TECO Westinghouse

MOTOR COMPANY

MA7200 *PLUS*

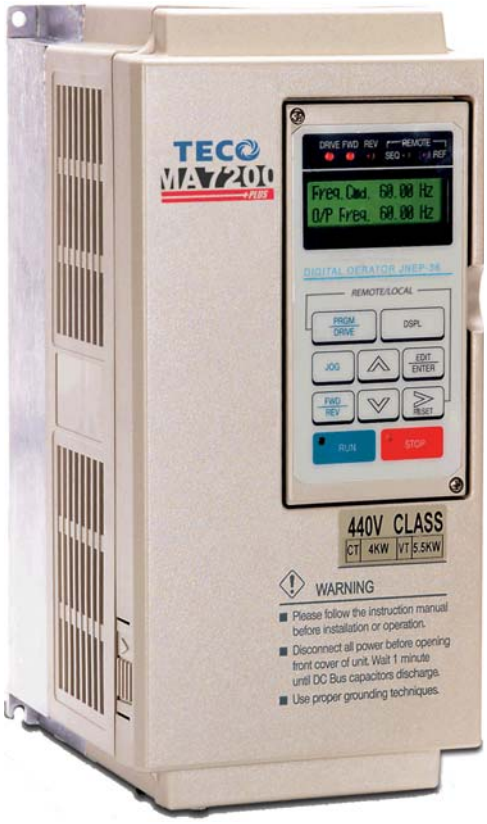
AC Inverter

Installation Manual

200 *to* 240V 1Ø & 3Ø 1 - 3 HP
3Ø 5 – 40 HP

380 *to* 480V 3Ø 1 – 75 HP

500 *to* 600V 3Ø 1 – 10 HP



No. XXXXXXX

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Cont.

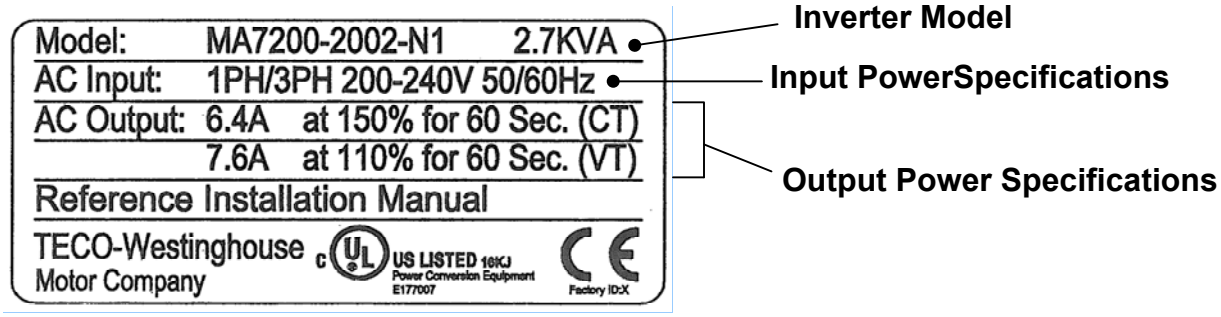
1.0 MA7200 PLUS Inspection, Handling and Installation

1.1 Inspection Procedure upon Receiving

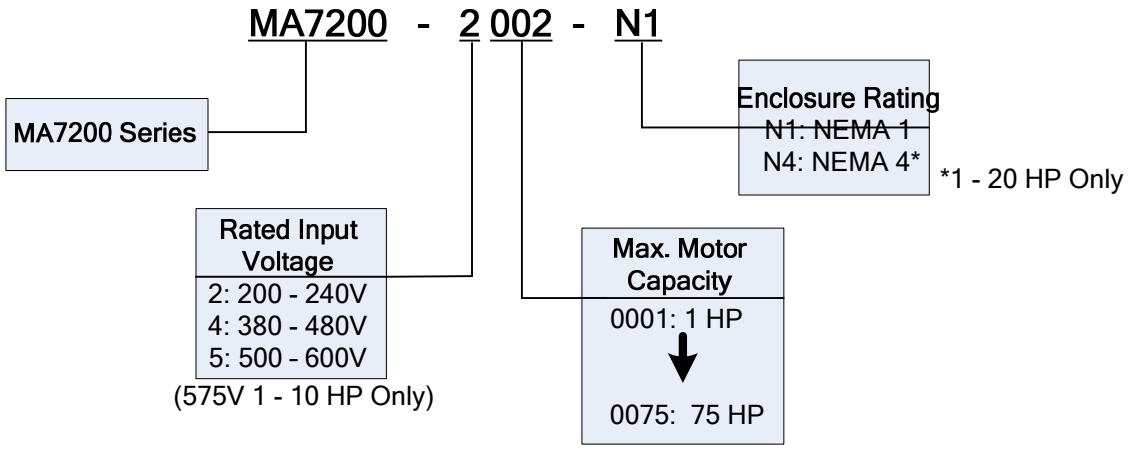
Before delivery, Every MA7200 PLUS inverter has been functionally tested and adjusted. After receiving the inverter, use the following procedure to ensure that the proper equipment has been received and is not damaged.

- Verify that the Model No. of the inverter you've received is the same as that listed on your purchase order. (Refer to the Nameplate)
- Observe the condition of the shipping container and report any damage immediately to the commercial carrier that delivered the equipment.

■ Inverter Nameplate:



- **Inverter Model Numbering:**



NOTES-

1.2 Installation

When installing the inverter, ensure that there is adequate space around the unit to allow normal heat dissipation as per the following Fig. 1.2.1

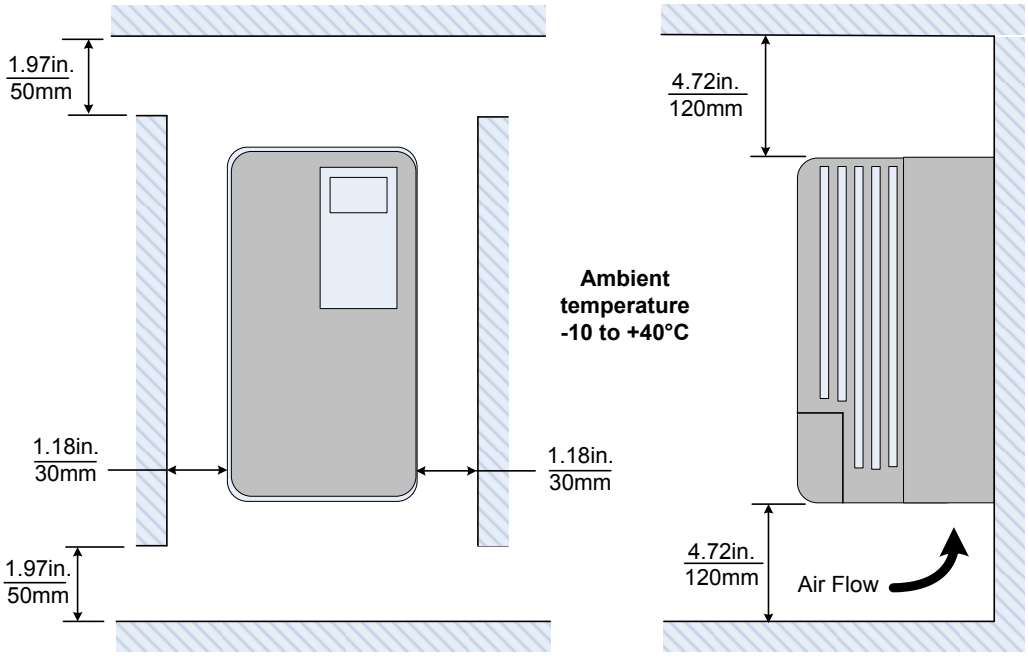
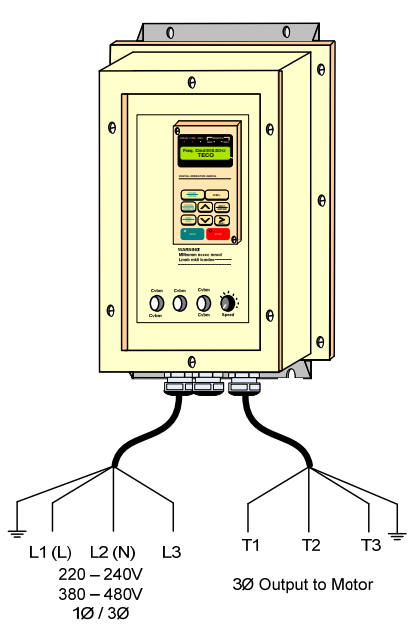
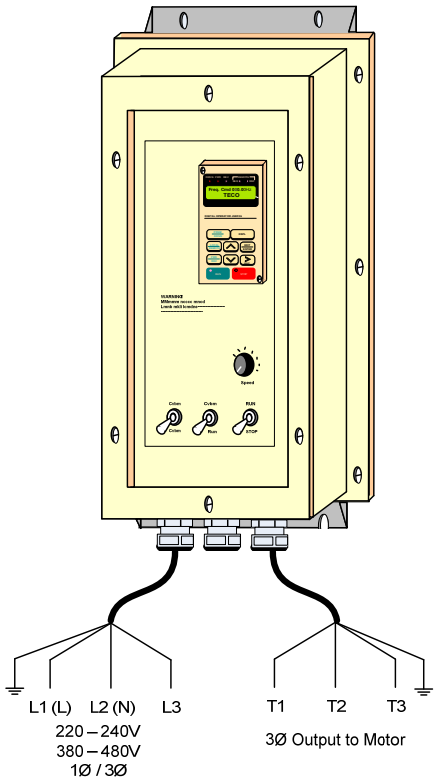


Fig. 1.2.1 MA7200 PLUS Wall Mount Clearance



(a) NEMA 4 Frame 1



(b) NEMA 4 Frame 2

Fig. 1.2.2 MA7200 PLUS NEMA 4 Installation *Cont.*

⚠ CAUTION

Location of equipment is important to achieve proper performance and normal operating life. The MA7200 PLUS inverter should be installed in area meeting the following conditions.

- Ambient temperature: +14 to 104°F, (-10 to 40°C).
- The location is protected from rain, moisture and direct sunlight.
- The location is free from harmful mists, gases, liquids, airborne dusts and metallic particles.
- The location is free from vibration and electromagnetic noise. (i.e. welding machines, power units, etc…)
- When mounting multiple units in a common enclosure, install a cooling fan or some other means to maintain the enclosure temperature below 104°F (+40°C).

1.3 Removing the Front Cover and Digital Operator

⚠ CAUTION

Before making any wiring connections to the MA7200 PLUS, the front cover needs to be removed.

- For models 230V, 1-25HP; 460V, 1-30HP and 575V 1-10HP: (Plastic cover) -The Digital Operator must be disassembled first before disassembling the front cover. After completing the wiring connection, assemble front cover first then the Digital Operator.
- For models 230V, 30HP&40HP and 460V, 40- 75HP: (Metal cover)- The front cover can be removed for wiring connection without disassembling the Digital Operator. Reinstall the front cover after completing the wiring.

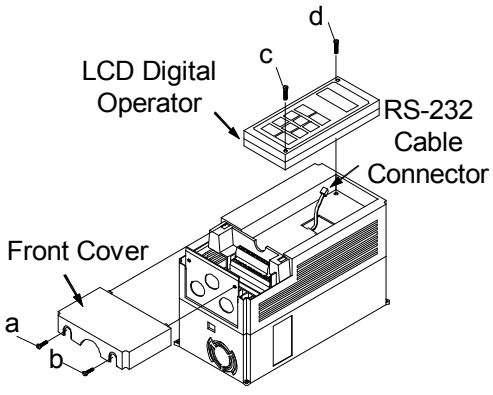
The procedure for disassembly / assembly for the MA7200 PLUS inverter will be dependent on the model as follows:

(A) 230V: 1-2HP and 460V: 1-2HP

- MA7200-2001-N1
- MA7200-2002-N1
- MA7200-4001-N1
- MA7200-4002-N1

■ Removing the front cover and Digital Operator:
Remove the two screws a and b on the front cover and remove. Next, remove the screws c and d on the Digital Operator and carefully pull upward enough to expose the connecting cable. Disconnect the RS-232 cable on the backside of the Digital Operator and remove the Digital Operator.

■ Attaching the front cover and Digital Operator:
Carefully connect the RS-232 cable connector to the back of the Digital Operator, place it on the inverter housing and secure with screws c and d. Insert the tabs of the upper part of front cover into the groove of the inverter housing and secure with screws a and b.



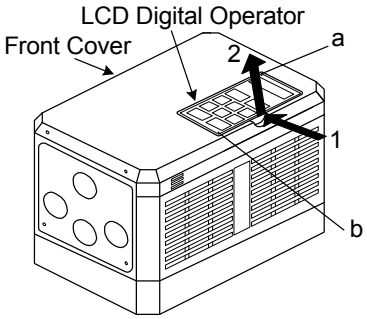
Cont.

(B) 230V: 3-10HP, 460V: 3-10HP and 575V: 1 -10 HP

- MA7200-2003-N1
- MA7200-2005-N1
- MA7200-2007-N1
- MA7200-2010-N1
- MA7200-4003-N1
- MA7200-4005-N1
- MA7200-4007-N1
- MA7200-4010-N1
- MA7200-5001-N1
- MA7200-5002-N1
- MA7200-5003-N1
- MA7200-5005-N1
- MA7200-5007-N1
- MA7200-5010-N1

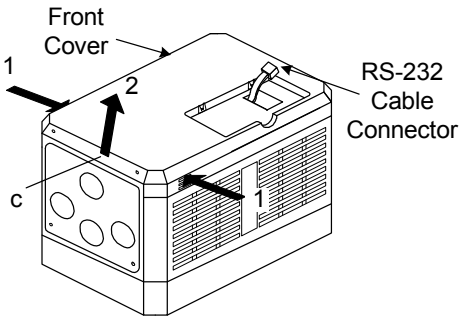
■ Removing the digital operator

Remove screws a and b. Press the lever on the side of the Digital Operator in the direction of arrow 1 to unlock the Digital Operator. Carefully disconnect the RS-232 cable connector on the back side of the LCD digital operator and lift the Digital Operator in the direction of arrow 2 to remove.



■ 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.

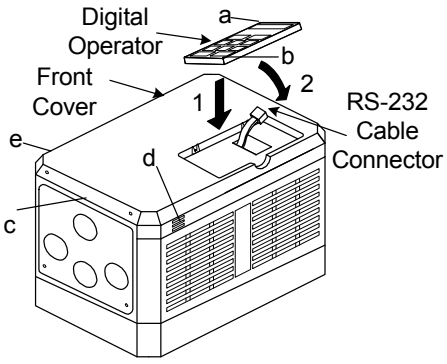


■ Mounting the front cover and Digital Operator

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

Connect the RS-232 cable connector to the back side of the Digital Operator and hook the one side of the Digital Operator on the front cover in the direction of arrow 1.

Press the digital operator in the direction of arrow 2 until it snaps into place and then secure with c and d.



Cont.

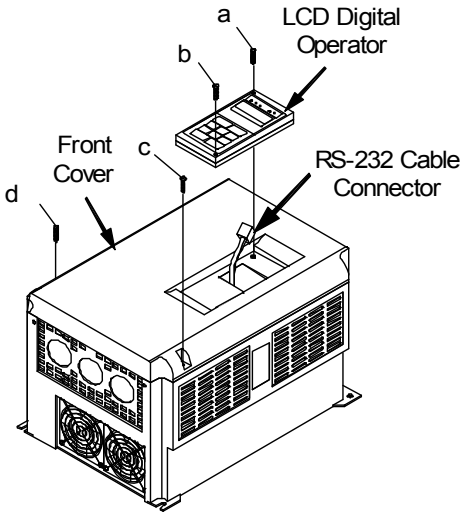
230V: 15,20HP and 460V: 15,20HP Series

- MA7200-2015-N1
- MA7200-2020-N1
- MA7200-4015-N1
- MA7200-4020-N1

■ Removing the Digital Operator:
Remove screws a and b and carefully lift up to expose the connecting cable. Disconnect the RS-232 cable connector on the back side of the Digital Operator and then remove the Digital Operator.

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

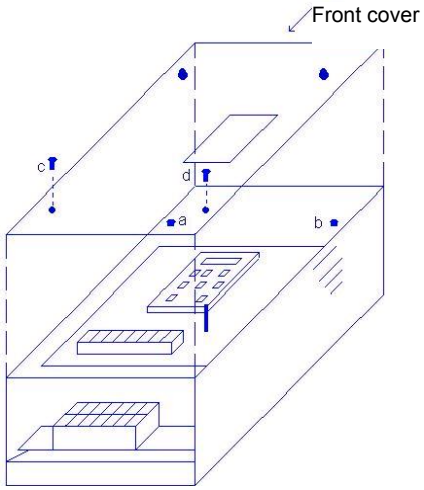
■ Mounting the front cover and Digital Operator:
Insert the tab of the upper part of front cover into the groove of the inverter housing and secure with screws c and d.
Connect the RS-232 cable connector on the back of the Digital Operator. Place the Digital Operator into the inverter housing and secure with screws a and b.



(C) 230V: 30- 40HP and 460V: 40- 75HP Series

■ Removing the front cover:
Loosen the two screws a and b of the front cover. Then loosen the two screws c and d and lift the front cover upwards. (Do not removing the digital operator.)

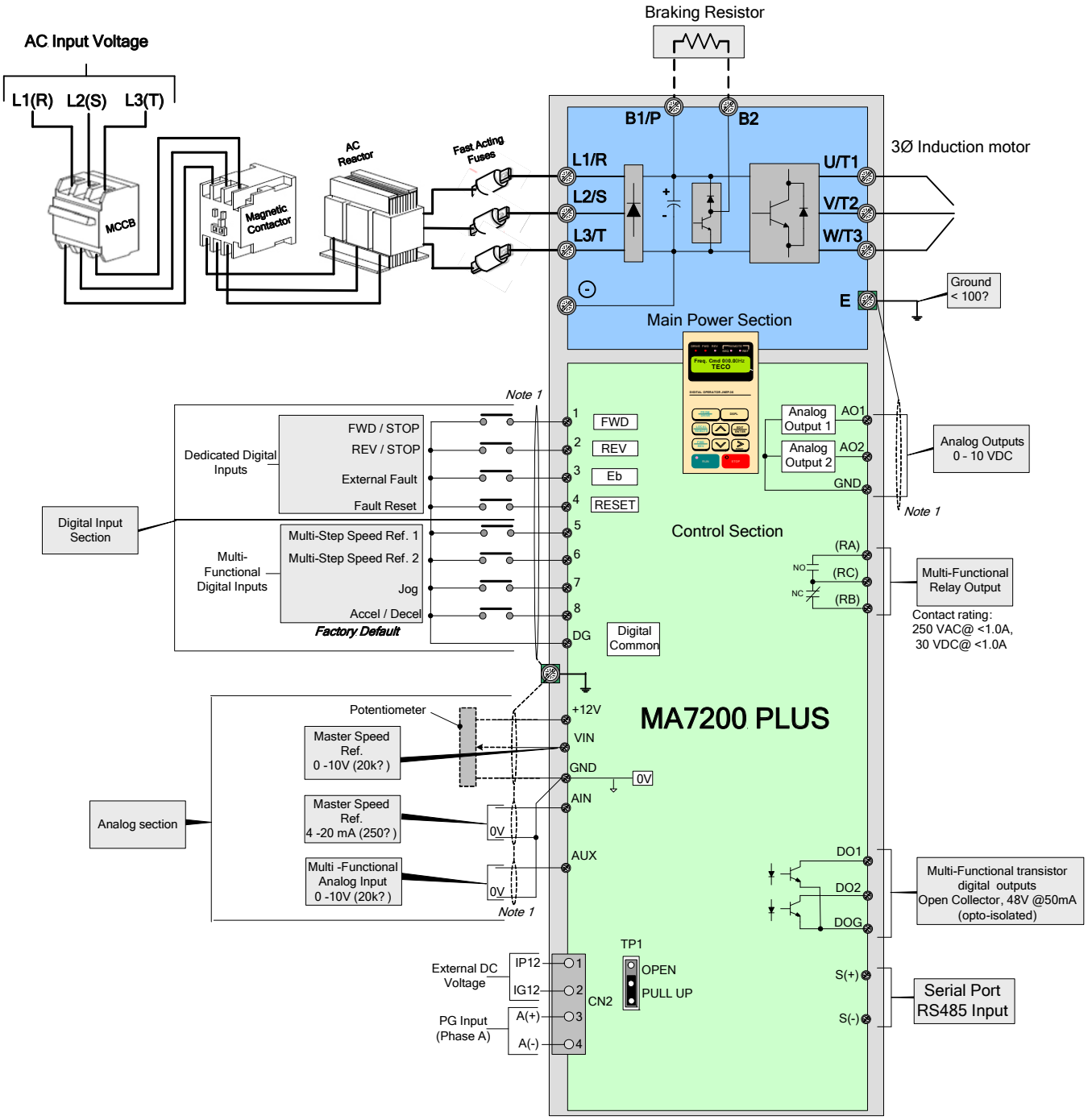
■ Mounting the front cover:
Place the front cover on the inverter housing and then secure with screws a, b, c and d.



2.0 General Wiring Diagrams

The general wiring diagram of the MA7200 PLUS is shown in Fig's. 2.1.1 and 2.1.2. There are three types of control boards, the first is shown in Fig. 2.1.1 and the other two in Fig. 2.1.2 along with the terminal arrangement.

Cont.



Terminal Layout ..... **(** Control Board code No.: 4H300D6730027)

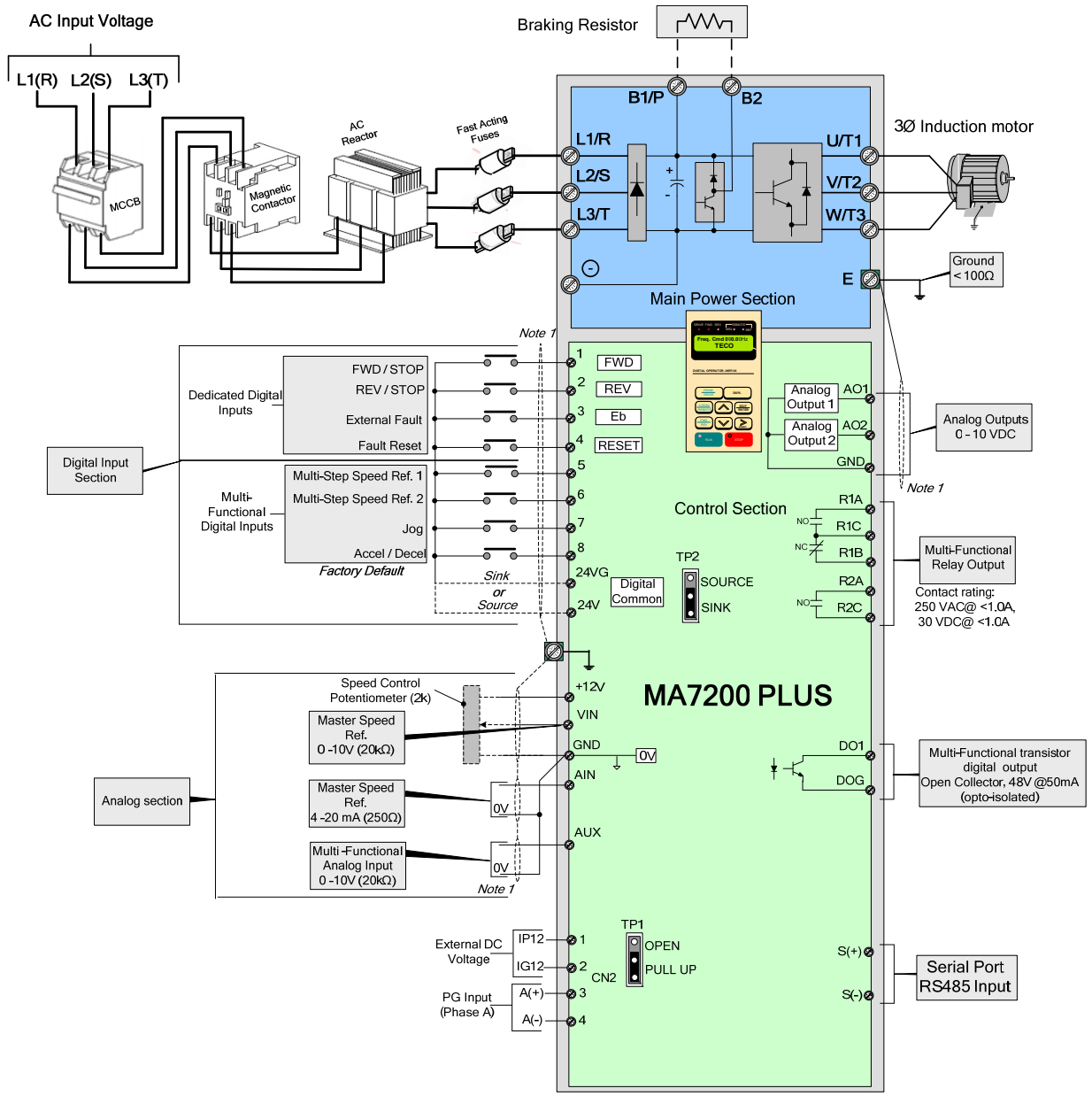
DG	1	3	5	7	VIN	AIN	AUX	DO1	DO2	DOG	S(-)
E	2	4	6	8	+12	GND	GND	AO1	AO2	S(-)	E

RA	RB	RC

NOTES:
1 - Use shielded wiring for digital inputs and analog outputs and shielded twisted pair for analog inputs
2 - Terminals A(+) and A(-) can be used as a pulse frequency input command, 50Hz - 32kHz, with an H of 3-12V. (Input resistance 27K).
In this case jumper TP1 must be set in the OPEN position. (CN2 connector wire code: 4H339D0250001)

Fig. 2.1.1 General Wiring Diagram

NEMA 1 - 230V: 1 - 2HP and 460V: 1 - 2HP (NEMA4 is the same)
(Models: MA7200-2001/2-N1 and MA7200-4001/2-N1)



Terminal Layout (Control Board code No.: 4H300D6740022 230V: 3 - 25HP and 460V: 3 - 30HP)
(Control Board code No.: 4H300D6750028 230V: 30 - 40HP and 460V: 30 - 75HP)
(Control Board code No.: 4LA41X258S01 575V: 1 - 10HP)

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

R2A	R2C	R1A	R1B	R1C

NOTES:
1 - Use shielded wiring for digital inputs and analog outputs and shielded twisted pair for analog inputs
2 - Digital inputs 1 - 8 can be set for SINK (0V Common) or Source (+24V common by setting the jumper TP2.
3 - Terminals A(+) and A(-) can be used as a pulse frequency input command, 50Hz - 32kHz, with an H of 3-12V. (Input resistance 27K).
In this case jumper TP1 must be set in the OPEN position.

Fig. 2.1.2 General Wiring Diagram

NEMA 1 - 230V: 3 – 40HP, 460V: 3- 75HP (NEMA4 up to 20HP) and 575: 1-10HP
(230V Models: MA7200-2003 thru MA7200-2040-N1), (460 Models: MA7200-4003-N1 thru MA7200-4075-N1) and (575V Models: MA7200-5001-N1 thru MA7200-5010-N1)

5.0 Power Section Terminal Layout, Wiring and Ratings

5.1 Power Terminals

The following Fig. 3.1.1 and Table 3.1.1 shows the power terminal layout and description for the complete horsepower range.

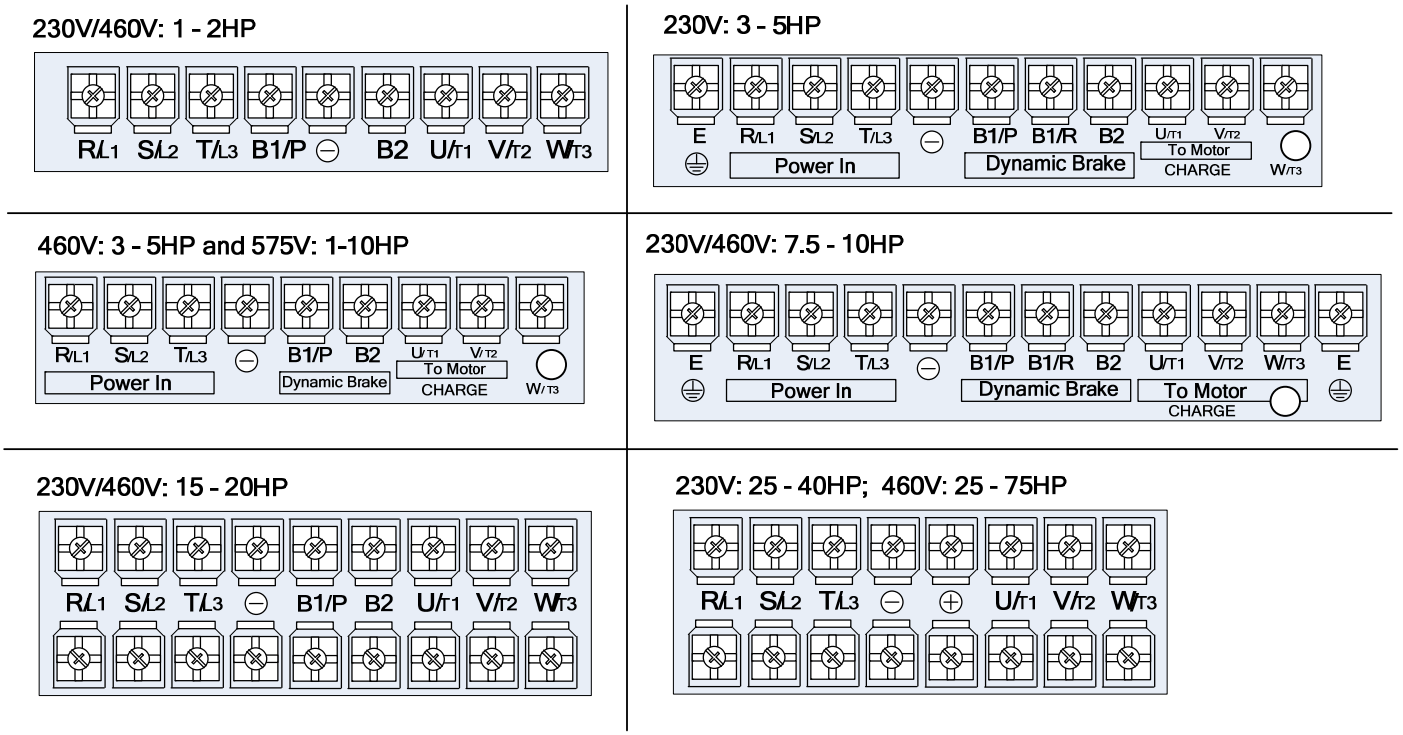


Fig. 3.1.1 Power Terminal Layout

Table 3.1.1 Power Terminal Designations

Terminal	230V: 1 - 20HP; 460V: 1 - 20HP 575V: 1 - 10 HP	230V: 25 - 40HP; 460V: 25 - 75HP
R/L1	Input Power Supply (For single phase use terminals R/L1 and S/L2)	
S/L2		
T/L3		
B1/P	B1/P, B2: External Braking Resistor	
B2	B1/P, ⊖: DC Power Supply Input	
⊖		⊕–⊖: DC Power Supply or Braking Unit
⊕		
B1/R		
U/T1	Inverter Output to 3Ø Induction Motor	
V/T2		
W/T3		
E	Ground (3rd type grounding)	

3.2 Power Input / Output Block Diagrams

The following Fig.3.2.1 A), B) and C) show the basic configuration of the power sections for the range of horsepower and input voltages. This is shown for reference only and is not a detailed depiction.

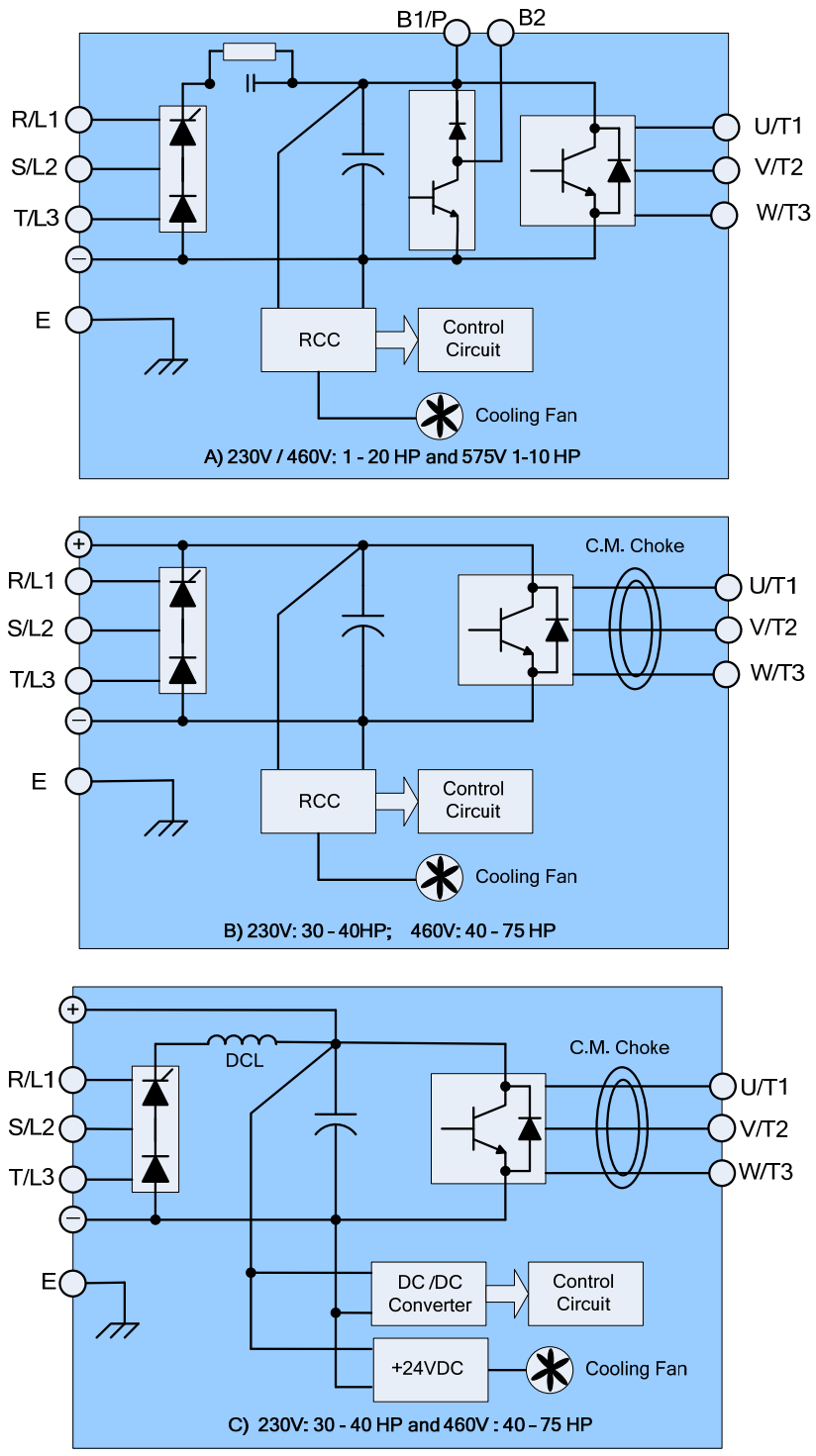


Fig.3.2.1 Power Input / Output Block Diagrams

3.3 Wiring Precautions

Danger	• Do Not remove any protective covers or attempt any wiring while input power is applied. Connect all wiring before applying input power. When making wiring changes after power up, remove input power and wait a minimum of five minutes after power has been turned off before starting. Also confirm that the charge lamp is off and that DC voltage between terminals B1/P or (+) and (-) does not exceed 25V, otherwise **electric shock may result.** • Only authorized personnel should work on the equipment. (Take off metal jewelry such as watches and rings and use insulated tools.), otherwise **electric shock or injury may result.**

(A) Power input terminals

1 - The Input power supply voltage can be connected in any phase sequence to power input terminals R/L1, S/L2, or T/L3 on the terminal block.

2 - DO NOT connect the AC input 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. If it does not, swap any 2 of the output cables to change motor direction.

5 - DO NOT connect phase correcting capacitors or LC/RC noise filter to the output circuit.

(B) Grounding

1 - Connect the ground terminal (E) to ground having a 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 local codes and standards for 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 in Fig. 3.4.

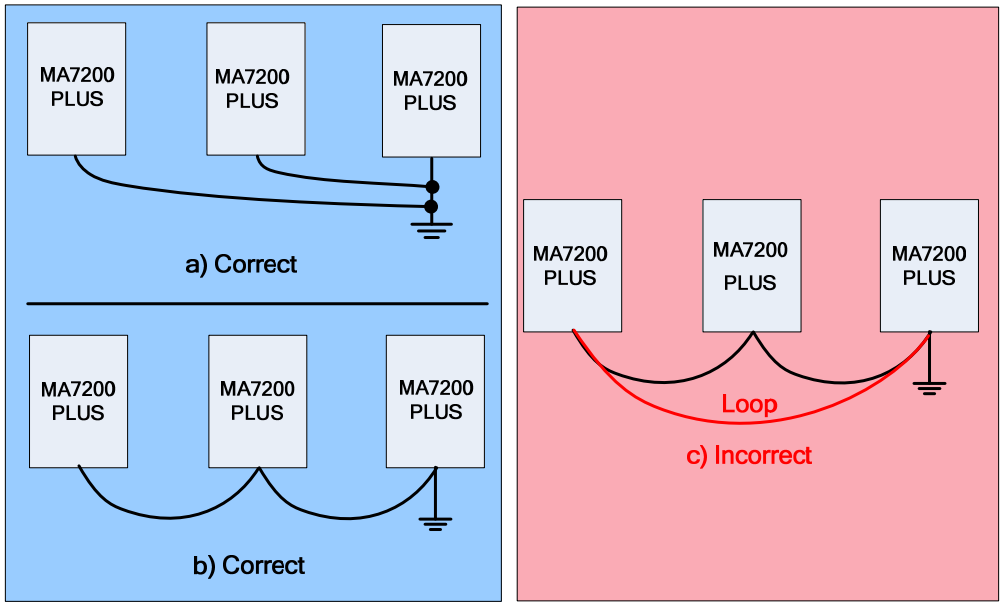


Fig. 3.3.1 Inverter Grounding

3.3.1 Input Power and Motor Cable Length

The length of the cables between the input power source and /or the motor and inverter can cause a significant phase to phase voltage reduction due to the voltage drop across the cables. The wire size shown in Tables 3.4.1a & b is based on a maximum voltage drop of 2%. If this value is exceeded, a wire size having larger diameter may be needed. To calculate phase tot phase voltage drop, apply the following formula:

Phase-to-phase voltage drop (V) = $\sqrt{3}$ ×resistance of wire (Ω/km) × length of line m) × current×10^{-3}.
(km=3280 x feet) (km=3.28 x feet)

3.3.2 Cable Length vs. Carrier Frequency

The allowable setting of the PWM carrier frequency is also determined by motor cable length and is specified in the following Table 3.3.2.1.

Table 3.3.2.1 Cable Length vs. Carrier Frequency

Cable length between the inverter and motor Ft.	< 100	100/165	166 / 138	≥ 329
Recommended carrier frequency allowed	15KHz max.	10KHz max.	5KHz max.	2.5KHz max.
Setting of parameter Cn-34	6	4	2	1

3.3.3 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.

NOTES-

3.4 Power Input Wire Size, NFB and MCB Part Numbers

A non-fusible-breaker (NFB) should be installed between the AC source and the R/L1-S/L2-T/L3 input terminals of MA7200 PLUS inverter. Depending on the application an optional electromagnetic contactor (MCB) may be installed. To protect against nuisance trips, a ground fault detector should have sensitivity of >200mA and operation time>0.1 sec. The following Tables 3.4.1a (NEMA 1) and 3.4.1b (NEMA 4) show the ratings and part numbers for the various horsepower.

Cont.

Table 3.4.1a NEMA 1 Wire Size, NFB & MCB Part Numbers vs. HP

MA7200 PLUS HP				Wire Size AWG / (mm^2) *4		Terminal Size MC / G	Tightening Torque In. / lbs MC / G	NFB *3	MCB *3
Input Power	HP *1	Rated KVA	Rated Current (A)	Main Circuit *2	Ground Connecting Wire E (G)				
230V 1 Ø／3 Ø	1	2	4.8	#14 - #10 / 2 - 5.5	#14 - #10 / 2 - 5.5	M4/M4	10/10	TO-50EC(15A)	CN-11
	2	2.7	6.4		#12 - #10 / 3.5 - 5.5			TO-50EC(20A)	CN-11
	3	4	9.6	#12 - #10/ 3.5 - 5.5				TO-50EC(20A)	CN-11
230V 3 Ø	5	7.5	17.5	#10 / 5.5	#10 / 5.5			TO-50EC(30A)	CN-16
	7.5	10.1	24	#8 / 8	5.5 - 8			TO-100S(50A)	CN-18
	10	13.7	32					TO-100S(60A)	CN-25
	15	20.6	48	#6 / 14	#8 / 8	M6/M6	30/35	TO-100S(100A)	CN-50
	20	27.4	64	#4 / 22				TO-100S(100A)	CN-65
	25	34	80		#6 / 14		35/35	TO-225S(150A)	CN-80
	30	41	96	#1 / 38		M8/M10	78/156	TO-225S(175A)	CN-100
	40	54	130	#00 / 60	#4 / 22			TO-225S(175A)	CN-125
460V 3 Ø	1	2.2	2.6	#14 - #10 / 2 - 5.5	#14 - #10 / 2 - 5.5	M4/M4	10/10	TO-50EC(15A)	CN-11
	2	3.4	4		#12 - #10 / 3.5 - 5.5			TO-50EC(15A)	CN-11
	3	4.1	4.8					TO-50EC(15A)	CN-11
	5	7.5	8.7					TO-50EC(15A)	CN-18
	7.5	10.3	12	#12 - #10 / 3.5 - 5.5	#12 - #10 / 3.5 - 5.5			TO-50EC(20A)	CN-18
	10	12.3	15	#10 / 5.5	#10 / 5.5			TO-50EC(30A)	CN-25
	15	20.6	24	#8 / 8	#8 / 8	M6/M6	15/35	TO-50EC(30A)	CN-25
	20	27.4	32					TO-100S(50A)	CN-35
	25	34	40				35/35	TO-100S(75A)	CN-50
	30	41	48	#6 / 14				TO-100S(100A)	CN-50
	40	54	64	#4 / 22		M8/M10	78/156	TO-100S(100A)	CN-65
	50	68	80		#6 / 14			TO-125S(125A)	CN-80
	60	82	96	#1 / 38				TO-225S(175A)	CN-100
	75	110	128	#00 / 60	#4 / 22			TO-225S(175A)	CN-125
575V 3 Ø	1	1.7	1.7	#14 - #10 / 2 - 5.5	#14 - #10 / 2 - 5.5	M4/M4	10/10	TO-50EC(15A)	CN-11
	2	3.0	3.0		#12 - #10 / 3.5 - 5.5			TO-50EC(15A)	CN-11
	3	4.2	4.2					TO-50EC(15A)	CN-11
	5	6.6	6.6					TO-50EC(15A)	CN-18
	7.5	9.9	9.9	#12 - #10 / 3.5 - 5.5				TO-50EC(15A)	CN-18
	10	12.2	12.2					TO-50EC(20A)	CN-18

*1 - Constant torque load.

*2 - The main circuit includes terminals (R/L1, S/L2, T/L3, U/T1, V/T2, W/T3, B1/P, B2/R, B2,Θ). If the length of the input power cable results in a voltage drop > 2%, a wire size with a larger diameter may be necessary. To calculate this reduction, apply the following formula:

Phase-to-phase voltage drop (V) = $\sqrt{3}$ ×resistance of wire (Ω/km) × length of line m) × current×10^{-3}.

*3 - In Table 3.4.1a, the specified NFB and MCB are TECO Part No's. Similar products with equivalent ratings from other sources may be used. To decrease noise interference, add a R-C surge suppressor having a rating of (R:10Ω / 5W, C: 0.1uF / 1000VDC) at the terminals of the coils of the electromagnetic contactor.

*4 - Use 140 / 167°F (60 / 75°C) copper wire only).

Table 3.4.1b NEMA 4 Wire Size, NFB & MCB Part Numbers vs. HP

MA7200 PLUS HP				Wire Size AWG / (mm^2) *4		Terminal Size MC / G	Tightening Torque In. / lbs MC / G	NFB *3	MCB *3
Input Power	HP *1	Rated KVA	Rated Current (A)	Main Circuit *2	Ground Connecting Wire E (G)				
230V 1 Ø／ 3 Ø	1	2	4.8	#14 - #10 / 2 - 5.5	#14 - #10 / 2 - 5.5	M4/M4	10/10	TO-50EC(15A)	CN-11
	2	2.7	6.4		#12 - #10 / 3.5 - 5.5			TO-50EC(20A)	CN-11
	3	4	9.6	#12 - #10/ 3.5 - 5.5				TO-50EC(20A)	CN-11
230V 3 Ø	5	7.5	17.5		#10 / 5.5			TO-50EC(30A)	CN-16
	7.5	10.1	24	#8 / 8	#10 - #8 / 5.5 - 8			TO-100S(50A)	CN-18
	10	13.7	32					TO-100S(60A)	CN-25
	15	20.6	48	#4 / 22	#8 / 8	M6/M6	35/35	TO-100S(100A)	CN-50
	20	27.4	64	#2 / 35				TO-100S(100A)	CN-65
460V 3 Ø	1	2.2	2.6	#14 - #10 / 2 - 5.5	#14 - #10 / 2 - 5.5	M4/M4	10/10	TO-50EC(15A)	CN-11
	2	3.4	4					TO-50EC(15A)	CN-11
	3	4.1	4.8					TO-50EC(15A)	CN-11
	5	7.5	8.7		#12 - #10 / 3.5 - 5.5			TO-50EC(15A)	CN-18
	7.5	10.3	12	#12 - #10 / 3.5 - 5.5	#12 - #10 / 3.5 - 5.5			TO-50EC(20A)	CN-18
	10	12.3	15	#10 / 5.5	#10 / 5.5			TO-50EC(30A)	CN-25
	15	20.6	24	#12 - #10 / 3.5 - 5.5	#12 - #10 / 3.5 - 5.5	M6/M6	35/35	TO-50EC(30A)	CN-25
	20	27.4	32	#10 / 5.5	#10 / 5.5			TO-100S(50A)	CN-35

*1 - Constant torque load.

*2 - The main circuit includes terminals (R/L1, S/L2, T/L3, U/T1, V/T2, W/T3, B1/P, B2/R, B2 and Θ).
If the length of the input power cable results in a voltage drop > 2%, a wire size with a larger diameter may be necessary. To calculate this reduction, apply the following formula:

Phase-to-phase voltage drop (V) = $\sqrt{3}$ ×resistance of wire (Ω/km) × length of line m) × current×10^{-3}.

*3 - In Table 3.4.1b, the specified NFB and MCB are TECO Part No's. Similar products with equivalent ratings from other sources may be used. To decrease noise interference, add a R-C surge suppressor having a rating of (R:10Ω / 5W, C: 0.1uF / 1000VDC) at the terminals of the coils of the electromagnetic contactor.

*4 - Use 140 / 167°F (60 / 75°C) copper wire only).

3.6 Notes for Circuit Protection and Environmental Ratings

- **Circuit Protection**
  The MA7200 PLUS is suitable for use in a circuit capable of delivering *not* more than the RMS value symmetrical amperes and V maximum shown in the following table 3.5.1.

Table 3.5.1 Circuit Protection Ratings

Device Rating		Short Circuit Rating (A)	Maximum Voltage (V)
Voltage	HP		
230V	1.5 - 50	5,000	240V
	51 - 100	10,000	
460V	1.5 - 50	5,000	480V
	51 - 200	10,000	

- **Environmental Ratings**
  The MA7200 is intended for use in pollution degree 2 environments.

3.8 Electrical Ratings for Constant Torque and Quadratic Torque

The following table 3.6.1a shows the electrical ratings for constant and quadratic torque.

Table 3.6.1a Electrical Ratings for Constant Torque and Quadratic Torque

MA7200 Model PLUS	Constant Torque (150%, 1minute)			Quadratic Torque (110%, 1minute)		
	Max. Appl. Motor Output HP (kW)	Rated Output Current (A)	Max. Switching Frequency (kHz)	Max. Appl. Motor Output HP (kW)	Rated Output Current (A)	Max. Switching Frequency (kHz)
MA7200-2001-N1	1 (0.75)	4.8 A	15	1 (0.75)	5.6 A	10
MA7200-2002-N1	2 (1.5)	6.4 A	15	2 (1.5)	7.6 A	5
MA7200-2003-N1	3 (2.2)	9.6 A	15	3 (2.2)	9.8 A	15
MA7200-2005-N1	5.4 (4)	17.5 A	15	7.5 (5.5)	22.7 A	5
MA7200-2007-N1	7.5 (5.5)	24 A	15	10 (7.5)	32 A	10
MA7200-2010-N1	10 (7.5)	32 A	15	10 (7.5)	32 A	15
MA7200-2015-N1	15 (11)	48 A	10	20 (15)	56.7 A	5
MA7200-2020-N1	20 (15)	64 A	10	25 (18.5)	70.9 A	5
MA7200-2025-N1	25 (18.5)	80 A	10	25 (18.5)	80 A	10
MA7200-2030-N1	30 (22)	96 A	10	40 (30)	108 A	5
MA7200-2040-N1	40 (30)	130 A	10	40 (30)	130 A	10
MA7200-4001-N1	1 (0.75)	2.6 A	15	1 (0.75)	2.9 A	5
MA7200-4002-N1	2 (1.5)	4 A	15	2 (1.5)	4.6 A	5
MA7200-4003-N1	3 (2.2)	4.8 A	15	3 (2.2)	4.9 A	15
MA7200-4005-N1	5.4 (4)	8.7 A	15	7.5 (5.5)	12.5 A	5
MA7200-4007-N1	7.5 (5.5)	12 A	15	10 (7.5)	15.4 A	10
MA7200-4010-N1	10 (7.5)	15 A	15	15 (11)	22.7 A	5
MA7200-4015-N1	15 (11)	24 A	10	20 (15)	30.3 A	5
MA7200-4020-N1	20 (15)	32 A	10	25 (18.5)	38 A	5
MA7200-4025-N1	25 (18.5)	40 A	10	30 (22)	44 A	5
MA7200-4030-N1	30 (22)	48 A	10	30 (22)	48 A	10
MA7200-4040-N1	40 (30)	64 A	10	50 (37)	71 A	5
MA7200-4050-N1	50 (37)	80 A	10	50 (37)	80 A	10
MA7200-4060-N1	60 (45)	96 A	10	75 (55)	108 A	5
MA7200-4075-N1	75 (55)	128 A	10	100 (75)	140 A	5
MA7200-5001-N1	1 (0.75)	1.7 A	10	*		
MA7200-5002-N1	2 (1.5)	3.0 A	10			
MA7200-5003-N1	3 (2.2)	4.2 A	10			
MA7200-5005-N1	5.4 (4)	6.6 A	10			
MA7200-5007-N1	7.5 (5.5)	9.9 A	10			
MA7200-5010-N1	10 (7.5)	12.2 A	10			

The above ratings are based on the following conditions shown in table 3.6b.

Cont.

Table 3.6.1b Conditions for Ratings in Table 3.6.1a

Item	Conditions	
	Constant Torque	Quadratic Torque
Output Overload	150% for 60s	110% for 60s
Operation Ambient Temperature	+14 - 104°F	+14 - 104°F
Allowable Voltage Fluctuation	-15% - +10%	-15% - +10%
Output Frequency	0.5Hz - 400Hz	0.5Hz - 400Hz
V/F curve	Dependent on parameter setting	Quadratic (or Cubic) Torque

3.9 Inverter Heat Loss

The following tables 3.7.1a, 3.7.1b and 3.7.1c show the heatsink, internal and total heat loss in watts for each inverters kVA and rated current.

Table 3.7.1a Inverter Heat Loss (200 – 230V)

Model MA7200- XXXX-N1		2001	2002	2003	2005	2007	2010	2015	2020	2025	2030	2040
Inverter Capacity kVA		2	2.7	4	7.5	10.1	13.7	20.6	27.4	34	41	54
Rated Current A		4.8	6.4	9.6	17.5	24	32	48	64	80	96	130
Heat Loss W	Heatsink	11	13	30	40	66	77	86	121	145	246	335
	Internal	65	77	185	248	409	474	529	742	889	1510	2059
	Total Heat Loss	76	90	215	288	475	551	615	863	1034	1756	2394

Table 3.7.1b Inverter Heat Loss (380 – 460V)

Model MA7200- XXXX-N1		4001	4002	4003	4005	4007	4010	4015	4020	4025	4030	4040	4050	4060	4075
Inverter Capacity kVA		2.2	3.4	4.1	7.5	10.3	12.3	20.6	27.4	34	41	54	68	82	110
Rated Current A		2.6	4	4.8	8.7	12	15	24	32	40	48	64	80	96	128
Heat Loss W	Heatsink	16	21	41	45	64	72	126	157	198	236	262	324	369	481
	Internal	99	129	249	278	393	442	772	965	1218	1449	1608	1993	2270	2957
	Total Heat Loss	115	150	290	323	457	514	898	1122	1416	1685	1870	2317	2639	3438

Table 3.7.1c Inverter Heat Loss (575V)

Model MA7200- XXXX-N1		5001	5002	5003	5005	5007	5010
Inverter Capacity kVA		1.7	3.0	4.2	6.6	9.9	12.2
Rated Current A		1.7	3.0	4.2	6.6	9.9	12.2
Heat Loss W	Heatsink	?	?	?	?	?	?
	Internal	?	?	?	?	?	?
	Total Heat Loss	?	?	?	?	?	?

4.0 Control Terminals Designations and Wiring

There are three different control boards that are used with the MA7200 PLUS. Each one is used with a specific horsepower range which is covered in the following explanations and in Fig. 2.1.1 and Fig. 2.1.2 in Section 2.

4.1 Control Terminals Layout

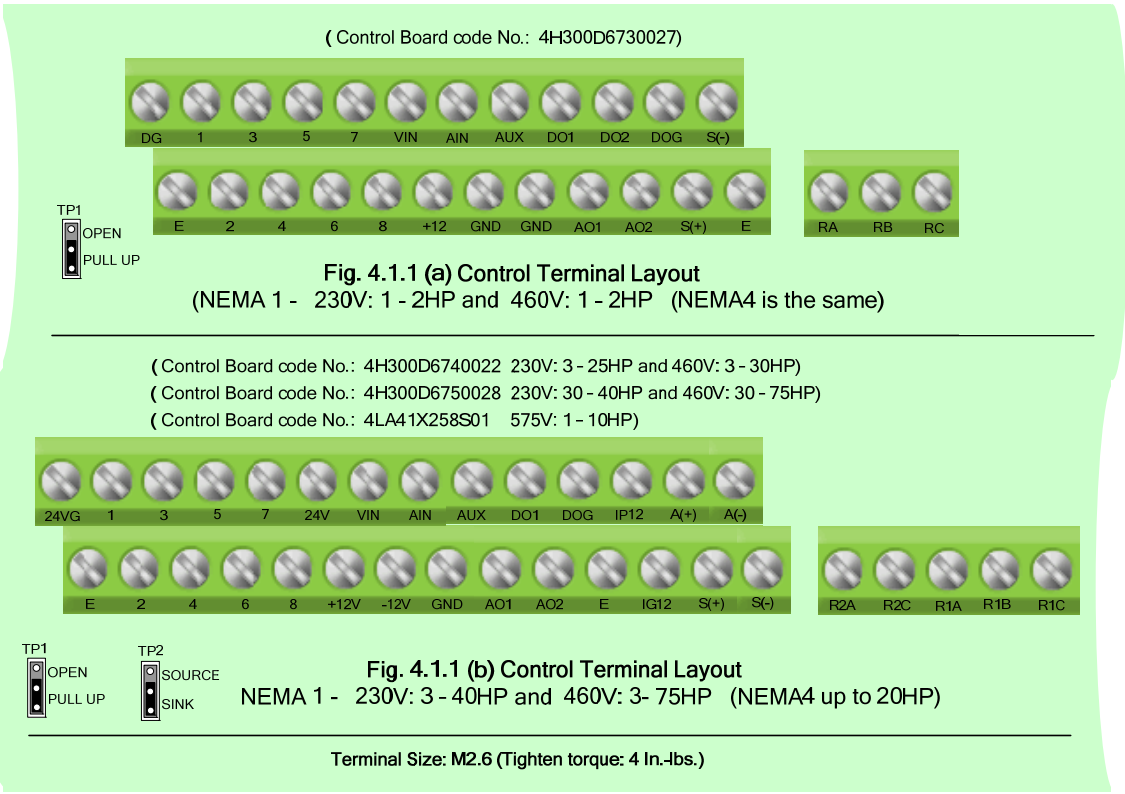


Fig. 4.1.1 MA7200 PLUS Control Board Terminal Layout

4.2 Control Circuit Wiring

(1) Separate the wiring for control circuit terminals RA-RB-RC (R1A-R2B-R2C) (Relay outputs) from wiring for terminals ① - ⑧, A01, A02, GND, DO1, DO2, DOG 24V (or +12V, -12V), VIN, AIN, AUX, GND, IP12, IG12, A (+), A (-), S (+) and S (-).

(2) Use shielded twisted-pair cables (#24 - #14 AWG / 0.5 -2 mm^2) shown in Fig. 4.2.1 for control circuits to minimize noise problems. The maximum wiring distance should not exceed 165 Ft. (50 m).

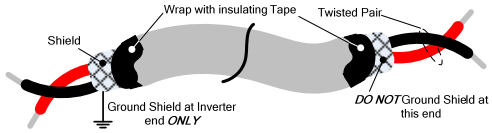


Fig. 4.2.1 Shielded Twisted-Pair

(3) When the digital multi-function output terminals (DO1, DO2) are connected to an external relay, a freewheeling diode should be connected across the relay coil to prevent an inductive voltage spike from damaging the output circuitry as shown in Fig. 4.2.2 below.

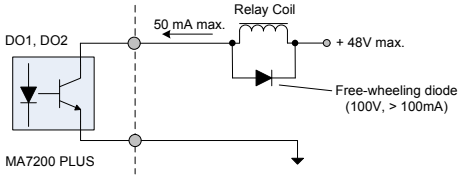


Fig. 4.2.2 Opto-Coupler Connected to an External Relay *Cont.*

(4) In Fig. 4.1.1b the control boards referenced have a jumper TP2 that can select the digital input to terminals ① - ⑧ to be set for SINK or SOURCE. The following Fig. 4.2.3 (a.) – (d.) show examples for the various SINK / Source interfaces.

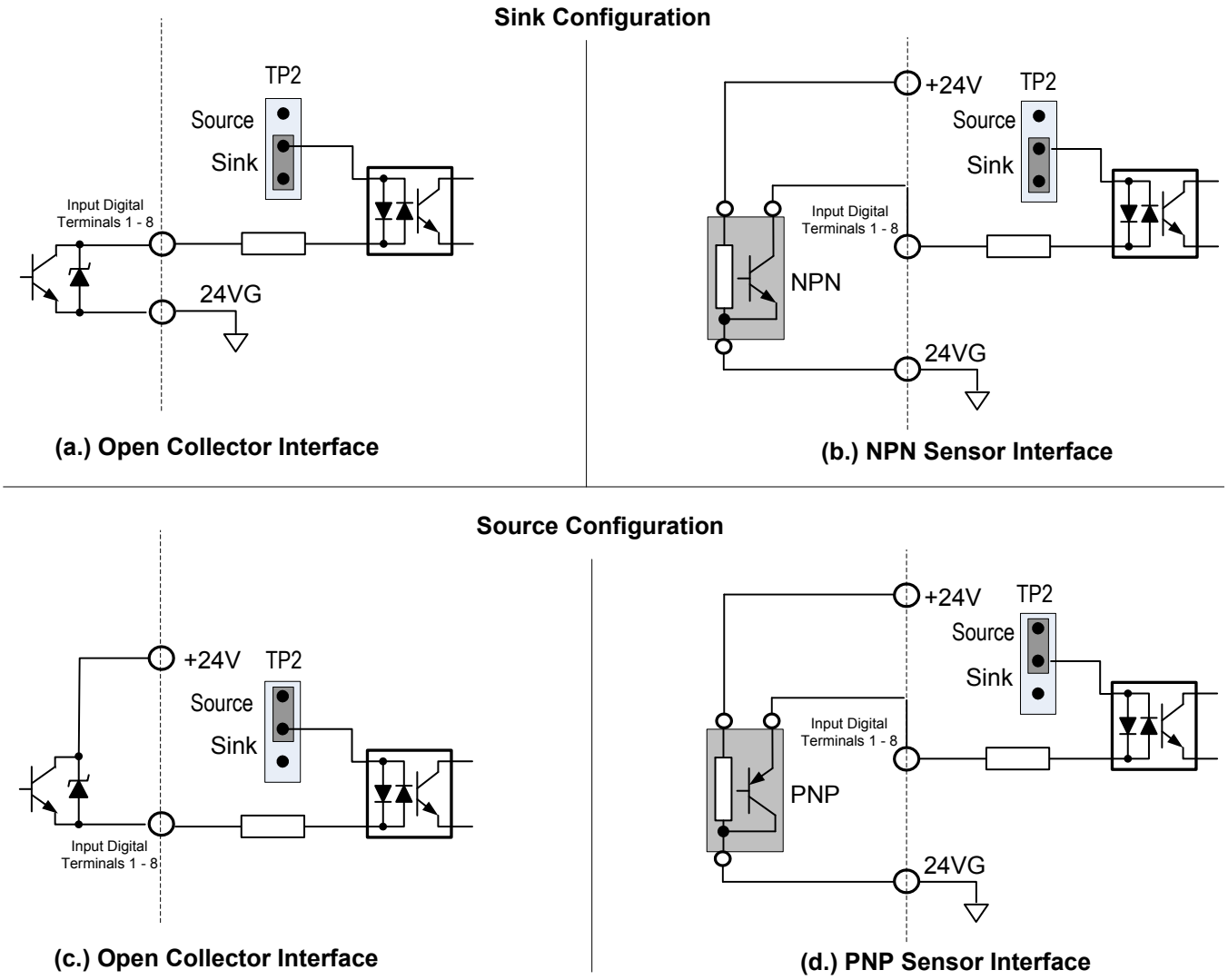


Fig. 4.2.3 Sink / Source Configurations

(5) The MA7200 PLUS inverter has a built-in PG (Encoder) interface and no external PG feedback option card is required. An external DC source of +12V is required to provide power to the PG.

The following Fig.4.2.4 shows the wiring required for the PG interface.

Cont.

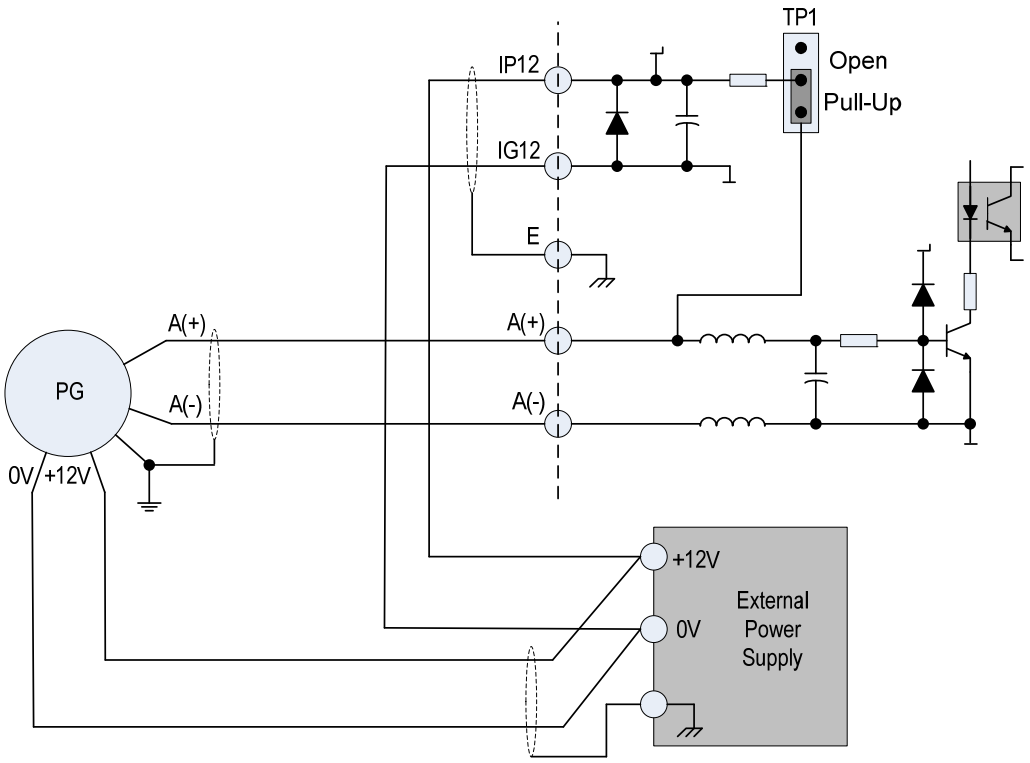


Fig. 4.2.4 PG Interface Wiring

Notes:
1 - Use twisted pair shielded cable and connect the shields to ground as shown.
2 - Terminal description:

Terminal	Description
A(+)	PG signal input terminal. Voltage level (H: 4 -12V, L: ≤1V). Max. frequency is < 32767 Hz
A(-)	
IP12	External power source input (+12V± 10%@ 40mA max.)
IG12	
+12V	External Power source (+12V± 10%, @ 0.5A min.)
0V	
E	Inverter ground.

3 - The A(+), A(-), IP12 and IG12 terminals are integrated in connector CN2 in compact version. (See Fig. 2.1.1). The code No. for the wiring is 4H339D0250001.
4 - The PG interface only supports an open-collector or complementary interface.
5 - The jumper TP1 is set to the PULL UP position for an open-collector interface (factory setting) and to the OPEN position for a complementary interface.
6 - The shielded twisted-pair cable used between the inverter and the PG should be less than 150 feet in length.
7 - Refer to the parameters in Section 9.0 for the settings used in the PG set-up.

Cont.

(6) The MA7200 PLUS inverter terminals S(+) and S(-) provide a serial communication RS485 interface with a MODBUS protocol. PROFIBUS protocol for communication is possible with an optional PROFIBUS Communication Card (MA-SP).

A. MODBUS Communication Protocol

The following Fig. 4.2.5 shows the wiring interface for the MODBUS protocol.

