor Rated I	*3		0.1A	3.3A[*4]	48
	Cn-10	No Load Current Of Motor	Cn-10= 30 Motor No-Load I	0	99	1	30	49
	Cn-11	Rated Slip Of Motor	Cn-11= 0.0% Motor Rated Slip	0	9.9	0.1%	0.0%	49
	Cn-12	Line-To-Line Resistance Of Motor	Cn-12= 05.732 Motor Line R	0	65.535	0.001	5.732[*4]	50
	Cn-13	Torque Compensation Of Core Loss	Cn-13= 0064W Core Loss	0	65535W	1W	64[*4]	
DC Braking Function	Cn-14	DC Injection Braking Starting Frequency	Cn-14= 01.5Hz DC Braking Start F	0.1	10.0 z	0.1Hz	1.5Hz	50
	Cn-15	DC Braking Current	Cn-15= 050 DC Braking Current	0	100	1	50	
	Cn-16	DC Injection Braking Time At Stop	Cn-16= 00.5s DC Braking Stop Time	0.0	25.5s	0.1s	0.5s	
	Cn-17	DC Injection Braking Time At Start	Cn-17= 00.0s DC Braking Start Time	0.0	25.5s	0.1s	0.0s	
Frequency Limit	Cn-18	Frequency Command Upper Bound	Cn-18= 100 Freq.Cmd. Up Bound	0	109	1%	100	51
	Cn-19	Frequency Command Lower Bound	Cn-19= 000 Freq. Cmd. Low Bound	0	109	1%	0	
Frequency Jump	Cn-20	Frequency Jump Point 1	Cn-20= 000.0Hz Freq. Jump 1	0.0	400.0Hz	0.1Hz	0.0Hz	51
	Cn-21	Frequency Jump Point 2	Cn-21= 000.0Hz Freq. Jump 2	0.0	400.0Hz	0.1Hz	0.0Hz	

Function	Parameter No.	Name	LCD display (English)	Setting range	Setting Unit	Factory Setting	Ref. Page
Frequency Jump	Cn-22	Frequency Jump Point 3	Cn-22= 000.0Hz Freq. Jump 3	0.0　400.0Hz	0.1Hz	0.0Hz	51
	Cn-23	Jump Frequency Width	Cn-23= 01.0Hz Freq. Jump Width	0.0　25.5Hz	0.1Hz	1.0Hz	
Retry Function	Cn-24	Number of Auto Restart Attempt	Cn-24= 00 Retry Times	0　10	1	0	52
Stall Prevention	Cn-25	Stall Prevention During Acceleration	Cn-25= 170 Acc. Stall	30　200	1%	170	53
	Cn-26	Stall Prevention During Running	Cn-26= 160 Run Stall	30　200	1%	160	
Comm. Fault detection	Cn-27	Communication Fault Detection Time	Cn-27=01.0s Comm. Flt Det. Time	0.1~25.5s	0.1s	1s	53
Display Unit	Cn-28	LCD Digital Operator Display Unit	Cn-28= 00000 Operator Disp. Unit	0-39999	1	0	54
Frequency Agree Detection	Cn-29	Freq. Agree Detection Level During Accel.	Cn-29= 000.0Hz Acc. Freq. Det.Level	0.0　400.0Hz	0.1Hz	0.0Hz	55
	Cn-30	Freq. Agree Detection Level During Decel.	Cn-30= 000.0Hz Dec. Freq. Det. Level	0.0　400.0Hz	0.1Hz	0.0Hz	
	Cn-31	Frequency Agree Detection Width	Cn-31= 02.0Hz F Agree Det. Width	0.1　25.5Hz	0.1Hz	2.0Hz	
Over-torque Detection	Cn-32	Overtorque Detection Level	Cn-32= 160 Over Tq. Det. Level	30　200	1	160	56
	Cn-33	Overtorque Detection Time	Cn-33= 00.1s Over Tq. Det. Time	0.0　25.5s	0.1s	0.1s	
Carrier Frequency	Cn-34	Carrier frequency setting	Cn-34= 6 Carry_Freq Setting	1　6	1	6	56
Speed Search Control	Cn-35	Speed Search Detection Level	Cn-35= 150 Sp-Search Level	0　200	1	150	57
	Cn-36	Speed Search Time	Cn-36= 02.0s Sp-Search Time	0.1　25.5s	0.1s	2.0s	
	Cn-37	Min. Baseblock Time	Cn-37= 0.5s Min. B.B. Time	0.5　5.0s	0.1s	0.5s	
	Cn-38	V/F Curve in Speed Search	Cn-38= 100 Sp-search V/F Gain	10　100	1	100	
Low Voltage Detection	Cn-39	Low Voltage Alarm Detection Level	Cn-39= 200V Low Volt. Det. Level	150　210V	1V	200V [*1]	59
Slip Comp.	Cn-40	Slip Compensation Primary Delay Time	Cn-40= 02.0s Slip Filter	0.0　25.5s	0.1s	2.0s	59
S-curve time	Cn-41	S-curve Characteristic Time at Accel. Start	Cn-41= 0.0s S1 Curve Time	0.0　1.0s	0.1s	0.0s	59
	Cn-42	S-curve Characteristic Time at Accel. End	Cn-42= 0.0s S2 Curve Time	0.0　1.0s	0.1s	0.0s	
	Cn-43	S-curve Characteristic Time at Decel. start	Cn-43= 0.0s S3 Curve Time	0.0　1.0s	0.1s	0.0s	
	Cn-44	S-curve Characteristic Time at Decel. end	Cn-44= 0.0s S4 Curve Time	0.0　1.0s	0.1s	0.0s	

Function	Parameter No.	Name	LCD display (English)	Setting range	Setting Unit	Factory Setting	Ref. Page
Speed feedback control	Cn-45	PG Parameter	Cn-45= 0000.0 PG Parameter	0.0 3000.0P/R	0.1P/R	0.0P/R	60
	Cn-46	Pole no. of Motor	Cn-46= 04P Motor Pole	2 32P	2P	4 P	
	Cn-47	ASR Proportional Gain 1	Cn-47= 0.00 ASR Gain 1	0.00 2.55	0.01	0.00	
	Cn-48	ASR Integral Gain 1	Cn-48= 01.0s ASR Intgl. Time 1	0.1 10.0S	0.1s	1.0s	
	Cn-49	ASR Proportional Gain 2	Cn-49= 0.02 ASR Gain 2	0.00 2.55	0.01	0.02	
	Cn-50	ASR Integral Gain 2	Cn-50= 01.0s ASR Intgl. Time 2	0.1 10.0S	0.1s	1.0s	
	Cn-51	ASR Upper Bound	Cn-51= 05.0 ASR Up Bound	0.1 10.0	0.1	5.0%	60
	Cn-52	ASR Lower Bound	Cn-52= 00.1 ASR Low Bound	0.1 10.0	0.1	0.1%	
	Cn-53	Excessive Speed Deviation Detection Level	Cn-53= 10 Sp.Deviat. Det.Level	1 50	1	10%	
	Cn-54	Overspeed Detection Level	Cn-54= 110 Over Sp.Det. Level	1 120%	1	110%	
PID Control	Cn-55	PID Integral Upper Bound	Cn-55= 100 PID I-Upper	0 109	1	100%	61
	Cn-56	PID Primary Delay Time Constant	Cn-56= 0.0s PID Filter	0.0 2.5s	0.1s	0.0s	
Sensorless Vector Control	Cn-57	Motor Line-to-Line Resistance (R1)	Cn-57= 02.233 Mtr LINE_R	0.001 60.000	0.001	2.233 [*4]	61, 62
	Cn-58	Motor Rotor Equivalent Resistance (R2)	Cn-58= 01.968 Mtr ROTOR_R	0.001 60.000	0.001	1.968 [*4]	
	Cn-59	Motor Leakage Inductance (Ls)	Cn-59= 9.6mH Mtr LEAKAGE_X	0.01 200.00mH	0.01mH	9.6mH[*4]	
	Cn-60	Motor Mutual Inductance (Lm)	Cn-60= 149.7mH Mtr MUTUAL_X	0.1 6553.5mH	0.1mH	149.7mH[*4]	
	Cn-61	Slip Compensation Gain	Cn-61= 1.00 SLIP GAIN	0.00 2.55	0.01	1.00	

*1 These are for a 220V class inverter. Value(*1) for a 440V class inverter is double.

*2 These are for a 220V class inverter. Value(*2) for a 440V class inverter is double.

*3 The setting range is 10% ~200% of the inverter rated current.

*4 The factory setting values will vary based upon the inverter capacity selection (Sn-01) value. In this case, the setting is for 4-pole, 220V, 60Hz, 1Hp TECO standard induction motors.

(1) Input Voltage Setting (Cn-01)

Set inverter voltage to match power supply voltage at input side (e.g. 200V/220V, 380V/415V/440V/460V)

(2) V/F Curve Parameter Settings (Cn-02　Cn-08)

The V/F curve can be set to either one of the preset curves (setting Sn-02=0　14) or a customer user-set curve (setting Sn-02=15).
Setting Cn-02　Cn-08 can be set by the user when Sn-02 has been set to "15". The user-defined V/F curve can be specified through the settings of Cn-02　Cn-08 as shown in Fig. 18. The factory setting is straight line for the V/F curve. (Cn-05=Cn-07, Cn-06 is not used) as shown below (220V/60Hz case).
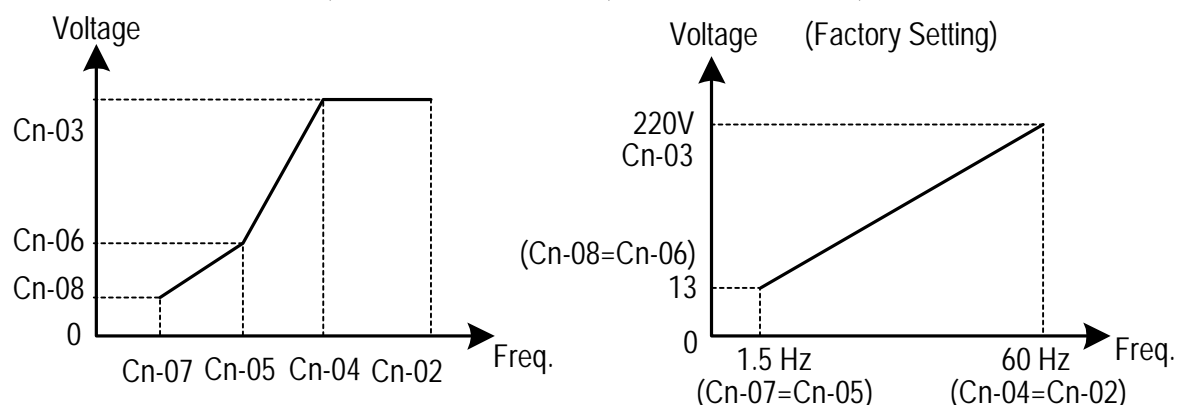

Fig. 18　User-defined V/F curve

In low speed operation (<3Hz), a larger torque can be generated by increasing the slope of V/F curve. However, the motor will be hot due to over-excitation. At the same time the inverter will be more inclined to fault. Based upon the applied load, properly adjust the V/F curve according to the magnitude of monitored current into the motor.
The four frequency settings must satisfy the following relationship, otherwise an error message "V/F Curve Invalid" will display.
(a) Max. output freq.　　Max. voltage freq.　　Mid. Output freq.　　Min. output freq.
　　　(Cn-02)　　　　　　　(Cn-04)　　　　　　(Cn-05)　　　　　　　(Cn-07)
(b) Max. output volt.　　Mid. output volt.　　Min. output voltage
　　　(Cn-03)　　　　　　　(Cn-06)　　　　　　(Cn-08)
If Mid. Output frequency (Cn-05) = Min. output frequency (Cn-07), the setting (Cn-06) is not effective.

(3) Motor Rated Current　(Cn-09)

Electronic overload thermal reference current
The factory setting depends upon the capacity type of inverter (Sn-01).
The setting range is 10%　200% of the inverter rated output current.
Set the rated current shown on the motor nameplate if not using the TECO 4-pole motor.

(4) Motor No-Load Current   (Cn-10)

This setting is used as a reference value for torque compensation function.
The setting range is 0   99   of the inverter rated current Cn-09 (100%).
The slip compensation is enabled when the output current is greater than motor no-load current (Cn-10). The output frequency will shift from f1 to f2 (>f1) for the positive change of load torque. (See Fig. 19)

$$\text{Slip compensation} = \frac{\text{Motor rated slip (Cn-11)} \ \times \ (\text{Output current} - \text{Motor no-load current(Cn-10)})}{\text{Motor rated current (Cn-09)} - \text{Motor no-load current (Cn-10)}}$$
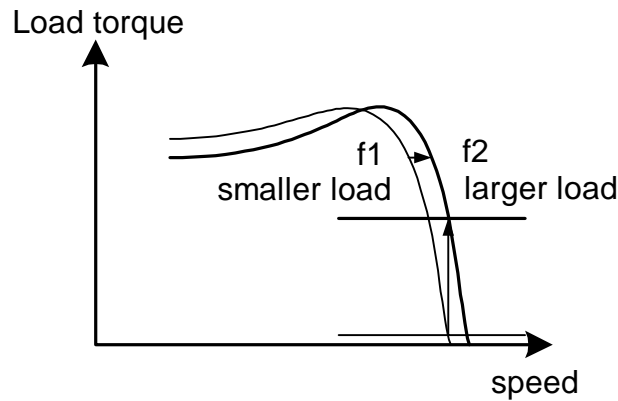

Fig. 19 Output frequency with slip compensation.

(5) Motor Rated Slip (Cn-11)

This setting is used as a reference value for torque compensation function. See Fig. 19. The setting is 0.0~9.9% as a percentage of motor Max. voltage frequency (Cn-04) as 100%.
The setting is shown in Fig. 20 in the constant torque and constant output range. If setting Cn-11 is zero, no slip compensation is used.
There is no slip compensation in the cases when the frequency command is less than the Min. output frequency or during regeneration.

$$\text{Motor rated slip (Cn-11)} = \frac{\text{Motor rated freq. (Hz)} \ \times \ (\text{Rated speed(RPM)} - \text{Motor No. of poles})}{\text{Max-voltage freq (Cn-04)} \ \times \ 120} \times 100\%$$
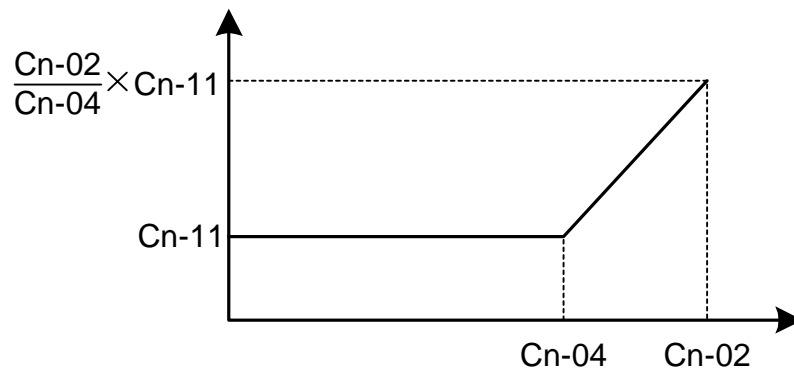

Fig. 20 Slip compensation limit

(6) Motor Line-to-Line Resistance   (Cn-12)
(7) Motor Iron-Core Loss   (Cn-13)

It is for torque compensation function. The default setting depends upon the inverter capacity (Sn-01). Normally, the setting does not need to be altered. See Table 10~11 on page 69.

(8) DC Injection Braking Starting Frequency   (Cn-14)
(9) DC Injection Braking Current   (Cn-15)
(10) DC Injection Braking Time at Stop   (Cn-16)
(11) DC Injection Braking Time at Start   (Cn-17)

The DC injection braking function decelerates by applying a DC current to the motor. This happens in the 2 cases:
a. DC injection braking time at start: It is effective for temporarily stopping and then restarting, without regeneration, a motor coasting by inertia.
b. DC injection braking time at stop: It is used to prevent coasting by inertia when the motor is not completely stopped by normal deceleration when there is a large load. Lengthening the DC injection braking time (Cn-16) or increasing the DC injection braking current (Cn-15) can shorten the stopping time.

For the DC injection braking current (Cn-15), set the value for the current that is output at the time of DC injection braking. DC injection braking current is set as a percentage of inverter rated output current, with the inverter rated output current taken as 100%.

For the DC injection braking time at start (Cn-17), set the DC injection braking operating time when the motor is started.

For the DC injection braking starting frequency (Cn-14), set the frequency for beginning DC injection braking for deceleration. If the excitation level is less than the Min. output frequency (Cn-07), the DC injection braking will begin from Min. output frequency.

If the DC injection braking time at start (Cn-17) is 0.0, the motor starts from the Min. output frequency and no DC injection braking are enabled.

If the DC injection braking time at stop (Cn-16) is 0.0, no DC injection braking is enabled. In this case, the inverter output will be blocked off when the output frequency is less than the DC injection braking at start frequency (Cn-14).
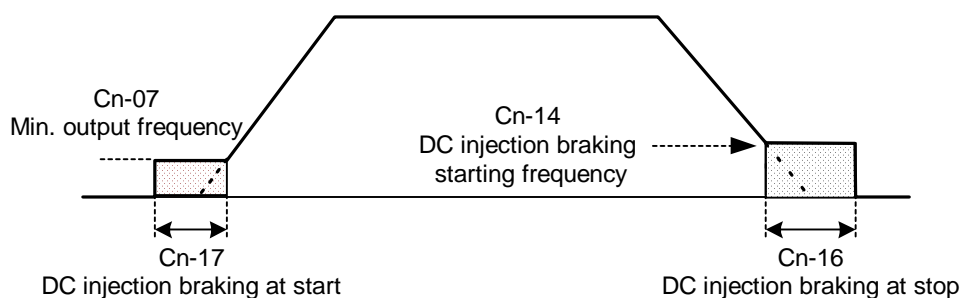
Fig. 21 DC injection braking time chart

(12) Frequency Command Upper Bound   (Cn-18)
(13) Frequency Command Lower Bound   (Cn-19)

The upper and lower bounds of the frequency command are set as a percentage of the Max. output frequency (Cn-02 as 100%), in increments of 1%.

The relationship Cn-18 > Cn-19 must be abided by. If not, an error message "Freq. Limit Setting Error" may occur.

When the frequency command is zero and a run command is input, the motor operates at the frequency command lower bound (Cn-19). The motor will not operate, however, if the lower limit is set lower than the Min. output frequency (Cn-07).
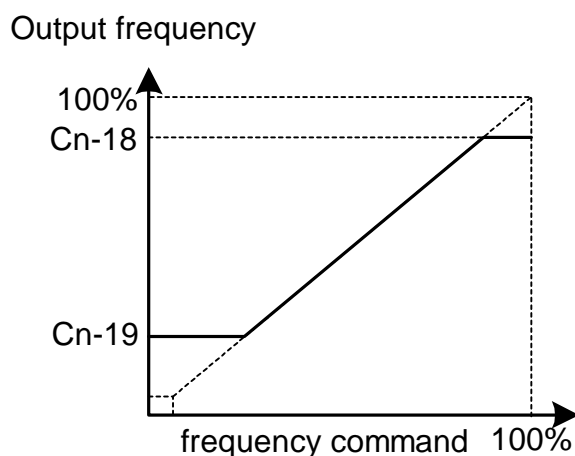

Fig. 22 Upper and lower bounds of the frequency command

(14) Frequency Jump Point 1   (Cn-20)
(15) Frequency Jump Point 2   (Cn-21)
(16) Frequency Jump Point 3   (Cn-22)
(17) Jump Frequency Width   (Cn-23)

These settings allow the "jumping" of certain frequencies within the inverter's output frequency range so that the motor can operate without resonant oscillations caused by some machine systems.
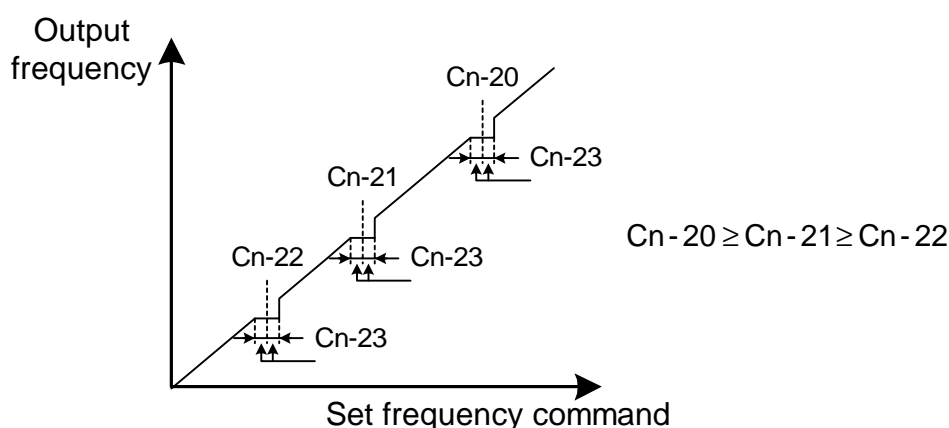
50

Fig. 23 setting jump frequencies

Operation is prohibited within the jump frequency range, but changes during acceleration and deceleration are smooth with no jump. To disable this function, set the jump frequency 1～3 (Cn-20～Cn-22) to 0.0Hz.

For the jump frequency 1～3 (Cn-20～Cn-22), set the center frequency to be jumped. Be sure to set the jump so that Cn-20 ≥ Cn-21 ≥ Cn-22. If not, a message "Jump frequency setting error" is displayed. For Cn-23, set the jump frequency bandwidth. If Cn-23 is set as 0.0Hz, the jump frequency function is disabled.

(18) Number of Auto Restart Attempt (Cn-24)

The fault restart function will restart the inverter even when an internal fault occurs during inverter operation. Use this function only when continuing operation is more important than possibly damaging the inverter.

The fault restart function is effective with the following faults. With other faults, the protective operations will engage immediately without attempting to restart operation.

Over-current   Ground fault   Main circuit over-voltage

The fault restart count will automatically increase upon the restart activated and will be cleared in the following cases:

a. When the operation is normal for 10 minutes after a fault restart is performed.

b. When the fault-reset input is received after the protection operation has been activated and the fault confirmed. (e.g., by pressing $\boxed{\underset{\text{RESET}}{>}}$ or enable Fault reset terminal ③)

c. When the power is turned off and on again.

When one of the multi-function output terminals (RA-RB-RC or R1A-R1B-R1C, DO1, DO2 or R2A-R2C) is set to restart enabled, the output will be ON while the fault restart function is in progress. See page 90 for the setting of (Sn-30~Sn-32).

(19) Stall Prevention Level During Acceleration   (Cn-25)
(20) Stall Prevention Level During Running   (Cn-26)

A stall occurs if the rotor can not keep up with the rotating electromagnetic field in the motor stator side when a large load is applied or a sudden acceleration or deceleration is performed. In this case, the inverter should automatically adjust the output frequency to prevent stall.

The stall prevention function can be set independently for accelerating and running.

Stall Prevention During Acceleration : See Fig. 24. Stop acceleration if Cn-25 setting is exceeded. Accelerate again when the current recovers.

Stall Prevention During running : See Fig. 25. Deceleration is started if the run stall prevention level Cn-26 is exceeded, especially when an impact load is applied suddenly. Accelerate again when the current level is lower than Cn-26.
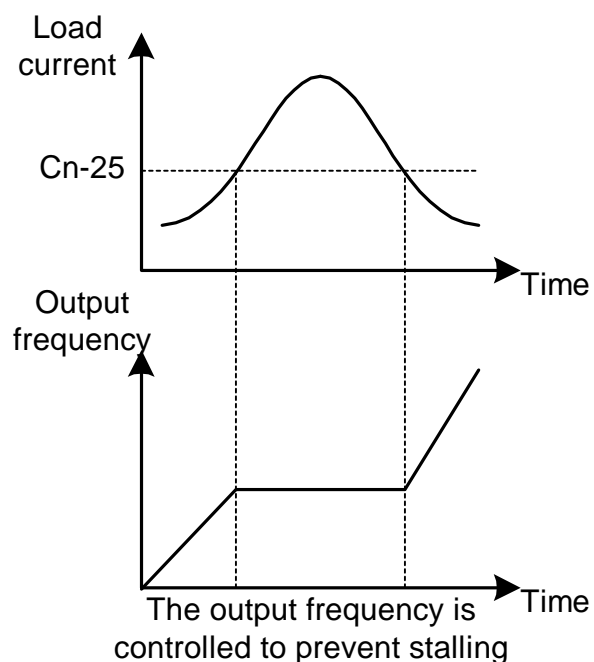

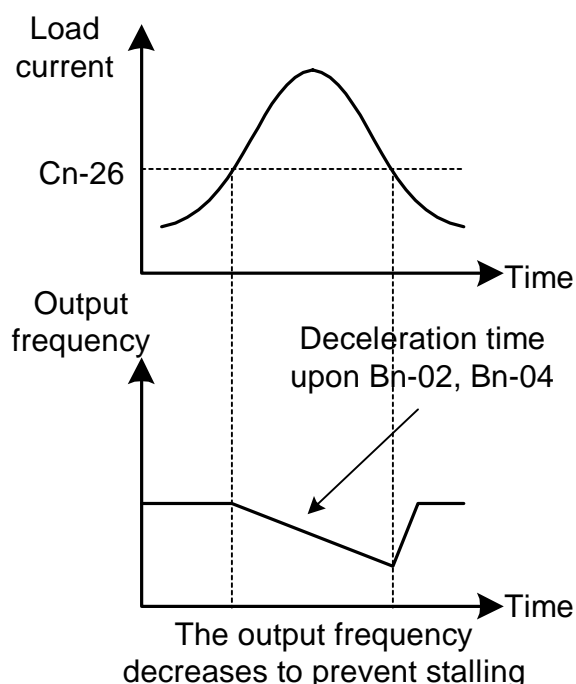Fig. 24 Acceleration stall prevention function

Fig. 25 Run stall prevention function

Set the parameters Cn-25 and Cn-26 as a percentage of inverter rated current (100% corresponds to inverter rated current).

See page 77 for stall prevention function selection.

(21) Communication Fault Detection Time (Cn-27)
    Please refer to "7200MA MODBUS/PROFIBUS Application Manual".