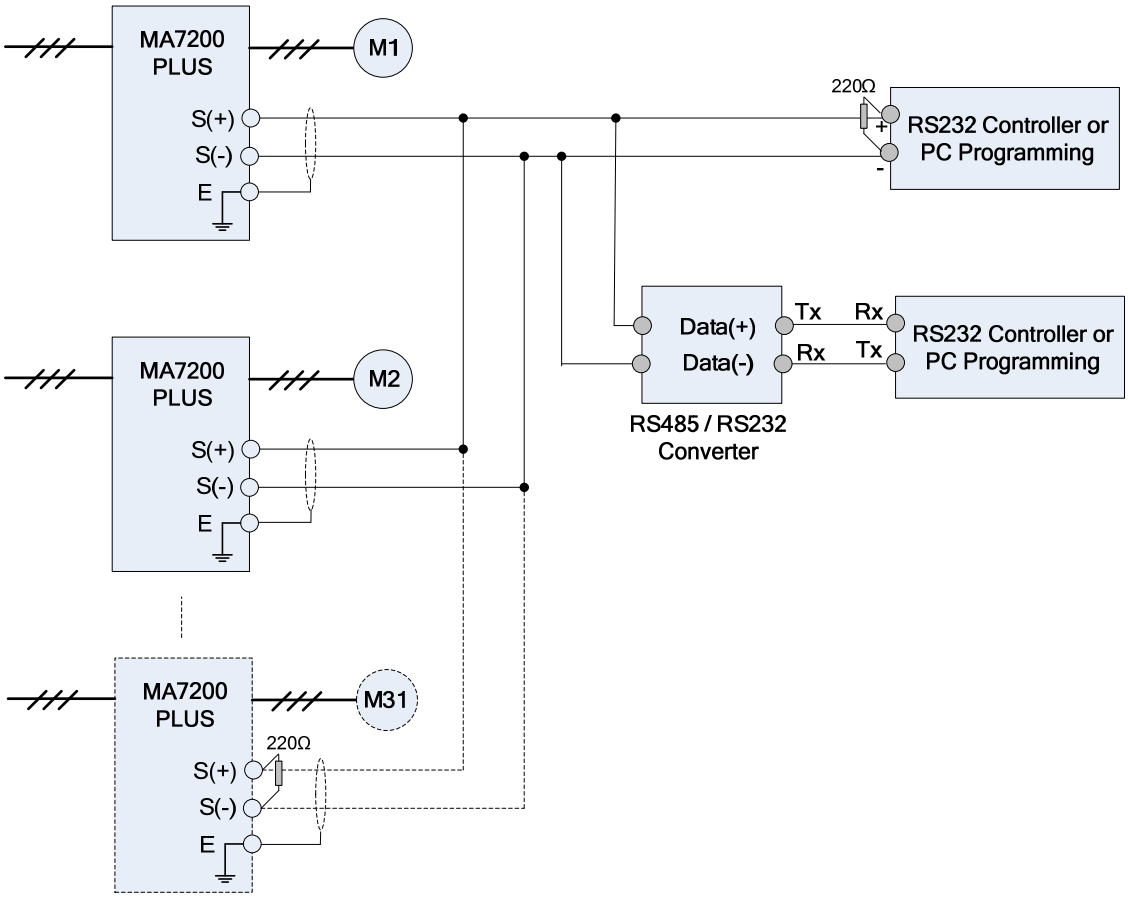


Fig. 4.2.5 MODBUS Interface Wiring

Notes:

1. A Host Controller with an RS485 interface can communicate with the MA7200 PLUS directly. If the Host Controller does not have an RS485 port but does have an RS-232 port (such as PC programming), an RS485 / RS232 converter can be used to connect between the Host Controller and the MA7200 PLUS as shown in Fig. 4.2.5.
2. A MODBUS Host Controller can network up to 31 inverters using the MODBUS communication standard. The last MA7200 PLUS inverter at the end of the network must have a 220Ω terminating resistor.
3. Please refer to “MA7200 RS485 MODBUS Communication Application Manual”.

B. PROFIBUS Communication Protocol

The MA7200 PLUS does not support the PROFIBUS protocol directly. An optional MA-SP PROFIBUS Communication Card is available and can be placed at the control board. An external customer supplied 24V DC Power Supply is needed for all MA-SP option cards. The following Fig. 4.2.6 shows the wiring interface for the PROFIBUS protocol.

Cont.

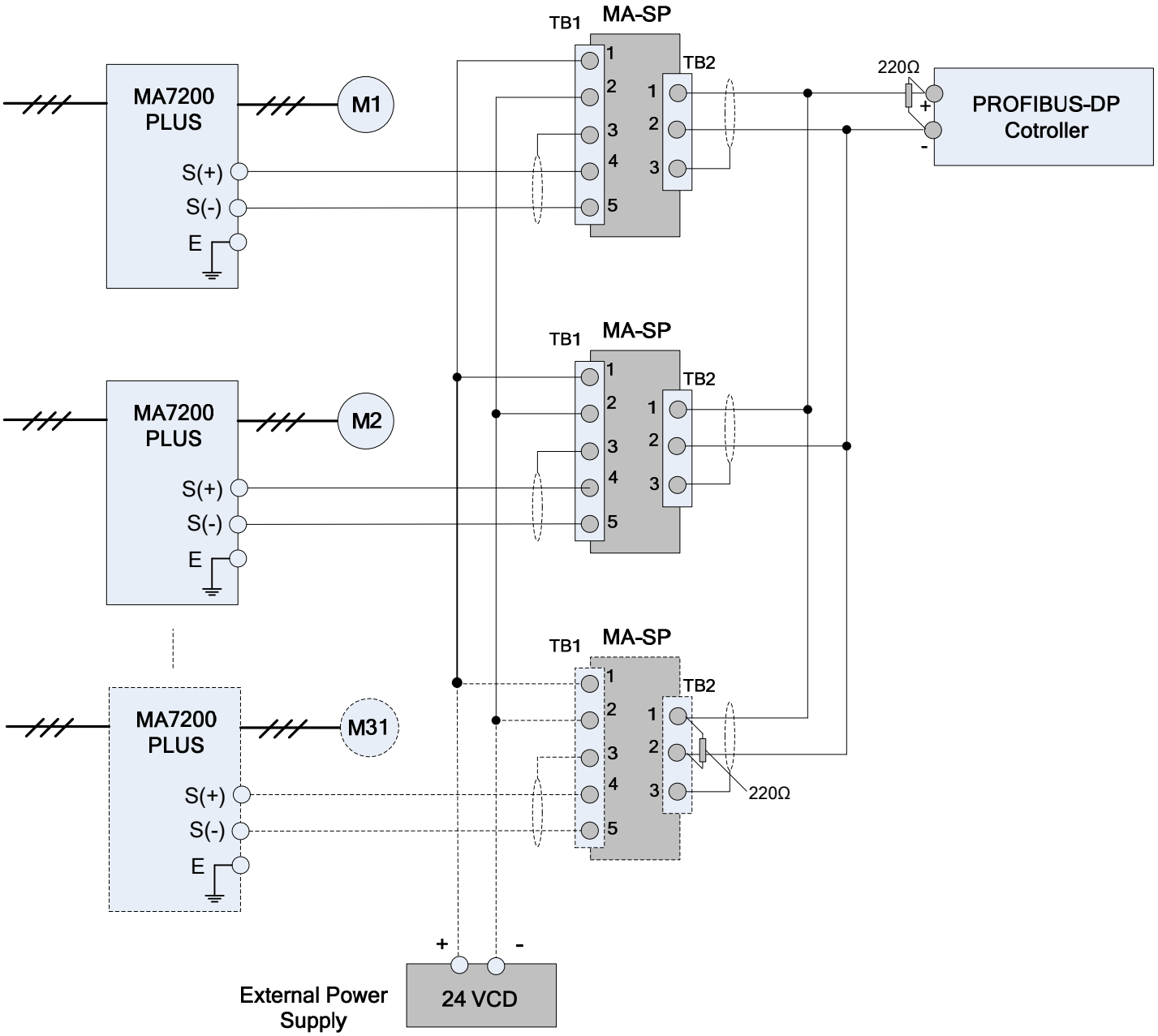


Fig. 4.2.6 PROFIBUS-DP Interface Wiring

Notes:

1. MA-SP Part Number: 4H300D0290009
2. Each station (Node) requires the use of the optional MA-SP interface card. Each card requires a power input of 24VDC @ 0.1A, so the external power supply needs to be sized accordingly.
3. A maximum of 31 PROFIBUS-DP stations (nodes) may be contained within a single network segment. The last MA-SP interface card on the drive at the end of the network, must have a 220Ω resistor between terminals 1 and 2.
4. For more details, refer to the “MA7200 PROFIBUS-DP Communication Application Manual”.

Table 4.2.1 Control Circuit Terminal Functions

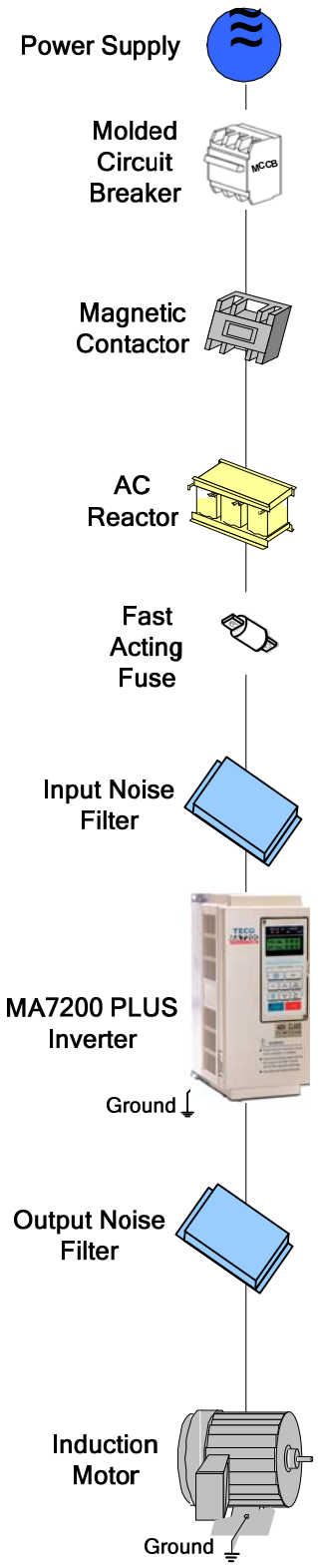
Terminal	Functions
1 (DI1)	Forward Operation – Stop Signal
2 (DI2)	Reverse Operation – Stop Signal
3 (DI3)	External Fault Input
4 (DI4)	Fault Reset
5 (DI5)	Multifunction Input Terminals: 3-Wire operation, Local / Remote control, Multi-Speed select, FWD / REV select, ACC / DEC select, ACC / DEC inhibit, Halting, Base Block, Overheat warning, PID control, DC braking, Speed search, Up / Down function, PG feedback control, External fault, Timer function, Multifunction analog Input setting. (See Parameter Section for details)
6 (DI6)	
7 (DI7)	
8 (DI8)	
DG (SC)	Digital signal ground (**230V: 1 - 2HP and 460V: 1 - 2HP models *Only)***
(24VG)	Sink Common Point (Set Jumper TP2 to **SINK** position) **(230V: 3 - 40HP and 460V: 3 - 75HP models *Only)***
24V	Source Common Point (Set jumper TP2 to **SOURCE** position) **(230V: 3 - 40HP and 460V: 3 - 75HP models *Only)***
E	Connection for signal shield lead (Chassis Ground)
+12V	DC voltage for External Device
-12V	Only supported in the **(230V: 3 - 40HP, 460V: 3 - 75HP and 575V: 1-10HPmodels *Only)***
VIN	Master speed Voltage Reference (0 - 10V) (Models above 2HP supports(–10V - 10V input)
AIN	Master speed Current Reference (4 - 20mA)
AUX	Auxiliary Analog Input: Auxiliary frequency command, Frequency gain, Frequency bias, Excess load detection, Output voltage bias, ACC / DEC ramp, DC-Brake current, Stall prevention current level during running, PID Control, Frequency command Lower-Bound, Frequency – Jump - 4, etc. (See Parameter Section for details)
GND	Analog Signal Common
IP12	External Power Source For PG Feedback (Set TP1 to PULL UP for external power source)
IG12	
A(+)	Signal Input from PG (Can also be used as the input terminals for a Pulse Input Frequency Command)
A(-)	
AO1	Analog Multifunction Output Port: Frequency command, Output frequency, Output current, Output voltage, DC voltage, PID controlled value, Analog command input of VIN, AIN or AUX.(Output current < 2mA) (See Parameter Section for details)
AO2	
GND	Analog Common
RA(R2A)	Relay Contacts, RA,RB and RC (**230V: 1 - 2HP and 460V: 1 - 2HP models *Only)***
RB(R2B)	Relay Contacts R2A, R2B and R2C **(230V: 3 - 40HP and 460V: 3 - 75HP models *Only)***
RC(R2C)	DO1Open Collector transistor **(All)**
R1B	DO2 Open Collector transistor (**230V: 1 - 2HP and 460V: 1 - 2HP models *Only)***
R1C	Functions:
DO1	During-Running, Zero-speed, Agree-frequency, Agree-frequency-setting, Frequency-output, Inverter-operation-ready, Undervoltage-detection, Base-block output, Run source, Frequency command, Excess load detection, Frequency command invalid, Fault, Undervoltage, Overheat, Motor overload, Inverter overload, During-retry, Communication-fault, Timer-function-output. (See Parameter Section for details)
DO2	
DOG	Common Terminal (Open collector transistor outputs)
S(+)	RS-485 Port
S(-)	

⚠ CAUTION

- Use the control circuit terminals VIN, AIN according the setting of parameterSn-24.
- The MAX. Output current at terminal (+24V or +12V) is 20mA.
- The multi-function analog output terminals AO1, AO2 are dedicated outputs to monitor frequency, amps, etc. Do not use these 2 analog outputs for feedback control or any other control purpose.

5.0 Peripheral Power Devices Overview

The following Fig. 5.0.1describes some of the precautions that should be followed when selecting peripheral power devices.



Power supply:

- ⚠ Make sure the correct voltage is applied to avoid damaging the inverter.

Molded-case circuit breaker (MCCB) or fused disconnect:

- A molded-case circuit breaker or fused disconnect must be installed between the AC source and the inverter that conforms to the rated voltage and current of the inverter to control the power and protect the inverter. (See Section 3.3)
- ⚠ Do not use the circuit breaker as the run/stop switch for the inverter.

Ground fault detector / breaker:

- ⚠ Install a ground fault breaker to prevent problems caused by current leakage and to protect personnel. Select current range up to 200mA, and action time up to 0.1 second to prevent high frequency failure.

Magnetic contactor:

- Normal operations do not need a magnetic contactor. When performing functions such as external control and auto restart after power failure, or when using a brake controller, install a magnetic contactor. (See Section 3.3)
- ⚠ Do not use the magnetic contactor as the run/stop switch for the inverter.

AC line reactor for power quality:

- When inverters are supplied by a high capacity (above 600KVA) power source, an AC reactor can be connected to improve the power factor. Refer to **Sec. 5.1**.

Install Fast Acting Fuse:

- To protect peripheral equipment, install fast acting fuses in accordance with the specifications in **Sec. 5.2**.

Input Noise filter:

When used with TECO specified Input Noise Filter, the MA7200 PLUS will comply with EN55011 class A regulation. Refer to **Sec. 5.3A.**

- A filter must be installed when there are inductive loads affecting the inverter.

Inverter:

- The input power supply can be connected to any terminal R/L1, S/L2, T/L3 on the terminal block. Connect output terminals T1, T2, and T3 are connected to U, V, and W terminals of the motor.
- Securely connect the ground terminal E to the site ground.

Output Noise filter:

Install an Output Noise Filter between the MA7200 PLUS and the Induction Motor to eliminate noise transmitted between the power line and the inverter. Refer to **Sec. 5.3B.**

Induction Motor:

- When multiple motors are driven in parallel with an inverter, the inverter rated current should be at least 1.1 times the total motor rated current.
- The inverter and the motor must be grounded separately.

Fig. 5.0.1 Peripheral Power Devices Overview

5.1 AC Input Reactor

An AC reactor can be added on the input power supply side if the inverter is connected to a much larger capacity power supply system (above 600KVA), or the inverter is within short distance (< 38.2 ft. (10m)) from the power supply system, or to increase the power factor on the power supply side.

Table 5.1.1 below shows the AC Reactor ratings, specifications, and the TECO part number for the various MA7200 PLUS horsepower ratings

Table 5.1.1 AC Reactor Ratings and Specifications

Inverter Ratings			AC reactor	
Voltage	**HP**	**Rated current**	**Part No.**	**Specification (mH/A)**
230V 1Φ / 3Φ	1	4.8A	3M200D1610021	2.1mH / 5A
	2	6.5A	3M200D1610030	1.1mH / 10A
	3	9.6A	3M200D1610048	0.71mH / 15A
230V 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
	25	80A	3M200D1610102	0.12mH / 90A
	30	96A	3M200D1610111	0.09mH / 120A
	40	130A	3M200D1610269	0.07mH / 160A
460V 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
	25	40A	3M200D1610218	0.42mH / 50A
	30	48A	3M200D1610226	0.36mH / 60A
	40	64A	3M200D1610234	0.26mH / 80A
	50	80A	3M200D1610242	0.24mH / 90A
	60	96A	3M200D1610251	0.18mH / 120A
	75	128A	3M200D1610315	0.15mH / 150A
575V 3Φ	1	1.7A	?	13.5mH / 3A
	2	3.0A	?	7.6mH / 5A
	3	4.2A	?	5.4mH / 7.5A
	5	6.6A	?	3.5mH / 10A
	7.5	9.9A	?	2.3mH / 15A
	10	12.2A	?	1.9mH / 15A

Note: The AC reactors are applied only to input side of the inverter. **Do not** apply to the output side.

5.2 Input Fuse Types and Ratings

The following Table 5.2.1 shows the fuse types and rating for the various voltage classes and horsepower.

Table 5.2.1 Input Fuse Types and Ratings

230V Class

Fuse Part Number	HP	KVA	100% Cont. Output AMPS	Rated Input AMPS	3Φ Fuse Rating	1Φ Fuse Rating
JNTMBG□□0001JK	1	2	4.8	6	12	15
JNTMBG□□0002JK	2	2.7	6.4	8	15	20
JNTMBG□□0003JK	3	4	9.6	12	20	25
JNTMBG□□0005JK	5	7.5	17.5	21	30	x
JNTMBG□□7R50JK	7.5	10.1	24	29	50	x
JNTMBG□□0010JK	10	13.7	32	38	60	x
JNTMBG□□0015JK	15	20.6	48	58	100	x
JNTMBG□□0020JK	20	27.4	64	77	125	x
JNTMBG□□0025JK	25	34	80	88	125	x
JNTMBG□□0030JK	30	41	96	106	150	x
JNTMBG□□0040JK	40	54	130	143	200	x

460V Class

Fuse Part Number	HP	KVA	100% Cont. Output AMPS	Rated Input AMPS	Fuse Rating
JNTMBG□□0001AZ	1	2.2	2.6	3	6
JNTMBG□□0002AZ	2	3.4	4	5	10
JNTMBG□□0003AZ	3	4.1	4.8	6	10
JNTMBG□□0005AZ	5	7.5	8.7	10	20
JNTMBG□□7R50AZ	7.5	10.3	12	14	25
JNTMBG□□0010AZ	10	12.3	15	18	30
JNTMBG□□0015AZ	15	20.6	24	29	50
JNTMBG□□0020AZ	20	27.4	32	38	60
JNTMBG□□0025AZ	25	34	40	48	70
JNTMBG□□0030AZ	30	41	48	53	80
JNTMBG□□0040AZ	40	54	64	70	100
JNTMBG□□0050AZ	50	68	80	88	125
JNTMBG□□0060AZ	60	82	96	106	150
JNTMBG□□0075AZ	75	110	128	141	200

575V Class

Fuse Part Number	HP	KVA	100% Cont. Output AMPS	Rated Input AMPS	Fuse Rating
JNTMBG□□0001AX	1	1.7	1.7	2.2	5
JNTMBG□□0002AX	2	3.0	3.0	3.75	8
JNTMBG□□0003AX	3	4.2	4.2	5.25	10
JNTMBG□□0005AX	5	6.6	6.6	8.25	25
JNTMBG□□7R50AX	7.5	9.9	9.9	12.414	25
JNTMBG□□0010AX	10	12.2	12.2	15.25	30

Fuse Type: UL designated SEMICONDUCTOR PROTECTION FUSES
Class: CC, J, T, RK1 or RK5
Voltage Range: 300V for 230V class VFD; 500V for 460V class VFD

6.3 Noise Filters

A. Input Noise Filter

Install a noise filter on power supply side to eliminate noise transmitted between the power line and the inverter. The MA7200 PLUS noise filter shown in Table 5.3.1 below meets the EN61800-3 class A specification.

Table 5.3.1 Input Noise Filter Specifications and Ratings

Inverter Rating			Noise Filter				
Voltage	HP	Rated Current (A)	Code		Specifications	Current	*Dimensions
230V 1 / 3Φ	1	4.8A	1Φ	4H300D1750003	JUNF12015S-MA	15 A	Fig.5.3.1a
			3Φ	4H300D1710001	JUNF32012S-MA	12 A	Fig.5.3.1a
	2	6.5A	1Φ	4H300D1750003	JUNF12015S-MA	15 A	Fig.5.3.1a
			3Φ	4H300D1710001	JUNF32012S-MA	12 A	Fig.5.3.1a
	3	9.6A	1Φ	4H300D1600001	JUNF12020S-MA	20 A	Fig.5.3.1a
			3Φ	4H300D1610007	JUNF32024S-MA	24 A	Fig.5.3.1a
230V 3Φ	5	17.5A	4H300D1610007		JUNF32024S-MA	24 A	Fig.5.3.1a
	7.5	24A	4H300D1620002		JUNF32048S-MA	48 A	Fig.5.3.1b
	10	32A	4H300D1620002		JUNF32048S-MA	48 A	Fig.5.3.1b
	15	48A	4H300D1730002		JUNF32070S-MA	70 A	Fig.5.3.1b
	20	64A	4H300D1730002		JUNF32070S-MA	70 A	Fig.5.3.1b
460V 3Φ	1	2.6A	4H300D1720007		JUNF34008S-MA	8 A	Fig.5.3.1a
	2	4A	4H300D1720007		JUNF34008S-MA	8 A	Fig.5.3.1a
	3	4.8A	4H300D1630008		JUNF34012S-MA	12 A	Fig.5.3.1a
	5	8.7A	4H300D1630008		JUNF34012S-MA	12 A	Fig.5.3.1a
	7.5	12A	4H300D1640003		JUNF34024S-MA	24 A	Fig.5.3.1b
	10	15A	4H300D1640003		JUNF34024S-MA	24 A	Fig.5.3.1b
	15	24A	4H300D1740008		JUNF34048S-MA	48 A	Fig.5.3.1b
	20	32A	4H300D1740008		JUNF34048S-MA	48 A	Fig.5.3.1b
	25	40A	4H000D1770008		KMF370A	70 A	Fig.5.3.1c
	30	48A	4H000D1790009		KMF370A	70 A	Fig.5.3.1c
	40	64A	4H000D1790009		KMF3100A	100 A	Fig.5.3.1c
	50	80A	4H000D1800004		KMF3100A	100 A	Fig.5.3.1c
	60	96A	4H000D1800004		KMF3150A	150 A	Fig.5.3.1c
	75	128A	4H000D1820005		KMF3180A	180 A	Fig.5.3.1c
575V 3Φ	1	1.7A	4H300D1720007		JUNF34008S-MA	8 A	Fig.5.3.1a
	2	3.0A	4H300D1720007		JUNF34008S-MA	8 A	Fig.5.3.1a
	3	4.2A	4H300D1630008		JUNF34012S-MA	12 A	Fig.5.3.1a
	5	6.6A	4H300D1630008		JUNF34012S-MA	12 A	Fig.5.3.1a
	7.5	9.9A	4H300D1640003		JUNF34024S-MA	24 A	Fig.5.3.1b
	10	12.2A	4H300D1640003		JUNF34024S-MA	24 A	Fig.5.3.1b

* Dimensions on following page

Cont.

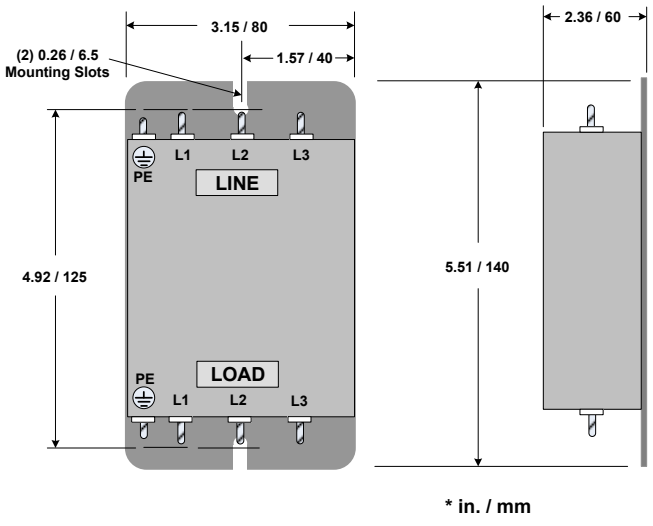


Fig. 5.3.1a

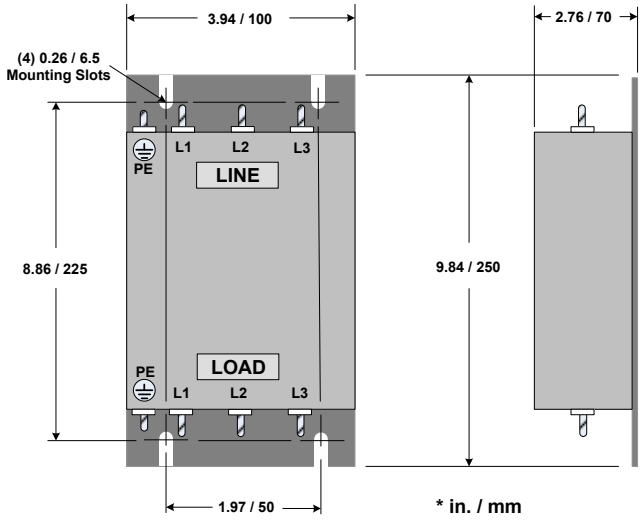
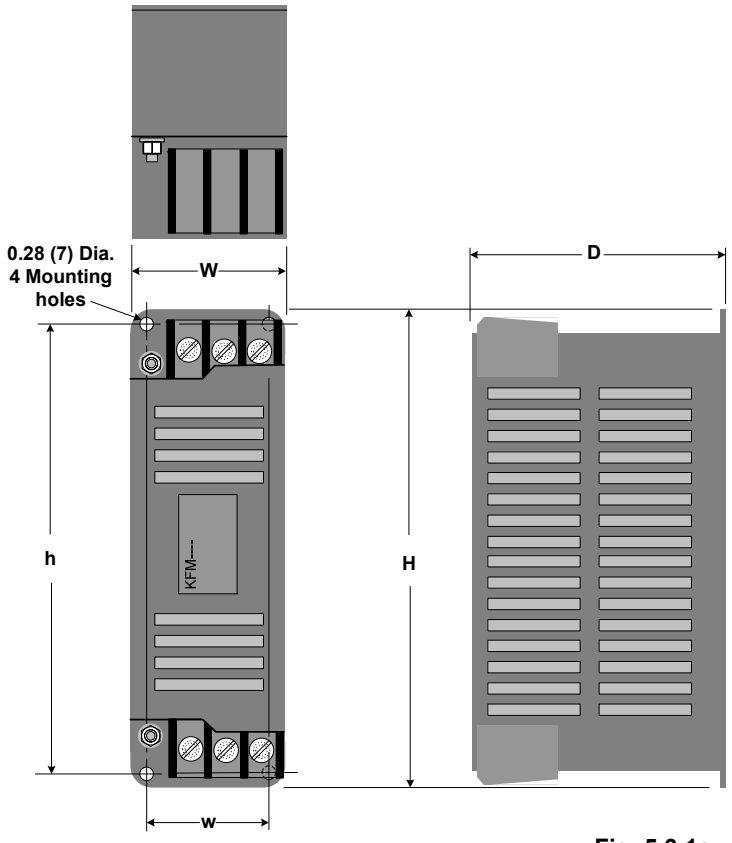


Fig. 5.3.1b



Model	KMF Dimensions in. (mm)				
	W	w	H	h	D
KMF37	3.66	3.11	12.3	11.7	7.48
KMF31	(93)	(79)	(312)	(298)	(190)
KMF31	4.96	4.41	12.3	11.7	8.82
KMF31	(126)	(112)	(312)	(298)	(224)

Fig. 5.3.1c

Fig. 5.3.1 Input Filter Dimensions

B. Input or Output Noise Filter (EMI Suppression Zero Phase Core)

Model: JUNFOC046S ———————— Code No.: 4H000D0250001

Select a matched ferrite core to suppress EMI noise according to the required power rating and wire size. The ferrite core can attenuate high frequencies in the range of 100kHz to 50MHz, as shown in Fig 5.3.2 below, and therefore should minimize the RFI generated by the inverter.

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 wound by following the same convention and in one direction. The more turns without resulting in saturation the better the attenuation. If the wire size is too large to be wound, all the wiring can be grouped and put through several cores together in one direction.

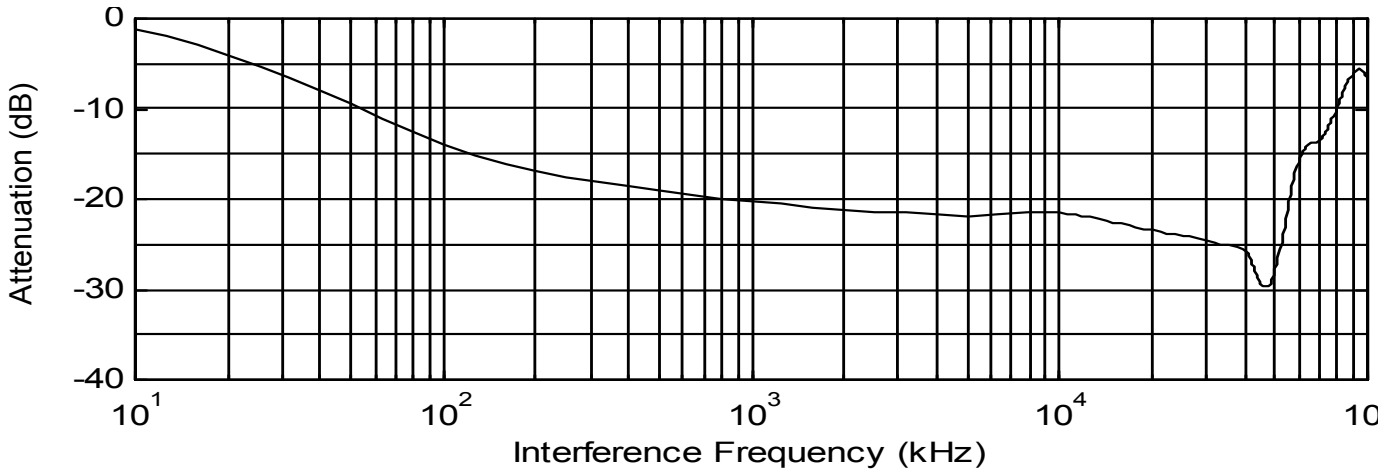


Fig. 5.3.2 Frequency attenuation characteristics (10 windings case)

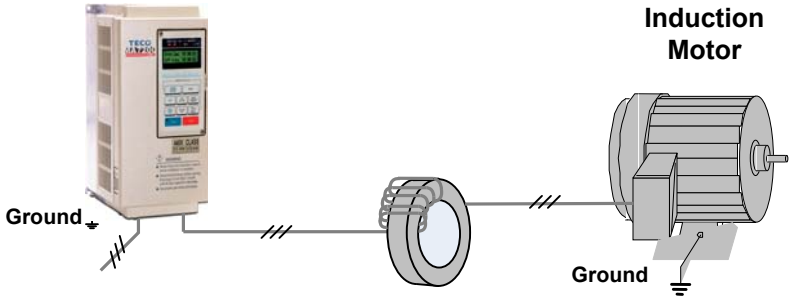


Fig. 5.3.3 Example of EMI Suppression Zero Phase Core Application

Note: All the wiring of phases U/T1, V/T2, W/T3 must pass through the same zero-phase core without crossing over.

6.4 Braking Resistors and Braking Units

The MA7200 PLUS 230V/460V, 1 - 20HP and 575V, 1-10HP models, have a built-in braking transistor and an external braking resistor can be connected between terminals B1/P and B2. For models above 25HP, connect a braking unit to terminals ⊕ - ⊖ of the inverter and connect the braking resistor(s) to terminals B-P0 of the braking unit.

Table 5.4.1 Braking Unit and Braking Resistor Ratings and Specifications

Inverter Rating			Braking Unit		Braking Resistor			Braking Torque (%)
Voltage	HP	Rated current (A)	Model	Number used	Code NO.	Specs.	Number used	
230V 1 / 3Φ	1	4.8	-	-	JNBR-150W200	150W/200Ω	1	119%, 10%ED
	2	6.4	-	-	JNBR-150W100	150W/100Ω	1	119%, 10%ED
	3	9.6	-	-	JNBR-260W70	260W/70Ω	1	115%, 10%ED
230V 3Φ	5	17.5	-	-	JNBR-390W40	390W/40Ω	1	119%, 10%ED
	7.5	24	-	-	JNBR-520W30	520W/30Ω	1	108%, 10%ED
	10	32	-	-	JNBR-780W20	780W/20Ω	1	119%, 10%ED
	15	48	-	-	JNBR-2R4KW13R6	2400W/13.6Ω	1	117%, 10%ED
	20	64	-	-	JNBR-3KW10	3000W/10Ω	1	119%, 10%ED
	25	80	JNTBU-230	1	JNBR-4R8KW8	4800W/8Ω	1	119%, 10%ED
	30	96	JNTBU-230	1	JNBR-4R8KW6R8	4800W/6.8Ω	1	117%, 10%ED
	40	130	JNTBU-230	2	JNBR-3KW10	3000W/10Ω	2	119%, 10%ED
460V 3Φ	1	2.6	-	-	JNBR-150W750	150W/750Ω	1	126%, 10%ED
	2	4	-	-	JNBR-150W400	150W/400Ω	1	119%, 10%ED
	3	4.8	-	-	JNBR-260W250	260W/250Ω	1	126%, 10%ED
	5	8.7	-	-	JNBR-400W150	400W/150Ω	1	126%, 10%ED
	7.5	12	-	-	JNBR-600W130	600W/130Ω	1	102%, 10%ED
	10	15	-	-	JNBR-800W100	800W/100Ω	1	99%, 10%ED
	15	24	-	-	JNBR-1R6KW50	1600W/50Ω	1	126%, 10%ED
	20	32	-	-	JNBR-1R5KW50	1500W/40Ω	1	119%, 10%ED
	25	40	JNTBU-430	1	JNBR-4R8KW32	4800W/32Ω	1	119%, 10%ED
	30	48	JNTBU-430	1	JNBR-4R8KW27R2	4800W/27.2Ω	1	117%, 10%ED
	40	64	JNTBU-430	1	JNBR-6KW20	6000W/20Ω	1	119%, 10%ED
	50	80	JNTBU-430	2	JNBR-4R8KW32	4800W/32Ω	2	119%, 10%ED
	60	96	JNTBU-430	2	JNBR-4R8KW27R2	4800W/27.2Ω	2	117%, 10%ED
	75	128	JNTBU-430	2	JNBR-6KW20	6000W/20Ω	2	126%, 10%ED
575V 3Φ	1	1.7	-	-	JNBR-260W250	260W/250Ω	1	126%,10%ED
	2	3.0	-	-	JNBR-260W250	260W/250Ω	1	126%,10%ED
	3	4.2	-	-	JNBR-260W250	260W/250Ω	1	126%,10%ED
	5	6.6	-	-	JNBR-400W150	400W/150Ω	1	126%,10%ED
	7.5	9.9	-	-	JNBR-600W130	800W/100Ω	1	170%,9%ED
	10	12.2	-	-	JNBR-800W100	800W/100Ω	1	125%,9%ED

Note 1: Alternate choices: 440V 50HP (JUVPHV-0060+JNBR-9R6KW16) x 1;
440V 60HP：(JUVPHV-0060+JNBR- 9R6KW13R6) x 1
Note 2: JUVPHV-0060 no UL certification
Note 3: When set up the braking unit and resistor, please make sure there is adequate ventilation.

6.0 Peripheral Control Devices

6.1 CD Operator with Extension Cable

When used for remote control purposes, the LCD operator can be removed and remotely connected with an extension cable. Some of the available extension cable lengths are listed in the following Table 6.1.1.

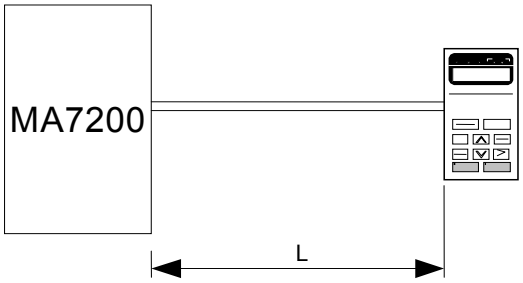


Table 6.1.1 Digital Operator Cable Extensions

Cable Length L In. / m	Extension Cable Set *1 P/N	Extension Cable *2 P/N	Blank Cover *3 P/N
3.28 / 1	4H332D0010000	4H314C0010003	4H300D1120000
6.56 / 2	4H332D0030001	4H314C0030004	
9.84 / 3	4H332D0020005	4H314C0020009	
16.4 / 5	4H332D0040006	4H314C0040000	
32.8 / 10	4H332D0130005	4H314C0060001	

*1: Includes the extension cable for the LCD digital operator, blank cover, screws and installation manual.
*2: Extension cable for LCD digital operator.
*3: B lank cover to protect against external dusts, metallic powder, etc.

The following Fig.6.1.1 shows the dimensional information for the remote mounting of the Digital Operator.

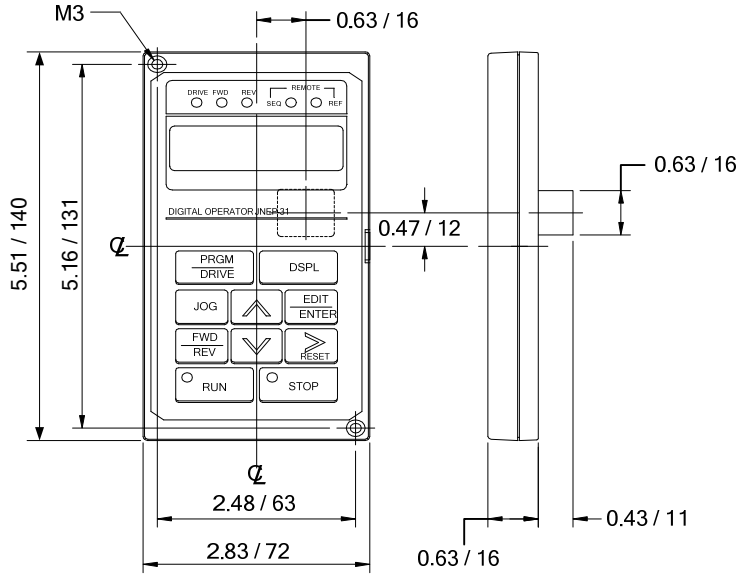
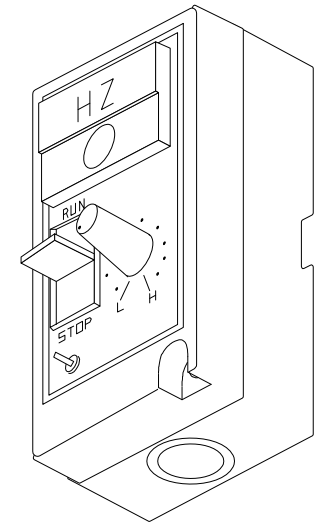


Fig. 6.1.1 LCD Digital Operator Dimension

6.4 Analog Operator

All MA7200 PLUS inverters are supplied with a Digital Operator. An Analog Operator, P/N JNEP-16 shown below in Fig. 6.2.1 is also available and can be connected as a portable operator. The wiring diagram is also shown.



JNEP-16 Analog Operator

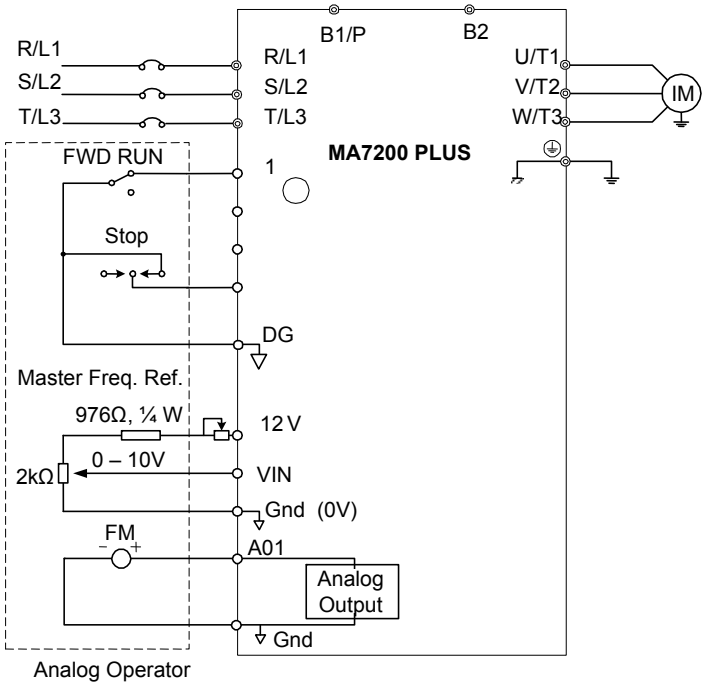


Fig. 6.2.1 Analog Operator Outline and Wiring Diagram

6.5 PROFIBUS Communication Card

Part No. : 4H300D0290009

Refer to the previous Section 4.1 (6) B and the “MA7200 PROFIBUS-DP Communication Application Manual” for Communication interface details.

NOTES-

7.0 MA7200 PLUS Specifications

7.1 Basic Specifications

The basic specifications for each voltage series are shown in the following Tables 7.1.1a - c.

Table 7.1.1a 230V Series

Inverter (HP)		1	2	3	5	7.5	10	15	20	25	30	40
Max. Applicable Motor Output HP*1 (KW)		1 (0.75)	2 (1.5)	3 (2.2)	5.4 (4)	7.5 (5.5)	10 (7.5)	15 (11)	20 (15)	25 (18.5)	30 (22)	40 (30)
Output Characteristics	Rated Output Capacity (KVA)	2	2.7	4	7.5	10.1	13.7	20.6	27.4	34	41	54
	Rated Output Current (A)	4.8	6.4	9.6	17.5	24	32	48	64	80	96	130
	Max. Output Voltage (V)	3-Phase, 200V - 240V										
	Max. Output Frequency (Hz)	Using Parameter Setting 0.1- 400.0 Hz										
Power Supply	Rated Voltage, Frequency	1PH / 3PH 200V - 240V, 50/60Hz			3-Phase, 200V - 240V, 50/60Hz							
	Allowable Voltage Fluctuation	-15% - +10%										
	Allowable Frequency Fluctuation	± 5%										

Table 7.1.1b 460V Series

Inverter (HP)		1	2	3	5	7.5	10	15	20	25	30	40	50	60	75
Max. Applicable Motor Output HP*1 (KW)		1 (0.75)	2 (1.5)	3 (2.2)	5.4 (4)	7.5 (5.5)	10 (7.5)	15 (11)	20 (15)	25 (18.5)	30 (22)	40 (30)	50 (37)	60 (45)	75 (55)
Output Characteristics	Rated Output Capacity (KVA)	2.2	3.4	4.1	7.5	10.3	12.3	20.6	27.4	34	41	54	68	82	110
	Rated Output Current (A)	2.6	4	4.8	8.7	12	15	24	32	40	48	64	80	96	128
	Max. Output Voltage (V)	3-Phase, 380V - 480V													
	Max. Output Frequency (Hz)	Using Parameter Setting 0.1 - 400.0 Hz													
Power Supply	Rated Voltage, Frequency	3-Phase, 380V - 480V, 50/60Hz													
	Allowable Voltage Fluctuation	-15% - +10%													
	Allowable Frequency Fluctuation	± 5%													

Cont.

Table 7.1.1c 575V Series

Inverter (HP)		1	2	3	5	7.5	10
Max. Applicable Motor Output HP*1 (KW)		1 (0.75)	2 (1.5)	3 (2.2)	5.4 (4)	7.5 (5.5)	10 (7.5)
Output Characteristics	Rated Output Capacity (KVA)	1.7	3.0	4.2	6.6	9.9	12.2
	Rated Output Current (A)	1.7	3.0	4.2	6.6	9.9	12.2
	Max. Output Voltage (V)	3-Phase: 500 / 550 - 600VAC					
	Max. Output Frequency (Hz)	Using Parameter Setting 0.1 - 400.0 Hz					
Power Supply	Rated Voltage, Frequency	3-Phase, 500 - 600VAC, 50/60Hz					
	Allowable Voltage Fluctuation	-15% - +10%					
	Allowable Frequency Fluctuation	± 5%					

*1. Based on 4 pole motor

*2. The specifications for NEMA4 are the same.

NOTES-

7.4 General Specifications

The following Table 7.2.1 shows the general specifications for the MA7200 PLUS series.

Cont.

Table 7.2.1- General Specifications

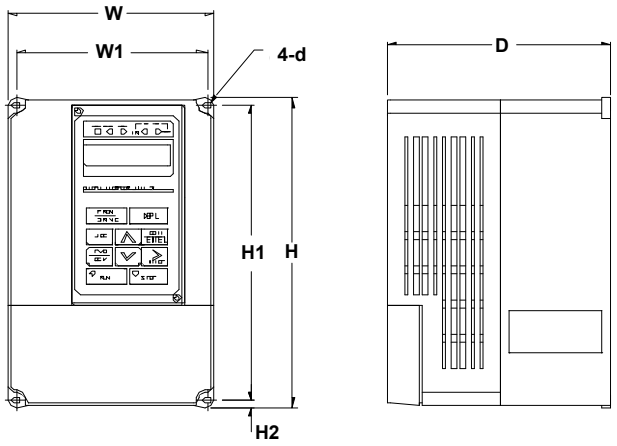
Control Characteristics	Operation Mode	Graphic LCD Panel (English only) with parameters copying
	Control Mode	Sinusoidal PWM
	Frequency Control Range	0.1Hz - 400Hz
	Frequency Accuracy (varied with temperature)	Digital Command: ± 0.01% (-10 - +40ºC), Analog Command: ± 0.1% (25ºC ± 10ºC),
	Speed Control Accuracy	± 0.1%(V/F with PG feedback); ± 0.5%(Sensorless Vector Control)
	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, DC-10V - +10V and Pulse Input Frequency Command (Above 230V / 460V, 25HP and 575V, 1-10 HP)
	Acc./ Dec. Time	0.0 - 6000.0 sec. (Acce l/ Decel Time Can Be Set Independently)
	Voltage–Frequency Characteristics	V/F Curve Can Be Selected Through Parameter Setting
	Regeneration Torque	Approx. 20%
	Basic Control Function	Restart After Momentary Power Loss, PID Control, Auto Torque Boost, Slip Compensation, RS485 Communication, Speed Feedback Control, Simple PLC function and 2 Analog Output Port.
	HVAC Function	Programmable Local / Remote Key, Engineering Unit Display, PID Sleep Function, External PID Function, Over / Low Feedback Detection, Low Suction Detection, Flow Meter Display via Analog Input or Pulse Input, Power Meter, kWh Meter and Energy Cost Usage.
	Additional Functions	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, Select Local / Remote, SINK / SOURCE Interface.
Protection Function	Stall Prevention	During Acceleration / Deceleration and constant Running Speed (Current Level Can Be Selected During Acceleration and Constant Running Speed. During Deceleration, Stall Prevention Can Be Enabled or Disabled)
	Instantaneous Overcurrent	Turns Off if above 200% Rated Current
	Motor Overload Protection	Electronic Overload Curve Protection
	Inverter Overload Protection	Turns Off if above 150% Rated Current for 1 Min.
	Overvoltage	Stop if VDC>410V (230 Class), VDC>820V (460 Class) or VDC>1050V (575 Class)
	Undervoltage	Stop if VDC<200V (230 Class), VDC<400V (460 Class) or VDC<546V (575 Class)
	Momentary Power Loss Ride-Through time	<15ms, otherwise Stop
	Overheat Protection	Protected by Thermistor
	Grounding Protection	Protection by DC Current Sensor
	Charge Indication (LED)	ON when the DC Bus Voltage Above 50V
	Output Phase Loss (OPL)	Motor coasts to stop at Output Phase Loss
Environ-mental	Application Site	Indoor (No Corrosive Gas and Dust Present)
	Ambient Temperature	-10ºC - +40ºC (Not Frozen)
	Storage Temperature	-20ºC - +60ºC
	Ambient Humidity	< 90%RH (Non-Condensing)
	Altitude, Vibration	< 1000M; 5.9m/S^2 (0.6G), (JISC0911 Standard)
Communication Function		RS485 Installed (MODBUS Protocol); (Optional Profibus Card)
Encoder Feedback Interface		Built-in PG Feedback Interface and set to Open-collector Interface Drive or Complementary Interface Drive
EMI		Meets EN 61800-3 With Specified EMI Filter
EMS Compatibility		Meets EN 61800-3

7.3 MA7200 PLUS Dimensions and Weights

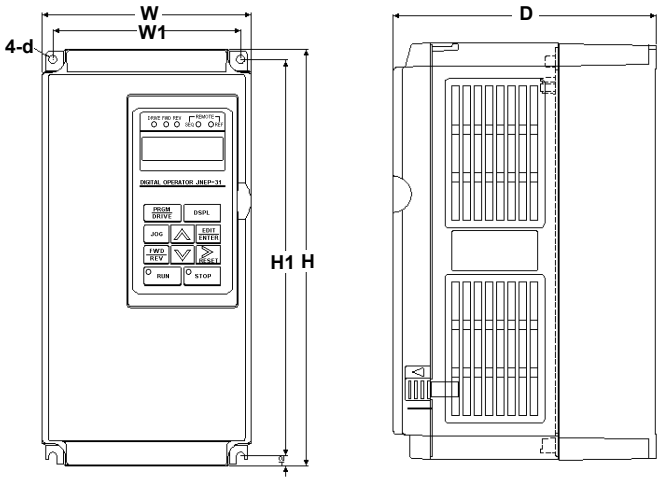
Table 7.3.1- MA7300 PLUS Open Chassis and NEMA 1 Dimensions and Weights

Voltage Rating	Inverter Capacity (HP)	Open Chassis Type (IP00) In. (mm) W	H	D	W1	H1	d	Wt. lb. (kg)	Enclosed Type (NEMA1) In. (mm) W	H	D	W1	H1	d	Wt. lbs (kg)	ACL/ DCL	Ref. Fig. 6.3.1
230V 1 / 3Φ	1							-	**5.2** (132)	**8.54** (217)	**5.65** (143.5)	**4.80** (122)	**8.15** (207)	M5	**5.07** (2.3)	External ACL (optional)	(a)
	2																
	3								**5.51** (140)	**11.0** (279.5)	**6.95** (176.5)	**4.96** (126)	**10.5** (266)	M6	**9.48** (4.3)		(b)
230V 3Φ	5							-	**5.51** (140)	279.5	**6.95** (176.5)	**4.96** (126)	**10.5** (266)		**9.48** (4.3)		
	7.5								**8.31** (211.2)	**11.0** (279.5)	**8.46** (215)	**7.56** (192)	**11.3** (286)		**12.6** (5.7)		
	10																
	15								**10.43** (265)	**14.17** (360)	**8.86** (225)	**9.65** (245)	**13.4** (340)		**26.5** (12)		
	20																
	25														**28.7** (13)		
	30	**10.6** (269)	**21.8** (553	**10.9** 277)	Top **8.27** (210) Bottom **7.1** (180)	**20.9** (530)	M10	**66.2** (30)	**10.59** (269)	**25.47** (647)	**10.91** (277)	Top **8.27** (210) Bottom **7.1** (180)	**20.9** (530)	M10	**68.4** (31)	DCL Built-in (Standard)	(c)
	40							**68.4** (31)							**70.6** (32)		
460V 3Φ	1							-	**5.2** (132)	**8.54** (217)	**5.65** (143.5)	**4.80** (122)	**8.15** (207)	M5	**5.07** (2.3	External ACL (option)	(a)
	2																
	3								**5.51** (140)	**11.0** (279.5)	**6.95** (176.5)	**4.96** (126)	**10.5** (266)	M6	**9.48** (4.3)		(b)
	5																
	7.5								**8.31** (211.2)	**11.81** (300)	**8.46** (215)	**7.56** (192)	**11.3** (286)		**12.6** (5.7)		
	10																
	15								**10.43** (265)	**14.17** (360)	**8.86** (225)	**9.65** (245)	**13.4** (340)		**26.5** (12)		
	20																
	25														**28.7** (13)		
	30																
	40	**10.6** (269)	**21.8** (553	**10.9** 277)	Top **8.27** (210) Bottom **7.1** (180)	**20.9** (530)	M10	**66.2** (30)	**10.59** (269)	**25.47** (647)	**10.91** (277	Top **8.27** (210) Bottom **7.1** (180)	**20.9** (530)	M10	**68.4** (31)	DCL Built-in (Standard)	(c)
	50																
	60	**12.2** (308)	**25.7** (653)	**11.1** (282)	Top **9.84** (250) Bottom **8.66** (220)	**24.8** (630)	M10	**101.4** (46)	**12.13** (308)	**29.41** (747)	**11.1** (282)	Top **9.84** (250) Bottom **8.66** (220)	**24.8** (630)		**103.6** (47)		
	75																
575V 3Φ	1							-	**5.51** (140)	**11.0** (279.5)	**6.95** (176.5)	**4.96** (126)	**10.5** (266)	M6	**9.48** (4.3)	External ACL (option)	(b)
	2																
	3																
	5								**8.31** (211.2)	**11.81** (300)	**8.46** (215)	**7.56** (192)	**11.3** (286)		**12.6** (5.7)		
	7.5																
	10																

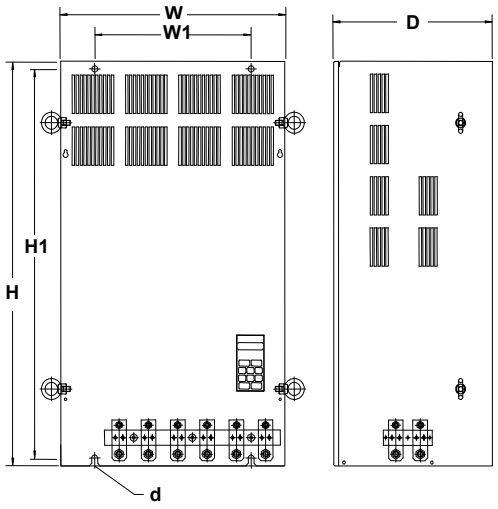
Cont.



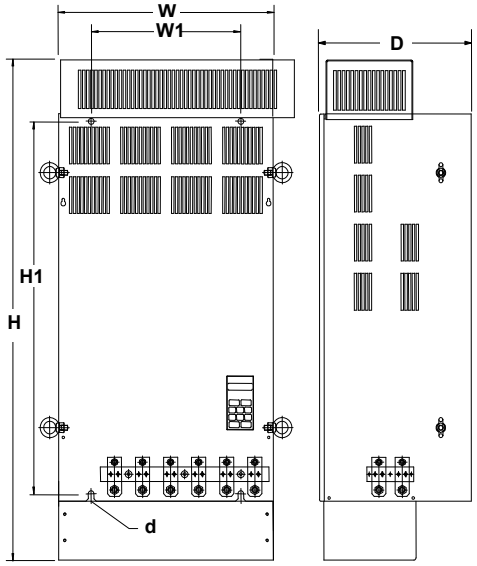
(a) 230V / 460V : 1- 2HP



(b) 230V : 3HP- 25HP
460V : 3HP- 30HP
575V : 1HP- 10HP



(Open Chassis Type - IP00)



(Enclosed, Wall-mounted Type - NEMA1)

(c) 230V : 30HP - 40HP
460V : 40HP - 75HP

Fig. 7.3.1 Open Chassis and NEMA 1 Outlines

Table 7.3.2 MA7300 PLUS NEMA 4 Dimensions and Weights

Voltage	Inverter Capacity (HP)	NEMA4 In. (mm)						Weight Lbs. (kg)
		W	H	D	W1	H1	d	
230V 1/3Φ	1	7.80 (198)	13.2 (335)	8.54 (217)	4.53 (115)	12.4 (315)	M6	13.9 (6.3)
	2							
	3							16.6 (7.5)
230V 3Φ	5						M6	
	7.5	8.78 (223)	18.1 (460)	9.65 (245)	5.51 (140)	17.32 (440)	M6	35.3 (16)
	10							
	15							
	20							
460V 3Φ	1	7.80 (198)	13.2 (335)	8.54 (217)	4.53 (115)	12.4 (315)	M6	13.9 (6.3)
	2							
	3							16.6 (7.5)
	5							
	7.5	8.78 (223)	18.1 (460)	9.65 (245)	5.51 (140)	17.32 (440)	M6	35.3 (16)
	10							
	15							
	20							

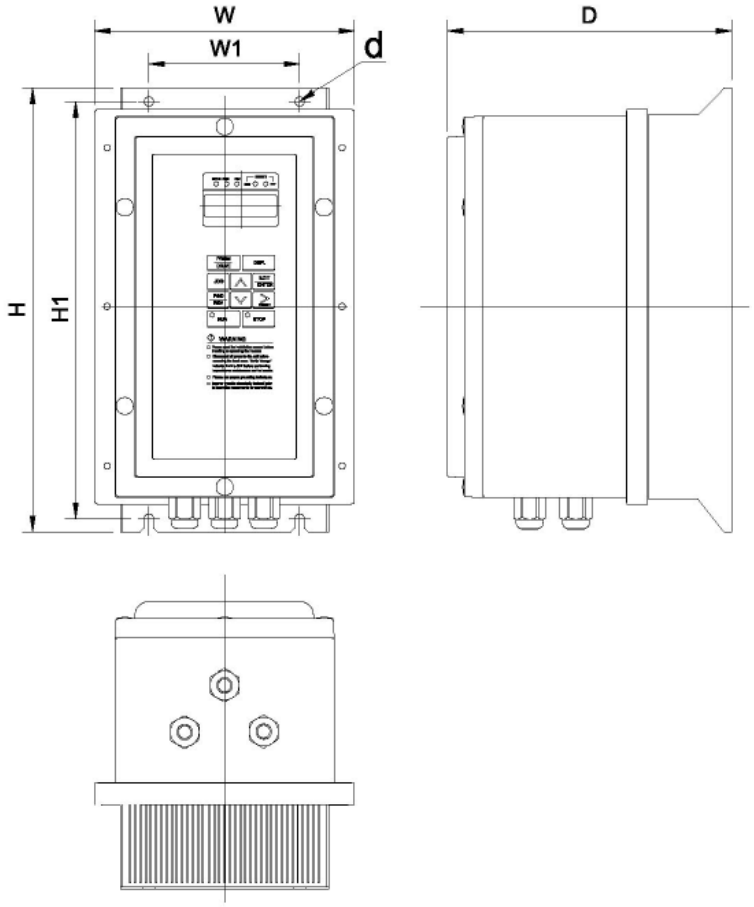


Fig. 7.3.2 and NEMA 4 Outline

8.0 Parameter Groups, Digital Operator, Menus and Keypad Navigation

8.1 Parameter Groups

The MA7200 PLUS has nine groups of user parameters and one monitor parameter group (Un-□□), that can not be changed by the user and is listed in the following Table 8.1.1. The parameters and values are accessed for setting and / or monitoring through the Digital Operator covered in Section 8.2. The parameter allowable settings and explanations are covered in detail in Section 9.0.

Table 8.1.1 Parameter Groups

Parameter	Description
An-□□	Frequency command
Bn-□□	Parameter group that can be changed during running
Sn-□□	System parameter group (Can be changes only after stop)
Cn-□□	Control parameter group (Can be changed only after stop)
P1-□□	HVAC parameter group (Can be changed only after stop)
P2-□□	HVAC parameter group (Can be changed during running)
P3-□□	HVAC parameter group (Can be changed only after stop)
P4-□□	HVAC parameter group (Can be changed only after stop)
P5-□□	HVAC parameter group (Can be changed during running)
Un-□□	Monitor group only (***There are no user settings for this group***)

The parameter setting of Sn – 03 (Operation Status) shown in Table 8.1.2 below determines if the values of the various parameter groups are allowed to be changed or can be monitored only.

Table 8.1.2 Sn-03 Setting

Sn-03	DRIVE mode		PRGM mode	
	Can be set	Monitored only	Can be set	Monitored only
0 *1	An,Bn,P2,P5	(Sn,Cn) *2, P1, P3, P4 *3	An, Bn, Sn, Cn, P1-P5	—
1	An	Bn, (Sn, Cn) *2 P1-P5	An	Bn, Sn, Cn, P1-P5

*1 Factory setting
*2 When in the DRIVE mode, the parameter groups Sn- and Cn- can only be monitored if the RESET and the DSPL keys are to be pressed simultaneously.
*3 Parameters P4-01 to P4-04 can be monitored only during the DRIVE mode. Parameter P4-05 can be set and monitored during the DRIVE mode.

Note: After the required modifications have been made, it is recommended that parameter SN-03 be set to 1 to prevent unwanted modifications to parameter groups other than An- (Frequency Command).

8.2 Digital Operator Layout and Description

The JNEP-36 LCD Digital Operator shown in Fig. 8.2.1 has a 2 line by 20 character LCD English display, LED status indicators and a membrane keypad for control and data entry.

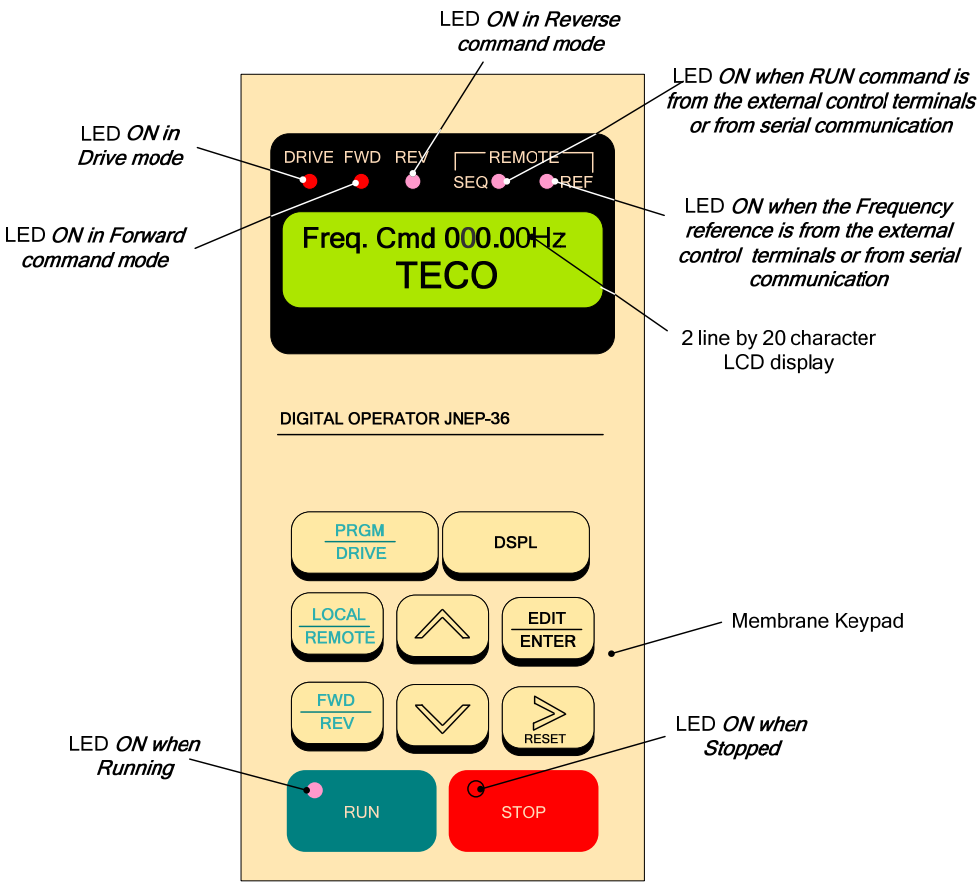


Fig. 8.2.1 JNEP-36 LCD Digital Operator

PRGM / Drive key-

There are two basoc digital operator modes: The Drive mode and the PRGM mode. When the inverter is stopped, the Drive mode or PRGM mode can be selected by pressing the PRGM/DRIVE key. In the Drive mode, the operation of the drive is enabled. In the PRGM mode the parameters can be set but drive operation is disabled.

Remote/Local function:

- Local mode – The RUN command is input from the LCD Digital Operator (SEQ LED off)
  – The Frequency command is input from the LCD Digital Operator (REF LED off)
- Remote mode – The RUN command is input from the control circuit terminals (when Sn-04=1) or the RS-485 comm. port (when Sn-04=2) (SEQ LED on)
  – The Frequency command is input from the control circuit terminals (when Sn-05=1) or the RS-485 comm. port (when Sn-05=2) (REF LED on)

LOCAL / REMOTE key-

The LOCAL/REMOTE key is used as Local/Remote key. It can be set as JOG key when parameter P1-03 = 1.

Cont.

8.3 Digital Operator Key Functions

The following Table 8.3.1 describes the functions of the keys.

Table 8.3.1 Key Functions

KEY	NAME	DESCRIPTION
PRGM / DRIVE	PRGM/DRIVE	Switches over between the program mode (PRGM) and the drive mode (DRIVE).
DSPL	DSPL	Displays the operating status.
LOCAL / REMOTE	LOCAL /REMOTE (JOG)	When parameter P1-03 = 0, it toggles the Local/Remote Function. When parameter P1-03 = 1, it act as the Jog key when in the DRIVE mode.
FWD / REV	FWD / REV	Sets the direction of rotation the Digital Operator.
RESET	Digit Select & RESET	Selects a particular digit to be changed when setting values on the LCD display. (Used with the Increment and Decrements keys). It also acts as the RESET key when a fault has occurred.
^	Increment	Selects menu items, groups, functions, parameters, and increments the value of a selected digit.
v	Decrement	Selects menu items, groups, functions, parameters, and decrements the value of a selected digit.
EDIT / ENTER	EDIT / ENTER	(EDIT) - select menu items, groups, functions and sets values. (ENTER) - saves a particular operation or value to memory.
RUN	RUN	Starts inverter operation in the (DRIVE) mode when the using the Digital Operator. (The LED will come ON.)
STOP	STOP	Stops inverter operation from the Digital Operator. The STOP key can be enabled or disabled by the setting of parameter Sn-07 when operating from the control circuit terminals.

⚠ **Caution**	To avoid keypad damage, do not operate it with a screwdriver or any sharp or hard tool.

8.4 Run / Stop Status Indicators

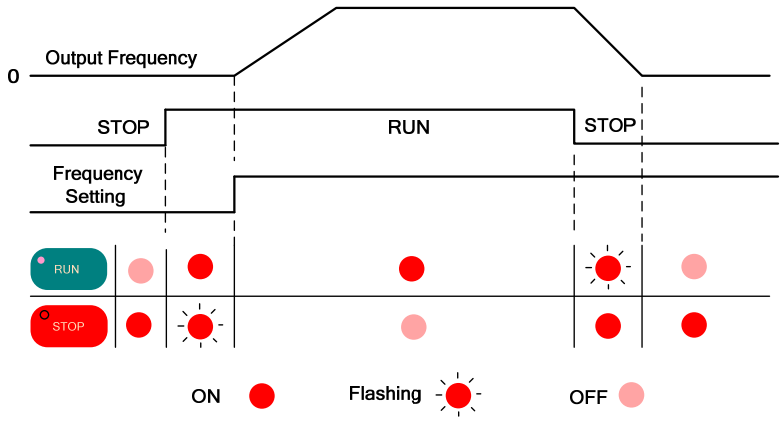


Fig. 8.4.1 Run / Stop Status Indicators

8.5 Display Menu for DRIVE and PRGM Modes

The following Fig. 8.5.1 shows the menu structure for the program mode (PRGM) and the drive mode (DRIVE). Refer to the parameter section 9.0 for an in depth explanation for the various parameter groups shown.