(22) LCD Digital Operator Display Unit (Cn-28)

Set the units to be displayed for the frequency command and frequency monitoring as described below:

Table 9

Cn-28 setting	Setting/Displayed contents			
0	0.01Hz unit.			
1	0.01% unit. (Max. output frequency is 100%)			
2 39	rpm unit. (Cn-28 sets the motor poles.) rpm = 120 × frequency command (Hz) / Cn-28			
00040 39999	Set the decimal point position using the value of the fifth digit.			
	Setting	Display	Displayed examples	
	00040 09999	XXXX	100% speed will be displayed 0200 Cn-28= 00200	
	10000 19999	XXX.X	100% speed will be displayed 200.0 Cn-28= 12000 60% speed will be displayed 120.0	
	20000 29999	XX.XX	100% speed will be displayed 65.00 Cn-28= 26500 60% speed will be displayed 39.00	
	30000 39999	X.XXX	100% speed will be displayed 2.555 Cn-28= 32555	

(23) Frequency Agree Detection Level During Acceleration   (Cn-29)
(24) Frequency Agree Detection Level During Deceleration   (Cn-30)
(25) Frequency Agree Detection Width   (Cn-31)

Frequency detection function: Set the multi-function output terminals (control circuit terminals RA-RB-RC or R1A-R1B-R1C, DO1, DO2 or R2A-R2C) to output the desired Frequency Agree signal, Setting Frequency Agree and Output Frequency Detection level (through proper setting of Sn-30 ~ Sn-32).

The time chart for Frequency Detection operation is described as follows:

Function	Frequency Detection Operation	Description
Frequency Agree		When output freq. is within freq. command +/- freq. Detection width (Cn-31), frequency agree output is "ON". Set Sn-30 Sn-32 to be "02" for the setting of frequency agree output.
Setting Frequency Agree		After acceleration, the output freq. reaches freq. Agree detection level during acceleration (Cn-29) and within freq. Agree detection width (Cn-31), agreed freq. output is "ON". Set Sn-30 Sn-32 to be "03".
Output Frequency Detection 1		During acceleration, the output freq. is less than freq. agree detection level during acceleration (Cn-29), output freq. Detection 1 is "ON". During deceleration, the output freq. is less than freq. agree detection level during deceleration (Cn-30), output freq. Detection 1 is "ON". Set Sn-30 Sn-32 to be "04" for the setting of output freq. detection.
Output Frequency Detection 2		During acceleration, the output freq. is larger than freq. Agree detection level during acceleration (Cn-29), output freq. detection 2 is "ON". During deceleration, the output freq. is larger than freq. Agree detection level during deceleration (Cn-30), output freq. detection 2 is "ON". Set Sn-30 Sn-32 to be "05" for the setting of output freq. detection.

(26) Overtorque Detection Level   (Cn-32)
(27) Overtorque Detection Time   (Cn-33)

The Overtorque detection function detects the excessive mechanical load from an increase of output current. When an overtorque detection is enabled through the setting Sn-12, be sure to set Overtorque Detection Level (Cn-32) and Overtorque Detection Time (Cn-33). An overtorque condition is detected when the output current exceeds the Overtorque Detection Level (Cn-32) for longer than the Overtorque Detection Time (Cn-33). The multi-function output terminals (control circuit terminals RA-RB-RC or R1A-R1B-R1C, DO1, DO2 or R2A-R2C) can be set to indicate an overtorque condition has been detected.
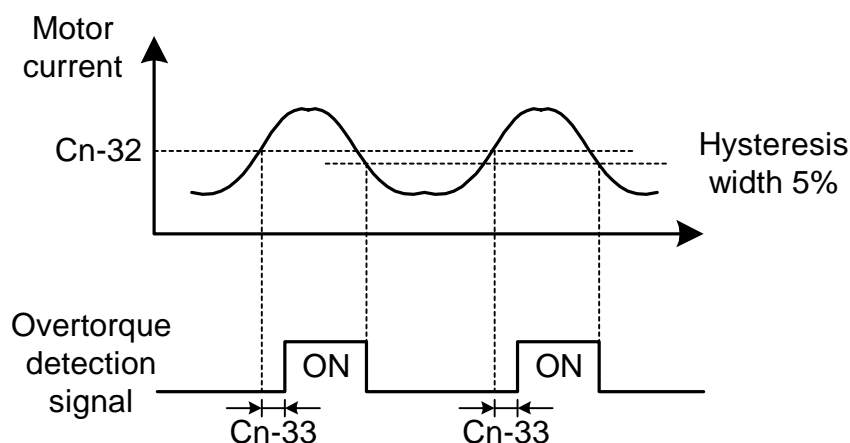

Fig. 26   Time chart for overtorque detection

Properly set the value of Sn-12 will allow
a. enable only during frequency agreement. Continue operation even after detection.
b. enable only during frequency agreement. Stop operation after detection.
c. enable at anytime. Continue operation even after detection.
d. enable at anytime. Stop operation after detection.
See more details on page 76

(28) Carrier Frequency Setting   (Cn-34)

Lower the carrier frequency can decrease the noise interference and leakage current. Its setting is shown below.

Carrier frequency(kHz) = 2.5kHz* Cn-34 setting

The output frequency does not need to be adjusted, except in the following cases.
a. If the wiring distance between the inverter and motor is long, lower the carrier frequency as shown below to allow less leakage current.

Wiring distance	<30m	30m~50m	50m~100m	>100m
Carrier frequency (Cn-34)	<15kHz	<10kHz	<5KHz	<2.5KHz

b. If there is great irregularity in speed or torque, lower the carrier frequency.

(29) Speed Search Detection Level   (Cn-35)
(30) Speed Search Time   (Cn-36)
(31) Min. Baseblock Time   (Cn-37)
(32) Speed Search V/F Curve   (Cn-38)

The speed search function will search the speed of a frequency coasting motor from the frequency command or max. frequency downward. And it will restart up smoothly from that frequency or max. frequency. It is effective in situations such as switching from a commercial power supply to an inverter without tripping occurred.
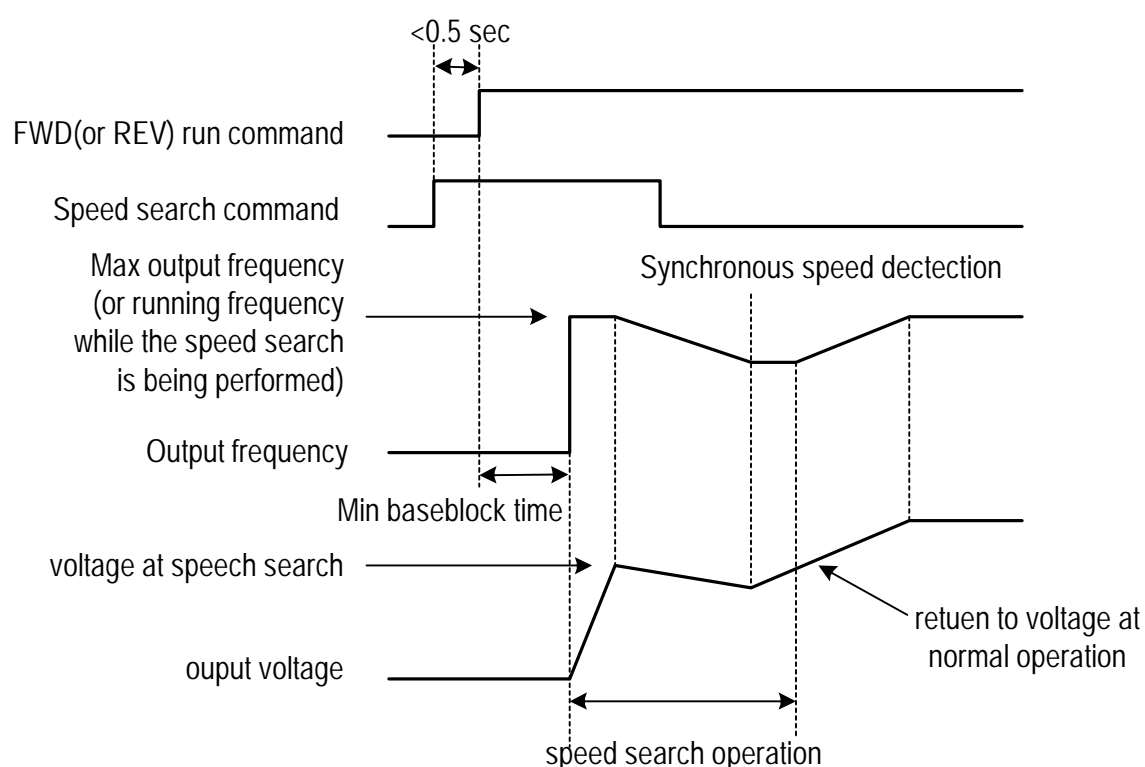The timing of speed search function as shown below

Fig. 27   Speed search timing chart

The speed search command can be set through the multi-function contact input terminal ⑤ ~ ⑧ (By setting the parameters Sn-25 ~ Sn-28).

If Sn-25 ~ Sn-28= 21 : Speed search is performed from Max. output frequency and motor is coasting freely.

If Sn-25 ~ Sn-28= 22 : Speed search starts from the frequency command when the speed search command is enabled.

After the inverter output is blocked, the user should input speed search command then enable run operation, the inverter will begin to search the motor speed after the min. baseblock time Cn-37.

Speed search operation, if the inverter output current is less than Cn-35, the inverter will take the output frequency as the real frequency at that time. From those values of real frequency, the inverter will accelerate or decelerate to the set frequency according to the acceleration or deceleration time.

While the speed search command is being performed, the user can slightly decrease the setting of V/F curve (Cn-38) in order to prevent the OC protection function enabled. Normally, the V/F curve need not be changed. (As below)

Speed search operating V/F curve = Cn-38 * (normal operating V/F curve)

Note : 1. The speed search operation will be disabled if the speed search command is enacted from the Max. frequency and the setting frequency. (I.e., Sn-25=20, Sn-26=21 and multi-function input terminals ⑤, ⑥ is used at the same time).

2. Make sure that the FWD/REV command must be performed after or at the same time with the speed search command. A typical operation sequence is shown below.
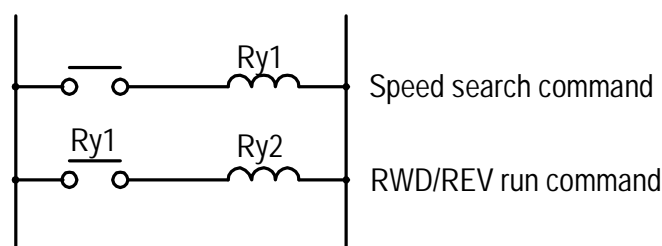
3. When the speed search and DC injection braking are set, set the Min. baseblock time (Cn-37). For the Min. baseblock time, set the time long enough to allow the motor's residual voltage to dissipate. If an overcurrent is detected when starting a speed search or DC injection braking, raise the setting Cn-37 to prevent a fault from occurring. As a result, the Cn-37 setting cannot be set too small.

(33) Low Voltage Alarm Detection Level　(Cn-39)

In most cases, the default setting Cn-39 need not be changed. If an external AC reactor is used, decrease the low voltage alarm detection level by adjusting Cn-39 setting smaller. Be sure to set a main-circuit DC voltage so that a main circuit undervoltage is detected.

(34) Slip Compensation Primary Delay Time　　　(Cn-40)

In most cases, the setting Cn-40 need not be changed. If the motor speed is not stable, increase the Cn-40 setting. If the speed response is slow, decrease the setting of Cn-40.

(35) S-curve Characteristic Time at Acceleration Start　(Cn-41)
(36) S-curve Characteristic Time at Acceleration End　(Cn-42)
(37) S-curve Characteristic Time at Deceleration Start　(Cn-43)
(38) S-curve Characteristic Time at Deceleration End　(Cn-44)

Using the S-curve characteristic function for acceleration and deceleration can reduce shock to the machinery when stopping and starting. With the inverter, S-curve characteristic time can be set respectively for beginning acceleration, ending acceleration, beginning deceleration and ending deceleration. The relation between these parameters is shown in Fig. 28.
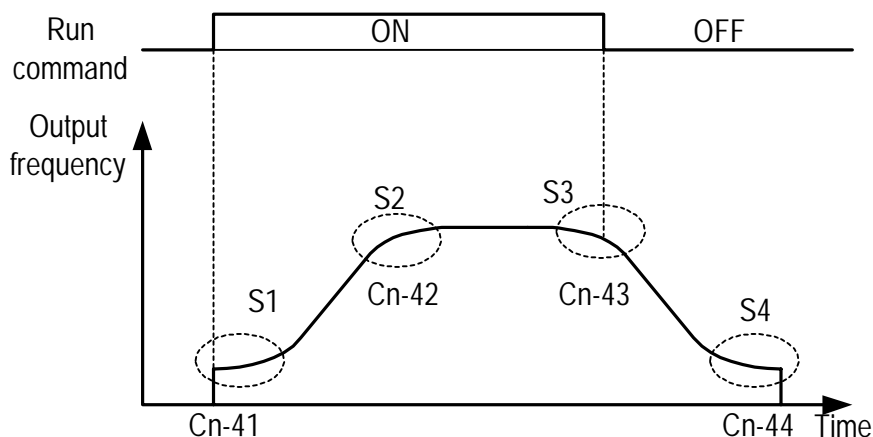

Fig. 28　S curve

After the S-curve time is set, the final acceleration and deceleration time will be as follows:

$$\text{Acc. time} = \text{selected Acc. Time 1 (or 2)} + \frac{(\text{Cn-41}) + (\text{Cn-42})}{2}$$

$$\text{Dec. time} = \text{selected Dec. Time 1 (or 2)} + \frac{(\text{Cn-43}) + (\text{Cn-44})}{2}$$

(39) PG Parameter   (Cn-45)

The parameter is set in the unit of pulse/revolution. The factory setting is 0.1 P/R.

(40) Pole Number of Motor   (Cn-46)

Cn-45 and Cn-46 must meet the following relationship:

$$\frac{2 * \text{Cn-45} * \text{Cn-02}}{\text{Cn-46}} < 32767$$

If not, an error message "Input Error" will be displayed

(41) ASR Proportion Gain 1   (Cn-47)
(42) ASR Integral Gain 1   (Cn-48)

Set the proportion gain and integral time of the speed control (ASR)

(43) ASR Proportion Gain 2   (Cn-49)
(44) ASR Integral Gain 2   (Cn-50)

Use these constants to set different proportional gain and integral time settings for high-speed operation.
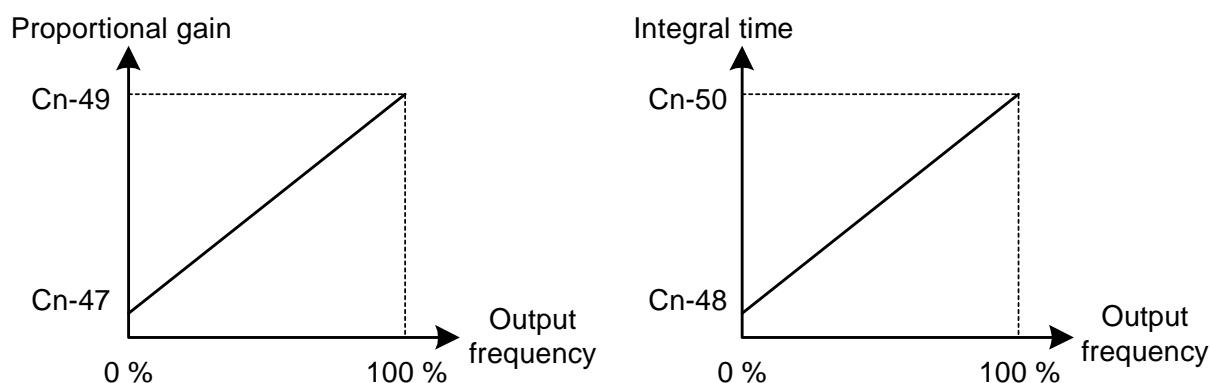
Fig 29

(45) ASR Upper Bound   (Cn-51)
(46) ASR Lower Bound   (Cn-52)

These settings of Cn-51 and Cn-52 will limit the ASR range. See Fig. 44 on page 86.

(47) Excessive Speed Deviation Detection Level   (Cn-53)

This parameter set the level of detecting PG speed deviation. The value of Cn-02 is referred as 100%, the default unit setting is 1%.

(48) Overspeed Detection Level   (Cn-54)

Set this parameter for detecting overspeed. The value of Cn-02 is referred as 100%, the default unit setting is 1%. Please refer setting of Sn-43 on page 96.

(49) PID Integral Upper Bound   (Cn-55)

(50) PID Primary Delay Time Constant   (Cn-56)

Please refer to Fig. 14〞 Block diagram for PID control in inverter〞

The parameter Cn-55 prevents the calculated value of the integral control of PID from exceeding the fixed amount. The value is limited within 0-109% of Max. output frequency (100%). Increase Cn-55 will improve the integral control. If hunting cannot be reduced by decreasing the Bn-18 or increasing Cn-56, Cn-55 has to decrease. If the setting of Cn-55 is too small, the output may not match the target setting.

The parameter Cn-56 is the low-pass filter setting for PID control output. If the viscous friction of the mechanical system is high, or if the rigidity is low, causing the mechanical system to oscillate, increase the setting Cn-56 so that it is higher than the oscillation period. It will decrease the responsiveness, but it will prevent the oscillation.

(51) Motor Line-to-Line Resistance R1   (Cn-57)

Set the motor's terminal resistance (including the motor external cable resistance) in Ω unit.

The default setting depends upon the type of inverter (but do not include the motor external motor cable resistance).

This value will be automatically set during autotuning. See "Motor parameter autotuning selection" on page 100.

Increase the setting when the generating torque is not large enough at low speed.

Decrease the setting when the generating torque is extremely high and cause overcurrent trip at low speed.

(52) Motor Rotor Equivalent Resistance R2   (Cn-58)

Set the motor's rotor Y-equivalent model resistance in Ω unit.

The default setting depends upon the type of inverter. Normally this value isn't shown on the motor's nameplate, so it might be necessary to contact motor manufactor.

This value will be automatically set during autotuning. See "Motor parameter autotuning selection" on page 100.

(53) Motor Leakage Inductance Ls   (Cn-59)

Set the motor's rotor Y-equivalent model leakage inductance in mH unit.

The default setting depends upon the type of inverter.

This value will be automatically set during autotuning. See "Motor parameter autotuning selection" on page 100.

(54) Motor Mutual Inductance Lm   (Cn-60)

Set the motor Y-equivalent model mutual inductance in mH unit.
The default setting depends upon the type of inverter.
This value will be automatically set during autotuning. See "Motor parameter autotuning selection" on page 100.

Note : The Induction Motor Y-equivalent model
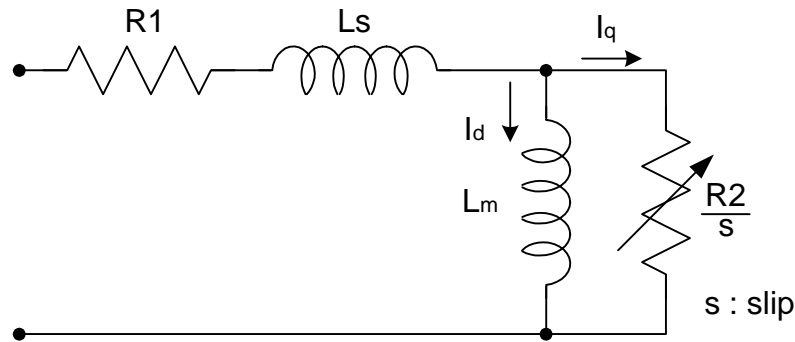
(55) Slip Compensation Gain   (Cn-61)

The parameter Cn-61 improves speed accuracy while operating with a load.
Usually, the setting Cn-61 need not be changed. Adjust the setting if the speed accuracy is needed to improve.
When actual speed is low, increase the set value.
When actual speed is high, decrease the set value.

3.4 System Parameters   Sn-

Function	Parameter No.	Name	LCD display (English)	Description	Factory Setting	Ref. Page
Capacity Setting	Sn-01	Inverter Capacity Selection	Sn-01= 01 220V 1HP	Inverter capacity selection	*1	69
V/F Curve	Sn-02	V/F Curve Selection	Sn-02= 01 V/F curve	0~14 : 15 fixed V/F curve pattern 15 : arbitrary V/F pattern selection		70
Operator Status	Sn-03	Operator Display	Sn-03= 00 Setting Valid	0 : An-　, Bn-　, Cn-　, Sn-　 setting & reading enabled 1 : An-　, setting & reading enabled Bn-　,Cn-　,Sn-　 reading only 2~5 : reserved 6 : clear fault message 7 : 2-wire initialization (220V/440V) 8 : 3-wire initialization (220V/440V) 9 : 2-wire initialization (200V/415V) 10 : 3-wire initialization (200V/415V) 11 : 2-wire initialization (200V/380V) 12 : 3-wire initialization (200V/380V) 13~15 : reserved		73
Operation Control Mode Selection	Sn-04	Run Source Selection	Sn-04= 0 Run source Operator	Run source 0 : Operator 1 : Control terminal 2 : RS-485 communication	0	73
	Sn-05	Frequency Command Selection	Sn-05= 0 Ref. Cmd. Operator	Frequency Command 0 : Operator 1 : Control circuit terminal 2 : RS-485 communication	0	73
	Sn-06	Stopping Method Selection	Sn-06= 0 Dec. Stop	0 : Deceleration to Stop 1 : Coast to Stop 2 : Whole_range braking stop 3 : Coast to Stop with Timer (restart after time Bn-02)	0	73
	Sn-07	Priority of Stopping	Sn-07= 0 Stop Key Valid	If operation command from control terminal or RS-485 communication port 0 : operator stop key effective 1 : operator stop key not effective	0	75
	Sn-08	Prohibition of REV Run	Sn-08= 0 Allow Reverse	0 : reverse run enabled 1 : reverse run disabled	0	75
	Sn-09	Output Frequency Up/Down Function	Sn-09= 0 Inhibit UP/DOWN	0 : Reference frequency is changed through the key "UP/DOWN" pressing, later followed by key "EDIT/ENTER" pressing, and then this output freq. will be acknowledged. 1 : reference frequency will be acknowledged immediately after the key "UP/DOWN" pressing.	0	75
	Sn-10	Frequency Command Characteristics Selection	Sn-10= 0 Ref. Cmd. Fwd. Char.	0 : Reference command has forward characteristics (0~10V or 4~20mA/0~100% 1 : Reference command has reverse characteristics (10~0V or 20~4mA/0~100%)	0	76

Function	Parameter No.	Name	LCD display (English)	Description	Factory Setting	Ref. Page
Operation Control Mode Selection	Sn-11	Scanning Times at Input Terminal	Sn-11= 0 Scan Time 5 ms	0 : scan and confirm once per 5 ms 1 : continuously scan and confirm twice per 10 ms	0	76
	Sn-12	Overtorque Detection Selection	Sn-12= 0 Overtorque Invalid	0 : Overtorque detection function is not effective. 1 : Overtorque is detected only at frequency_agree; the motor will sustain operation even after the overtorque has been detected 2 : Overtorque is detected only at frequency_agree; the motor will stop after the baseblock time when the overtorque has been detected. 3 : Overtorque is detected during running (ACC, DEC included). The motor will sustain operation even after the overtorque has been detected. 4 : Overtorque is detected during running (ACC, DEC included). The motor will stop after the baseblock time when the overtorque has been detected.	0	76
	Sn-13	Output Voltage Limit Selection	Sn-13= 0 V Limit Invalid	0 : V/F output voltage is limited 1 : V/F output voltage is not limited	0	76
Protection Charac-teristic. selection	Sn-14	Stall Prevention During Acc. Function Selection	Sn-14= 1 Acc. Stall Valid	0 : invalid (Too much a torque may cause the stall) 1 : valid (stop acceleration if current exceeds Cn-25 setting)	1	77
	Sn-15	Stall Prevention During Dec. Function Selection	Sn-15= 1 Dec. Stall Valid	0 : invalid (installed with external brake unit) 1 : valid (no external brake unit used)	1	77
	Sn-16	Stall Prevention During Running Function Selection	Sn-16= 1 Run Stall Valid	0 : invalid 1 : valid –Deceleration time1 for stall prevention during running (no external brake unit used) 2 : valid –Deceleration time2 for stall prevention during running (no external brake unit used)	1	77
	Sn-17	Fault Retry Setting	Sn-17= 0 Retry No O/P	0 : Do not output fault retry. (The fault contact does not operate.) 1 : Output fault retry. (The fault contact operates.)	0	77
	Sn-18	Operation Selection At Power Loss	Sn-18= 0 PwrL_to_ON Stop O/P	0 : stop running 1 : continue to run	0	78
	Sn-19	Zero Speed Braking Operation Selection	Sn-19= 0 Z_braking Invalid	(analog) Speed reference is 0 during running on, the braking function selection 0 : invalid 1 : valid	0	78

Function	Parameter No.	Name	LCD display (English)	Description		Factory Setting	Ref. Page
Protection Charac-teristic. Selection	Sn-20	External Fault Contact ③ Contact Selection	Sn-20= 0 Term.3 NO_Cont.	0 : A-contact (normally open input) 1 : B-contact (normally close input)		0	78
	Sn-21	External Fault Contact ③ Detection Selection	Sn-21= 0 All Time Ext. Fault	0 : detect all time 1 : detect only during operation		0	78
	Sn-22	External Fault Operation Selection	Sn-22= 1 Ext. Fault Free run	0 : dec. to stop (upon dec. time1 Bn-02) 1 : coast (free run) to stop 2 : dec. to stop (upon dec. time1 Bn-04) 3 : continue operating		1	78
	Sn-23	Motor Overload Protection Selection	Sn-23= 1 Cold Start Over Load	Electronically motor overload protection selection 0 : electronically motor overload protection invalid 1 : standard motor cold start overload protection characteristics 2 : standard motor hot start overload protection characteristics 3 : special motor cold start overload protection characteristics 4 : special motor hot start overload protection characteristics		1	79
	Sn-24	Frequency Command Characteristics Selection at External Analog Input Terminal	Sn-24= 0 ~ Cmd. VIN	Frequency command characteristics selection at external analog input terminal 0 : voltage signal 0~10V (VIN) 1 : current signal 4~20mA (AIN) 2 : addition of voltage signal 0~10V and current signal 4~20 mA (VIN+AIN) 3 : subtraction of current signal 4~20mA and voltage signal 0~10V (VIN-AIN)		0	79
Multi-function Input Contact Selection	Sn-25	Multi-Function Input Terminal ⑤ Function Selection	Sn-25= 02 Multi-Fun. Command1	00~25	The factory setting is multi-function command1	02	80
	Sn-26	Multi-Function Input Terminal ⑥ Function Selection	Sn-26= 03 Multi-Fun. Command1	01~26	The factory setting is multi-function command2	03	
	Sn-27	Multi-Function Input Terminal ⑦ Function Selection	Sn-27= 06 Jog Command	02~27	The factory setting is jog command	06	
	Sn-28	Multi-Function Input Terminal ⑧ Function Selection	Sn-28= 07 Acc. & Dec Switch	03~29	The factory setting is Acc. & Dec. Interrupt	07	
Multi-function Analog Input Selection	Sn-29	Multi-Function Analog Input (AUX) Function Selection	Sn-29= 00 Auxiliary Freq. Cmd.	Multi-function analog input terminal (AUX) as Auxiliary frequency command. (factory setting)		00	88