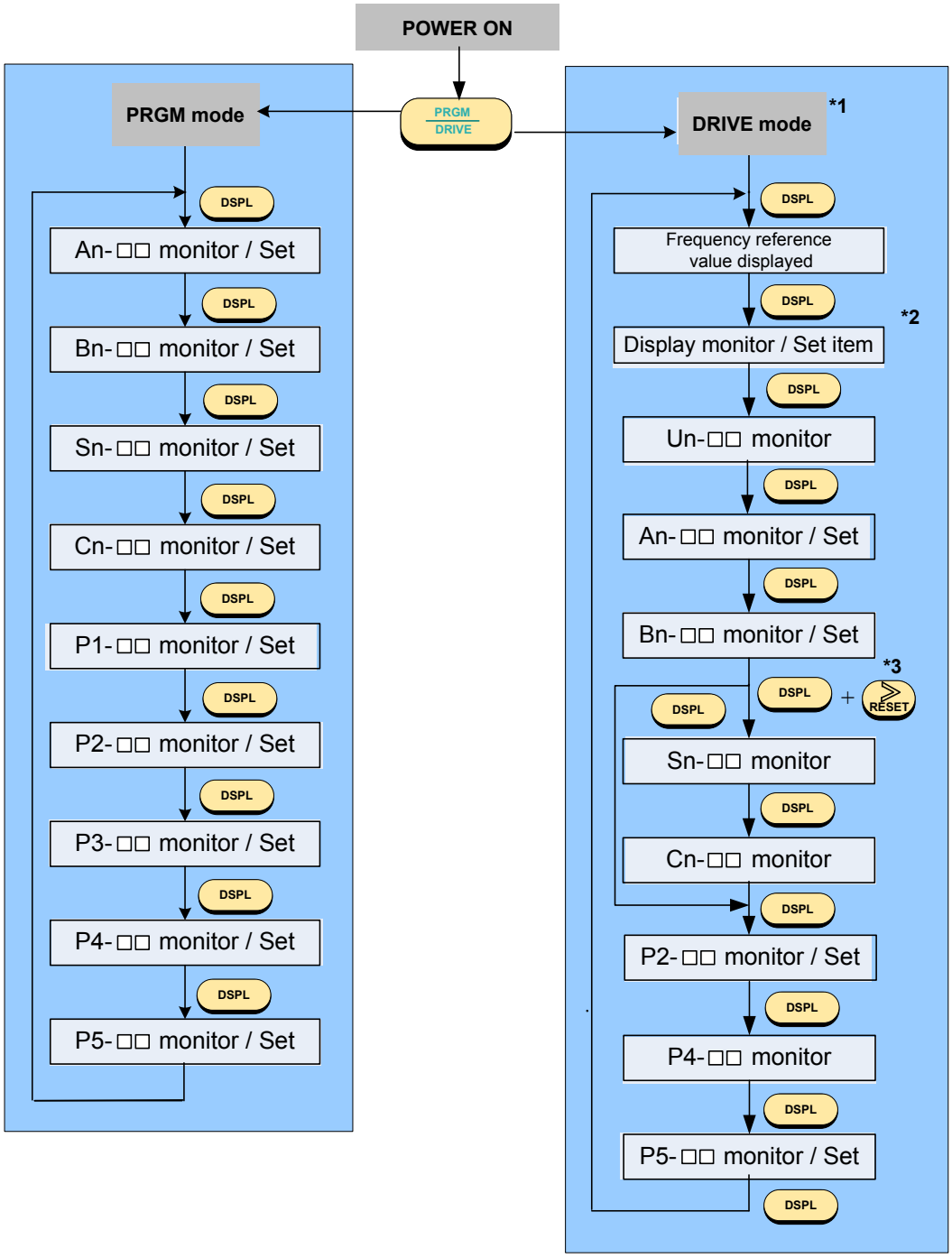


Fig. 8.5.1 DRIVE and PRGM Display Menus

*1 When powered up, the inverter immediately enters the DRIVE mode. Pressing the PRGM / DRIVE key will switch to the PRGM mode. If a fault occurs, press the PRGM / DRIVE key and enter the DRIVE mode and then the DSPL key to access the corresponding Un-□□ fault contents. Once the fault is cleared, press the RESET key.

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

*3 When in the DRIVE mode, press the DSPL key and the RESET key; the set values of parameters Sn- □□ and Cn-□□ will be displayed for monitoring only and can not be changed or set here.

8.6 Some Examples of keypad navigation

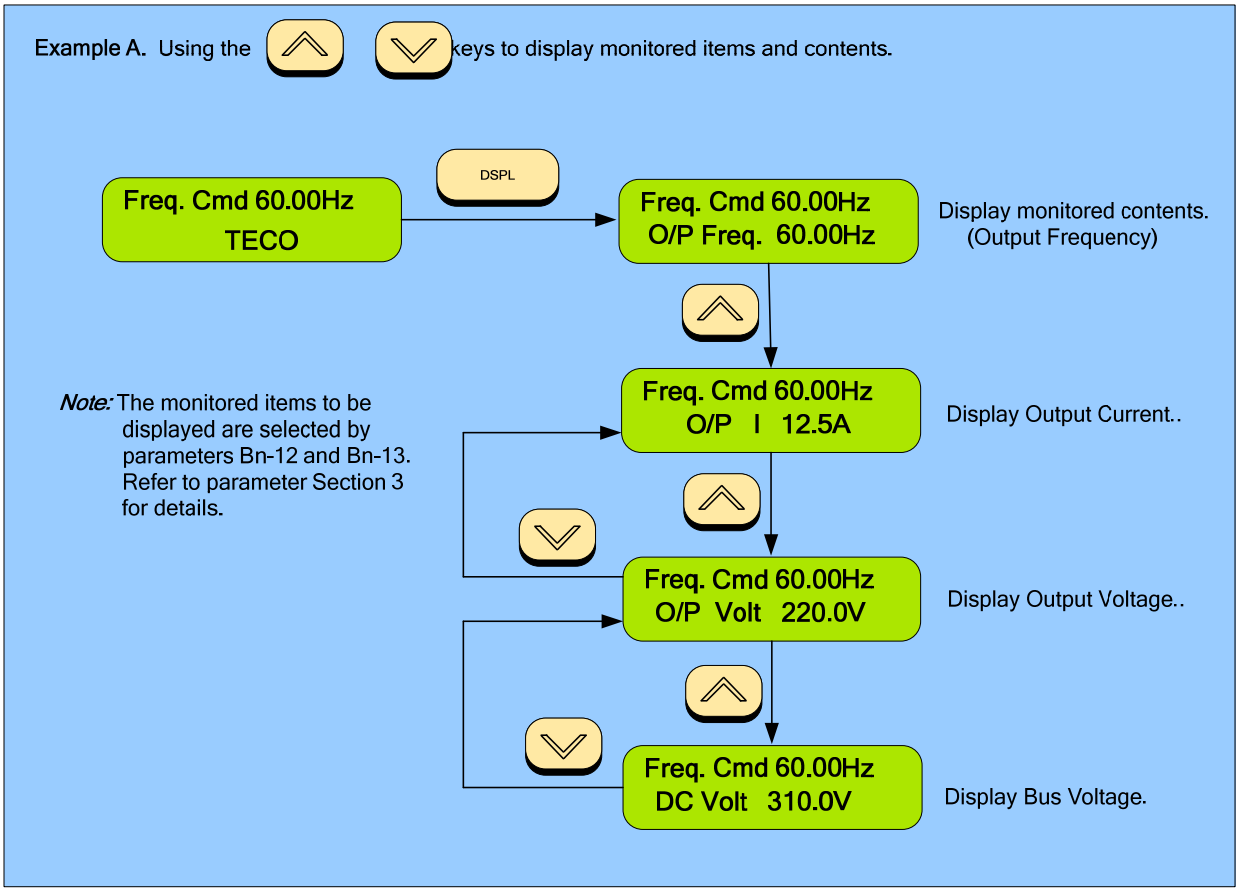


Fig. 8.6.1 Using the UP / DWN Keys

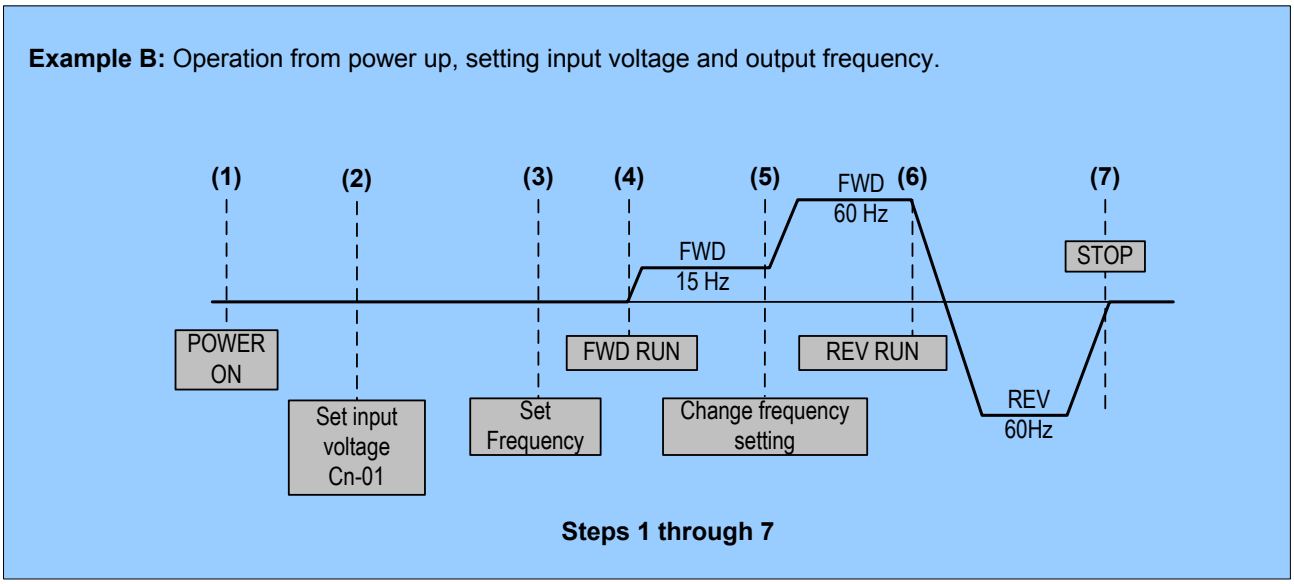


Fig. 8.6.2 Setting the Input Voltage and Output Frequency

The following Fig. 8.6.3 shows the keypad navigation for Example B following Steps 1 to 7. It will acquaint the user with the process of changing other parameters and settings.

Cont.

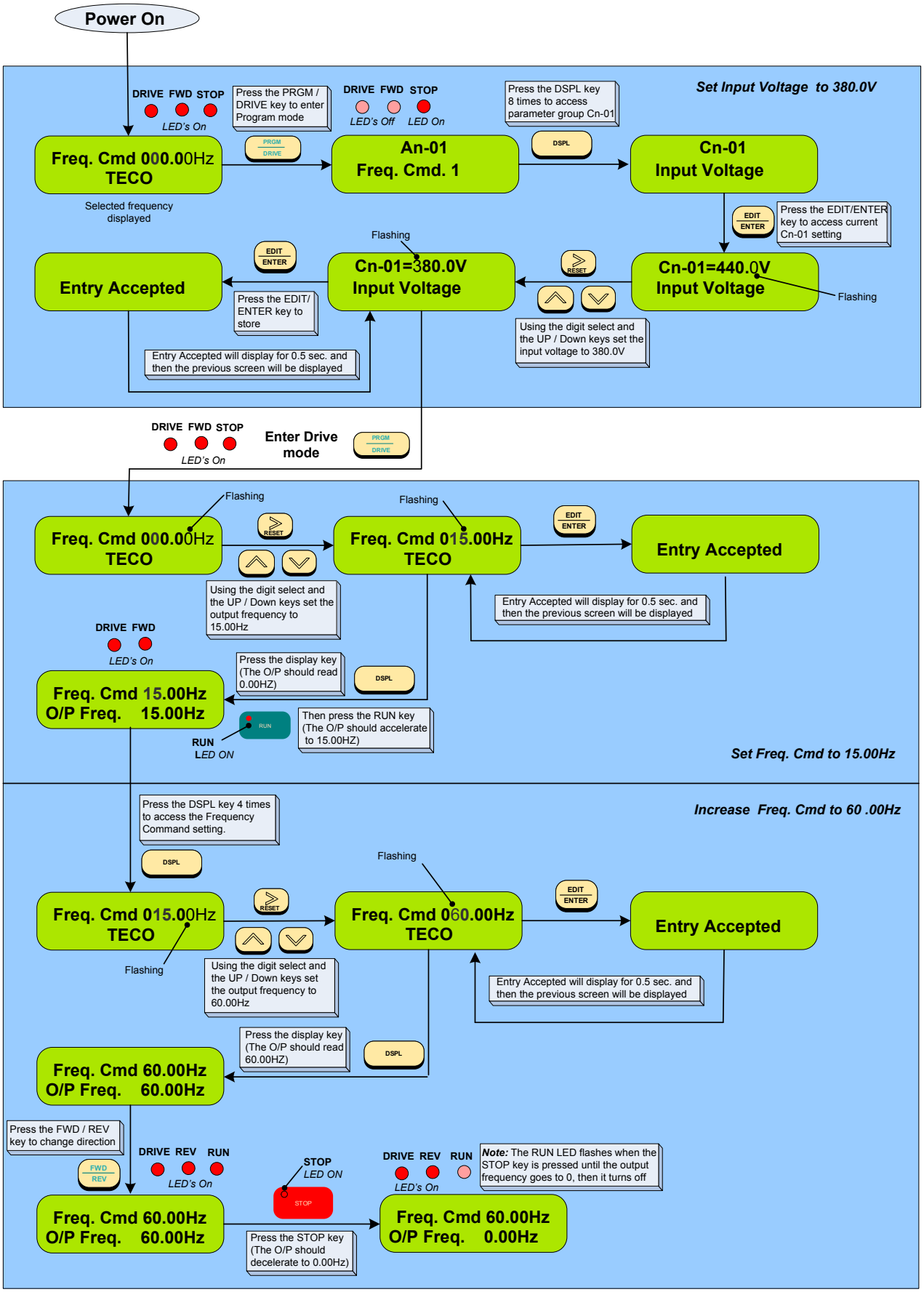


Fig. 8.6.3 PRGM and DRIVE Keypad Navigation

9.0 Parameter Summary and Explanation

This section describes the various parameter groups that are available in the MA7200 PLUS. Sub-section 9.1 gives a summary of the parameters while Sub-section 9.2 gives a more detailed explanation.

9.1 Parameter Summary Tables

Table 9.1.1 An-□□ Frequency Command (Multi-speed operation)

(In the drive mode these parameters can be monitored and their values set.)

Parameter No.	Name	LCD Display (English)	Setting Range	Setting Unit *1	Factory Setting	Ref.
An-01	Frequency Command 1	An-01= 000.00Hz Freq. Cmd. 1	0.00 - 400.00Hz	0.01Hz	0.00Hz	Sec. 9.2.3
An-02	Frequency Command 2	An-02= 000.00Hz Freq. Cmd. 2				
An-03	Frequency Command 3	An-03= 000.00Hz Freq. Cmd. 3				
An-04	Frequency Command 4	An-04= 000.00Hz Freq. Cmd. 4				
An-05	Frequency Command 5	An-05= 000.00Hz Freq. Cmd. 5				
An-06	Frequency Command 6	An-06= 000.00Hz Freq. Cmd. 6				
An-07	Frequency Command 7	An-07= 000.00Hz Freq. Cmd. 7				
An-08	Frequency Command 8	An-08= 000.00Hz Freq. Cmd. 8				
An-09	Frequency Command 9	An-09= 000.00Hz Freq. Cmd. 9				
An-10	Frequency Command 10	An-10= 000.00Hz Freq. Cmd. 10				
An-11	Frequency Command 11	An-11= 000.00Hz Freq. Cmd. 11				
An-12	Frequency Command 12	An-12= 000.00Hz Freq. Cmd. 12				
An-13	Frequency Command 13	An-13= 000.00Hz Freq. Cmd. 13				
An-14	Frequency Command 14	An-14= 000.00Hz Freq. Cmd. 14				
An-15	Frequency Command 15	An-15= 000.00Hz Freq. Cmd. 15				
An-16	Frequency Command 16	An-16= 000.00Hz Freq. Cmd. 16				
An-17	Jog Frequency Command	An-17= 000.00Hz Jog Freq. Cmd.			6.00Hz	

1 - The values assigned to parameters An-01 to An-02 are selected by the multi-function input terminals 5-8 and set by parameters Sn-25 to Sn-28. (See Table 9.3.2.4)

2- The units to be displayed can be changed through the parameter Cn-28 and P1-01.

Table 9.1.2 Bn-□□ Parameter Groups that can be Changed During Running

(In the drive mode the parameters can be monitored and their values set.)

Function	Parameter No.	Name	LCD display (English)	Setting range	Setting Unit	Factory Setting	Ref.
Acc/Dec time	Bn-01	Acceleration Time 1	Bn-01= 0010.0s Acc. Time 1	0.0 - 6000.0s	0.1s	30.0s	Sec. 9.2.1 & App-1
	Bn-02	Deceleration Time 1	Bn-02= 0010.0s Dec. Time 1				
	Bn-03	Acceleration Time 2	Bn-03= 0010.0s Acc. Time 2				
	Bn-04	Deceleration Time 2	Bn-04= 0010.0s Dec. Time 2				
Analog Frequency	Bn-05	Analog Frequency Cmd. Gain (Voltage)	Bn-05= 0100.0% Voltage Cmd. Gain	0.0 -1000.0%	0.10%	100.00%	Sec. 9.2.1
	Bn-06	Analog Frequency Cmd. Bias (Voltage)	Bn-06= 000.0% Voltage Cmd. Bias	-100.0% -100.0%		0.00%	
	Bn-07	Analog Frequency Cmd Gain. (Current)	Bn-07= 0100.0% Current Cmd. Gain	0.0 - 1000.0%		100.00%	
	Bn-08	Analog Frequency Cmd Bias (Current)	Bn-08= 000.0% Current Cmd. Bias	-100.0% - 100.0%		0.00%	
Multi-Function Analog Input	Bn-09	Multi-Function Analog Input Gain	Bn-09= 0100.0% Multi_Fun. ~Gain	0.0 - 1000.0%		100.00%	
	Bn-10	Multi-Function Analog Input Bias	Bn-10= 000.0% Multi_Fun. ~Bias	-100.0% - 100.0%		0.00%	
Torque Boost	Bn-11	Auto Torque Boost Gain	Bn-11= 0.5 Auto_Boost Gain	0.0 - 2.0	0.1	0.5	
Monitor	Bn-12	Monitor 1	Bn-12= 01 Display: Freq.Cmd.	1 - 30	1	1	
	Bn-13	Monitor 2	Bn-13= 19 Display: PID FBK.			19	
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	
	Bn-15	Multi-Function Analog Output AO2 Gain	Bn-15= 1.00 -Output AO2 Gain				
PID Control	Bn-16	PID Detection Gain	Bn-16= 01.00 PID Cmd. Gain	0.01 - 10.00	0.01	1	Sec. 9.2.1 & APP-1
	Bn-17	PID Proportional Gain	Bn-17= 01.00 PID P_gain				
	Bn-18	PID integral time	Bn-18= 10.00s PID I_Time	0.00 -100.00s	0.01s	10.00s	
	Bn-19	PID Differential Time	Bn-19= 0.00s PID D_Time	0 -1.00s		0.00s	
	Bn-20	PID Bias	Bn-20= 0% PID Bias	0 -109%	1%	0%	

Cont.

Function	Parameter No.	Name	LCD display (English)	Setting range	Setting Unit	Factory Setting	Ref. Page
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	Sec. 9.2.1
	Bn-22	2nd_Step Time Under Auto_Run Mode	Bn-22= 0000.0s Time 2				
	Bn-23	3rd_Step Time Under Auto_Run Mode	Bn-23= 0000.0s Time 3				
	Bn-24	4th_Step Time Under Auto_Run Mode	Bn-24= 0000.0s Time 4				
	Bn-25	5th_Step Time Under Auto_Run Mode	Bn-25= 0000.0s Time 5				
	Bn-26	6th_Step Time Under Auto_Run Mode	Bn-26= 0000.0s Time 6				
	Bn-27	7th_Step Time Under Auto_Run Mode	Bn-27= 0000.0s Time 7				
	Bn-28	8th_Step Time Under Auto_Run Mode	Bn-28= 0000.0s Time 8				
	Bn-29	9th_Step Time Under Auto_Run Mode	Bn-29= 0000.0s Time 9				
	Bn-30	10th_Step Time Under Auto_Run Mode	Bn-30= 0000.0s Time 10				
	Bn-31	11th_Step Time Under Auto_Run Mode	Bn-31= 0000.0s Time 11				
	Bn-32	12th_Step Time Under Auto_Run Mode	Bn-32= 0000.0s Time 12				
	Bn-33	13th_Step Time Under Auto_Run Mode	Bn-33= 0000.0s Time 13				
	Bn-34	14th_Step Time Under Auto_Run Mode	Bn-34= 0000.0s Time 14				
	Bn-35	15th_Step Time Under Auto_Run Mode	Bn-35= 0000.0s Time 15				
	Bn-36	16th_Step Time Under Auto_Run Mode	Bn-36= 0000.0s Time 16				
Timer Function	Bn-37	Timer Function On_Delay Time	Bn-37= 0000.0s ON_delay Setting				Sec. 9.2.1
	Bn-38	Timer Function Off_Delay Time	Bn-38= 0000.0s OFF_delay Setting				
Energy Saving	Bn-39	Energy_Saving Gain	Bn-39= 100% Eg.Saving Gain	50 - 150%	1%	100%	Sec. 9.2.1
Monitor	Bn-40	Monitor 3	Bn-40=00 Display : Set_Freq.	00 - 30	1	0	

Cont.

Function	Parameter No.	Name	LCD display (English)	Setting range	Setting Unit	Factory Setting	Ref. Page
Pulse Input	Bn-41	Pulse Input Upper Limit	Bn-41=1440 Hz Pulse_Mul._Up_Bound	1440 - 32000	1 Hz	1440	Sec. 9.2.1
	Bn-42	Pulse Input Gain	Bn-41=100.0 % Pulse_Mul._Gain	0.0 - 1000.0	0.10%	100	
	Bn-43	Pulse Input Bias	Bn-41=000.0 % Pulse_Mul._Bias	-100.0 - 100.0	0.1Hz	0	
	Bn-44	Pulse Input Delay Time	Bn-41=0.10 s Pulse_Mul._Filter	0.00 - 2.00	0.01s	0.1	
–	Bn-45*1	Not Used	–	–	–	–	–
	Bn-46*1	Not Used	–	–	–	–	

*1 - These parameters are not available for 77.01 and later software versions.

Table 9.1.3 Cn- □□ Control Parameters

Function	Parameter No.	Name	LCD display (English)	Setting range	Setting Unit	Factory Setting	Ref.
V/F Pattern Setting	Cn-01	Input Voltage	Cn-01= 230.0V Input Voltage	150.0 - 255.0V *1	0.1V	230.0V *1	Sec. 9.2.2
	Cn-02	Max. Output Frequency	Cn-02= 060.0Hz Max. O/P Freq.	50.0 - 400.0Hz	0.1Hz	60.0Hz	
	Cn-03	Max. Output Voltage	Cn-03= 230.0Hz Max. Voltage	0.1 - 255.0V *1	0.1V	230.0V *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.			3.0Hz	
	Cn-06	Voltage At Middle Output Frequency	Cn-06= 014.9V Middle Voltage	0.1 - 255.0V *1	0.1V	15.5V *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 *1	0.1V	8.2V *1	
Motor Parameter	Cn-09	Motor Rated Current	Cn-09= 0003.3A Motor Rated I	*2	0.1A	3.3A *3	
	Cn-10	No Load Current Of Motor	Cn-10= 30% Motor No-Load I	0 - 99%	1%	30%	
	Cn-11	Rated Slip Of Motor	Cn-11= 0.0% Motor Rated Slip		0.10%	0.00%	
	Cn-12	Line-To-Line Resistance Of Motor	Cn-12= 05.732Ω Motor Line R	0 - 65.535Ω	0.001Ω	5.732 *3	
	Cn-13	Torque Compensation Of Core Loss	Cn-13= 0064W Core Loss	0 - 65535W	1W	64 *3	

Cont.

Function	Parameter No.	Name	LCD display (English)	Setting range	Setting Unit	Factory Setting	Ref.
DC Braking Function	Cn-14	DC Injection Braking Starting Frequency	Cn-14= 01.5Hz C Braking Start F	0.1 - 10.0 Hz	0.1Hz	1.5Hz	Sec. 9.2.2
	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			0.0s	
Frequency Limit	Cn-18	Frequency Command Upper Bound	Cn-18= 100% Freq.Cmd. Up Bound	0 - 109%	1%	100%	
	Cn-19	Frequency Command Lower Bound	Cn-19= 000% Freq. Cmd. Low Bound			0%	
Frequency Jump	Cn-20	Frequency Jump Point 1	Cn-20= 000.0Hz Freq. Jump 1	0.0 - 400.0Hz	0.1Hz	0.0Hz	
	Cn-21	Frequency Jump Point 2	Cn-21= 000.0Hz Freq. Jump 2				
	Cn-22	Frequency Jump Point 3	Cn-22= 000.0Hz Freq. Jump 3				
	Cn-23	Jump Frequency Width	Cn-23= 01.0Hz Freq. Jump Width	0.0 - 25.5Hz	0.1Hz	1.0Hz	
	Cn-24	Number of Auto Restart Attempt	Cn-24= 00 Retry Times	0 - 10	1	0	
	Cn-25	Stall Prevention During Acceleration	Cn-25= 170% Acc. Stall	30 - 200%	1%	170%	
	Cn-26	Stall Prevention During Running	Cn-26= 160% Run Stall			160%	
	Cn-27	Communication Fault Detection Time	Cn-27=01.0s Comm. Flt Det. Time	0.1 - 25.5s	0.1s	1s	
	Cn-28	LCD Digital Operator Display Unit	Cn-28= 00000 Operator Disp. Unit	0 -39999	1	0	
	Cn-29	Freq. Agree Detection Level During Accel.	Cn-29= 000.0Hz Acc. Freq. Det.Level	0.0 - 400.0Hz	0.1Hz	0.0Hz	
	Cn-30	Freq. Agree Detection Level During Decel.	Cn-30= 000.0Hz Dec. Freq. Det. Level				
	Cn-31	Frequency Agree Detection Width	Cn-31= 02.0Hz F Agree Det. Width	0.1 - 25.5Hz	0.1Hz	2.0Hz	
	Cn-32	Excess Load Detection Level	Cn-32= 160% Excess Load Level	0 - 200%	1%	160%	
	Cn-33	Excess Load Detection Time	Cn-33= 00.1s Excess Load Det.Time	0.0 - 25.5s	0.1s	0.1s	
	Cn-34	Carrier frequency setting	Cn-34= 6 Carry_Freq Setting	1- 6	1	6	

Cont.

Function	Parameter No.	Name	LCD display (English)	Setting range	Setting Unit	Factory Setting	Ref.
Speed Search Control	Cn-35	Speed Search Detection Level	Cn-35= 150% Sp-Search Level	0 - 200%	1%	150%	Sec. 9.2.2 & 9.2.3
	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		0.5s	
	Cn-38	V/F Curve in Speed Search	Cn-38= 80% Sp-search V/F Gain	10 - 100%	1%	80%	
Low Voltage Detection	Cn-39	Low Voltage Alarm Detection Level	Cn-39= 200V Low Volt. Det. Level	150 - 210V *1	1V	200V *1	Sec. 9.2.2
Slip Comp.	Cn-40	Slip Compensation Primary Delay Time	Cn-40= 02.0s Slip Filter	0.0 - 25.5s	0.1s	2.0s	
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	
	Cn-42	S-curve Characteristic Time at Accel. End	Cn-42= 0.0s S2 Curve Time				
	Cn-43	S-curve Characteristic Time at Decel. start	Cn-43= 0.0s S3 Curve Time				
	Cn-44	S-curve Characteristic Time at Decel. end	Cn-44= 0.0s S4 Curve Time				
Speed feedback control	Cn-45	PG Parameter	Cn-45= 0000.0 PG Parameter	0.0 - 3000.0P/R	0.1P/R	0.0P/R	Sec. 9.2.2 & Fig. 4.2.4
	Cn-46	Pole no. of Motor	Cn-46= 04P Motor Pole	2 - 32P	2P	4P	
	Cn-47	ASR Proportional Gain 1	Cn-47= 0.00 ASR Gain 1	0.00 - 2.55	0.01	0	Sec. 9.2.2
	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%	0.10%	5.00%	
	Cn-52	ASR Lower Bound	Cn-52= 00.1% ASR Low Bound			0.10%	
	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%	Sec. 9.2.2 & App-1
	Cn-56	PID Primary Delay Time Constant	Cn-56= 0.0s PID Filter	0.0 - 2.5s	0.1s	0.0s	

Cont.

Function	Parameter No.	Name	LCD display (English)	Setting range	Setting Unit	Factory Setting	Ref.
Sensorless Vector Control	Cn-57	Motor Line-to-Line Resistance (R1)	Cn-57= 02.233Ω Mtr LINE_R	0.001 - 60.000Ω	0.001Ω	2.233Ω *3	Sec. 9.2.2 & Appx A
	Cn-58	Motor Rotor Equivalent Resistance (R2)	Cn-58= 01.968Ω Mtr ROTOR_R			1.968Ω *3	
	Cn-59	Motor Leakage Inductance (Ls)	Cn-59= 9.6mH Mtr LEAKAGE_X	0.01- 200.00mH	0.01mH	9.6mH *3	
	Cn-60	Motor Mutual Inductance (Lm)	Cn-60= 149.7mH Mtr MUTUAL_X	0.1 - 6553.5mH	0.1mH	149.7mH *3	
	Cn-61	Slip Compensation Gain	Cn-61= 1.00 SLIP GAIN	0.00 - 2.55	0.01	1.00	
–	Cn-62*4	Not Used *4	–	–	–	–	
	Cn-63*4	Not Used *4	–	–	–	–	
PID Target Limit	Cn-64	PID Target Upper Limit	Cn-64 = 100% PID Target U_Limit	0 -100%	1%	100%	APP-1
	Cn-65	PID Target Lower Limit	Cn-65 = 0% PID Target L_Limit			0%	

*1 These values are for a 230V class inverter. Double the value for a 460V class inverter, and multiply the value by 2.875 for a 575v class inverter.

*2 The setting range is 10% - 200% of the inverter rated current.

*3 The factory setting values will vary based upon the inverter capacity selection (Sn-01) value. In this case, the setting is for 4-pole, 230V, 60Hz, 1Hp TECO standard induction motors.

*4. These parameters are not available for 77.01 and later software versions.

Table 9.1.4 Sn- □□ System Parameters

Function	Parameter No.	Name	LCD display (English)	Description	Factory Setting	Ref.
Capacity Setting	Sn-01	Inverter Capacity Selection	Sn-01= 01 220V 1HP	Inverter capacity selection	*1	Sec. 9.2.3
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	-	
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: C lear fault message 7: 2-wire initialization (230V/460V) 8: 3-wire initialization (230V/460V) 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	-	

Cont.

Function	Parameter No.	Name	LCD display (English)	Description	Factory Setting	Ref.
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	Sec. 9.2.3
	Sn-05	Frequency Command Selection	Sn-05= 0 Ref. Cmd. Operator	Frequency Command 0: Operator 1: Control circuit terminal 2: RS-485 communication 3: Pulse input		
	Sn-06	Stopping Method Selection	Sn-06= 0 Dec. Stop	0: Deceleration to Stop 1: Coast to Stop 2: Total_range braking stop 3: Coast to Stop with Timer (Restart after time Bn-02)		
	Sn-07	Priority of Stopping	Sn-07= 0 Stop Key Valid	When operation command is from control terminal or RS-485 communication port 0: operator stop key effective 1: operator stop key not effective		
	Sn-08	Prohibition of REV Run	Sn-08= 0 Allow Reverse	0: reverse run enabled 1: reverse run disabled		
	Sn-09	Output Frequency Up/Down Function	Sn-09= 0 Inhibit UP/DOWN	0: Reference frequency is changed through pressing the ”UP/DOWN” key, and then followed by pressing the “EDIT/ENTER” key. 1: Reference frequency will be changed immediately after the ”UP/DOWN” is pressed.		
	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%)		
	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		

Cont.

Function	Parameter No.	Name	LCD display (English)	Description	Factory Setting	Ref.
Operation Control Mode Selection *Cont.*	Sn-12	Excess Load Detection Selection	Sn-12= 0 Detection Invalid	0: Excess Load detection function is not effective. 1: Excess Load is detected only at frequency agree. Continue operation after detection. 2: Excess Load is detected only at frequency agree. Stop operation after detection. 3: Excess Load is detected during running (Accel.,Decel. included). Continue operation after detection. 4: Excess Load is detected during running (Accel., Decel included). Stop operation after detection.	0	Sec. 9.2.3 & 9.2.2
	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		
Protection Charac-teristic. selection	Sn-14	Stall Prevention During Acc. Function Selection	Sn-14= 1 Acc. Stall Valid	0: invalid (Excessive torque may cause stall) 1: valid (Stop acceleration if current exceeds Cn-25 setting)	1	Sec. 9.2.3
	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)		
	Sn-16	Stall Prevention During Running Function Selection	Sn-16= 1 Run Stall Valid	0: invalid 1: valid –Deceleration time 1 for stall prevention during running (No external brake unit used) 2: valid –Deceleration time 2 for stall prevention during running (No external brake unit used)	1	
	Sn-17	Fault Retry Setting	Sn-17= 0 Retry No O/P	0: No output for fault retry. (The fault contact does not operate.) 1: Output fault retry. (The fault contact operates.)	0	
	Sn-18	Operation Selection At Power Loss	Sn-18= 0 PwrL_to_ON Stop O/P	0: Stop running 1: Continue to run		
	Sn-19	Zero Speed Braking Operation Selection	Sn-19= 0 Z_braking Invalid	When analog speed reference is 0 during running , the braking function is ON 0: invalid 1: valid		
	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)		

Cont.

Function	Parameter No.	Name	LCD display (English)	Description		Factory Setting	Ref.
Protection Charac-teristic. selection *Cont.*	Sn-21	External Fault Contact ③ Detection Selection	Sn-21= 0 All Time Ext. Fault	0: Detect all time 1: Detect only during operation		1	Sec. 9.2.3
	Sn-22	External Fault Operation Selection	Sn-22 = 1 Ext. Fault Free run	0: Dec. to stop (Dec. time 1 Bn-02) 1: Coast (Free run) to stop 2: Dec. to stop (Dec. time 1 Bn-04) 3: Continue operating			
	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	
	Sn-24	Frequency Command Characteristics Selection at External Analog Input Terminal	Sn-24= 1 - Cmd. AIN	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	
Multi-function Digital Input Selection	Sn-25	Multi-Function Input Terminal ⑤ Function Selection	Sn-25= 02 Multi-Fun. Command1	00-33	The factory setting is multi-function command 1	02	Sec. 9.2.3 & Figs' 2.1.2, 2.1.3 & 4.1.1
	Sn-26	Multi-Function Input Terminal ⑥ Function Selection	Sn-26= 03 Multi-Fun. Command 2	01-33	The factory setting is multi-function command 2	03	
	Sn-27	Multi-Function Input Terminal ⑦ Function Selection	Sn-27= 06 Jog Command	02-33	The factory setting is jog command	06	
	Sn-28	Multi-Function Input Terminal ⑧ Function Selection	Sn-28= 07 Acc. & Dec Switch	03-33	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.	00-19	Multi-function analog input terminal (AUX) as Auxiliary frequency command. (factory setting)	00	

Cont.

Function	Parameter No.	Name	LCD display (English)	Description		Factory Setting	Ref.
Multi-function Digital Output Selection	Sn-30	Multi-Function Output Terminal (RA-RB-RC) Function Selection	Sn-30= 13 Fault	00-28	Terminal (RA-RB-RC or R1A-R1B-R1C) as fault output (factory setting)	13	Sec. 9.2.3 & Figs' 2.1.2, 2.1.3 & 4.1.1
	Sn-31	Multi-Function Output Terminal (DO1) Function Selection	Sn-31= 00 Running	00-28	Terminal (DO1-DOG) as digital output during running (factory setting).	00	
	Sn-32	Multi-Function Output Terminal (DO2) Function Selection	Sn-32= 01 Zero Speed	00-28	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. (10V / MAX frequency command, Cn-02) 1: Output frequency (10V / MAX. output frequency) 2: Output current (10V / input rated current) 3: Output voltage (10V / input voltage, Cn-01) 4: DC voltage (10V / 400V or 10V / 800.V)		00	
	Sn-34	Multi-Function Analog Output (AO2) Function Selection	Sn-34= 01 Term. AO2 O/P Freq.	5: External analog input command VIN (0-10V / 0-10V) 6: External analog input command AIN (0 – 10 V / 4 - 20mA) 7: Multi-function analog input (AUX) (10V / 10V) 8: PID control input 9: PID control output 1 10: PID control output 2 11: Communication Control 12 -14: HVAC Function		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	
RS-485 Commu-nication Function	Sn-36	Inverter Address	Sn-36= 01 Inverter Address	Inverter address can be set as 1~31		01	Sec. 9.2.3 & Fig. 4.2.5
	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 4: 19200 bps		3	
	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	

Cont.

Function	Parameter No.	Name	LCD display (English)	Description	Factory Setting	Ref.
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	Sec. 9.2.3, 9.2.1 & Fig. 4.2.5
	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	
	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	
	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	
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. (continue running from the unfinished step if restarting) 2: Auto_Run mode be performed periodically (continue running from the unfinished step if restarting) 3: Auto_Run mode for one single cycle, then hold the speed of final step to run. (continue 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)		Sec. 9.2.3
	Sn-45	Auto_Run Mode Operation Selection1	Sn-45= 0 Auto_Run Stop	0: stop (Bn-02) 1: forward 2: reverse	0	
	Sn-46	Auto_Run Mode Operation Selection2	Sn-46= 0 Auto_Run Stop			

Cont.

Function	Parameter No.	Name	LCD display (English)	Description	Factory Setting	Ref.
Auto_Run Mode *Cont.*	Sn-47	Auto_Run Mode Operation Selection3	Sn-47= 0 Auto_Run Stop	0: stop (Bn-02) 1: forward 2: reverse	0	Sec. 9.2.3, 9.1.1 & 9.2.2
	Sn-48	Auto_Run Mode Operation Selection4	Sn-48= 0 Auto_Run Stop			
	Sn-49	Auto_Run Mode Operation Selection5	Sn-49= 0 Auto_Run Stop			
	Sn-50	Auto_Run Mode Operation Selection6	Sn-50= 0 Auto_Run Stop			
	Sn-51	Auto_Run Mode Operation Selection7	Sn-51= 0 Auto_Run Stop			
	Sn-52	Auto_Run Mode Operation Selection8	Sn-52= 0 Auto_Run Stop			
	Sn-53	Auto_Run Mode Operation Selection9	Sn-53= 0 Auto_Run Stop			
	Sn-54	Auto_Run Mode Operation Selection10	Sn-54= 0 Auto_Run Stop			
	Sn-55	Auto_Run Mode Operation Selection11	Sn-55= 0 Auto_Run Stop			
	Sn-56	Auto_Run Mode Operation Selection12	Sn-56= 0 Auto_Run Stop			
	Sn-57	Auto_Run Mode Operation Selection13	Sn-57= 0 Auto_Run Stop			
	Sn-58	Auto_Run Mode Operation Selection14	Sn-58= 0 Auto_Run Stop			
	Sn-59	Auto_Run Mode Operation Selection15	Sn-59= 0 Auto_Run Stop			
	Sn-60	Auto_Run Mode Operation Selection16	Sn-60= 0 Auto_Run Stop			
	Sn-61	Applied Torque Mode	Sn-61= 0 Const. Tq. Load	0: Constant torque 1: Variable (quadratic) torque	0	Sec. 9.2.3
	Sn-62 [*2]	Not Used	Sn-62= 0 Reserved	–	–	

Cont.

Function	Parameter No.	Name	LCD display (English)	Description	Factory Setting	Ref.
	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: Test the EEPROM of digital operator 4: Test the EEPROM of inverter	0	Sec. 9.2.3
	Sn-64	PID Function	Sn-64=0 PID Invalid	0: PID invalid 1 - 8: PID valid	0	Sec. 9.2.3 & APP-1
	Sn-65 *2	Not Used	Sn-65=0 Reserved	–	–	–
Sensorless Vector Control	Sn-66	Motor Parameters Autotuning Selection	Sn-66=0 AUTO TUNE SEL	0: Autotuning invalid 1: Autotuning valid	0	Sec. 9.2.3 & Appnx A
	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		Sec. 9.2.3, 9.2.2 & Appx A
	Sn-68	Control selection	Sn-68＝0000 Control selection	_ _ _ 1: Output phase loss protection function valid _ _ _ 0: Output phase loss protection function invalid _ _ 1 _: Reserved _ _ 0 _: Reserved *2_ 1 _ _: ±10V analog voltage input function is valid *2_ 0 _ _: ±10V analog voltage input function is invalid 1 _ _ _: Frequency Up/Down hold function valid 0 _ _ _: Frequency Up/Down hold function invalid * 1-2HP inverter does not support Input of ±10V analog voltage.	0	Sec. 9.2.3
	Sn-69	Not Used	–	This parameter is not available for version 77.01 and later.	0	
	Sn-70	Not Used	–	This parameter is not available for version 77.01 and later.	0	

*1. The default setting will depend upon the inverter capacity.

*2. These parameters are not available for version 77.01 and later.

Table 9.1.4 P□- □□ Application Parameters

(The P parameters were developed mainly for fan and pump applications. **"App-2 Fan and PUMP Application Note"** covers this subject and details the use of these and other parameters.)

Function	Parameter No.	Name	LCD display (English)	Setting range	Factory Setting	Ref.
Engineering Unit	P1-01	Engineering Unit Selection	P1-01 Engineering Unit	00 - 25	00 (Set by Cn-28)	Sec. 9.2.4 & APP-1, APP-2
Maximum Feedback	P1-02	Maximum Feedback Selection	P1-02 Feedback Maximum	10 - 9999 (Engineering Units set by P1-01)	0	
Local / Remote	P1-03	Local / Remote Key	P1-03 Local / Remote Key	0: Enabled 1: Disabled	0	
Sleep Function	P1-04	Sleep Function Enable / Disable	P1-04 PID Sleep Function	0: PID Sleep Invalid 1: PID Sleep Valid	0	
	P1-05	PID Wakeup Direction	P1-05 PID Wakeup Direction	0: Feedback above 1: Feedback below	1	
External PID Control	P1-06	External PID Function	P1-06 Ext. PID Function	0: Ext. PID Invalid 1: Ext. PID, AO1 output 2: Ext. PID, AO2 output	0	Sec. 9.2.4 & APP-1
	P1-07	External PID Set Point Source	P1-07 Ext. PID Set Source	0: Set Point Parameter 1: Terminal VIN 2: Terminal AIN 3: Terminal AUX 4: Set Point RS-485	0	
	P1-08	External PID Set Feedback Source	P1-08 Ext. PID Fbk. Source	1: Feedback Term. VIN 2: Feedback Term. AIN 3: Feedback Term. AUX	3	
	P1-09	External PID Set Point Integral Limit	P1-09 Ext. PID I Limit	1 - 100%	100%	
	P1-10	External PID Filter Time	P1-10 Ext. PID Filter	0.0 - 2.5s	0.0s	
Sleep Function	P2-01	Sleep Start Level	P2-01 Sleep Start Level	000.00 - 100.00%	000.00%	Sec. 9.2.4 & APP-2
	P2-02	Sleep StartDelay	P2-02 Sleep Start Delay	000.1 - 600.0 s	0001.0 s	
	P2-03	Sleep Wakeup Level	P2-03 Sleep Wakeup Level	000.00 - 099.99%	000.00%	
	P2-04	Sleep Wakeup Delay	P2-04 Sleep Wakeup Delay	000.1 - 600.0 s	001.0 s	
External PID Control	P2-05	External PID Set Point Range	P2-05 Ext. PID Set Point	0.0 - 100.0%	0.0%	Sec. 9.2.4 & APP-1
	P2-06	External PID Set Point Feedback Gain	P2-06 Ext. PID Fbk. Gain	0.01 - 10.00	1.00	
	P2-07	External PID Set Point Proportional Gain	P2-07 Ext. PID P Gain	0.01 - 10.00	1.00	

Cont.

Function	Parameter No.	Name	LCD display (English)	Setting range	Factory Setting	Ref.
External PID Control	P2-08	External PID Set Point Integral Gain	P2-08 Ext. PID I Time	0.00 - 100.00 s	10.00 s	Sec. 9.2.4 & APP-1
	P2-09	External PID Set Point Derivative Gain	P2-09 Ext. PID D Time	0.00 - 1.00s	1.00 s	
	P2-10	External PID Bias	P2-10 Ext. PID Bias	-100 -100%	0%	
Load Loss	P3-01	Load Loss Detection Level	P3-01 Load Loss Det. Level	000 - 200%	030%	Sec. 9.2.4 & APP-2
	P3-02	Load Loss Detection Time	P3-02 Load Loss Det. Time	00.0 - 25.5s	05.0s	
	P3-04	Load Loss Action	P3-03 Load Loss Action	0: None 1: Load Loss Alarm 2: Load Loss Fault	0	
Feedback	P3-04		P3-04 Over Feedback Level	* 000.00 - 099.99%	000.00%	
	P3-05		P3-05 Over Fbk. Delay Time	0000.0 - 6000.0s	0003.0s	
	P3-06	Over Feedback Action	P3-06 Over Fbk. Action	0: None 1: Over Feedback Alarm 2: Over Feedback Fault	0	
	P3-07	Low Feedback Level	P3-07 Low Feedback Level	* 000.00 - 099.99%	000.00%	
	P3-08	Low Feedback Delay Time	P3-08 Low Fbk. Delay Time	0000.0 - 6000.0s	0003.0s	
	P3-09	Low Feedback Action	P3-09 Low Fbk. Action	0: None 1: Low Feedback Alarm 2: Low Feedback Fault	0	
Suction	P3-10	Low Suction Detection	P3-10 Low Suction Detect	1: PID Error 2: Current 3: Error and Current	1	
	P3-11	Low Suction Detection Time	P3-11 Low Suc. Det. Time	000 - 300s	100s	
	P3-12	Low Suction PID Error	P3-12 Low Suc. PID Error	01 - 30%	10%	
	P3-13	Low Suction Current	P3-13 Low Suction Current	000.1 - 200.0A	001.0 A	
	P3-14	Low Suction Action	P3-14 Low Suction Action	0: None 1: Low Suction Alarm 2: Low Suction Fault 3: Fault and Restart	1	
Restart	P3-15	Restart Delay	P3-15 Restart Delay	0005 – 6000s	0300s	
	P3-16	Restart Selection	P3-16 Restart Selection	0: With Speed Search 1: W/O Speed Search	1	

* The engineering units and range are set by parameter P1-01

Cont.

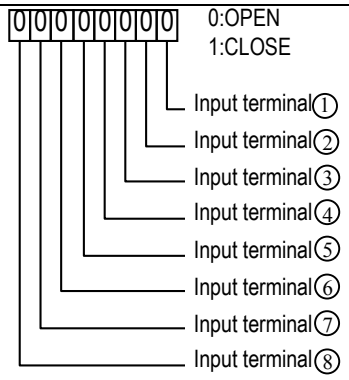
Function	Parameter No.	Name	LCD display (English)	Setting range	Factory Setting	Ref.
Flow Meter	P4-01	Flow Meter Function	P4-01 Flow Meter Function	0: None 1: Aux Input 2: Pulse Train Input	0	Sec. 9.2.4 & APP-1
	P4-02	Maximum Flow for 10V AUX	P4-02 Max Flow for 10V AUX	00000 – 50000 GPM	01000 GPM	
	P4-03	No Flow for AUX	P4-03 No Flow point for AUX	0.0 - 5.0V	0.0V	
	P4-04	Input Pulse Multiplier	P4-04 Pulse Multiplier	000.01 – 500.00	100.00	
	P4-05	Flow Meter Offset	P4-05 Flow Meter Offset	0.00 - 0.99	0.00	
Energy Monitoring	P5-01	Energy Cost per kWh	P5-01 Energy Cost per kWh	0.000 - 5.000$	0.000$	
	P5-02	Reset Energy Usage	P5-02 Reset Energy Usage	0: No 1: Reset	0	

Engineering Units Selection by Parameter P1-01

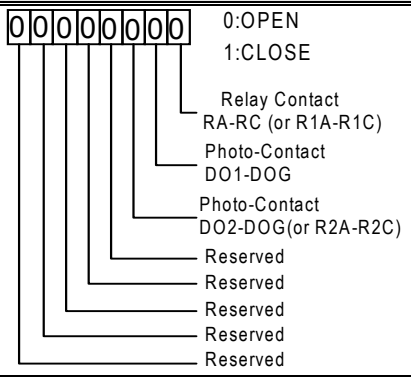
Setting	Engineering Unit	Description
0	Set by Cn - 28	
1	%	%
2	PSI	PSI
3	GPH	gallon / hour
4	GPM	gallon / minute
5	inW	Inch water
6	FPM	feet / minute
7	CFM	$feet^3$ / minute
8	in	inch
9	ft	feet
10	HP	HP
11	°F	°F
12	m/s	meter / second

Setting	Engineering Unit	Description
13	MPM	meter / minute
14	CMM	$meter^3$ / minute
15	W	W
16	kW	kW
17	°C	°C
18	m	meter
19	A	A
20	RPM	RPM
21	SPM	stroke/minute
22	/s	unit / s
23	/m	unit / m
24	/h	unit / h
25	-	none

Table 9.1.5 Un- □□ Monitoring Parameters

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 / 230V or 10V / 460V
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	—		—

Cont.

Parameter No.	Name	LCD display (English	Unit	Description	Multi-function Analog Output Level
Un-12	Output Terminal Status	Un-12= 00000000 O/P Term. Status	—		—
Un-13	Amount of PG Speed Feedback	Un-13 = 100.0% PG Feedback.	0.1%	100.0%=MAX. output frequency	-
Un-14	Amount of PG Speed Compen.	Un-14 = 100.0% PG Compen.			
Un-15	PID Control Input	Un-15 = 100% PID Input			10V / Max. output frequency
Un-16	PID Control Output 1	Un-16 = 100% PID Output1			
Un-17	PID Control Output 2	Un-17 = 00% PID Output2			
Un-18	Fault Message 1	Overcurrent Message 1	—	Fault message occurred last	—
Un-19	Fault Message 2	Overcurrent Message 2	—	Fault message occurred previous	—
Un-20	Fault Message 3	Overheat Message 3	—	Fault message occurred two times previous	—
Un-21	Fault Message 4	Excess Load Message 4	—	Fault message occurred three times pevious	—
Un-22	The Time Period Between Last Fault And The Current 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 When Fault Occurs	Un-23 = 60.00Hz Last Fault Freq.Cmd.	0.01Hz	—	—
Un-24	Output Freq. When Fault Occurs	Un-24 = 60.00Hz Last Fault O/P Freq.	0.01Hz	—	—
Un-25	Output Current When Fault Occurs	Un-25 = 12.5A Last Fault O/P I	0.1A	—	—

Cont.

Parameter No.	Name	LCD display (English	Unit	Description	Multi-function Analog Output Level
Un-26	Output Voltage When Fault Occurs	Un-26 = 220.0V Last Fault O/P V	0.1V	—	—
Un-27	DC Voltage When Fault Occurs	Un-27 = 310.0V Last Fault O/P V	0.1V	—	—
Un-28	I/P Terminal Status While Fault Occurs	Un-28 = 00000000 Last Fault I/P Term.	—	Same as Un-11, display terminal status	—
Un-29	O/P Terminal Status When Fault Occurs	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
Un-34	PID Feedback Display	Un-34 = 00000 PID Feedback	*1	Displays PID feedback signal	
Un-35	During PID Sleep	Un-35 During PID Sleep	0 or 1	Displays whether or not the inverter is in the sleep mode.	
Un-36	Output Power	Un-36 Output Power	0.0 - 999.9 kW	Displays the power output in kW	
Un-37	Energy Used in kWh	Un-37 Energy Used in kWh	0.0 - 999.9 kWh	Displays the energy usage in kWh	
Un-38	Energy Used in MWh	Un-38 Energy Used in MWh	0.0 - 50000 MWh	Displays the energy usage in MWh	
Un-39	Energy Cost in $	Un-39 Energy Cost in $	0 - 9999 $	Displays the energy usage in Dollars ($)	
Un-40	Energy Cost in 10000$	Un-40 Cost in 10000$	0 - 25000 (0$ - 250 Mil$)	Displays the energy usage in Ten Thousand Dollar Units ($)	

Cont.

Parameter No.	Name	LCD display (English	Unit	Description	Multi-function Analog Output Level
Un-41	Flow Meter	Un-41 Flow Meter	GPM	Displays Gallons per Minute (GPM)	
Un-42	Ext. PID Feedback	Un-42 Ext. PID Feedback	%	Displays the External PID Feedback Value	
Un-43	Ext. PID Input	Un-43 Ext. PID Input	%	Displays the External PID Set Point Value	
Un-44	Ext. PID Output 1	Un-44 Ext. PID Output 1	%	Displays the External PID Output Value	
Un-45	Ext. PID Output 2	Un-45 Ext. PID Output 2	%	Displays the External PID Output (2) Value	

*1. The unit can be changed through parameter P1-01.

9.2 Parameter Detail

9.2.1 Parameters Bn- (Parameter Groups that can be Changed During Running)

Bn-01 - Acceleration Time 1 (0.0 – 6000.0s)
Bn-02 - Deceleration Time 1 (0.0 – 6000.0s)
Bn-03 - Acceleration Time 2 (0.0 – 6000.0s)
Bn-04 - Deceleration Time 2 (0.0 – 6000.0s)

- 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.
- Using one of the multi-function inputs terminals ⑤-⑧, two different acceleration / deceleration times set by (1st) Bn-01& Bn-02 and (2nd) Bn-03 & Bn-04 may be selected by opening or closing an external switch contact. This switching can be done while the drive is operating. (See Fig. 9.2.1.1 below)

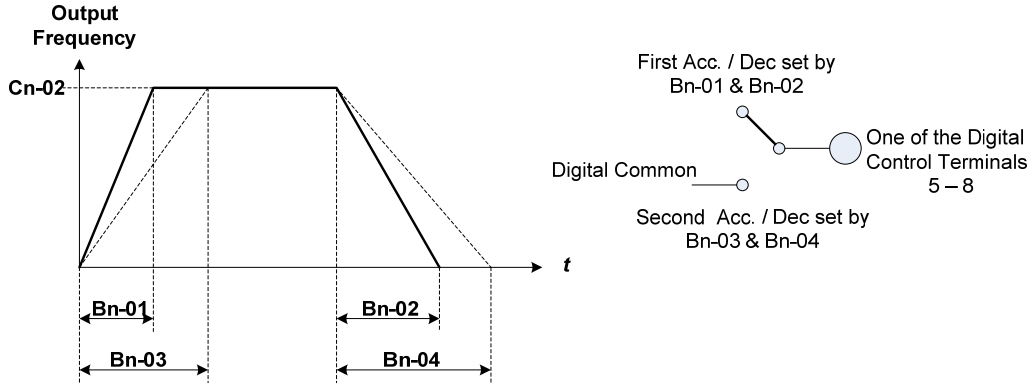


Fig. 9.2.1.1 Two Separate Acceleration and Deceleration Times

Note:
S-curve characteristic times can be set for beginning-accel., end-accel., beginning-decel. and end-decel. using parameters Cn-41 to Cn-44.

Bn-05 - Analog Frequency Command Gain (Voltage) (0.0 – 1000.0%)
Bn-06 - Analog Frequency Command Bias (Voltage) (-100.0 – 100.0%)
Bn-07 - Analog Frequency Command Gain (Current) (0.0 – 1000.0%)
Bn-08 - Analog Frequency Command Bias (Current) (-100.0 – 100.0%)
Bn-09 - Multi-function Analog Input Gain (0.0 – 1000.0%)
Bn-10 - Multi-function Analog Input Bias (-100.0 – 100.0%)

For each analog input frequency command (voltage or current) and multi-function analog inputs, the corresponding gain and bias should be set using parameters Bn-05 to Bn-10. (See Fig. 9.2.1.2)

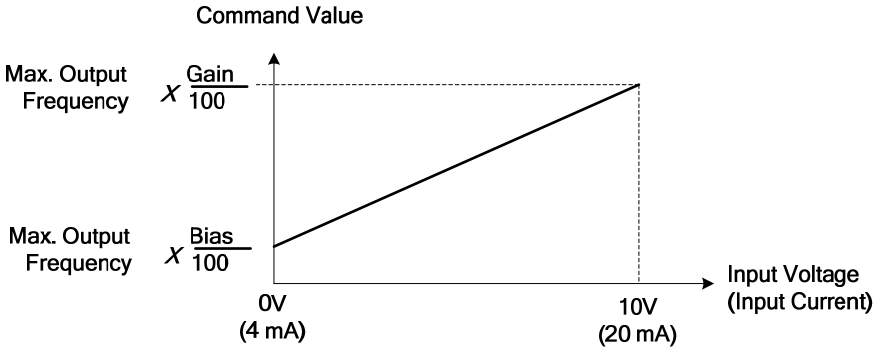


Fig. 9.2.1.2 Analog Input Gain and Bias

Bn-11 - Auto Torque Boost Gain (0.0 – 2.0)

The inverter can automatically increase the output torque of the drive to compensate for load increases using the auto torque boost function. In the case that the wiring distance between the inverter and the motor is excessive (e.g. more than 100m), the motor torque may become insufficient because of the voltage drop. To compensate for this, increase the value of Bn-11 gradually but make sure that the current increase is not excessive. Normally however, no adjustment is necessary.

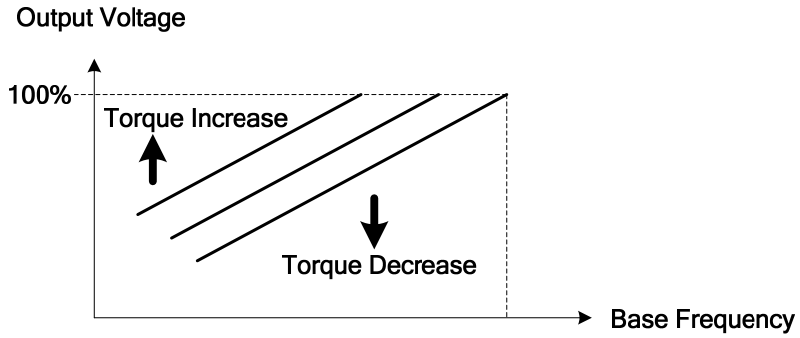


Fig. 9.2.1.3 Adjust Auto Torque Boost Gain to Increase Output Torque

- If the drive motor capacity is less than the inverter capacity (Max. applicable motor capacity), increase the setting.
- If the motor oscillates excessively, lower the setting.

Bn-12 - Monitor 1 (1 – 30)
Bn-13 - Monitor 2(1 – 30)

- In the DRIVE mode, 2 inverter input / output statuses can be monitored at the same time. The specified items are set by parameters Bn-12 and Bn-13. Refer to Table 9.2.1.1 below for the selectable monitored items.

Table 9.2.1.1a Setting of Bn-12 and Bn-13 Monitoring contents

Bn-12 or Bn-13 Setting	Monitoring contents	Description
01	Freq.Cmd.	Frequency Command
02	O/P Freq.	Output Frequency
03	O/P I	Output Current
04	O/P V	Output Voltage
05	DC Volt	Main Circuit DC Voltage
06	Term. VIN	Terminal Command VIN
07	Term. AIN	Terminal Command AIN
08	Term. AUX	Terminal Command AUX
09	x Output	Analog Output AO1
10	x Output	Analog Output AO2
11	I/P Term	Input Terminal Status
12	O/P Term	Output Terminal Status
13	Sp. FBK	PG Speed Feedback
14	Sp. Compen.	PG Speed Compensation
15	PID I/P	PID Input
16	PID O/P	PID Output 1
17	PID O/P	PID Output 2
18	Motor Sp.	Motor Speed

Cont.

- For versions 77.01 and later, eight additional monitor items were added for HVAC applications and are listed in Table 9.2.1.1b below.

Table 9.2.1.1b Setting of Bn-12 and Bn-13 Monitoring contents

Bn-12 or Bn-13 Setting	Monitoring contents	Description
19	PID FBK.	PID Feedback
20	PID Sleep	PID Sleep Status
21	O/P Power	Output Power
22	Reserved	Reserved
23	Reserved	Reserved
24	Reserved	Reserved
25	Reserved	Reserved
26	FLOW	Flow Meter Display
27	E_PID FBK	External PID Feedback
28	E_PID I/P	External PID Input
29	E_PID O/P	External PID Output 1
30	E_PID O/P	External PID Output 2

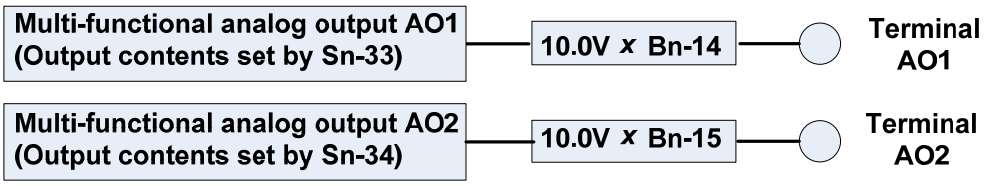
- Some examples:

Example	Bn -	Display	
(1)	Bn-12= 02 Bn-13= 01	O/P Freq. Freq.Cmd.	15.00Hz 15.00Hz
(2)	Bn-12= 03 Bn-13= 05	O/P I DC Volt	21.0A 311V
(3)	Bn-12= 11 Bn-13= 12	I/P Term. O/P Term.	00101010 00010010

Note: While monitoring, use the ⋀ or ⋁ key to display the information for the next lower-row. The setting of Bn-12 and Bn-13 does not change.

Bn-14 - Multi-function Analog Output AO1 Gain (0.01 – 2.55)
Bn-15 - Multi-function Analog Output AO2 Gain (0.01 – 2.55)

The output voltage of the Multi-function analog outputs AO1 and AO2 can be set (scaled) using parameters Bn-14 and Bn-15 respectively.



Bn-16 - PID Detection Gain (0.01 – 10.00)
Bn-17 - PID Proportional Gain (0.01 – 10.00)
Bn-18 - PID Integral Time (0.00 – 100.00s)
Bn-19 - PID Differential Time (0 – 1.00s)
Bn-20 - PID Bias (0 -109%)
Refer to: App-1 PID Application Note for further information and application details.

Bn-21 to Bn-36 - Time Setting in Auto_Run Mode In Auto_Run mode, the time setting for individual steps is described in "(Sn-44-60) auto run mode selection and enable". (0.0 – 6000.0s)
Bn-37 - Timer ON_Delay Time (0.0 – 6000.0s)
Bn-38 - Timer OFF_Delay Time (0.0 – 6000.0s)

- The timer function is enabled when the timer function input setting (Sn-25-28=19) and the output setting (Sn-30-32=21) are set for multi-function input and output respectively.
- These inputs and outputs serve as general-purpose I/O's. Setting ON/OFF delay time (Bn-37 / Bn-37) for the timer can prevent input switch contact bounce etc.
- When the timer input ON time is longer than the value set for Bn-37, the timer function output turns ON.
- When the timer input OFF time is longer than the value set for Bn-38, the timer function output turns OFF.

An example is shown below in Fig. 9.2.1.4.

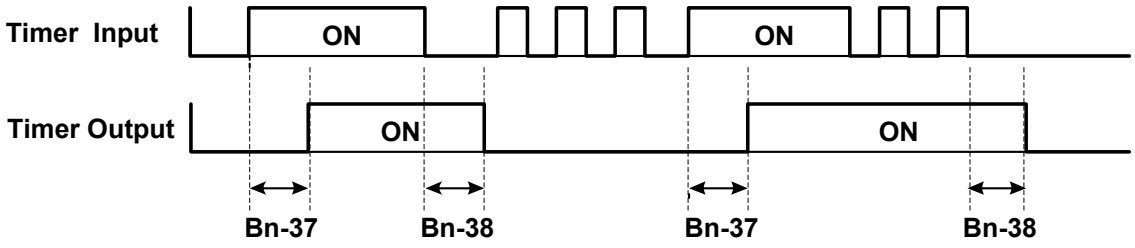


Fig. 9.2.1.4 Timer Input / Output Example

Bn-39 - Energy Saving Gain (50 – 150%)

- The input the energy saving command causes the inverter output voltage to be reduced when the motor load is light , thus saving energy. This value is set as a percentage of the V/F pattern. The setting range is 50 - 150%. When Bn-39 is set to 100% (factory default) the energy saving function is disabled. When Bn-39 is not set to 100%, the energy saving function is enabled.
- In the 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 so small that the motor will stall.
- The energy saving function is disabled when using PID close-loop control and during acceleration and deceleration.

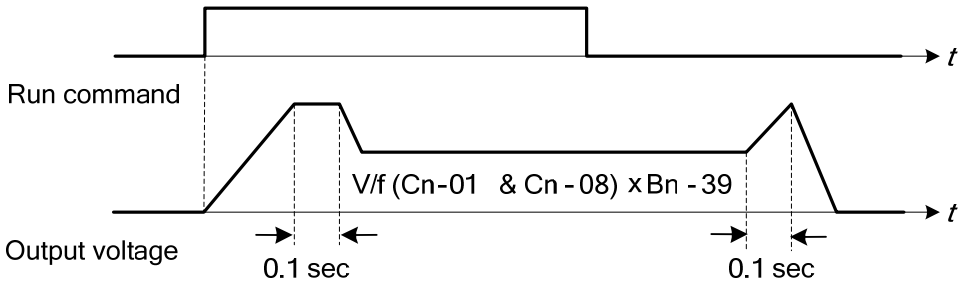


Fig. 9.2.1.5 Energy Savings Time Chart

Bn-40 - Monitor 3 (00 – 30)

- This parameter sets the display contents immediately after power is applied.
- When Bn-40 = 00, and power is applied, the first line will display frequency command value, while the second line will display the characters “TECO” as shown in the following diagram:

Freq . Cmd. : 15.00 Hz
TECO

- When Bn-40 = 01 - 30, the display will show the set monitored items after power is applied. The first line of the display content is determined by Bn-12. The second line is determined by Bn-40 as shown in the following example:

Set by: Bn-12 = 01	**Freq . Cmd. : 15.00 Hz**
Bn-40 = 02	**O / P Freq.: 00.00 Hz**

- Bn-40 = 01-30 parameter description is same with Bn-12, Bn-13.
  Refer to Tables 9.2.1a and 9.2.1b, “Setting of Monitoring Contents“.

Bn-41 to Bn-44 - Pulse Input setting (1440 – 32000)

- Set Sn-05 = 3 before starting Pulse Input function. Refer to parameter Sn-05 for details.
- Refer to the following Fig.9.2.1.6.

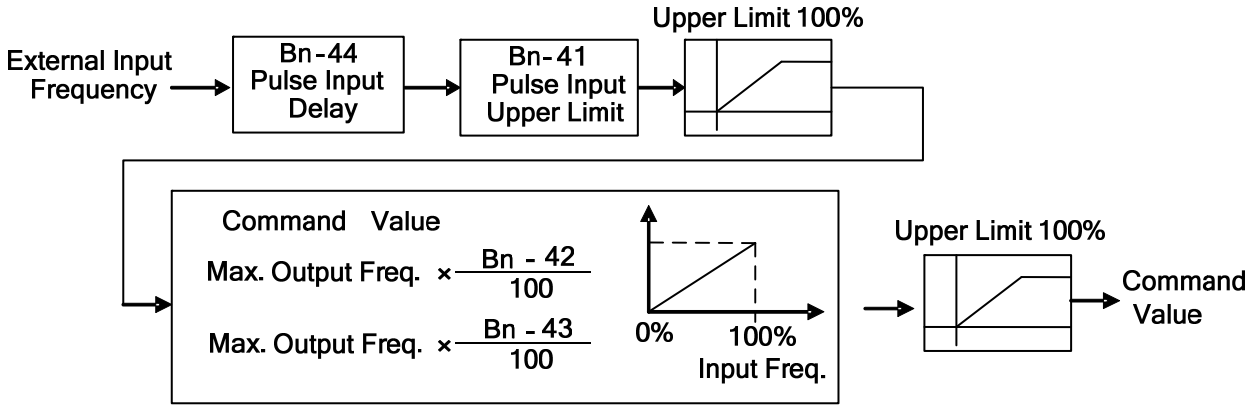


Fig. 9.2.1.6 Pulse Input Function

Bn-45 - PID Feedback Display at 0%
Bn-46 - PID Feedback Display at 100%
These parameters are not available for software version 77.01 and later. In this case Use parameter Feedback Maximum (P1-02). See P parameters for details.

9.2.2 Parameters Cn- (Control Parameters)

Cn-01 - Input Voltage Setting (Range depends on inverter voltage class. See parameter summary)

- Set the inverter voltage to match the input power supply voltage (e.g. : 200V / 230V, 380V /415V /440V /460V / 575V)

Cn-02 to Cn-08 - V/F Curve Parameter Settings (See parameter summary for setting range)

- The V/F curve can be set to either one of the preset curves (Sn-02 = 0 -14) or a customer set curve (Sn-02 = 15).
- Cn-02 - Cn-08 can be set by the user when Sn-02 is set to 15. The user-defined V/F curve can be specified using the settings of Cn-02 - Cn-08 as shown in Fig. 9.2.2.1a. The factory default setting is a straight line for the V/F curve (Cn-05=Cn-07, Cn-06 is not used) as shown below in Fig. 9.2.2.1b for the 230V / 60Hz example.