Function	Parameter No.	Name	LCD display (English)	Description		Factory Setting	Ref. Page
Multi-function Digital Output Selection	Sn-30	Multi-Function Output Terminal (RA-RB-RC) Function Selection	Sn-30= 13 Fault	00~22	Terminal (RA-RB-RC or R1A-R1B-R1C) as fault output (factory setting)	13	90
	Sn-31	Multi-Function Output Terminal (DO1) Function Selection	Sn-31= 01 Running	00~22	Terminal (DO1-DOG) as digital output during running (factory setting).	00	
	Sn-32	Multi-Function Output Terminal (DO2) Function Selection	Sn-32= 00 Zero Speed	00~22	Terminal (DO2-DOG or R2A-R2C) as digital output at zero speed (factory setting)	01	
Multi-function Analog Output Selection	Sn-33	Multi-Function Analog Output (AO1) Function Selection	Sn-33= 00 Term. AO1 Freq. Cmd.	0 : Freq. Cmd. (10.V/MAX frequency command, Cn-02) 1 : Output frequency (10.V/MAX. output frequency) 2 : Output current (10.V/input rated current) 3 : Output voltage (10.V/input voltage, Cn-01) 4 : DC voltage (10.V/400.V or 10.V/800.V)		00	94
	Sn-34	Multi-Function Analog Output (AO2) Function Selection	Sn-34= 01 Term. AO2 O/P Freq.	5 : External analog input command VIN (0.~10.V/0.~10.V) 6 : External analog input command AIN (0.~10.V/4.~20.mA) 7 : Multi-function analog input (AUX) (10.V/10.V) 8 : PID control input 9 : PID control output1 10:PID control output2 11:Communication Control		01	
	Sn-35	Pulse Output Multiplier Selection	Sn-35= 1 Pulse Mul. 6	When multi-function output terminal (DO1,DO2) is set as pulse signal output 0:1F 1:6F 2:10F 3:12F 4:36F		1	94
RS-485 Communication Function	Sn-36	Inverter Address	Sn-36= 01 Inverter Address	Inverter address can be set as 1~31		01	
	Sn-37	RS-485 Comm. Baud Rate Setting	Sn-37= 1 Baud rate 2400	0 : 1200 bps 1 : 2400 bps 2 : 4800 bps 3 : 9600 bps		1	95
	Sn-38	RS-485 Comm. Transmission Parity Setting	Sn-38= 0 Reversed Bit	0 : no parity 1 : even parity 2 : odd parity		0	
	Sn-39	RS-485 Comm. Fault Stop Selection	Sn-39= 0 1st. Dec. stop	0 : deceleration to stop (Bn-02) 1 : coast to stop 2 : deceleration to stop (Bn-04) 3 : continue to run		0	

Function	Parameter No.	Name	LCD display (English)	Description	Factory Setting	Ref. Page
PG Speed Control	Sn-40	PG Speed Control Function	Sn-40= 0 PG Invalid	0 : without speed control 1 : with speed control 2 : with speed control but no integration control during Acc/Dec. 3 : with speed control and integration control during Acc/Dec.	0	96
	Sn-41	Operation Selection At PG Open Circuit	Sn-41= 0 1st. Dec. Stop	0 : deceleration to stop (Bn-02) 1 : coast to stop 2 : deceleration to stop (Bn-04) 3 : continue to run	0	96
	Sn-42	Operation Selection At PG Large Speed Deviation	Sn-42= 0 1st. Dec Stop	0 : deceleration to stop (Bn-02) 1 : coast to stop 2 : deceleration to stop (Bn-04) 3 : continue to run	0	96
	Sn-43	Operation Selection At PG Overspeed Detection Deviation	Sn-43= 0 1st. Dec. Stop	0 : deceleration to stop (Bn-02) 1 : coast to stop 2 : deceleration to stop (Bn-04) 3 : continue to run	0	96
Auto_Run Mode	Sn-44	Operation Mode Selection During Auto_Run	Sn-44= 0 Auto_Run Invalid	0 : Auto_Run mode not effective 1 : Auto_Run mode for one single cycle. (continuing running from the unfinished step if restarting) 2 : Auto_Run mode be performed periodically (continuing running from the unfinished step if restarting) 3 : Auto_Run mode for one single cycle, then hold the speed of final step to run. (continuing running from the unfinished step if restarting) 4 : Auto_Run mode for one single cycle. (starting a new cycle if restarting) 5 : Auto_Run mode be performed periodically (starting a new cycle if restarting) 6 : Auto_Run mode for one single cycle, then hold the speed of final step to run. (starting a new cycle if restarting)	0	97
	Sn-45	Auto_Run Mode Operation Selection1	Sn-45= 0 Auto_Run Stop		0	
	Sn-46	Auto_Run Mode Operation Selection2	Sn-46= 0 Auto_Run Stop		0	
	Sn-47	Auto_Run Mode Operation Selection3	Sn-47= 0 Auto_Run Stop	0 : stop (Bn-02) 1 : forward 2 : reverse	0	97
	Sn-48	Auto_Run Mode Operation Selection4	Sn-48= 0 Auto_Run Stop		0	
	Sn-49	Auto_Run Mode Operation Selection5	Sn-49= 0 Auto_Run Stop		0	
	Sn-50	Auto_Run Mode Operation Selection6	Sn-50= 0 Auto_Run Stop		0	

Function	Parameter No.	Name	LCD display (English)	Description	Factory Setting	Ref. Page
Auto_Run Mode	Sn-51	Auto_Run Mode Operation Selection7	Sn-51= 0 Auto_Run Stop	0 : stop (Bn-02) 1 : forward 2 : reverse	0	97
	Sn-52	Auto_Run Mode Operation Selection8	Sn-52= 0 Auto_Run Stop		0	
	Sn-53	Auto_Run Mode Operation Selection9	Sn-53= 0 Auto_Run Stop		0	
	Sn-54	Auto_Run Mode Operation Selection10	Sn-54= 0 Auto_Run Stop		0	
	Sn-55	Auto_Run Mode Operation Selection11	Sn-55= 0 Auto_Run Stop		0	
	Sn-56	Auto_Run Mode Operation Selection12	Sn-56= 0 Auto_Run Stop		0	
	Sn-57	Auto_Run Mode Operation Selection13	Sn-57= 0 Auto_Run Stop		0	
	Sn-58	Auto_Run Mode Operation Selection14	Sn-58= 0 Auto_Run Stop		0	
	Sn-59	Auto_Run Mode Operation Selection15	Sn-59= 0 Auto_Run Stop		0	
	Sn-60	Auto_Run Mode Operation Selection16	Sn-60= 0 Auto_Run Stop		0	
	Sn-61	Applied Torque Mode	Sn-61= 0 Const. Tq. Load	0 : constant torque 1 : variable(quadratic) torque	0	98
	Sn-62	Language Selection	Sn-62= 0 Language: English	0 : English 1 : Traditional Chinese	0	99
	Sn-63	Parameter Copy	Sn-63=0 Not Load	0 : not loaded (copied) 1 : upload from digital operator to inverter 2 : download from inverter to digital operator 3 : inspect the EEPROM of digital operator 4 : inspect the EEPROM of inverter	0	99
	Sn-64	PID Function	Sn-64=0 PID Invalid	0 : PID invalid 1 : PID valid	0	99
	Sn-65	Brake Resistor Protection	Sn-65=0 Protect Invalid	0 : Braking resistor protection invalid 1 : Braking resistor protection valid	0	100
*2 Sensorless Vector Control	Sn-66	Motor Parameters Autotuning Selection	Sn-66=0 AUTO TUNE SEL	0 : Autotuning invalid 1 : Autotuning valid	0	100
	Sn-67	Control Mode Selection	Sn-67=0 CNTRL MODE SEL	0 : V/F control mode (include V/F control with pulse generator feedback) 1 : Sensorless Vector Control Mode	0	100

*1 The default setting will depend upon the different inverter capacity.
*2 Sensorless vector control will be available soon in all UL type 7200MA inverters.

(1) Inverter capacity selection　　(Sn-01)

　　The inverter capacity has already been set at factory according to the following tables. Whenever the control board is replaced, the setting Sn-01 must be set again according to the following tables.

　　Whenever the setting Sn-01 has been changed, the inverter system parameter settings should be changed based upon the constant torque (CT) load (setting of Sn-61= 0) or variable torque (VT) load (Sn-61= 1).

Table 10　　220V Class Inverter Capacity Selection

Sn-01 setting			001		002		003		004		005		006		007		008	
Item name		CT (Sn-61= 0) VT (Sn-61= 1)	CT	VT	CT	VT	CT	VT	CT	VT	CT	VT	CT	VT	CT	VT	CT	VT
Inverter rated capacity(KVA)			2		2.7		4		7.5		10.1		13.7		20.6		27.4	
Inverter rated current　　(A)			4.8		6.4		9.6		17.5		24		32		48		64	
Max. applicable capacity　(HP)			1	2	2	3	3	3	5.4	7.5	7.5	10	10	10	15	20	20	25
Factory Setting	Cn-09	Motor rated current　　(A)	3.4	6.1	6.1	8.7	8.7	8.7	14.6	20.1	20.1	25.1	25.1	25.1	36.7	50.3	50.3	62.9
	Cn-12	Motor line impedance(　)	5.732	2.407	2.407	1.583	1.583	1.583	0.684	0.444	0.444	0.288	0.288	0.288	0.159	0.109	0.109	0.077
	Cn-13	Core loss torque compensation(W	64	108	108	142	142	142	208	252	252	285	285	285	370	471	471	425
	Cn-34	Carrier freq.　　(kHz)	15	10	15	5	15	15	15	5	15	10	15	15	10	5	10	5
	Cn-37	Min. baseblock time　　(sec)	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7
	Sn-02	V/F curve	01	07[*1]	01	07[*1]	01	07[*1]	01	07[*1]	01	07[*1]	01	07[*1]	01	07[*1]	01	07[*1]

Table 11　　440V Class Inverter Capacity Selection

Sn-01 setting			021		022		023		024		025		026		027		028	
Item name		CT (Sn-61= 0) VT (Sn-61= 1)	CT	VT	CT	VT	CT	VT	CT	VT	CT	VT	CT	VT	CT	VT	CT	VT
Inverter rated capacity(KVA)			2.2		3.4		4.1		7.5		10.3		12.3		20.6		27.4	
Inverter rated current　　(A)			2.6		4		4.8		8.7		12		15		24		32	
Max. applicable capacity　(HP)			1	2	2	3	3	3	5.4	7.5	7.5	10	10	15	15	20	20	25
Factory Setting	Cn-09	Motor rated current　　(A)	1.7	2.9	2.9	4	4	4	7.3	10.2	10.2	12.6	12.6	18.6	18.6	24.8	24.8	31.1
	Cn-12	Motor line impedance(　)	22.97	9.628	9.628	6.333	6.333	6.333	2.735	1.776	1.776	1.151	1.151	0.634	0.634	0.436	0.436	0.308
	Cn-13	Core loss torque compensation(W	64	108	108	142	142	142	208	252	252	285	285	370	370	471	471	425
	Cn-34	Carrier freq.　　(kHz)	15	10	15	5	15	15	15	5	15	10	15	5	10	5	10	5
	Cn-37	Min. baseblock time　　(sec)	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7
	Sn-02	V/F curve	01	07[*1]	01	07[*1]	01	07[*1]	01	07[*1]	01	07[*1]	01	07[*1]	01	07[*1]	01	07[*1]

*1 Use the variable torque patterns when there is a quadratic or cubic relationship between the speed and load, such as in fan or pump applications. The user can properly choose the desired (V/f) patterns (Sn-02=04, 05, 06,or 07) based upon the load torque characteristics.

*2 In the fan or pump applications, the load torque have a quadratic or cubic relationship between the speed and load. The inverter capacity rating can be increased to a value that doubles its own specified capacity rating in some special case. For example, a 1-Hp inverter can be used to drive a 2-Hp motor with same voltage class. But, due to the real hardware limitation, 220V 3HP, 10HP and 440V 3HP can not be adapted any larger capacity.
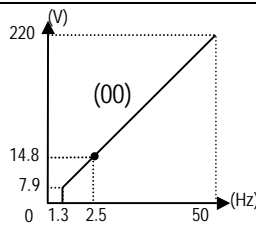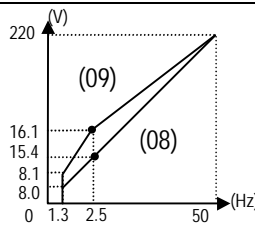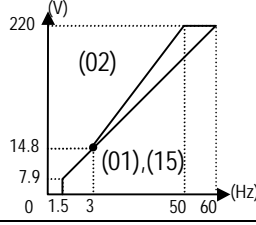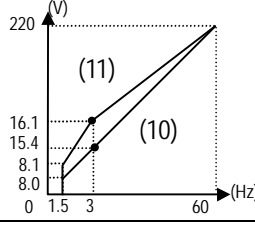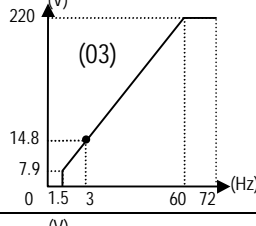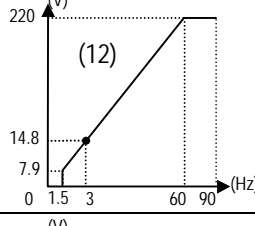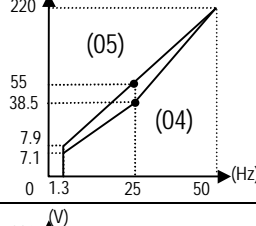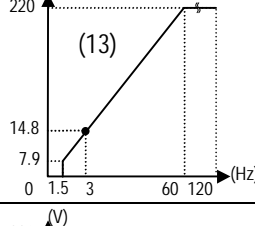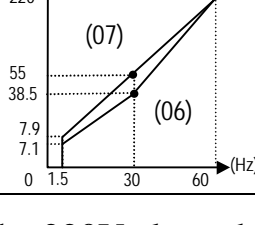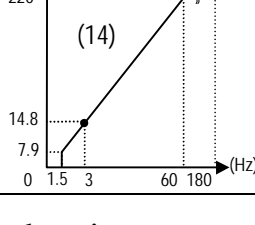
(2) V/F curve selection (Sn-02)

Set the inverter input voltage (Cn-01) first to match the power supply voltage. The V/f curve can be set to ant of the following.
Sn-02 = 00~14 : one of 15 pre-set curve patterns
       = 15   : V/F pattern can be set by the user through setting of Cn-01~Cn-08

Table 12　V/F curve of 1~2 HP compact size, 220V Class MA inverter *

	Specifications		Sn-02	V/F Pattern†		Specifications		Sn-02	V/F Pattern†
General Purpose	50Hz		00	(00)　220, 14.8, 7.9　0 1.3 2.5 50 (Hz)	High Starting Torque‡‡	50Hz	Low Starting Torque	08	(09)(08)　220, 16.1, 15.4, 8.1, 8.0　0 1.3 2.5 50 (Hz)
							High Starting Torque	09	
	60Hz	60Hz Saturation	01 15	(02) (01),(15)　220, 14.8, 7.9　0 1.5 3 50 60 (Hz)		60Hz	Low Starting Torque	10	(11)(10)　220, 16.1, 15.4, 8.1, 8.0　0 1.5 3 60 (Hz)
		50Hz Saturation	02				High Starting Torque	11	
	72Hz		03	(03)　220, 14.8, 7.9　0 1.5 3 60 72 (Hz)	Rated Output Operation (Machine Tool)	90Hz		12	(12)　220, 14.8, 7.9　0 1.5 3 60 90 (Hz)
Variable Torque Characteristic	50Hz	Variable Torque 1	04	(05)(04)　220, 55, 38.5, 7.9, 7.1　0 1.3 25 50 (Hz)		120Hz		13	(13)　220, 14.8, 7.9　0 1.5 3 60 120 (Hz)
		Variable Torque 2	05						
	60Hz	Variable Torque 3	06	(07)(06)　220, 55, 38.5, 7.9, 7.1　0 1.5 30 60 (Hz)		180Hz		14	(14)　220, 14.8, 7.9　0 1.5 3 60 180 (Hz)
		Variable Torque 4	07						

* These values are for the 220V class; double the values for 440V class inverters.

† Consider the following items as the conditions for selecting a V/f pattern.
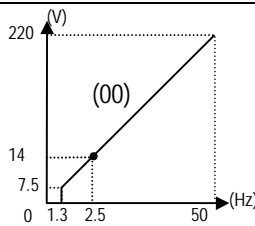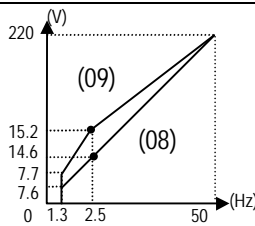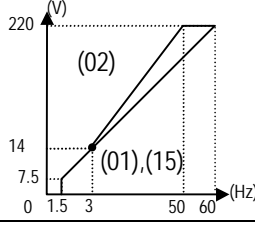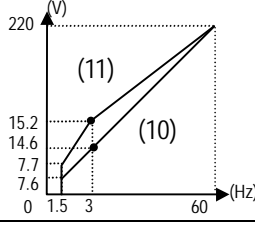 They must be suitable for
  (1) The voltage and frequency characteristic of motor.
  (2) The maximum speed of motor.
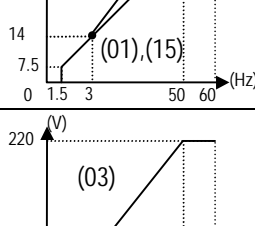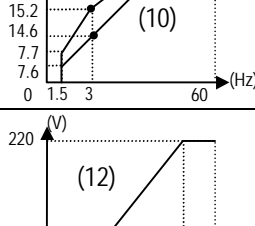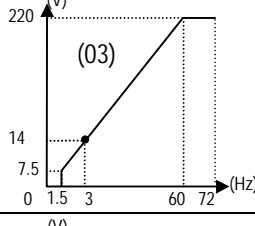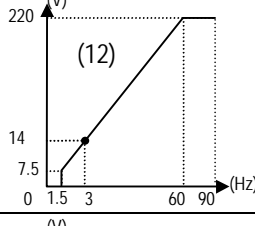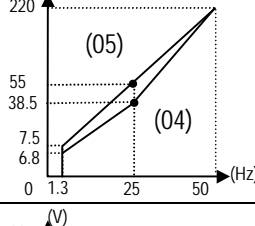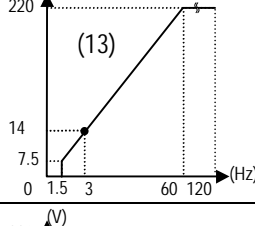
‡ Select high starting torque only in the following conditions. Normally, the selection is not required.
  (1) The power cable length is long [492ft (150m) and above].
  (2) Voltage drop at startup is large.
  (3) AC reactor is inserted at the input side or output side of the inverter.
  (4) A motor with capacity smaller than the maximum applicable inverter capacity is used.

Table 13   V/F curve of 3~20 HP, 220V Class MA inverter *

	Specifications	Sn-02	V/F Pattern†		Specifications		Sn-02	V/F Pattern†
General Purpose	50Hz	00	(00) 220 / 14 / 7.5 ; 0 1.3 2.5 50 (Hz)	High Staring Torque‡	50Hz	Low Starting Torque	08	(09) (08) 220 / 15.2 / 14.6 / 7.7 / 7.6 ; 0 1.3 2.5 50 (Hz)
						High Starting Torque	09	
	60Hz — 60Hz Saturation	01, 15	(02) (01),(15) 220 / 14 / 7.5 ; 0 1.5 3 50 60 (Hz)		60Hz	Low Starting Torque	10	(11) (10) 220 / 15.2 / 14.6 / 7.7 / 7.6 ; 0 1.5 3 60 (Hz)
	60Hz — 50Hz Saturation	02				High Starting Torque	11	
	72Hz	03	(03) 220 / 14 / 7.5 ; 0 1.5 3 60 72 (Hz)	Rated Output Operation (Machine Tool)	90Hz		12	(12) 220 / 14 / 7.5 ; 0 1.5 3 60 90 (Hz)
Variable Torque Characteristic	50Hz — Variable Torque 1	04	(05) (04) 220 / 55 / 38.5 / 7.5 / 6.8 ; 0 1.3 25 50 (Hz)		120Hz		13	(13) 220 / 14 / 7.5 ; 0 1.5 3 60 120 (Hz)
	50Hz — Variable Torque 2	05						
	60Hz — Variable Torque 3	06	(07) (06) 220 / 55 / 38.5 / 7.5 / 6.8 ; 0 1.5 30 60 (Hz)		180Hz		14	(14) 220 / 14 / 7.5 ; 0 1.5 3 60 180 (Hz)
	60Hz — Variable Torque 4	07						

* These values are for the 220V class; double the values for 440V class inverters.

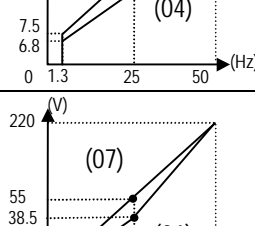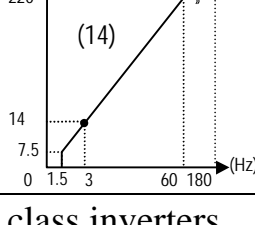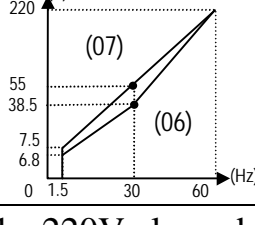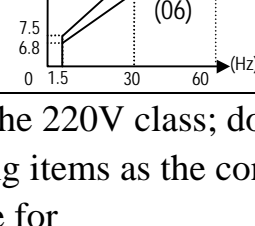† Consider the following items as the conditions for selecting a V/f pattern. They must be suitable for
  (1) The voltage and frequency characteristic of motor.
  (2) The maximum speed of motor.

‡ Select high starting torque only in the following conditions. Normally, the selection if not required.
  (1) The power cable length is long [492ft (150m) and above].
  (2) Voltage drop at startup is large.
  (3) AC reactor is inserted at the input side or output side of the inverter.
  (4) A motor with capacity smaller than the maximum applicable inverter capacity is used.

(3) Operator Display (Sn-03)

Parameter code (Sn-03= 0 or 1)
Set the parameter Sn-03 as 0 or 1 to determine the access status as follows.

Sn-03	DRIVE mode		PRGM mode	
	Set	Read Only	Set	Read Only
0	An, Bn	Sn, Cn	An, Bn, Sn, Cn	
1	An	Bn, Sn, Cn	An	Bn, Sn, Cn

Initialized setting of parameter (Sn-03= 7～12)
Except the parameter of Sn-01～02 and Sn-61, the parameter groups of An-□□, Bn-□□, Cn-□□ and Sn-□□ can be initialized as factory setting according to the different input voltage. At the same time, the terminal ⑤～⑧ can be set as 2-wire or 3-wire operation mode under different setting of Sn-03. Please see 2-/3-wire operation mode on page 81.

(4) Run Source Selection (Sn-04)

The parameter is used to select the source of run command.
Sn-04 = 0 : digital operator
        1 : control circuit terminal
        2 : RS-485 communication
If Sn-04 is set as 1, the run source is from the control circuit terminal. Under the initial setting of 2-wire operation (through setting of Sn-03=7 or 9 or 11), the run source will be FWD/STOP, REV/STOP.
If Sn-04 is set as 1, the run source is from the control circuit terminal. Under the initial setting of 3-wire operation (through setting of Sn-03=8 or 10 or 12), the run source will be RUN, STOP, FWD/ REV.
For more details, see "2-/3- wire operation" on page 81.

(5) Frequency Command Setting Method Selection (Sn-05)

The parameter is used to select the source of frequency command.
Sn-05 = 0 : digital operator
        1 : control circuit terminal
        2 : RS-485 communication

(6) Stopping Method Selection　(Sn-06)

Setting the stopping method used when a stop command is executed.

Setting	Function
0	Deceleration to stop
1	Coast to stop
2	DC braking stop: Stops faster than coast to stop, without regenerative operation.
3	Coast to stop with timer: Run sources are disregarded during decel. time.

The following diagrams show the operation of each stopping method.
a) Deceleration to Stop (Sn-06= 0)

  Deceleration to a stop at a rate set with the selected deceleration time.
b) Coast to Stop (Sn-06= 1)

  After the stop command is executed, run source is disregarded until the Min. baseblock time Cn-37 has elapsed.
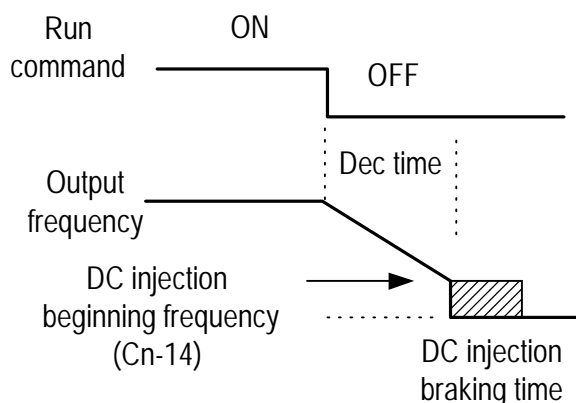
Fig. 30   Deceleration to stop
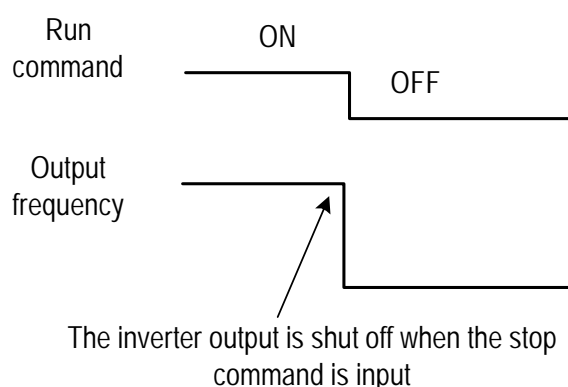
Fig. 31   Coast to Stop

c) Whole Range DC Injection Braking Stop (Sn-06= 2)
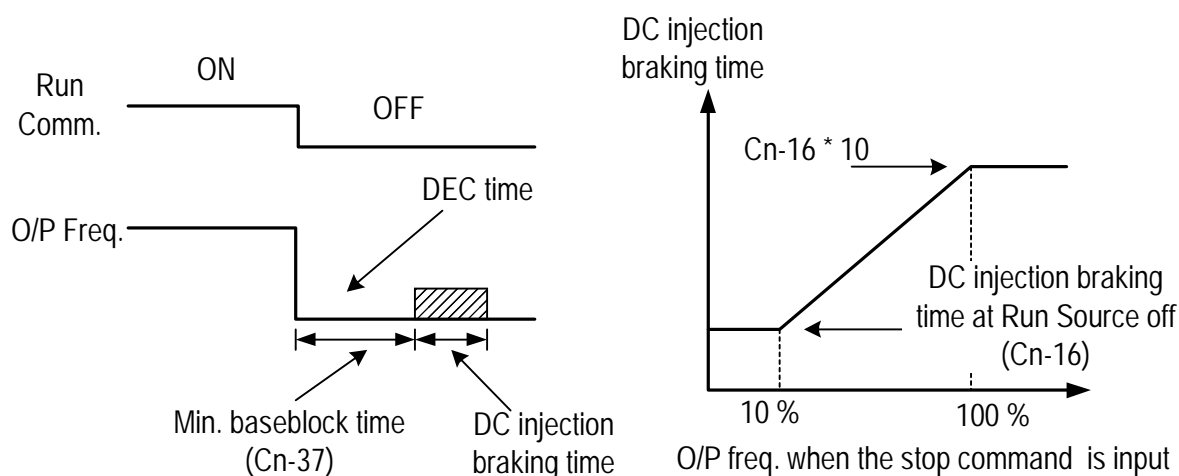
Fig. 32 Whole range DC Injecting Braking Stop

  After the stop command is input and the minimum baseblock time (Cn-37) has elapsed, DC injection braking is applied and the motor stopped.