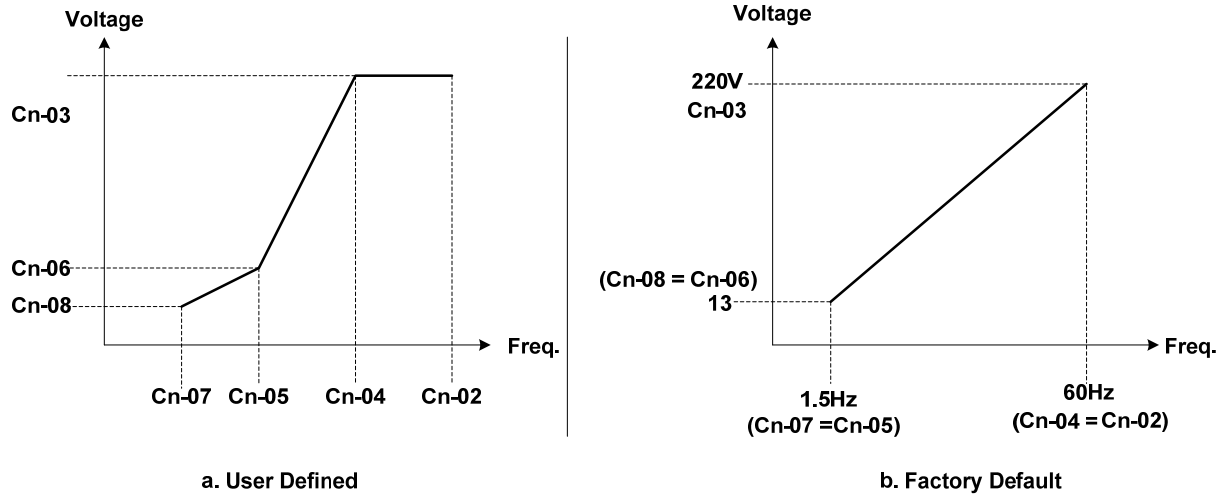


Fig. 9.2.2.1 User Defined V/F Curve

- When operating at low speed (<3Hz), a larger torque can be generated by increasing the slope of V/F curve. However, the motor temperature will increase due to over-excitation and may result in a fault. Based on the applied load, adjust the V/F curve and observe the magnitude of the motor current.
- The four frequency settings must satisfy the following relationship, otherwise an error message “V/F Curve Invalid” will be displayed.
  (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.

Cn-09 Motor Rated Current (10% - 200% of the inverter rated output current)

- 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 to that shown on the motor nameplate if not using a TECO 4-pole motor.

Cn-10 Motor No-Load Current (0 – 99%)

- This setting is used as a reference value for torque the 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. 9.2.2.2)

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

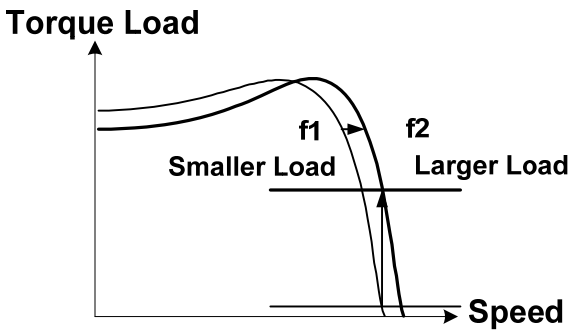


Fig. 9.2.2.2 Output Frequency with Slip Compensation

Cn-11 Motor Rated Slip (0.0 - 9.9%)

- This setting is used as a reference value for the torque compensation function (See Fig. 9.2.2.3). The setting range is 0.0 - 9.9% of the motor maximum voltage frequency with Cn-04=100%.
- The setting is shown in Fig. 9.2.2.3 in the constant torque and constant output range. If setting Cn-11 is zero, no slip compensation is used.
- There is no slip compensation when the frequency command is less than the Min. output frequency or during regeneration.

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

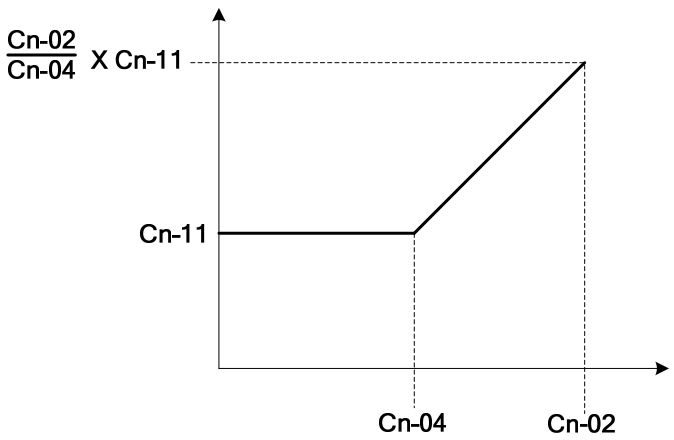


Fig. 9.2.2.3 Slip Compensation Limit

Cn-12 Motor Line-to-Line Resistance (0 – 65.535Ω)
Cn-13 Motor Iron-Core Loss (0 – 65535W)
This parameter is used for the torque compensation function. The default setting depends on the inverter capacity (Sn-01). Normally, the setting does not need to be changed. See Table 10 - 11 on page 3-36.

Cn-14 DC Injection Braking Starting Frequency (0.1 – 10.0Hz.)
Cn-15 DC Injection Braking Current (0 – 100%)
Cn-16 DC Injection Braking Time at Stop (0.0 – 25.5 Sec.)
Cn-17 DC Injection Braking Time at Start (0.0 – 25.5 Sec.)

- The DC injection braking function decelerates the motor by applying a DC current to the motor windings and is active in the following two cases:
  a.) DC injection braking time at start: This is used to temporarily stop and then restart a motor coasting from inertia in a drive without regeneration.
  b.) DC injection braking time at stop: This is used to prevent the motor from coasting over an extended time due to a high inertia load. Increasing the DC injection braking time (Cn-16) or increasing the DC injection braking current (Cn-15) will decrease the stopping time.
- The DC injection braking current parameter (Cn-15) sets the current level that is active at the time of DC injection braking. The braking current is set as a percentage of inverter rated output current at 100%.
- The DC injection braking start time (Cn-17) starts when the motor is started.
- The DC injection braking start frequency (Cn-14) is set at the point where the DC injection braking for deceleration is to begin. If this frequency is less than the Min. output frequency (Cn-07), the DC injection braking will then begin at the Min. output frequency.
- If the DC injection braking time at start (Cn-17) is 0.0s, the motor starts from the Min. output frequency (Cn-07) and DC injection braking is not enabled.
- If the DC injection braking time at stop (Cn-16) is 0.0s, DC injection braking is not enabled. In this case, the inverter output will be blocked when the output frequency is less than the DC injection braking at the start frequency (Cn-14).

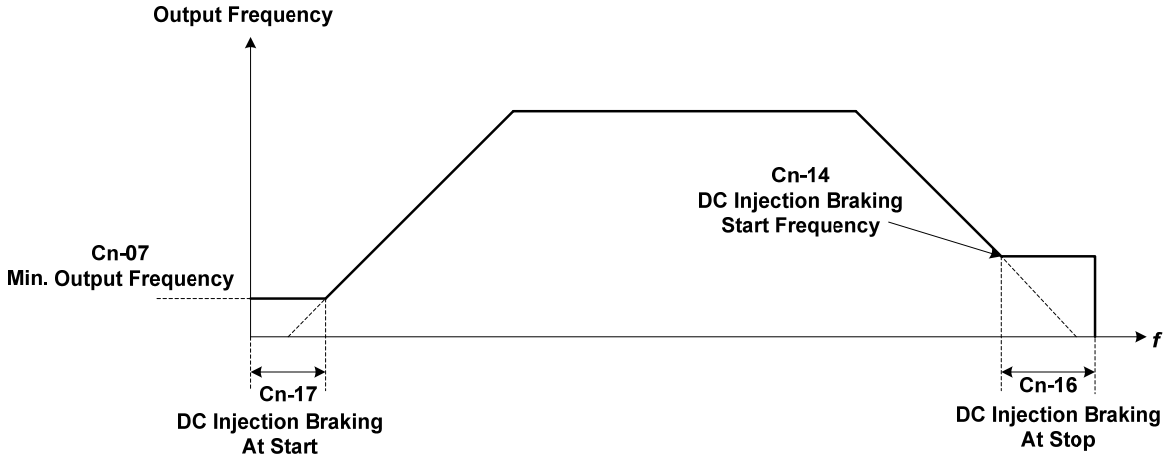


Fig. 9.2.2.4 DC Injection Braking Time Chart

Cn-18 Frequency Command Upper Bound (0 – 109%)
Cn-19 Frequency Command Lower Bound (0 – 109%

- The upper and lower bounds of the frequency command are set as a percentage of the Max. output frequency (Cn-02 is 100%), in increments of 1%.
- The relationship Cn-18 > Cn-19 must be maintained otherwise an error message, “Freq. Limit Setting Error” may occur.

Cont.

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

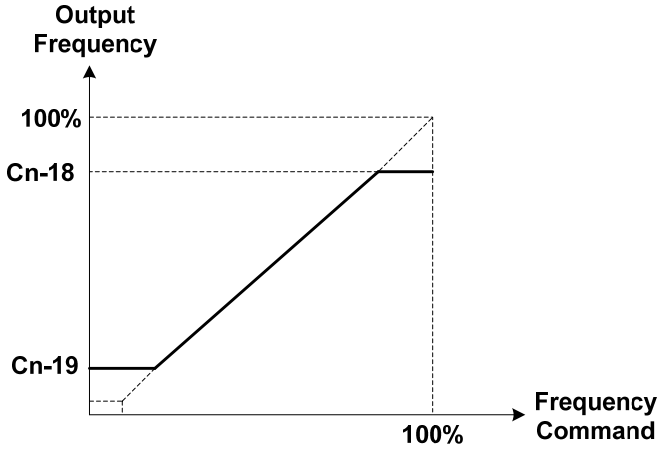


Fig. 9.2.2.5 Upper and Lower Bound of the Frequency Command

Cn-20 Frequency Jump Point 1 (0.0 – 400.0Hz.)
Cn-21 Frequency Jump Point 2 (0.0 – 400.0Hz.)
Cn-22 Frequency Jump Point 3 (0.0 – 400.0Hz.)
Cn-23 Jump Frequency Width (0.0 –25.5Hz.)

- These parameters allow the "jumping over" of certain frequencies that can cause unstable operation due to resonance within some driven systems.

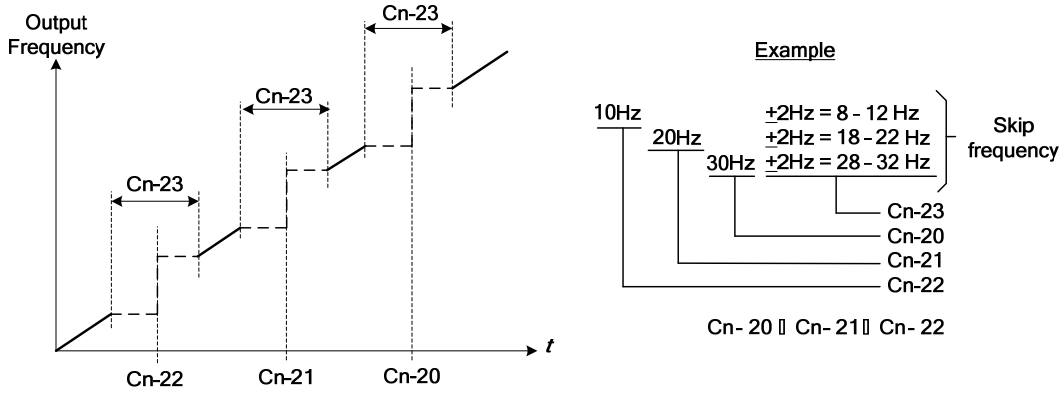


Fig. 9.2.2.6 Jump Frequency Settings

- Operation within the jump frequency range is not allowed, but transitions during acceleration and deceleration through these set ranges are smooth with no jump. To disable this function, set the jump frequencies 1-3 (Cn-20 - Cn-22) to 0.0Hz.
- For the jump frequencies 1 - 3 (Cn-20 - Cn-22), set the center frequency to be jumped.
- Be sure to set the jump frequencies so that Cn-20 ≥ Cn-21 ≥ Cn-22. If not, a message "Jump frequency setting error" will be displayed. Parameter Cn-23 sets the jump frequency bandwidth. If Cn-23 is set to 0.0Hz, the jump frequency function is disabled.

Cn-24 Number of Auto Restart Attempts (1 – 10)

- 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 active when the following faults occur.
  Over-current, Ground fault and Main circuit Over-voltage
  With other faults, the protective operations will engage immediately without attempting to restart operation.
- The fault restart count will automatically increase upon each attempted restart. If the drive restarts within the set number of accumulated tries then the count will be reset to 0 when the operation is normal for 10 minutes. If the accumulated number of tries exceeds the set count then no further attempts will be made and the drive will only start when the fault is cleared and the fault-reset input is received. (e.g., by pressing RESET or enabling the Fault reset terminal ③) or 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 parameters Sn-30 – Sn-32).

Cn-25 Stall Prevention Level During Acceleration (30 – 200%)
Cn-26 Stall Prevention Level During Running (30 – 200%)

- A motor stall can occur when a large load is applied or on sudden acceleration with a high inertia load. 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: Acceleration will stop if Cn-25 setting is exceeded. The acceleration will resume when the current is less than Cn-25. (See Fig. 9.2.2.7a.)
- Stall Prevention During running: Deceleration is started if the run stall prevention level Cn-26 is exceeded. Acceleration will resume when the current level is less than Cn-26. (See Fig. 9.2.2.7b.)

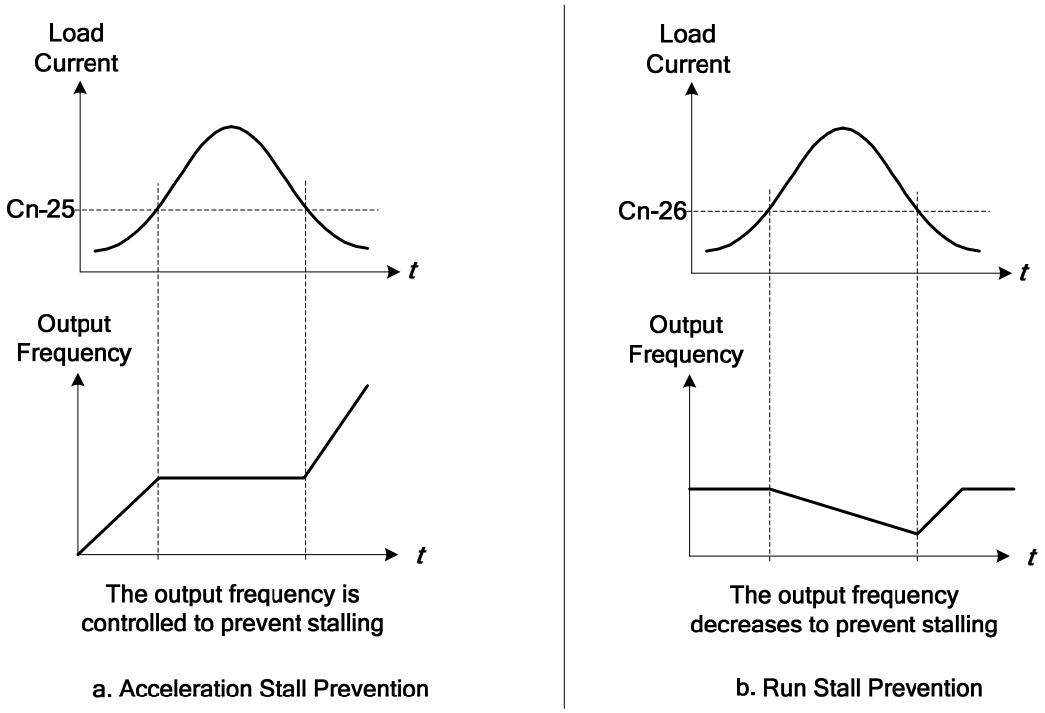


Fig. 9.2.2.7 Stall Prevention Function

- Set the parameters Cn-25 and Cn-26 as a percentage of inverter rated current. (100% corresponds to inverter rated current).
- See page 3-45, 3-46 for stall prevention function selection.

Cn-27 Communication Fault Detection Time (0.1 - 25.5s)
Please refer to “MODBUS / PROFIBUS Application Manual”.

Cn-28 LCD Digital Operator Display Unit (0 – 39999)

- This parameter sets the units to be displayed for the frequency command and frequency monitoring as described below in the following Table 9.2.2.1.

Table 9.2.2.1 Digital Operator Display Units

Cn-28	Setting / Reading Content
	Frequency Command / Monitoring
0	Units of 0.01 Hz
1	Units of 0.01%
2 to 39	Set in the units of r / min (0 to 39999). r / min = 120 x frequency reference (Hz) / Cn-28 (Set the number of motor poles in Cn-28, only even data is allowed)
40 to 39999	The position of decimal point is set by the value of the 5th digit of Cn-28. 5th digit = 0: Displayed as XXXX 5th digit = 1: Displayed as XXX.X 5th digit = 2: Displayed as XX.XX 5th digit = 3: Displayed as X.XXX The 1st digit to 4th digits of Cn-28 set the value of 100% frequency.

Example 1:
If 200.0 represents a speed of 100%, Cn-28 = 12000.
60% speed is displayed as 120.0
Example 2:
If 65.00 represents a speed of 100%, Cn-28 = 26500.
60% speed is displayed as 39.00

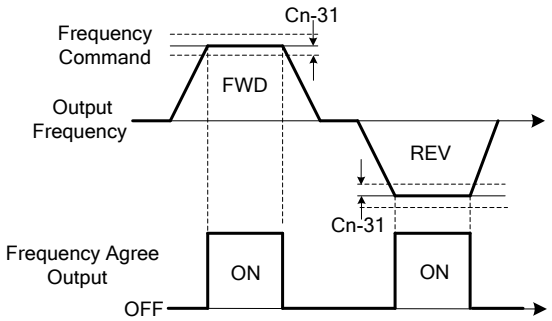
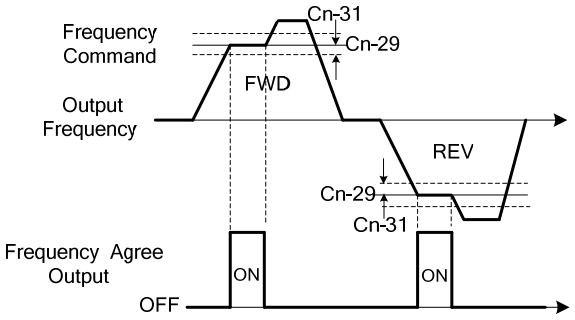
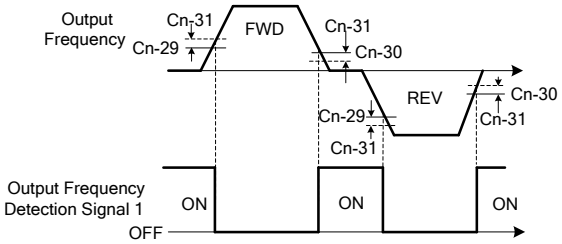
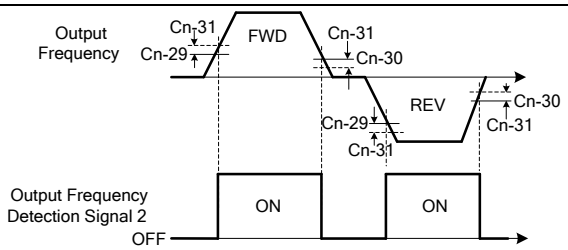
- The function of Cn-28 is valid while the Engineering Unit (P1-01) is 0 (invalid). If the Engineering Unit (P1-01) is set to nonzero value, the frequency command display format is then set by P1-01 and P1-02.

Cn-29 Frequency Agree Detection Level During Acceleration (0.0 – 400.0Hz.)
Cn-30 Frequency Agree Detection Level During Deceleration(0.0 – 400.0Hz.)
Cn-31 Frequency Agree Detection Width (0.10 – 25.5Hz.)

- Using parameters Sn-30 - Sn-32, the multi-function output terminals RA-RB-RC or R1A-R1B-R1C, DO1, DO2 or R2A-R2C can be programmed to output the desired Frequency Agree signal, Setting Frequency Agree and Output Frequency Detection level.
- The following Table 9.2.2.2 shows the various settings for the frequency detection function.

Cont.

Table 9.2.2.2 Frequency Detection Function

Function	Frequency Detection Operation	Description
Frequency Agree		• When the Output freq. is within the Freq. command +/- Freq. detection width (Cn-31), the Frequency agree output is “ON”. • Set Sn-30 - Sn-32 to 02 (Frequency agree).
Setting Frequency Agree		• After acceleration, when the Output freq. reaches the Freq. agree detection level, (Cn-29) and is within the Freq. agree detection width (Cn-31), the Agreed freq. output is “ON”. • Set Sn-30 - Sn-32 to 03 (Setting freq. agree.)
Output Frequency Detection 1		• During acceleration, when the Output freq. is less than Freq. agree detection level (Cn-29), Output freq. detection 1 is “ON”. • During deceleration, when the Output freq. is less than Freq. agree detection level (Cn-30), Output freq. detection 1 is “ON”. • Set Sn-30 - Sn-32 to 04 (Output freq. detection 1)
Output Frequency Detection 2		• During acceleration, when the Output freq. is greater than Freq. agree detection level (Cn-29), Output freq. detection 2 is “ON”. • During deceleration, when the Output freq. is greater than Freq. agree detection level(Cn-30), Output freq. detection 2 is “ON”. • Set Sn-30 - Sn-32 to 05 (Output freq. detection 2)

Cn-32 Excess Load Detection Level (0 – 200%)
Cn-33 Excess Load Detection Time (0.0 – 25.5s)

- The excess load Detection Function detects excessive mechanical load from an increase in output current.
- An excess load condition is detected when the output current exceeds the Excess Load Detection Level (Cn-32) for longer than the Excess Load Detection Time (Cn-33). (See Fig.9.2.2.8)
- The Multi-Function Output Terminals RA-RB-RC or R1A-R1B-R1C, DO1, DO2 or R2A-R2C can be set to indicate that an excess load condition has been detected.

Cont.

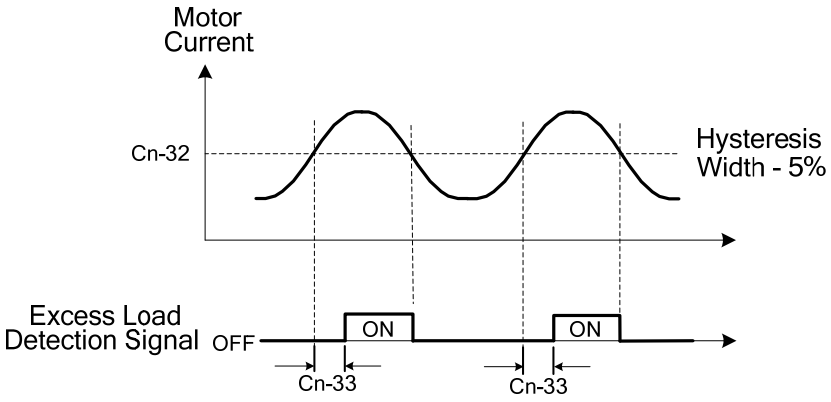


Fig. 9.2.2.8 Excess Load Detection

- Set the value of Sn-12 (Excess Load Detection Selection) to select:
  a. Excess Load Detection only during speed agree- Stop output or continue running after excess load condition is detected.
  b. Excess Load Detection at any time - Stop output, or continue running after excess load condition is detected.
- The excess load detection level (Cn-32) must be higher than the load loss detection level set by (P3-01), otherwise, an error message “Load Detection Setting Error” will be displayed.

Cn-62 Torque Detection Level 2

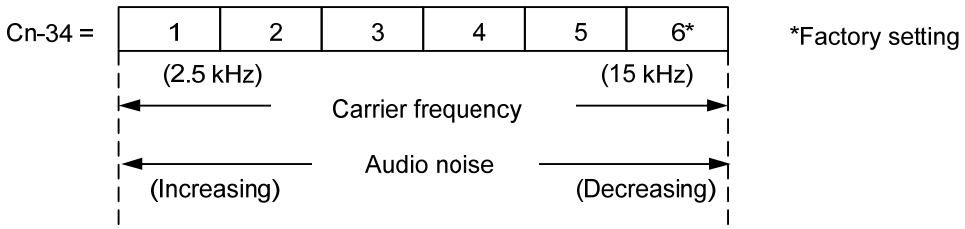
Cn-63 Torque Detection Time 2

Parameters Cn-62 and Cn- 63 are not available in version 77.01 and later. Use Cn-32 and Cn-33 to set excess load detection level and time, and use P3-02 and P3-03 to set load loss detection level and time.

Cn-34 Carrier Frequency Setting (1 – 6)

- Lowering the carrier frequency can decrease noise interference and leakage current. The settings are shown below.

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



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

Wring distance	< 100ft.	100-165ft.	166-328ft.	≥ 329ft.
Carrier frequency (Cn-34)	<15kHz	<10kHz	<5KHz	<2.5KHz

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

Cn-35 Speed Search Detection Level (0 – 200%)
Cn-36 Speed Search Time (0.1 – 25.5s)
Cn-37 Min. Baseblock Time (0.5 – 5.0s)
Cn-38 Speed Search V/F Curve (10 – 100%)

- The speed search function will search the speed (frequency) of a coasting motor starting with the frequency command or maximum frequency. Using this frequency value the motor will be restarted from this point providing a smooth recovery. This is effective in situations such as switching from a commercial power supply to an inverter without tripping.
- The timing of speed search function as shown in Fig. 9.2.2.9 below.

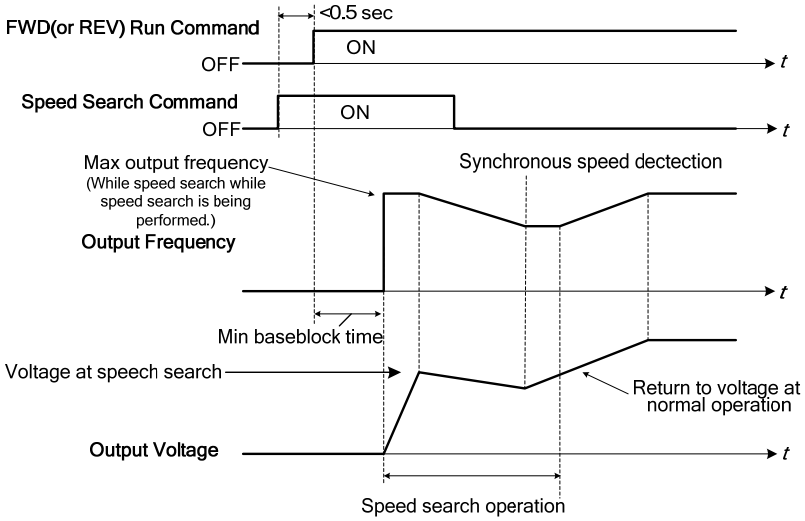
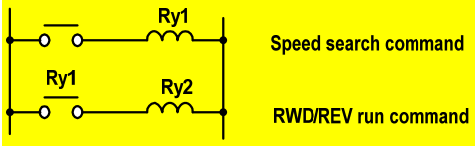


Fig. 9.2.2.9 Speed Search Timing Chart

- The speed search command can be set through one of the multi-function contact input terminals ⑤ - ⑧ using parameters Sn-25 - Sn-28.
  If Sn-25 - Sn-28= 21: Speed search is performed from the 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 the speed search command and then enable the run operation. The inverter will begin to search the motor speed after the min. baseblock time set by parameter Cn-37.
- In 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. Using the 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 the V/F curve (Cn-38) in order to prevent the OC protection function from being enabled. Normally, the V/F curve need not be changed. (As below)
- The speed search operating V/F curve = Cn-38 x (normal operating V/F curve)

Notes: 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- The FWD/REV command must be performed after or at the same time the speed search command is enabled. A typical operation sequence is shown below.



3- When the speed search and DC injection braking are enabled, the Min. baseblock time (Cn-37) must be set long enough to allow for the motor's residual voltage to decrease. If an overcurrent is detected when starting a speed search and DC injection braking is active, increase the setting of Cn-37 to prevent a fault from occurring. As a result, the Cn-37 setting cannot be set too small.

Cn-39 Low Voltage Alarm Detection Level (Range depends on the inverter voltage class)

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

Cn-40 Slip Compensation Primary Delay Time (0.0 – 25.5s)

- In most cases, the setting Cn-40 need not be changed. If the motor speed is unstable, increase the value of Cn-40. If the speed of response is to low, decrease the value of Cn-40.

Cn-41 S-curve Characteristic Time at Acceleration Start (0.0 – 1.0s)
Cn-42 S-curve Characteristic Time at Acceleration End (0.0 – 1.0s)
Cn-43 S-curve Characteristic Time at Deceleration Start (0.0 – 1.0s)
Cn-44 S-curve Characteristic Time at Deceleration End (0.0 – 1.0s)

- Using the S-curve characteristic function for acceleration and deceleration can reduce mechanical shock to the machinery when stopping and starting. The 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.9.2.2.10.

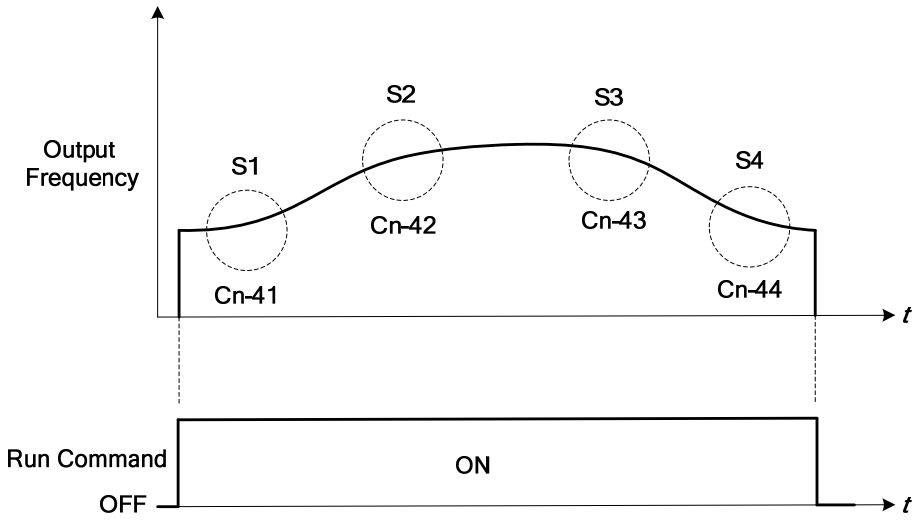


Fig. 9.2.2.10 S Curve

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

$$Acc.Time = Selected\ Acc.\ Time1\ (or\ 2) + \frac{(Cn-41)+(Cn-42)}{2}$$

$$Decel.\ Time = Selected\ Decel.\ Time1\ (or\ 2) + \frac{(Cn-43)+(Cn-44)}{2}$$

Cn-45 PG Parameter (0.0 – 3000.0 P/R)

The parameter sets the number of pulse/revolution for the PG. The factory setting is 0.1 P/R.

Cn-46 Pole Number of Motor (2 - 32)

Cn-45 and Cn-46 must meet the following relationship: $\frac{2 \times Cn-45 \times Cn-02}{Cn-46} < 32767$ If not, an error message "PG Parameter Setting Error" will be displayed

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Cn-47 ASR Proportion Gain 1(0.00 – 2.55)
Cn-48 ASR Integral Gain 1 (0.1 – 10.0s)
Set the proportion gain and integral time of the speed control (ASR).
Cn-49 ASR Proportion Gain 2 (0.00 – 2.55)
Cn-50 ASR Integral Gain 2(0.1 – 10.0s)
Use these constants to set different proportional gain and integral time settings for high-speed operation.

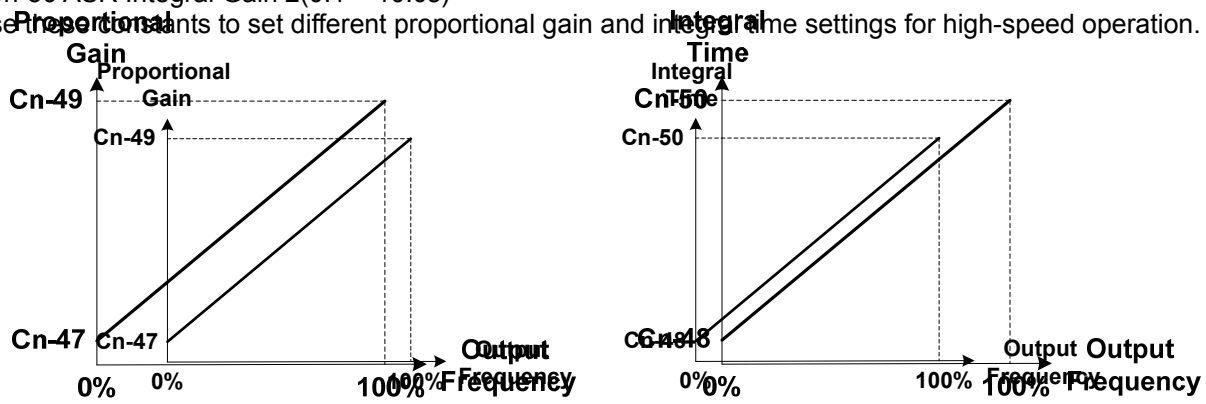


Fig. 9.2.2.11 ASR Proportional Gain and Integral Time

Cn-51 ASR Upper Bound
Cn-52 ASR Lower Bound
The settings of Cn-51 and Cn-52 will limit the ASR range.

Cn-53 Excessive Speed Deviation Detection Level (1 – 50%)
This parameter sets the level of detecting the PG speed deviation. The value of Cn-02 (Max. frequency) is referenced as 100%, the default unit setting is 1%.
Cn-54 Overspeed Detection Level (1 -120%)
Set this parameter for detecting overspeed. The value of Cn-02 (Max. frequency) is referenced as 100%, the default unit setting is 1%. Please refer to the setting of Sn-53.

Cn-55 PID Integral Upper Bound (0 – 109%)
Cn-56 PID Primary Delay Time Constant (0.0 – 2.5s)
Refer to "APP-1 PID Application Note" for more details.

Cn-57 Motor Line-to-Line Resistance R1 (0.001 – 60.000Ω) (See parameter summary)

- This parameter is used to set the motor's terminal resistance (including the motor external cable resistance) in Ohm's Ω.
- The default setting depends upon the inverter capacity and does not include the motor external motor cable resistance.
  This value will be automatically set during auto-tuning. See "***Appendix A* Auto-tuning Procedure / Sensorless Vector Control"**
- Increase the setting when the torque is not high enough at low speed.
- Decrease the setting when the torque is too high and cause an overcurrent trip at low speed.

Cn-58 Motor Rotor Equivalent Resistance R2 (0.001 – 60.000Ω) (See parameter summary)

- This parameter is used to set the motor's rotor Y-equivalent model resistance in Ohm's Ω.
- The default setting depends upon the inverter capacity. Normally this value is not shown on the motor's nameplate, therefore it may be necessary to contact motor manufacturer.

This value will be automatically set during auto-tuning. "***Appendix A*** **Auto-tuning Procedure / Sensorless Vector Control"**

Cn-59 Motor Leakage Inductance Ls (0.01 – 200.00mH) (See parameter summary)

- This parameter sets the motor's rotor Y-equivalent model leakage inductance in mH.
- The default setting depends upon the inverter capacity.

This value will be automatically set during auto-tuning. "***Appendix A*** **Auto-tuning Procedure / Sensorless Vector Control"**

Cn- 60 Motor Mutual Inductance Lm (0.1 – 6553mH) (See parameter summary)

- This parameter sets the motor Y-equivalent model mutual inductance in mH.
- The default setting depends upon the inverter capacity.

This value will be automatically set during auto-tuning. "***Appendix A*** **Auto-tuning Procedure / Sensorless Vector Control"**

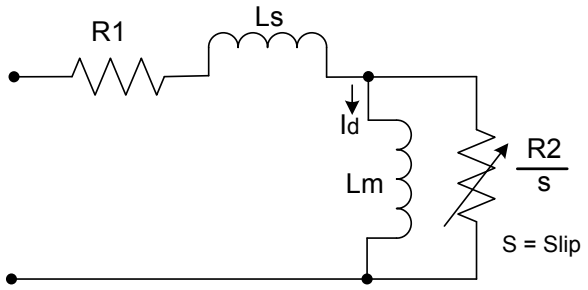


Fig. 9.2.2.12 Induction Motor Y-Equivalent Model

Cn - 61 Slip Compensation Gain

- Parameter Cn-61 is used to improve the speed accuracy while operating under load by providing slip compensation.
- Normally, the setting Cn-61 does need to be changed. However if the speed accuracy needs to be improved, then adjust Cn-61 accordingly. To decrease the actual speed change with load, increase the setting of Cn-61. Decrease the setting if the speed change over compensates or increases with load.

NOTES-

9.2.3 Parameters Sn- (System Parameters)

Sn-01 Inverter capacity selection

- The inverter capacity has already been set at factory in accordance with the following tables. If the control board is replaced, the setting Sn-01 must be reset to the value shown in the following tables.
- When the setting Sn-01 has been changed, the inverter system parameter settings should be changed based on the constant torque (CT) load (Sn-61= 0) or variable torque (VT) load (Sn-61= 1).

Table 9.2.3.1a 230V Class Inverter Capacity Selection

Sn-01 setting			001		002		003		004		005		006	
CT(Sn-61=0) VT(Sn-61=1) / Item Name			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	
Inverter rated current (A)			4.8		6.4		9.6		17.5		24		32	
Max. applicable capacity (HP) *2			1	1	2	2	3	3	5.4	7.5	7.5	10	10	10
Factory Setting	Cn-09	Motor rated current (A)	3.4	3.4	6.1	6.1	8.7	8.7	14.6	20.1	20.1	25.1	25.1	25.1
	Cn-12	Motor line impedance (Ω)	5.732	5.732	2.407	2.407	1.583	1.583	0.684	0.444	0.444	0.288	0.288	0.288
	Cn-13	Core loss torque compensation (W)	64	64	108	108	142	142	208	252	252	285	285	285
	Cn-34	Carrier freq.(kHz)	10	10	10	5	10	10	10	5	10	10	10	10
	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
	Sn-02	V/F curve	01	07*1	01	07*1	01	07*1	01	07*1	01	07*1	01	07*1
Max. carrier freq. (kHz)			15	10	15	5	15	15	15	5	15	10	15	15

Sn-01 setting			007		008		009		010		011	
CT(Sn-61=0) VT(Sn-61=1) / Item Name			CT	VT	CT	VT	CT	VT	CT	VT	CT	VT
Inverter rated capacity (KVA)			20.6		27.4		34		41		54	
Inverter rated current (A)			48		64		80		96		130	
Max. applicable capacity (HP) *2			15	20	20	25	25	25	30	40	40	40
Factory Setting	Cn-09	Motor rated current (A)	36.7	50.3	50.3	62.9	62.9	62.9	72.9	96.7	96.7	96.7
	Cn-12	Motor line impedance (Ω)	0.159	0.109	0.109	0.077	0.077	0.077	0.060	0.041	0.041	0.041
	Cn-13	Core loss torque compensation (W)	370	471	471	425	425	425	582	536	536	536
	Cn-34	Carrier freq.(kHz)	10	5	10	5	10	10	10	5	10	10
	Cn-37	Min. baseblock time (sec)	0.7	0.7	0.7	0.7	1.0	1.0	1.0	1.0	1.0	1.0
	Sn-02	V/F curve	01	07*1	01	07*1	01	07*1	01	07*1	01	07*1
Max. carrier freq. (kHz)			10	5	10	5	10	10	10	5	10	10

Cont.

Table 9.2.3.1b 460V Class Inverter Capacity Selection

Sn-01 setting			021		022		023		024		025		026		027	
CT(Sn-61=0) VT(Sn-61=1) / Item Name			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	
Inverter rated current (A)			2.6		4		4.8		8.7		12		15		24	
Max. applicable capacity (HP) ***2**			1	1	2	2	3	3	5.4	7.5	7.5	10	10	15	15	20
Factory Setting	Cn-09	Motor rated current (A)	1.7	1.7	2.9	2.9	4	4	7.3	10.2	10.2	12.6	12.6	18.6	18.6	24.8
	Cn-12	Motor line impedance (Ω)	22.927	22.927	9.628	9.628	6.333	6.333	2.735	1.776	1.776	1.151	1.151	0.634	0.634	0.436
	Cn-13	Core loss torque compensation (W)	64	64	108	108	142	142	208	252	252	285	285	370	370	471
	Cn-34	Carrier freq. (kHz)	10	5	10	5	10	10	10	5	10	10	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
	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**
Max. carrier freq. (kHz)			15	5	15	5	15	15	15	5	15	10	15	5	10	5

Sn-01 setting			028		029		030		031		032		033		034	
CT(Sn-61=0) VT(Sn-61=1) / Item Name			CT	VT	CT	VT	CT	VT	CT	VT	CT	VT	CT	VT	CT	VT
Inverter rated capacity (KVA)			27.4		34		41		54		68		82		110	
Inverter rated current (A)			32		40		48		64		80		96		128	
Max. applicable capacity (HP) ***2**			20	25	25	30	30	30	40	50	50	50	60	75	75	100
Factory Setting	Cn-09	Motor rated current (A)	24.8	31.1	31.1	36.3	36.3	36.3	48.7	59.0	59.0	59.0	70.5	80.0	80.0	114
	Cn-12	Motor line impedance (Ω)	0.436	0.308	0.308	0.239	0.239	0.239	0.164	0.133	0.133	0.133	0.110	0.074	0.074	0.027
	Cn-13	Core loss torque compensation (W)	471	425	425	582	582	582	536	641	641	641	737	790	790	1800
	Cn-34	Carrier freq. (kHz)	10	5	10	5	10	10	10	5	10	10	10	5	10	5
	Cn-37	Min. baseblock time (sec)	0.7	0.7	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
	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**
Max. carrier freq. (kHz)			10	5	10	5	10	10	10	5	10	10	10	5	10	5

Cont.

Table 9.2.3.1c 575V Class Inverter Capacity Selection

Sn-01 setting			051	052	053	054	055	056
CT(Sn-61＝0) VT(Sn-61＝1) / Item Name			CT	CT	CT	CT	CT	CT
Inverter rated capacity (KVA)			1.7	3	4.2	6.6	9.9	12.2
Inverter rated current (A)			1.7	3	4.2	6.6	9.9	12.2
Max. applicable capacity (HP)			1	2	3	5.4	7.5	10
Factory Setting	Cn-09	Motor rated current (A)	1.3	2.3	3.1	5.1	7.5	9.6
	Cn-12	Motor line impedance (Ω)	39.259	17.048	10.316	4.939	2.601	1.446
	Cn-13	Core loss torque compensation (W)	48	65	81	130	193	263
	Cn-34	Carrier freq.(kHz)	10	10	10	10	10	10
	Cn-37	Min. baseblock time (sec)	0.5	0.5	0.5	0.5	0.7	0.7
	Sn-02	V/F curve	01	01	01	01	01	01
Max. carrier freq. (kHz)			10	10	10	10	10	10

***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 torque load characteristics.

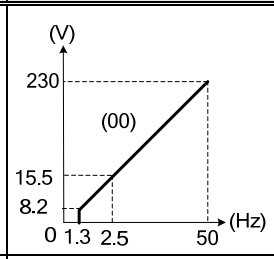
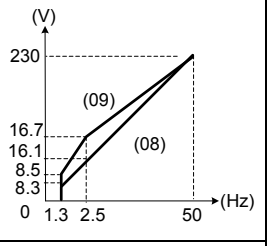
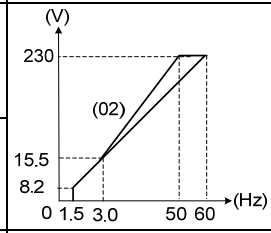
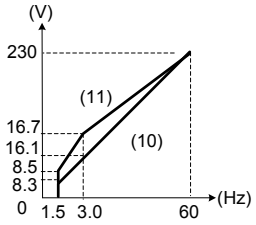
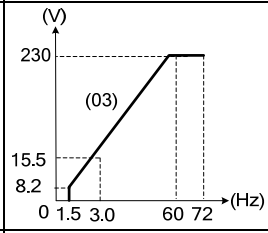
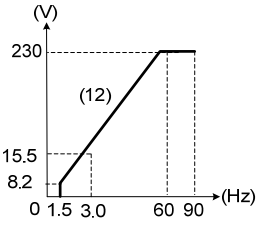
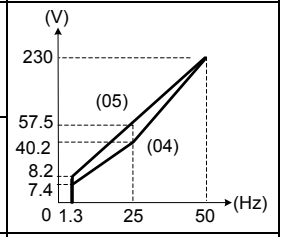
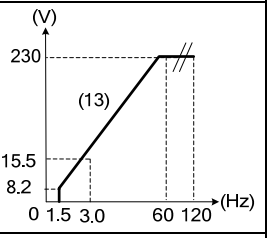
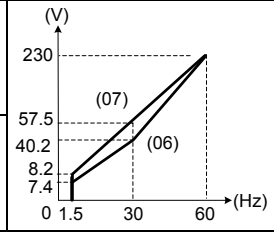
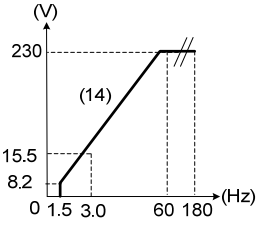
***2** In fan or pump applications, the torque load has a quadratic or cubic relationship between the speed and load. The inverter capacity rating can be increased to a value that doubles its own specified capacity rating in some special cases. However, due to the real hardware limitation, 230V: 1HP, 2HP, 3HP, 10HP, 25HP, 40HP and 460V: 1HP, 2HP, 3HP, 30HP, 50HP can not be adapted to any larger capacity.

NOTES-

Sn-02 V/F curve selection (0 – 15)

- First set the inverter input voltage (Cn-01) to match the power supply voltage. Then using parameter Sn-02 the V / f curve can be set to any of the pre-set patterns 00 – 14 or can be customized by setting Sn-02 to 15.
- The following tables show the various Sn-02 patterns 0 -14

Table 9.2.3.2a V/F curve of 1 - 2 HP, 230V Class Inverter *

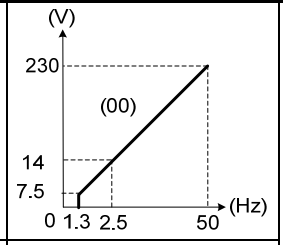
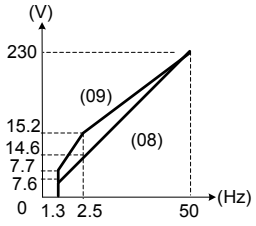
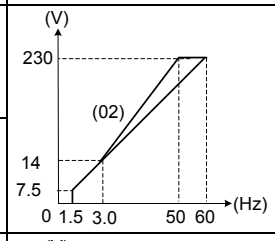
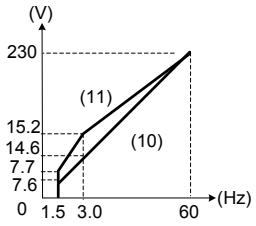
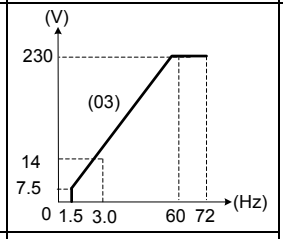
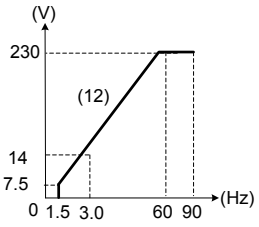
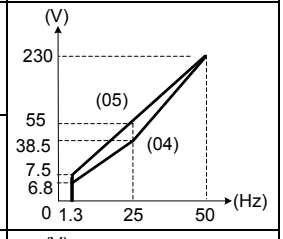
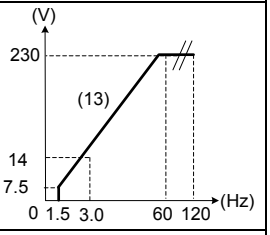
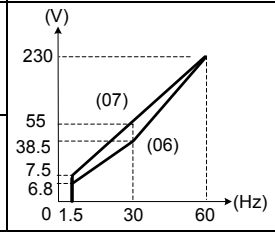
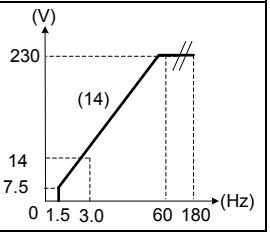
	Specifications		Sn-02	V/F Pattern†		Specifications		Sn-02	V/F Pattern†
General Purpose	50Hz		**00**		High Staring Torque‡	50Hz	Low Starting Torque	**08**	
							High Starting Torque	**09**	
	60Hz	60Hz Saturation	**01 15**			60Hz	Low Starting Torque	**10**	
		50Hz Saturation	**02**				High Starting Torque	**11**	
	72Hz		**03**		Rated Output Operation (Machine Tool)	90Hz		**12**	
Variable Torque Characteristic	50Hz	Variable Torque 1	**04**			120Hz		**13**	
		Variable Torque 2	**05**						
	60Hz	Variable Torque 3	**06**			180Hz		**14**	
		Variable Torque 4	**07**						

* These values are for the 230V class; double the values for 460V class inverters.

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

‡ Select high starting torque only for the following conditions.
(1) The power cable length is > 492ft (150m).
(2) Voltage drop at startup is high.
(3) An AC reactor is inserted at the input side or output side of the inverter.
(4) A motor with a capacity smaller than the maximum applicable inverter capacity is used. *Cont.*

Table 9.2.3.2a V/F curve of 3 - 40 HP, 230V Class Inverter *

	Specifications		Sn-02	V/F Pattern†		Specifications		Sn-02	V/F Pattern†
General Purpose	50Hz		**00**		High Staring Torque‡	50Hz	Low Starting Torque	**08**	
							High Starting Torque	**09**	
	60Hz	60Hz Saturation	**01 15**			60Hz	Low Starting Torque	**10**	
		50Hz Saturation	**02**				High Starting Torque	**11**	
	72Hz		**03**		Rated Output Operation (Machine Tool)	90Hz		**12**	
Variable Torque Characteristic	50Hz	Variable Torque 1	**04**			120Hz		**13**	
		Variable Torque 2	**05**						
	60Hz	Variable Torque 3	**06**			180Hz		**14**	
		Variable Torque 4	**07**						

* These values are for the 230V class; double the values for 460V class 3~75HP inverters and multiply the value by 2.61 for the 575V class.

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

‡ Select high starting torque only for the following conditions.
(5) The power cable length is > 492ft (150m).
(6) Voltage drop at startup is high.
(7) An AC reactor is inserted at the input side or output side of the inverter.
A motor with a capacity smaller than the maximum applicable inverter capacity is used.

Sn-03 Operator Display (0 – 12)

- Parameter code (Sn-03= 0 or 1)

Set the parameter Sn-03 to 0 or 1 to determine the access status of the following.

Sn-03	DRIVE Mode		PRGM Mode	
	Set	Read Only	Set	Read Only
0	An,Bn,P2, P4-05, P5	Sn,Cn,P1,P3, P4-01- 04	An,Bn,Sn,Cn, P1 - P5	–
1	An	Bn,Sn,Cn, P1- P5	An	Bn,Sn,Cn, P1- P5

- Setting Sn-03 = 7 – 12 (2 / 3 Wire operation):
  (1) The setting of parameters Sn-03= 7-12 will set terminals ⑤ - ⑧ for 2-wire or 3-wire operation with the associated voltage. (See parameter summary)
  (2) With the exception of parameters Sn-01-02 and Sn-61, the setting of parameter Sn-03 = 7-12 will Reinitialize some of the parameters within the groups, An-□□, Bn-□□, Cn-□□, Sn-□□ and P1-□□ - P5-□ to the factory default settings to the corresponding voltage.

⚠ Caution	By setting Sn-03 = 7-12, some parameters are reset to factory default for the associated voltage. If these parameters had been previously set by the user the values will be lost.

- Parameters Sn-02 – 05 and 13-15 are reserved.

Sn-04 Run Source Selection (0 – 3)

- This parameter is used to select the source of run command.
  Sn-04 = 0: digital operator
  1: control circuit terminal
  2: RS-485 communication
- By setting Sn-04 =1, the run source will be from the control circuit terminals and the run source function will depend on the setting of Sn-03 as follows.

Initial Setting	2-Wire Operation (Sn-03=7, 9 or 11)	3-Wire Operation (Sn-03=8, 10 or 12)
Run Source	FWD/STOP, REV/STOP	RUN, STOP, FWD/ REV.

Sn-05 Frequency Command Setting Method Selection

The parameter is used to select the source of frequency command.
Sn-05 = 0: digital operator
1: control circuit terminals
2: RS-485 communication
3: pulse input (See "pulse input setting" on page 3-10)

Sn-06 Stopping Method Selection (0 – 3)

- Set the stopping method when a stop command is executed as follows.

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

Cont.

- The following diagrams show the operation of each stopping method.
  a) Sn-06= 0 Deceleration to Stop
  Deceleration to a stop at a rate set by the selected deceleration time.
  b) Sn-06=1 Coast to Stop
  After the stop command is executed, the run source is disregarded until the minimum baseblock time Cn-37 has elapsed.

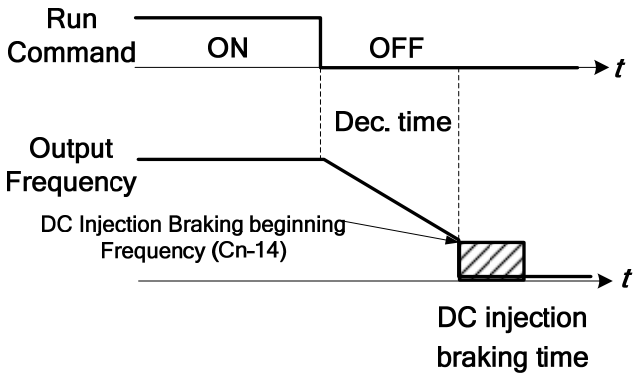


Fig. 9.2.3.1 Sn-06 = 0 Deceleration to Stop

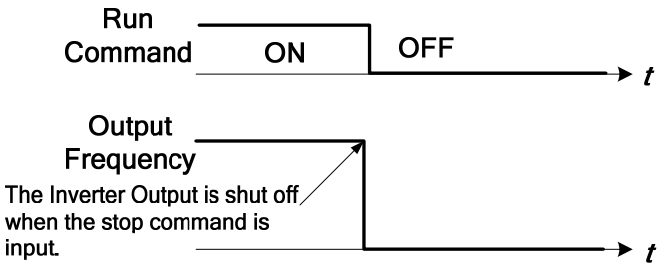


Fig. 9.2.3.2 Sn-06=1 Coast to Stop

c) Sn-06=2 Whole Range DC Injection Braking to Stop

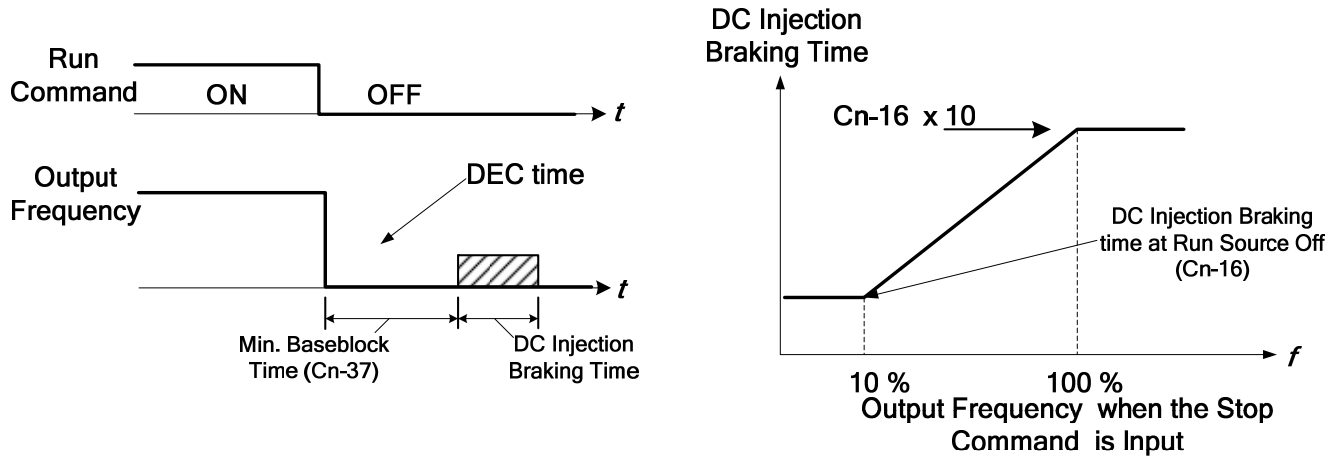


Fig. 9.2.3.3 Whole Range DC Injection Braking to Stop

- After the stop command is input and the minimum baseblock time (Cn-37) has elapsed, DC injection braking is applied and the motor stops.
- The DC injection braking time depends on the output frequency when the stop command is input and the setting of parameter Cn-16 (DC injection time at stop) is as shown in Fig.9.2.21.
- When the power applied 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. In this case, lengthen the minimum baseblock time (Cn-37) to prevent an overcurrent (OC) during stopping.

Cont.

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

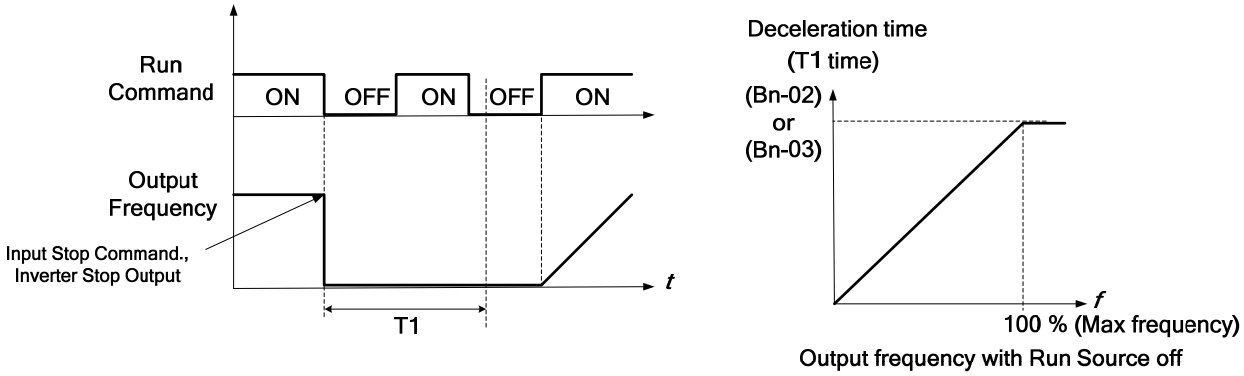


Fig. 9.2.3.4 Coast to Stop with Timer

After the stop command is executed, the 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 also on the deceleration time set by parameter (Bn-02 or Bn-04).

Sn-07 Stopping Priority (0 – 1)
This parameter enables or disables the STOP key on the digital operator when the run source is from the control terminals or from serial communication port while the motor is running.

Sn-07 = 0: Enabled. (The STOP key is enabled at all times during running.)
1: Disabled (The STOP key is disabled when the run source is from the control terminals or serial communication.)

Sn-08 Prohibition of Reverse Run
When the parameter Sn-08 is set to 1 reverse running of the motor is prohibited.

Sn-09 Output Frequency UP/DOWN Function (0 -1)

- The output frequency can be increased or decreased (UP/DOWN) using the digital operator.
  Sn-09 = 0: The output frequency can be changed by pressing the UP / DOWN keys on the digital operator but will not be effective until the ENTER key is pressed.
  1: The output frequency can be changed by pressing the UP / DOWN keys on the digital operator without pressing the ENTER key.
- The output frequency can be changed (increasing (UP) or decreasing (DOWN)) through either the digital operator or the external multi-function input terminals (terminals ⑤ - ⑧).

Sn-10 Frequency Command Characteristics Selection (0 – 1)
Sn10=0 (***For 30.16 software versions or earlier, set Sn-68= –0—***) The positive and negative characteristics of the analog frequency command (0 - 10V / 4 - 20mA) is as per the following Fig. 9.2.3.5a.

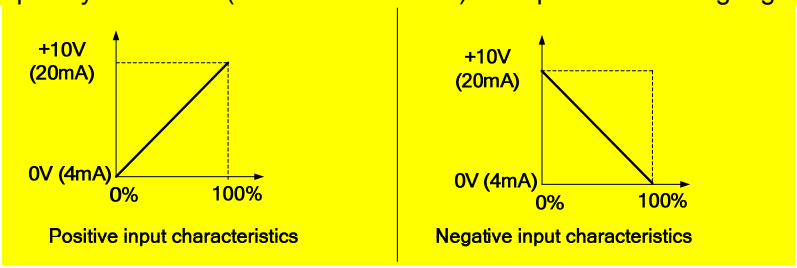


Fig. 9.2.3.5a Sn-10=0 Frequency Command Characteristics Selection *Cont.*

Sn10=1 (***For 30.16 software versions or earlier, set Sn-68= –1—***) The positive and negative characteristics of the analog frequency command (-10 - +10V) is as per the following Fig. 9.2.3.5b.

Note- Only 230V: 3-40HP and 460V: 3-75HP inverters support an input of -10V - 10V analog voltage.

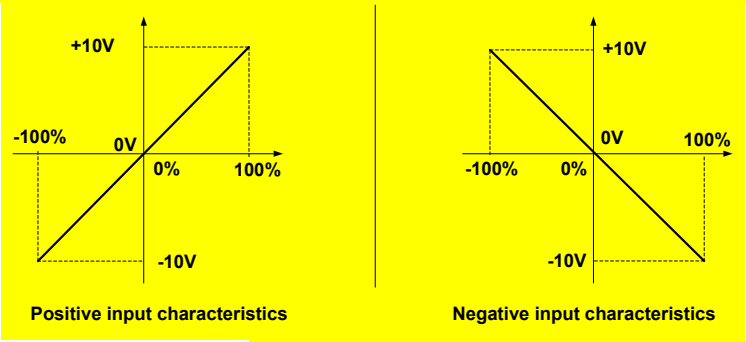


Fig. 9.2.3.5 b Sn-10=1 Frequency Command Characteristics Selection

Sn-11 Input Terminal Scan Time

This parameter sets the scan frequency of the input terminals.

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

1: Scan input terminals every 10ms.

Sn-12 Excess Load Detection Selection (0 – 4)

- When Excess Load Detection is enabled by Sn-12, parameters Cn-32 Excess Load Detection Level and Cn-33 Excess Load Detection Time must also be set.
- An excess load condition is detected when the Excess Load Detection is enabled, and the current exceeds the Excess Detection Level (Cn-32) longer than the Excess Load Detection Time (Cn-33).

Sn-12	Function	Display
0	Excess Load detection disabled	
1	Detect excess load only during speed agree. Continue operation after detection. (Minor fault)	"Excess Load Alarm" blinks
2	Detect excess load only during speed agree. Stop output after detection (Fault)	"Excess Load Fault" lights
3	Detect excess load at any time. Continue operation after detection. (Minor fault)	" Excess Load Alarm" blinks
4	Detect excess load at any time. Stop output after detection (Fault)	" Excess Load Fault" lights

Sn-13 Output Voltage Limit Selection (0 -1)

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

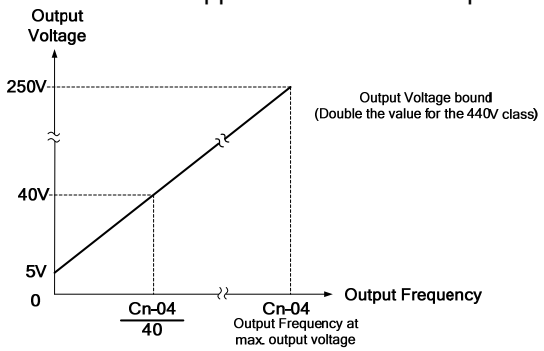


Fig. 9.2.3.6 Sn-13 Output Voltage Limit

Sn-14 Stall Prevention Selection During Acceleration (0 -1)

Sn-14= 0: Disabled (Accelerate according to the set rate. Stall may occurs with excessive loads.)

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

Refer to “Stall prevention level during acceleration” on page 3-19.

Sn-15 Stall Prevention Selection During Acceleration (0 -1)

- If an external braking resistor unit is installed, Sn-15 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 large and it exceeds the regenerative braking torque, set parameter Sn-15 =1. When Sn-15= 1 (enabled), the deceleration time (Bn-02 or Bn-04) is extended so that a main circuit overvoltage does not occur.

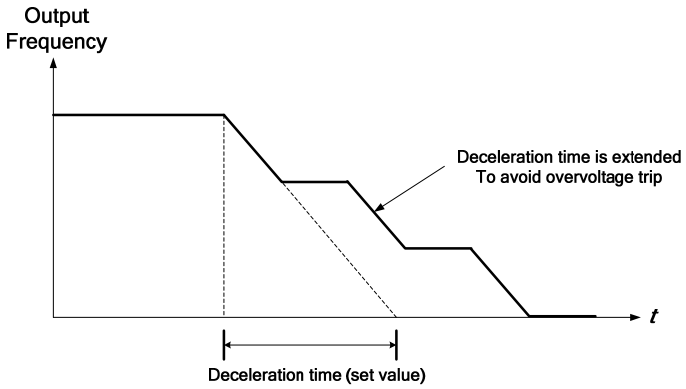


Fig. 9.2.3.7 Sn-15=1 Stall Prevention During Deceleration

Sn-16 Stall Prevention Selection during Running (0 – 1)

Sn-16= 0: Disabled (Stall can 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 when the current falls below the level set by parameter Cn-26.)

Refer to “Stall prevention level during running” on page 3-19.

Sn-17 Operation of output Fault Contact during Fault Retry (0 - 1)

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

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

Refer to “Number of auto restart attempt” on page 3-18.

Sn-18 Operation Processing for momentary Power Loss (0 – 1)

- 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 disabled Sn-18=0, the inverter will stop after a momentary power loss and an undervoltage fault will be detected.

  1: When power loss ride through is enabled Sn-18=1, the operation will be restarted after a speed search if the power is restored within the allowed time.
- If the power is interrupted for more than 2 seconds, the fault contact output will operate and the motor will coast to stop.

Sn-19 Zero Speed Braking Selection (0 – 1)

- When the run-source and frequency command is input from control circuit settings Sn-04=1 and Sn-05=1, If Sn-19 is enabled, the holding torque will be generated in DC-braking mode when the frequency command is 0V and forward–run source is on.
- A time-chart for the above action is shown in Fig. 9.2.26 below. The zero-braking selection Sn-19 is set to 1 and the DC-braking current Cn-15 is limited to within 20% of rated current.

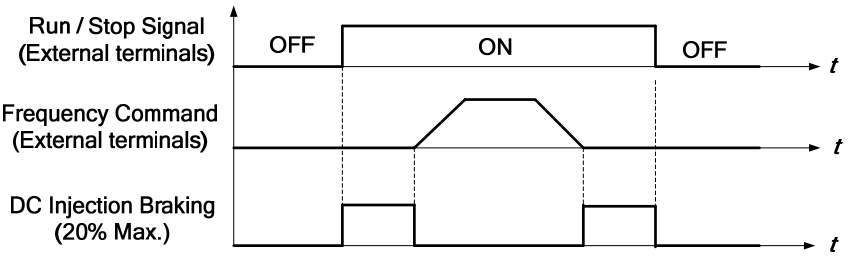


Fig. 9.2.3.8 Zero Speed Braking Operation

Sn-20 External Fault Contact Selection (0 – 1)

Sn-20= 0: Input signal is from a normally open contact.
1: Input signal is from a normal closed contact.

Sn-21 External Fault Contact Detection Selection (0 – 1)

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

Sn-22 Detection Mode Selection of External Fault (0 – 3)

When an external fault is detected, the following operation will be performed based on the setting of Sn-22.
Sn-22= 0: Decelerate to stop with the specified deceleration time of Bn-02.
1: Coast to stop.
2: Decelerate to stop with the specified deceleration time Bn-04.
3: Continue running.

Sn-23 Motor Overload Protection Selection (0 – 4)

Sn-23 = 0: Electronic overload protection disabled.
When Sn-23=1- 4, the electronic overload protection is enabled. The electronic thermal overload is detected in accordance with the characteristic curves of 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.