  The DC injection braking time depends upon the output frequency when the stop command is input and the "DC injection time at stop" setting (Cn-16) as shown in Fig. 32.

  Lengthen the minimum baseblock time (Cn-37) when an overcurrent (OC) occurs during stopping. When the power to an induction motor is turned OFF, the counter-electromotive force generated by the residual magnetic field in the motor can cause an overcurrent to be detected when DC injection braking stop is applied.

d) Coast to Stop with Timer (Sn-06= 3)

Fig. 33   Coast to Stop with Timer

After the stop command is executed, run sources are disregarded until the time T1 has elapsed. The time T1 depends upon the output frequency when the stop command is executed and upon the deceleration time (Bn-02 or Bn-04).
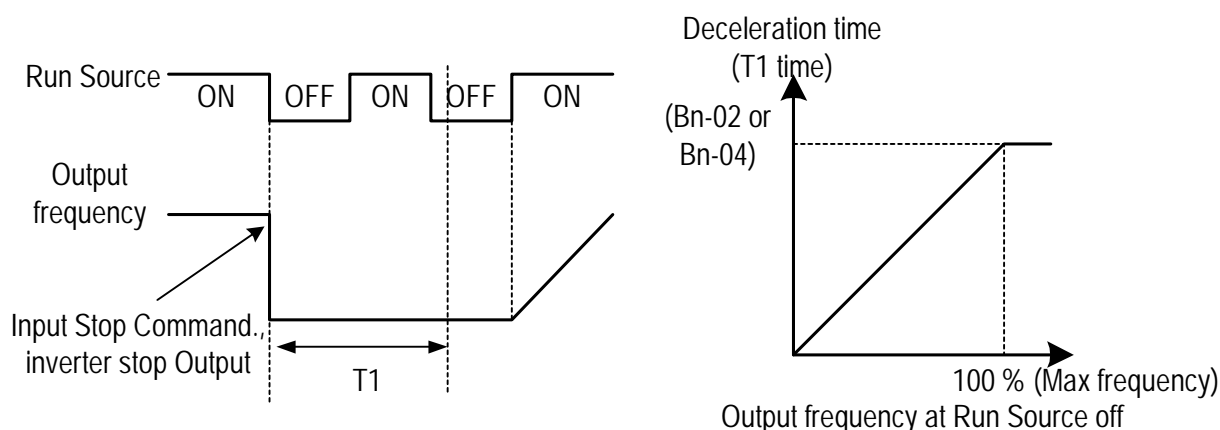
(7)   Priority of Stopping (Sn-07)

This parameter enable or disable the STOP key on the digital operator when the run source is from an control circuit terminal or RS-485 communicate port while the motor is running.

Sn-07 = 0 : enabled. (The STOP key is enabled at all time during running)

＝1 : disabled (The STOP key is disabled when the run source is from control terminal or RS-485 port)

(8)   Prohibition of REV Run (Sn-08)

While the parameter Sn-08 is set as 1. The reverse run of motor is not allowed

(9)   Output Frequency UP/DOWN Function   (Sn-09)

The output frequency can be increased or decreased (UP/DOWN) through digital operator

Sn-09= 0 :   Change output frequency through the ($\wedge$ / $\vee$) key. The frequency command will be accepted only after the key $\boxed{\substack{\text{EDIT}\\\text{ENTER}}}$ has been pressed.

＝1   Change output frequency through the ($\wedge$ / $\vee$) key. The frequency command can be recalled even restarting the inverter if the $\boxed{\substack{\text{EDIT}\\\text{ENTER}}}$ key has been pressed at that time.

The output frequency can be changed (increasing (UP) or decreasing (DOWN)) through either the LCD digital operator or external multi-function input terminal (terminals ⑤   ⑧). See page 73.

(10) Frequency Command Characteristics Selection   (Sn-10)

Sn-10 = 0 : Forward characteristics of frequency command
              (0~10V or 4~20mA /0~100%)
       = 1 : Reverse characteristics of frequency command
              (10~0V or 20~4mA /100~0%)

(11) Scan Time at Input Terminal   (Sn-11)

Setting of scan frequency of input terminal (Forward/Reverse, multi-function input)

Sn-11 = 0 : Scan input terminals every 5ms.
       = 1 : Scan input terminals every 10ms.

(12) Overtorque Detection Selection   (Sn-12)

When overtorque detection is enabled, be sure to set the value of the overtorque detection level (Cn-32) and the overtorque detection time (Cn-33). An overtorque condition us detected when the current exceeds the overtorque detection level for longer than the overtorque detection time.

Sn-12	Function	Display
0	Overtorque detection disabled	
1	Detect only during speed agree. Continue operation after detection. (Miner fault)	"Over Torque" blinks
2	Detect only during speed agree. Stop output after detection (Fault)	"Over Torque" lights
3	Detect overtorque at any time. Continue operation after detection. (Miner fault)	"Over Torque" blinks
4	Detect overtorque at any time. Stop output after detection (Fault)	"Over Torque" lights

(13) Output Voltage Limitation Selection   (Sn-13)

In low speed region, if the output voltage from V/f pattern is too high, the inverter will be driven into fault status. As a result, the user can use this option to set the upper bound limit of output voltage.
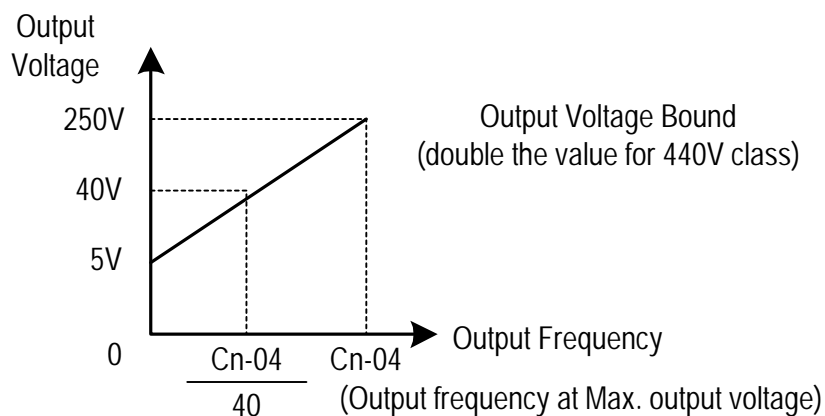

Fig. 34 Output voltage limit

(14) Stall Prevention Selection During Acceleration   (Sn-14)

Sn-14 = 0 : Disabled (Accelerate according to the setting. Stall may occurs with large load)

= 1 : Enabled (Stop acceleration if Cn-25 setting is exceeded. Accelerate again when current recovers)

Please refer to "Stall prevention level during acceleration" on page 53.

(15) Stall Prevention Selection During Deceleration   (Sn-15)

If external braking resistor unit is installed, the Sn-15 setting must be disabled (Sn-15= 0).

If no external braking resistor unit is installed, the inverter can provide about 20% regenerative braking torque. If the load inertia is so large that it exceeds the regenerative braking torque, the parameter Sn-15 is set as "1". When setting Sn-15= 1 (enabled) is selected, the deceleration time (Bn-02 or Bn-04) is extended so that a main circuit overvoltage does not occur.
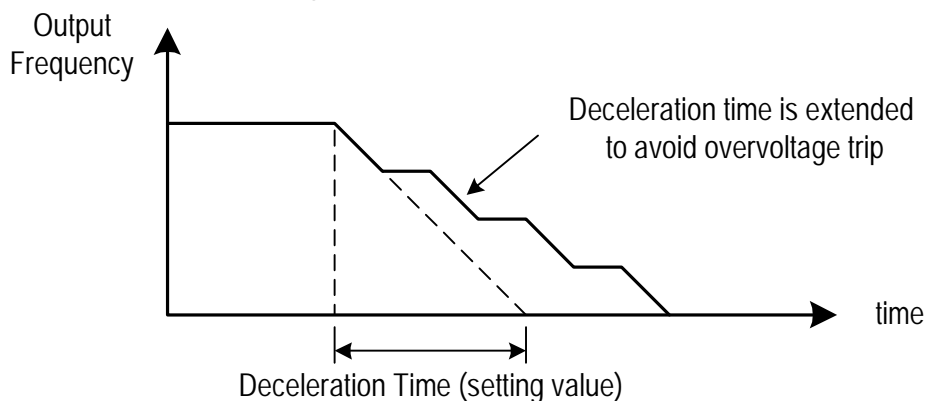
Fig. 35   Stall prevention function during deceleration (Sn-15= 1)

(16) Stall Prevention Selection during Running(Sn-16)

Sn-16 = 0 : Disabled (Stall may occur when a large load is applied)

= 1 : Enabled (Deceleration will start if the motor current is larger than the stall prevention level during running and continues for more than 100ms. The motor is accelerated back to the reference frequency again when the current falls below this level Cn-26).

Please refer to "Stall prevention level during running" on page 53.

(17) Operation Selection at Fault Contact during Fault Retrying (Sn-17)

Sn-17 = 0 : Do not output fault restart. (The fault contact does not work)

= 1 : Output fault restart. (The fault contact operates)

Please refer to "Number of auto restart attempt" on page 52.

(18) Operation Selection at Power Loss   (Sn-18)

This parameter specifies the processing to be performed when a momentary power loss occurs (within 2 sec)

Sn-18= 0 : When power loss ride through is enabled, operation will be restarted after a speed search envoked if the power is restored within the allowed time.

= 1 : When power loss ride-through is disabled the inverter will stop after a momentary power loss. An undervoltage fault will be detected then. If the power is interrupted for more than 2 seconds, the fault contact output will operate and the motor will coast to stop.

(19) Zero Speed Braking Selection   (Sn-19)

The run-source and frequency command is input from control circuit under the setting of Sn-04=1 & Sn-05=1, If Sn-19 is enabled, the blocking torque will be generated in DC-braking mode when the frequency command is 0V and forward – run source is "ON".

A time-chart shows the above action as below. The zero-braking selection Sn-19 is set to 1 and the DC-braking current Cn-15 is limited within 20% of rated current.
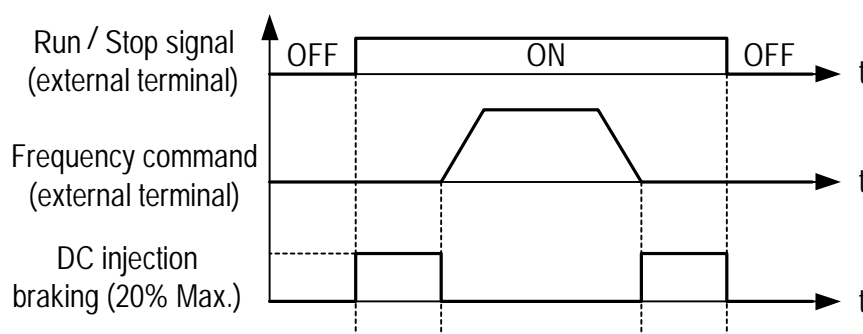
Fig. 36   Zero speed braking operation selection

(20) External Fault Contact ③ Contact Selection   (Sn-20)

Sn-20 = 0 : Input signal is from A-contact. (Normal-open contact)
= 1 : Input signal is from B-contact. (Normal-close contact)

(21) External Fault Contact ③ Detection Selection (Sn-21)

Sn-21 = 0: Always detects.
= 1: Detect only during running.

(22) Detection Mode Selection of External Fault   (Sn-22)

An external fault is detected (at terminal ③), the following operation will be performed based upon the setting of Sn-22

Sn-22 = 0: Decelerate to stop with the specified deceleration time Bn-02.
= 1: Coast to stop.
= 2: Decelerate to stop with the specified deceleration time Bn-04.
= 3: Continue running with no regard of external fault.

(23) Motor Overload Protection Selection (Sn-23)

Sn-23 = 0: Electronic overload protection disable.

Sn-23 = 1~4 : Electronic overload protection enabled. The electronic thermal overload is detected according to the characteristic curves of protection operating time. vs. motor rated current setting (Cn-09).

Sn-23 = 1 : The overload is detected according to the standard motor cold start curve.

    = 2 : The overload is detected according to the standard motor hot start curve.

    = 3 : The overload is detected according to the specific motor cold start curve.

    = 4 : The overload is detected according to the specific motor hot start curve.

Disable the motor protection function (setting 0) when 2 or more motors are connected to a single inverter. Use another method to provide overload protection separately to each motor, such as connecting a thermal overload relay to the power line of each motor.

The motor overload protection function should be set as Sn-23= 2 or 4 (hot start protection characteristic curve) when the power supply is turned on or off frequently, because the thermal values is reset each time when the power is turned off.

For the motor without forced cooling fan, the heat dissipation capability is lower when in the low speed operation. The setting Sn-23 can be either '1' or '2'.

For the motor with forced cooling fan, the heat dissipation capability is not dependent upon the rotating speed. The setting Sn-23 can be either '3' or '4'.

To protect the motor from overload by use of electronic overload protection, be sure to set the parameter Cn-09 according to the rated current value shown on the motor nameplate.
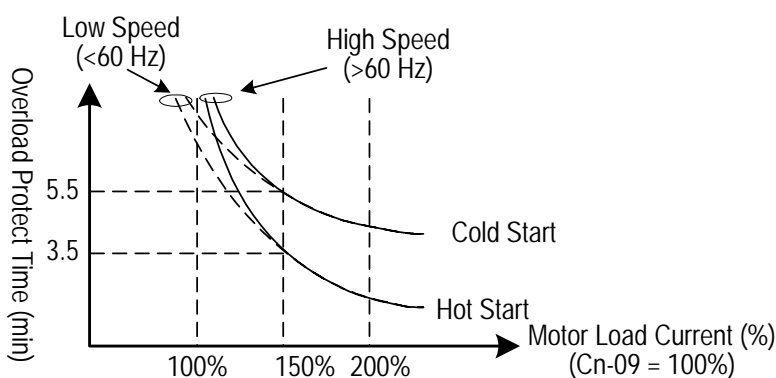
Fig. 37 Motor overload protection curve (Cn-09 setting = 100%)

(24) Frequency Characteristics Command Selection at External Analog Input Terminal (Sn-24)

Sn-24 = 0 : Frequency command is input at VIN terminal (0~10V)

    = 1 : Frequency command is input at AIN terminal (4~20mA)

    = 2 : Frequency command is the addition (VIN + AIN) at VIN (0~10V) and AIN (4~20mA) terminal.

    = 3 : Frequency command is the combination (VIN - AIN) at VIN (0~10V) and AIN (4~20mA) terminal. If the value (VIN - AIN) is negative, the reference command will take '0' as a result.

(25) Multi-Function Input Terminal ⑤ Function Selection (Sn-25)
(26) Multi-Function Input Terminal ⑥ Function Selection (Sn-26)
(27) Multi-Function Input Terminal ⑦ Function Selection (Sn-27)
(28) Multi-Function Input Terminal ⑧ Function Selection (Sn-28)
　　The settings and functions for the multi-function input are listed in Table 14.

Table 14　Multi-Function Input Setting

Setting	Function	LCD Display	Description
00	Forward/Reverse command	3_Wire Run	3-wire operation mode
01	2-wire key-pressing input stop command	2_Wire Stop Key	2-wire operation mode
02	Multi-speed command1	Multi-Fun. Command 1	Multi-speed frequency command selection
03	Multi-speed command2	Multi-Fun. Command 2	
04	Multi-speed command3	Multi-Fun. Command 3	
05	Multi-speed command4	Multi-Fun. Command 4	
06	Jogging	Jog Command	ON: select jogging frequency
07	Acc/Dec time switch command	Acc.&Dec. Switch	OFF: the first stage Acc/Dec time (Bn-01, Bn-02), ON: the second stage Acc/Dec time (Bn-03, Bn-04),
08	External base-block command A-contact)	Ext.B.B. NO_Cont	ON: inverter output baseblock
09	External base-block command (B-contact)	Ext.B.B. NC_Cont	OFF: inverter output baseblock
10	Inhibit Acc/Dec command	Inhibit Acc&Dec	Inhibit Acc/Dec (hold frequency)
11	Inverter overheat warning	Over Heat Alarm	ON: blink show overheat (inverter can proceed running)
12	FJOG	Forward Jog	ON: forward jog
13	RJOG	Reverse Jog	ON: reverse jog
14	PID integration reset	I_Time Reset	ON: Reset PID integration
15	PID control invalid	PID Invalid	ON: PID control not effective
16	External fault (A-contact)	Ext.Fault NO_Cont	ON: External fault input (normally open)
17	External fault (B-contact)	Ext.Fault NC_Cont	OFF: External fault input (normally close)
18	Multi-function analog input	~ Input Valid	ON: multi-function analog input (AUX) effective
19	Timer function input	Timer Function	ON: ON-delay/OFF-delay timer input
20	DC braking command	' Brakin Command	ON: DC injection braking applied when the frequency output is less than the DC injection start frequency
21	Speed search 1 command	Max Freq. Sp_Search	ON: speed search is performed from max. output frequency
22	Speed search 2 command	Set Freq. Sp_Search	ON: speed search is performed from reference frequency
23	Local/Remote control I	Operator Control	ON: local mode control (through LCD operator) OFF: Run Source and Frequency Command is determined according to (Sn-04, Sn-05) setting
24	Local/Remote control II	Ext. Term. Control	ON: local mode control (through control circuit terminal) OFF: Run Source and Frequency Command is determined according to (Sn-04, Sn-05) setting
25	RS-485 communication application	Comm. Control	PLC application extension use. (Please refer to "RS-485 MODBUS/PROFIBUS Application Manual")
26	speed control without PG	PG Invalid	ON: Speed control without PG
27	Reset integration of speed control with PG	I_Time Invalid	ON: Reset integration of speed control with PG
28	Frequency Up/Down function	UP/DOWN Function	Only Sn-28 can be set as Sn-28=28, terminal ⑦ used as up cmd. and terminal ⑧ used as down cmd. when Sn-28=28
29	Force operation signal	Force Run	Only Sn-28 can be set as Sn-28=29

Note : An error message of "Multi-Fun. Parameter" / "Setting Error" will be displayed if:
　　　Setting combination of (Sn-25~Sn28) is not organized in monotonically increasing order.
　　　Setting 21, 22 (both for speed search command) are set at the same time.

Forward/Reverse Change   (setting   00)

Under 3-wire initialization mode (Sn-03= 8 or 10 or 12)   the multi-function input terminals ⑤~⑧ have setting "00", the inverter will be in the 3-wire mode operation. As shown in Fig. 38, the Forward/Reverse change mode is set at the terminal ⑤.

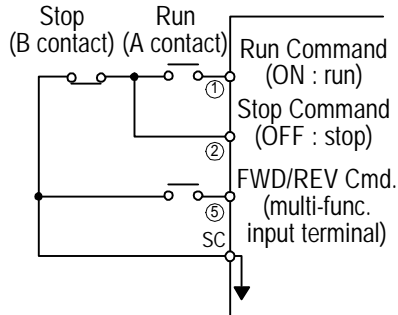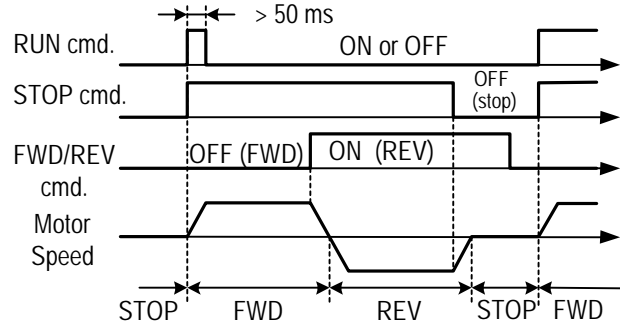

Fig. 38 3-wire mode connection
diagram

Fig. 39 Operation sequence in 3-wire mode

Input STOP Command during 2-Wire Mode Operation (setting   01)

Under a standard 2-wire initialization mode as shown in Fig. 40(a), S1 and S2 can not be both "ON" at the same time.

When S1="ON" and S2="OFF", the motor is FWD running. When S1="OFF" and S2="ON", the motor is REV running. When S1="OFF" and S2="OFF", the motor stops running.

When Sn-25='01', the 2-wire operation mode has its self-sustaining function. Only through the multi-function input terminal ⑤, the operator can stop the inverter after pressing the "STOP" key as shown in Fig. 40(b). As shown in Fig. 40(b), the switches S1, S2 and S3 do not need to be the self-sustaining switches. When S1 is depressed "ON", the motor will be forward running. After S3 is depressed "ON", the motor will stop. When S2 is depressed "ON", the motor will be reverse running. After S3 is depressed "ON", the motor will stop.
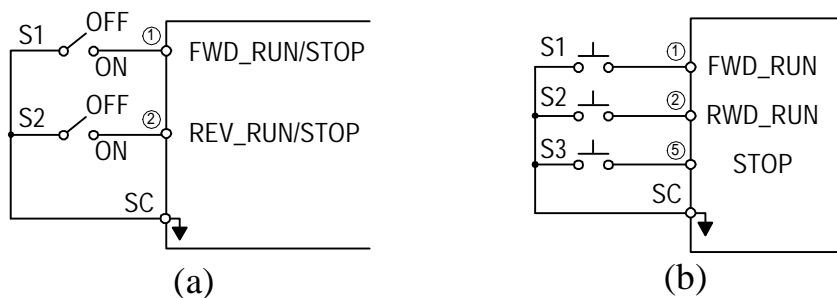
Fig. 40   2-wire mode connection diagram

Note   1. For the other setting value (except "00", "01"), the external operation mode is defaulted as 2-wire mode and no self-sustaining function. (that is, the inverter will stop when contact ① and ② are not close.)

2. Under the 2-wire mode, the error message "Freq. Comm. Error" will be displayed in the digital operator when terminal ① and ② are both ON at the same time, the inverter will stop. After the above case cleared, the inverter will return normal.

Multi-Step Speed Command1   (Setting   02)
Multi-Step Speed Command2   (Setting   03)
Multi-Step Speed Command3   (Setting   04)
Multi-Step Speed Command4   (Setting   05)
Jog Frequency Selection   (Setting   06)

There are 16 (maximum) step speed command selection from the combination of the Multi-Step Speed Command and jog frequency command.

Multi-Step Speed command 1~4 and Jog Frequency Selection Setting Table.

Terminal ⑧ (Sn-28= 05) Multi-step speed cmd. 4	Terminal ⑦ (Sn-27= 04) Multi-step speed cmd. 3	Terminal⑥ (Sn-26= 03) Multi-step speed cmd. 2	Terminal ⑤ (Sn-25= 02) Multi-step speed cmd. 1	Selected frequency
0	0	0	0	Freq. Cmd. 1 (An-01)[*1]
0	0	0	1	Freq. Cmd. 2 (An-02)[*1]
0	0	1	0	Freq. Cmd. 3 (An-03)[*1]
0	0	1	1	Freq. Cmd. 4 (An-04)[*1]
0	1	0	0	Freq. Cmd. 5 (An-05)[*1]
0	1	0	1	Freq. Cmd. 6 (An-06)[*1]
0	1	1	0	Freq. Cmd. 7 (An-07)[*1]
0	1	1	1	Freq. Cmd. 8 (An-08)[*1]
1	1	1	1	Freq. Cmd. 16 (An-16)[*1]

Note: "0"   terminal is "OFF"   "1"   terminal is "ON"

An example shows the operation sequence of a multi-step speed and jog command is as below.
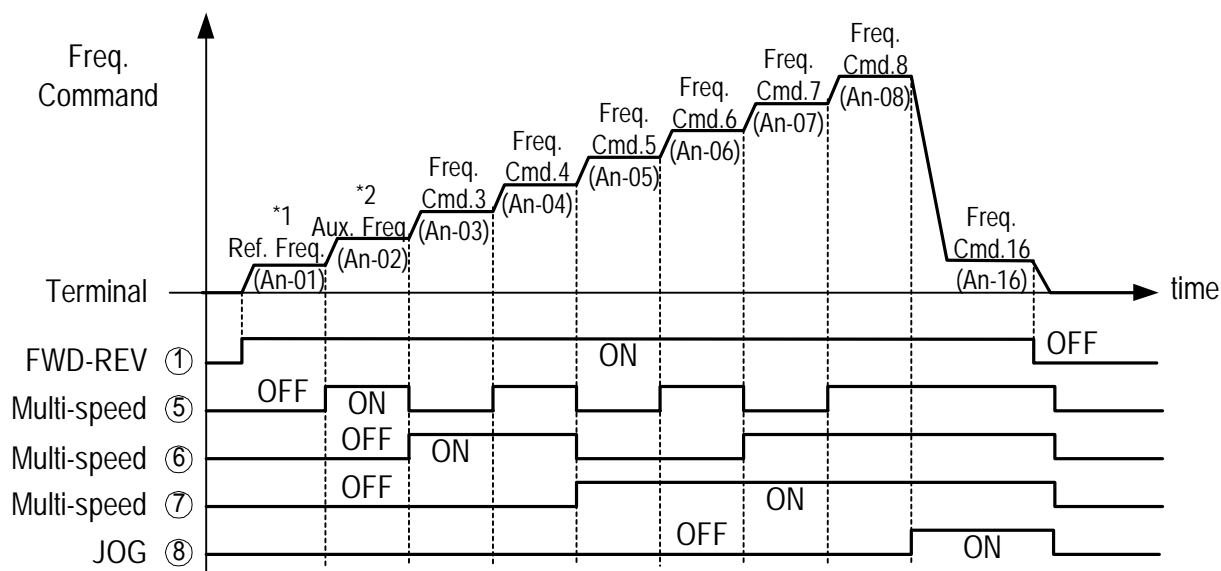
Fig. 41   Time chart for multi-step speed and jog command

*1 When the parameter Sn-05= 0, the reference command is input by the setting of An-01. Instead, when the parameter Sn-05= 1, the reference command is input from analog command through the terminal VIN and AIN.