- Set Sn-23=0 (Disable) when 2 or more motors are connected to a single inverter. An alternate method can be used 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 to Sn-23 = (2 or 4) (hot start protection characteristic curve) when the power supply is turned on and off frequently since the thermal values are reset each time the power is turned off.
- For a motor without a forced cooling fan, the heat dissipation capability is lower at low speed operation. In this case the setting for Sn-23 can be either (1 or 2).
- For a motor with a forced cooling fan, the heat dissipation capability is not dependent upon the rotating speed Therefore, the setting Sn-23 can be either (3 or 4).
- To protect the motor from overload by the use of electronic overload protection, ensure that the parameter Cn-09 is set the rated current value shown on the motor nameplate.
- See Fig. 9.2.3.9.

Cont.

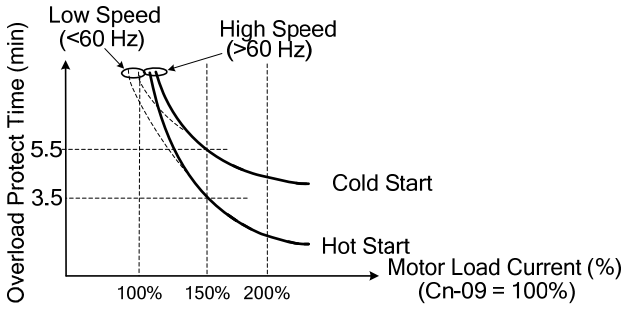


Fig. 9.2.3.9 Motor Overload Protection Curve (Cn-09=100%)

Sn-24 External Analog Input Frequency Characteristics Command Selection (0 -3)
Sn-24=0: Frequency command is from input VIN: 0 - 10V
1: Frequency command is from input AIN: 4 - 20mA
2: Frequency command is the sum of inputs (VIN + AIN). VIN: 0 - 10V and AIN: 4 - 20mA.
3: Frequency command is the difference of inputs (VIN - AIN). 0 - 10V and AIN: 4 - 20mA. If the value (VIN - AIN) is negative, the reference command will be 0.

- For inverters rated 230V: 3-40HP and 460V: 3-75HP, VIN accepts an input of ±10V if parameters Sn-68=–1— and Sn-05=1. Set Sn-24 to select the main frequency as follows:

Sn-24= 0: The frequency command is controlled by VIN (-10 - +10V).
(Corresponding command frequency: -10V - +10V→ Reverse frequency 100% - forward frequency 100%)
1: The frequency command in controlled by AIN (4 - 20mA).
(The status of forward/ reverse is set by the user)
2: The frequency command is controlled by the sum of VIN and AIN.
3: The frequency command is controlled by the difference of VIN and AIN.
(When (VIN + AIN) < 0 or (VIN - AIN) < 0, main frequency switched to reverse status. When Sn-24 = 0, 2 or 3, forward or reverse is controlled by main the frequency command polarity.)

Sn-25 Multi-Function Input Terminal ⑤ Function Selection
Sn-26 Multi-Function Input Terminal ⑥ Function Selection
Sn-27 Multi-Function Input Terminal ⑦ Function Selection
Sn-28 Multi-Function Input Terminal ⑧ Function Selection

The settings and functions for the multi-function input are listed in Table 9.2.3.3.

Table 9.2.3.3 Multi-function Input Settings

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 command 1	Multi-Fun. Command 1	Multi-speed frequency command selection
03	Multi-speed command 2	Multi-Fun. Command 2	
04	Multi-speed command 3	Multi-Fun. Command 3	
05	Multi-speed command 4	Multi-Fun. Command 4	
06	Jog	Jog Command	ON: Select jog 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 (N.O. contact)	Ext.B.B. NO_Cont	ON: inverter output baseblock

Cont.

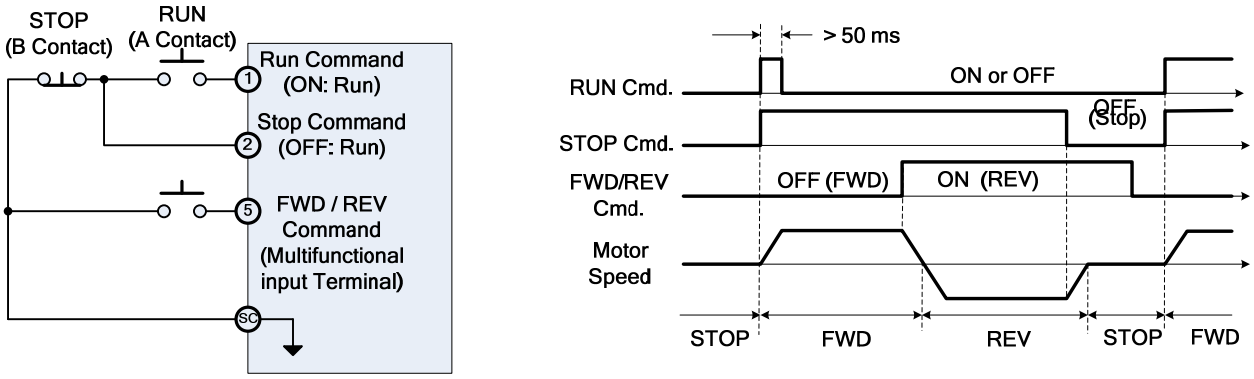
Table 9.2.3.3 Multi-function Input Settings *Cont.*

Setting	Function	LCD Display	Description
09	External base-block command (N.C. 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: Overheat indicator flashing (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 (N.O. contact)	Ext.Fault NO_Cont	ON: External fault input (normally open)
17	External fault (N. C. contact)	Ext.Fault NC_Cont	OFF: External fault input (normally closed)
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	DC 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 digital 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 (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
30	PID control invalid 2	PID Invalid w An-16	See App-1 PID Application Note for further description.
31	External PID Invalid	Ext. PID Invalid	ON: The External PID is disabled
32	External PID Integrator Reset	Ext. I Time Reset	ON: The integration time is reset
33	PID Sleep	PID Sleep	ON: The sleep function is activated

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

Sn-25-28=00 3-wire operation mode

When parameter Sn-03 = 8,10 or 12, 3-wire initialization mode, the multi-function input terminals ⑤-⑧ will be set for 3-wire operation. As shown in Fig.9.2.3.10, the Forward / Reverse control mode is set at terminal ⑤.

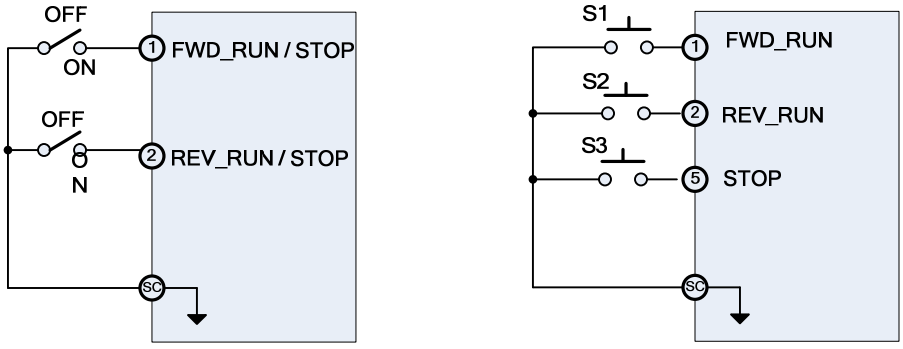


3-Wire Connection Diagram　　3-Wire Operation Sequence

Fig. 9.2.3.10 3-Wire Operation (Sn-28=00)

Sn-25-28=0 1 Input STOP Command during 2-Wire Mode Operation

- The Stop command can be only set by parameter Sn-25 (Terminal ⑤).
- When initialized for standard 2-wire operation as shown in Fig. 9.2.3.11a, S1 and S2 can not be both ON at the same time. When S1= ON and S2= OFF, the motor runs FWD. When S1=OFF and S2= ON, the motor runs REV. When S1= OFF and S2= OFF, the motor Stops.
- When Sn-25= 01, the 2-wire operation mode has its self-sustaining function. Only through the multi-function input terminal⑤ can the inverter can be stopped after pressing the STOP key as shown in Fig.9.2.3.11b. The switches S1, S2 and S3 are momentary switches. When S1 is pressed, the motor will run FWD. When S2 is pressed, the motor will run REV. When S3 is pressed, the motor will stop.



a.　　**b.**

Fig. 9.2.3.11 2-Wire Operation

Note: 1. With the exception of Sn-28= 00 or 01, the external operation mode is defaulted to 2-wire operation and no self-sustaining function. i.e., the inverter will stop when the input contact at terminals ① and ② are not closed.

2. In 2-wire mode, the error message “Freq. Comm. Error” will be displayed by the digital operator when terminals ① and ② are both ON at the same time, and the inverter will stop. When cleared, the inverter will return normal.

Cont.

Sn-25=02 Multi-Step Speed Command 1
Sn-26=03 Multi-Step Speed Command 2
Sn-27=04 Multi-Step Speed Command 3
Sn-28=05 Multi-Step Speed Command 4
Sn-28=06 Jog Frequency Selection

- There are 16 (maximum) step speed command selections from the combination of the 4 Multi-Step Speed Commands and the jog frequency command.
- Multi-Step Speed command 1 - 4 and Jog Frequency Selection Setting Table 9.2.3.4.

Table 9.2.3.4

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

0: terminal is OFF; 1: terminal is ON

- The example shown in Fig. 9.2.3.12 below shows the operation sequence of a multi-step speed and jog command.

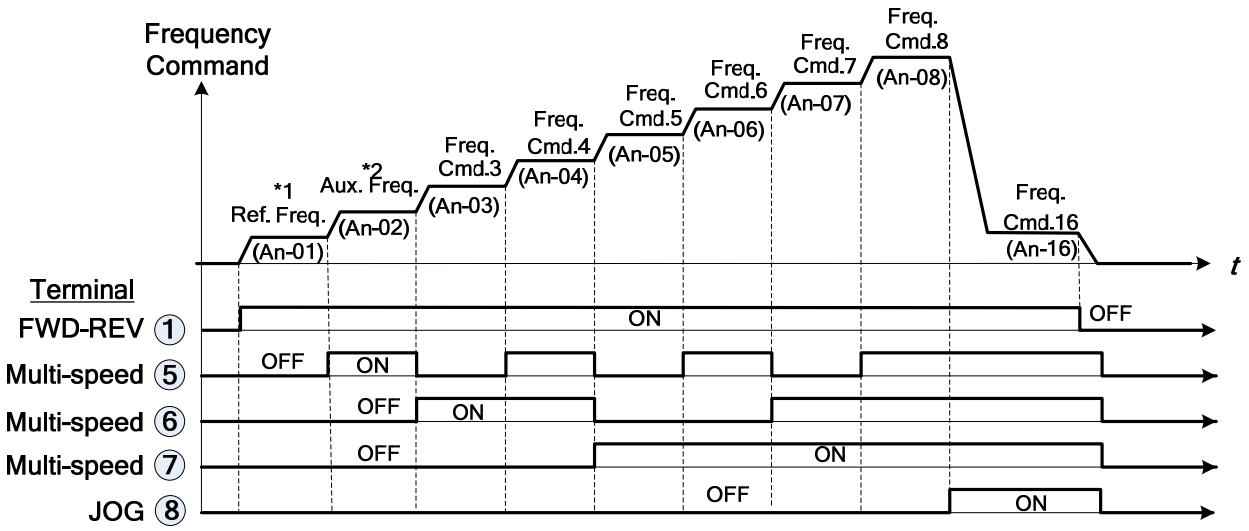


Fig. 9.2.3.12 Timing Chart for Multi-Step Speed and Jog Command

*1 When parameter Sn-05=0, the frequency reference command is set by An-01.When Sn-05= 1, the reference command is input from the analog terminals VIN and AIN.
*2 If 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 parameter An-02.

Cont.

Sn-25-28=07 Acceleration Time And Deceleration Time Change

The acceleration time and deceleration time can be changed through the control terminals ⑤-⑧ as described on page 3-4.

Sn-25-28=08 External Baseblock (N.O. Contact)

Sn-25-28 =09 External Baseblock (N.C. Contact)

- Either of these settings will control inverter baseblock operation, through the multi-function input terminals.
- During running when an external baseblock signal is detected, the digital operator will display “B.B. Alarm” and the inverter output is blocked. After the baseblock signal is cleared, the motor will resume operationl.
- During deceleration, when an external baseblock signal is input, the digital operator will display “ B.B. Alarm” and the inverter output is blocked and the output frequency will drop to zero. The motor will then coast to stop freely. After the external baseblock signal is cleared, the inverter will remain in the stop mode.

Sn-25-28=10 Acceleration and Deceleration Ramp Hold

This setting will pause the acceleration or deceleration of the motor and maintain the current output frequency. The motor will coast to stop if an OFF command is input while the acceleration / deceleration ramp hold input is ON and the current output frequency will be stored. When the ramp hold signal is released the acceleration / deceleration ramp will resume at the stored frequency. (See Fig. 9.2.3.13 below)

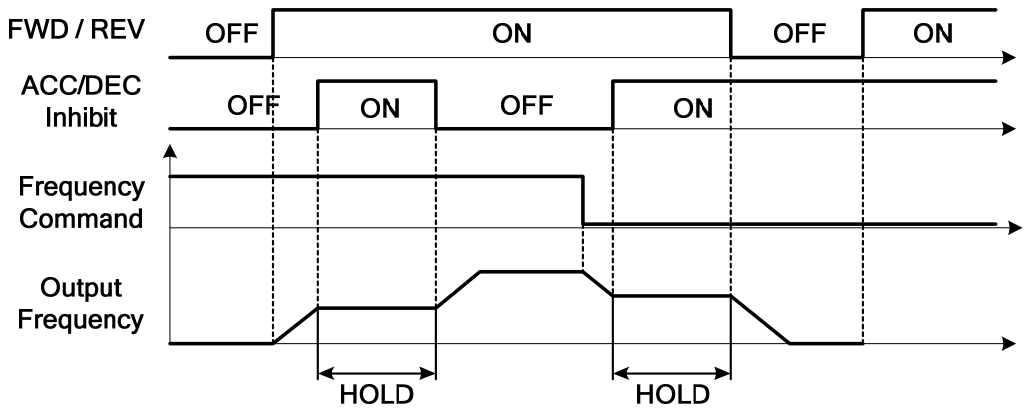


Fig. 9.2.3.13 Acceleration and Deceleration Ramp Hold

Sn-25-28=11 Inverter Overheat Alarm

When the inverter detects a overheat signal, the digital operator will display “Overheat Alarm”. and the inverter will maintain normal operation. When the overheat signal is OFF, the digital operator will return to its previous display automatically. No RESET is required.

Sn-25-28=12 FJOG Command

Sn-25-28=13 RJOG Command

- Jogging can be performed in forward or reverse direction.
  Setting: 12 - FJOG command ON run forward at the jog frequency set by An-17.
  13 - RJOG command ON run reverse at the jog frequency set by An-17.
- The forward and reverse jog commands have priority over other frequency commands.
- The inverter will stop running in accordance the setting of Sn-06, if the forward jog and reverse jog commands are both ON for more than 500 ms.

Sn-25-28=14 PID Integral Reset

Sn-25-28=15 PID Control Invalid

See **"APP-1 PID Application Note"** for a description.

Sn-25-28=16 External Fault N.O. Contact

Sn-25-28=17 External Fault N.C. Contact

- When the external fault input terminal is ON, an external fault is detected. If external input terminal ⑥ is set for an external fault, a message “Fault Ext. Fault 6” will be displayed.
- There are 5 terminals that can assigned as external fault inputs, they are terminals ③, ⑤, ⑥, ⑦, ⑧.
- When an external fault occurs, the inverter will be blocked from output and the motor will coast to stop.

Cont.

Sn-25-28=18 Multi-Function Analog Input Setting
The multi-function analog input at the AUX terminal can be enabled or disabled by an external signal. When the PID function is enabled, the AUX function will be disabled.

Sn-25-28=19 Timer Function Input Terminal
Refer to the setting of the timer function output terminal on page 3-63

Sn-25-28=20 DC Injection Braking Command
- DC injection braking is used to prevent the motor from rotating due to inertia or external forces when the inverter is stopped.
- When the DC injection braking signal is ON, the motor will stop. If a run source or jog command is input, the DC injection braking will be cleared and the motor will begin to run. (See Fig. 9.2.3.14 below)

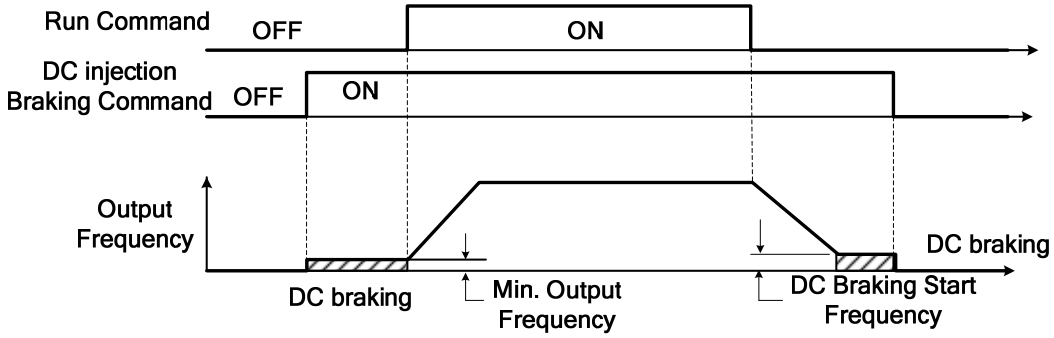


Fig. 9.2.3.14 Time chart for DC injection braking command

Sn-25-28=21 Speed Search 1
Sn-25-28=22 Speed Search 2
Refer to 'speed search' function on page 3-23.

Sn-25-28=23 LOCAL/REMOTE Control 1

OFF	**Remote Control:** The Run command and Frequency command is performed through the control terminal inputs or the RS-485 communication port. It is set by the combination of settings of parameters Sn-04 and Sn-05. The REMOTE-REF and the SEQ LED's are ON.
ON	**Local Control:** The Run and Frequency commands are performed through digital operator. The REMOTE-REF and SEQ LED's are OFF.

The LOCAL to REMOTE mode can only be changed when the inverter is in the STOP mode.

Sn-25-28=24 LOCAL/REMOTE Control 2

OFF	**Remote Control:** The Run command and Frequency command is performed through the control terminal inputs or the RS-485 communication port. It is set by the combination of settings of parameters Sn-04 and Sn-05. The REMOTE-REF and the SEQ LED's are ON.
ON	**Local Control:** The Run command and Frequency commands are performed through control circuit terminals. The REMOTE-REF and SEQ LED's are OFF.

The LOCAL to REMOTE mode can only be changed when the inverter is in the STOP mode.

Sn-25-28=25 RS-485 Communication Application
The multi-function input terminals ⑤ - ⑧ can be used as the extension contact terminals of a PLC with the command communicated through the RS-485 port. (Refer to the "RS-485 MODBUS/PROFIBUS APPLICATION MANUAL" for further information) *Cont.*

Sn-25-28=26 Speed Control Action without PG

Sn-25-28=27 Reset Integration of Speed Control with PG
When PG feedback is used, the integral control (used with PG feedback compensation) can be disabled or enabled from the external control terminals. The external terminals can also be used to clear the integral value. (See Fig. 9.2.3.15 below)

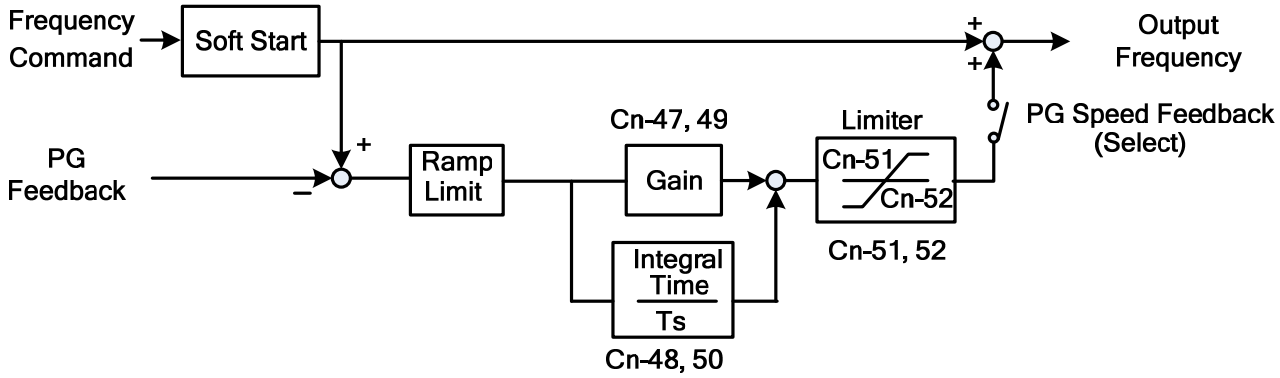


Fig. 9.2.3.15 PG Speed Control Block Diagram

Sn-25-28=28 Frequency UP/DOWN Function

- The output frequency can be changed up or down using either the digital operator or the external multi-function input terminals (⑦ or ⑧).
- By setting parameters Sn-04=1 and Sn-05=1, the run source and frequency command is set through the control circuit terminals. By setting parameter Sn-28=28, terminal ⑦ will now have the UP function and its original function is disabled. Terminals ⑦ and ⑧ can now be used for the UP / DOWN function to control or change the output frequency.
- The Operation sequence is as shown 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)

- See Fig. 9.2.3.16 below.

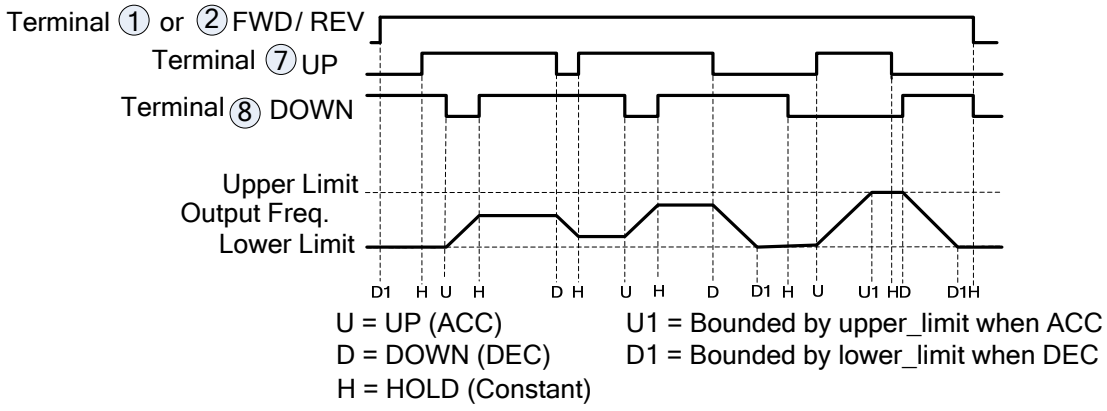


Fig. 9.2.3.16 Time Chart of Output Frequency with UP/DOWN Function

Cont.

- UP/DOWN operation can only be set through parameter Sn-28.
- When the frequency UP/DOWN function is being used, the output frequency will accelerate to the lower_limit set by Cn-19 when a run command is activated.
- If in a HOLD state, and the 4th bit of Sn-68 is set to 1, the value of the output frequency will be stored when the power is off. When power is restored and a Run command is given, the inverter will run at the stored output frequency.
- Under auto operation mode, the UP/DOWN function will not operate.
- 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.
- With UP/DOWN operation, both the PID and Multi-Step Speed Commands are unavailable.

Sn-25-28=29 Forced Run
- Forced Run can only be set through parameter Sn-28=28. It is for special use (smoke fan, etc.)
- The inverter will ignore the fault or alarm and the PID function will be disabled if the Forced Run input is ON.
- If the Forced Run input is ON and RUN command is ON, the inverter will run at maximum frequency set by parameter Cn-02 and the frequency command becomes invalid.

Sn-25-28=30 PID control invalid 2

Sn-25-28=31 External PID Invalid

Sn-25-28=32 External PID Integrator Reset

Sn-25-28=33 PID Sleep

Sn-29 Multi-Function Analog Input Function Selection
- The settings and functions for the multi-function analog input (Terminal AUX) are listed in Table 9.2.3.5.

Table 9.2.3.5 Multi-function Analog Input Functions

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)	Instruction gain 1	Total gain =(Bn-05, Bn-07) ×FGAIN
02	Frequency command bias 1 (FBIAS1)	Cmd. Bias 1	Total bias =(Bn-06, Bn-08) + FBIAS1
03	Frequency command bias 2 (FBIAS2)	Cmd. Bias 2	Total bias =(Bn-06, Bn-08) + FBIAS2
04	Excess Load Level	Excess Load Level	According to analog input voltage (0-10V), change excess load level (setting of Cn-32 is disabled)
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 to24) / TK

Cont.

Table 9.2.3.5 Multi-function Analog Input Functions *(Cont.)*

Setting	Function	LCD Display	Description (100% output corresponds to 10 V level)
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-10V), 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). Refer to App-1 PID Application Note.
10	Frequency command lower limit	Freq. Cmd. Low Bound	Changes 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 value of Cn-19 and the value corresponding to the multi-function analog input terminal).
11	Jump frequency setting4	Freq Jump 4	Sets the jump frequency 4, according to analog input voltage (0-10V), while Cn-20 to 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 – 10V can be read through serial communication (RS485). The scaling is (0 -10V = 0 – 1024)
13	Frequency instruction gain 2 (FGAIN)	Instruction gain2	With Bn-05, 06 (or Bn-07, 08) set, adjust analog frequency instruction gain and bias (gain and bias adjustment is similar to 7200GA)
14	Frequency instruction bias 3 (FBIAS1)	Instruction bias 3	?
15	Frequency instruction bias 4 (FBIAS2)	Instruction bias 4	?
16	Load Loss Level	Load Loss Level	?
17	Flow Meter	Flow Meter	?
18	External PID Set Point	Ext. PID Set Point	?
19	External PID Feedback	Ext. PID Feedback	?

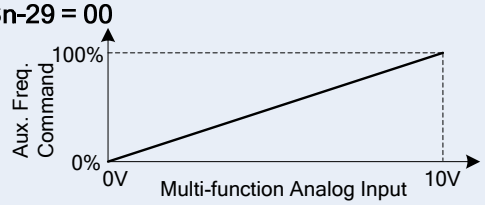
- The AUX analog input can provide two groups of gain and bias; Sn-29 =1-3 and Sn-29=13-15. When Sn-29=13-15, the adjustment of gain and bias is similar to the GA series. (See Fig. 9.2.3.17)

Fig. 9.2.3.17 Gain and Bias

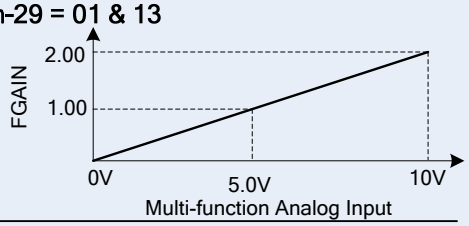
- The following Fig. 9.2.3.18 shows the multi – function analog input characteristics.

Cont.

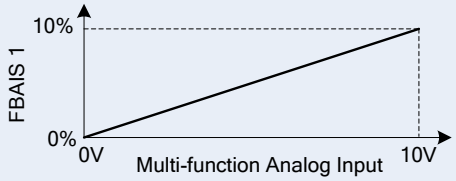
Sn-29 = 00



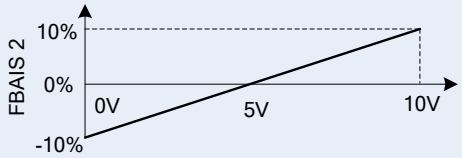
Sn-29 = 01 & 13



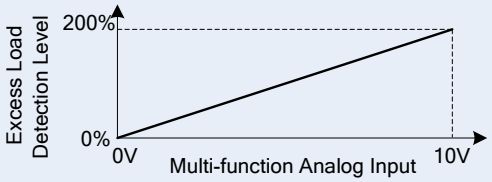
Sn-29 = 02 & 14



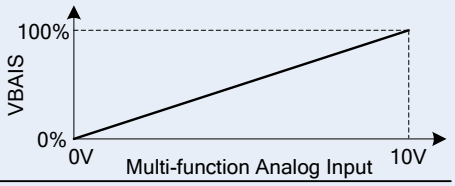
Sn-29 = 03 & 15



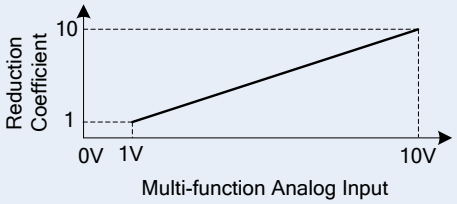
Sn-29 = 04



Sn-29 = 05

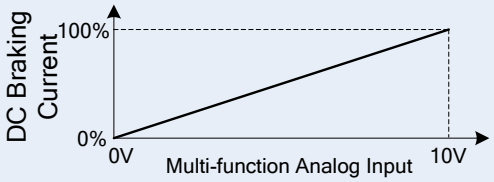


Sn-29 = 06

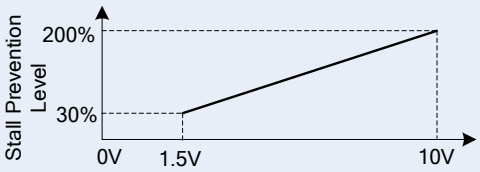


$$\text{Real ACC/DEC Time} = \frac{\text{ACC/DEC Time (Bn-01 to 04}}{\text{Reduction Coefficient (TK)}}$$

Sn-29 = 07



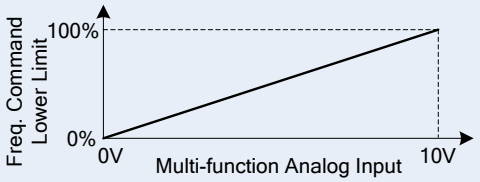
Sn-29 = 08



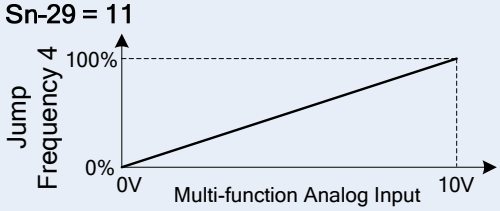
Sn-29 = 08

Multi-function analog input (AUX. terminal) used as PID control reference input (0-10V). Refer to App-1 PID Application Note.

Sn-29 = 10



Sn-29 = 11



Sn-29=12 : This parameter is used for serial communication (RS485). The analog value of AUX 0-10V can be read through serial communication. The scaling is (0 -10V = 0-1023). Refer to the 'RS-485 MODBUS/PROFIBUS Application Manual' for further details.

Fig. 9.2.3.18 Multi-Function Analog Input Characteristics

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

Table 9.2.3.6 Multi-Function Output Terminal Settings and Functions

Setting	Function	LCD Display	Description
00	During running	Running	ON: During running
01	Zero speed	Zero Speed	ON: Zero speed
02	Frequency agree	Frequency Arrive	Speed agree width: Cn-31
03	Setting frequency agree	Agreed F Arrive	ON: Output frequency = ±Cn-29, Speed agree width: Cn-31
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
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
06	Inverter ready	Run Ready OK!	ON: READY
07	Undervoltage detected	Low Volt Detect	ON: Undervoltage detected
08	Output baseblocked	Output B.B.	ON: Output baseblocked
09	Run source mode	Run Source Operator	ON: Run source from digital operator (Local mode)
10	Frequency command mode	Ref. Cmd. Operator	ON: Frequency command from digital operator (Local mode)
11	Excess Load Detection, NO Contact	Excess Load NO_Cont	ON: Excess Load detection (N.O. Contact)
12	Frequency command Invalid	Freq. Cmd. Invalid	ON: Frequency command Invalid
13	Fault	Fault	ON: Fault
14	Pulse signal output	Pulse Mul. Output	Only set by Sn-31, Sn-32 (Terminals DO1-DOG)
15	Undervoltage alarm	Low Volt Alarm	ON: Undervoltage alarm
16	Inverter overheat	Inverter Over Heat	ON: Inverter Overheating
17	Motor overload	Motor Over Load	ON: Motor Overload
18	Inverter Overload	Inverter Over Load	ON: Inverter Overload
19	Fault retry	Fault Retry	ON: Retry
20	RS-485 communication fault	RS-485 Fault	ON: RS-485 communication fault
21	Timer function output	Timer Function	Signal delay output (.vs. timer function input)
22	RS-485 Communication Application	Comm. Control	Extension Output Contact application (Please refer to MA7200 RS-485 MODBUS /PROFIBUS Application Manual')
23	Excess Load Detection, NC Contact	Excess Load NC_Cont	ON: Excess Load detection (N.C. Contact)
24	Load Loss Detect	Load Loss Detect	ON: Loss of Load Detected
25	Over Feedback	Over Fbk. Detect	ON: Over Feedback Detection
26	Low Feedback	Low Fbk. Detect	ON: Low Feedback Detection
27	During PID Sleep	During PID Sleep	ON: During PID Sleep
28	Low Suction Detection	Low Suction	ON: Low Suction Detected

Cont.

Sn-30-32=00 During Running

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

Sn-30-32=01 Zero Speed

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

Sn-30-32=02 Frequency Agree
Sn-30-32=03 Setting Frequency Agree
Sn-30-32=04 Output Frequency Detected 1
Sn-30-32=05 Output Frequency Detected 2
Refer to frequency detection function on page 3-21.

Sn-30-32=06 Inverter Ready
Sn-30-32=07 Undervoltage Detected
When the DC link voltage of main circuit is lower than the UNDERVOLTAGE DETECTION LEVEL set by parameter Cn-39, the output contact is in the 'ON' state.

Sn-30-32=08 Output Blocked

Sn-30-32=09 Run Command Mode

OFF	**Remote Mode:** When parameter Sn-04=1or 2, or one of multi-function input terminals ⑤-⑧ is set as Local/remote control I mode or Local/remote control II mode and the input to the terminal is OFF. The Remote SEQ LED on digital operator is ON.
ON	**Local Mode:** When parameter Sn-04 = 0 or the multi-function input terminal ⑤-⑧ is set as Local/remote control I mode and contact terminal is ON. The Remote-SEQ LCD is OFF, and the RUN command is from the digital operator.

Sn-30-32=10 Frequency Command Mode

OFF	**Remote mode:** When parameter Sn-05 = 1,2 or one of the multi- function input terminals ⑤-⑧ is set as Local/remote control I mode or Local/remote control II mode and the input to the terminal is OFF. The Remote-REF LED on the digital operator is ON.
ON	**Local mode:** When Sn-05 = 0 or one of the multi- function input terminasl ⑤-⑧ is set as Local/remote control I mode and contact terminal is ON. The Remote-REF LED is OFF and the RUN command is from digital operator.

Sn-30-32=11 Excess Load Detection (N.O. Contact)
See page 3-22, 3-44 for excess load detection function.

Sn-30-32=12 Frequency Command Missing
When the Run source is ON and the frequency command is 0, the output at the multi-function output terminal is ON.

Cont.

Sn-30-32=13 Fault
If a fault occurs, the multi-function output terminal is ON. However, no response will occur if a communication fault occurs.

Sn-31=14 Pulse Signal Output
- Only multi-function output terminal DO1-DOG (Setting Sn-31) can be set as the pulse signal output.
- DO1 is a photo-coupler output and its pulse output frequency is set by parameter Sn-35.
- See Fig. 9.2.3.19. below.

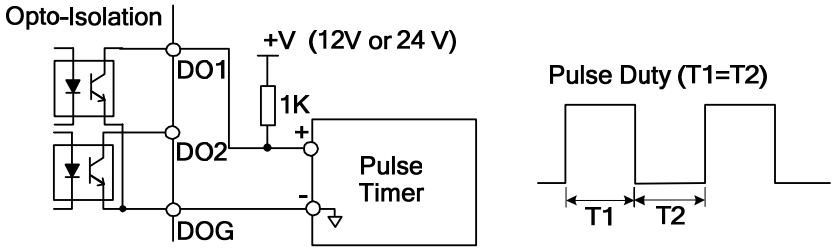


Fig. 9.2.3.19 Pulse Signal Output

Sn-30-32=15 Undervoltage Alarm
- If the main circuit DC bus voltage is below the undervoltage alarm detection level, the multi-function output terminal is ON.
- Undervoltage alarm detection level : 230V Class: 240VDC
  460V Class: 460VDC

Sn-30-32=16 Inverter Overheat
See Page 4-2. If the heat-sink is overheating, the multi-function output terminal is ON.

Sn-30-32=17 Motor Overload
See “Motor overload protection selection” on page 3-48. When the motor has an overload fault, the multi-function output terminal is ON.

Sn-30-32=18 Inverter Overload OL2
If the inverter has overload fault, the multi-function output terminal is ON. See page 4-2.

Sn-30-32=19 Fault Retry
See “Fault restart function” (Cn-24) on page 3-18. Upon restart, the multi-function output terminal is ON.

Sn-30-32=20 Communication Fault
See page 4-2.

Sn-30-32=21 Timer Function Output
If the multi-function input terminals ⑤-⑧ are set as timer inputs (Sn-25 - 28 = 19), the signal will be output through the corresponding multi-function output terminals with a specified ON-delay and OFF-delay, as shown below in Fig. 6.2.3.20. See “Timer function” on page 3-8 for further information.

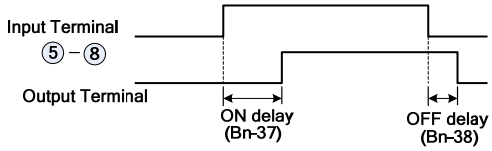


Fig. 9.2.3.20 Input / Output Timer Function

Cont.

Sn-30-32=22 Communication Application
The multi-function output terminals can be used as a PLC Extension Output Contact Terminals for control commands that are executed through serial communication. For further details, Please refer to 'RS-485 MODBUS/PROFIBUS Application Manual'.

Sn-30-32=23 Excess Load Detection (N.C. Contact)
See page 3-22, 3-44 for excess load detection function.

Sn-30-32=24 Load Loss Detect

Sn-30-32=25 Over Feedback

Sn-30-32=26 Low Feedback

Sn-30-32=27 During PID Sleep

Sn-30-32=28 Low Suction Detection

Sn-33 Multi-Function Analog Output (Terminal AO1) Selection (00 – 14)
Sn-34 Multi-Function Analog Output (Terminal AO2) Selection (00 – 14)
The multi-function analog output can be set to monitor the following 12 status items as shown in Table 9.2.3.7 below.

Table 9.2.3.7 Multi-Function Analog Output Monitor Selection

Sn-33 & Sn-34 Setting	Monitored Items	Description	
		Input	Output
00	Frequency Command	0 - Max. frequency	0 -10V
01	Output Frequency	0 - Max. frequency	
02	Output Current	0 - Rated current	
03	Output Voltage	0 - Rated voltage	
04	DC Voltage	230V Class 0-400V 460V Class 0-800V	
05	VIN Analog Command	0 - 10 V	
06	AIN Analog Command	4 - 20 mA	
07	AUX Analog Command	0 - 10 V	
08	PID Input	0 - Max frequency	

Cont.

Table 9.2.3.7 Multi-Function Analog Output Monitor Selection *Cont.*

Sn-33 & Sn-34 Setting	Monitored Items	Description	
		Input	Output
09	PID Output1	0 - Max frequency	0 -10V
10	PID Output2	0 - Max frequency	
11	Comm. Control	0 - 100%*1	
12	External PID Input	?	
13	External PID Output	?	
14	External PID Output 2	?	

*1: When the setting of Sn-33, 34 = 11, the multi-function output terminals AO1, AO2 are controlled through the RS-485 port either by MODBUS or PROFIBUS protocol. Refer to the "RS-485 MODBUS/PROFIBUS Application Manual"

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

Sn-35 Pulse Output Multiplication-Gain Selection (0 – 4)

- If the multi-function output terminal (DO1) is set as pulse output (when Sn-31 or Sn-32 = 14), the final output pulse frequency is a multiple (set by Sn-35) of the inverter output frequency. Refer to Fig. 6.2.36 for the pulse signal output.
  Example: When Sn-35= 0 and the inverter output frequency is 60Hz, the output pulse frequency is 60 Hz (50% duty cycle).

- The following Table 9.2.3.8 shows the pulse output frequency for various Sn-35 settings.

Table 9.2.3.8

Sn-35 Setting	Pulse Output Frequency	Applicable Freq. Range
0	1 × Inverter output frequency	3.83 -400.0Hz
1	6 × Inverter output frequency	2.56 - 360.0Hz
2	10 ×Inverter output frequency	1.54 - 210.0Hz
3	12 × Inverter output frequency	1.28 - 180.0Hz
4	36 × Inverter output frequency	0.5 - 60.0Hz

Sn-36 Inverter Station Address (0 – 31)
This parameter sets the address of the inverter when networking.

Sn-37 RS485 Communication Baud Rate Setting (0 – 4)
0: 1200, 1: 2400, 2: 4800, 3: 9600, 4: 19200

Sn-38 RS485 Parity Setting (0 – 2)
0: Reserved, 1: Even, 2: Odd

Cont.

Sn-39 RS485 Stopping Method After Communication Error (0 – 3)

- The MA7200 PLUS inverter has a built-in RS485 port for monitoring inverter status and reading the parameter settings. The user can also change the parameter settings to control motor operation.
- The MA7200 PLUS uses MODBUS protocol to communicate with external units through the RS485 port.
- The parameter settings are as follows:

  Sn-36: Inverter station address, setting range 1 - 31.

  Sn-37 = 0: 1200bps (bps: bit / sec)
  1: 2400bps
  2: 4800bps
  3: 9600bps
  4: 19200bps

  Sn-38 = 0: No parity
  1: Even parity
  2: Odd parity

  Sn-39 = 0: Deceleration to stop with Bn-02 (deceleration time), when RS485 has communication error.
  1: Coast to stop
  2: Deceleration to stop with Bn-04 (deceleration time), when RS485 has communication error.
  3: Continue to run (Stop when stop key 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.
- 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 changes of settings Sn-36, Sn-37 and Sn-38 will be effective on the next power up after turning off the inverter.
- Do not make the DRIVE/PRGM changeover while writing the data to the inverter.
- For further details on serial communication, refer to “RS-485 MODBUS/PROFIBUS Communication Application Manual”.

Sn-40 PG Speed Control Settings (0 – 3)

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.

Sn-41 Operation mode when PG opens (Disconnects) (0 – 3)

Sn-40= 0: Deceleration to stop set by (Bn-02) (Display “PG Open”)
1: Coast to stop (Display “PG Open”)
2: Deceleration to stop set by (Bn-04) (Display “PG Open”)
3: Continue to run (Flashing display “PG Open”)

Sn-42 Operation mode when PG speed deviation is outside limit (0 – 3)

Sn-42=0: Deceleration to stop (Bn-02) (Display “Sp. Deviate Over”)
1: Coast to stop (Display “Sp. Deviate Over”)
2: Deceleration to stop (Bn-04) (Display “Sp. Deviate Over”)
3: Continue to run (Flashing display “Sp. Deviate Over”)

Sn-43 Operation mode when PG over speed detection (0 – 3)

Sn-43=0: Deceleration to stop (Bn-02) (Display “Over Speed”)
1: Coast to stop (Display “Over Speed”)
2: Deceleration to stop (Bn-04) (Display “Over Speed”)
3: Continue to run (Flashing display “Over Speed”)

Sn-44 Auto_Run Mode Selection (0 – 6)

Sn-44=0: Auto_Run invalid
1: Single Cycle Running (1)
2: Periodic running (1)
3: Continue running (1)
4: Single cycle running (2)
5: Periodic running (2)
6: Continue running (2)

(1) Sn-44 = 1,2 and 3: If the inverter stops and re-starts again, it will continue running from the unfinished step, according to the setting of Sn-44.

(2) Sn-44 = 4,5 and 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-45 to Sn-60 Auto_Run Mode settings Selection (Turn set 1 – 16)

- A PLC operation mode is ready to use with the following setting of the multi-step frequency command 1 – 16 (An-01 to An-16), Auto_Run mode time setting (Bn-21 to Bn-36) with the auto_run mode selection of (Sn-44). The FWD/REV direction can be set by parameters Sn45 to Sn-60.
- In auto operation mode, setting the direction by operator, multi-function input terminal or RS-485 are all invalid.
- In auto operation mode, presetting the frequency by the multifunction input terminals ⑤ - ⑧, and the frequency UP/DOWN function is invalid. However, if the input JOG command is set as FJOG, RJOG, they will have priority (refer to Sn-25 - 28) .

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

The inverter will run for a single full cycle based upon the specified parameter settings and will then stop.

Example: Fig. 9.2.3.21a shows single cycle auto-run using the following parameter values.

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		

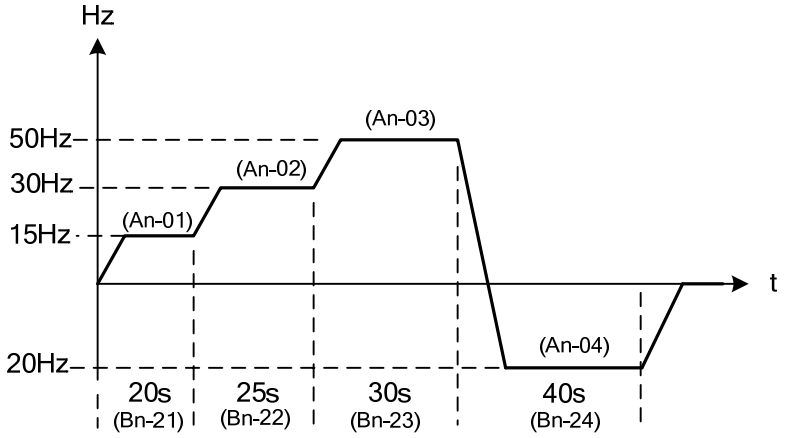


Fig. 9.2.3.21a Single Cycle Auto-Run

(B) Periodic Running (Sn-44＝2 or 5)

The inverter will repeat the same cycle periodically.

Example: Fig. 9.2.3.21b shows the same cycle periodic running based on the specified parameter settings.

Sn-44 ＝ 2

An-01 - 16, Bn-21 - 36, Sn-45 - 60: Same settings as the example (A) *Cont.*

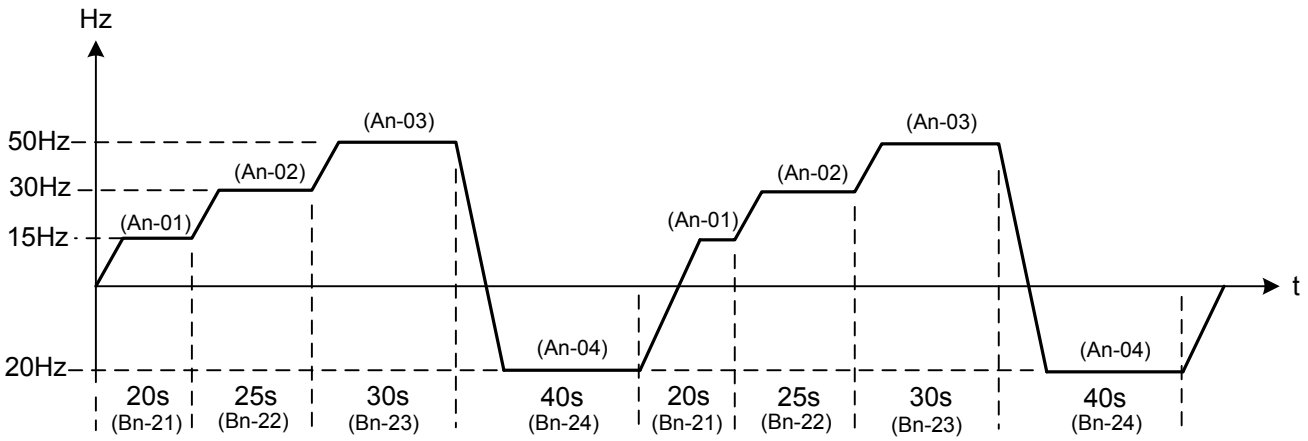


Fig. 9.2.3.21b Periodic Cycle Auto-Run

(C) Single Cycle with final step hold

The speed of final step will be held to run continuous.

Example: Fig. 9.2.3.21c shows the initial cycle with continuous running based on the specified parameter settings.

Sn-44 = 3

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

An-01 - 16, Bn-21 – 36: Same settings as the example (A)

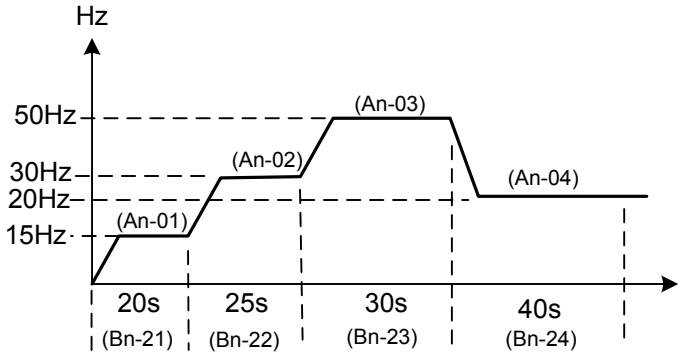


Fig. 9.2.3.21c Single Cycle Auto-Run with Final Step Hold

- The ACC/DEC times will follow the settings of Bn-01, Bn-02 in Auto_Run Mode.
- If the set values of Bn-21to Bn-36 are all zero, the Auto_Run Mode is disabled.

Sn-61 Applied torque load (0 – 1)

Selects either the constant torque load (Sn-61=0) or variable torque load (Sn-61=1). The inverter will automatically choose the proper V/F pattern and change the inverter overload protection curve. (See page 3-36 for 'INVERTER CAPACITY SELECTION').

Sn-62 Language Displayed Selection

This parameter is not available in version 77.01 and later. *Cont.*

Sn-63 Parameter Copy (0 – 4)

- The digital operator can upload the parameter settings from the digital operator to inverter and download parameter settings from the inverter to the digital operator.
- The digital operator will check its EEPROM or the inverter's EEPROM under the following settings.
- Sn-63= 0: NO action
  1: Upload data (Digital operator →inverter). During this period, the LED's on the digital operator will light sequentially in the CW direction.
  2: Download data (Inverter → digital operator). During this period, the LED's on the digital operator will light sequentially in the CCW direction.
  3: Verification check on the digital operator EEPROM; during this period the LED's will be switch-on between 2 groups.
  4: Verification check on inverter's EEPROM; during this period the LED's will not be on.
- Follow steps 1-3 to copy parameters between different inverters (either upload or download).
  Step 1: Check the contents of digital operator's EEPROM (Sn-63=03), then check the contents of inverter's EEPROM (Sn-63=04). Make sure that both EEPROM's function properly.
  Step 2: Download and copy the inverter's parameter settings to digital operator's EEPROM (Sn-63=2).
  Step 3: Upload and copy the parameter settings of digital operator to other inverter's EEPROM (Sn-63=1).

Sn-64 PID Function Selection (0 – 8)

Sn-64= 0: Disable PID control
1 - 8: Enable PID control (See App-1 PID Application Note for further details)
The PID function can also be enabled / disabled using the multi-function terminals ⑤ - ⑧.

Sn-65 Braking Resistor Protection Selection

Please see the Appendix A "PID Control Function" for more details.

Sn-66 Motor Parameter Auto-tuning Selection (0 – 1)

- Sn-66 = 0: Auto-tuning Disable
  1: Auto-tuning Enable
- The auto-tuning feature can be used to access and store the parameters of the motor.
- Auto-tuning can only be performed in the Sensorless Vector Control Mode (Sn-67=1).
- Perform auto-tuning with the load uncoupled.

Sn-67 Control Mode Selection (0 – 1)

Sn-67= 0: V/F Control Mode (Includes V/F control with PG feedback)
1: Sensorless Vector Control Mode (See Appendix A)
Note- For output frequencies less than 1.5Hz using sensorless vector control, set parameter Sn-02=15 (Arbitrary V/F pattern selection) and then change Cn-07 to required frequency.

Sn-68 Control Selection (1000 – 0001)

- This parameter is used to set bits to enable (1) or disable (0) the functions described below.
- Bit 1(– – –B) Corresponds to a phase loss protection function. When ON the function, the inverter will stop the output when there is an output terminal phase-lose.
- Bit 2 (– –B–) Reversed with no function.
- Bit 3 (–B– –) When set to 1, an input voltage of -10V - +10V can be input to analog voltage input terminal (Vin). When set to 0, the analog input terminal (Vin) is defaulted to 0V. This function is available only in versions 30.16 and later for 230V: 3-40HP and 460V: 3-75HP inverters. In the previous versions and 1-2HP inverters, the function is invalid.
  If the PID function is enabled (Sn-64 = 1), a ±10V signal is invalid.
- Bit 4(B– – –) When set to 1, the last output frequency value is stored before the UP/DOWN function goes into the HOLD state. When set to 0, the function is unavailable. Refer to parameter Sn-28=28 for a description of the frequency UP/DOWN function.

Sn-69 Torque Detection 2 Selection
The parameter is not available for software version 77.01 and later.
Use parameter Sn-12 for excess load detection and parameter P3-03 for load loss detection as an alternative.

Sn-70 Engineering Unit
The parameter is not available for software version 77.01 and later.
Use parameter P1-01 for engineering unit as an alternative.

9.2.4 Parameters PП (Application Parameters)

The P parameters, together with interacting parameters from other groups, are used to set and control the following eleven categories In this section only the P parameters are described in detail. The other related parameters are described in their own individual sections

1. Scaled Feedback and Engineering units
2. Programmable Local / Remote Switch
3. PID Sleep Functions
4. External PID Functions (Input / Output Terminal)
5. External PID Functions (Gain Setting and Monitoring)
6. Load Loss Detection Function
7. Over Feedback Function for PID Feedback Signal
8. Low Feedback Function for PID Feedback Signal
9. Low Suction Detection Function
10. Flow Meter Display
11. Power Meter, KWh Meter, and Energy Cost Usage.

P1-01 Engineering Unit (00-25)

- P1-01Engineering Unit is used to setup engineering units for normal and PID operation. It also sets the display format and maximum value of the following parameters.
  1 - Set point frequency command (An)
  2 - The parameters for the engineering units.
  3 - PID feedback monitor point Un-34.
- When P1-01 is set to 00, parameter Cn-28 can be used to set the display format of the frequency commands. When P1-01 is set to a value of 01 to 25, parameter Cn-28 is ineffective.
- The following Table 9.2.4.1 shows the display format and maximum value according to the setting of P1-01.

Table 9.2.4.1

Setting of P1-01	Display Format		Maximum Value	
	Set Point and Freq. Command	PID Feedback Monitor and Engineering parameters	Set Point and Freq. Command	PID Feedback Monitor and Engineering parameters
0	Follow the Setting of Cn-28	XXX.XX %	Follow the Setting of Cn-28	100.00%
1	XXX.XX %		100.00%	
2 - 25	XXXX		Parameter P1-02	

- Table 9.2.4.2 shows the engineering units that can be selected by P1-01.

Table 9.2.4.2 Engineering Units Selection by Parameter P1-01

Setting	Engineering Unit	Description
0	Set by Cn - 28	
1	%	%
2	PSI	PSI
3	GPH	gallon / hour
4	GPM	gallon / minute
5	inW	Inch water
6	FPM	feet / minute
7	CFM	$feet^3$ / minute
8	in	inch
9	ft	feet
10	HP	HP
11	°F	°F
12	m/s	meter / second

Setting	Engineering Unit	Description
13	MPM	meter / minute
14	CMM	$meter^3$ / minute
15	W	W
16	kW	kW
17	°C	°C
18	m	meter
19	A	A
20	RPM	RPM
21	SPM	stroke/minute
22	/s	unit / s
23	/m	unit / m
24	/h	unit / h
25	-	none

P1-02 Feedback Maximum (10-9999)
This parameter is used to set the maximum value of the Engineering Units selected by P1-01, provided P1-01 is ***not*** set to 00 or 01 (%). This value then becomes the maximum that can be set by all other Engineering Unit parameters.

Example: P1-01 = 2 (PSI), P1-02 = 300, then the PID Feedback Signal (0 – 10V / 4-20mA) = 0 - 300PSI.

- P1-01 must be set first and P1-02 must be set second before any other Engineering Units related parameters can be set.
- Monitor point Un-34, PID Feedback Display, is used to monitor the PID feedback signal applied to terminal AIN or VIN as set by parameter Sn-24. The Engineering Units and maximum value are set by parameters P1-01 and P1-02. The monitor value is zero if PID function is disabled. (See Fig. 9.2.4.1 below)

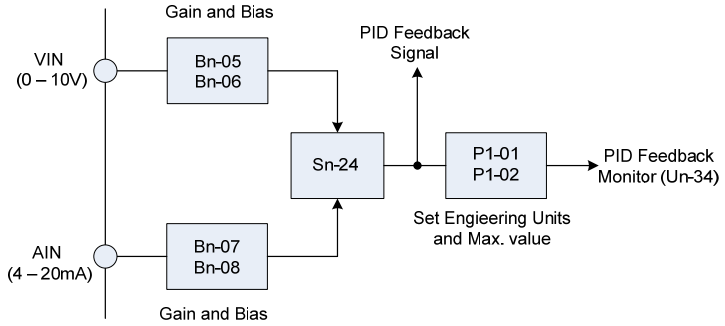


Fig. 9.2.4.1

][

P1-03 Local / Remote Key (0 -1)
P1-03=0: Local / Remote key is enabled.
1: Local / Remote key is disabled. *(When disabled this key is used as a JOG key)*

- When P1-03 is enabled, the local / remote function is effective when the inverter is in ***stop*** mode. Below is a list of Run Source, Frequency Source, SEQ LED Status, and REF LED Status during Remote Mode and Local Mode.

Status	Run command source and frequency command source	SEQ LED Status	REF LED Status
Remote	Set by parameters Sn-04, Run Source Selection and Sn-05, Frequency Source Selection.	ON if Sn-04 is not 0 (Run source is not from keypad)	ON if Sn-05 is not 0 (Frequency source is not from keypad)
Local	From keypad	OFF	OFF

- When P1-03 is enabled, the inverter is in remote mode after power-on and the Local / Remote switch is effective only when the inverter is in stop mode.
- Generally, the local / remote switch is used when Sn-04 and Sn-05 = 0 at the same time (*either the RUN source or Frequency source is controlled by the keypad*). The local / remote function is disabled if both Sn-04 and Sn-05 are set to 0.
- When P1-03 is disabled, the Local / Remote key operates as a JOG key. The JOG function is effective if:
  1 -The inverter is in stop mode and
  2 - Sn-04 = 0 (Run source is from the keypad).

The following parameters pertain to the sleep function.

P1-04 PID sleep function (0 -1) *Cannot be changed during operation.*
P1-04=0: PID function invalid
1: PID function valid
If the PID function is *disabled*, Sn-64 = 0, and the parameter P1-04 PID Sleep Function is set to 1 (PID Sleep Valid), a *"PID Sleep Setting Error"* will occur.

P1-05 PID wake up direction (0 -1) *Cannot be changed during operation.*
P1-05=0: Feedback above
1: Feedback below

P2-01 Sleep start level (000.00 – 100.00%) *Can be changed during operation.*

P2-02 Sleep start delay (000.1 – 600.0sec.) *Can be changed during operation.*

P2-03 Sleep wake up level (000.00 – 099.99%) *Can be changed during operation.*

P2-04 Sleep wake up delay (000.1 – 600.0sec.) *Can be changed during operation.*

- Figs. 9.2.4.2a and 9.2.4.2b below show a block diagram and a graph illustrating the sleep function.

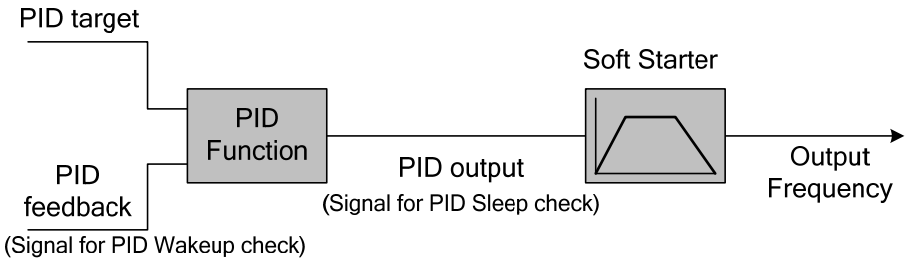


Fig. 9.2.4.2a PID Sleep Function Block Diagram

Cont.

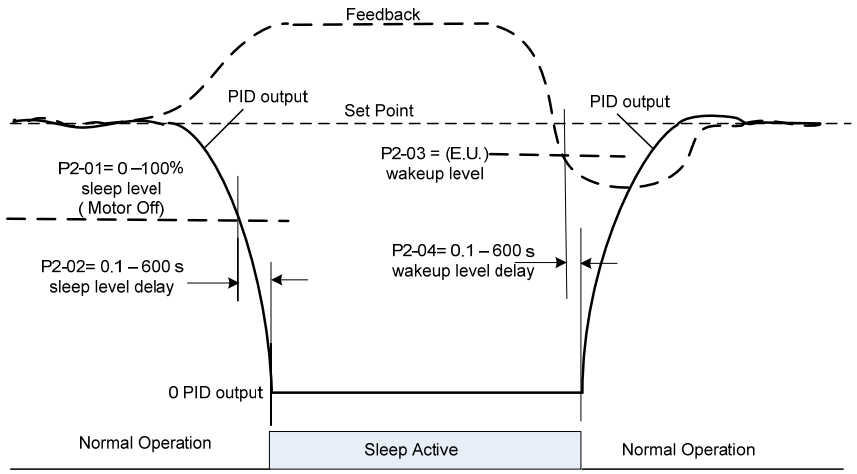


Fig. 9.2.4.2b PID Sleep Function Graph

- When the PID output falls below the Sleep Start Level P2-01 for a time exceeding the Sleep Start Delay P2-02 setting, the sleep function will be activated.
- The PID Sleep function can also be activated using a digital input. When the corresponding digital input Sn-25 –28 = 33 is ON for a time exceeding Sleep Start Delay P2-02 setting, the sleep function will be activated.
- If the sleep start level P2-01 is less than the minimum output frequency set by Cn-07, and none of the multi-Functional input terminals Sn-25-28 are set to =33 (PID Sleep), the sleep function will be disabled.
- A *"DI PID Sleep Setting Error"* will occur if any of Sn-25-28 is set to =33 (PID Sleep) and:
  1. The PID function is disabled, Sn-64 = 0 or,
  2. The PID sleep function is disabled, P1-04 = 0.
- The PID Wakeup Direction P1-05 is used to set the condition for PID Wakeup Check.
  0: PID Wakeup while the PID feedback rises above the wakeup level.
  1: PID Wakeup while the PID feedback falls below the wakeup level.
  While the PID sleep function is valid, the PID wakeup direction also affects the PID function.
- Sleep Wakeup Level P2-03 and Sleep Wakeup Delay P2-04, are used for PID Wakeup Check. When the inverter is in the PID sleep mode, and the PID feedback falls below or rises above (direction set by P1-05 PID Wakeup Direction) the sleep wakeup level P2-03 for a time exceeding the programmed wakeup delay time P2-04, the inverter will exit the sleep mode and resume run.
- If PID sleep is enabled and the inverter is in PID sleep mode, the During PID Sleep Monitor Un-35 will be 1. If any of Multi-Function Output Functions Sn-30 -32 is set as "During PID Sleep", the corresponding output will be ON.
- If the inverter is in PID sleep mode, the accumulated integration error of the PID function will be cleared.

External PID

The following parameters pertain to the external PID function input and output terminals.

P1-06 External PID function (Cannot be changed during operation)
P1-06=0: External PID function disabled
1: External PID Enabled. Terminal AO1 is the output signal of the external PID function.
2: External PID Enabled. Terminal AO2 is the output signal of the external PID function.

P1-07 External PID source
P1-07=0: Set point parameter
1: Terminal VIN
2: Terminal AIN
3: Terminal AUX
4: Set point RS485 serial communication

Cont.

P1-08 External PID feedback source
P1-08=1: Terminal VIN
2: Terminal AIN
3: Terminal AUX

- The External PID Function P1-06 is used to activate the external PID function and to set output terminal AO1 or AO2 to external PID output signal.
- The External PID Function is enabled when P1-06 is set to a nonzero value and the inverter is in the DRIVE mode, independent of the RUN / STOP status of the inverter
- If the External PID Function P1-06 is set to select output AO1 or AO2, the corresponding parameter Sn-33 or Sn-34 will be set to = 14 (Ext. Output 2) automatically, and cannot be changed until P1-06 is set = 0 (Invalid).
- The External PID Set Point Source P1-07 and External PID Feedback Source P1-08, are used to select the input source of the set point and feedback of the external PID function as shown in the following table 9.2.4.3.

Table 9.2.4.3 External PID Set Point and Feedback Selection

Value	Parameter P1-07 (External PID Set Point Source)	Parameter P1-08 (External PID Feedback Source)
0	Keypad (Parameter P2-05)	————
1	Terminal VIN	Terminal VIN
2	Terminal AIN	Terminal AIN
3	Terminal AUX	Terminal AUX
4	RS-485 Communication (0x0009, 1000/100.0%)	————

- If P1-07 and P1-08 set to the same source, the *"Ext PID Setting Error"* message will be displayed.
- Generally, each of the analog input terminals AIN (0/4-20mA), VIN (0-10V), and AUX (0-10V), can be used for the following provided that certain conditions are met :
  1-Frequency Command Source, when Sn-05=1
  2-Main PID function, when SN-64=1 for both set point and feedback.
  3-External PID, when P1-06= 1 or 2 for both set point and feedback.

When selected by a given function, <u>that analog input is not available</u> for any other function, and must be considered when planning for a particular application. If any of the unavailable terminals are selected as the External PID Function set point or feedback source, an "Ext PID Setting Error" message will occur.

The following tables 9.2.4.4a and 9.2.4.4b serve to further illustrate the terminals that are available to the external PID loop under the conditions specified.

Table 9.2.4.4a

Terminals available for external PID while (main) PID is *DISABLED* (Sn-64 = 0)				
Sn-05 Setting	*Sn-24 Setting*	*Sn-29 Setting*	*Terminals Available to Ext. PID*	*Comment*
1	0	0	AIN, AUX	VIN (0-10V) is used as the Frequency command
	1		VIN, AUX	AIN (0/4-20mA) is used as the Frequency command
	2 or 3		AUX (0-10V)	VIN & AIN are used as the Frequency command
0, 2 or 3	——		VIN, AIN, & AUX	————

Cont.

Table 9.2.4.4b

Terminals available for external PID while (main) PID is *ENABLED* (Sn-64 ≠ 0)				
Sn-05 Setting	*Sn-24 Setting*	*Sn-29 Setting*	*Terminals Available to Ext. PID*	*Comment*
1	0	9*	AIN (0/4-20mA)	VIN is used as main PID feedback AUX is used as main PID set point
	1	9	VIN (0-10V)	AIN is used as main PID feedback AUX is used as main PID set point
		≠ 9	AUX (0-10V)	AIN is used as main PID feedback VIN is used as main PID set point
	2 or 3	9*	None (External PID is unavailable)	VIN and AIN are used as main PID feedback AUX is used as main PID set point
0, 2, or 3	0	———	AIN, AUX	VIN is used as main PID feedback
	1		VIN, AUX	AIN is used as main PID feedback
	2 or 3		AUX	VIN and AIN are used as main PID feedback

*Terminal VIN is used as the main PID feedback and Sn-29 must equal 9 to set terminal AUX as the main PID set point, otherwise an error message will be displayed.

- If the AUX input is selected for use by the External PID Functions (P1-07=3) or (P1-08=3), Sn-29 will be set to 18 (Ext PID Set point) or 19 (Ext PID Feedback) automatically, and can not be edited until input AUX is not selected as an External PID Function Source.

The following parameters pertain to the external PID function gain settings and monitoring.

P1-09 PID Integral (I) limit (Cannot change during operation)
P1-09 Range: 1 – 100%

P1-10 PID filter time constant (Cannot change during operation)
P1-10 Range: 0.0 – 2.5 sec.

P2-05 PID set point value (Can change during operation)
P2-05 Range: 0.0 – 100.0%

P2-06 PID feedback gain (Can change during operation)
P2-06 Range: 0.01 – 10.00

P2-07 PID proportional gain (P) (Can change during operation)
P2-07 Range: 0.01 – 10.00

P2-08 PID Integration (I) time (Can change during operation)
P2-08 Range: 0.00 – 100.00 sec.

P2-09 PID derivative (D) time (Can change during operation)
P2-09 Range: 0.00 – 1.00 sec.

P2-10 PID bias (Can change during operation)
P2-10 Range: -100 – 100%

Cont.