*2 If the parameter Sn-29= 0, the auxiliary frequency (the 2nd step frequency setting: AUX frequency) is input from the AUX terminal. If the parameter Sn-29 ≠ 0, the 2nd step frequency setting is determined by the parameter of An-02.

Acceleration Time And Deceleration Time Change (Setting 07)

The acceleration time and deceleration time can be changed through the control circuit terminal ⑤~⑧ as described on page 39.

External Baseblock (A Contact) (Setting 08)
External Baseblock (B Contact) (Setting 09)

With either of these settings, the multi-function input terminal controls its inverter baseblock operation.

During running : As an external baseblock signal is detected, the digital operator will display a "B.B. Alarm". Then, the inverter output is blocked. After the baseblock signal is cleared, the motor will resume running according to its then reference signal.

During deceleration : An external baseblock signal is input, the digital operator will display " B.B. Alarm", the inverter is blocked from output and the output frequency will drop to zero. The motor will then coast to stop freely. After this external baseblock signal is cleared, the inverter will stay in stop mode.

Acceleration and Deceleration Ramp Hold (Setting:10)

With this setting, the signal of Acceleration/deceleration ramp hold (input from the multi-function input terminals) will pause the Acceleration/deceleration of motor and maintain the then output frequency. The motor will coast to stop if an OFF command is input while the acceleration / deceleration ramp hold input is ON, the then output frequency will be memorized and the command of Acceleration/deceleration ramp hold is released.
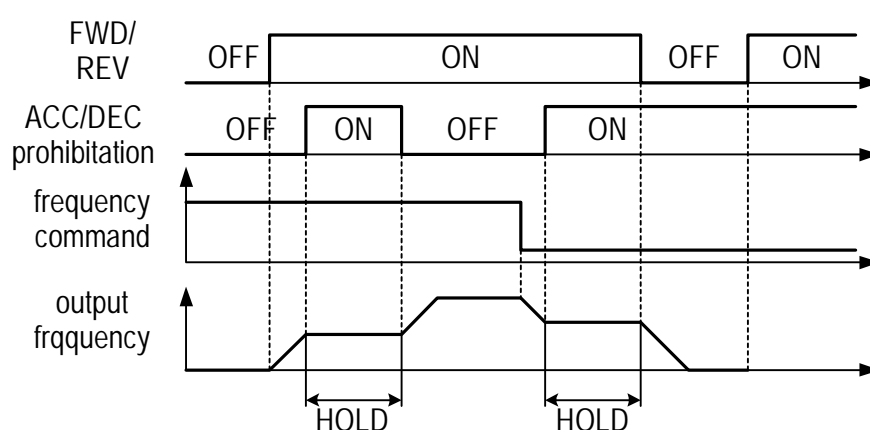

Fig. 42 Acceleration and deceleration ramp hold

Inverter Overheat Alarm   (Setting   11)

When the inverter detects a overheat signal "ON", the digital operator will change its display as "Overheat Alarm". And the inverter still maintains its operation. When the overheat signal is "OFF", the digital operator will restore its previous display automatically. No RESET-key pressing is required.

FJOG Command (Setting   12)
RJOG Command (Setting   13)

The jogging can be performed in forward or reverse rotation.
Setting = 12   FJOG command "ON": Run forward at the jog frequency (An-17).
        = 13   RJOG command "ON": Run reverse at the jog frequency (An-17).
The forward jog and reverse jog commands have priority over other frequency command commands.
The inverter will stop running with the stopping method set by the setting of Sn-06 if the forward jog and reverse jog commands are both ON for more than 500 ms.

PID Integral Reset (Setting   14)

In the application of PID control, the integral can be reset to zero (ground) through the multi-function input terminal ⑤~⑧ (Sn-25   28= 14).

PID Control Invalid   (Setting   15)

OFF	PID control valid (close-loop)
ON	PID control invalid (open-loop)

This setting can be used in the changeover of test run. To disable the PID function (PID control invalid is "ON") an open-loop operation or jog operation can be performed in the test. The system can be set up properly after some test runs. Then, the system can be changed into PID control mode. Moreover, if the feedback signal is not usable, the PID function is disabled through this setting.
The setting of Sn-64 can be used to enable or disable the PID function.

External Fault Contact A (Setting   16)
External Fault Contact B (Setting   17)

The external fault input terminal is set to "ON", an external fault then occurs. If the external input terminal ⑥ is set for the external fault input terminal use, a message of "Fault Ext. Fault 6" will be displayed.
There are 5 terminal to be assigned as external fault inputs, they are terminal ③, ⑤, ⑥, ⑦, ⑧
When an external fault occurs, the inverter will be blocked from output and the motor will coast to stop.

Multi-Function Analog Input Setting (Setting:18)

To disable or enable the multi-function analog input at AUX terminal is controlled by the input signal at an external terminal. When the PID function is enabled, the original AUX function will be disabled.

Timer Function Input Terminal (Setting 19)

Refer to the setting of timer function output terminal on page 90.

DC Injection Braking Command (Setting 20)

DC injection braking is used to prevent the motor from rotating due to inertia or external forces when the inverter is stopped.
the DC injection braking will be performed and the inverter will be stopped if the DC injection braking input is ON.
If a run source or jog command is input, the DC injection braking will be cleared and the motor will begin to run.
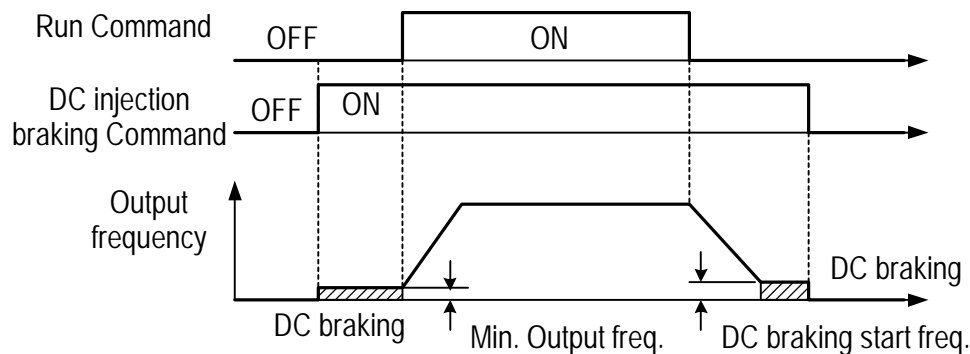

Fig. 43 Time chart for DC injection braking command

Speed Search 1   (Setting 21)
Speed Search 2   (Setting 22)

Refer to 'speed search' function on page 57.

LOCAL/REMOTE Control I (setting 23)

OFF	**Remote Control** Run command and frequency command is performed through control circuit input or RS-485 communication port. (It will be set by the combination of settings of Sn-04 and Sn-05.) The REMOTE-REF SEQ LED light is ON.
ON	**Local Control** Run command and frequency command is performed through digital operator. The REMOTE-REF SEQ LED light is OFF.

To change the operation mode from LOCAL to REMOTE mode is effective only when the inverter is in STOP mode.

LOCAL/REMOTE Control II (setting 24)

OFF	**Remote Control** Run command and frequency command is performed through control circuit input or RS-485 communication port. (It will be set by the combination of settings of Sn-04 and Sn-05.) The REMOTE-REF SEQ LED light is ON.
ON	**Local Control** Run command and frequency command is performed through control circuit terminal. The REMOTE-REF SEQ LED light is OFF.

To change the operation mode from LOCAL to REMOTE mode is effective only when the inverter is in STOP mode.

RS-485 Communication Application (Setting : 25)

The multi-function input terminals ⑤ ~ ⑧ can be used as the extension contact terminals of PLC with the command communicated through the RS-485 port. (Please refer to the '7200MA RS-485 MODBUS/PROFIBUS APPLICATION MANUAL'.)

PG-Less Speed Control Action (Setting : 26)
Reset Integration of Speed Control with PG (Setting : 27)

When PG feedback is used, the integral control (to add the PG feedback compensation) can be disabled or enabled from the external terminals. And, user can use the external terminals to clear the integral value.
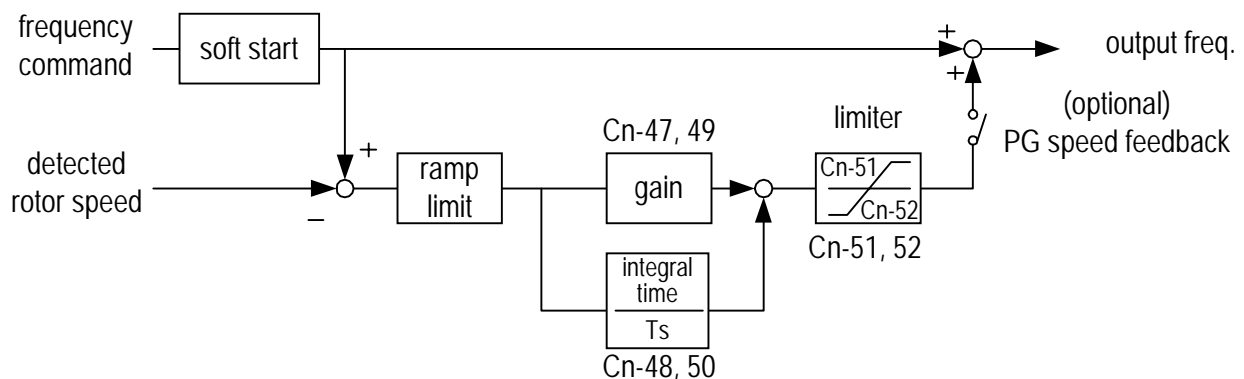

Fig. 44   PG speed control block diagram

Frequency UP/DOWN Function (Setting　28)

    The inverter can use either the digital operator or external multi-function input terminals (terminal ⑦ or ⑧) to change the output frequency upward or downward.

    By setting the parameters of (Sn-04= 1　Sn-05= 1), firstly the run source and frequency command is set through the control circuit terminals. Secondly, set the parameter Sn-28 = 28 (terminal ⑦ will now have the function "UP", its original function is disabled). Then, terminal ⑦ and ⑧ can be used for "UP" and "DOWN" function to control /change the output frequency.

    Operation sequence as below:

Control circuit terminal ⑦ : UP function	ON	OFF	OFF	ON
Control circuit terminal ⑧ : DOWN function	OFF	ON	OFF	ON
Operation status	ACC (UP)	DEC (DOWN)	Constant (HOLD)	Constant (HOLD)

terminal ① or ② FWD　REV

terminal ⑦　UP

terminal ⑧　DOWN

upper limit

output freq.

lower limit

D1 H U　H　D H U　H　D D1 H U U1 H D D1 H

U = UP (ACC) status　　U1 = bounded from upper_limit while ACC
D = DOWN (DEC) status　D1 = bounded from lower_limit while DEC
H = HOLD (Constant) status
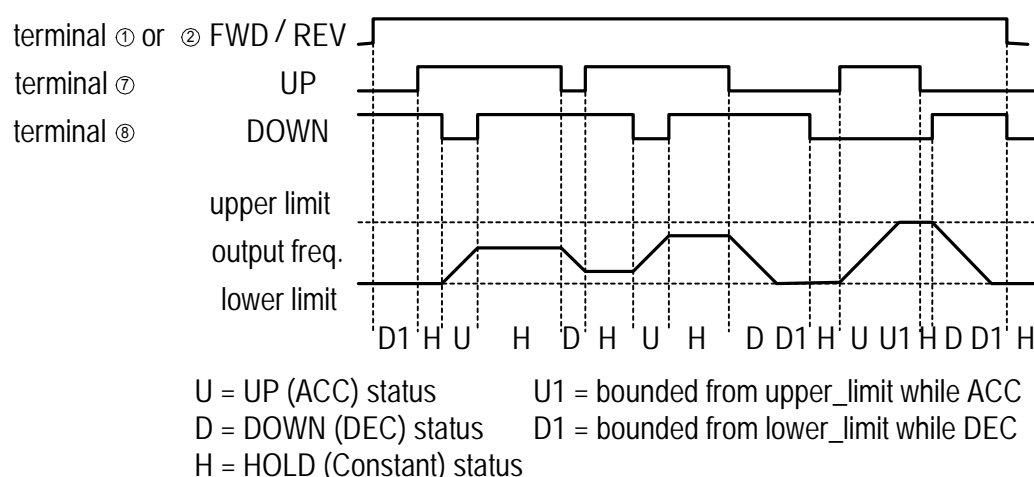
Fig. 45　Time chart of output frequency with the UP/DOWN function

Only set through parameter Sn-28
When the frequency UP/DOWN function is being used, the output frequency will accelerate to the lower_limit (Cn-19) if a run command is pressed.
The output frequency held by the UP/DOWN function will be stored in memory. This output frequency will be retained even after a power loss. When power is back, the inverter will restart at this hold frequency if a run command is pressed next time.
When the UP/DOWN function and jog frequency command are both assigned to multi-function inputs, the jog frequency command input has the highest priority.

Forced Run (Setting　29)

  Only set through parameter Sn-28. It is for special use (smoke fan, etc.)

(29) Multi-Function Analog Input Function Selection　　(Sn-29)

The settings and functions for the multi-function analog input (terminal AUX) are listed in Table 15.

Table 15　　Multi-function analog input function list

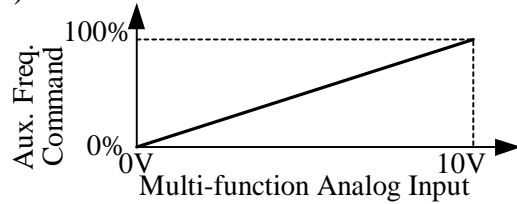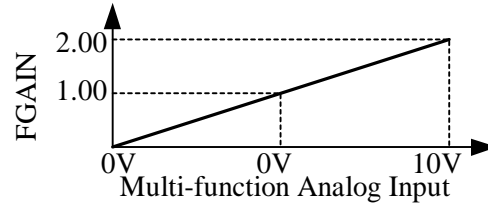| Setting	Function	LCD Display	Description (100% output corresponds to 10 V level)
00	Auxiliary frequency command	Auxilary Freq. Cmd.	(Max. output frequency)
01	Frequency command gain (FGAIN)	Freq. Cmd. Gain	Total gain= Bn-05 × FGAIN (Frequency command in voltage form, terminal VIN frequency command)
02	Frequency command bias 1 (FBIAS1)	Cmd. Bias 1	Total bias= Bn-06 + FBIAS1
03	Frequency command bias 2 (FBIAS2)	Cmd. Bias 2	Total bias= Bn-06 + FBIAS2
04	Overtorque detection level	Over Tq. Level	According to analog input voltage (0　10V), change overtorque detection level (setting of Cn-32 is disabled)
05	Output frequency bias (VBIAS)	Output Voltage	Total output voltage= V/F pattern voltage + VBIAS
06	Scaling of ACC/DEC time(TK)	Acc&Dec Coeff	Real ACC/DEC time= ACC/DEC time (Bn-0~24) / TK
07	DC injection braking	DC Brakin current	According to analog input voltage (0　10V), change the level of DC injection current (0-100　). (inverter rated current=100%, the setting of DC injection current Cn-15 is disabled)
08	Stall prevention level during running	Run Still Level	According to analog input voltage (1.5V　10　), change the level of stall prevention during running (30%　200%) (inverter rated current=100%, the setting Cn-26 is disabled.)
09	PID control reference input	PID Command	Multi-function analog input (terminal AUX) used as PID control reference input (0~10V). Please refer to "PID CONTROL BLOCK DIAGRAM" on page 42.
10	Frequency command lower limit	Freq. Cmd. Low Bound	Change the frequency command lower-limit (0-100　) value according to the then analog input voltage (0~10V) (Max. output frequency (Cn-02) corresponds to the 100% analog output. The actual lower-limit is determined by the maximum of Cn-19 and the value corresponding to the multi-function analog input terminal).
11	Jump frequency setting4	Freq Jump 4	Set the jump frequency 4, according to analog input voltage (0~10V), while Cn-20~Cn-23 can be used to set the jump frequency 1~3 and their jump frequency width.
12	RS-485 communication application	Comm. Control	The analog value of AUX (0-1024/0-10V) can be read through RS-485 communication.

Multi-function analog input characteristics

(1) Sn-29 = 00

Y-axis: Aux. Freq. Command (0% to 100%); X-axis: Multi-function Analog Input (0V to 10V)

(2) Sn-29 = 01

Y-axis: FGAIN (1.00, 2.00); X-axis: Multi-function Analog Input (0V, 0V, 10V)

(3) Sn-29 = 02

Y-axis: FBAIS1 (0% to 10%); X-axis: Multi-function Analog Input (0V to 10V)

(4) Sn-29 = 03

Y-axis: FBAIS2 (-10%, 0%, 10%); X-axis: Multi-function Analog Input (0V, 5V, 10V)

(5) Sn-29 = 04

Y-axis: Overtorque Detection Level (0% to 200%); X-axis: Multi-function Analog Input (0V to 10V)

(6) Sn-29 = 05

Y-axis: VBAIS (0% to 100%); X-axis: Multi-function Analog Input (0V to 10V)

(7) Sn-29 = 06

Y-axis: Reduction Coefficient (1 to 10); X-axis: Multi-function Analog Input (0V, 1V, 10V)

(8) Sn-29 = 07

Y-axis: DC Braking Current (0% to 100%); X-axis: Multi-function Analog Input (0V to 10V)

$$\text{Real ACC/DEC Time} = \frac{\text{ACC/DEC Time (Bn-01\~04)}}{\text{Reduction Coefficient (TK)}}$$

(9) Sn-29 = 08

Y-axis: Stall Prevention Level (30% to 200%); X-axis: Multi-function Analog Input (0V, 1.5V, 10V)
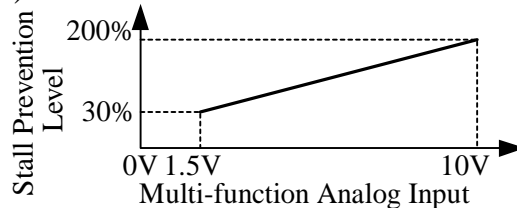
(10) Sn-29 = 09

Multi-function analog input (terminal AUX) used as PID control reference input (0~10V). Please refer to "PID CONTROL BLOCK DIAGRAM" on page 42 and 112.

(11) Sn-29 = 10

Y-axis: Freq. Command Lower Limit (0% to 100%); X-axis: Multi-function Analog Input (0V to 10V)

(12) Sn-29 = 11

Y-axis: Jump Frequency 4 (0% to 100%); X-axis: Multi-function Analog Input (0V to 10V)
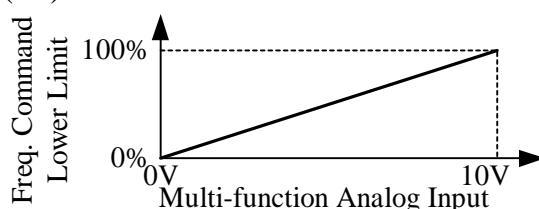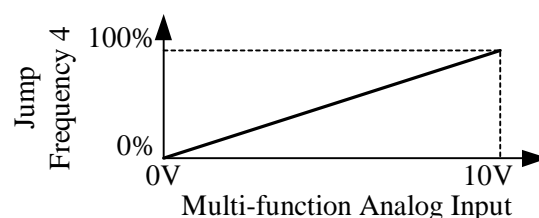
(13) Sn-29=12 : For RS-485 communication use. The analog value of AUX (0-1024/0-10V) can be read through RS-485 communication. (Please refer to '7200MA RS-485 MODBUS/PROFIBUS Application Manual')

(30) Multi-Function Output Terminal (RA-RB-RC or R1A-R1B-R1C) Function Selection (Sn-30)
(31) Multi-Function Output Terminal (DO1-DOG) Function Selection (Sn-31)
(32) Multi-Function Output Terminal (DO2-DOG or R2A-R2C) Function Selection (Sn-32)

Multi-function output terminal setting and its function as shown in Table 16.

Table 16 Multi-function output terminal function

Setting	Function	LCD Display	Description		Ref. Page
00	During running	Running	ON	During running	91
01	Zero speed	Zero Speed	ON	Zero speed	91
02	Frequency agree	Frequency Arrive	Speed agree width: Cn-31		55
03	Setting frequency agree	Agreed F Arrive	ON	output frequency = $\pm$ Cn-29, Speed agree width: Cn-31	55
04	Output frequency detection1	Freq. Det. 1	ON	while ACC, -Cn-29 output freq. Cn-29 while DEC, -Cn-30 output freq. Cn-30 Speed agree width: Cn-31	55
05	Output frequency detection2	Freq. Det. 2	ON	while ACC, output freq Cn-29(or -Cn-29) while DEC, output freq Cn-30(or -Cn-30) Speed agree width: Cn-31	55
06	Inverter ready	Run Ready OK!	ON	READY	91
07	Undervoltage detected	Low Volt Detect	ON	Undervoltage detected	91
08	Output baseblocked	Output B.B.	ON	Output baseblocked	91
09	Run source mode	Run Source Operator	ON	Run source from digital operator (Local mode)	91
10	Frequency command mode	Ref. Cmd. Operator	ON	Frequency command from digital operator (Local mode)	91
11	Overtorque detected	Over Tq. Detect	ON	Overtorque detected	56,76
12	Frequency command Invalid	Freq. Cmd. Invalid	ON	Frequency command Invalid	92
13	Fault	Fault	ON	Fault	92
14	Pulse signal output	Pulse Mul. Output	Only set by Sn-31, Sn-32 (terminal DO1-DOG)		92
15	Undervoltage alarm	Low Volt Alarm	ON	Undervoltage alarm	92
16	Inverter overheat	Inverter Over Heat	ON	Inverter Overheat	106
17	Motor overload	Motor Over Load	ON	Motor Overload	79
18	Inverter Overload	Inverter Over Load	ON	Inverter Overload	106
19	Fault retry	Fault Retry	ON	Retry	52
20	RS-485 communication fault	RS-485 Fault	ON	RS-485 communication fault	106
21	Timer function output	Timer Function	Signal delay output (.vs. timer function input)		44,93
22	RS-485 Communication Application	Comm. Control	Extension Output Contact application (Please refer to '7200MA RS-485 MODBUS /PROFIBUS Application Manual')		93

During Running (Setting:00)

OFF	Run source OFF, inverter is off.
ON	Run source ON, or Run source OFF but residues output exists

Zero Speed (Setting   01)

OFF	Output frequency	MIN. output frequency (Cn-07)
ON	Output frequency	MIN. output frequency (Cn-07)

Frequency Agree :   (Setting   02)
Setting Frequency Agree :   (Setting   03)
Output Frequency Detected 1 : (Setting   04)
Output Frequency Detected 2 : (Setting   05)

Refer frequency detection function on page 55.

Inverter Ready (Setting   06)
Undervoltage Detected (Setting   07)

When the DC link voltage of main circuit is lower than the UNDERVOLTAGE DETECTION LEVEL (Cn-39), the output contact is in 'ON' state.

Output Blocked (Setting   08)

Run Command Mode (Setting   09)

OFF	**Remote Mode** (Sn-04 = 1,2, or multi-function input terminal ⑤~⑧ is set as Local/remote control I mode or Local/remote control II mode and contact terminal is OFF). Remote-SEQ LED is light in LCD digital operator
ON	**Local Mode** (Sn-04 = 0 multi-function input terminal ⑤~⑧ is set as Local/remote control I mode and contact terminal is ON).Remote-SEQ LCD is OFF, run command is from LCD digital operator

Frequency Command Mode (Setting   10)

OFF	**Remote mode** (Sn-05 = 1,2 or multi- function input terminal ⑤~⑧ is set as Local/remote control I mode or Local/remote control II mode and contact terminal is OFF). Remote-REF LED is light in LCD digital operator
ON	**Local mode** (Sn-05 = 0 multi- function input terminal ⑤~⑧ is set as Local/remote control I mode and contact terminal is ON). Remote-REF LED is OFF, run command is from LCD digital operator

Overtorque Detected (Setting 11)

See page 56, 76 for overtorque detection function.

Frequency Command Missing (Setting 12)

Run source is ON and frequency command is 0, the output at the multi-function output terminal is ON.

Fault (Setting 13)

If a fault occurs, the multi-function output terminal is ON. However, no response will occur if a communication fault occurs.

Pulse Signal Output   (Setting:14)

Only multi-function output terminal DO1-DOG (Setting Sn-31) can be set as the pulse signal output.

DO1 is a photo-coupler output, its pulse output frequency is set by parameter Sn-35.

Its wiring is:

DO1
+V (12V or 24 V)
1KΩ
pulse duty (T1=T2)
DO2
pulse timer
DOG
T1 T2
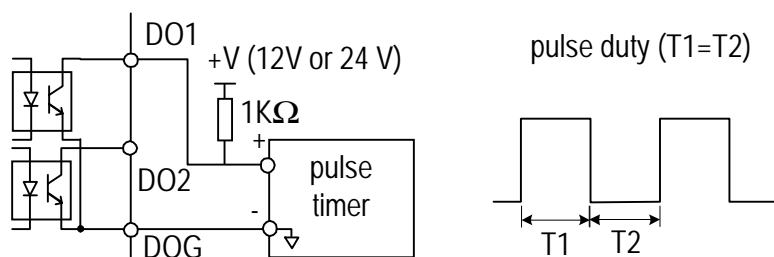
Fig. 46   Pulse signal output

Undervoltage Alarm   (Setting 15)

If the main circuit DC bus voltage is below the undervoltage alarm detected level, the multi-function output terminal is ON.

Undervoltage alarm detected level :   220V Class : 240VDC

440V Class : 460VDC

Inverter Overheat (Setting 16)

See Page 106. If the cooling fin is overheat, the multi-function output terminal is ON.

Motor Overload   (Setting 17)

See "Motor overload protection selection" on page 79. If the motor has overload fault, the multi-function output terminal is ON.

Inverter Overload OL2   (Setting 18)

If the inverter has overloadfault, the multi-function output terminal is ON. See page 106.

Fault Retry　(Setting　19)

　　See "Fault restart function" (Cn-24) on page 52. Upon restart, the multi-function output terminal is ON.

RS-485 Communication Fault　(Setting　20)

　　See page 106.

Timer Function Output　　(Setting　21)

　　If the multi-function input terminals ⑤~⑧ are set as the timer input terminals (Sn-25　28= 19)　the signal will be output through the corresponding multi-function output terminals with the specified ON-delay and OFF-delay, as shown below. See "Timer function" on page 44.

input terminal ⑤ ~ ⑧

output terminal

ON delay (Bn-37)

OFF delay (Bn-38)

Fig. 47　The input/output signal in 'Timer' function application

RS-485 Communication Application (Setting:22)

　　In the application that the control commands are executed through the RS-485 communication port, the multi-function output terminals can be used as 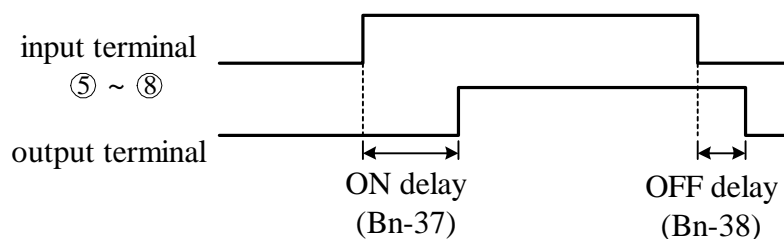the PLC Extension Output Contact Terminals. For more details, Please refer to '7200MA RS-485 MODBUS/PROFIBUS Application Manual'.

(33) Multi-Function Analog Output (Terminal AO1) Selection   (Sn-33)

(34) Multi-Function Analog Output (Terminal AO2) Selection   (Sn-34)

The multi-function analog output can be set to monitor the following 12 status items as shown below

Sn-33, Sn-34 Setting	Monitored contents	Description	
		Input	Output
00	Frequency Command	0 ~ max. frequency	
01	Output Frequency	0 ~ max. frequency	
02	Output Current	0 ~ rated current	
03	Output Voltage	0 ~ rated voltage	
04	DC Voltage	220V class 0~400V 440V class 0~800V	
05	VIN Analog Command	0 ~ 10 V	0~10V
06	AIN Analog Command	4 ~ 20 mA	
07	AUX Analog Command	0 ~ 10 V	
08	PID Input	0 ~ max frequency	
09	PID Output1	0 ~ max frequency	
10	PID Output2	0 ~ max frequency	
11	Comm. Control	0~100% [*1]	

Note : *1: when the setting of Sn-33~34='11', the multi-function output terminals AO1, AO2 are controlled through RS-485 port either by MODBUS or PROFIBUS protocol. Please refer to "7200MA RS-485 MODBUS/PROFIBUS Application Manual"

The output gain (Bn-14 and Bn-15) will determine the output voltage at multi-function analog output at AO1, AO2 terminal. The specified multiple of 10V will correspond to the 100% output monitored value.

(35) Pulse Output Multiplication-Gain Selection (Sn-35)

If the multi-function output terminal (DO1) be set as pulse output (when Sn-31 or Sn-32= 14),the final output pulse frequency is the multiple (according to Sn-35) of the inverter output frequency. Refer to Fig. 46 for pulse signal output.

Ex1 : when Sn-35= 0, the inverter output frequency is 60Hz, the output pulse frequency is 60 Hz (duty = 50%).

Different settings of Sn-35 and their corresponding multiple numbers as shown below :

Sn-35 setting	Pulse output frequency		Applicable freq. range	
0	1F	1 × inverter output frequency	3.83	400.0Hz
1	6F	6 × inverter output frequency	2.56	360.0Hz
2	10F	10 × inverter output frequency	1.54	210.0Hz
3	12F	12 × inverter output frequency	1.28	180.0Hz
4	36F	36 × inverter output frequency	0.5	60.0Hz

(36) Inverter Station Address   (Sn-36)
(37) RS-485 Communication Baud Rate Setting   (Sn-37)
(38) RS-485 Communication Parity Setting   (Sn-38)
(39) RS-485 Stopping Method After Communication Error (Sn-39)

The 7200MA inverter has a built-in RS-485 port for monitoring inverter status and reading the parameter setting. Under the remote mode operation, the inverter status and the parameter settings can be monitored. Moreover, the user can change the parameters setting to control the motor operation.

7200MA will use MODBUS protocol to communicate with external units by means of the cable line form RS-485 port.

Parameter definition is as follows

Sn-36   inverter station address, setting range 1~31.

Sn-37 = 0   1200bps (bps: bit / sec)
      = 1   2400bps
      = 2   4800bps
      = 3   9600bps

Sn-38 = 0   no parity
      = 1   even parity
      = 2   odd parity

Sn-39 = 0   Deceleration to stop with Bn-02 (deceleration time), when RS-485 has communication error.
      = 1   Coast to stop
      = 2   Deceleration to stop with Bn-04 (deceleration time), when RS-485 has communication error.
      = 3   Continue to run (will stop if the key stop is pressed)

Every data stream has a data length of 11 bits : 1 start bit   8 data bits   1 parity bit and 1 stop bit. If Sn-38=0, the parity bit is 1.

3 different commands are used for communication between the inverter and external units:

a. Read command : external units to read the memory address of the inverter.

b. Write command : external units to write the memory address of the inverter in order to control the inverter.

c. Circuit test command : To test the communication status between the inverter and external units.

The change of setting Sn-36, Sn-37, Sn-38 will be effective in the next start time after turning off the inverter.

Do not make the DRIVE/PRGM changeover while writing the date into the inverter through RS-485 port.

For more details of RS-485 communication, refer to
"7200MA RS-485 MODBUS/PROFIBUS Communication Application Manual".

(40) PG Speed Control Settings (Sn-40)

Sn-40 = 0 : Disable speed control function.
 = 1 : Enable speed control.
 = 2 : Enable speed control. No integral action during ACC/DEC.
 = 3 : Enable speed control. Integral action is enabled.

(41) Operation Selection at PG Opens (Sn-41)

Sn-41 = 0 : deceleration to stop (Bn-02) ⎫
 = 1 : coast to stop   ⎬ Display "PG Open″ alarm.
 = 2 : deceleration to stop (Bn-04) ⎭
 = 3 : continue to run   Blinking display "PG Open" alarm.

(42) Operation Selection at PG Speed Deviation Over   (Sn-42)

Sn-42 = 0 : deceleration to stop (Bn-02) ⎫
 = 1 : coast to stop   ⎬ Display "Sp. Deviat Over" fault message.
 = 2 : deceleration to stop (Bn-04) ⎭
 = 3 : continue to run   Blinking display "Sp. Deviat Over" alarm.

(43) Overspeed Detection (Sn-43)

Sn-43 = 0 : deceleration to stop (Bn-02) ⎫
 = 1 : coast to stop   ⎬ Display "Over Speed" fault message.
 = 2 : deceleration to stop (Bn-04) ⎭
 = 3 : continue to run   Blinking display "Over Speed" alarm.

(44) Auto_Run Mode Selection (Sn-44)

(45) Auto_Run Mode Setting Selection (Sn-45~Sn-60)

A PLC operation mode is ready to use with the following setting of the multi-step frequency command1~16 (An-01~An-16), Auto_Run mode time setting (Bn-21~Bn-36) under the auto_run mode selection (Sn-44). The FWD/REV direction can be set with the setting of Sn45~60.

In the auto_Run mode, the multi-step frequency command 1～4 derived from the multi-function input terminals ⑤~⑧ are ineffective.

Some example in auto_run mode

(A) Single Cycle Running (Sn-44= 1, 4)

The inverter will run for a single full cycle based upon the specified setting mode. Then, it will stop.

For example :

Sn-44　1	Sn-45~47=1(FWD)	Sn-48=2(REV)	Sn-49~60　0
An-01　15Hz	An-02　30Hz	An-03　50Hz	An-04　20Hz
Bn-21　20s	Bn-22　25s	Bn-23　30s	Bn-24　40s
An-05~16　0Hz	Bn-25~36　0s		
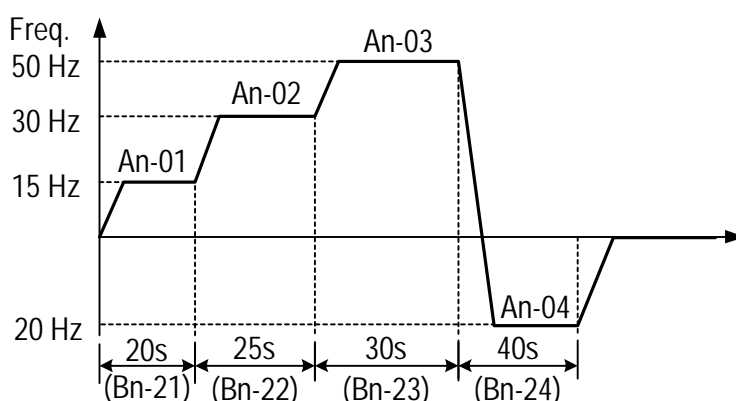
(B) Periodic Running (Sn-44　2, 5)

The inverter will repeat the same cycle periodically.

For example :

Sn-44　　2

An-01～16, Bn-21～36, Sn-45-60　　same setting as the example (A)
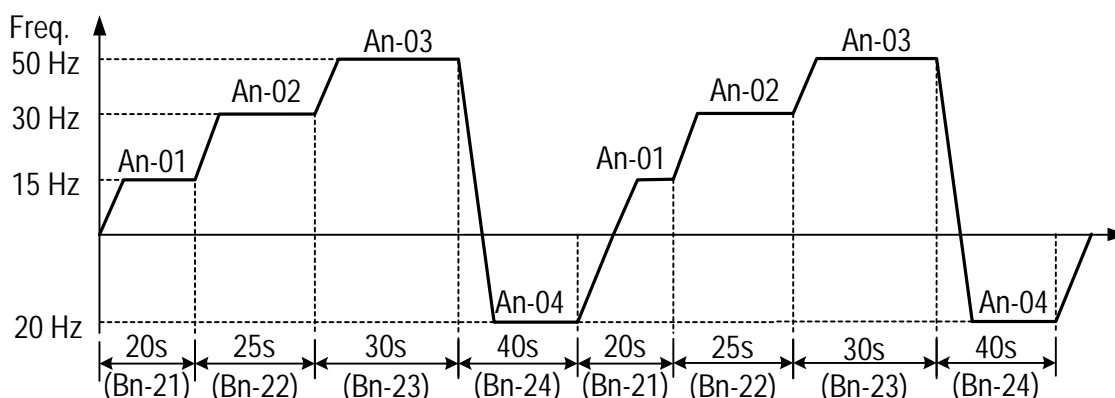
(C) Auto_Run Mode for Single Cycle

The speed of final step will be held to run.

For example :

Sn-44   3

Sn-45~48 = 1 (FWD)   Sn-49~60   0

An-01   16,   Bn-21   36   same setting as the example (A)
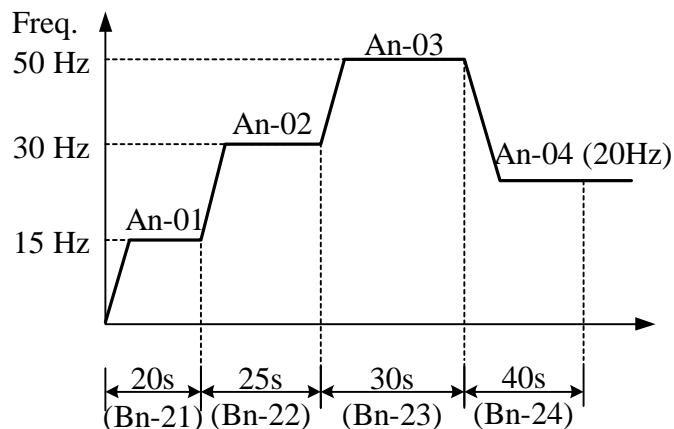
Sn-44 = 1~3 : If the inverter stops and re-starts again, it will continue running from the unfinished step, according to the setting of Sn-44.

= 4~6 : If the inverter stops and re-starts again, it will begin a new cycle and continue running according to the setting of Sn-44.

Sn-44	1~3	4~6
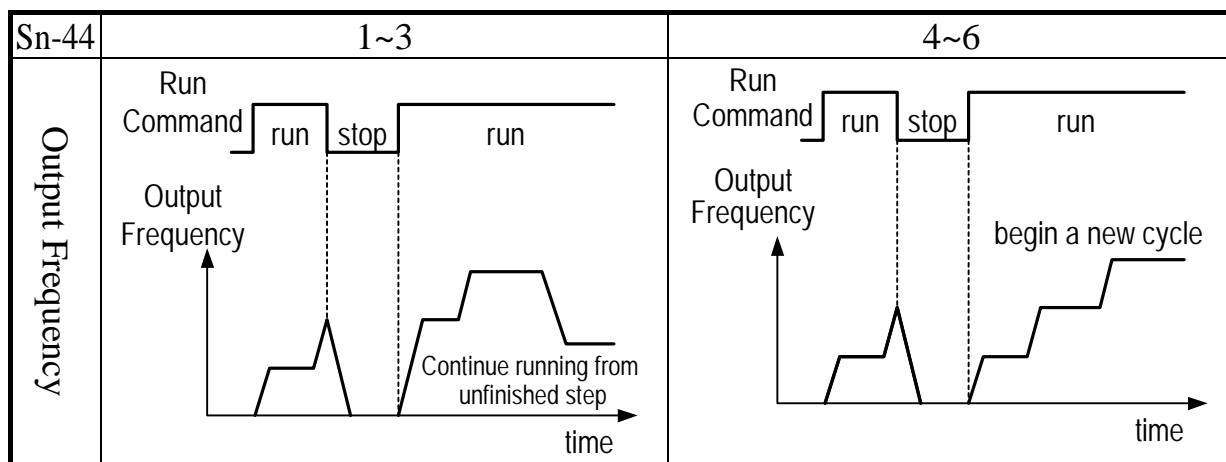
ACC/DEC time follow the setting of Bn-01   Bn-02 in Auto_Run Mode.

If the setting values of Bn-21   Bn-36 are all zero, the Auto_Run Mode is disabled.

(46) Applied Torque Load (Sn-61)

Select either the constant torque load (Sn-61=0) or varied torque load (Sn-61=1). The inverter will automatically choose the proper V/F pattern and change the inverter overload protection curve. (See page 69 for 'INVERTER CAPACITY SELECTION').

(47) LCD Language Displayed Selection (Sn-62)

   Sn-62 = 0 : English
         = 1 : Chinese

(48) Parameter Copy (Sn-63)

JNEP-31 LCD digital operator can upload the parameter settings from the LCD digital operator to inverter and download parameter settings from the inverter to the LCD digital operator.

LCD digital operator will check its EEPROM or the inverter's EEPROM under the following settings.

   Sn-63 = 0 : NO action
         = 1 : Upload data (LCD digital operator   inverter). During this period, the LED on the LCD digital operator will light sequentially in the CW sense.
         = 2 : Download data (inverter   LCD digital operator). During this period, the LED on the LCD digital operator will light sequentially in the CCW sense.
         = 3 : Verification check on LCD's EEPROM; during this period the LED will be switch-on between 2 groups.
         = 4 : Verification check on inverter's EEPROM; during this period the LED will not light.

Please follow the below steps to implement the action of parameter copy between different inverters (either upload or download).

Step 1 : Check the contents of (LCD) digital operator EEPROM (Sn-63='03'), then check the contents of inverter's EEPROM (Sn-63='04'). Make sure that both EEPROM function properly.

Step 2 : Download and copy the inverter's parameter settings to LCD digital operator EEPROM (Sn-63=2).

Step 3 : Upload and copy the parameter settings of LCD digital operator to other inverter's EEPROM (Sn-63=1).

(49) PID Function Selection (Sn-64)

To enable PID control, set Sn-64=1. Otherwise, set Sn-64=0 to disable PID control function. Moreover, it is possible to use the multi-function terminals $5 \sim 8$ to enable/disable PID control.

(50) Braking Resistor Protection Selection   (Sn-65)

Sn-65 = 0 : External braking resistor protection invalid
     = 1 : External braking resistor protection valid

Whenever the external braking resistor is used, be sure that the parameter 'Sn-65 = 1' is set.

(51) Motor Parameter Autotuning Selection   (Sn-66)

The AUTOTUNE feature can be used to identify and store the motor's parameters

Sn-66 = 0 : Autotuning Disable
     = 1 : Autotuning Enable

(52) Control Mode Selection   (Sn-67)

Select one of the two control modes

Sn-67 = 0 : V/F Control Mode (include V/F control with PG feedback)
     = 1 : Sensorless Vector Control Mode
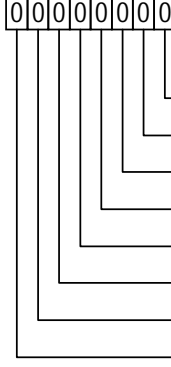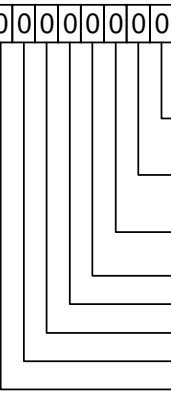
| Sensorless Control | [*1] [*2]

1. Set Sn-67 = 1 for sensorless vector control.
2. Set Sn-66 = 1 for autotuning.

*1. Sensorless Vector Control will be available soon in all UL type 7200MA inverters.
*2. For output frequency less than 1.5Hz in sensorless vector control, set Sn-02=15 and then change Cn-07 to required frequency.

3.5 Monitoring parametersUn-

Parameter No.	Name	LCD display (English)	Unit	Description	Multi-function Analog Output Level
Un-01	Frequency Command	Un-01=60.00Hz Frequency Command	0.01Hz	Display frequency command. The displayed unit is determined by Cn-28.	10V/MAX. Output Frequency
Un-02	Output Frequency	Un-02=60.00Hz Output Frequency	0.01Hz	Display output frequency. The displayed unit is determined by Cn-28.	10V/MAX. Output Frequency
Un-03	Output Current	Un-03=12.5A Output current	0.1A	Display inverter output current.	10V/Inverter Rated Current
Un-04	Output Voltage	Un-04=220.0V Output Voltage	0.1V	Display output voltage command of inverter	10V/220V or 10V/440V
Un-05	Main Circuit DC Voltage	Un-05=310.0V DC Voltage	0.1V	Display DC voltage of inverter main circuit.	10V/400V or 10V/800V
Un-06	External Analog Command VIN	Un-06=100% Voltage ~Cmd.	0.1%		10V/100%
Un-07	External Analog Command AIN	Un-07=100% Current ~Cmd.	0.1%		20mA/100%
Un-08	Multi-Function Analog Input Command AUX	Un-08=100% Multi_Fun ~Cmd.	0.1%		10V/100%
Un-09	External Analog Output AO1	Un-09=100% Term.AO1 Output	0.1%		10V/100%
Un-10	External Analog Output AO1	Un-10=100% Term.AO2 Output	0.1%		10V/100%
Un-11	Input Terminal Status	Un-11= 00000000 I/P Term. Status		0 OPEN / 1 CLOSE — Input terminal ①, Input terminal ②, Input terminal ③, Input terminal ④, Input terminal ⑤, Input terminal ⑥, Input terminal ⑦, Input terminal ⑧	
Un-12	Output Terminal Status	Un-12= 00000000 O/P Term. Status		0 OPEN / 1 CLOSE — Relay Contact RA-RC (or R1A-R1C), Photo-Contact DO1-DOG, Photo-Contact DO2-DOG(or R2A-R2C), Reserved, Reserved, Reserved, Reserved, Reserved	

Note : Term. is terminal abbrev.

Parameter No.	Name	LCD display (English)	Unit	Description	Multi-function Analog Output Level
Un-13	Amount of PG Speed Feedback	Un-13= 100.0% PG Feedback.	0.1%	100.0%=MAX. output frequency	10V/MAX. Output Frequency
Un-14	Amount of PG Speed Compen.	Un-14= 100.0% PG Compen.	0.1%	100.0%=MAX. output freq.	10V/MAX. Output Frequency
Un-15	PID Control Input	Un-15= 100% PID Input	0.1%	100.0%=MAX. output freq.	10V/Max. output frequency
Un-16	PID Control Output 1	Un-16= 100% PID Output1	0.1%	100.0%=MAX. output freq.	10V/Max. output frequency
Un-17	PID Control Output 2	Un-17= 00% PID Output2	0.1%	100.0%=MAX. output freq.	10V/Max. output frequency
Un-18	Fault Message 1	Overcurrent Message1		Fault message occurred now	
Un-19	Fault Message 2	Overcurrent Message2		Fault message occurred last time	
Un-20	Fault Message 3	Overheat Message3		Fault message occurred last two time	
Un-21	Fault Message 4	Overtorque Message4		Fault message occurred last three time	
Un-22	The Parameter Of Time Period Between Last Fault And The Nearest Fault.	Un-22= 2400Hr Last Fault Run Time	1Hr	The value of 'Run Elapse Time' parameter will be cleared after fault has been cleared.	
Un-23	Frequency Command While Fault Occurred	Un-23= 60.00Hz Last Fault Freq.Cmd.	0.01Hz		
Un-24	Output Freq. While Fault Occurred	Un-24= 60.00Hz Last Fault O/P Freq.	0.01Hz		
Un-25	Output Current While Fault Occurred	Un-25= 12.5A Last Fault O/P I	0.1A		
Un-26	Output Voltage While Fault Occurred	Un-26= 220.0V Last Fault O/P V	0.1V		
Un-27	DC Voltage While Fault Occurred	Un-27= 310.0V Last Fault O/P V	0.1V		
Un-28	I/P Terminal Status While Fault Occurred	Un-28= 00000000 Last Fault I/P Term.		Same as Un-11, display terminal status	
Un-29	O/P Terminal Status While Fault Occurred	Un-29= 00000000 Last Fault O/P Term.		Same as Un-12, display terminal status	
Un-30	Time Elapsed After Power-On	Un-31= 00002Hr P Elapsed Time	1Hr	Display total time elapsed after power ON	
Un-31	Time Elapsed After Run	Un-31= 00002Hr R Elapsed Time	1Hr	Display total time elapsed after pressing RUN	
Un-32	EPROM S/W Version	Un-32= 00001 Soft Number		-Manufacturing use-	
Un-33	Feedback Motor Speed	Un-33= 00000rpm Motor Speed	1rpm	Display motor speed while PG feedback is set.	10V/MAX. Motor Speed

(1) Frequency Command (Un-01)
(2) Output Frequency (Un-02)
(3) Output Current (Un-03)
(4) Output Voltage (Un-04)
(5) Main Circuit DC Voltage (Un-05)

Through the settings of Sn-33, Sn-34, the above contents can be displayed at the multi-function analog output terminals (AO1, AO2) in different voltage level of (0~10V)

(6) External Analog Command VIN (Un-06)

The parameter can monitor the external analog terminal voltage VIN (0~100%/0~10V). The voltage can be output through the multi-function analog output terminal AO1, AO2 (Sn-33=05 or Sn-34=05). The output voltage is the PID feedback voltage when the PID function is used. Please refer to page 42, "PID controller block diagram".

(7) External Analog Command AIN (Un-07)

The parameter can monitor the external analog terminal current AIN (0~100%/0~20mA). The current can be output through the multi-function analog output terminal AO1, AO2 (Sn-33=06 or Sn-34=06). The output current is the PID feedback voltage when the PID function is used. Please refer to page 42, "PID controller block diagram".

(8) Multi-Function Analog Input Command AUX (Un-08)

The parameter can monitor the multi-function analog input terminal AUX voltage (0~100%/0~20mA). The voltage can be output through the multi-function analog output terminal AO1, AO2 (Sn-33=07 or Sn-34=07). The output voltage is the PID target voltage (reference) when the PID function is used. Please refer to page 42, "PID controller block diagram".

(9) External Analog Output AO1, AO2 (Un-09, Un-10)

The parameter can monitor analog output terminal AO1, AO2 voltage (0~10V). Their output gain can be adjusted through the setting of parameters Bn-14 or Bn-15. Their outputs are determined and varied proportionally according to the setting of (Sn-33 or Sn-34).

(10) Input Terminal Status (Un-11)

The parameter will monitor the status of input terminal 1 ~ 8 : 'ON' or 'OFF'.

(11) Output Terminal Status (Un-12)

The parameter will monitor the status of input terminal RA-RC or R1A-R1C, DO1-DOG, DO2-DOG or R2A-R2C : 'ON' or 'OFF'.

(12) PG Speed Feedback and PG Speed Compensation (Un-13, Un-14)

These parameters will monitor the PG speed feedback and PG speed compensation signal if PG feedback function is used.

(13) PID Control Input   (Un-15)
(14) PID Control Output1 (Un-16)
(15) PID Control Output2 (Un-17)

The values in Fig. 14 (on page 42) can be monitored through the parameters of Un-15, Un-16 and Un-17. Moreover, the multi-function analog output terminal AO1, AO2 can be used to monitor the output value through the proper setting of Sn-33 and Sn-34.

(16) Message 1   (Un-18)
(17) Message 2   (Un-19)
(18) Message 3   (Un-20)
(19) Message 4   (Un-21)

These parameters are used to display the fault messages whenever the fault occurred. The user can take proper action for trouble-shooting based upon the displayed message.

(20) The Cumulative Operation Time Setting   (Un-22)

The parameter is used to count the elapsed time from the previous fault to the latest fault occurred recently. Its setting range is 0~65536 Hr. After the fault have been cleared and system reset again, the Un-22 will be cleared to zero and counted again.

(21) The Frequency Command While Last Fault Occurred   (Un-23)
(22) The Output Frequency While Last Fault Occurred   (Un-24)
(23) The Output Current While Last Fault Occurred   (Un-25)
(24) The Output Voltage While Last Fault Occurred   (Un-26)
(25) The DC Voltage While Last Fault Occurred   (Un-27)
(26) The Input Terminal Status While Last Fault Occurred   (Un-28)
(27) The Output Terminal Status While Last Fault Occurred (Un-29)

The above parameters will display the inverter status when the fault occurred lately. The contents of parameters Un-15~21 will be cleared after the faults have been cleared and the system reset again.

(28) The Cumulative Time Whenever The Input Power Is On   (Un-30)

The parameter will record the cumulative operation time from power-on to power-off. Its value is 0~65536 Hr. If the value exceed 65536, it will restart from 0 again.

(29) The Cumulative Run Time Whenever The Output Power Is On   (Un-31)

The parameter will record the cumulative operation time from power-on to power-off. Its value is 0~65536 Hr. If the value exceeds 65536, it will restart from 0 again.

(30) The EPROM Software Version   (Un-32)

The parameter will specify the updated software version in this 7200 MA inverter.

(31) Motor Speed While PG Feedback Is Set.   (Un-33)

While PG feedback control is set, The motor speed can be monitored through Un-33.

4. Fault display and troubleshooting

4.1 General

    The 7200MA have the protective and warning self-diagnostic functions. If fault occurs, the fault code is displayed on the digital operator. The fault contact output (RA-RB-RC or R1A-R1B-R1C, DO1, DO2 or R2A-R2C) operates, and the inverter shut off to stop the motor. If warning occurs, the digital operator will display the warning code. However, the fault-contact output does not operate. (except some certain cases, see page on 'Warning and Self-Diagnosis Functions'). The digital operator will return to its previous status when the above warning is clear.

    When a fault has occurred, refer to the following table to identify and to clear the cause of the fault.