Fig. 9.2.4.5 below is a block diagram depicting the external PID function.

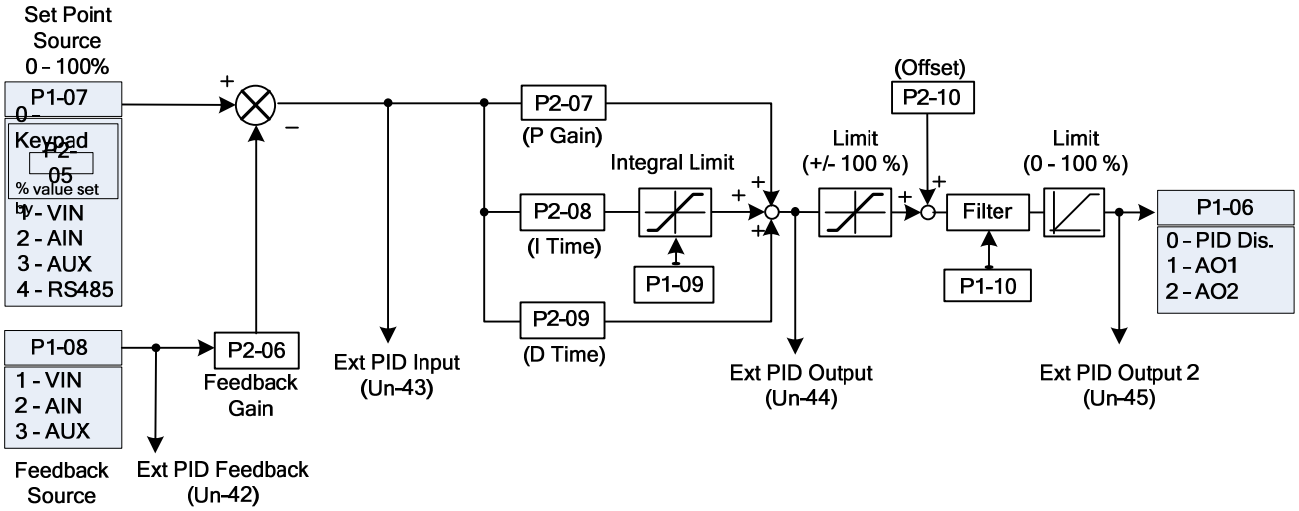


Fig. 9.2.4.5 External PID Functional Block Diagram

- When the External PID Set Point P1-07 is set to 0 (keypad), P2-05 is used to the value of the set point in percent.
- External PID Feedback Gain P2-06 is used to set the feedback gain for the External PID Feedback Source P1-08.
  Note: If the Set Point Source P1-07 and Feedback Source P1-08 are set to the same input an ERROR MESSAGE will occur.
- External PID P Gain P2-07 is used to set the proportion gain (01 – 10).
- External PID I Time P2-08 is used to set the integral time (0 – 100 sec.). Setting I to= 0, disables the integral function.
- External PID D Time P2-09 is used to set the differential time (0 – 1 sec.). Setting D to =0, disables the differential function.
- External PID Bias P2-10 is used to set the offset (-100 to +100%).
- External PID I Limit P1-09 is used to set the integral limit (1 – 100%).
- External PID Filter P1-10 is used to set the filter time constant (0 – 2.5 sec.).
- External PID Feedback Un-42, is used to monitor the feedback of the External PID Function.
- External PID Input, External PID Output, and External PID Output 2 are monitored by Un-43, Un-44, and Un-45 respectively.
- The PID Input and Output 2 can be accessed through Analog Output Terminal AO1 or AO2 by setting the corresponding parameter Sn-33 and Sn-34 to =12 (External PID Input) or to =13 (External PID Output)
- By setting one of the digital inputs Sn25-28 to =31 (External PID Invalid), the External PID function can be disabled by activating that input. During the External PID Invalid mode, the PID feedback, Input, Output 1, and Output 2 are equal to zero.
- By setting one of the digital inputs Sn25-28 to =32 (External PID Integration Reset), the accumulated integration error can be reset by activating that input.

The following parameters pertain to the load loss function.

P3-01 Load loss detection level (Cannot change during operation)
P3-01 Range: 000 – 200%

P3-02 Load loss detection time (Cannot change during operation)
P3-01 Range: 00.0 – 25.5 sec.

P3-03 Load loss action (Cannot change during operation)
P3-03=0: None
2: Load loss alarm
3: Load loss fault

Cont.

- The Load Loss Detection Level can be set by Multi –function Analog Input parameter Sn-29 (AUX Function) when it is set to 16 *or* by P3-01 Load Loss Det. Level, when Sn-29 is ≠ 16.
  Note: When Sn-29 is set to =16 (Aux Function), the load loss level is determined by the analog value applied to the AUX input terminal and parameter P3-01Load Loss Detect Level is invalid.
- P3-01 Load Loss Detect Level is set as a percentage of inverter rated current. When Sn-29 = 16, the Load Loss Detect Level is determined by the voltage applied to the AUX input terminal as shown in Fig. 9.2.4.6 below.

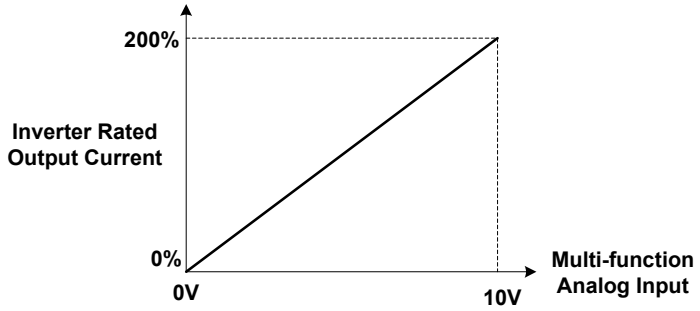


Fig. 9.2.4.6 Load Loss Detect Level Set by AUX Input

- When the inverter output current falls below the Load Loss Detect Level for a time exceeding the programmed Load Loss Detect Time P3-02, the inverter status will be as set by parameter P3-03 Load Loss Action as shown in the following table 9.2.4.5. Also, if any of the Multi-Function Outputs Sn-30 (Relay), Sn-31 (DO1), or Sn-32 (DO2) are set to =24 (Load Loss Detect), that output will be turned ON.

Table 9.2.4.5 Inverter Status vs. P3-03 Value

P3-03 Value	Inverter Status while Load Loss	Message while Load Loss
0	Continue Running	——
1	Continue Running	Load Loss Alarm
2	Shut Down	Load Loss Fault

- Below Fig. 9.2.4.6 shows a block diagram and graph illustrating the Load Loss Detection Function.

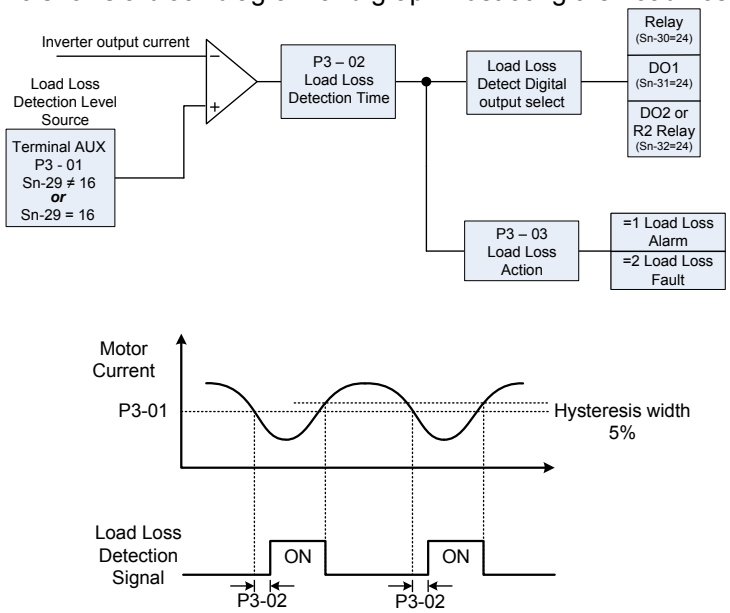


Fig. 9.2.4.6 Load Loss Detection Function

The following parameters pertain to the PID over feedback signal.

P3-04 Over feedback level (Cannot change during operation)
P3-04 Range: 000.00 – 099.99%
Note- The engineering units and range are set by parameter P1-01

P3-05 Over feedback detection delay time (Cannot change during operation)
P3-05 Range: 0000.0 – 6000.0 sec.

P3-06 Over feedback action (Cannot change during operation)
P3-06=0: None
1: Over feedback alarm
2: Over feedback fault

- If PID is enabled (Sn-64 ≠ 0), Over Feedback Detection is enabled if P3-06 Over Feedback Action is set to =1 or 2 *or* at least one of Multi-Function Outputs Sn-30 (Relay), Sn-31 (DO1), or Sn-32 (DO2 or R2 Relay) is set to =25 (Over Feedback)
- When PID feedback rises above the Over Feedback Level set via P3-04 for the time exceeding the programmed Over Feedback Delay Time P3-05, the inverter status will be controlled by parameter P3-06 Over Feedback Action as shown in the following table 9.2.4.6. Also if any of the Multi-Function Outputs Sn-30 (Relay), Sn-31 (DO1), or Sn-32 (DO2 or R2 Relay) are set to =25 (Over Feedback), that output will be turned ON.

Table 9.2.4.6 Inverter Status vs. P3-06 Value

P3-06 Value	Inverter Status while Over Feedback	Message while Over Feedback
0	Continue Running	No Message
1	Continue Running	Over Feedback Alarm
2	Shut Down	Over Feedback Fault

- Fig. 9.2.4.7 below shows a block diagram illustrating the Over Feedback Detection Function.

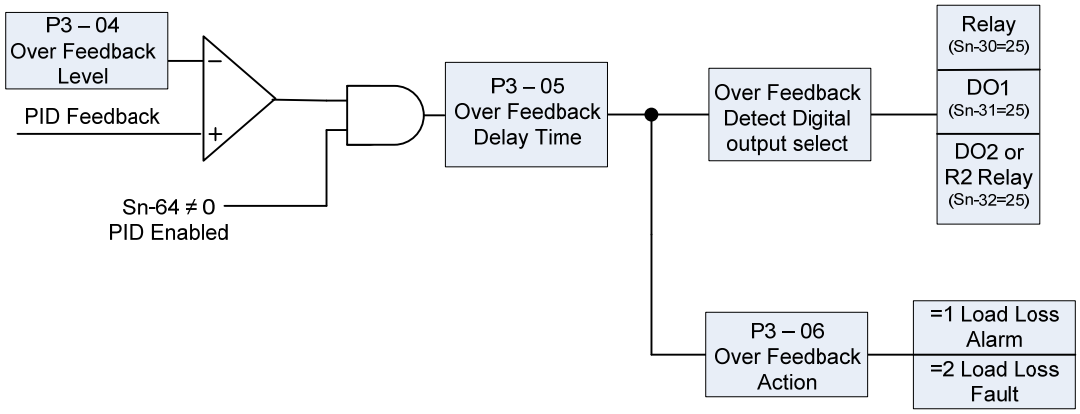


Fig. 9.2.4.7 Over Feedback Detection Function

The following parameters pertain to the PID low feedback signal.

P3-07 Low feedback level (Cannot change during operation)
P3-07 Range: 000.09 0 099.99%
Note - The engineering units and range are set by parameter P1-01

P3-08 Low **f**eedback detection delay time (Cannot change during operation)
P3-07 Range: 0000.0 – 6000.0 sec.

P3-09 Low feedback action (Cannot change during operation)
P3-09=0: None
1: Low feedback alarm
2: Low feedback fault

- Fig. 9.2.4.8 below shows a diagram of the Low Feedback Detection Function.

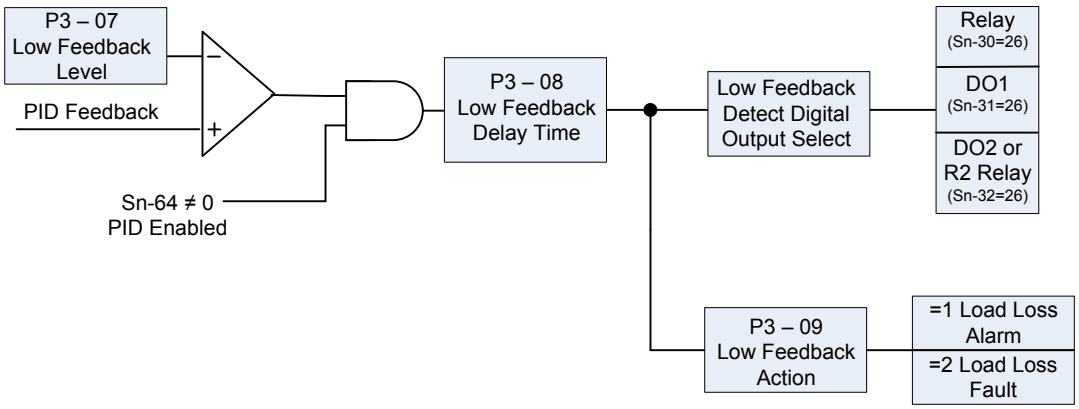


Fig. 9.2.4.8 Low Feedback Detection Function

- If PID is enabled (Sn-64 ≠ 0), Low Feedback Detection is enabled if P3-09 Low Feedback Action is set to =1 or 2 *or* at least one of Multi-Function Outputs Sn-30 (Relay), Sn-31 (DO1), or Sn-32 (DO2 or R2 Relay) is set to =26 (Low Feedback)
- When the PID Feedback falls below the Low Feedback Level set via P3-07 for the time exceeding the programmed Low Feedback Delay Time P3-08, the inverter status will be controlled by parameter P3-09 (Low Feedback Action) as shown in the following Table 9.2.4.7. Also if any of the Multi-Function Outputs Sn-30 (Relay), Sn-31 (DO1), or Sn-32 (DO2 or R2 Relay) are set to =26 (Low Feedback), that output will be turned ON.

Table 9.2.4.7 Inverter Status vs. P3-09 Value

P3-09 Value	Inverter Status while Low Feedback	Message while Low Feedback
0	Continue Running	No Message
1	Continue Running	Low Feedback Alarm
2	Shut Down	Low Feedback Fault

The following parameters pertain to the low suction detection function.

The Low suction detection function is for pump applications. It can detect the break in suction or the absence of the supply medium (e.g. water).

P3-10 Low suction detection selection (Cannot change during operation)
P3-10=0: PID error
1: Current
2: PID Error and current

P3-11 Low suction detection time (Cannot change during operation)
P3-11 Range: 000 – 300 sec.

P3-12 Low suction PID error (Cannot change during operation)
P3-12 Range: 01 – 30%

P3-13 Low suction current (Cannot change during operation)
P3-13 Range: 000.1 – 200.0A

P3-14 Low suction action (Cannot change during operation)
P3-14=0: None
1: Low suction alarm
2: Low suction fault
3: Low suction fault and restart

P3-15 Restart delay (Cannot change during operation)
P3-15 Range: 0005 – 6000 sec.

P3-16 Restart selection (Cannot change during operation)
P3-16=0: With speed search
1: Without speed search

- P3-10 Low Suction Detect is used to select which signal is used for low suction detection as shown in the following Table 9.2.4.8.

Table 9.2.4.8 Low Suction Detect Signal Selection

P3-10 Value	Detection Signal	
	PID Error (PID Input)	Output Current
1	1	0
2	0	1
3	BOTH	

- When P3-10 Low Suction Detect is set to =1, (Detect PID Error), the PID Error (PID Input, Un-15) is used for low suction detection.
- When P3-10 Low Suction Detect is set to =2, (Detect Current), the output current is used for low suction detection.
- When P3-10 Low Suction Detect is set to =3, both the PID Error and Output Current are used for low suction detection.
- In order to generate a Low Suction Detection output, the following conditions must be satisfied for the time specified by P3-11Low Suction Det. Time.
  1. Sn-64 ≠ 0 (PID is enabled) and the Un-15 PID Input (PID Error) is higher than P3-12 Low Suc. PID Error set level.
  2. The output frequency is > Cn-01 (Max. Output Frequency) - Cn-31(Frequency Agree Detection Width)
- The Low Suction Detection function block diagram is shown in the following Fig. 9.2.4.9.

Cont.

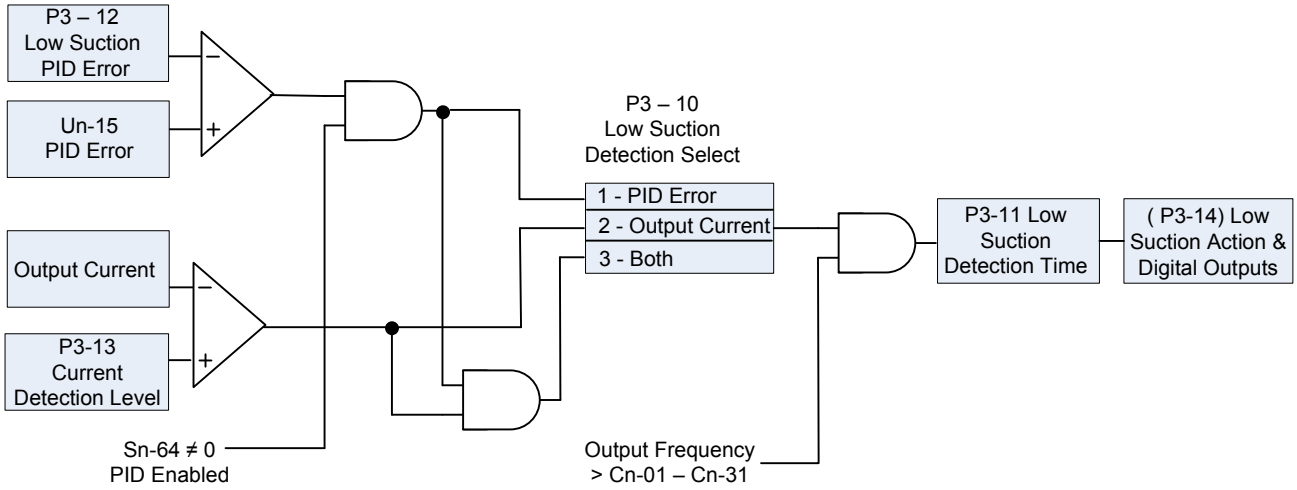


Fig. 9.2.4.9 Low Suction Detection Function

- P 3-14 Low Suction Action, is used to set the inverter action after low suction detection has occurred per the following Table 9.2.18.

Table 9.2.4.9 Inverter Action vs. P3-14 Value

P3-14	Inverter Status	Message	Fault Contact Output
0	Continue Running	No Message	No operation
1	Continue Running	Over Feedback Alarm	No operation
2	Shut Down	Over Feedback Fault	Operation
3	Shut Down and Restart	Over Feedback Fault (before restart)	Operation (before restart)

- The following Fig. 9.2.4.10, is a block diagram showing the Low Suction Output function.

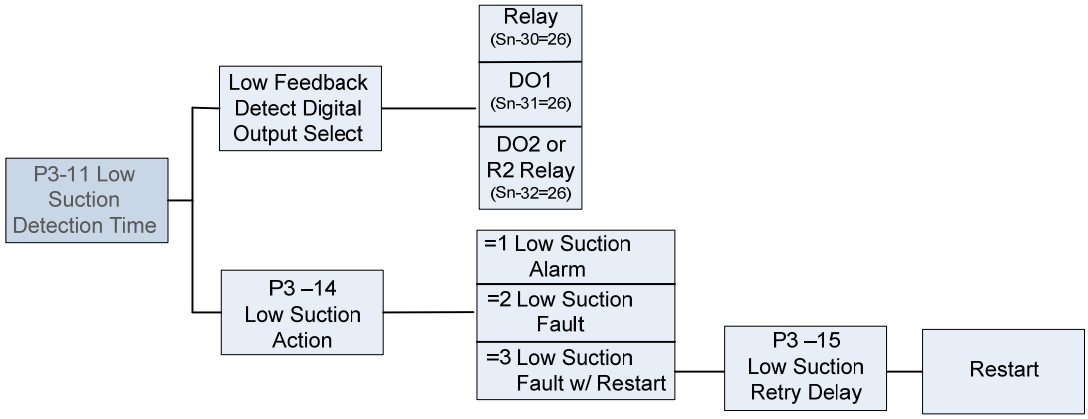


Fig. 9.2.4.10 Low Suction Output Function

- If P3-11 Low Suction Action, is set to =3 (Shut Down and Restart), the inverter will shut down and restart after the time specified by P3-15 Low Suction Retry Delay. This retry function is enabled as long as:
  1- Low Suction Detection is enabled
  2- P3-11, Low Suction Action, is set to =3.
  3- There is no STOP command during the low suction retry delay time.
  Note -The setting of parameter Cn-24 (Number of Auto Restart Attempts) is independent of the retry function of low suction detection.

Cont.

- P3-16 Low Suction Restart Selection, determines the action while the inverter restarts as per the following Table 9.2.4.10.

Table 9.2.4.10 Low Suction Restart Action

P3-16	Action during Restart		Description
	Speed Search	DC-injection braking	
0	Valid	Invalid	This setting is used when the restart delay time is short and the motor is still running because of inertia.
1	Invalid	Depends on the setting of Cn-17	This setting is used when the restart delay time is long enough to stop the motor before restart.

- If low suction is detected and any of the Multi-Function Output Functions (Sn-30 -32) are set to 28 (Low Suction), the corresponding terminal will be ON. If P3-11Low Suction Action is set to =3 (Shut Down and Restart), the corresponding terminal will be OFF after the inverter restarts.

The following parameters pertain to the flow meter display.

Table 9.2.4.11 shows the parameters that pertain to the flow meter display.

Table 9.2.4.11 Flow Meter Display Parameters

Parameter No.	LCD Display	Setting Range	Factory Setting	Change During Operation	Modbus Address
P4-01	P4-01 Flow Meter Function	0: None 1: Aux Input 2: Pulse Train Input	0	NO	0x0880
P4-02	P4-02 Max Flow for 10V AUX	00000 – 50000 GPM	01000 GPM	NO	0x0881
P4-03	P4-03 No Flow point for AUX	0.0 - 5.0V	0.0V	NO	0x0882
P4-04	P4-04 Pulse Multiplier	000.01 – 500.00	100.00	NO	0x0883
P4-05	P4-05 Flow Meter Offset	0.00 - 0.99	0.00	YES	0x0884
Un-41	Un-41 Flow Meter	0 - 50000 GPM	——	——	0x0047

- P4-01Flow Meter Selection, is used to enable or disable the flow meter function and to select one of two the inputs for this function as follows.
  1. Terminal Aux: 0-10V or 4-20mA signal. *(Note – If using a 4-20 mA input signal, place a 500Ω resistor from the AUX input terminal to GND).*
  2. Terminal A(+) / A(-): Pulse Train Input with open-collector or complementary interface. The pulse input frequency range is 50Hz - 32kHz.
- The following Table 9.2.4.12 shows the P4-01 function and the parameters used with selection 1 or 2.

Table 9.2.4.12 Flow Meter Function

P4-01	Flow Meter Function	Flow Meter Signal	Flow Meter Parameters
0	Disabled	——	——
1	Enabled	AUX Input	P4-02, P4-03 (P4-04, P4-05 is fixed)
2	Enabled	Pulse Train Input	P4-04, P4-05 (P4-02, P4-03 is fixed)

Cont.

- Flow Meter monitor point Un-41 is used to display the output of the flow meter function in GPM. If the P4-01 is set to 0, the Flow Meter is zero.
- Fig. 9.2.4.11below is a diagram of the flow meter function when Flow Meter Selection P4-01 is set to =1 (AUX input).

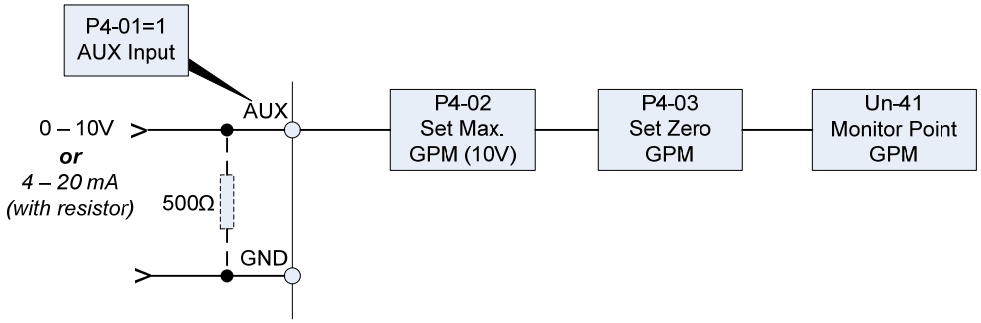


Fig. 9.2.4.11 Flow Meter Function with AUX Input

- When P4-01 is set to =1(AUX Input), the Flow Meter signal is input to terminal AUX and parameters P4-02 (Max Flow for 10V AUX) and P4-03 (AUX for No Flow) are used to set flow meter functions. Also, the parameters below will be set automatically.
  1. Parameters P4-04 and P4-05.
  2. AUX Function Selection (Sn-29)
  3. Terminal AUX Gain and Bias (Bn-09 and Bn-10).

  These parameters can not be edited until the setting of P4-01 is changed. Also when P4-01 is set to =1 any previous AUX Function (Sn-29) setting will become invalid.
- An error message "*Flow Meter Setting Error*" will be displayed if P4-01 is set to 1 and one of the conditions below is satisfied.
  1. Sn-29 (AUX Function Selection) =9 (PID Target).
  2. P1-07 (External PID Set Source) =3 (AUX Function).
  3. P1-08 (External PID Feedback Source) =3 (AUX Function).
- P4-02 Max Flow for 10V AUX, is used to set the maximum flow level in GPM, which corresponds to a 10 V input to the Aux input.

  Example: P4-02 is set to = 2500 GPM (max flow level).
  Aux input 0 – 10 V = 0 - 2500GPM.
- P4-03 Aux for No Flow, is used to offset the input signal to terminal AUX, which corresponds to *zero* flow. An example of this would be if the input flow signal is 4-20mA, where 4mA = 0 GPM, and a 500Ω resistor is used between AUX and GND. The input voltage to the AUX terminal would be 4mA x 500Ω = 2V. P4-03 would then be set to =2V so that 4 mA would represent zero flow. The maximum flow would be as set in the previous example by P4-02.
- Fig. 9.2.4.12 below is a diagram of the flow meter function while Flow Meter Selection P4-01 is set to 2 (Pulse Train Input).

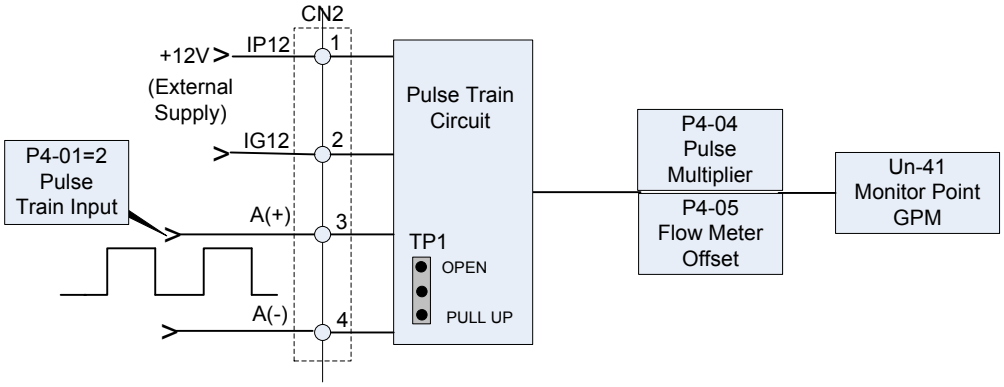


Fig. 9.2.4.12 Flow Meter Function with Pulse Train Input

Cont.

- When P4-01 is set to 2 (Pulse Train Input), the Flow Meter signal is input to terminals A(+) and A(-) and the parameters P4-04 (Pulse Multiplier) and P4-05 (Flow Meter Offset) are used to set the flow meter functions. In this case, parameters P4-02 and P4-03 will be set automatically and can not be edited until the setting of P4-01 is changed.
- The input to terminals A(+) and A(-) allows for open-collector or complementary interface by setting jumper TP1 to PULL-UP position for open-collector interface or to OPEN position for complementary interface.
- An error message "*Flow Meter Setting Error*" will be displayed if P4-01 is set to 2 and one of the conditions below is satisfied.
  1. Sn-40 (PG Speed Control Settings) ≠ 0 (Speed Control Enabled).
  2. Sn-05 (Frequency Command Setting) = 3 (Pulse Input).
- P4-04 Flow Multiplier is used to scale the flow meter monitor value, while P4-05 Flow Offset is used to calibrate the flow meter.

  Output GPM = Input Pulse Train Frequency (Hz) x (P4-04 + P4-05).

  Example: Input Pulse Train Frequency = 60Hz, P4-04 = 500.1 and P4-05 = 0.20
  Flow Meter Monitor = 60 x (500.1 + 0.2) = 30018 GPM.

The following parameters pertain to Power Meter, kWH and Energy use.

The following Table 9.2.4.13, sows the parameters for these functions.

Table 9.2.4.13 Power Meter, kWH and Energy use Parameters

Parameter No.	LCD Display	Setting Range	Factory Setting	Change During Operation	Modbus Address
P5-01	P5-01 Energy Cost per kWh	0.000 - 5.000$	0.000$	YES	0x08C0
P5-02	P5-02 Reset Energy Usage	0: No 1: Reset	0	YES	0x08C1
Un-36	Un-36 Output Power	0.0 - 999.9 kW	——	——	0x0042
Un-37	Un-37 Energy Used in kWh	0.0 - 999.9 kWh	——	——	0x0043
Un-38	Un-38 Energy Used in MWh	0.0 - 50000 MWh	——	——	0x0044
Un-39	Un-39 Energy Cost in $	0 - 9999 $	——	——	0x0045
Un-40	Un-40 Cost in 10000$	0 - 25000 (0$ - 250 Mil$)	——	——	0x0046

- Un-36 Output Power, is used to monitor the output power in kW. The display range is 0.0 - 999.9kW.
- Un-37 Energy Used in kWh and Un-38 Energy Used in MWh, are used to monitor the total energy used by the inverter. The maximum value of monitor energy is 50000MWh.

  Example: If 800 kWh of energy is used, Un-37 = 800 kWh and Un-38 = 0 MWh.
  If 32.3 MWh of energy is used, Un-37 = 300 kWh and Un-38 = 32 MWh.
- P5-01 Energy Cost per kWh, is used to set the unit energy cost per kWh.

Cont.

- Un-39 Energy Cost in $ and Un-40 Energy Cost in 10000, are used to monitor the total energy cost of inverter. The maximum value of monitor energy cost is 250 Million $

  Example: If the energy cost is 2,000$, Un-39 = 2000$ and Un-40 = 0.
  If the energy cost is 123,200$, Un-39 = 3200$ and Un-40 = 12.
- When the power is OFF, the inverter will retain the values of energy used (Un-37, Un-38) and energy cost (Un-39, Un-40), and the stored data will be available after power up.
- P5-02 Reset Energy Usage is used to clear the monitor variables for energy usage and energy cost.
  P5-02 = 0: No Reset
  P5-02 = 1: Reset (The data will be cleared automatically after P5-02 is set to =1)

9.2.5 Parameters Un- (Monitoring Parameters)

Un-01 - Frequency Command
Un-02 - Output Frequency
Un-03 - Output Current
Un-04 - Output Voltage
Un-05 - Main Circuit DC Voltage

Through the settings of Sn-33, Sn-34, the above contents can be output to at the multi-function analog output terminals (AO1, AO2) at various set voltage levels between 0 and 10V.

Un-06 - External Analog command (VIN)

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. Refer to App-1 PID Application Note.

Un-07 - External Analog Command (AIN)

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. Refer to App-1 PID Application Note.

Un-08 – Multi-function Analog Input Command (AUX)

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. Refer to App-1 PID Application Note.

Un-09 - Analog Output (AO1)
Un-10 - Analog Output (AO2)

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

Un-11 - Digital Input Terminal Status (1 – 8)

The parameter monitors the status (ON or OFF) of input terminals 1 thru 8.

Un-12 - Digital Output Terminal Status (Relay and Open Collector)

The parameter will monitor the status (ON or OFF) of output terminals RA-RC or R1A-R1C, or DO1-DOG, DO2-DOG, or R2A-R2C.

Un-13 - PG Feedback
Un-14 - PG Speed Compensation

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

Un-15 - PID Control Input
Un-16 - PID Control Output 1
Un-17 - PID Control Output 2

The values in Fig. 46, 47 (on page APP-5, APP-6) 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.

Un-18 - Message 1
Un-19 - Message 2
Un-20 - Message 3
Un-21 - Message 4

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

Un-22 - Cumulative Operation Time Setting

The parameter is used to count the elapsed time from the previous fault to the latest fault. The setting range is 0 - 65536 Hr. After the fault(s) has been cleared and system reset, Un-22 will be reset to zero.

Un-23 - The Frequency Command While Last Fault Occurred
Un-24 - The Output Frequency When the Last Fault Occurred
Un-25 - The Output Current When the Last Fault Occurred
Un-26 - The Output Voltage When the Last Fault Occurred
Un-27 - The DC Voltage When the Last Fault Occurred
Un-28 - The Input Terminal Status When the Last Fault Occurred
Un-29 - The Output Terminal Status When the Last Fault Occurred

The above parameters will display the inverter status at the time of the latest fault. The contents of parameters Un-23 -29 will be cleared after the fault(s) has been cleared and the system is reset.

Un-30 - Cumulative Run Time Whenever the input Power Is On

This parameter will record the cumulative operation time from input power-on to input power-off. Its value is 0 - 65535 Hr. If the value exceeds 65535, it will restart from 0.

Un-31 - Cumulative Run Time Whenever the Output Power Is On

This parameter will record the cumulative operation time from output power-on to output power-off. Its value is 0 - 65535 Hr. If the value exceeds 65535, it will restart from 0.

Un-32 - EPROM software version
The parameter will specify the version of software that is currently used in the inverter.

Un-33 - Motor Speed While PG Feedback Is Set.
When PG feedback control is being set, the motor speed can be monitored through Un-33.

Un-34 - PID feedback display
- When the PID Function is enabled, the PID feedback signal can be monitored through Un-34. If the PID Function is not enabled Un-34 will be zero.
- The display content can be set by P1-01 and P1-02.
  P1-01 sets the units of Un-34.
  P1-02 is the equivalent value displayed for 100% PID Feedback.

Un-35 - PID Sleep Monitor
Displays the status of the sleep mode (=1: Sleep mode active; =0: Sleep mode inactive)

Un-36 - Inverter Output Power
Displays the inverter output power in kilowatts (0.0 - 999.9 kW)

Un-37 - Inverter Energy Usage
Displays the inverter energy usage in kilowatt/hrs (0.0 - 999.9 kWh)

Un-38 - Inverter Energy Usage
Displays the inverter energy usage in megawatt/hrs (0.0 - 50000 MWh)

Un-39 - Inverter Energy Cost
Displays the inverter energy cost in dollars (0 - 9999 $)

Un-40 - Inverter Energy Cost
Displays the inverter energy cost in units of (ten thousand) dollars (0$ - 250 Mil$)

Un-41 - Flow Meter
Displays the flow meter in gallons/minute (0 - 50000 GPM)

Un-42 - External PID Feedback display
Displays the PID feedback in (0.0%)

Un-43 - External PID Set Point display
Displays the PID feedback in (0.0%)

Un-44 - External PID Output 1 display
Displays the PID output 1 in (0.0%)

Un-45 - External PID Output 2 display
Displays the PID output 2 in (0.0%)

10.0 Error Messages and Troubleshooting

10.1 General

The MA7200 PLUS has basically two modes of operation when a problem occurs during operation; A Fault or a Warning.

10.1.1 Fault

When a Fault occur, the Fault code is displayed on the Digital Operator and the Fault output contact (RA-RB-RC or R1A-R1B-R1C, DO1, DO2 or R2A-R2C) activates. The inverter shuts off and the motor stops. In order to restart the Inverter, the Fault must be identified and cleared and then the Reset key on the Digital Operator can be pressed or the digital input to terminal 4 can be activated. The main power to the inverter can also be cycled.

The following Table 10.1.1.1shows the Fault display on the Digital Operator, the Fault description, the possible cause and suggested remedy.

Table 10.1.1.1 Fault Messages, Causes and Remedies

LCD Display (English) Fault	Fault Description	Fault Contact Output	Fault Causes	Remedy
DC Volt. Low	The main circuit DC voltage is lower than the low voltage detection level (Cn-39).	ON	• 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 contactor.	• Check the source voltage and wiring. • Check the power capacity and power system.
Over Current	The inverter output current becomes approx. 200% and above the inverter rated current.	ON	• Extremely rapid accel. • Short-circuit or ground- fault at the inverter output side. • Motor capacity greater than the inverter rating. • High-speed motor and pulse motor has been started.	• Extend the accel. time. • Check the load wiring. • Increase inverter capacity
Ground Fault	A ground fault occurs at the inverter output side and the ground-fault current exceeds approx. 50% of the inverter rated current.	ON	• Motor dielectric strength is insufficient. • Load wiring is not proper.	Check the motor wiring impedance and the load wiring.
Over Voltage	The main circuit DC voltage becomes excessive because of regeneration energy caused by motor decelerating.	ON	• Insufficient deceleration time. • High input voltage compared to motor rated voltage.	• Extend the accel. time. • Use a braking resistor.
Over Heat	The temperature of the heatsink reaches the detection level.	ON	• Defective cooling fan. • Ambient temperature too high • Clogged filter.	Check for the fan, filter and the ambient temperature.
Motor Over Load	Motor overload is detected by the electronic thermal relay. (motor protection)	ON	• Overload at 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.

Cont.

Table 10.1.1.1 Fault Messages, Causes and Remedies (*Cont.*)

LCD Display (English) Fault	Fault Description	Fault Contact Output	Fault Causes	Remedy
Inverter Over Load	The electronic thermal sensor detects inverter overload while the output current exceeds 112% of rated value. (inverter protection)	ON	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.
Excess Load	Excess Load is detected while the output current is larger than or equal to the setting of Cn-26. (machine protection)	ON	Machine errors or overload	• Check the use of the machine. • Set a higher protection level (Cn-32).
Ext. Faul t3	External fault signal ③	ON	Fault input of external signal ③, ⑤, ⑥, ⑦ and ⑧.	Identify the fault signal using Un-11.
Ext. Fault 5	External fault signal ⑤	ON		
Ext. Faul t6	External fault signal ⑥	ON		
Ext. Fault7	External fault signal ⑦	ON		
Ext. Fault8	External fault signal ⑧	ON		
Inverter EEPROM	EEPROM fault	ON	• 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.
	EEPROM (BCC, no.) is bad.	ON		
Inverter A/D	A/D converter (inside the CPU) fault	ON		
PG Over Sp.	Excessive PG speed fault	ON	Improper setting of ASR parameter or over-speed protection level.	Check the parameters of ASR and the protection level.
PG Open	PG is open-circuit	ON	The PG wiring is not properly connected or open-circuit.	Check the PG wiring.
Sp.Deviat Over	Excessive speed deviation	ON	Improper setting of ASR parameter or speed deviation level.	Check parameters of ASR and speed deviation level.

Cont.

Table 10.1.1.1 Fault Messages, Causes and Remedies (*Cont.*)

LCD Display (English) Fault	Fault Description	Fault Contact Output	Fault Causes	**Remedy**
RS-485 Interrupt	MODBUS Communication fault occurs .The inverter remains operating.	ON	• External noise • Excessive vibration or impact Communication wire. • Not properly connected	• Check the parameter setting, including Sn-01, Sn-02. • Check if the comm. wire for proper connection. • Restart, if fault remains, contact your representative.
Output Power Loss	One of the inverter output phases is lost. The motor coasts to stop.	ON	• One of the inverter output phases is lost. • DCCT fault.	• Check the wiring between inverter and motor. • Replace the DCCT.
Load Loss	Load Loss is detected when the output current is smaller than the setting of P3-01. (machine protection)	ON	• Machine errors or broken belts.	• Check the use of the machine. If the load is connected by a belt, also check the belt. • Set a lower detection level (P3-01) or longer detection time (P3-02).
Over Feedback	Over feedback is detected while the PID feedback signal is larger than the setting of P3-04.	ON	• The feedback level is beyond the acceptable level. • Improper feedback detection level (P3-04)	• Check the load, or the feedback signal sensor. • Set a lower protection level (P3-04) or longer detection time (P3-05).
Low Feedback	Low feedback is detected while the PID feedback signal is smaller than the setting of P3-07.	ON	• The feedback level is beyond the acceptable level. • Improper feedback detection level (P3-07)	• Check the load, or the feedback signal sensor. • Set a higher protection level (P3-07) or longer detection time (P3-08).
Low Suction	Low Suction is detected while the output frequency approaches maximum output frequency (Cn-01) and; 1. PID error is larger than the setting of the setting of P3-12 and / or: 2. the output current is smaller the setting of the setting of P3-13	ON	The pump breaks suction or the pump loses the water supply.	Check the pump system.
Low Suction (Retry)	Low Suction is detected while the output frequency approaches maximum output frequency (Cn-01) and; 1. PID error is larger than the setting of the setting of P3-12 and / or: 2. The output current is smaller the setting of the setting of P3-13.After the time specified by P3-15, this fault will be reset automatically and inverter will re-start.	ON	The pump breaks suction or the pump losses the water supply.	Check the pump system.

9.1.2 Warnings and Self- Diagnosis

If warning occurs, the Digital Operator will display the warning code. However, the fault-contact output does not operate, except in certain cases. The Digital Operator will return to its previous status when the above warning clears.

The following table 10.1.2.1 shows the Warning display on the Digital Operator, the Warning description, the possible cause and suggested remedy.

Table 10.1.2.1 Warning Messages, Causes and Remedies

LCD Display (English) Alarm	Warning Description	Fault Contact Output	Warning Causes	**Remedy**
(blinking) Alarm DC Volt. Low	The main circuit DC voltage is lower than the set under-voltage level before the motor starts.	OFF	Input voltage drop	Measure the main circuit DC voltage, if the voltage is lower than the set level, regulate the input voltage.
(blinking) Alarm Over Voltage	The main circuit DC voltage becomes higher than the set high-voltage level before the motor starts.	OFF	Input voltage rise	Measure the main circuit DC voltage, if the voltage is higher than set level, regulate the input voltage.
(blinking) Alarm Over Heat	The external terminal thermal protection contact is activated.	OFF	• Overload • Cooling fan fault. • Ambient temperature rises. • Clogged filter.	Check for the fan, filter and the ambient temperature.
(blinking) Alarm Excess Load	Excess Load is detected when the output current is larger than or equal to the setting of Cn-26. However, Sn-12 has been set such that the inverter continue to run and disregards the over-torque warning.	OFF	Machine error or overload	• Check the use of the machine. • Set a higher protection level (Cn-32).
–	Stall prevention operates while accelerating. Stall prevention operates while running Stall prevention operates while decelerating.	OFF	• Insufficient Accel ./ Decel. time • Overload • Excessive load impact occurs while operating	• Increase Accel. / Decel. time. • Check the load.
(blinking) Alarm External Fault	Forward and reverse rotation commands are simultaneously detected for a period of time exceeding 500ms. (The inverter stops according to the method preset by Sn-04.)	OFF	• Operation sequence error • 3-wire/2-wire selection error	• Check the wiring of system • Check the setting of system parameters Sn-25, 26, 27, and 28.
(blinking) Alarm RS-485 Interrupt	MODBUS Communication fault occurs. The inverter remains operating.	OFF	• External noise • Excessive vibration or impact on communication wire • Not properly connected	• Check the parameter setting, including Sn-01, Sn-02. • Check if the comm. wire is not properly connected. • Restart, if fault remains, please contact to us.
Comm. Fault	Transmission fault of digital operator		• Comm. between digital operator and inverter has not been established for 5 seconds after system starts. • Communication is established after system starts, but transmission fault occurs after 2 seconds.	• Re-insert the connector of the digital operator. • Replace the control board.

Cont.

Table 10.1.2.1 Warning Messages, Causes and Remedies *(Cont.)*

LCD Display (English) Alarm	Warning Description	Fault Contact Output	Warning Causes	**Remedy**
(blinking) Alarm B.B.	External B.B. signal is input (terminal ③). The inverter stops and the motors stops without braking.	OFF	External B.B. signal is input.	After the external BB signal is removed, execute a speed search.
Alarm Input Error	Improper inverter capacity (Sn-01) setting.		Inverter KVA setting error.	Set proper KVA value. Be aware of the difference of 230V and 460V.
Multi-Fun. Parameter Setting Error	Improper setting of multi-function input signal (Sn-25, 26, 27 and 28).	OFF	• The value of Sn-25 -Sn-28 is not in ascending order (Ex. Sn-25= 05, Sn-28= 02, these are improper setting). • Setting speed search command of 21 and 22 simultaneously.	• Set these values in order (the value of Sn-25 must be smaller than those of Sn-26, 27, 28) • Command 21 and 22 can not be set by two multi-function-input contacts simultaneously.
V/F Parameter Setting Error	Improper setting of V/F characteristic (Cn-02 - 08)	OFF	The values of Cn-02 - Cn-08 do not satisfy $F_{max} \geq F_A \geq F_B \geq F_{min}$.	Change the settings.
Frequency Limit Setting Error	Improper setting of Cn-18, Cn-19	OFF	Upper limit and lower limit setting is incorrect.	Change the settings.
PID Sleep Setting Error	Improper setting of PID function and the PID sleep function.	OFF	The PID sleep function is valid (P1-04 = 1) and the PID function is invalid (Sn-64 = 0)	Set PID Function valid for using PID sleep function.
Ext PID Parameter Setting Error	Improper setting of input terminal of the external PID function (P1-07, P1-08).	OFF	• The target signal and feedback signal of external PID function use the same analog terminal. (Ex. P1-07 = P1-08 = 1, Terminal VIN is used for both target and feedback signal) • The analog terminal of target (or feedback) signal of external PID function is also used as frequency command, target (or feedback) of original PID function. (Ex. P1-07=2 (AIN = Ext. PID Target), Sn-64 = 1 (PID enabled, the AIN is feedback of PID function.)	• Use different analog terminals for external PID target and feedback. • Refer to “External PID Function (Input and Output Terminal)” to get the terminals available for different setting frequency command source (Sn-05) and PID function (Sn-64).
Flow Meter Setting Error	Improper setting of the flow meter function	OFF	• The AUX flow meter function is set (P4-01 = 1) and the terminal AUX is also used for PID function (Sn-29 = 9) or external PID function (P1-07 = 3 or P1-08 = 3). • The pulse flow meter function is set (P4-01 = 2) and the frequency command is from pulse input (Sn-05 = 3).	Change the settings

Cont.

Table 10.1.2.1 Warning Messages, Causes and Remedies *(Cont.)*

LCD Display (English) Alarm	Warning Description	Fault Contact Output	Warning Causes	**Remedy**
(blinking) Alarm Load Loss	Load Loss is detected while the output current is smaller than or equal to the setting of P3-01. However, P3-03 has been set such that the inverter continue to run and disregards the over-torque warning.	OFF	• Machine errors or broken belts.	• Check the use of the machine. If the load is connected by a belt, also check the belt. • Set a lower detection level (P3-01) or longer detection time (P3-02).
(blinking) Alarm Over Speed	Excessive speed (operation remains)	OFF	• Improper ASR parameter setting or over-torque protection level.	• Check the ASR parameter and over-torque protection level.
(blinking) Alarm PG Open	PG Open-circuit (operation remains)	OFF	• The circuit of PG is not properly connected or open-circuit.	• Check the wiring of PG.
Alarm Sp.Deviat Over	Excessive speed deviation (operation remains)	OFF	• Improper ASR parameter setting or over-torque protection level.	• Check the ASR parameter and over-torque protection level.
Load Fail	Error during upload and download (operation remains)	OFF	• Bad communication during operator and inverter. • The connector is not properly connected.	• Check if the connector is properly connected.
EEPROM Fault	Operator EEPROM error.	OFF	• Operator EEPROM error.	• Disable load function of operator. • Replace the operator.
Upload Error	Data incorrect during Communication from the operator to the inverter.	OFF	• Incorrect inverter data format • Communication noise.	• Download the data to the operator again. • Check if the connector is properly connected.
Download Error	Data incorrect during Communication from the inverter to the operator.	OFF	• Communication noise	• Check if the connector is properly connected.
Alarm Auto Tun-Error	Motor parameter auto-tuning error	OFF	• Inverter capacity and motor ratings are not properly matched. • The wiring between inverter and motor is disconnected. • Motor load unbalance.	Correct the inverter/motor capacity, check wiring cable and motor load.
PID Function Setting Error	Improper setting of PID function for target signal and feedback signal.	OFF	The terminal VIN is used in both PID target and PID feedback Ex. Sn-64 = 0, Sn-05 = 1, Sn-24 = 0 (or 2, 3) and Sn-29 is a value other than 9	Set Sn-29 = 9 to use AUX as PID target
PID Target Limit Setting Error	Improper setting of Cn-64 and Cn-65.	OFF	Upper limit and Lower Limit setting is incorrect	Change the settings
PG Parameter Setting Error	Improper setting of Cn-45 and Cn-46.	OFF	$\frac{2 \times Cn-45 \times Cn-02}{Cn-46} > 32767$	Change the settings.
Load Detection Setting Error	Improper setting of Cn-32 and P3-01.	OFF	The excess load level (Cn-32) is smaller than the load loss level (P03-01)	Modify the Excess Load Level and Load Loss Level

Cont.

Table 10.1.2.1 Warning Messages, Causes and Remedies *(Cont.)*

LCD Display (English) Alarm	Warning Description	Fault Contact Output	Warning Causes	**Remedy**
Feedback Detection Setting Error	Improper setting of P3-04 and P3-07.	OFF	The over feedback level (P3-04) is smaller than the low feedback level (P03-07)	Modify the Over Feedback Level and Low feedback level
PID Wakeup Setting Error	Improper setting of PID wakeup level and the Low Feedback Level.	OFF	The PID wakeup level (P02-03) is smaller than the Low Feedback level (P03-07) and the low feedback action (P03-09) is not 0	Modify the PID wakeup level and low feedback level

NOTES-

Appendix A - Control Mode Selection and Auto-tuning Procedure

As shown in Fig. A.1 below, the MA7200 PLUS has two selectable control modes; V/F Control Mode (Sn-67=0) and Sensorless Vector Control Mode (Sn-67=1). When selecting the Sensorless Vector Control Mode the inverter capacity must match the motor rating. To achieve the highest performance in the Sensorless Vector Control Mode the Auto-Tune feature is performed to identify and store the actual motor parameters. Refer to the parameter explanation section 9.2 for additional details.

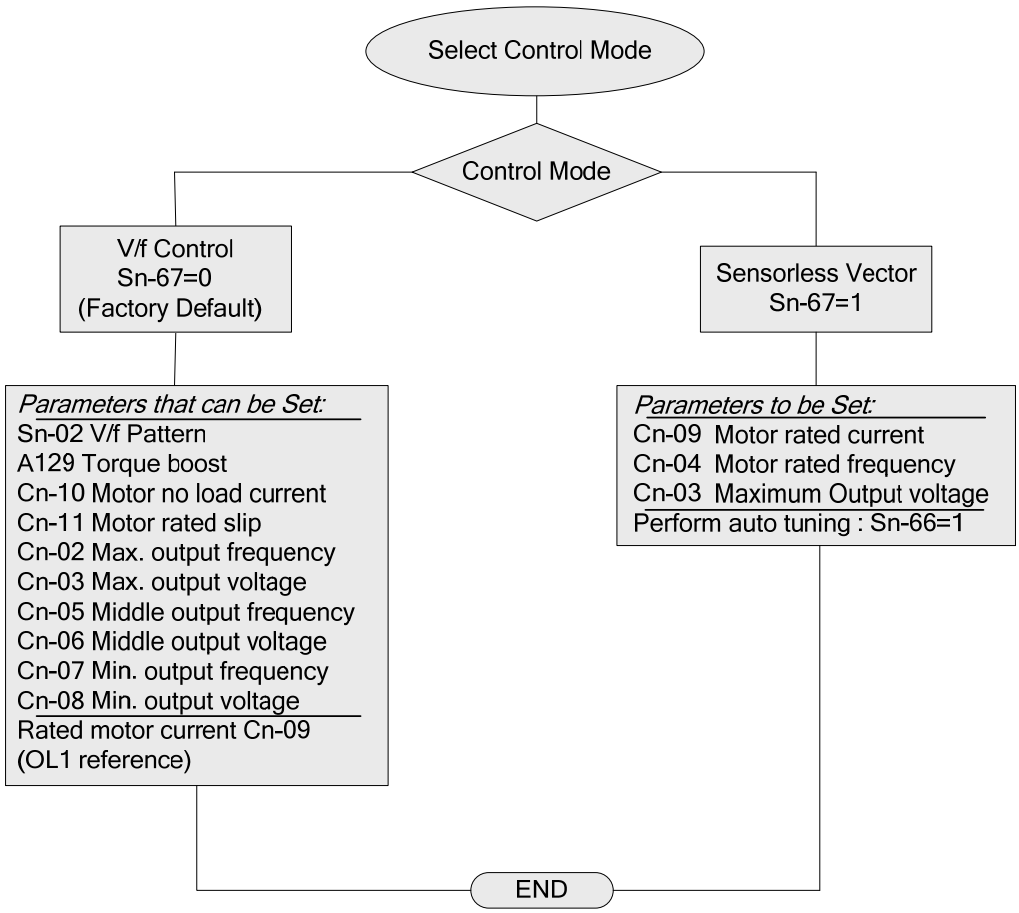


Fig. A.1 MA7200 PLUS Control Modes

V/f Control *(Factory Default)*

The V/f control mode should be used when the following conditions apply.

1. Using one inverter to drive several motors simultaneously.
   - In this case the rated inverter output current must equal or exceed the sum total of all of the motors connected.
   - The correct V/f pattern must be set by parameter Sn-02.
2. The motors' nameplate information is unknown or the motor ratings are not standard.
   - In this case the inverter will set the motor characteristics in accordance with a standard TWMC motor.
3. The specifications of the inverter and motor differ by more than 1 HP.

In V/f control motor parameters Cn-09 – Cn-13, max. & min. values are determined by the TWMC standard motor specification limit.

Cont.

Sensorless Vector Control

When setting up Sensorless Vector control:

1. Ensure that the inverter capacity is matched to the motor rating.
2. Use the AUTO-TUNE procedure as described above to identify and store the motor parameters after the initial installation and before using the Sensorless Vector Control Mode.
3. Enable the Sensorless Vector Control Mode by setting parameter Sn-67= 1.
4. Increase the setting of parameter Cn-57 (Motor Line-to-Line Resistance R1) to increase the generated torque at low speed. If an overcurrent trip at low speed occurs when doing this, decrease the setting of Cn-57 until proper performance is achieved.
5. Adjust the setting of parameter Cn-61(Slip Compensation Gain) to improve the speed accuracy with load change if required. If the actual speed decrease with a load change is too great (Under compensation), increase the set value. If the actual speed increases with a load change (Over compensation), decrease the set value.
6. If the motor speed is not stable or the load inertia is too large, increase the value of parameter Cn-40 (Slip Compensation Primary Delay Time). If the speed response is slow, decrease the setting of Cn-40.

Auto-tuning Procedure

The following steps are used for Auto-tuning:

1. Disconnect the motor from the load and ensure that the wiring between the inverter and the motor is sized and connected properly. The difference between inverter capacity and motor rating should not be greater than two frame sizes.
2. Switch to PRGM operation mode by pressing the Digital Operator PRGM / DRIVE key.
3. Input the Motor Rated Voltage Data to parameter Cn-03 (Maximum Output Voltage), the Motor Rated Frequency to parameter Cn-04 (Maximum Voltage Frequency) and the motor rated current (FLA) to parameter Cn-09, using the data from the motor's nameplate. Enable the Sensorless Vector Control Mode by setting parameter Sn-67 = 1.
4. Enable the Auto-tuning Function by setting parameter Sn-66 = 1.
5. Switch to DRIVE operation mode by pressing the PRGM / DRIVE key and then run the inverter by pressing the RUN key.
6. The inverter immediately enters into the auto-tuning process, taking approximately 25 seconds for completion. The inverter will then return to a stopped condition. If an abnormality occurs during the auto-tuning operation press the STOP key to stop the auto-tuning process.
7. When complete, press the STOP key to return the system to the normal operation mode. The value of motor parameters 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).

Appendix B - Spare Parts

B.1 - 230V Class (NEMA1)

Table B.1.1 - 230V Class (NEMA1): Control Board, Power Board, Power Module and Diode Module

INVERTER & PARTS NAME			Control PC Board	Power Board	Power Module (IGBT)		Diode Module
HP							
1	MA7200-2001-N1	MODEL	—	—	FP15R06W1E3		
		CODE	4H300D6730027 *1	4P106C01600A1	4LA32X025S01		
		Q'TY	1	1	1		
2	MA7200-2002-N1	MODEL	—	—	FP20R06W1E3		
		CODE	4H300D6730027 *1	4P106C0160003	4LA32X026S01		
		Q'TY	1	1	1		
3	MA7200-2003-N1	MODEL	—	—	7MBR30SA 060	MUBW20-06A7	
		CODE	4H300D6740022 *2	4P106C01800B1	277831619	277830132	
		Q'TY	1	1	1		
5	MA7200-2005-N1	MODEL	—	—	7MBR50SA 060	MUBW30-06A7	
		CODE	4H300D6740022 *2	4P106C01800C9	277831627	277830141	
		Q'TY	1	1	1		
7.5	MA7200-2007-N1	MODEL	—	—	7MBP50RA060		DF75LA80
		CODE	4H300D6740022 *2	4P106C0210001	277831660		4M903D1480016
		Q'TY	1	1	1		1
10	MA7200-2010-N1	MODEL	—	—	7MBP75RA060		DF75LA80
		CODE	4H300D6740022 *2	4P106C0220006	277831678		4M903D1480016
		Q'TY	1	1	1		1
15	MA7200-2015-N1	MODEL	—	—	7MBP100RTA060		DF100BA80
		CODE	4H300D6740022 *2	4P106C01500A6	277831694		277192209
		Q'TY	1	1	1		1
20	MA7200-2020-N1	MODEL	—	—	7MBP160RTA060		DF150BA80
		CODE	4H300D6740022 *2	4P106C01500B4	277831708		277192179
		Q'TY	1	1	1		1
25	MA7200-2025-N1	MODEL	—	—	MIG200J6CMB1W		SKKH72/16E
		CODE	4H300D6740022 *2	4P106C03300B2	277830086		277112337
		Q'TY	1	1	1		3

Cont.

Table B.1.1 - 230V Class (NEMA1): Control Board, Power Board, Power Module and Diode Module *(Cont.)*

INVERTER & PARTS NAME			Control PC Board	Power Board	Power Module (IGBT)	Diode Module
HP	MODEL	SPEC.				
30	MA7200-2030-N1	MODEL	—	—	CM200DY-12NF	SKKH106/16E
		CODE	4H300D6750028 *2	4P106C04000A2	4KA32X064S01	277112302
		Q'TY	1	1	3	3
40	MA7200-2040-N1	MODEL	—	—	SKM300GB063DN	SKKH106/16E
		CODE	4H300D6750028 *2	4P106C04000A2	277810662	277112302
		Q'TY	1	1	3	3

*1: Previous versions, Code No is; 4P101C0040001.
*2: Previous versions, Code No is; 4P101C0060002.

Table B.1.2 - 230V Class (NEMA1): Cooling Fan and Braking Resistor

INVERTER & PARTS NAME			Cooling Fan		Braking Resistor	
HP	MODEL	SPEC.				
1	MA7200-2001-N1	MODEL	KD1204PFBX	MGA4012YR-A10(L)	N20SP-12-Y2	
		CODE	4M903D0880002	4M903D0880002S2	3M903D1820000	
		Q'TY	1		1	
2	MA7200-2002-N1	MODEL	KD1204PFBX	MGA4012YR-A10(L)	N20SP-12-Y2	
		CODE	4M903D0880002	4M903D0880002S2	3M903D1820000	
		Q'TY	1		1	
3	MA7200-2003-N1	MODEL	AFB0624H	MGA6024XR-O25(L)	8W/12Ω	
		CODE	4H300D0190012	4H300D0190012S2	4M903D0180086	
		Q'TY	1		2	
5	MA7200-2005-N1	MODEL	AFB0624H	MGA6024XR-O25(L)	8W/12Ω	
		CODE	4H300D0190012	4H300D0190012S2	4M903D0180086	
		Q'TY	1		2	
7.5	MA7200-2007-N1	MODEL	AFB0824VH	MGA8024YR-O25(L)	8W/6.2Ω	8W/6.2Ω
		CODE	4H300D0200018	4H300D0200018S1	4M903D0180078	4M903D2330018
		Q'TY	1		1	1
10	MA7200-2010-N1	MODEL	AFB0824VH	MGA8024YR-O25(L)	8W/6.2Ω	8W/6.2Ω
		CODE	4H300D0200018	4H300D0200018S1	4M903D0180078	4M903D2330018
		Q'TY	1		1	1

Cont.

Table B.1.2 - 230V Class (NEMA1): Cooling Fan and Braking Resistor *(Cont.)*

INVERTER & PARTS NAME			Cooling Fan				Resistor
HP	MODEL	SPEC.					
15	MA7200-2015-N1	MODEL	AFB0824SH-B		MGA8024YR-O25(L)		60W/2.2Ω
		CODE	4H300D3340007		4H300D1440004S1		3H300D2350005
		Q'TY	1				1
20	MA7200-2020-N1	MODEL	AFB0824SH-B		MGA8024YR-O25(L)		60W/2.2Ω
		CODE	4H300D3340007		4H300D1440004S1		3H300D2350005
		Q'TY	1				1
25	MA7200-2025-N1	MODEL	PMD2408PMB1-A	MGA8024XB-O38	KD2406PTB1	MGA6024XR-O25(L)	60W/120Ω
		CODE	4H300D6040004	4H300D5790000S1	4H300D6060021	4H300D1060007S1	3K3A4880
		Q'TY	2		1		1
30	MA7200-2030-N1	MODEL	PSD2412PMB1	MGA12024UB-O38(L)	KD2406PTB1	MGA6024XR-O25(L)	60W/120Ω
		CODE	4H300D6040004	4H300D5790000S1	4H300D6060021	4H300D1060007S1	3K3A4880
		Q'TY	2		1		1
40	MA7200-2040-N1	MODEL	PSD2412PMB1	MGA12024UB-O38(L)	KD2406PTB1	MGA6024XR-O25(L)	60W/120Ω
		CODE	4H300D6040004	4H300D5790000S1	4H300D6060021	4H300D1060007S1	3K3A4880
		Q'TY	2		1		1

Table B.1.3 - 230V Class (NEMA1): Relay, DCCT, Capacitor and Digital Operator

INVERTER & PARTS NAME			Relay	DCCT		Capacitor	Digital Operator
HP	MODEL	SPEC.					
1	MA7200-2001-N1	MODEL	0Z-SS-112LM	LX-7.5	TB-7.5	330uF/400V	JNEP-36A
		CODE	271608055	3K3A2468	4M903D1030029S1	3K3A1868	4KA93X030T01
		Q'TY	1	2		3	1
2	MA7200-2002-N1	MODEL	0Z-SS-112LM	HY-10P	TB-10	330uF/400V	JNEP-36A
		CODE	271608055	273014331	273014332S1	3K3A1868	4KA93X030T01
		Q'TY	1	2		4	1
3	MA7200-2003-N1	MODEL	841-S-1A-D-H-24VDC	SY-15T	TK15	470uF/400v	JNEP-36A
		CODE	271608969	3M903D1420001	3M903D1420001S1	4M903D03000 22	4KA93X030T01
		Q'TY	1	3		4	1

Cont.

Table B.1.3 - 230V Class (NEMA1): Relay, DCCT, Capacitor and Digital Operator *(Cont.)*

INVERTER & PARTS NAME			Relay	DCCT		Capacitor	Digital Operator
HP	MODEL	SPEC.					
5	MA7200-2005-N1	MODEL	841-S-1A-D-H-24VDC	SY-25T2	TK25	470uF/400v	JNEP-36A
		CODE	271608969	3M903D3860009	3M903D3860009S1	4M903D0300022	4KA93X030T01
		Q'TY	1	3		4	1
7.5	MA7200-2007-N1	MODEL	841-S-2A-D-H-24VDC	HY37-P	TC-37.5A	1500uF/400V	JNEP-36A
		CODE	271608977	4M903D1020015	4M903D1020015S1	4M903D0310010	4KA93X030T01
		Q'TY	1	3		2	1
10	MA7200-2010-N1	MODEL	841-S-2A-D-H-24VDC	HY50-P	TC-50A	1800uF/400V	JNEP-36A
		CODE	271608977	4M903D1020023	4M903D1020023S1	4M903D0310010	4KA93X030T01
		Q'TY	1	3		2	1
15	MA7200-2015-N1	MODEL	G7J-4A-B-DC24V	HC-PT075V4B15	TP75	3300uF/400V	JNEP-36A
		CODE	3K3A2390	3M903D4030034	3M903D4030034S1	4M903D0310061	4KA93X030T01
		Q'TY	1	1		2	1
20	MA7200-2020-N1	MODEL	G7J-4A-B-DC24V	HC-PT100V4B15	TP100	4400uF/400V	JNEP-36A
		CODE	3K3A2390	3M903D4030042	3M903D4030042S1	4M903D0310052	4KA93X030T01
		Q'TY	1	1		2	1
25	MA7200-2025-N1	MODEL	942H-2C-24-DS	L08P150D15	TD 150A	400V/6800uF	JNEP-36A
		CODE	4M903D2800006	4M903D3960031	4M903D4390034S1	4M903D4110007	4KA93X030T01
		Q'TY	1	3		2	1
30	MA7200-2030-N1	MODEL	942H-2C-24-DS	CT/Board		CAP./Board	JNEP-36A
		CODE	4M903D2800006	4P108C00800A2		4P108C0050008	4KA93X030T01
		Q'TY	1	1		1	1
40	MA7200-2040-N1	MODEL	942H-2C-24-DS	CT/Board		CAP./Board	JNEP-36A
		CODE	4M903D2800006	4P108C0090000		4P108C0060003	4KA93X030T01
		Q'TY	1	1		1	1

B.2 - 460V Class (NEMA1)

Table B.2.1 460V Class (NEMA1): Control Board, Power Board, Power Module and Diode Module

INVERTER & PARTS NAME			Control PC Board	Power Board	Power Module (IGBT)	Diode Module
HP	MODEL	SPEC.				
1	MA7200-4001-N1	MODEL	–	–	FP10R12NT3	
		CODE	4H300D6730027 *1	4P106C0250002	4LB34D001S01	
		Q'TY	1	1	1	
2	MA7200-4002-N1	MODEL	–	–	FP10R12NT3	
		CODE	4H300D6730027 *1	4P106C02500A1	4LB34D001S01	
		Q'TY	1	1	1	
3	MA7200-4003-N1	MODEL	–		MUBW10-12A7	
		CODE	4H300D6740022 *2	4P106C0240007	277830159	
		Q'TY	1	1	1	
5	MA7200-4005-N1	MODEL	–	–	MUBW15-12A7	
		CODE	4H300D6740022 *2	4P106C02400A5	277830167	
		Q'TY	1	1	1	
7.5	MA7200-4007-N1	MODEL	–		31NAB12	6RI30G-160
		CODE	4H300D6740022 *2	4P106C0110006	277830621	277191067
		Q'TY	1	1	1	1
10	MA7200-4010-N1	MODEL	–		31NAB12	6RI30G-160
		CODE	4H300D6740022 *2	4P106C0110006	277830621	277191067
		Q'TY	1	1	1	1
15	MA7200-4015-N1	MODEL	–		7MBP75RA120	DF75AA160
		CODE	4H300D6740022 *2	4P106C0150008	277831538	277192128
		Q'TY	1	1	1	
20	MA7200-4020-N1	MODEL	–		7MBP75RA120	DF75AA160
		CODE	4H300D6740022 *2	4P106C0150016	277831538	277192128
		Q'TY	1	1	1	1
25	MA7200-4025-N1	MODEL	–		MIG100Q6CMB1X	SKKH72/16E
		CODE	4H300D6740022 *2	4P106C0330006	277830094	277112337
		Q'TY	1	1	1	3
30	MA7200-4030-N1	MODEL	–		MIG150Q6CMB1X	SKKH72/16E
		CODE	4H300D6740022 *2	4P106C03300A4	277830108	277112337
		Q'TY	1	1	1	3

Cont.