    Use one of the following methods to reset the fault after restarting the inverter.

    1. Stop the inverter.

    2. Switch the fault reset input at terminal ④ signal or press the RESET key on the digital operator.

    3. Turn off the main circuit power supply and turn on again.

4.2   Error Message and Troubleshooting

(A) Protective Function

LCD Display (English)	Fault Contents	Fault Contact Output	
Fault DC Volt. Low	The main circuit DC voltage becomes lower than the low voltage detection level (Cn-34).	Operation	
Fault Over Current	The inverter output current becomes approx. 200% and above the inverter rated current.	Operation	
Fault Ground Fault	A ground fault occurs at the inverter output side and the ground-fault current exceeds approx. 50% of the inverter rated current.	Operation	
Fault Over Voltage	The main circuit DC voltage becomes excessive because of regeneration energy caused by motor decelerating.	Operation	
Fault Over Heat	The temperature of the cooling fin reaches the detection level.	Operation	
Fault Motor Over Load	Motor overload is detected by the electronic thermal relay. (motor protection)	Operation	
Fault Inverter Over Load	The electronic thermal sensor detects inverter overload while the output current exceeds 112% of rated value. (inverter protection)	Operation	
Fault Over Torque	Over torque is detected while the output current is larger than or equal to the setting of Cn-26. (machine protection)	Operation	
Fault Ext. Fault3	External fault signal ③	Operation	
Fault Ext. Fault5	External fault signal ⑤		
Fault Ext. Fault6	External fault signal ⑥		
Fault Ext. Fault7	External fault signal ⑦		
Fault Ext. Fault8	External fault signal ⑧		
Fault Inverter EEPROM	EEPROM fault	Operation	
	EEPROM (BCC, no.) is bad.		
Fault Inverter A/D	A/D converter (inside the CPU) fault		
Fault PG Over Sp.	Excessive PG speed fault	Operation	
Fault PG Open	PG is open-circuit	Operation	
Fault Sp.Deviat Over	Excessive speed deviation	Operation	
Fault RS-485 Interrupt	MODBUS Communication fault occurs .The inverter remains operating.	operation	

Error Causes	Action to Be Taken
Power capacity is too small. Voltage drop due to wiring resistance. A motor of large capacity connected to the same power system has been started. Defective electromagnetic contractor.	Check the source voltage and wiring. Check the power capacity and power system.
Extremely rapid accel. Short-circuit or ground- fault at the inverter output side. Motor of a capacity greater than the inverter rating has been started. High-speed motor and pulse motor has been started.	Extend the accel. time. Check the load wiring.
Motor dielectric strength is insufficient. Load wiring is not proper.	Check the motor wiring impedance and the load wiring.
Insufficient deceleration time. High input voltage compared to motor rated voltage.	Extend the accel. time. Use a braking resistor.
Defective cooling fan. Ambient temperature rise Clogged filter.	Check for the fan, filter and the ambient temperature.
Overload, low speed operation or extended accel. time. Improper V-f characteristic setting	Measure the temperature rise of the motor. Decrease the output load. Set proper V/f characteristic.
Improper rated current (Cn-09) setting	Set proper V/f characteristic. Set proper rated current (Cn-09) If inverter is reset repetitively before fault removed, the inverter may be damaged.
Machine errors or overload	Check the use of the machine. Set a higher protection level (Cn-32).
Fault input of external signal ③, ⑤, ⑥, ⑦ and ⑧.	Identify the fault signal using Un-11.
Disturbance of external noise Excessive impact or vibration	Reset NVRAM by running Sn-03. Replace the control board if the fault can't be cleared.
Improper setting of ASR parameter or over-speed protection level.	Check the parameters of ASR and the protection level.
The PG wiring is not properly connected or open-circuit.	Check the PG wiring.
Improper setting of ASR parameter or speed deviation level.	Check parameters of ASR and speed deviation level.
External noise Excessive vibration or impact Communication wire Not properly contacted	Check the parameter setting, including Sn-01, Sn-02. Check if the comm. wire is not properly contacted. Restart, if fault remains, please contact to us.

(B). Warning and Self-Diagnosis Functions

LCD Display (English)	Fault Contents	Fault Contact Output	
(blinking) Alarm DC Volt. Low	The main circuit DC voltage becomes lower than the lower under-voltage level before the motor starts.	No operation	
(blinking) Alarm Over Voltage	The main circuit DC voltage becomes higher than the lower under-voltage level before the motor starts.	No operation	
(blinking) Alarm Over Heat	The thermal protection contact is input to the external terminal.	No operation	
(blinking) Alarm Over Torque	Over torque is detected while the output current is larger than or equal to the setting of Cn-26. However, the Sn-12 has been set such that the inverter continue to run and disregard the over-torque warning.	No operation	
	Stall prevention operates while acceleration.	No operation	
	Stall prevention operates while running		
	Stall prevention operates while deceleration.		
(blinking) Alarm External Fault	Forward and reverse rotation commands are simultaneously detected for a period of time exceeding 500ms. (The inverter is stopped according to the stop method preset by Sn-04.)	No operation	
(blinking) Alarm RS-485 Interrupt	MODBUS Communication fault occurs. The inverter remains operating.	No operation	
Comm. Fault	Transmission fault of digital operator	No operation	
(blinking) Alarm B.B.	External B.B. signal (terminal ③) is input (The inverter stops and the motors stops without braking)	No operation	
Alarm Input Error	Improper inverter capacity (Sn-01) setting.	No operation	
	Improper setting of multi-function input signal (Sn-25, 26, 27 and 28).	No operation	
	Improper setting of V/F characteristic (Cn-02~08)	No operation	
	Improper setting of Cn-18, Cn-19	No operation	
(blinking) Alarm Over Speed	Excessive speed　　(operation remains)	No operation	
(blinking) Alarm PG Open	PG Open-circuit　　(operation remains)	No operation	
Alarm Sp.Deviat Over	Excessive speed deviation　　(operation remains)	No operation	
Load Fail	Error during upload and download　　(operation remains)	No operation	
EEPROM Fault	Operator EEPROM error.	No operation	
Upload Error	Data incorrect during Communication from the operator to the inverter.	No operation	
Download Error	Data incorrect during Communication from the inverter to the operator.	No operation	
Alarm Auto Tun-Error	Motor parameter autotuning error	No operation	

Error Causes	Action to Be Taken
Input voltage drop	Measure the main circuit DC voltage, if the voltage is lower allowance level, regulate the input voltage.
Input voltage rise	Measure the main circuit DC voltage, if the voltage is higher than allowance level, regulate the input voltage.
Overload Cooling fan fault. Ambient temperature rises. Clogged filter.	Check for the fan, filter and the ambient temperature.
Machine error or overload	Check the use of the machine. Set a higher protection level (Cn-32).
Insufficient Accel./Decel. Time Overload Excessive load impact occurs while operating	Increase Accel./Decel. Time. Check the load.
Operation sequence error 3-wire/2-wire selection error	Check the circuit of system Check the setting of system parameters Sn-25, 26, 27, and 28.
External noise Excessive vibration or impact on Communication wire Not properly contacted	Check the parameter setting, including Sn-01, Sn-02. Check if the comm. wire is not properly contacted. Restart, if fault remains, please contact to us.
Comm. between digital operator and inverter has not been established after system starts for 5 seconds. Communication is established after system starts, but transmission fault occurs for 2 seconds.	Re-plug the connector of the digital operators. Replace the control board.
External B.B. signal is input.	After external BB signal is removed, execute the speed search of the inverter.
Inverter KVA setting error.	Set proper KVA value. Be aware of the difference of 220V and 440V
The value of Sn-25~Sn-28 is not in ascending order (Ex. Sn-25= 05, Sn-28= 02, those are improper setting). Set speed search command of 21 and 22 simultaneously.	Set these values by order (the value of Sn-25 must be smaller than those of Sn-26, 27, 28) Command 21 and 22 can not be set on two multi-function-input contacts simultaneously.
The values of Cn-02~Cn-08 do not satisfy $F_{max} \geq F_A \geq F_B \geq F_{min}$.	Change the settings.
Upper limit and lower limit setting is incorrect.	Change the settings.
Improper ASR parameter setting or over-torque protection level.	Check the ASR parameter and over-torque protection level.
The circuit of PG is not properly connected or open-circuit.	Check the wiring of PG.
Improper ASR parameter setting or over-torque protection level.	Check the ASR parameter and over-torque protection level.
Bad communication during operator and inverter. The connector is not properly connected.	Check if the connector is not properly connected.
Operator EEPROM error.	Disable load function of operator. Replace the operator.
Incorrect inverter data format Communication noise.	Download the data to the operator again. Check if the connector is not properly connected.
Communication noise	Check if the connector is not properly connected.
Inverter capacity and motor rating are not properly matched. The wiring between inverter and motor is disconnected. Motor load unbalance.	Correct the inverter/motor capacity ratio, wiring cable and motor load.

APPENDIX

A. Adjusting PID controller

Use the following procedure to activate PID control and then adjust it while monitoring the response.

1. Enable PID control.
2. Increase the proportional gain Bn-17 as far as possible without creating oscillation.
3. Decrease the integral time Bn-18 as far as possible without creating oscillation.
4. Increase the derivative time Bn-19 as far as possible without creating oscillation.

The Proportional, Integral and Derivative control function provides closed-loop control, or regulation, of a system process variable (pressure, temperature, etc.). This regulation is accomplished by comparing a feedback signal with a reference signal, which results in an error signal. The PID control algorithm then performs calculations, based upon the PID parameter settings (Bn-16 through Bn-20 on page 38), on this error signal. The result of the PID algorithm is then used as the new frequency reference, or is added to the existing speed reference.

The PID target value can come from the frequency command (from operator) or a Multi-Function Analog Input.

Select the PID control feedback signal from external terminal AIN for a current signal (4-20mA DC) or from VIN for a voltage (0-10 VDC).

The Proportional gain is the value by which the error signal is multiplied to generate a new PID controller output. A higher setting will result in a system with quicker response. A lower setting will result in a more stable yet slower system.

The Integral Time is a parameter that determines how fast the PID controller will seek to eliminate any steady-state error. The smaller the setting, the faster the error will be eliminated. To eliminate the integral function entirely, set this parameter to 0.0 seconds. A lower setting will result in a more responsive system. A higher setting will result in a more stable yet slower system.

The Integral Upper Limit is a parameter that will limit the effect that the integrator can have. It works if the PID controller output is positive or negative. It can also be used to prevent integrator "wind-up."

The Derivative Time is a parameter that can be adjusted to increase system response to fast load or reference changes, and to reduce overshoot upon startup. To eliminate the differential function entirely, set this parameter to 0.00 seconds.

The PID Output Limit (Cn-51, Cn-52) is parameter that can be used to set the maximum effect the PID controller will have on the system. It also will limit the PID output when it is either positive or negative.

NOTE : When the PID output limit is reached, the integrator will hold and not change in value until the PID output is less than the PID output limit.

The PID bias (Bn-20) is a parameter that will add a fixed percentage to the PID output. It can be used to tune out small system offsets.

NOTE : This parameter is set as a percentage of maximum output frequency.

The above parameters are factory set for optimum results for most applications, and generally do not need to be changed.

The PID Primary Delay Time is a parameter that adds a filter to the PID output to keep it from changing too quickly. The higher the setting, the slower the PID output will change.

All of these parameters are interactive, and will need to be adjusted until the control loop is properly tuned, i.e. stable with minimal steady-state error. A general procedure for tuning these parameters is as follows:

1. Adjust Proportional Gain until continuous oscillations in the Controlled Variable are at a minimum.
2. The addition of Integral Time will cause the steady-state error to approach zero. The time should be adjusted so that this minimal error is attained as fast as possible, without making the system oscillate.
3. If necessary, adjust derivative time to reduce overshoot during startup. The drive's acceleration and deceleration rate times can also be used for this purpose.
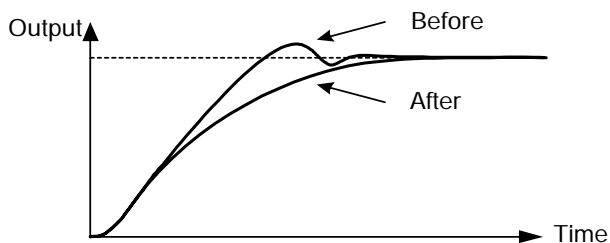
If overshoot occurs, shorten the derivative time (D) and lengthen the integral time (I).
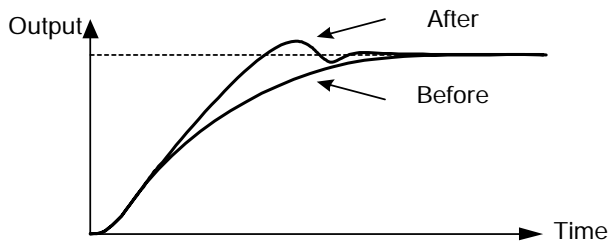
To rapidly stabilize the control conditions even when overshooting occurs, shorten the integral time (I) and lengthen the derivative time (D).
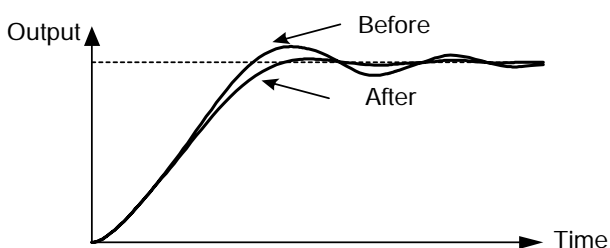
If oscillation occurs with a longer cycle than the integral time (I) setting, it means that the integral operation is strong. The oscillation will be reduced as the integral time (I) is lengthened.
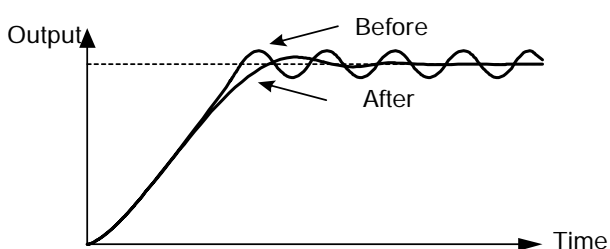
If oscillation cycle is short and approx. the same as the derivative time (D) setting, it means that the derivative operation is strong. The oscillation will be reduced as the derivative time (D) is shortened. If even setting the derivative time (D) to 0.00 cannot reduce oscillation, then either decrease the proportional gain (P) or raise the PID primary delay time constant.

B. Supplementary on PID Control Block Diagram

A PID control block diagram is
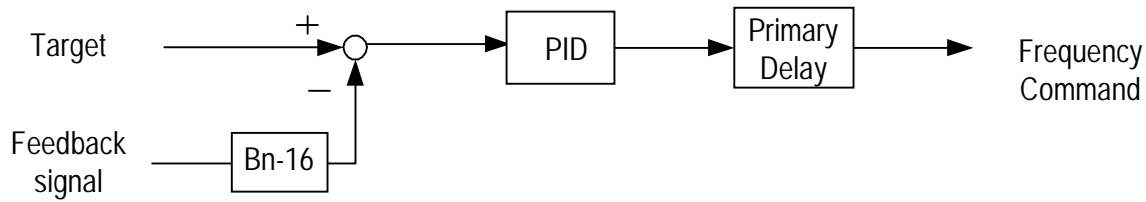
Fig. 48   PID control block diagram

Note : 1. A target signal may come from digital operator, PS-485 port or multi-function analog input terminal-AUX setting. (upon Sn-05 setting).
2. The detected signal can be input either from terminal VIN (Sn-24=0, voltage command 0~10V) or from terminal AIN (Sn-24=1, current command 4~20mA).
3. If the target signal is from the terminal AUX, please use the wiring as below: (Sn-05=01, Sn-29=09)

Fig. 49   PID wiring diagram

4. Please refer to page 42, 43 for more details about PID use.

C. Wiring for PG Feedback Use

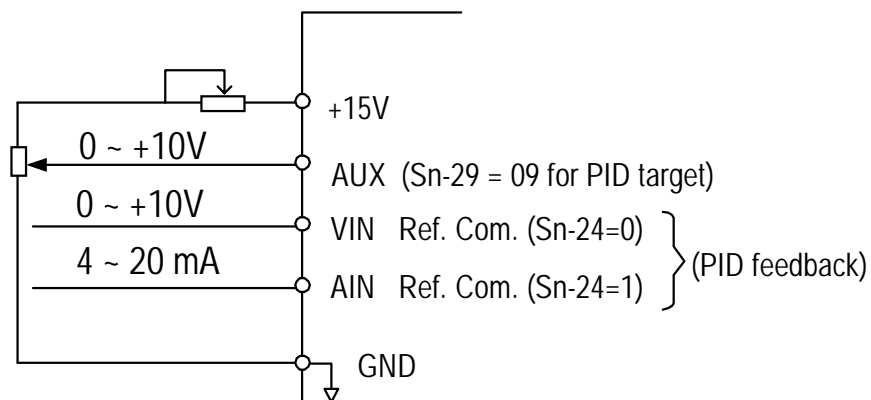The 7200MA inverter has a built-in PG interface, no external PG feedback option is needed. An independent DC source of +12V should be provided from external source.
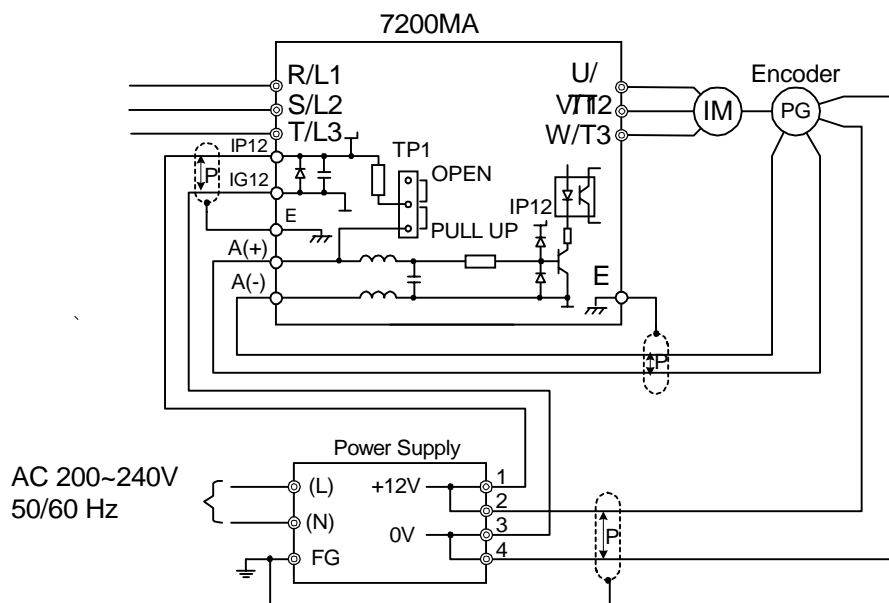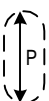

Fig. 50   Wiring of PG feedback

Note :

1. ⌇P⌇ : Isolated twisted cable wire.

2. Notation for PG terminals

Terminal	Function
A(+)	PG signal input terminal. The voltage level is (H: 4~12V, L: ≤1V). Its Max. frequency is < 32767 Hz
A(-)	
IP12	Terminals feed in the (+12)VDC external power
IG12	source (+12V± 10%, the Max. current is 40mA)
+12V	(+12)V DC source (+12V± 10%, min. 0.5A)
0V	
E	Inverter ground.

3. Please refer to page 60, 60, 96 for more details on PG feedback.
4. The A(+), A(-), IP12, IG12 terminals are integrated as CN2 in compact version. (see page 9). The code No. of the wire is 4H339D0250001.
5. The PG interface only allows the open-collector interface drive or comple-mentary interface drive.
6. The short pin of TP1 set to PULL UP position for open-collector interface (factory setting) and set to OPEN position for complementary interface. The PG interface only allows the open-collector interface drive or complementary interface drive.
7. The shielded twisted-pair cable wire should be used between the inverter and PG, its length should be less than 50 meters.

D. RS-485 Communication Interface

7200MA RS-485 interface (terminal S(+), S(-)) can provide MODBUS protocol for communication. The PROFIBUS protocol for communication is possible if the user adopt the PROFIBUS option card (MA-SP).

Wiring diagram of MODBUS and PROFIBUS-DP:

(a) MODBUS protocol communication
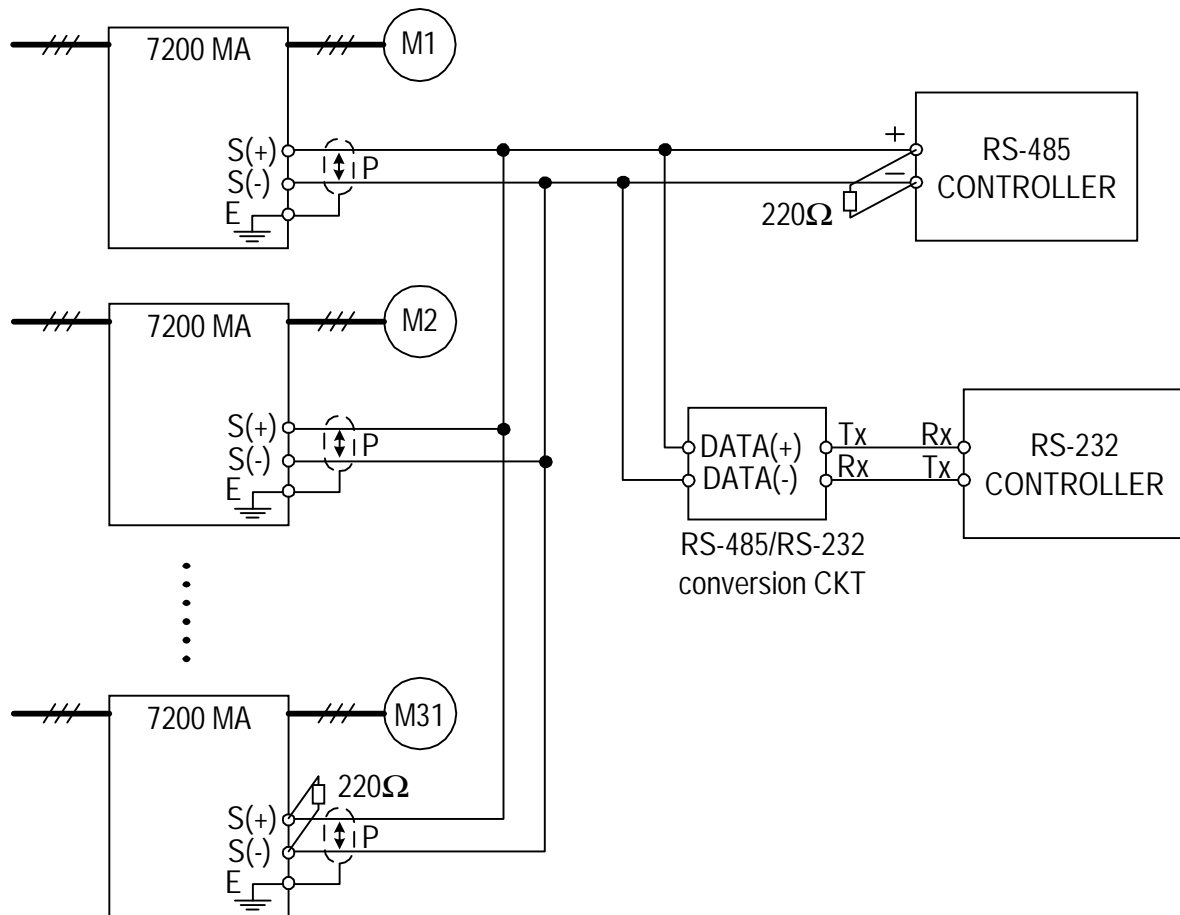
Fig. 51   Wiring for MODBUS Protocol communication

Note : 1. A Host Controller with RS-485 interface can communicate with the 7200MA unit through RS-485 interface connection directly. If the Host Controller does not provide the RS-485 port and its RS-232 port is available, an RS-485/RS-232 conversion card should be used to connect between this Host Controller and 7200MA unit.

2. A MODBUS Host Controller can drive the network with no more than 31 drivers connected, using MODBUS communication standard. If the driver (e.g., 7200MA drive) is at the end of the network, it must have the terminating resistors 220Ω at both terminals. All other drives in the system should not have terminators.

3. Please refer to "7200MA RS-485 MODBUS Communication Application Manual".

(b) PROFIBUS protocol communication

      The MA-SP PROFIBUS option supports the PROFIBUS protocol. The MA-SP option can be placed at the control board. An independent 24V DC is needed for all MA SP option.
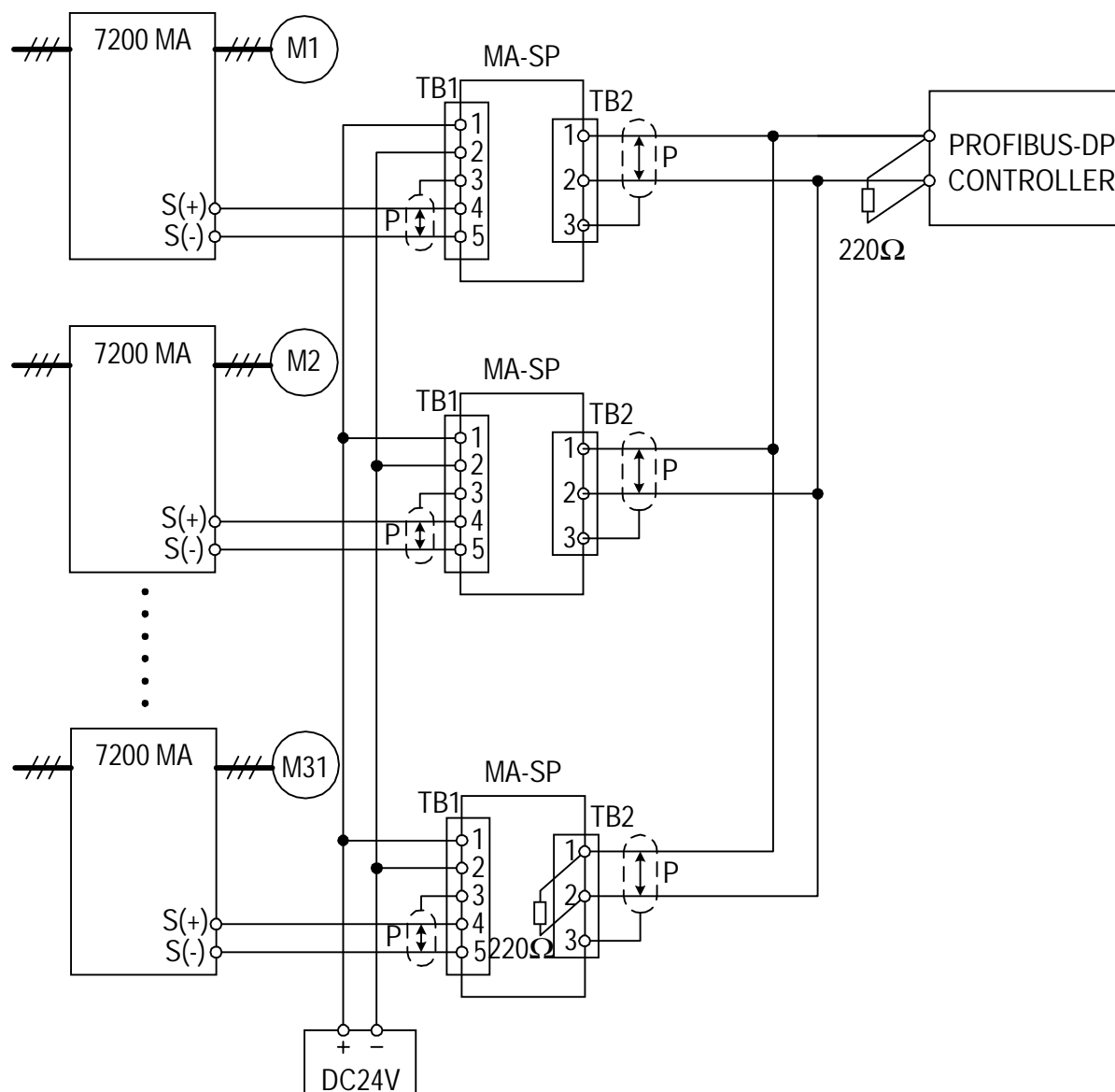
Fig. 52   Wiring for PROFIBUS protocol communication

Note： 1. Code No. : 4H300D0290009

     2. An MA-SP option card will consume about 2.4W(=24.0V*0.1A). Choose the proper DC power supply to meet your system capacity based upon the station number.