Table B.2.1 - 460V Class (NEMA1): Control Board, Power Board, Power Module and Diode Module *(Cont.)*

INVERTER & PARTS NAME			Control PC Board	Power Board	Power Module (IGBT)	Diode Module
HP	MODEL	SPEC.				
40	MA7200-4040-N1	MODEL	—		CM150DY-24A	SKKH72/16E
		CODE	4H300D6750028 *2	4P106C0400007	277810328	277112337
		Q'TY	1	1	3	3
50	MA7200-4050-N1	MODEL	—		CM200DY-24A	SKKH106/16E
		CODE	4H300D6750028 *2	4P106C0400007	277810336	277112302
		Q'TY	1	1	3	3
60	MA7200-4060-N1	MODEL	—		SKM400GB128D	SKKH106/16E
		CODE	4H300D6750028 *2	4P106C0410000	4KA32X047S01	277112302
		Q'TY	1	1	3	3
75	MA7200-4075-N1	MODEL	—		SKM400GB128D	SKKH106/16E
		CODE	4H300D6750028 *2	4P106C0410000	4KA32X047S01	277112302
		Q'TY	1	1	3	3

*1: Previous versions, Code No is; 4P101C0040001.
*2: Previous versions, Code No is; 4P101C0060002.

Table B.2.2 - 430V Class (NEMA1): Cooling Fan and Braking Resistor

INVERTER & PARTS NAME			Cooling Fan		Resistor	
HP	MODEL	SPEC.				
1	MA7200-4001-N1	MODEL	KD1204PFBX	MGA4012YR-A10(L)	5W/40Ω	
		CODE	4M903D0880002	4M903D0880002S2	3M112Z0010006	
		Q'TY	1		2	
2	MA7200-4002-N1	MODEL	KD1204PFBX	MGA4012YR-A10(L)	5W/40Ω	
		CODE	4M903D0880002	4M903D0880002S2	3M112Z0010006	
		Q'TY	1		2	
3	MA7200-4003-N1	MODEL	AFB0624H	MGA6024XR-O25(L)	8W/120Ω	
		CODE	4H300D0190004	4H300D0190012S2	4M903D0180060	
		Q'TY	1		1	
5	MA7200-4005-N1	MODEL	AFB0624H	MGA6024XR-O25(L)	8W/120Ω	
		CODE	4H300D0190004	4H300D0190012S2	4M903D0180060	
		Q'TY	1		1	
7.5	MA7200-4007-N1	MODEL	AFB0824SH	MGA8024YR-O25(L)	10W/16Ω	10W/16Ω
		CODE	4H300D0200000	4H300D0200018S1	4M903D0190022	4M903D2330026
		Q'TY	1		1	1

Cont.

Table B.2.2 - 430V Class (NEMA1): Cooling Fan and Braking Resistor *(Cont.)*

INVERTER & PARTS NAME			Cooling Fan				Resistor	
HP	MODEL	SPEC.						
10	MA7200-4010-N1	MODEL	AFB0824SH		MGA8024YR-O25(L)		10W/16Ω	10W/16Ω
		CODE	4H300D0200000		4H300D0200018S1		4M903D0190022	4M903D2330026
		Q'TY	1				1	1
15	MA7200-4015-N1	MODEL	AFB0824SH		MGA8024YR-O25(L)		80W/6.2 Ω	
		CODE	4H300D1440004		4H300D1440004S1		3H300D2360001	
		Q'TY	1				1	
20	MA7200-4020-N1	MODEL	AFB0824SH		MGA8024YR-O25(L)		80W/6.2 Ω	
		CODE	4H300D1440004		4H300D1440004S1		3H300D2360001	
		Q'TY	1				1	
25	MA7200-4025-N1	MODEL	EEB0824EHE	MGA8024XB-O38	ASB0624H-B	MGA6024XR-O25(L)	60W/240Ω	
		CODE	4H300D5590001	4H300D5590001S1	4H300D6060013	4H300D0190012S2	3K3A4879	
		Q'TY	2		1		1	
30	MA7200-4030-N1	MODEL	EEB0824EHE	MGA8024XB-O38	ASB0624H-B	MGA6024XR-O25(L)	60W/240Ω	
		CODE	4H300D6050000	4H300D5590001S1	4H300D6060013	4H300D0190012S2	3K3A4879	
		Q'TY	2		1		1	
40	MA7200-4040-N1	MODEL	PSD2412PMB1	MGA12024UB-O38(L)	KD2406PTB1	MGA6024XR-O25(L)	60W/240Ω	
		CODE	4H300D6040004	4H300D5790000S1	4H300D6060021	4H300D1060007S1	3K3A4881	
		Q'TY	2		1		1	
50	MA7200-4050-N1	MODEL	PSD2412PMB1	MGA12024UB-O38(L)	KD2406PTB1	MGA6024XR-O25(L)	60W/240Ω	
		CODE	4H300D6040004	4H300D5790000S1	4H300D6060021	4H300D1060007S1	3K3A4881	
		Q'TY	2		1		1	
60	MA7200-4060-N1	MODEL	PSD2412PMB1	MGA12024UB-O38(L)	KD2406PTB1	MGA6024XR-O25(L)	60W/240Ω	
		CODE	4H300D6040004	4H300D5790000S1	4H300D6060021	4H300D1060007S1	3K3A4881	
		Q'TY	2		1		1	
75	MA7200-4075-N1	MODEL	PSD2412PMB1	MGA12024UB-O38(L)	KD2406PTB1	MGA6024XR-O25(L)	60W/240Ω	
		CODE	4H300D6040004	4H300D5790000S1	4H300D6060021	4H300D1060007S1	3K3A4881	
		Q'TY	2		1		1	

Table B.2.3 - 460V Class (NEMA1): Relay, DCCT, Capacitor and Digital Operator

INVERTER & PARTS NAME			Relay	DCCT	Capacitor	OPERATOR
HP	MODEL	SPEC.				
1	MA7200-4001-N1	MODEL	RT444012	TB5A 4V	330uF/400V	JNEP-36A
		CODE	4M903D1040008	4M903D2210012	3K3A1868	4KA93X030T01
		Q'TY	1	2	2	1
2	MA7200-4002-N1	MODEL	RT444012	TB5A 4V	330uF/400V	JNEP-36A
		CODE	4M903D1040008	4M903D2210012	3K3A1868	4KA93X030T01
		Q'TY	1	2	4	1

Cont.

B.2.3 - 460V Class (NEMA1): Relay, DCCT, Capacitor and Digital Operator *(Cont.)*

INVERTER & PARTS NAME			Relay	DCCT		Capacitor	OPERATOR
HP	MODEL	SPEC.					
3	MA7200-4003-N1	MODEL	953-1A-24DG-DC24V	HC-PSG075V4B15	TK7.5	330uF/400V	JNEP-36A
		CODE	271603711	4M903D2220026	4M903D2220026S1	4M903D0300014	4KA93X030T01
		Q'TY	1	3		4	1
5	MA7200-4005-N1	MODEL	953-1A-24DG-DC24V	HC-PSG125V4B15	TK12.5	560uF/400V	JNEP-36A
		CODE	271603711	4M903D2220042	4M903D2220042S1	4M903D0300031	4KA93X030T01
		Q'TY	1	3		4	1
7.5	MA7200-4007-N1	MODEL	841-S-2A-D-H	TC25A 4V		2200uF/400V	JNEP-36A
		CODE	271608977	4M903D2210063		4M903D0310036	4KA93X030T01
		Q'TY	1	3		2	1
10	MA7200-4010-N1	MODEL	841-S-2A-D-H	TC25A 4V		2200uF/400V	JNEP-36A
		CODE	271608977	4M903D2210063		4M903D0310036	4KA93X030T01
		Q'TY	1	3		2	1
15	MA7200-4015-N1	MODEL	G7J-4A-B-DC24V	HC-PT0375V4B15	TP37.5	3300uF/400V	JNEP-36A
		CODE	3K3A2390	3M903D4030018	3M903D4030018S1	4M903D0310061	4KA93X030T01
		Q'TY	1	1		2	1
20	MA7200-4020-N1	MODEL	G7J-4A-B-DC24V	HC-PT050V4B15	TP50	4400uF/400V	JNEP-36A
		CODE	3K3A2390	3M903D4030026	3M903D4030026S1	4M903D0310052	4KA93X030T01
		Q'TY	1	1		2	1
25	MA7200-4025-N1	MODEL	942H-2C-24-DS	L08P075D15	TD75A	400V/6800uF	JNEP-36A
		CODE	4M903D2800006	4M903D3960015	4M903D4390018S1	4M903D4110007	4KA93X030T01
		Q'TY	1	3		2	1
30	MA7200-4030-N1	MODEL	942H-2C-24-DS	L08P100D15	TD100A	400V/6800uF	JNEP-36A
		CODE	4M903D2800006	4M903D3960023	4M903D4390026S1	4M903D4110007	4KA93X030T01
		Q'TY	1	3		2	1
40	MA7200-4040-N1	MODEL	942H-2C-24-DS	CT/Board		CAP./Board	JNEP-36A
		CODE	4M903D2800006	4P108C0080004		4P108C0040002	4KA93X030T01
		Q'TY	1	1		1	1
50	MA7200-4050-N1	MODEL	942H-2C-24-DS	CT/Board		CAP./Board	JNEP-36A
		CODE	4M903D2800006	4P108C00800A2		4P108C00400A1	4KA93X030T01
		Q'TY	1	1		1	1
60	MA7200-4060-N1	MODEL	942H-2C-24-DS	CT/Board		CAP./Board	JNEP-36A
		CODE	4M903D2800006	4P108C0100005		4P108C0020001	4KA93X030T01
		Q'TY	1	1		1	1
75	MA7200-4075-N1	MODEL	942H-2C-24-DS	CT/Board		CAP./Board	JNEP-36A
		CODE	4M903D2800006	4P108C0100005		4P108C00200A0	4KA93X030T01
		Q'TY	1	1		1	1

B.3 - 230V Class (NEMA 4)

Table B.3.1 - 230V Class (NEMA 4): Control Board, Power Board, Rectifier Board, Transistor and Cover Ass'y

INVERTER & PARTS NAME			Control PC Board	Power Board	Rectifier Board	Main Circuit Transistor	Cover Ass'y
HP	MODEL	SPEC.					
1	MA7200-2001-N4	MODEL	–	–	–	FP15R06W1E3	–
		CODE	4H300D6730027	4P106C01600A1	–	4LA32X025S01	4LA41X371S01
		Q'TY	1	1	–	1	1
2	MA7200-2002-N4	MODEL	–	–	–	FP15R06W1E3	–
		CODE	4H300D6730027	4P106C0160003	–	4LA32X025S01	4LA41X371S01
		Q'TY	1	1	–	1	1
3	MA7200-2003-N4	MODEL	–	–	–	7MBP50RA060	–
		CODE	4H300D6740022	4P106C04900B0 4P106C05000B5	–	277831660	4LA41X371S01
		Q'TY	1	1	–	1	1
5	MA7200-2005-N4	MODEL	–	–	–	7MBP50RA060	–
		CODE	4H300D6740022	4P106C04900B0 4P106C05000B5	–	277831660	4LA41X371S01
		Q'TY	1	1	–	1	1
7.5	MA7200-2007-N4	MODEL	–	–	–	7MBP50RA060	–
		CODE	4H300D6740022	4P106C01500C2	4P106C0480008	277831660	4LA41X372S01
		Q'TY	1	1	1	1	1
10	MA7200-2010-N4	MODEL	–	–	–	7MBP75RA060	–
		CODE	4H300D6740022	4P106C01500D1	4P106C0480008	277831678	4LA41X372S01
		Q'TY	1	1	1	1	1
15	MA7200-2015-N4	MODEL	–	–	–	7MBP100RTA060	–
		CODE	4H300D6740022	4P106C01500A6	4P106C0470002	4M903D4390026S1	4LA41X372S01
		Q'TY	1	1	1	1	1
20	MA7200-2020-N4	MODEL	–	–	–	7MBP160RTA060	–
		CODE	4H300D6740022	4P106C01500B4	4P106C0470002	277831708	4LA41X372S01
		Q'TY	1	1	1	1	1

Table B.3.2 - 230V Class (NEMA 4): Main Diode, Cooling Fans, and Digital Operator

INVERTER & PARTS NAME			Main Circuit Diode	Cooling Fan (inside)		Cooling Fan (outside)		Digital Operator
HP	MODEL	SPEC.						
1	MA7200-2001-N4	MODEL	—	KDE1204PFVX	MGA4012YR-A10(L)	—		JNEP-36A
		CODE	—	4KA66X015T01	4M903D0880002S2	—		4P303C00100B7
		Q'TY	—	1		—		1
2	MA7200-2002-N4	MODEL	—	KDE1204PFVX	MGA4012YR-A10(L)	—		JNEP-36A
		CODE	—	4KA66X015T01	4M903D0880002S2	—		4P303C00100B7
		Q'TY	—	1		—		1
3	MA7200-2003-N4	MODEL	DB35-16	AD0424HB-G70(T)	MGA4024XS-O10(L)	KD2406PTB1	MGA6024XR-O25(L)	JNEP-36A
		CODE	4M903D4410001	4M903D4630001	4KA66X022S01	4M903D4640006	4M903D4640006S1	4P303C00100B7
		Q'TY	1	1		2		1
5	MA7200-2005-N4	MODEL	DB35-16	AD0424HB-G70(T)	MGA4024XS-O10(L)	KD2406PTB1	MGA6024XR-O25(L)	JNEP-36A
		CODE	4M903D4410001	4M903D4630001	4KA66X022S01	4M903D4640006	4M903D4640006S1	4P303C00100B7
		Q'TY	1	1		2		1
7.5	MA7200-2007-N4	MODEL	VVZ 70-16	AFB0624H	MGA6024XR-O25(L)	PMD2408PMB1-A(2)I55	MGA8024XB-O38	JNEP-36A
		CODE	277111331	4H300D0190004	4H300D0190004S2	4M903D4730005	4M903D4730005S1	4P303C00100B7
		Q'TY	1	1		2		1
10	MA7200-2010-N4	MODEL	VVZ 70-16	AFB0624H	MGA6024XR-O25(L)	PMD2408PMB1-A(2)I55	MGA8024XB-O38	JNEP-36A
		CODE	277111331	4H300D0190004	4H300D0190004S2	4M903D4730005	4M903D4730005S1	4P303C00100B7
		Q'TY	1	1		2		1
15	MA7200-2015-N4	MODEL	VVZ110-12	AFB0624H	MGA6024XR-O25(L)	PMD2408PMB1-A(2)I55	MGA8024XB-O38	JNEP-36A
		CODE	277111322	4H300D0190004	4H300D0190004S2	4M903D4730005	4M903D4730005S1	4P303C00100B7
		Q'TY	1	1		2		1
20	MA7200-2020-N4	MODEL	VVZ175-12	AFB0624H	MGA6024XR-O25(L)	PMD2408PMB1-A(2)I55	MGA8024XB-O38	JNEP-36A
		CODE	277111314	4H300D0190004	4H300D0190004S2	4M903D4730005	4M903D4730005S1	4P303C00100B7
		Q'TY	1	1		2		1

B.4 - 460V Class (NEMA 4)

Table B.4.1 - 460V Class (NEMA 4): Control Board, Power Board, Rectifier Board, Transistor and Cover Ass'y

INVERTER & PARTS NAME			Control PC Board	Power Board	Rectifier Board	Main Circuit Transistor	Cover Assy
HP	MODEL	SPEC.					
1	MA7200-4001-N4	MODEL	—	—	—	FP10R12NT3	—
		CODE	4H300D6730027	4P106C0250002	—	4LB34D001S01	4LA41X371S01
		Q'TY	1	1	—	1	1
2	MA7200-4002-N4	MODEL	—	—	—	FP10R12NT3	—
		CODE	4H300D6730027	4P106C02500A1	—	4LB34D001S01	4LA41X371S01
		Q'TY	1	1	—	1	1
3	MA7200-4003-N4	MODEL	—	—	—	7MBP25RA120	—
		CODE	4H300D6740022	4P106C0490011 4P106C0500017	—	277831716	4LA41X371S01
		Q'TY	1	1	—	1	1
5	MA7200-4005-N4	MODEL	—	—	—	7MBP25RA120	—
		CODE	4H300D6740022	4P106C0490003 4P106C0500009	—	277831716	4LA41X371S01
		Q'TY	1	1	—	1	1
7.5	MA7200-4007-N4	MODEL	—	—	—	7MBP50RA120	—
		CODE	4H300D6740022	4P106C0150032	4P106C0460007	277831686	4LA41X372S01
		Q'TY	1	1	1	1	1
10	MA7200-4010-N4	MODEL	—	—	—	7MBP50RA120	—
		CODE	4H300D6740022	4P106C0150032	4P106C0460007	277831686	4LA41X372S01
		Q'TY	1	1	1	1	1
15	MA7200-4015-N4	MODEL	—	—	—	7MBP75RA120	—
		CODE	4H300D6740022	4P106C0150024	4P106C0450001	277831538	4LA41X372S01
		Q'TY	1	1	1	1	1
20	MA7200-4020-N4	MODEL	—	—	—	7MBP75RA120	—
		CODE	4H300D6740022	4P106C0150032	4P106C0450001	277831538	4LA41X372S01
		Q'TY	1	1	1	1	1

Table B.4.2 - 460V Class (NEMA 4): Main Diode, Cooling Fans, and Digital Operator

INVERTER & PARTS NAME			Main Circuit Diode	Cooling Fan (inside)		Cooling Fan (outside)		Digital Operator
HP	MODEL	SPEC.						
1	MA7200-4001-N4	MODEL	—	KDE1204PFVX	MGA4012YR-A10(L)	—		JNEP-36A
		CODE	—	4KA66X015T01	4M903D0880002S2	—		4P303C00100B7
		Q'TY	—	1		—		1
2	MA7200-4002-N4	MODEL	—	KDE1204PFVX	MGA4012YR-A10(L)	—		JNEP-36A
		CODE	—	4KA66X015T01	4M903D0880002S2	—		4P303C00100B7
		Q'TY	—	1		—		1
3	MA7200-4003-N4	MODEL	DB35-16	AD0424HB-G70(T)	MGA4024XS-O10(L)	KD2406PTB1	MGA6024XR-O25(L)	JNEP-36A
		CODE	4M903D4410001	4M903D4630001	4KA66X022S01	4M903D4640006	4M903D4640006S1	4P303C00100B7
		Q'TY	1	1		2		1
5	MA7200-4005-N4	MODEL	DB35-16	AD0424HB-G70(T)	MGA4024XS-O10(L)	KD2406PTB1	MGA6024XR-O25(L)	JNEP-36A
		CODE	4M903D4410001	4M903D4630001	4KA66X022S01	4M903D4640006	4M903D4640006S1	4P303C00100B7
		Q'TY	1	1		2		1
7.5	MA7200-4007-N4	MODEL	VVZ40-16	AFB0624H	MGA6024XR-O25(L)	PMD2408PMB1-A(2)I55	MGA8024XB-O38	JNEP-36A
		CODE	27711349	4H300D0190004	4H300D0190004S2	4M903D4730005	4M903D4730005S1	4P303C00100B7
		Q'TY	1	1		2		1
10	MA7200-4010-N4	MODEL	VVZ40-16	AFB0624H	MGA6024XR-O25(L)	PMD2408PMB1-A(2)I55	MGA8024XB-O38	JNEP-36A
		CODE	27711349	4H300D0190004	4H300D0190004S2	4M903D4730005	4M903D4730005S1	4P303C00100B7
		Q'TY	1	1		2		1
15	MA7200-4015-N4	MODEL	VVZ 70-16	AFB0624H	MGA6024XR-O25(L)	PMD2408PMB1-A(2)I55	MGA8024XB-O38	JNEP-36A
		CODE	277111331	4H300D0190004	4H300D0190004S2	4M903D4730005	4M903D4730005S1	4P303C00100B7
		Q'TY	1	1		2		1
20	MA7200-4020-N4	MODEL	VVZ 70-16	AFB0624H	MGA6024XR-O25(L)	PMD2408PMB1-A(2)I55	MGA8024XB-O38	JNEP-36A
		CODE	277111331	4H300D0190004	4H300D0190004S2	4M903D4730005	4M903D4730005S1	4P303C00100B7
		Q'TY	1	1		2		1

B.5 - 575V Class (NEMA1)

Table B.5.1 - 575V Class (NEMA1): Control Board, Power Board, Power Module and Diode Module

INVERTER & PARTS NAME			CONTROL PC BOARD	POWER BOARD	Power Module (IGBT)	Diode Module
HP	MODEL	SPEC.				
1	MA7200-5001-N1	MODEL	—	—	7MBR10SA-140	
		CODE	4LA41X258S01	4LA41X278S01	4LA32D019S01	
		Q'TY	1	1	1	
2	MA7200-5002-N1	MODEL	—	—	7MBR10SA-140	
		CODE	4LA41X258S01	4LA41X279S01	4LA32D019S01	
		Q'TY	1	1	1	
3	MA7200-5003-N1	MODEL	—		7MBR10SA-140	
		CODE	4LA41X258S01	4LA41X280S01	4LA32D019S01	
		Q'TY	1	1	1	
5	MA7200-5005-N1	MODEL	—	—	7MBR15SA-140	
		CODE	4LA41X258S01	4LA41X227S01	3K3A2834	
		Q'TY	1	1	1	
7.5	MA7200-5007-N1	MODEL	—		7MBR25SA-140	
		CODE	4LA41X258S01	4LA41X228S01	3K3A2835	
		Q'TY	1	1	1	
10	MA7200-5010-N1	MODEL	—		7MBR25SA-140	
		CODE	4LA41X258S01	4LA41X229S01	3K3A2835	
		Q'TY	1	1	1	

Table B.5.2 - 575V Class (NEMA1): Cooling Fan and Braking Resistor

INVERTER & PARTS NAME			COOLING FAN	Resistor
HP	MODEL	SPEC.		
1	MA7200-5001-N1	MODEL	AFB0624H	8W/120Ω
		CODE	4H300D0190004	4M903D0180060
		Q'TY	1	2
2	MA7200-5002-N1	MODEL	AFB0624H	8W/120Ω
		CODE	4H300D0190004	4M903D0180060
		Q'TY	1	2
3	MA7200-5003-N1	MODEL	AFB0624H	8W/120Ω
		CODE	4H300D0190004	4M903D0180060
		Q'TY	1	2
5	MA7200-5005-N1	MODEL	AFB0824SH	KNY10W10J(10J10W)
		CODE	4H300D0200000	3K3A1923
		Q'TY	1	2

Cont.

Table B.5.2 - 575V Class (NEMA1): Cooling Fan and Braking Resistor *(Cont.)*

INVERTER & PARTS NAME			COOLING FAN	Resistor
HP	MODEL	SPEC.		
7.5	MA7200-5007-N1	MODEL	AFB0824SH	KNY10W10J(10J10W)
		CODE	4H300D0200000	3K3A1923
		Q'TY	1	2
10	MA7200-5010-N1	MODEL	AFB0824SH	KNY10W10J(10J10W)
		CODE	4H300D0200000	3K3A1923
		Q'TY	1	2

Table B.5.3 – 575V Class (NEMA1): Relay, DCCT, Capacitor and Digital Operator

INVERTER & PARTS NAME			Relay	DCCT	Capacitor	OPERATOR
HP	MODEL	SPEC.				
1	MA7200-5001-N1	MODEL	953-1A-24DG-DC24V	TK5A 4V	120uF/500V	JNEP-36
		CODE	271603711	4LA65D009S01	4LA11D003S01	4H300C0050000
		Q'TY	1	3	4	1
2	MA7200-5002-N1	MODEL	953-1A-24DG-DC24V	TK5A 4V	120uF/500V	JNEP-36
		CODE	271603711	4LA65D009S01	4LA11D003S01	4H300C0050000
		Q'TY	1	3	4	1
3	MA7200-5003-N1	MODEL	953-1A-24DG-DC24V	TK5A 4V	120uF/500V	JNEP-36
		CODE	271603711	4LA65D009S01	4LA11D003S01	4H300C0050000
		Q'TY	1	3	6	1
5	MA7200-5005-N1	MODEL	953-1A-24DG-DC24V	TA10A4V	FX22H122ID	JNEP-36
		CODE	271603711	3K3A2826	3K3A4841	4H300C0050000 *1
		Q'TY	1	3	2	1
7.5	MA7200-5007-N1	MODEL	953-1A-24DG-DC24V	TA17.5A 4V	FX22H122ID	JNEP-36
		CODE	271603711	4LA65D026S01	3K3A4841	4H300C0050000
		Q'TY	1	3	2	1
10	MA7200-5010-N1	MODEL	953-1A-24DG-DC24V	TA17.5A 4V	FX22H122ID	JNEP-36
		CODE	271603711	4LA65D026S01	3K3A4841	4H300C0050000
		Q'TY	1	3	2	1

*1: Previous versions, code no. is 4H300C0020003 (JNEP-31V).

Appendix C - Inverter Parameter Setting List

Customer:	**MA7200 PLUS Model No.**
Site:	
Equipment:	

An		**Bn**						**Cn**	
Para	Setting	Para	Setting	Para	Setting	Para	Setting	Para	Setting
An-01		Bn-01		Bn-17		Bn-41		Cn-01	
An-02		Bn-02		Bn-18		Bn-42		Cn-02	
An-03		Bn-03		Bn-19		Bn-43		Cn-03	
An-04		Bn-04		Bn-20		Bn-44		Cn-04	
An-05		Bn-05		Bn-15		Bn-45		Cn-05	
An-06		Bn-06		Bn-16		Bn-46		Cn-06	
An-07		Bn-07		Bn-17				Cn-07	
An-08		Bn-08		Bn-18				Cn-08	
An-09		Bn-09		Bn-19				Cn-09	
An-10		Bn-10		Bn-20				Cn-10	
An-11		Bn-11		Bn-15				Cn-11	
An-12		Bn-12		Bn-16				Cn-12	
An-13		Bn-13		Bn-17				Cn-13	
An-14		Bn-14		Bn-18				Cn-14	
An-15		Bn-15		Bn-19				Cn-15	
An-16		Bn-16		Bn-20				Cn-16	
An-17		Bn-17		Bn-21				Cn-17	
		Bn-18		Bn-22				Cn-18	
		Bn-19		Bn-23				Cn-19	
		Bn-20		Bn-24				Cn-20	
		Bn-01		Bn-25				Cn-21	
		Bn-02		Bn-26				Cn-22	
		Bn-03		Bn-27				Cn-23	
		Bn-04		Bn-28				Cn-24	
		Bn-05		Bn-29				Cn-25	
		Bn-06		Bn-30				Cn-26	
		Bn-07		Bn-31				Cn-27	
		Bn-08		Bn-32				Cn-28	
		Bn-09		Bn-33				Cn-29	
		Bn-10		Bn-34				Cn-30	
		Bn-11		Bn-35				Cn-31	
		Bn-12		Bn-36				Cn-32	
		Bn-13		Bn-37				Cn-33	
		Bn-14		Bn-38				Cn-34	
		Bn-15		Bn-39				Cn-35	
		Bn-16		Bn-40				Cn-36	

Cont.

Cn		Sn				P		Un	
Para	Setting	Para	Setting	Para	Setting	Para	Setting	Monitor	Setting
Cn-37		Sn-03		Sn-39		P1-01		Un-01	
Cn-38		Sn-04		Sn-40		P1-02		Un-02	
Cn-39		Sn-05		Sn-41		P1-03		Un-03	
Cn-40		Sn-06		Sn-42		P1-04		Un-04	
Cn-41		Sn-07		Sn-43		P1-05		Un-05	
Cn-42		Sn-08		Sn-44		P1-06		Un-06	
Cn-43		Sn-09		Sn-45		P1-07		Un-07	
Cn-44		Sn-10		Sn-46		P1-08		Un-08	
Cn-45		Sn-11		Sn-47		P1-09		Un-09	
Cn-46		Sn-12		Sn-48		P1-10		Un-10	
Cn-47		Sn-13		Sn-49		P2-01		Un-11	
Cn-48		Sn-14		Sn-50		P2-02		Un-12	
Cn-49		Sn-15		Sn-51		P2-03		Un-13	
Cn-50		Sn-10		Sn-52		P2-04		Un-14	
Cn-51		Sn-11		Sn-53		P2-05		Un-15	
Cn-52		Sn-12		Sn-54		P2-06		Un-16	
Cn-53		Sn-13		Sn-55		P2-07		Un-17	
Cn-54		Sn-14		Sn-56		P2-08		Un-18	
Cn-55		Sn-15		Sn-57		P2-09		Un-19	
Cn-56		Sn-16		Sn-58		P2-10		Un-20	
Cn-57		Sn-17		Sn-59		P3-01		Un-21	
Cn-58		Sn-18		Sn-60		P3-02		Un-22	
Cn-59		Sn-19		Sn-61		P3-03		Un-23	
Cn-60		Sn-20		Sn-62		P3-04		Un-24	
Cn-61		Sn-21		Sn-63		P3-05		Un-25	
Cn-62		Sn-22		Sn-64		P3-06		Un-26	
Cn-63		Sn-23		Sn-65		P3-07		Un-27	
Cn-64		Sn-24		Sn-66		P3-08		Un-28	
Cn-65		Sn-25		Sn-67		P3-09		Un-29	
		Sn-26		Sn-68		P3-10		Un-30	
		Sn-27		Sn-69		P3-11		Un-31	
		Sn-28		Sn-70		P3-12		Un-32	
		Sn-29				P3-13		Un-33	
		Sn-30				P3-14		Un-34	
		Sn-31				P3-15			
		Sn-32				P3-16			
		Sn-33				P4-01			
		Sn-34				P4-02			
		Sn-35				P4-03			
		Sn-36				P4-04			
		Sn-37				P4-05			
		Sn-38				P5-01			
						P5-02			

APP-1 PID Application Note

The PID control (loop) serves to maintain a given process within certain limits whether it be, pressure, flow etc. To do this a feedback signal representing the actual process value is compared to a set-point, the desired process value, and the difference becomes the error signal for the PID control. The PID control then responds by trying to minimize this error. How small the difference becomes is dependent upon the value of the *Proportional Gain* set by parameter Bn-17(P-gain). The greater the gain, the lower the difference becomes. However, in any system as the gain is increased there is a point that the system may become unstable (oscillate). To correct this instability, the response time of the system can be adjusted by using parameter Bn-18 (*Integral Time*) to slow the response and / or Bn-17 (*Derivative Time)* to increase the response. However slowing the system down too much may be unsatisfactory for the process and too high a response can result in instability. The end result is that these parameters in conjunction with parameters Bn-01 (acceleration) and Bn-02 (deceleration) times are adjusted to achieve optimum performance for a particular application.

The MA7200 PLUS supports two independent PID loops; a Main PID control and an External PID control. The main PID control is used for a process that is controlled by the motor. The external PID control may be used to regulate an external function such as temperature, using the inverter output terminal AO1 or AO2. Both PID loops can be used simultaneously but there are certain parameters that are common to both that must be assigned to one or the other. This is covered in detail later in this application note.

1.0 Main PID Control

1.1 PID Parameters

The following tables, 1.1.1 and 1.1.2 below show the various parameters used in the PID function.

Table 1.1.1 PID Parameters

Function	Parameter No.	Name and Description	LCD display (English)	Setting range	Setting Unit	Factory Setting
Setting of PID Control Parameter	Bn-16	PID Detection Gain	Bn-16= 01.00 PID Cmd. Gain	0.01-10.00	0.01	1
	Bn-17	PID Proportional Gain	Bn-17= 01.00 PID P_gain	0.01-10.00	0.01	1
	Bn-18	PID integral time	Bn-18= 10.00s PID I_Time	0.00 -100.00s	0.01s	10.00s
	Bn-19	PID Differential Time	Bn-19= 0.00s PID D_Time	0 -1.00s	0.01s	0.00s
	Bn-20	PID Bias	Bn-20= 0% PID Bias	0 -109%	1%	0%
	Cn-55	PID Integral Upper Bound	Cn-55= 100% PID I-Upper	0 -109%	1%	100%
	Cn-56	PID Primary Delay Time Constant	Cn-56= 0.0s PID Filter	0.0 - 2.5s	0.1s	0.0s
	Cn-64	PID Target Upper Limit	Cn-64 = 100% PID Target U_Limit	0 - 100%	1%	100%
	Cn-65	PID Target Lower Limit	Cn-65 = 0% PID Target L_Limit	0 - 100%	1%	0%

Cont.

Table 1.1.1 PID Parameters *(Cont.)*

Function	Parameter No.	Name and Description	LCD display (English)	Setting range	Setting Unit	Factory Setting
PID Target Selection	Sn-05	Frequency Command Selection	Sn-05= 0 Ref. Cmd. Operator	0 - 3	1	0
PID Feedback Selection	Sn-24	External Analog Input	Sn-24= 0 -Cmd. VIN	0 - 3	1	0
PID Monitor	Un-15	PID Control Input	Un-15= 100% PID Input	–	0.1%	–
	Un-16	PID Control Output 1	Un-16= 100% PID Output1	–	0.1%	–
	Un-17	PID Control Output 2	Un-17= 00% PID Output2	–	0.1%	–
	Un-34	PID Feedback Display	Un-34= 00000 PID Feedback	–	0	–

Table1.1.2 PID Parameters

Function	Parameter No.	Name	Description
PID Integral Reset	Sn-25 - Sn-28	Multi-Function Output (RA-RB-RC, DO1, DO2) Function Selection	14: PID Integral Reset
PID Invalid	Sn-25 - Sn-28	Multi-Function Output (RA-RB-RC, DO1, DO2) Function Selection	15: PID Invalid
PID Invalid 2	Sn-25 - Sn-28	Multi-Function Output (RA-RB-RC, DO1, DO2) Function Selection	30: PID Invalid, An-16 is used as frequency command
PID Target Selection	Sn-29	Multi-Function Analog Input (AUX) Function Selection	9: Use terminal AUX as PID Target if Sn-05 = 1 others : Use terminal VIN as PID Target if Sn-05 = 1

Some parameters have been developed mainly for fan and pump application functions as shown below and are covered in detail in application note App-2.

- Scaled PID Feedback Signal and Engineering Units.
- PID Sleep Function.
- Over Feedback Detection for PID Feedback Signal.
- Low Feedback Detection for PID Feedback Signal.
- Low Suction Detection Function.

1.2 PID Inputs

- When the PID function is enabled, the frequency command is used as PID Set-point (target). The PID feedback signal is a combination signals from terminals AIN and terminal VIN, depending on the setting of Sn-24 (external analog input). If multi-step speed reference 1 - 4 (set by Sn-25 - 28) is not set, the PID set-point (target) may come from keypad, terminal AUX or VIN, RS-485 communication or pulse input.
- The following Tables 1.2.1a and 1.2.1b is a list of the settings for the source of the PID set-point and PID feedback. Fig.1.2.1 shows the PID input wiring diagram.

Table 1.2.1a PID Target Source

Sn-05	Sn-29	PID Target	Available setting for Sn-24
0	–	From Keypad	0, 1, 2, 3
1	9	From Terminal AUX (0-10V / 0 -100%)	0, 1, 2, 3
	else	From Terminal VIN (0-10V / 0 -100%)	1
2	–	From RS-485 Communication	0, 1, 2, 3
3	–	From Pulse Input	0, 1, 2, 3

Table 1.2.1b PID Feedback Source

Sn-24	PID Feedback	Comments
0	From Terminal VIN (0 -10V / 0 -100%)	It is not valid if VIN is used as PID set-point
1	From Terminal AIN (4 -20mA / 0 -100%)	
2	From VIN + AIN	It is not valid if VIN is used as PID set-point
3	From VIN – AIN	

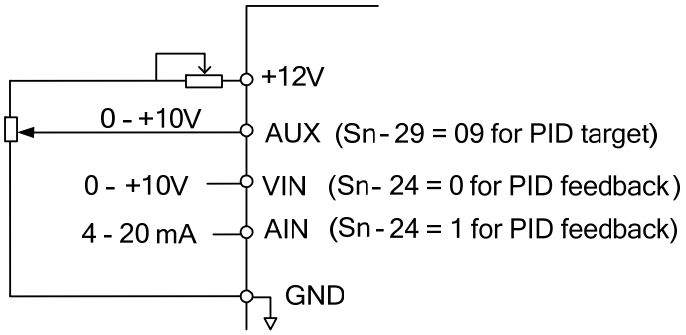


Fig. 1.2.1 PID input Wiring Diagram.

- An error message “PID Setting Error” will be displayed if all the conditions below are satisfied.
  1. The PID function is enabled (Sn-64 = 1 - 8)
  2. Sn-05 = 1 and the value of Sn-29 is not 9 (VIN is used as the PID set-point).
  3. Sn-24 = 0, 2 or 3 (VIN is also included in the PID feedback).
- Table 1.2.2 below shows the functions affected when setting the PID target / feedback signals.

Table1.2.2

Function	Description
External PID function	Terminals VIN, AIN and AUX used in main PID function cannot be used for external PID function.
Flow Meter Display (App-2)	If terminal AUX is used in main PID function, the analog flow meter display function (P4-01 = 1) is not allowed

Cont.

- If multi-step speed reference 1- 4 is used, An-02 - An-16 can be selected to be the PID set-point signal as shown below in Table 1.2.3.

Table 1.2.3

Multi-step Speed 4	Multi-step Speed 3	Multi-step Speed 2	Multi-step Speed 1	PID Target
0	0	0	0	An-01 *1
0	0	0	1	An-02
0	0	1	0	An-03
0	0	1	1	An-04
0	1	0	0	An-05
0	1	0	1	An-06
1	1	1	1	An-16

*1-When parameter Sn-05 is not zero, the PID set-point depends on the combination of Sn-05 and Sn-29.

1.3 PID Control Modes

- The PID control function will be disabled if
  1. The Auto-Run is set (Sn-40 is nonzero value) or
  2. The Forced Run command is set (Sn-25 ~ 28 = 29 and the corresponding digital input is ON) or
  3. Frequency UP/DOWN Function (Sn-28 = 28) is set
- The various control modes for PID are listed in the following Table 1.3.1

Table 1.3.1 PID Control Modes

Sn-64 (PID Mode)	Characteristic		Input of Differential Controller		Actual PID Output	
	Positive	Negative	Difference of Target and Feedback	Feedback Value	PID Output	PID Output plus Target Value
0	PID Unavailable					
1	V		V		V	
2	V			V	V	
3	V		V			V
4	V			V		V
5		V	V		V	
6		V		V	V	
7		V	V			V
8		V		V		V

- Fig. 1.3.1 below shows a block diagram of the PID function with the various parameters used.

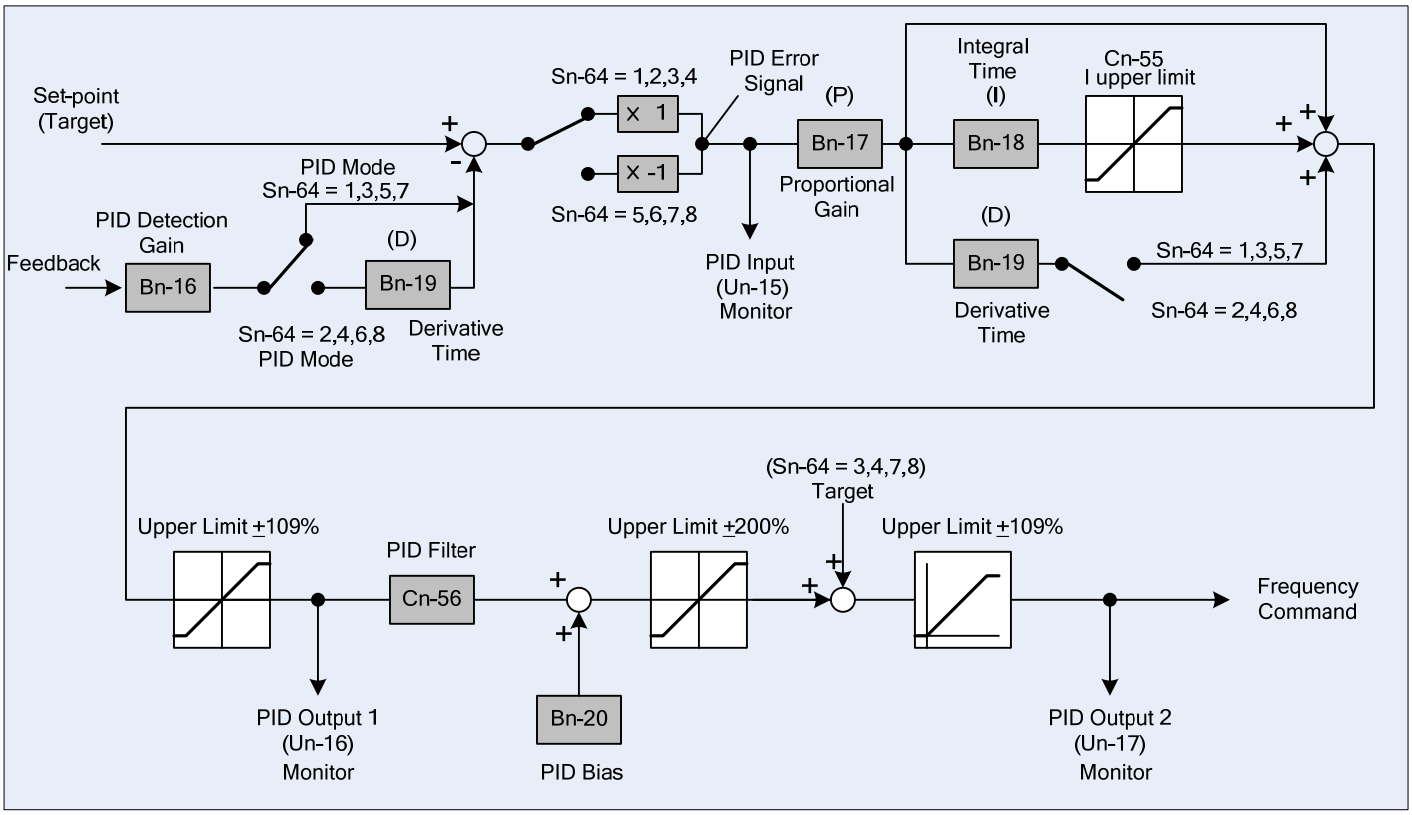


Fig. 1.3.1 PID Block Diagram

- Fig.1.3.2 below shows the response of the PID function with a step input.

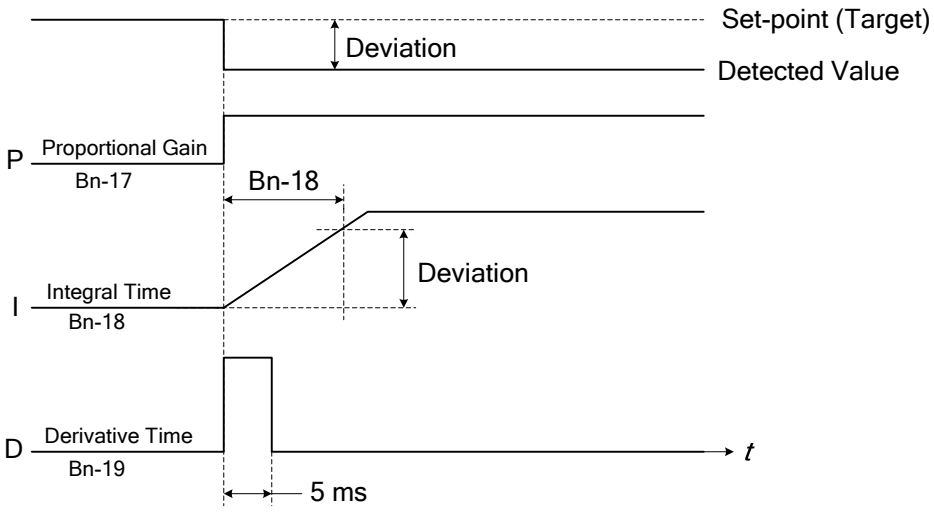


Fig. 1.3.2 Response of PID Function with Step Input

Cont.

- Deviation = Set-point (Target) value – Detected value × Bn-16 (Detection gain).
- Control output (P) = deviation × Bn-17 (Proportional gain).
- The output of the (I) control block will increase with time (integral) and the output will be equal to the deviation after time specified by parameter Bn-18 (Integral time).
- The output of the (D) control block depends on the setting of PID parameter Sn-64 and is as follows.

When Sn-64 = 1,3,5 or 7: D control block output = PID error × ($\frac{\text{Bn-19}}{\text{5 m sec}}$)

When Sn-64 = 2,4,6,or 8: D control block output = PID feedback × ($\frac{\text{Bn-19}}{\text{5 m sec}}$)

- The parameter Cn-55 (I Upper limit bound) prevents the calculated value of the integral control block from exceeding a fixed amount. The value is limited to within 0-109% of the maximum output frequency (100%). Increasing the value of Cn-55 improves integral control. If hunting or speed oscillation cannot be reduced by decreasing the value of Bn-18 or increasing the value of Cn-56 (PID primary delay constant) , then Cn-55 must be decreased. However, if the setting of Cn-55 is set too small, the output error between the set-point and the feedback value increases. So the various parameters need to be adjusted to achieve optimum results for a particular application.
- The parameter Cn-56 is a low-pass (integral) filter setting for the PID control output. If the viscous friction of the mechanical system is high, or if the rigidity is low, causing the mechanical system to become unstable (oscillate), increase the setting Cn-56 so that it is higher than the oscillation period. This will decrease the response time of the system, but it will result in system stability.
- The parameters Cn-64 (PID Target Upper Limit) and Cn-65 (PID Target Lower Limit) limit the value of the PID set-point (target) signal. The actual frequency command is limited by parameters Cn-18 (Frequency command upper bound) and Cn-19 (Frequency command lower bound). This is shown in Fig. 1.3.3 below.

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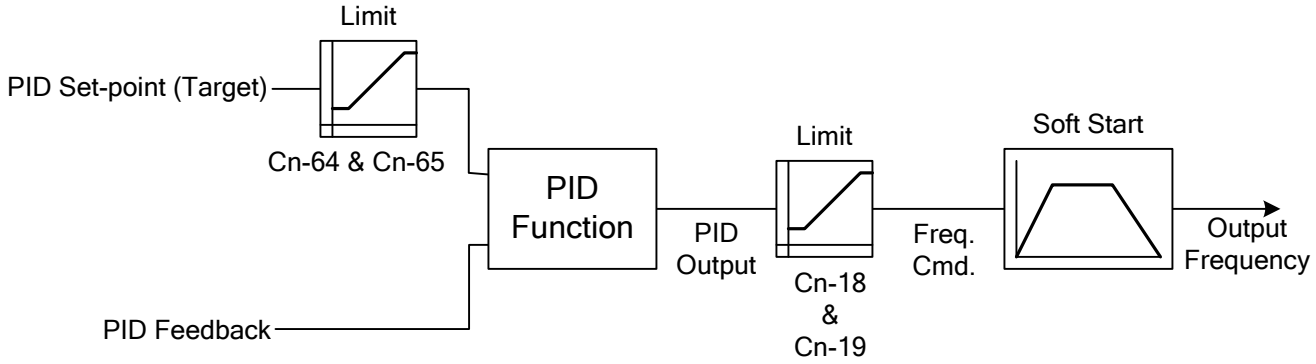


Fig. 1.3.3 Cn-64 & Cn-65 and Cn-18 & Cn-19 Limits

1.4 PID Control Functions Using the Multi-function Input Terminals

Table.1.4.1 below lists of the settings for multi-function inputs (Sn-25 to Sn-28) for the PID function.

Table 1.4.1 Multi-function Input Settings for Parameters Sn-25 to Sn-28

Sn-25 to Sn-28 Setting	Function	Description
14	PID integration reset	ON: Reset PID integration
15	PID control invalid	ON: PID control not effective
30	PID control invalid 2	ON: PID control not effective, using An-16 as frequency command

- PID Integral Reset (Setting: 14).

The integral can be reset to zero through one of the multi-function input terminals ⑤-⑧ (Sn-25 to 28 = 14).

Cont.

- PID Control Invalid (Setting: 15)
- PID Control Invalid 2 (Setting: 30)

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

1- If the PID function is enabled (Sn-64≠ 0), the setting can be used to disable PID function. It is often Used in the changeover of test run.
2- When the PID function is disabled (PID control invalid is “ON”), an open-loop operation or jog operation can be performed for system testing. The system can then be changed to PID control.
3- Setting Sn-25 – 28 = 15 disables the PID function and sets the previous PID target as the frequency command.
4- Setting Sn-25 – 28 = 30 disables the PID function and sets parameter An-16 as the frequency command.
5- Table1.4.2 below shows a list of the frequency command sources available while the PID function is invalid.

Table 1.4.2

Sn-05	Sn-29	Frequency Command Source with PID control invalid	
		Sn-25 - 28 = 15	Sn-25 - 28 = 30
0	–	From Keypad	An-16
1	9	From Terminal AUX (0 -10V / 0 -100%)	
	Other Value	From Terminal VIN (0 -10V / 0 -100%)	
2	–	From RS-485 Communication	
3	–	From Pulse Input	

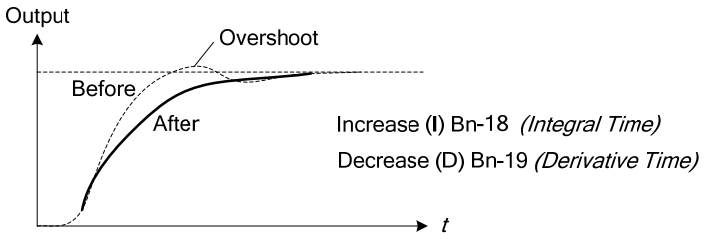
6- If both PID control invalid (Sn-25 - 28 = 15 and 30) are set, PID control invalid 2 (30) has the priority.

1.5 Adjusting the PID Control Functions

The following procedure can be used to initially set up the PID loop and then adjustments can be made while monitoring the response.

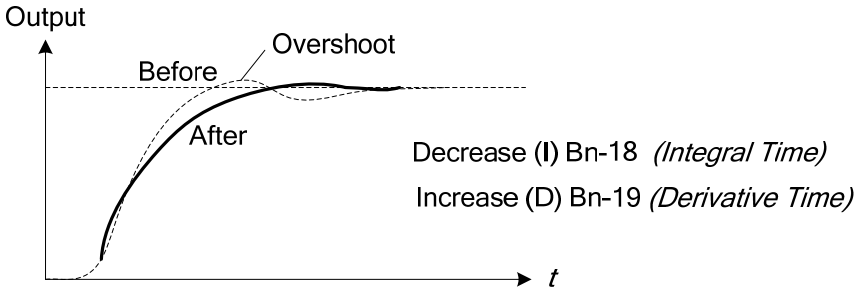
1- Enable PID control by setting Sn-64 = 1 to 8 (select for the application)
2- Adjust the Proportional Gain Bn-17 until continuous oscillations in the Controlled Variable are at a minimum.
3- Adjust the Integral Time Bn-18 so that the steady-state error will approach zero. The time should be adjusted so that a minimal error is attained as fast as possible without making the system oscillate.
4- If necessary, adjust Derivative Time Bn-19 to reduce overshoot during acceleration. Parameters Bn-01 (Acceleration time) and Bn-02 (Deceleration time) may also be adjusted for this purpose. All of these parameters are interactive, and will need to be adjusted until the control loop is properly Set so that stability is achieved with minimal steady-state error. A general procedure for adjusting these parameters is as follows:

- Reducing Overshoot
  If overshoot occurs, decrease the derivative time (D) and lengthen the integral time (I).

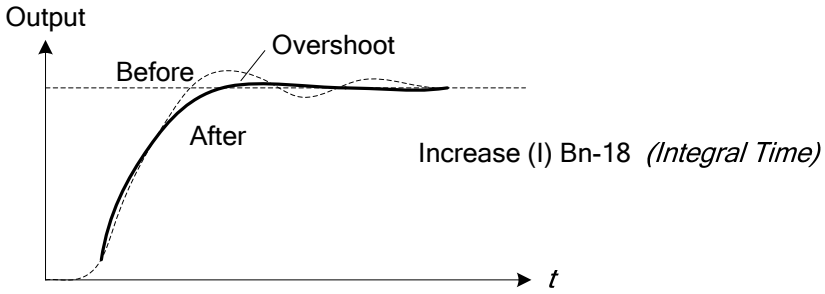


Cont.

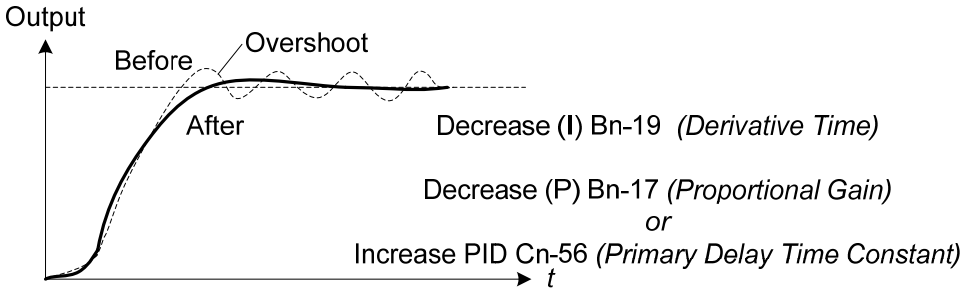
- Rapid Stabilization
  To rapidly stabilize the control conditions even when overshooting occurs, shorten the integral time (I) and lengthen the derivative time (D).



- Reducing Long-Cycle Oscillation
  If oscillation occurs with a longer cycle than the integral time (I) setting, then increase the integral time (I).



- Reducing Short-Cycle Oscillation
  If the oscillation cycle is short and it is approximately the same as the derivative time (D) setting, then reduce the derivative time (D). If the oscillation still exists after setting the derivative time (D) to 0.00, then either decrease the proportional gain (P) or increase the PID primary delay time constant.



2.0 External PID Control

2.1 External PID Parameters

Many of the principles described in the implementation of the main PID loop can also be applied to the external PID loop with the main difference being the controlling parameters. Also some parameters are common to both loops and must be treated in accordance with **Sec. 2.3.**
The following Tables, 2.1.1, 2.1.2 and 2.1.3 show the various parameters used in the External PID function.

Table 2.1.1 External PID Parameters (Input and Output Terminals)

Parameter No.	LCD Display	Setting Range	Factory Setting	Change During Operation	Modbus Address
P1-06	P1-06 Ext. PID Function	0: Ext. PID Invalid 1: Ext. PID, AO1 output 2: Ext. PID, AO2 output	0	NO	0x0605
P1-07	P1-07 Ext. PID Set Source	0: Set Point Parameter 1: Terminal VIN 2: Terminal AIN 3: Terminal AUX 4: Set Point RS-485	0	NO	0x0606
P1-08	P1-08 Ext. PID Fbk. Source	1: Feedback Term. VIN 2: Feedback Term. AIN 3: Feedback Term. AUX	3	NO	0x0607
Sn-29	Multi-Function Analog Input (AUX) Function Selection	18: External PID Set Point (Set Automatically while P1-07 = 3) 19: External PID Feedback (Set Automatically while P1-08 = 3)			
Sn-33 - Sn-34	Multi-Function Analog Output (AO1, AO2) Function Selection	14: External PID Output 2 (Set Automatically when P1-06 = 1 or 2)			

- External PID Function P1-06, is used to activate the external PID function and to set output terminal AO1or AO2 to external PID output signal.
  0: External PID Disabled
  1: External PID Enabled. Terminal AO1 is the output signal of the external PID function.
  2: External PID Enabled. Terminal AO2 is the output signal of the external PID function.
- External PID Function is enabled when P1-06 is set to a nonzero value and the inverter is in the DRIVE mode, independent of the RUN / STOP status of the inverter.

- If the External PID Function P1-06 is set to select output AO1 or AO2, the corresponding parameter Sn-33 or Sn-34 will be set to = 14 (Ext. Output 2) automatically, and cannot be changed until P1-06 is set = 0 (Invalid).
- External PID Set Point Source P1-07 and External PID Feedback Source P1-08, are used to select the input source of the set point and feedback of the external PID function as shown in the following Table 2.1.2

Cont.

Table 2.1.2 External PID Parameters P-07 and P1-08

Value	Parameter P1-07 (External PID Set Point Source)	Parameter P1-08 (External PID Feedback Source)
0	Keypad (Parameter P2-05)	————
1	Terminal VIN	Terminal VIN
2	Terminal AIN	Terminal AIN
3	Terminal AUX	Terminal AUX
4	RS-485 Communication (0x0009, 1000/100.0%)	————

- If P1-07 and P1-08 are set to the same source, the *"Ext PID Setting Error"* message will be displayed.
- Generally, each of the analog input terminals AIN (0/4-20mA), VIN (0-10V), and AUX (0-10V), can be used for the following provided that certain conditions are met :
  1- Frequency Command Source, when Sn-05=1
  2- Main PID function, when SN-64=1 for both set point and feedback.
  3- External PID, when P1-06= 1 or 2 for both set point and feedback.

When selected by a given function, that analog input is not available for any other function, and must be considered when planning for a particular application. If any of the unavailable terminals are selected as the External PID Function set point or feedback source, an "Ext PID Setting Error" message will occur.

Table 2.1.3 External PID Parameters (Gain Setting and Monitor)

Parameter No.	LCD Display	Setting Range	Factory Setting	Change During Operation	Modbus Address
P1-09	P1-09 Ext. PID I Limit	1 - 100%	100%	NO	0x0608
P1-10	P1-10 Ext. PID Filter	0.0 - 2.5s	0.0s	NO	0x0609
P2-05	P2-05 Ext. PID Set Point	0.0 - 100.0%	0.0%	YES	0x0704
P2-06	P2-06 Ext. PID Fbk. Gain	0.01 - 10.00	1.00	YES	0x0705
P2-07	P2-07 Ext. PID P Gain	0.01 - 10.00	1.00	YES	0x0706
P2-08	P2-08 Ext. PID I Time	0.00 - 100.00 s	10.00 s	YES	0x0707
P2-09	P2-09 Ext. PID D Time	0.00 - 1.00s	1.00 s	YES	0x0708
P2-10	P2-10 Ext. PID Bias	-100 -100%	0%	YES	0x0709

Cont.

Table 2.1.3 External PID Parameters (Gain Setting and Monitor) ***Cont.***

Parameter No.	LCD Display	Setting Range	Factory Setting	Change During Operation	Modbus Address
Un-42	Un-42 Ext. PID Feedback	——	——	——	0x0048
Un-43	Un-43 Ext. PID Input	——	——	——	0x0049
Un-44	Un-44 Ext. PID Output	——	——	——	0x004A
Un-45	Un-45 Ext. PID Output 2	——	——	——	0x004B
Sn-25 - Sn-28	Multi-Function Input Terminal 5, 6, 7,8 Function Selection	31: External PID Invalid 32: External PID Integrator Reset			
Sn-33 - Sn-34	Multi-Function Analog Output (AO1, AO2) Function Selection	12: External PID Input 13: External PID Output			

2.2 External PID Block Diagram

The following Fig. 2.2.1 shows a block diagram for the external PID function

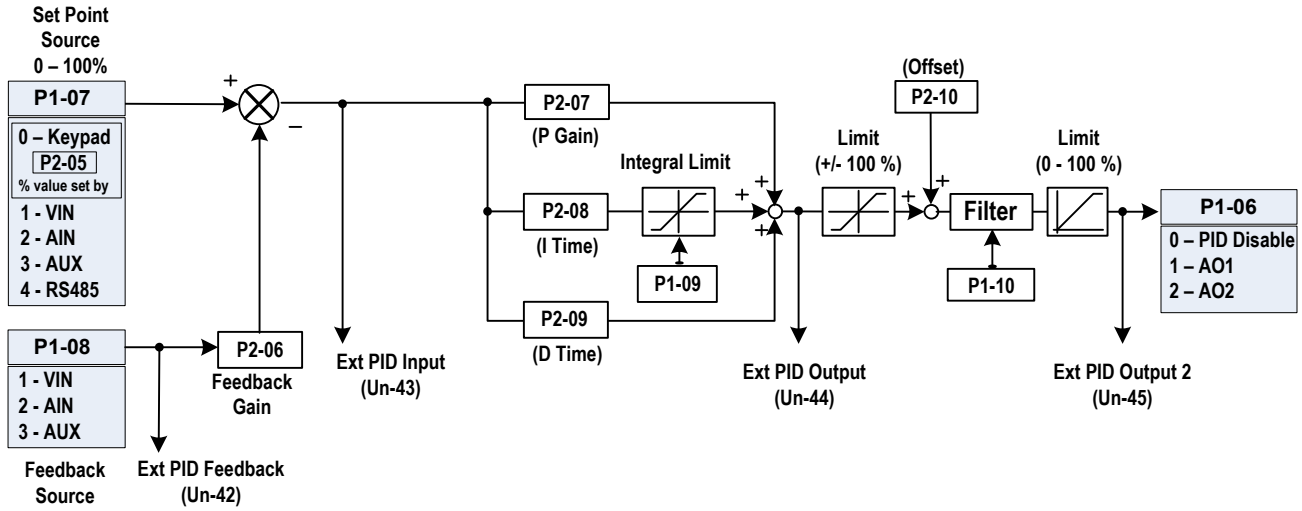


Fig. 2.2.1 External PID Block Diagram

- When the External PID Set Point Source P1-07 is set to 0 (keypad), P2-05 is used to set the value of the set point in percent.
- External PID Feedback Gain P2-06 is used to set the feedback gain for the External PID Feedback Source P1-08.

Note: If the Set Point Source P1-07 and Feedback Source P1-08 are set to the same input an ERROR MESSAGE will occur.

- External PID P Gain P2-07 is used to set the proportion gain (01 – 10).

Cont.

- External PID I Time P2-08 is used to set the integral time (0 – 100 sec.). Setting I to= 0, disables the integral function.
- External PID D Time P2-09 is used to set the differential time (0 – 1 sec.). Setting D to =0, disables the differential function.
- External PID Bias P2-10 is used to set the offset (-100 to +100%).
- External PID I Limit P1-09 is used to set the integral limit (1 – 100%).
- External PID Filter P1-10 is used to set the filter time constant (0 – 2.5 sec.).
- External PID Feedback Un-42 is used to monitor the feedback of the External PID Function.
- External PID Input, External PID Output 1, and External PID Output 2 are monitored by Un-43, Un-44, and Un-45 respectively.
- The PID Input and Output 2 can be accessed through Analog Output Terminal AO1 or AO2 by setting the corresponding parameter Sn-33 and Sn-34 to =12 (External PID Input) or to =13 (External PID Output)
- By setting one of the digital inputs Sn25-28 to =31 (External PID Invalid), the External PID function can be disabled by activating that input. During the External PID Invalid mode, the PID feedback, Input, Output 1, and Output 2 are equal to zero.
- By setting one of the digital inputs Sn25-28 to =32 (External PID Integration Reset), the accumulated integration error can be reset by activating that input.

2.3 Main and External PID Parameter Interaction

As mentioned previously certain parameters are common to both the main PID loop and the external PID loop. The following Tables, 2.3.1 and 2.3.2 show the various parameters that are available to be used in the external PID function when the main PID loop is disabled and when the main PID loop is enabled .

Table 2.3.1 Main PID Loop Disabled

Terminals available for external PID while (main) PID is *DISABLED* (Sn-64 = 0)				
Sn-05 Setting	*Sn-24 Setting*	*Sn-29 Setting*	*Terminals Available to Ext. PID*	*Comment*
1	0	0	AIN, AUX	VIN (0-10V) is used as the Frequency command
	1		VIN, AUX	AIN (0/4-20mA) is used as the Frequency command
	2 or 3		AUX (0-10V)	VIN & AIN are used as the Frequency command
0, 2 or 3	——		VIN, AIN, & AUX	——

Cont.

Table 2.3.2 Main PID Loop Enabled

Terminals available for external PID while (main) PID is *ENABLED* (Sn-64 ≠ 0)				
Sn-05 Setting	*Sn-24 Setting*	*Sn-29 Setting*	*Terminals Available to Ext. PID*	*Comment*
1	0	9*	AIN (0/4-20mA)	VIN is used as main PID feedback AUX is used as main PID set point
	1	9	VIN (0-10V)	AIN is used as main PID feedback AUX is used as main PID set point
		≠ 9	AUX (0-10V)	AIN is used as main PID feedback VIN is used as main PID set point
	2 or 3	9*	None (External PID is unavailable)	VIN and AIN are used as main PID feedback AUX is used as main PID set point
0, 2, or 3	0	———	AIN, AUX	VIN is used as main PID feedback
	1		VIN, AUX	AIN is used as main PID feedback
	2 or 3		AUX	VIN and AIN are used as main PID feedback

* Terminal VIN is used as the main PID feedback and Sn-29 must equal 9 to set terminal AUX as the main PID set point, otherwise an error message will be displayed.

- If the AUX input is selected for use by the External PID Functions (P1-07=3) or (P1-08=3), Sn-29 will be set to 18 (Ext PID Set point) or 19 (Ext PID Feedback) automatically, and can not be edited until input AUX is not selected as an External PID Function Source.

APP-2 Fan and Pump Application Note

This application note describes the parameters and their application used mainly for fan and pump control although much of the information can also be applied to other areas of control as well. It also provides the user with information to enable an initial power-up and operational check in section A-2.17 and in section A-2.18 setting up a simple PID loop. The reader is also directed to App-1 PID Control as the PID function is integral to fan and pump control.

The following features are provided by the MA7200 PLUS Inverter Series to facilitate the fan and pump application.

- ***Scaled PID Feedback Signal*** *and* ***Engineering Units.***
- ***Programmable Local/Remote Switch*** with single key in keypad.
- ***PID Sleep Function*** (Sleep based on PID output frequency or digital input, Wake-up based on feedback).
- ***Load Loss Detection*** function with programmable shutdown.
- ***Over Feedback for PID Feedback Signal*** with programmable shutdown.
- ***Low Feedback for PID Feedback Signal*** with programmable shutdown.
- ***Low Suction Detection*** function with programmable shutdown and restart.
- ***Flow Meter Display*** (Input via analog input or pulse train).
- ***Power Meter, kWh Meter,*** and ***Energy Cost Usage.***

Each of the parameters affecting the above listed features will be described in some detail. Although the parameters covered herein are mainly for fan and pump applications, they can be used in other applications as well.

As can be seen, the features listed mainly have to do with closed loop PID operations, although display functions and energy monitoring are also covered. There are two PID loops available, the **main** PID loop and the **external** PID loop and the reader is directed to application note App-1 PID Control for an in depth treatment of these functions. The main PID loop is used for applications directly affecting the operation of the inverter with the motor and is used for fan and pump control. The external PID loop, is available to control a non-drive function and will not be covered in this note.

Sections A-2.1 and A-2.2 summarize the P parameters that were developed mainly for fan and pump applications.

Sections A-2.11 to A-2.16 show block diagrams and control wiring diagrams for the 1 - 2 HP and 3 - 75 HP inverters. These diagrams are used to show the terminal connections and are referred to in the various sections of this note.

Section A-2.17 covers the initial drive start up. It will allow the user to get the motor up and running and to set certain parameters through the keypad.

In Section A-2.18, a step by step example for a simple PID loop will be given. This will familiarize the user with the implementation of some of the parameters covered in Sections A-2.1 and A-2.2. The parameters will be set via the keypad which will give the user some familiarity with keypad navigation. Although the parameters and control of the inverter can also be set via s*erial communication,* it is beyond the scope of this note. However, Modbus addresses are given for the parameters in Sections A-2.1 and A-2.2. For further information on serial communication control or special external control, the user is referred to the appropriate section of this manual.

1.0 P parameters (P1 thru P5) and Engineering Unit Selection Summary.

Table 1.0.1summarizes the P parameters and will be explained more in detail in the next section.
Table 1.0.2 summarizes the Engineering Units that can be used and displayed.