     3. A maximum of 31 PROFIBUS-DP stations (nodes) may be contained within a single network segment. If the drive is at the end of the network it must have 220Ω between terminals (S-, S+)

     4. For more details, please refer to the manual "7200MA PROFIBUS-DP Communication Application manual".

E. SINK/SOURCE Typical Connection Diagram

The UL/CUL standard type control board (Code No. : 4P101C0060002) terminal ①~⑧ can be set as sink or source type input interface, the typical connection examples shown as below.

(a) SINK type input interface : The short pin of TP2 set to SINK position.
Transistor (Open-collector) used for operation signal
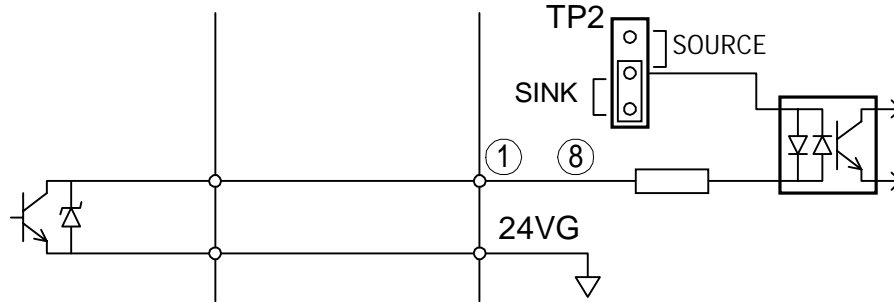
NPN sensor (sink) used for operation signal
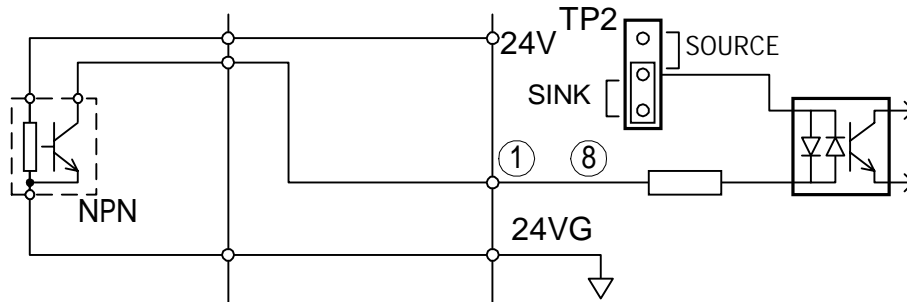
(b) SOURCE type input interface : The short pin of TP2 set to SINK position.
Transistor (Open-collector) used for operation signal
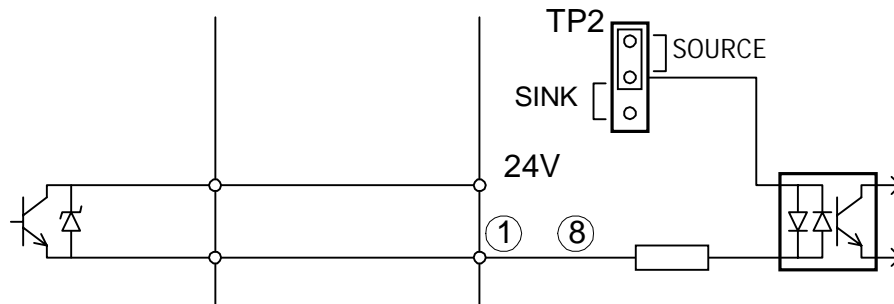
PNP sensor (source) used for operation signal
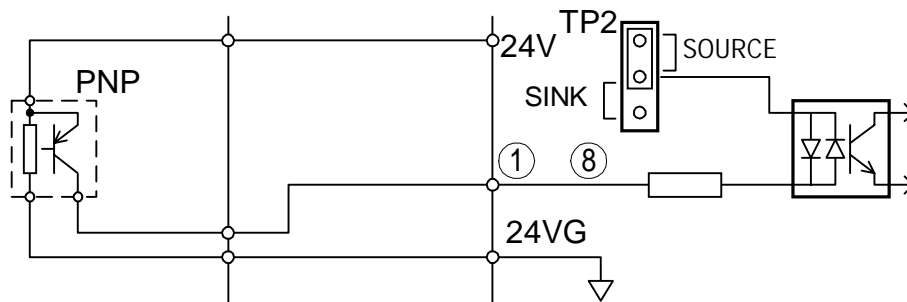
F. RS-232C Serial Communications Connection Diagram

The LCD Digital operator uses RS-232C serial communication through connector CN1 to communicate with control board. Using the CN1 port on the control board, parameters can be monitored and updated by a suitable PC programming tool.

The CN1 port is an un-isolated RS-232C with baud rate 2400 bps. Contact TECO for further information.

The pin definitions of CN1

6 pin telephone jack
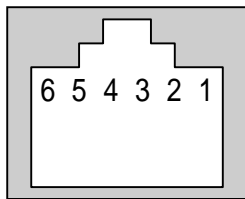
Pin	Signal Definition
1	LCD/PC selection
2	5V
3	Rx
4	Tx
5	0V
6	Reserved (-5V, for LCD display)

Typical connection diagram
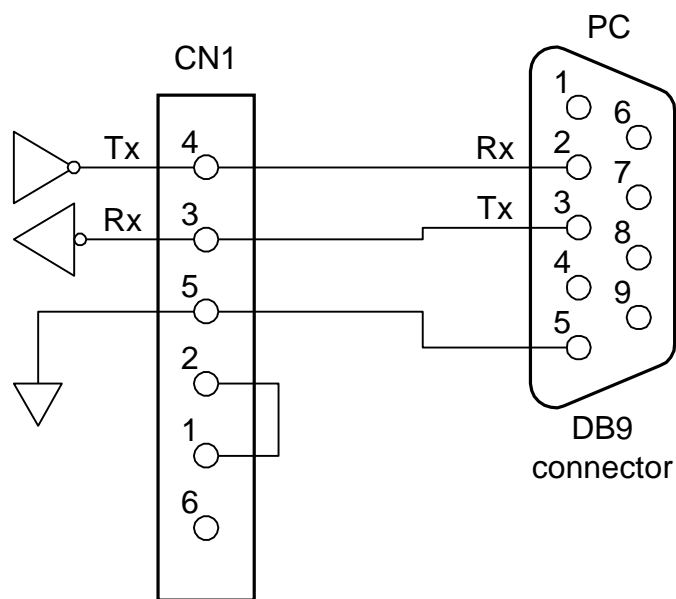
G   Set-up using the Sensorless Vector Control.

The 7200MA standard with two selectable control modes, V/F control mode (Sn-67=0) and sensorless vector control mode (Sn-67=1). When the sensorless vector control mode is selected, be sure to make the inverter capacity and the motor rating are suitably matched.

The AUTOTUNE feature can be used to identify and store the important motor parameters for the sensorless control mode.

Refer to p. 60, 61 and 100 to see more details about sensorless vector control.

The Sequence of Motor Parameter Autotuning:

1. Disconnect the motor load and make sure that the wiring between the inverter and the motor is suitable. Check the class difference of inverter capacity and motor rating is less than 2 class or equal.
2. Switch to PRGM operation mode by pressing the LCD Digital Operator $\boxed{\substack{\text{PRGM}\\\text{DRIVE}}}$ key.
3. Key in motor rated voltage data to Cn-03 (Max. Output Voltage) and the motor rated frequency to Cn-04 (Max. voltage frequency) according to the motor's nameplate.
4. Enable the Autotuning function by setting Sn-66=1.
5. Switch to DRIVE operation mode by pressing the $\boxed{\substack{\text{PRGM}\\\text{DRIVE}}}$ key, then run the inverter by pressing the $\boxed{\text{RUN}}$ key.
6. The inverter system immediately enters into the autotuning operation, while complete (normally, about 25 seconds), the inverter return to stopped condition. Press the $\boxed{\text{STOP}}$ key to stop the parameter autotuning operation while abnormality occurs during autotuning operation.
7. Finally, press the $\boxed{\text{STOP}}$ key to return the system to normal operation mode. The value of motor parameter will be automatically stored in these parameters Cn-57 (motor line-to-line resistance R1), Cn-58 (motor rotor equivalent resistance R2), Cn-59 (motor leakage inductance Ls) and Cn-60 (mutual inductance Lm).

The Operations and Adjustments of Sensorless Vector Control

1. Make sure the inverter capacity and motor rating is suitable matched. Used the AUTOTUNE feature to identify and store the motor parameters in the first time sensorless vector operation after installation, and key in the motor rated voltage data onto Cn-03 and the motor rated frequency onto Cn-04 according to the motor nameplate.
2. Enable the sensorless vector control mode by setting Sn-67=1.
3. Increase the setting Cn-57 to increase the generating torque at low speed. Decrease the setting Cn-57 to reduce the generating torque to avoid over current trip at low speed.
4. Adjust the setting Cn-61 if the speed accuracy need to improve. When the actual speed is low, increase the set value and when the actual speed is high, decrease the set value.
5. If the motor speed is not stable or the load inertia is too large, increase the Cn-40 (slip compensation primary delay time) setting.
   If the speed response is slow, decrease the setting of Cn-40.

H. Notes for circuit protection and environmental ratings

Circuit Protection

The MA series are "suitable for use in a circuit capable of delivering not more than_____rms symmetrical amperes_____V maximum." Where the rms value symmetrical amperes and V maximum are to be as follows:

Device Rating		Short circuit Rating (A)	Maximum Voltage (V)
Voltage	HP		
220V	1.5 ~ 50	5,000	240V
	51 ~ 100	10,000	
440V	1.5 ~ 50	5,000	480V
	51 ~ 200	10,000	

Environmental Ratings

The MA series are intended for use in pollution degree 2 environments.

Field Wiring Terminals and Tightening Torque

The wiring terminals and tightening torque are listed as follows.
(The main circuit terminal specifications – use 60/75°C copper wire only)

(A) 220V class

Circuit	Inverter Rating (HP)	Terminals Mark	Cable Size (AWG)	Terminals	Tightening Torque (Pound-inch)
Main Circuit	1	L1, L2, L3, T1, T2, T3, B1/P, B1/R, B2, ⊖	14 ~ 10	M4	10
		⏚	14 ~ 10	M4	10
	2	L1, L2, L3, T1, T2, T3, B1/P, B1/R, B2, ⊖	14 ~ 10	M4	10
		⏚	12 ~ 10	M4	10
	3	L1, L2, L3, T1, T2, T3, B1/P, B1/R, B2, ⊖	12 ~ 10	M4	10
		⏚	12 ~ 10	M4	10
	5	L1, L2, L3, T1, T2, T3, B1/P, B1/R, B2, ⊖	12 ~ 10	M4	10
		⏚	10	M4	10
	7.5	L1, L2, L3, T1, T2, T3, B1/P, B1/R, B2, ⊖	8	M4	10
		⏚	10 ~ 8	M4	10
	10	L1, L2, L3, T1, T2, T3, B1/P, B1/R, B2, ⊖	8	M4	10
		⏚	10 ~ 8	M4	10
	15	L1, L2, L3, T1, T2, T3, B1/P B2, ⊖	4	M6	35
		⏚	8	M6	35
	20	L1, L2, L3, T1, T2, T3, B1/P, B2, ⊖	2	M6	35
		⏚	8	M6	35
Control Circuit	All series	①~⑧, 15V, VIN, AIN, AUX, AO1, AO2 RA, RB, RC, DO1, DO2, (or R2A, R2C)	24~14	M2.6	4

(B) 440V class

Circuit	Inverter Rating (HP)	Terminals Mark	Cable Size (AWG)	Terminals	Tightening Torque (Pound-inch)
Main Circuit	1	L1, L2, L3, T1, T2, T3, B1/P, B1/R, B2, ⊖	14 ~ 10	M4	10
		⏚	14 ~ 10	M4	10
	2	L1, L2, L3, T1, T2, T3, B1/P, B1/R, B2, ⊖	14 ~ 10	M4	10
		⏚	14 ~ 10	M4	10
	3	L1, L2, L3, T1, T2, T3, B1/P, B1/R, B2, ⊖	14 ~ 10	M4	10
		⏚	14 ~ 10	M4	10
	5	L1, L2, L3, T1, T2, T3, B1/P, B1/R, B2, ⊖	14 ~ 10	M4	10
		⏚	12 ~ 10	M4	10
	7.5	L1, L2, L3, T1, T2, T3, B1/P, B1/R, B2, ⊖	12 ~ 10	M4	10
		⏚	12 ~ 10	M4	10
	10	L1, L2, L3, T1, T2, T3, B1/P, B1/R, B2, ⊖	10	M4	10
		⏚	10	M4	10
	15	L1, L2, L3, T1, T2, T3, B1/P, B1/R, B2, ⊖	12 ~ 10	M6	35
		⏚	12 ~ 10	M6	35
	20	L1, L2, L3, T1, T2, T3, B1/P, B1/R, B2, ⊖	10	M6	35
		⏚	10	M6	35
Control Circuit	All series	①~⑧, 15V, VIN, AIN, AUX, AO1, AO2 RA, RB, RC, DO1, DO2, (or R2A, R2C)	24~14	M2.6	4

I. Spare Parts

(A) 220V class

HP	Inverter & Parts Name MODEL	SPEC.	Control PC Board	Power Board	
1	JNTMBGBB0001JK - 1	MODEL CODE Q'ty	3P101C0380003 *1 1	4P106C0180004 1	
	JNTMBGBB0001JKS 1	MODEL CODE Q'ty	4P101C0040001 1	4P106C01600A1 1	
2	JNTMBGBB0002JK - 1	MODEL CODE Q'ty	3P101C0380003 *1 1	4P106C01800A2 1	
	JNTMBGBB0002JKS 1	MODEL CODE Q'ty	4P101C0040001 1	4P106C0160003 1	
3	JNTMBGBB0003JK - 1	MODEL CODE Q'ty	3P101C0380003 *1 1	4P106C01800B1 1	
5.4	JNTMBGBB0005JK - 1	MODEL CODE Q'ty	3P101C0380003 *1 1	4P106C01800C9 1	
7.5	JNTMBGBB7R50JK - 1	MODEL CODE Q'ty	3P101C0380003 *1 1	4P106C0200005 1	
	JNTMBGBB7R50JKA 1	MODEL CODE Q'ty	3P101C0380003 *1 1	4P106C0210001 1	
10	JNTMBGBB0010JK - 1	MODEL CODE Q'ty	3P101C0380003 *1 1	4P106C02000A3 1	
	JNTMBGBB0010JKA 1	MODEL CODE Q'ty	3P101C0380003 *1 1	4P106C0220006 1	
15	JNTMBGBB0015JK - 1	MODEL CODE Q'ty	3P101C0380003 *1 1	4P106C01500A6 1	
20	JNTMBGBB0020JK - 1	MODEL CODE Q'ty	3P101C0380003 *1 1	4P106C01500B4 1	

*1 : For standard type (--1, A-1), code no. is 3P101C0380003.
   For UL type (-U1, AU1), code no. is 4P101C0060002.

Main Circuit Transistor		Main Circuit Diode	Cooling Fan	Digital Operator
MUBW10-06A7				JNEP-31 [*2]
277830116				4H300C0010008[*2]
1				1
CM15MDL-12H			KD1204PFBX	JNEP-31 [*2]
277830540			4M903D0880002	4H300C0010008[*2]
1			1	1
MUBW15-06A7				JNEP-31 [*2]
277830124				4H300C0010008[*2]
1				1
CM20MDL-12H			KD1204PFBX	JNEP-31 [*2]
277830558			4M903D0880002	4H300C0010008[*2]
1			1	1
MUBW20-06A7 or	7MBR30SA060		AFB0624H	JNEP-31 [*2]
277830132	277831619		4H300D0190004	4H300C0010008[*2]
1	1		1	1
MUBW30-06A7 or	7MBR50SA060		AFB0624H	JNEP-31 [*2]
277830141	277831627		4H300D0190004	4H300C0010008[*2]
1	1		1	1
32NAB06			AFB0824SH	JNEP-31 [*2]
277830612			4H300D0200000	4H300C0010008[*2]
1			1	1
7MBP50RA060		DF75LA80	AFB0824SH	JNEP-31 [*2]
277831660		4M903D1480016	4H300D0200000	4H300C0010008[*2]
1		1	1	1
32NAB06			AFB0824SH	JNEP-31 [*2]
277830612			4H300D0200000	4H300C0010008[*2]
1			1	1
7MBP75RA060		DF75LA80	AFB0824SH	JNEP-31 [*2]
277831678		4M903D1480016	4H300D0200000	4H300C0010008[*2]
1		1	1	1
PM100RSE060 or	7MBP100RA060	DF100BA80	AFB0824SH	JNEP-31 [*2]
277820242	277831511	277192209	4H300D1440004	4H300C0010008[*2]
1	1	1	1	1
PM150RSE060 or	7MBP150RA06	DF150BA80	AFB0824SH	JNEP-31 [*2]
277820251	277831520	277192179	4H300D1440004	4H300C0010008[*2]
1	1	1	1	1

*2 : For standard type (--1, A-1), code no. is 4H300C0010008 and model is JNEP-31.
   For UL type (-U1, AU1), code no. is 4H300C0020003 and model is JNEP-31 (v).

(B) 440V class

	Inverter & Parts Name			Control PC Board	Power Board	
HP	MODEL		SPEC.			
1	JNTMBGBB0001AZ - 1		MODEL			
			CODE	3P101C0380003 [*1]	4P106C0190000	
			Q'ty	1	1	
	JNTMBGBB0001AZS 1		MODEL			
			CODE	4P101C0040001	4P106C01300A5	
			Q'ty	1	1	
2	JNTMBGBB0002AZ - 1		MODEL			
			CODE	3P101C0380003 [*1]	4P106C01900A8	
			Q'ty	1	1	
	JNTMBGBB0002AZS 1		MODEL			
			CODE	4P101C0040001	4P106C0130007	
			Q'ty	1	1	
3	JNTMBGBB0003AZ - 1		MODEL			
			CODE	3P101C0380003 [*1]	4P106C01900B6	
			Q'ty	1	1	
5.4	JNTMBGBB0005AZ - 1		MODEL			
			CODE	3P101C0380003 [*1]	4P106C01900C4	
			Q'ty	1	1	
7.5	J NTMBGBB7R50AZ - 1		MODEL			
			CODE	3P101C0380003 [*1]	4P106C0170009	
			Q'ty	1	1	
	JNTMBGBB7R50AZA 1		MODEL			
			CODE	3P101C0380003 [*1]	4P106C0110006	
			Q'ty	1	1	
10	JNTMBGBB0010AZ - 1		MODEL			
			CODE	3P101C0380003 [*1]	4P106C01700A7	
			Q'ty	1	1	
	JNTMBGBB0010AZA 1		MODEL			
			CODE	3P101C0380003 [*1]	4P106C0110006	
			Q'ty	1	1	
15	JNTMBGBB0015AZ - 1		MODEL			
			CODE	3P101C0380003 [*1]	4P106C0150008	
			Q'ty	1	1	
20	JNTMBGBB0020AZ - 1		MODEL			
			CODE	3P101C0380003 [*1]	4P106C0150016	
			Q'ty	1	1	

*1 : For standard type (--1, A-1), code no. is 3P101C0380003.
For UL type (-U1, AU1), code no. is 4P101C0060002.

Main Circuit Transistor	Main Circuit Diode	Cooling Fan	Digital Operator
MUBW10-12A7			JNEP-31 [*2]
277830159			4H300C0010008[*2]
1			1
CM10MDL-24H		KD1204PFBX	JNEP-31 [*2]
277840049		4M903D0880002	4H300C0010008[*2]
1		1	1
MUBW10-12A7			JNEP-31 [*2]
277830159			4H300C0010008[*2]
1			1
CM10MDL-24H		KD1204PFBX	JNEP-31 [*2]
277840049		4M903D0880002	4H300C0010008[*2]
1		1	1
MUBW10-12A7 or 7MBR15SA120		AFB0624H	JNEP-31 [*2]
277830159 277831643		4H300D0190004	4H300C0010008[*2]
1 1		1	1
MUBW15-12A7 or 7MBR25SA120		AFB0624H	JNEP-31 [*2]
277830167 277831651		4H300D0190004	4H300C0010008[*2]
1 1		1	1
31NAB12		AFB0824SH	JNEP-31 [*2]
277830621		4H300D0200000	4H300C0010008[*2]
1		1	1
7MBP50RA120	6RI30G-160	AFB0824SH	JNEP-31 [*2]
277831686	277191067	4H300D0200000	4H300C0010008[*2]
1	1	1	1
31NAB12		AFB0824SH	JNEP-31 [*2]
277830621		4H300D0200000	4H300C0010008[*2]
1		1	1
7MBP50RA120	6RI30G-160	AFB0824SH	JNEP-31 [*2]
277831686	277191067	4H300D0200000	4H300C0010008[*2]
1	1	1	1
PM75RSE120 or 7MBP75RA120	DF75AA160	AFB0824SH	JNEP-31 [*2]
277820269 277831538	277192128	4H300D1440004	4H300C0010008[*2]
1 1	1	1	1
PM75RSE120 or 7MBP75RA120	DF75AA160	AFB0824SH	JNEP-31 [*2]
277820269 277831538	277192128	4H300D1440004	4H300C0010008[*2]
1 1	1	1	1

*2 : For standard type (--1, A-1), code no. is 4H300C0010008 and model is JNEP-31.
    For UL type (-U1, AU1), code no. is 4H300C0020003 and model is JNEP-31 (v).

J.   Electrical Ratings For Contstant Torque and Quadratic Torque

7200MA Model	Constant Torque (150%, 1minute)			Quadratic Torque (110%, 1minute)		
	Max. Appli. Motor Output HP (kW)	Rated Output Current Ir (A)	Max. Switching Freq. Fcmax (kHz)	Max. Appli. Motor Output HP (kW)	Rated Output Current Ir (A)	Max. Switching Freq. Fcmax (kHz)
JNTMBGBB0001JK	1 (0.75)	4.8 A	15	2 (1.5)	6.9 A	10
JNTMBGBB0002JK	2 (1.5)	6.4 A	15	3 (2.2)	9.8 A	5
JNTMBGBB0003JK	3 (2.2)	9.6 A	15	3 (2.2)	9.8 A	15
JNTMBGBB0005JK	5.4 (4)	17.5 A	15	(5.4) (4)* 7.5 (5.5)	22.7 A	5
JNTMBGBB7R50JK	7.5 (5.5)	24 A	15	10 (7.5)	32 A	10
JNTMBGBB0010JK	10 (7.5)	32 A	15	10 (7.5)	32 A	10
JNTMBGBB0015JK	15 (11)	48 A	10	(15) (11)* 20 (15)	56.7 A	5
JNTMBGBB0020JK	20 (15)	64 A	10	25 (18.5)	70.9 A	5
JNTMBGBB0001AZ	1 (0.75)	2.6 A	15	2 (1.5)	3.5 A	10
JNTMBGBB0002AZ	2 (1.5)	4 A	15	3 (2.2)	4.9 A	5
JNTMBGBB0003AZ	3 (2.2)	4.8 A	15	3 (2.2)	4.9 A	15
JNTMBGB0005AZ	5.4 (4)	8.7 A	15	(5.4) (4)* 7.5 (5.5)	12.5 A	5
JNTMBGB7R50AZ	7.5 (5.5)	12 A	15	10 (7.5)	15.4 A	10
JNTMBGBB0010AZ	10 (7.5)	15 A	15	15 (11)	22.7 A	5
JNTMBGBB0015AZ	15 (11)	24 A	10	20 (15)	30.3 A	5
JNTMBGBB0020AZ	20 (15)	32 A	10	25 (18.5)	38.0 A	5

*Same as constant torque setting (Sn-61=0)

Item	Common details	
	Constant Torque	Quadratic Torque
Output Overload	150% for 60s	110% for 60s
Operation Ambient Temperature	-10°C ~ 40°C	-10°C ~ 40°C
Allowable Voltage Fluctuation	-15% ~ +10%	-15% ~ +10%
Output Frequency	0.5Hz ~ 400Hz	0.5Hz ~ 400Hz
V/f curve	Depend on parameter setting	Quadratic (or Cubic) Torque

K. Inverter Heat Loss

(A) 220V Class

Model JNTMBGBB JK		0001	0002	0003	0005	7R50	0010	0015	0020
Inverter Capacity kVA		2	2.7	4	7.5	10.1	13.7	20.6	27.4
Rated Current A		4.8	6.4	9.6	17.5	24	32	48	64
Heat Loss W	Fin	22	34	73	156	214	257	457	599
	Inside Unit	61	74	63	83	93	116	173	217
	Total Heat Loss	83	108	136	239	307	373	630	816

(B) 440V Class

Model JNTMBGBB AZ		0001	0002	0003	0005	7R50	0010	0015	0020
Inverter Capacity kVA		2.2	3.4	4.1	7.5	10.3	12.3	20.6	27.4
Rated Current A		2.6	4	4.8	8.7	12	15	24	32
Heat Loss W	Fin	17	27	44	96	129	181	301	411
	Inside Unit	60	76	72	71	82	100	125	184
	Total Heat Loss	77	103	116	167	211	281	426	595