Table 1.0.1 MA7200 PLUS Inverter Series P1 to P5 Parameters

Parameter No.	LCD Display	Setting Range	Factory Setting	Change During Operation	Modbus Address
P1-01 (***Note 1***)	P1-01 Engineering Unit	00 - 25	00 (Set by Cn-28)	NO	0x0600
P1-02 (***Note 2***)	P1-02 Feedback Maximum	10 - 9999 (Engineering Units set by P1-01)	0	NO	0x0601
P1-03	P1-03 Local/Remote Key	0: Enabled 1: Disabled (Jog)	0	NO	0x0602
P1-04	P1-04 PID Sleep Function	0: PID Sleep Invalid 1: PID Sleep Valid	0	NO	0x0603
P1-05	P1-05 PID Wakeup Direction	0: Feedback above 1: Feedback below	1	NO	0x0604
P1-06	P1-06 Ext. PID Function	0: Ext. PID Invalid 1: Ext. PID, AO1 output 2:Ext. PID, AO2 output	0	NO	0x0605
P1-07	P1-07 Ext. PID Set Source	0: Set Point Parameter 1: Terminal VIN 2: Terminal AIN 3: Terminal AUX 4: Set Point RS-485	0	NO	0x0606
P1-08	P1-08 Ext. PID Fbk. Source	1: Feedback Term. VIN 2: Feedback Term. AIN 3: Feedback Term. AUX	3	NO	0x0607
P1-09	P1-09 Ext. PID I Limit	001 - 100%	100%	NO	0x0608
P1-10	Ext. PID Filter	0.0 - 2.5s	0.0s	NO	0x0609
P2-01	P2-01 Sleep Start Level	000.00 - 100.00%	000.00%	YES	0x0700
P2-02	P2-02 Sleep Start Delay	000.1 - 600.0 s	0001.0 s	YES	0x0701
P2-03	P2-03 Sleep Wakeup Level	000.00 - 099.99%	000.00%	YES	0x0702
P2-04	P2-04 Sleep Wakeup Delay	000.1 - 600.0 s	001.0 s	YES	0x0703

Cont.

Table 1.0.2 MA7200 PLUS Inverter Series P1 to P5 Parameters *(Cont.)*

Parameter No.	LCD Display	Setting Range	Factory Setting	Change During Operation	Modbus Address
P2-05	P2-05 Ext. PID Set Point	000.0 - 100.0%	000.0%	YES	0x0704
P2-06	P2-06 Ext. PID Fbk. Gain	00.01 - 10.00	01.00	YES	0x0705
P2-07	P2-07 Ext. PID P Gain	00.01 - 10.00	01.00	YES	0x0706
P2-08	P2-08 Ext. PID I Time	000.00 - 100.00 s	010.00 s	YES	0x0707
P2-09	P2-09 Ext. PID D Time	0.00 - 1.00s	0.00 s	YES	0x0708
P2-10	P2-10 Ext. PID Bias	-100 - 100%	000%	YES	0x0709
P3-01	P3-01 Load Loss Det. Level	000 - 200%	030%	NO	0x0800
P3-02	P3-02 Load Loss Det. Time	00.0 - 25.5s	05.0s	NO	0x0801
P3-03	P3-03 Load Loss Action	0: None 1: Load Loss Alarm 2: Load Loss Fault	0	NO	0x0802
P3-04	P3-04 Over Feedback Level	000.00 - 099.99%	000.00%	NO	0x0803
P3-05	P3-05 Over Fbk. Delay Time	0000.0 - 6000.0s	0003.0s	NO	0x0804
P3-06	P3-06 Over Fbk. Action	0: None 1: Over Feedback Alarm 2: Over Feedback Fault	0	NO	0x0805
P3-07	P3-07 Low Feedback Level	000.00 - 099.99%	000.00%	NO	0x0806
P3-08	P3-08 Low Fbk. Delay Time	0000.0 - 6000.0s	0003.0s	NO	0x0807
P3-09	P3-09 Low Fbk. Action	0: None 1: Low Feedback Alarm 2: Low Feedback Fault	0	NO	0x0808
P3-10	P3-10 Low Suction Detect	1: PID Error 2: Current 3: Error and Current	1	NO	0x0809
P3-11	P3-11 Low Suc. Det. Time	000 - 300s	100s	NO	0x080A

Cont.

Table1.0.2 MA7200 PLUS Inverter Series P1 to P5 Parameters *(Cont.)*

Parameter No.	LCD Display	Setting Range	Factory Setting	Change During Operation	Modbus Address
P3-12	P3-12 Low Suc. PID Error	01 - 30%	10%	NO	0x080B
P3-13	P3-13 Low Suction Current	000.1 - 200.0A	001.0 A	NO	0x080C
P3-14	P3-14 Low Suction Action	0:None 1: Low Suction Alarm 2: Low Suction Fault 3: Fault and Restart	1	NO	0x080D
P3-15	P3-15 Restart Delay	0005 – 6000s	0300s	NO	0x080E
P3-16	P3-16 Restart Selection	0: With Speed Search 1: W/O Speed Search	1	NO	0x080F
P4-01	P4-01 Flow Meter Function	0: None 1: Aux Input 2: Pulse Train Input	0	NO	0x0880
P4-02	P4-02 Max Flow for 10V AUX	00000 – 50000 GPM	01000 GPM	NO	0x0881
P4-03	P4-03 No Flow Point for Aux	0.0 - 5.0V	0.0V	NO	0x0882
P4-04	P4-04 Pulse Multiplier	000.01 – 500.00	100.00	NO	0x0883
P4-05	P4-05 Flow Meter Offset	0.00 - 0.99	0.00	YES	0x0884
P5-01	P5-01 Energy Cost per kWh	0.000 - 5.000$	0.000$	YES	0x08C0
P5-02	P5-02 Reset Energy Usage	0: No 1: Reset	0	YES	0x08C1

Note 1 - The following table A-2.1.2 shows the Engineering Units that can be selected by P1-01.

Note 2 - Parameter P1-02 may be assigned a value in the range shown (10 – 9999) ***only*** when an Engineering Unit from 2 to 24 is selected for parameter P1-02.

Cont.

Table 1.0.3 - Engineering Units Selection by Parameter P1-01

Setting	Engineering Unit	Description	Setting	Engineering Unit	Description
0	Set by Cn - 28		13	MPM	meter / minute
1	%	%	14	CMM	$meter^3$ / minute
2	PSI	PSI	15	W	W
3	GPH	gallon / hour	16	kW	kW
4	GPM	gallon / minute	17	°C	°C
5	inW	Inch water	18	m	meter
6	FPM	feet / minute	19	A	A
7	CFM	$feet^3$ / minute	20	RPM	RPM
8	in	inch	21	SPM	stroke/minute
9	ft	feet	22	/s	unit / s
10	HP	HP	23	/m	unit / m
11	°F	°F	24	/h	unit / h
12	m/s	meter / second	25	-	none

1.1 P Parameter Specifications

The P parameters, together with interacting parameters from other groups, are used to set and control the following eleven categories.

1. Scaled Feedback and Engineering units
2. Programmable Local / Remote Switch
3. PID Sleep Functions
4. External PID Functions (Input / Output Terminal)
5. External PID Functions (Gain Setting and Monitoring)
6. Load Loss Detection Function
7. Over Feedback Function for PID Feedback Signal
8. Low Feedback Function for PID Feedback Signal
9. Low Suction Detection Function
10. Flow Meter Display
11. Power Meter, KWh Meter, and Energy Cost Usage.

Although only the P parameters are explained in detail in this note, the user can refer to the appropriate sections of this manual for further detailed information on the other parameters covered.

Table 1.1.1 Scaled Feedback and Engineering Units

Parameter No.	LCD Display	Setting Range	Factory Setting	Change During Operation	Modbus Address
P1-01 (***Note 1***)	P1-01 Engineering Unit	00 - 25	00 (Set by Cn-28)	NO	0x0600
P1-02 (***Note 2***)	P1-02 Feedback Maximum	10 - 9999 (Engineering Units set by P1-01)	0	NO	0x0601
Un-34	Un-34 PID Feedback Display	——	——	——	0x0035

Cont.

Note 1 - The previous Table 1.1.1 shows the Engineering Units that can be selected by P1-01.
Note 2 - Parameter P1-02 may be assigned a value in the range shown (10 – 9999) ***only*** when an Engineering Unit from 2 to 24 is selected by parameter P1-02.

- P1-01Engineering Unit is used to setup engineering units for normal and PID operation. It also sets the display format and maximum value of the following parameters.
  1 - Set point frequency command (An).
  2 - The parameters for the engineering units.
  3 - PID feedback monitor point Un-34.
- When P1-01 is set to 00, parameter Cn-28 can be used to set the display format of the frequency commands (See Section 9.0 for more details). When P1-01 is set to a value of 01 to 25, parameter Cn-28 is ineffective.
- The following Table 1.1.2 shows the display format and maximum value according to the setting of P1-01.

Table 1.1.2

Setting of P1-01	Display Format		Maximum Value	
	Set Point and Freq. Command	PID Feedback Monitor and Engineering parameters	Set Point and Freq. Command	PID Feedback Monitor and Engineering parameters
0	Follow the Setting of Cn-28	XXX.XX %	Follow the Setting of Cn-28	100.00%
1	XXX.XX %		100.00%	
2 - 25	XXXX		Parameter P1-02	

- P1-02 Feedback Maximum is used to set the maximum value of the Engineering Units selected by P1-01, provided P1-01 is ***not*** set to 00 or 01 (%). This value then becomes the maximum that can be set by all other Engineering Unit parameters.

  Example: P1-01 = 2 (PSI), P1-02 = 300, then the PID Feedback Signal (0 – 10V / 4-20mA) = 0 - 300PSI.

- P1-01 must be set first and P1-02 must be set second before any other Engineering Units related parameters can be set.
- Monitor point Un-34, PID Feedback Display, is used to monitor the PID feedback signal applied to terminal AIN or VIN, as set by parameter Sn-24. The Engineering Units and maximum value are set by parameters P1-01 and P1-02. The monitor value is zero if PID function is disabled. (See Fig.1.1.1 below)

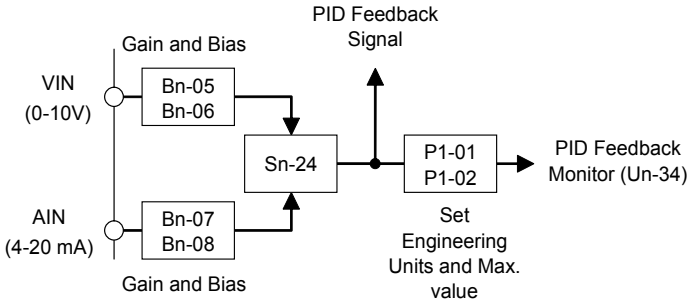


Fig. 1.1.1

1.2 Programmable Local/Remote Switch

Table 1.2.1

Parameter No.	LCD Display	Setting Range	Factory Setting	Change During Operation	Modbus Address
P1-03	P1-03 Local / Remote Key	0: Enabled 1: Disabled	0	NO	0x0602

- P1-03 is used to set the function of the Local / Remote key.
  0: Local / Remote key is enabled.
  1: Local / Remote key is disabled. *(When disabled this key is used as a JOG key)*
- When P1-03 is enabled, the local / remote function is effective when the inverter is in ***stop*** mode. Table 1.2.2 Below is a list of Run Source, Frequency Source, SEQ LED Status, and REF LED Status during Remote Mode and Local Mode.

Table 1.2.2

Status	Run command source and frequency command source	SEQ LED Status	REF LED Status
Remote	Set by parameters Sn-04, Run Source Selection and Sn-05, Frequency Source Selection.	ON if Sn-04 is not 0 (Run source is not from keypad)	ON if Sn-05 is not 0 (Frequency source is not from keypad)
Local	From keypad	OFF	OFF

- When P1-03 is enabled, the inverter is in remote mode after power-on and the Local / Remote switch is effective only when the inverter is in stop mode.
- Generally, the local / remote switch is used when Sn-04 and Sn-05 = 0 at the same time (*either the RUN source or Frequency source is controlled by the keypad*). The local / remote function is disabled if both Sn-04 and Sn-05 are set to 0.
- When P1-03 is disabled, the Local / Remote key operates as a JOG key. The JOG function is effective if:
  1 -The inverter is in stop mode and
  2 - Sn-04 = 0 (Run source is from the keypad).

1.3 PID Sleep Function

The PID Sleep Function is used in pumping applications to protect the operation of the motor and also to save on energy by shutting down the motor under certain conditions. Table 1.3.1below shows the parameters for the PID sleep function.

Table 1.3.1 PID Sleep Function Parameters

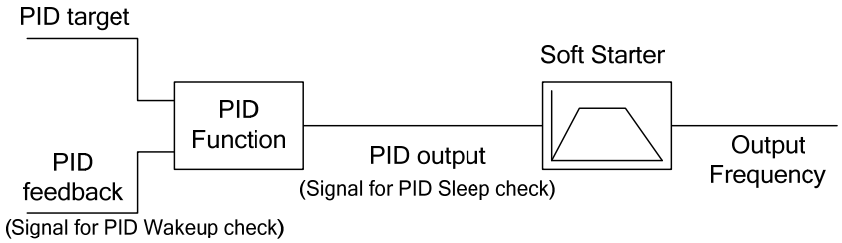
Parameter No.	LCD Display	Setting Range	Factory Setting	Change During Operation	Modbus Address
P1-04	P1-04 PID Sleep Function	0: PID Sleep Invalid 1: PID Sleep Valid	0	NO	0x0603
P1-05	P1-05 PID Wakeup Direction	0: Feedback above 1: Feedback below	1	NO	0x0604
P2-01	P2-01 Sleep Start Level	000.00 - 100.00%	000.00%	YES	0x0700
P2-02	P2-02 Sleep Start Delay	000.1 - 600.0 s	0001.0 s	YES	0x0701

Cont.

Table 1.3.1 PID Sleep Function Parameters *(Cont.)*

Parameter No.	LCD Display	Setting Range	Factory Setting	Change During Operation	Modbus Address
P2-03	P2-03 Sleep Wakeup Level	000.00 - 099.99%	000.00%	YES	0x0702
P2-04	P2-04 Sleep Wakeup Delay	000.1 - 600.0 s	001.0 s	YES	0x0703
Un-35	Un-35 During PID Sleep	——	——	——	0x0041
Sn-25 -Sn-28	Multi-Function Input Terminal 5, 6, 7,8 Function Selection	33: PID Sleep			0x0119 – 0x011C
Sn-30 - Sn-32	Multi-Function Output (RA-RB-RC, DO1, R2A-R2C) Function Selection	27: During PID Sleep			0x011E-0x0120

- If the PID function is *disabled*, Sn-64 = 0, and the parameter P1-04 PID Sleep Function is set to 1 (PID Sleep Valid), a *"PID Sleep Setting Error"* will occur.
- The following Fig.1.3.1 shows a block diagram and graph illustrating the PID sleep function.



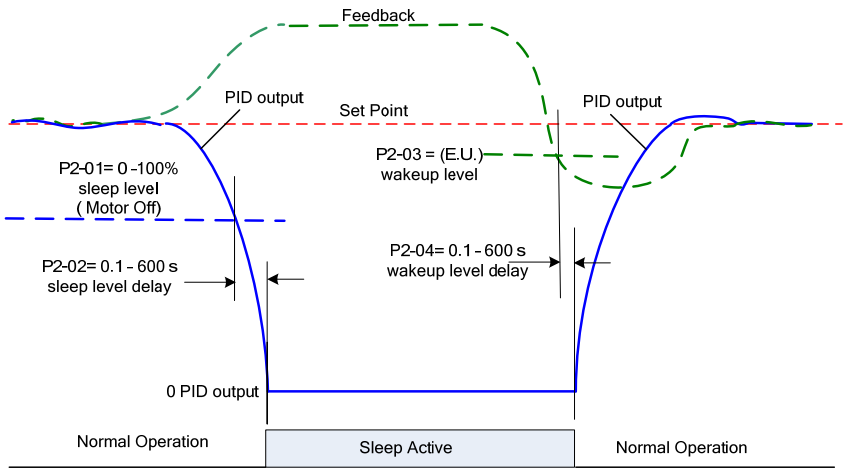


Fig. 1.3.1 PID Sleep Function

Cont.

- When the PID output falls below the Sleep Start Level P2-01 for a time exceeding the Sleep Start Delay P2-02 setting, the sleep function will be activated.
- The PID Sleep function can also be activated using a digital input. When the corresponding digital input Sn-25 –28 = 33 is ON for a time exceeding Sleep Start Delay P2-02 setting, the sleep function will be activated.
- If the sleep start level P2-01 is less than the minimum output frequency set by Cn-07, and none of the multi-functional input terminals Sn-25-28 are set to =33 (PID Sleep), the sleep function will be disabled.
- A *"DI PID Sleep Setting Error"* will occur if any of Sn-25-28 is set to =33 (PID Sleep) and:
  1. The PID function is disabled, Sn-64 = 0 or,
  2. The PID sleep function is disabled, P1-04 = 0.
- The PID Wakeup Direction P1-05 is used to set the condition for PID Wakeup Check.
  0: PID Wakeup while the PID feedback rises above the wakeup level.
  1: PID Wakeup while the PID feedback falls below the wakeup level.
  While the PID sleep function is valid, the PID wakeup direction also affects the PID function.
- Sleep Wakeup Level P2-03 and Sleep Wakeup Delay P2-04, are used for PID Wakeup Check. When the inverter is in the PID sleep mode, and the PID feedback falls below or rises above (direction set by P1-05 PID Wakeup Direction) the sleep wakeup level P2-03 for a time exceeding the programmed wakeup delay time P2-04, the inverter will exit the sleep mode and resume run.
- If PID sleep is enabled and the inverter is in PID sleep mode, the During PID Sleep Monitor Un-35 will be 1. If any of Multi-Function Output Functions Sn-30 -32 is set as "During PID Sleep", the corresponding output will be ON.
- If the inverter is in PID sleep mode, the accumulated integration error of the PID function will be cleared.

1.4 Load Loss Detection Function

Table 1.4.1 shows the parameters for the load loss detection function.

Table 1.4.1 Load Loss Detection Function Parameters

Parameter No.	LCD Display	Setting Range	Factory Setting	Change During Operation	Modbus Address
P3-01	P3-01 Load Loss Det. Level	000 - 200%	030%	NO	0x0800
P3-02	P3-02 Load Loss Det. Time	00.0 - 25.5s	05.0s	NO	0x0801
P3-03	P3-03 Load Loss Action	0: None 1: Load Loss Alarm 2: Load Loss Fault	0	NO	0x0802
Sn-29	Multi-Function Analog Input (AUX) Function Selection	16: Load Loss Level			
Sn-30 - Sn-32	Multi-Function Output (RA-RB-RC, DO1, DO2) Function Selection	24: Load Loss Detect			

- The Load Loss Detection Level can be set by Multi –function Analog Input parameter Sn-29 (AUX Function) when it is set to 16 *or* by P3-01 Load Loss Det. Level, when Sn-29 is ≠ 16.
  Note: When Sn-29 is set to =16 (Aux Function), the load loss level is determined by the analog value applied to the AUX input terminal and parameter P3-01Load Loss Detect Level is invalid.
- P3-01 Load Loss Detect Level is set as a percentage of inverter rated current. When Sn-29 = 16, the Load Loss Detect Level is determined by the voltage applied to the AUX input terminal as shown in Fig.1.4.1.

Cont.

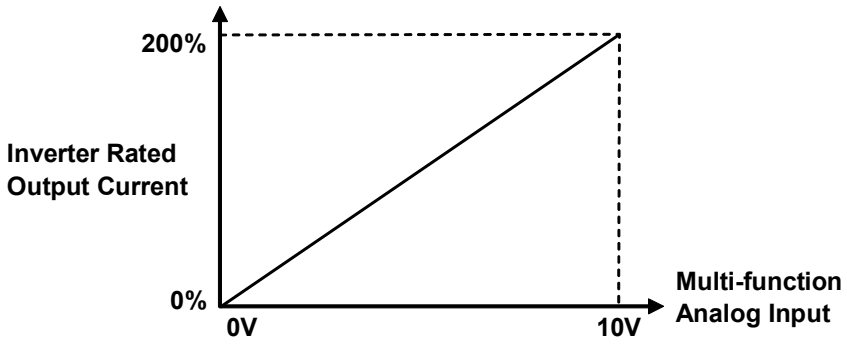


Fig. 1.4.1

- When the inverter output current falls below the Load Loss Detect Level for a time exceeding the programmed Load Loss Detect Time P3-02, the inverter status will be as set by parameter P3-03 Load Loss Action as shown in the following Table 1.4.2. Also, if any of the Multi-Function Outputs Sn-30 (Relay), Sn-31 (DO1), or Sn-32 (DO2) are set to =24 (Load Loss Detect), that output will be turned ON.

Table 1.4.2 Load Loss Action

P3-03 Value	Inverter Status while Load Loss	Message while Load Loss
0	Continue Running	——
1	Continue Running	Load Loss Alarm
2	Shut Down	Load Loss Fault

- The Fig. 1.4.2 below shows a block diagram and graph illustrating the Load Loss Detection Function.

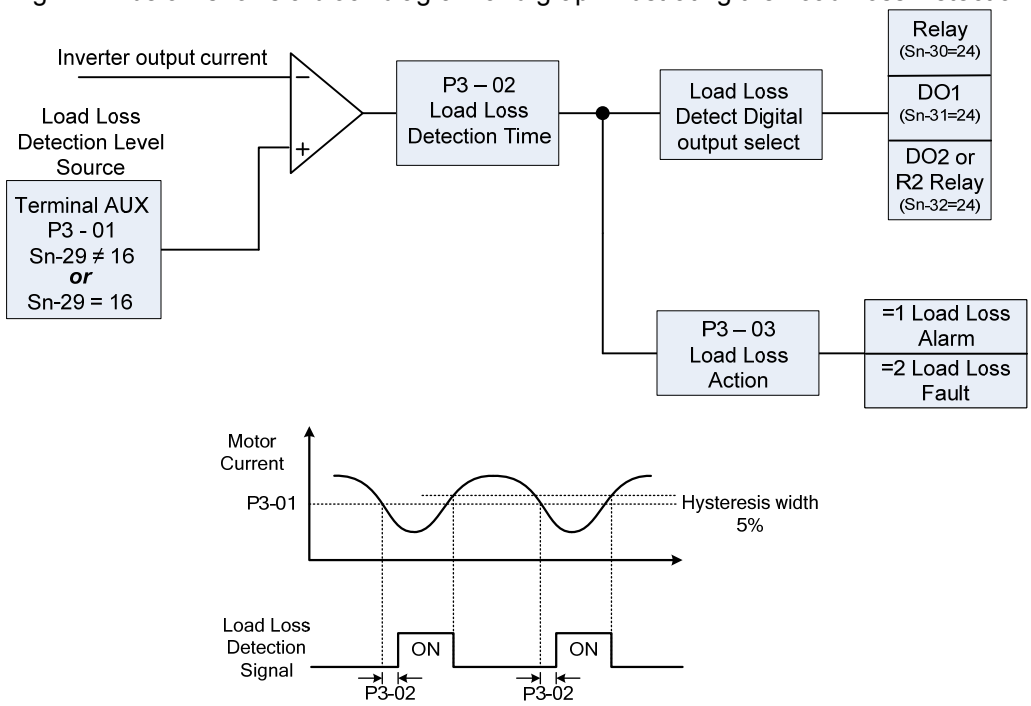


Fig. 1.4.2 Load Loss Detection Function

1.5 PID Over Feedback Signal Function

Table1.5.1 below shows the parameters for the PID over feedback signal function.

Table1.5.1 PID Over Feedback Signal Function

Parameter No.	LCD Display	Setting Range	Factory Setting	Change During Operation	Modbus Address
P3-04	P3-04 Over Feedback Level	*000.00 - 099.99%	000.00%	NO	0x0803
P3-05	P3-05 Over Fbk. Delay Time	0000.0 - 6000.0s	0003.0s	NO	0x0804
P3-06	P3-06 Over Fbk. Action	0: None 1: Over Feedback Alarm 2: Over Feedback Fault	0	NO	0x0805
Sn-30 - Sn-32	Multi-Function Output (RA-RB-RC, DO1, DO2 or R2 Relay) Function Selection	25: Over Feedback			

* The engineering units and range are set by parameter P1-01

- If PID is enabled (Sn-64 ≠ 0), Over Feedback Detection is enabled if P3-06 Over Feedback Action is set to =1 or 2 *or* at least one of Multi-Function Outputs Sn-30 (Relay), Sn-31 (DO1), or Sn-32 (DO2 or R2 Relay) is set to =25 (Over Feedback)
- When PID feedback rises above the Over Feedback Level set via P3-04 for the time exceeding the programmed Over Feedback Delay Time P3-05, the inverter status will be controlled by parameter P3-06 Over Feedback Action as shown in the following Table 1.5.2. Also if any of the Multi-Function Outputs Sn-30 (Relay), Sn-31 (DO1), or Sn-32 (DO2 or R2 Relay) are set to =25 (Over Feedback), that output will be turned ON.

Table 1.5.2 PID Over Feedback Signal Action

P3-06 Value	Inverter Status while Over Feedback	Message while Over Feedback
0	Continue Running	No Message
1	Continue Running	Over Feedback Alarm
2	Shut Down	Over Feedback Fault

- Fig.1.5.1 below is a block diagram illustrating the Over Feedback Detection Function.

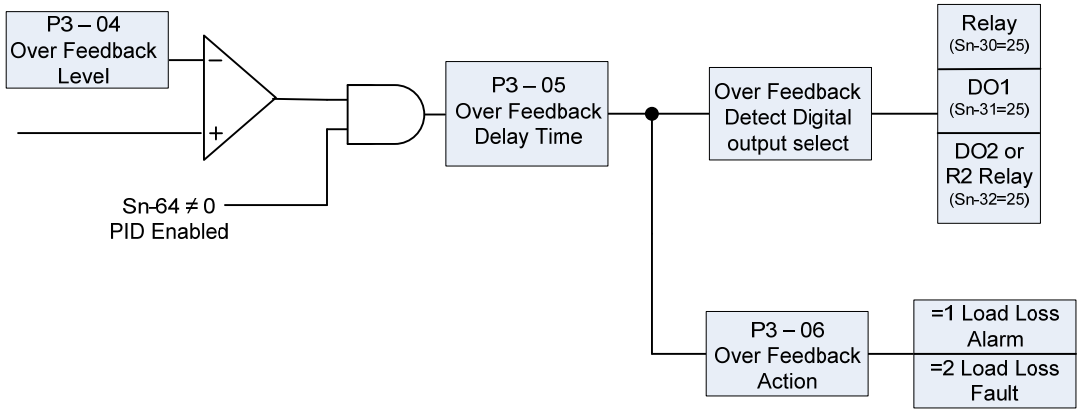


Fig. 1.5.1 Over Feedback Signal Function

1.6 PID Low Feedback Signal Function

Table1.6.1 below shows the parameters for the PID low feedback signal function.

Table 1.6.1 PID Low Feedback Signal Function

Parameter No.	LCD Display	Setting Range	Factory Setting	Change During Operation	Modbus Address
P3-07	P3-07 Low Feedback Level	*000.00 - 099.99%	000.00%	NO	0x0806
P3-08	P3-08 Low Fbk. Delay Time	0000.0 - 6000.0s	0003.0s	NO	0x0807
P3-09	Low Fbk. Action P3-09	0: None 1: Low Feedback Alarm 2: Low Feedback Fault	0	NO	0x0808
Sn-30 - Sn-32	Multi-Function Output (RA-RB-RC, DO1, DO2 or R2A –R2B) Function Selection	26: Low Feedback			

* The engineering units and range are set by parameter P1-01

- Fig.1.6.1 below is a diagram of the Low Feedback Detection Function.

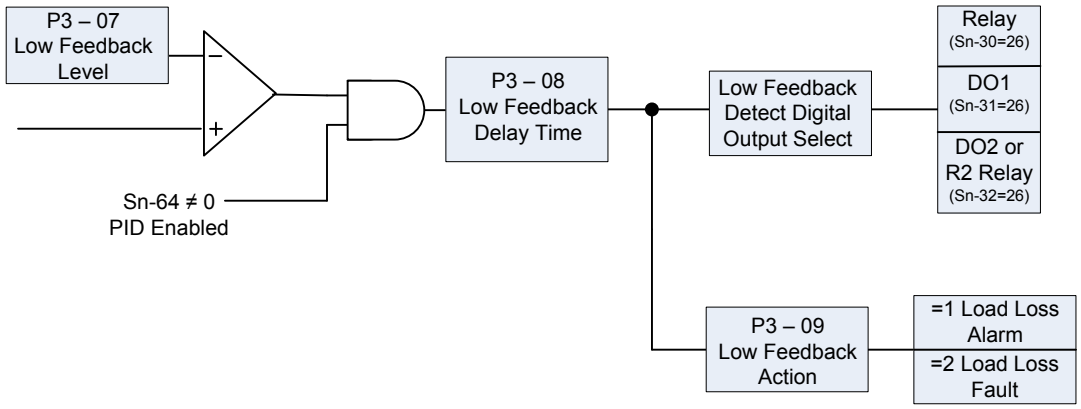


Fig.1.6.1 Low Feedback Detection Function

- If PID is enabled (Sn-64 ≠ 0), Low Feedback Detection is enabled if P3-09 Low Feedback Action is set to =1 or 2 *or* at least one of Multi-Function Outputs Sn-30 (Relay), Sn-31 (DO1), or Sn-32 (DO2 or R2 Relay) is set to =26 (Low Feedback)
- When the PID Feedback falls below the Low Feedback Level set via P3-07 for the time exceeding the programmed Low Feedback Delay Time P3-08, the inverter status will be controlled by parameter P3-09 Low Feedback Action as shown in the following Table1.6.2. Also if any of the Multi-Function Outputs Sn-30 (Relay), Sn-31 (DO1), or Sn-32 (DO2 or R2 Relay) are set to =26 (Low Feedback), that output will be turned ON.

Table 1.6.2 Low Feedback Action

P3-09 Value	Inverter Status while Low Feedback	Message while Low Feedback
0	Continue Running	No Message
1	Continue Running	Low Feedback Alarm
2	Shut Down	Low Feedback Fault

1.7 Low Suction Detection Function

The Low suction detection function is for pump applications. It can detect a break in suction or the absence of the supply medium (e.g. water). Table 1.7.1 below shows the parameters for the low suction detection function.

Table 1.7.1 Low Suction Detection Function

Parameter No.	LCD Display	Setting Range	Factory Setting	Change During Operation	Modbus Address
P3-10	P3-10 Low Suction Detect	1: PID Error 2: Current 3: Error and Current	1	NO	0x0809
P3-11	P3-11 Low Suc. Det. Time	000 - 300s	100s	NO	0x080A
P3-12	P3-12 Low Suc. PID Error	01 - 30%	10%	NO	0x080B
P3-13	P3-13 Low Suction Current	000.1 - 200.0A	001.0 A	NO	0x080C
P3-14	P3-14 Low Suction Action	0: None 1: Low Suction Alarm 2: Low Suction Fault 3: Fault and Restart	1	NO	0x080D
P3-15	P3-15 Restart Delay	0005 – 6000s	0300s	NO	0x080E
P3-16	P3-16 Restart Selection	0: With Speed Search 1: W/O Speed Search	1	NO	0x080F
Sn-30 - Sn-32	Multi-Function Output (RA-RB-RC, DO1, DO2 or R2 Relay) Function Selection	28: Low Suction Detection			

- P3-10 Low Suction Detect is used to select which signal is used for low suction detection as shown in the following Table 1.7.2.

Table 1.7.2 P3-10 Selection

P3-10 Value	Detection Signal	
	PID Error (PID Input)	Output Current
1	1	0
2	0	1
3	BOTH	

- When P3-10 Low Suction Detect is set to =1, (Detect PID Error), the PID Error (PID Input, Un-15) is used for low suction detection.
- When P3-10 Low Suction Detect is set to =2, (Detect Current), the output current is used for low suction detection.
- When P3-10 Low Suction Detect is set to =3, both the PID Error and Output Current are used for low suction detection.
- In order to generate a Low Suction Detection output, the following conditions must be satisfied for the time specified by P3-11 Low Suction Det. Time.
  1. Sn-64 ≠ 0 (PID is enabled) and the Un-15 PID Input (PID Error) is higher than P3-12 Low Suc. PID Error set level.
  2. The output frequency is > Cn-01 (Max. Output Frequency) - Cn-31(Frequency Agree Detection Width)

Cont.

- Fig.1.7.1 below shows a block diagram of the low suction detection function.

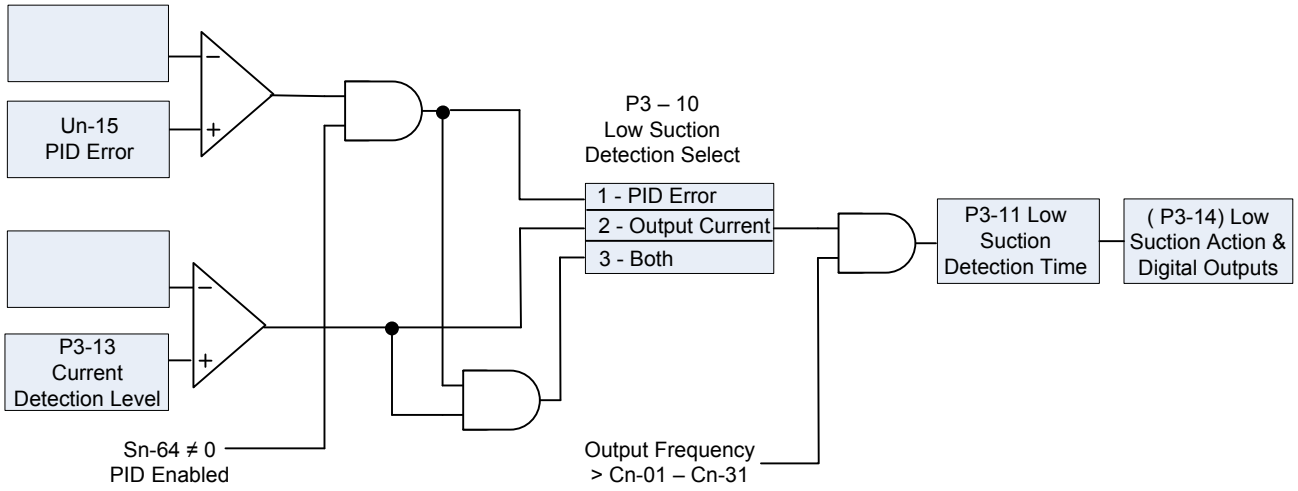


Fig. 1.7.1 Low Suction Detection Function

- P3-14 Low Suction Action, is used to set the inverter action after low suction detection has occurred per the following Table1.7.3.

Table 1.7.3 Low Suction Action

P3-14	Inverter Status	Message	Fault Contact Output
0	Continue Running	No Message	No operation
1	Continue Running	Over Feedback Alarm	No operation
2	Shut Down	Over Feedback Fault	Operation
3	Shut Down and Restart	Over Feedback Fault (before restart)	Operation (before restart)

- Fig.1.7.2 below is a block diagram of the low suction output function.

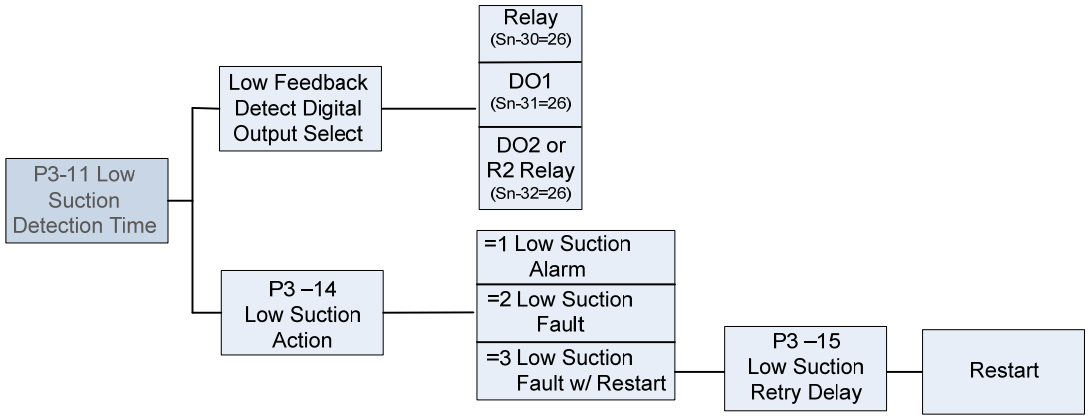


Fig. 1.7.2 Low Suction Output Function

- If P3-11 Low Suction Action, is set to =3 (Shut Down and Restart), the inverter will shut down and restart after the time specified by P3-15 Low Suction Retry Delay. This retry function is enabled as long as:
  1- Low Suction Detection is enabled
  2- P3-11, Low Suction Action, is set to =3.
  3- There is no STOP command during the low suction retry delay time.
  Note -The setting of parameter Cn-24 (Number of Auto Restart Attempts) is independent of the retry function of low suction detection.

Cont.

- P3-16 Low Suction Restart Selection, determines the action while the inverter restarts as per the following Table 1.7.4.

Table 1.7.4 Low Suction Restart Selection

P3-16	Action during Restart		Description
	Speed Search	DC-injection braking	
0	Valid	Invalid	This setting is used when the restart delay time is short and the motor is still running because of inertia.
1	Invalid	Depends on the setting of Cn-17	This setting is used when the restart delay time is long enough to stop the motor before restart.

- If low suction is detected and any of the Multi-Function Output Functions (Sn-30 -32) are set to 28 (Low Suction), the corresponding terminal will be ON.
  If P3-11Low Suction Action is set to =3 (Shut Down and Restart), the corresponding terminal will be OFF after the inverter restarts.

1.8 Flow Meter Display

Table 1.8.1 below shows the parameters used for the flow meter display.

Table 1.8.1 Flow Meter Display

Parameter No.	LCD Display	Setting Range	Factory Setting	Change During Operation	Modbus Address
P4-01	P4-01 Flow Meter Function	0: None 1: Aux Input 2: Pulse Train Input	0	NO	0x0880
P4-02	P4-02 Max Flow for 10V AUX	00000 – 50000 GPM	01000 GPM	NO	0x0881
P4-03	P4-03 No Flow point for AUX	0.0 - 5.0V	0.0V	NO	0x0882
P4-04	P4-04 Pulse Multiplier	000.01 – 500.00	100.00	NO	0x0883
P4-05	P4-05 Flow Meter Offset	0.00 - 0.99	0.00	YES	0x0884
Un-41	Un-41 Flow Meter	0 - 50000 GPM	——	——	0x0047

- P4-01Flow Meter Selection, is used to enable or disable the flow meter function and to select one of two the inputs for this function as follows.
  1. Terminal Aux: 0-10V or 4-20mA signal. *(Note – If using a 4-20 mA input signal, place a 500Ω resistor from the AUX input terminal to GND).*
  2. Terminal A(+) / A(-): Pulse Train Input with open-collector or complementary interface. The pulse input frequency range is 50Hz - 32kHz.
- The following Table 1.8.2 shows the P4-01 function and the parameters used with selection 1 or 2.

Table 1.8.2 P4-01 Selection

P4-01	Flow Meter Function	Flow Meter Signal	Flow Meter Parameters
0	Disabled	——	——
1	Enabled	AUX Input	P4-02, P4-03 (P4-04, P4-05 is fixed)
2	Enabled	Pulse Train Input	P4-04, P4-05 (P4-02, P4-03 is fixed)

Cont.

- Flow Meter monitor point Un-41 is used to display the output of the flow meter function in GPM. If the P4-01 is set to 0, the Flow Meter is zero.
- Fig.1.8.1 below is a block diagram of the flow meter function when Flow Meter Selection P4-01 is set to =1 (AUX input).

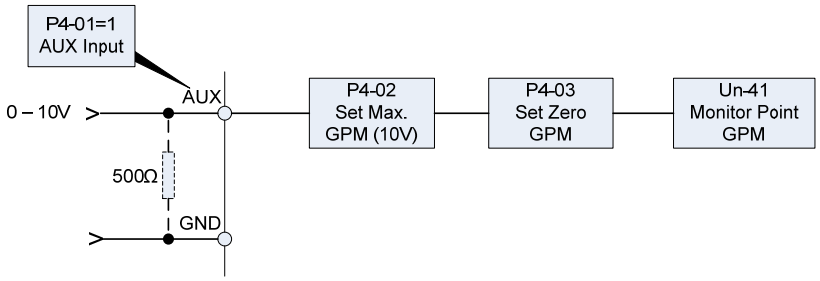


Fig. 1.8.1 Flow Meter (P4-01=1 Aux. Input)

- When P4-01 is set to =1(AUX Input), the Flow Meter signal is input to terminal AUX and parameters P4-02 (Max Flow for 10V AUX) and P4-03 (AUX for No Flow) are used to set flow meter functions. Also, the parameters below will be set automatically.
  1. Parameters P4-04 and P4-05.
  2. AUX Function Selection (Sn-29)
  3. Terminal AUX Gain and Bias (Bn-09 and Bn-10).

  These parameters can not be edited until the setting of P4-01 is changed. Also when P4-01 is set to =1 any previous AUX Function (Sn-29) setting will become invalid.
- An error message "*Flow Meter Setting Error*" will be displayed if P4-01 is set to 1 and one of the conditions below is satisfied.
  1. Sn-29 (AUX Function Selection) =9 (PID Target).
  2. P1-07 (External PID Set Source) =3 (AUX Function).
  3. P1-08 (External PID Feedback Source) =3 (AUX Function).
- P4-02 Max Flow for 10V AUX, is used to set the maximum flow level in GPM, which corresponds to a 10 V input to the Aux input.

  Example: P4-02 is set to = 2500 GPM (max flow level).
  Aux input 0 – 10 V = 0 - 2500GPM.
- P4-03 Aux for No Flow, is used to offset the input signal to terminal AUX, which corresponds to *zero* flow. An example of this would be if the input flow signal is 4-20mA, where 4mA = 0 GPM, and a 500Ω resistor is used between AUX and GND. The input voltage to the AUX terminal would be 4mA x 500Ω = 2V. P4-03 would then be set to =2V so that 4 mA would represent zero flow. The maximum flow would be as set in the previous example by P4-02.

- Fig.1.8.2 below is a diagram of the flow meter function while Flow Meter Selection P4-01 is set to 2 (Pulse Train Input).

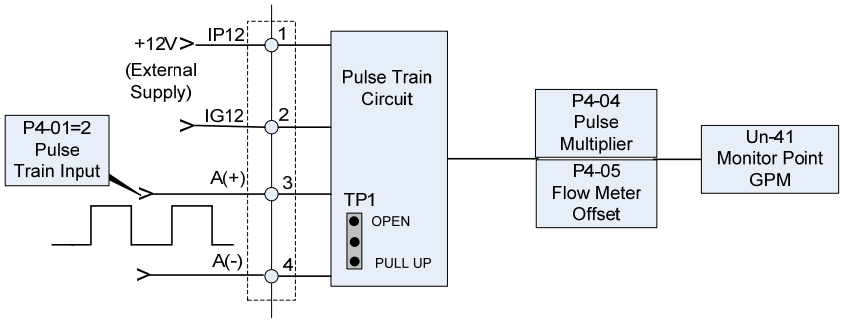


Fig. 1.8.2 Flow Meter (Pulse Train Input)

- When P4-01 is set to 2 (Pulse Train Input), the Flow Meter signal is input to terminals A(+) and A(-) and the parameters P4-04 (Pulse Multiplier) and P4-05 (Flow Meter Offset) are used to set the flow meter functions. In this case, parameters P4-02 and P4-03 will be set automatically and can not be edited until the setting of P4-01 is changed.

Cont.

- The input to terminals A(+) and A(-) allows for open-collector or complementary interface by setting jumper TP1 to PULL-UP position for open-collector interface or to OPEN position for complementary interface.
- An error message "*Flow Meter Setting Error*" will be displayed if P4-01 is set to 2 and one of the conditions below is satisfied.
  1. Sn-40 (PG Speed Control Settings) ≠ 0 (Speed Control Enabled).
  2. Sn-05 (Frequency Command Setting) = 3 (Pulse Input).
- P4-04 Flow Multiplier is used to scale the flow meter monitor value, while P4-05 Flow Offset is used to calibrate the flow meter.

  Output GPM = Input Pulse Train Frequency (Hz) x (P4-04 + P4-05).

  Example: Input Pulse Train Frequency = 60Hz, P4-04 = 500.1 and P4-05 = 0.20
  Flow Meter Monitor = 60 x (500.1 + 0.2) = 30018 GPM.

1.9 Power Meter, KWh Meter, and Energy Cost Usage

Table A-2.10.1 below shows the parameters used for power meter, Kwh meter and energy cost usage.

Table 1.9.1 Power Meter, KWh Meter, and Energy Cost Usage

Parameter No.	LCD Display	Setting Range	Factory Setting	Change During Operation	Modbus Address
P5-01	P5-01 Energy Cost per kWh	0.000 - 5.000$	0.000$	YES	0x08C0
P5-02	P5-02 Reset Energy Usage	0: No 1: Reset	0	YES	0x08C1
Un-36	Un-36 Output Power	0.0 - 999.9 kW	——	——	0x0042
Un-37	Un-37 Energy Used in kWh	0.0 - 999.9 kWh	——	——	0x0043
Un-38	Un-38 Energy Used in MWh	0.0 - 50000 MWh	——	——	0x0044
Un-39	Un-39 Energy Cost in $	0 - 9999 $	——	——	0x0045
Un-40	Un-40 Cost in 10000$	0 - 25000 (0$ - 250 Mil$)	——	——	0x0046

- Un-36 Output Power, is used to monitor the output power in kW. The display range is 0.0 - 999.9kW.
- Un-37 Energy Used in kWh and Un-38 Energy Used in MWh, are used to monitor the total energy used by the inverter.

  The maximum value of monitor energy is 50000MWh.

  Example: If 800 kWh of energy is used, Un-37 = 800 kWh and Un-38 = 0 MWh.
  If 32.3 MWh energy is used, Un-37 = 300 kWh and Un-38 = 32 MWh.
- P5-01 Energy Cost per kWh, is used to set the unit energy cost per kWh.
- Un-39 Energy Cost in $ and Un-40 Energy Cost in 10000, are used to monitor the total energy cost of inverter.

  The maximum value of monitor energy cost is 250 Million $

  Example: If the energy cost is 2,000$, Un-39 = 2000$ and Un-40 = 0.
  If the energy cost is 123,200$, Un-39 = 3200$ and Un-40 = 12.
- When the power is OFF, the inverter will retain the values of energy used (Un-37, Un-38) and energy cost (Un-39, Un-40), and the stored data will be available after power up.
- P5-02 Reset Energy Usage is used to clear the monitor variables for energy usage and energy cost.

  P5-02 = 0: No Reset

  P5-02 = 1: Reset (The data will be cleared automatically after P5-02 is set to =1)

2.0 (1- 2 HP) MA7200 PLUS Block Diagram

Fig. 2.0.1 below is an overall basic electrical connection diagram for the **MA7200 PLUS 1 – 2 HP**. It is used in conjunction with the other sections of this application note to give the user the ability to successfully start up a Fan or Pump application. Additional information is available in other sections of this manual to which the user may refer.

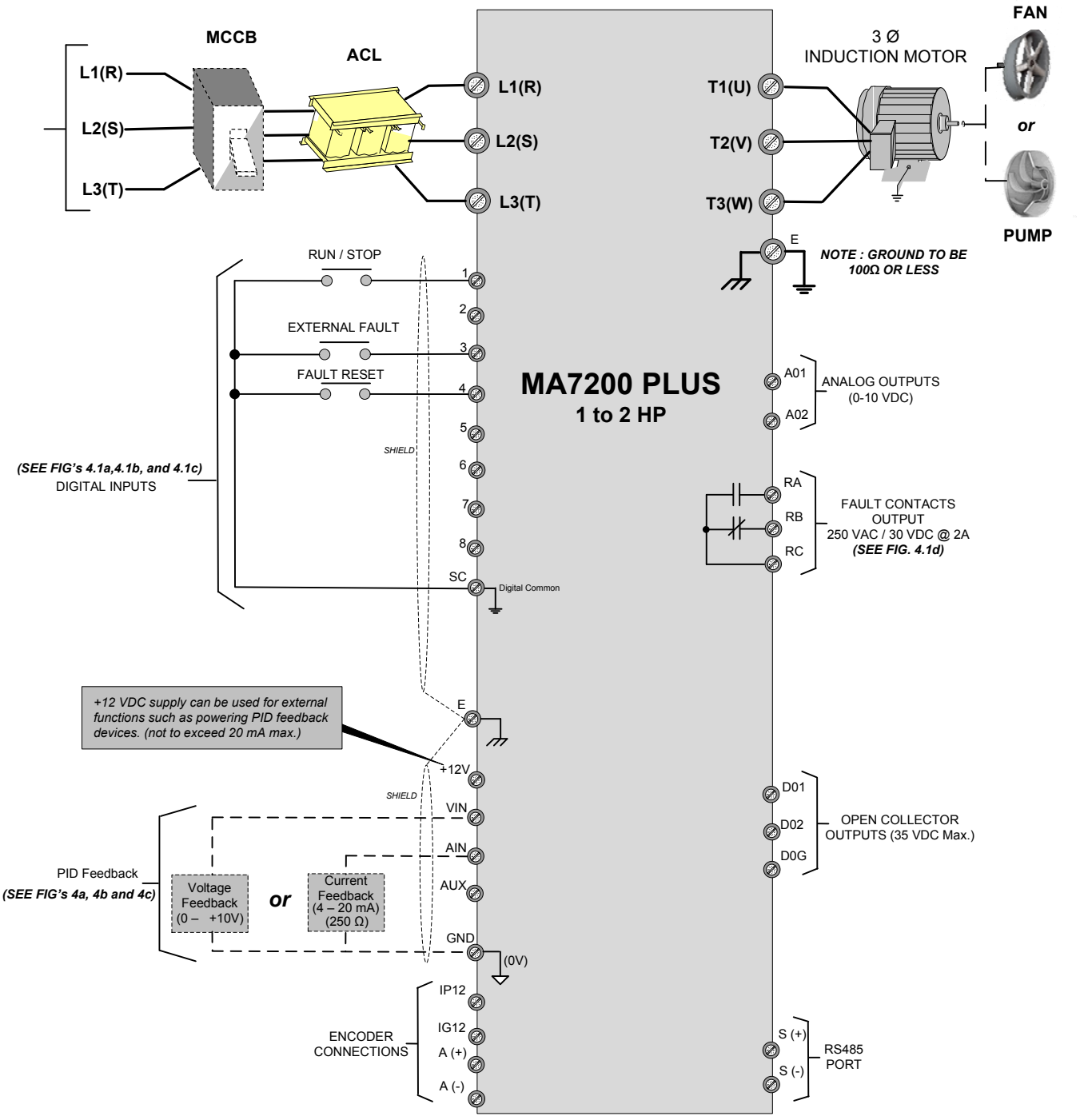


Fig. 2.0.1 (1 to 2 HP) MA7200 PLUS Fan or Pump Application Diagram

Cont.

2.1 (3- 75 HP) MA7200 PLUS Block Diagram

Fig. 2.1.1 below is an overall basic electrical connection diagram for the **MA7200 PLUS 3 – 75 HP**. It is used in conjunction with the other sections of this guide to give the user the ability to successfully start up a Fan or Pump application.

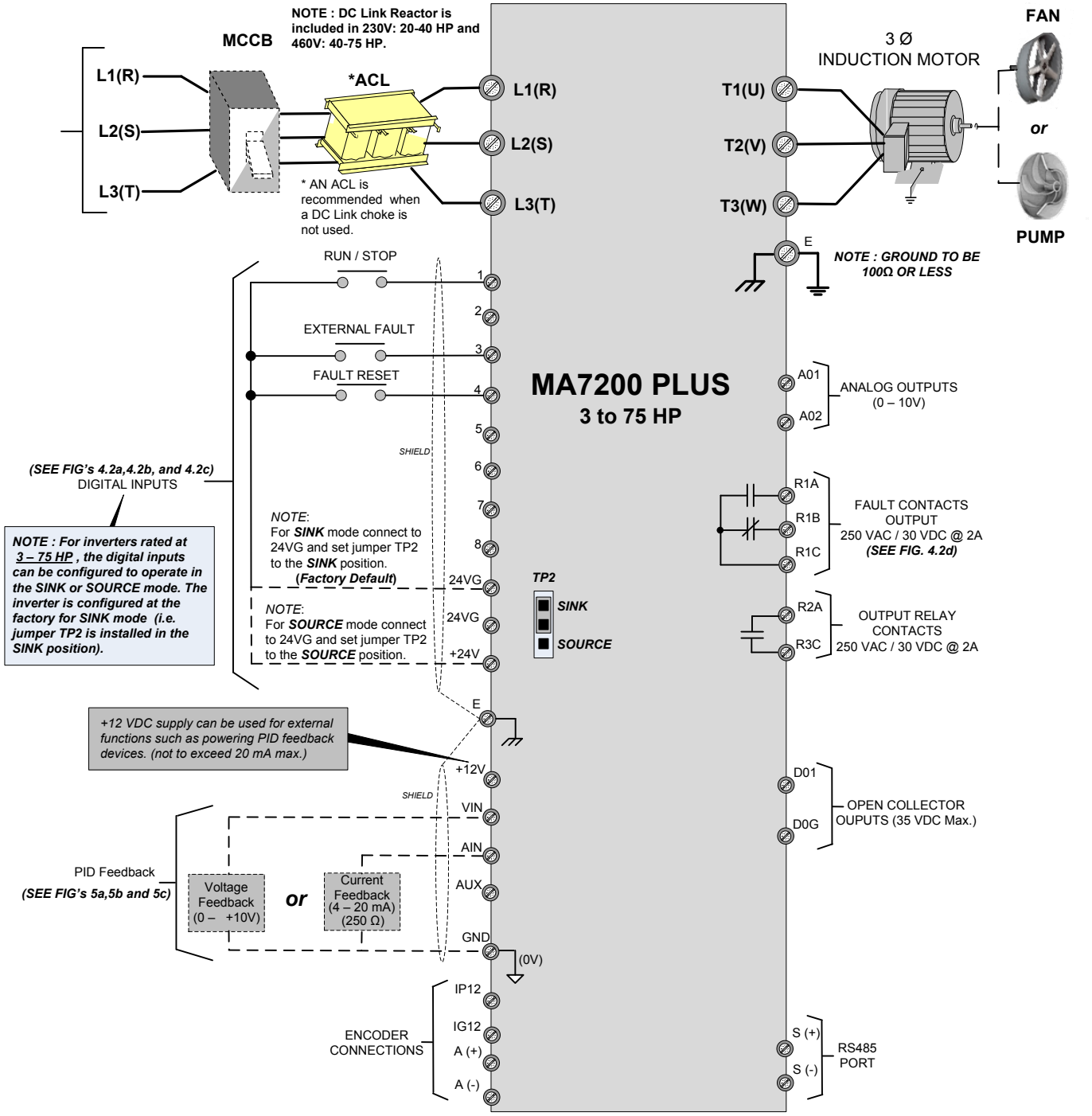
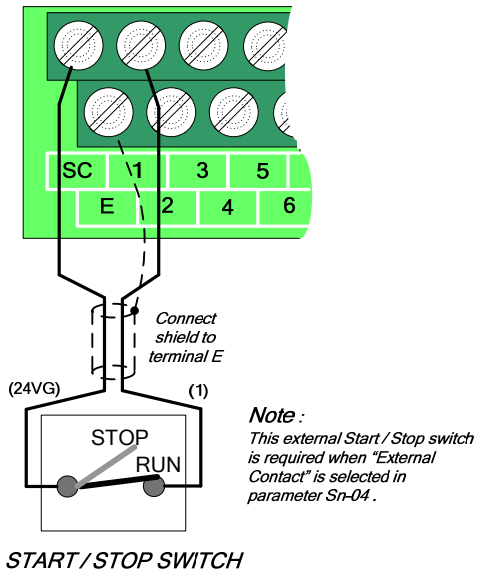


Fig. 2.1.1 (3 to 75 HP) MA7200 PLUS Fan or Pump Application Diagram

2.2 (1 – 2 HP) MA7200 PLUS Digital Input / Output Control Terminal Connections

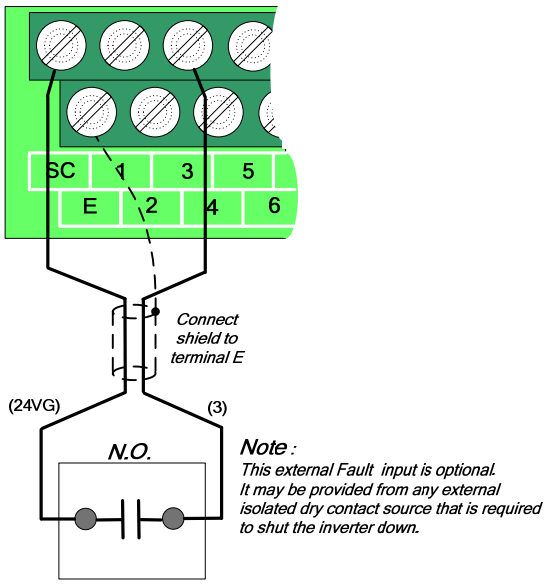
Fig's 2.2.1a, A-2.2.1b and 2.2.1c below show the terminal connections for input control functions for the MA7200 PLUS **1 - 2 HP**. The connections shown are typical and the user is referred to other sections of this manual for additional information is required. Fig. 2.2.1d shows an example for the use of the ***Fault Output Relay***.

Fig. 2.2.1a Start / Stop Switch Connection



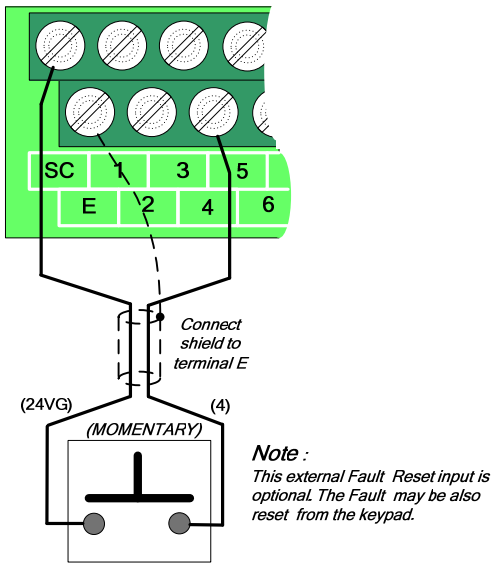
START / STOP SWITCH

Fig. 2.2.1b External Fault Contact Connection



EXTERNAL FAULT CONTACT

Fig. 2.2.1c Fault Reset Switch Connection



FAULT RESET SWITCH

Fig. 2.2.1d Fault Output Contacts

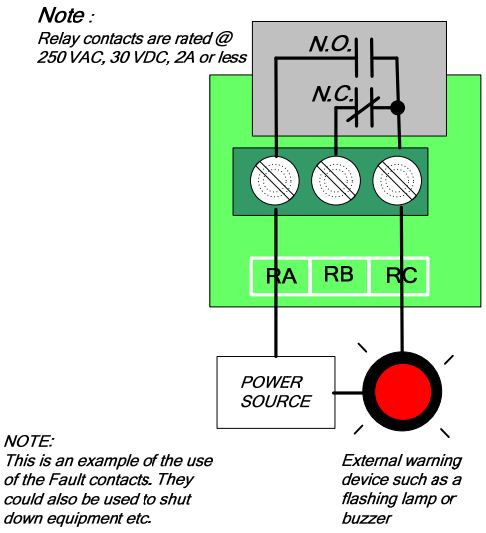


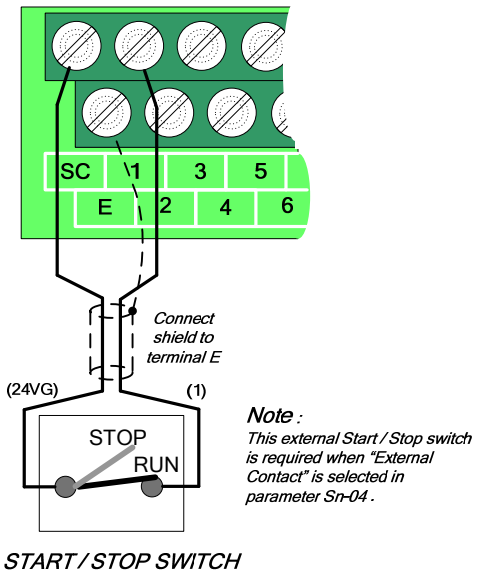
Fig. 2.2.1 (1 – 2 HP) MA7200 PLUS Digital Input / Output Control Terminal Connections

Cont.

2.3 (3 – 75 HP) MA7200 PLUS Digital Input / Output Control Terminal Connections

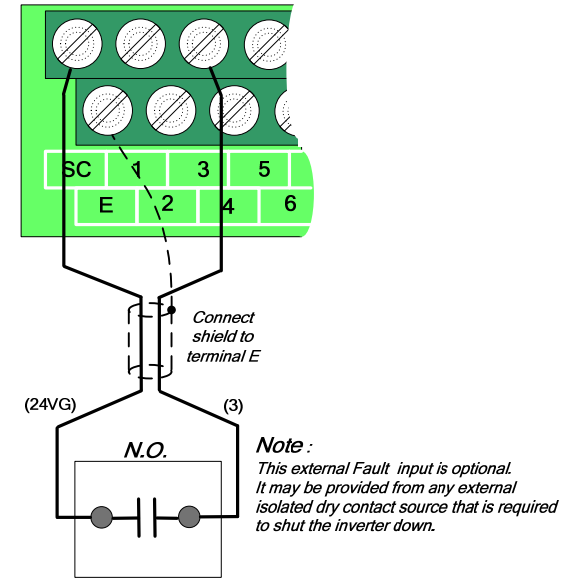
Fig's 2.3.1a, 2.3.1b and 2.3.1c below show the terminal connections for input control functions for the MA7200 PLUS **3 – 75 HP**. The connections shown are typical and the user is referred to the **MA7200 PLUS Manual** if additional information is required. Fig. 2.3.1d shows an example for the use of the ***Fault Output Relay***.

Fig. 2.3.1a Start / Stop Switch Connection



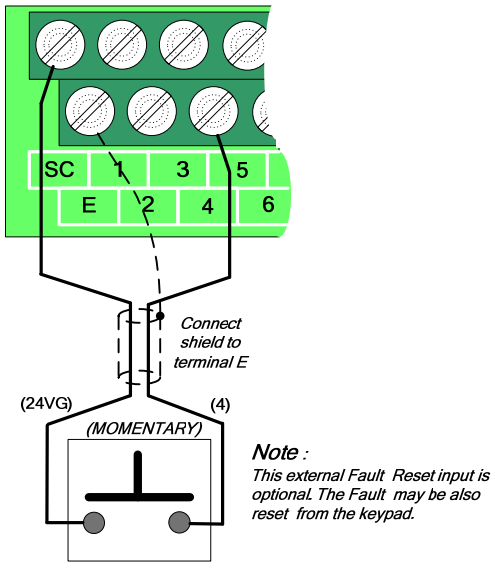
START / STOP SWITCH

Fig. 2.3.1b External Fault Contact Connection



EXTERNAL FAULT CONTACT

Fig. 2.3.1c Fault Reset Switch Connection



FAULT RESET SWITCH

Fig. 2.3.1d Fault Output Contacts

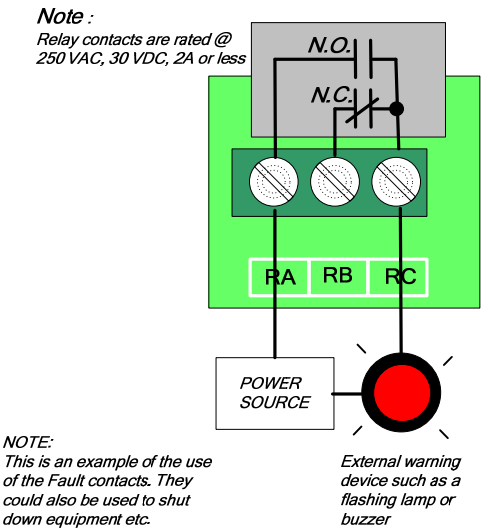


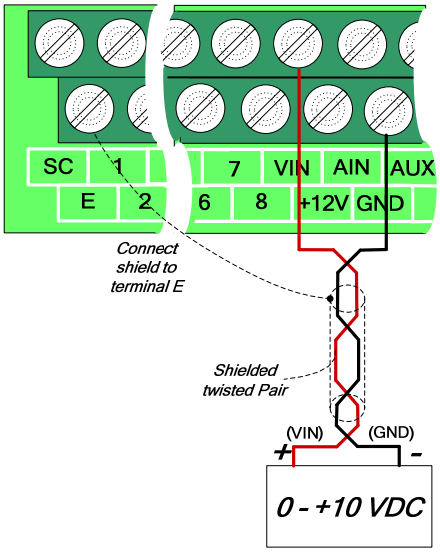
Fig. 2.3.1 (3 – 75 HP) MA7200 PLUS Digital Input / Output Control Terminal Connections

Cont.

2.4 (1 –2HP) MA7200 PLUS Analog Feedback Control Terminal Connections

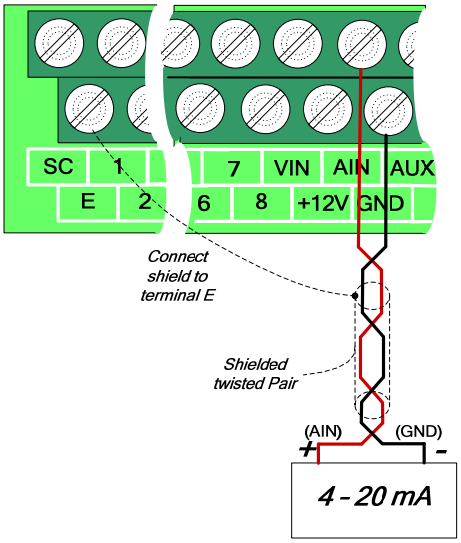
Fig's 2.4.1a, 2.4.1b and 2.4.1c show the analog feedback schemes (*10VDC or 4-20mA)* for the MA7200 PLUS **1- 2 HP**.

Fig. 2.4.1a 0 - +10 VDC Analog Feedback (Notes 1&2)



0 - +10 VDC FEEDBACK VOLTAGE SOURCE

Fig. 2.4.1b 4 - 20 mA Analog Feedback (Notes 1&2)



4 - 20 mA FEEDBACK CURRENT SOURCE

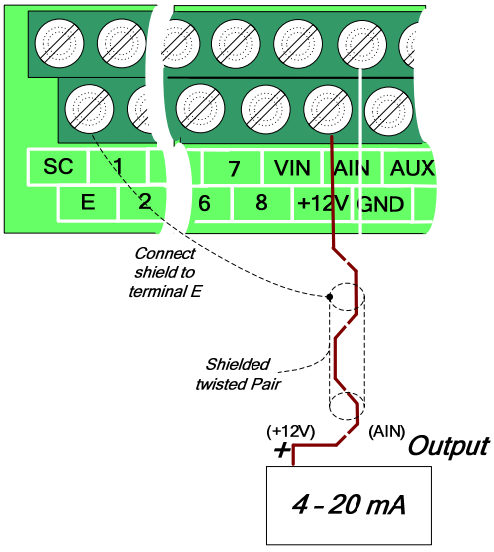
NOTES:

1 - Before connecting any feedback device, be sure to read the manufacturers instructions thoroughly as wiring color codes and connections may vary.

2 - Fig's 2.4.1a and 2.4.1b show typical connections for 0 - +10VDC and 4 - 20 mA feedback devices. The wiring color codes red and black and the connections shown are for illustrative purposes and may be different for a particular feedback device.

3 - As an example Fig. 2.4.1c shows the connections for a 4-20 mA pressure transducer used in water pump applications. Note that the color code is brown and white and the connections are to +12 and AIN .

Fig. 2.4.1c 4 - 20 mA Analog Feedback (Note 3)



4 - 20 mA Pressure Transducer

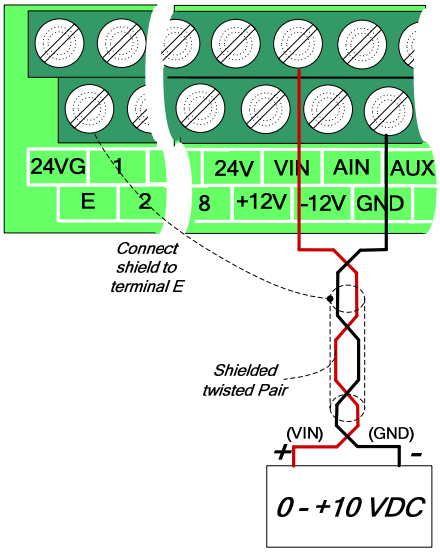
Fig. 2.41 (1 –2HP) MA7200 PLUS Analog Feedback Control Terminal Connections

Cont.

2.5 (3 –75HP) MA7200 PLUS Analog Feedback Control Terminal Connections

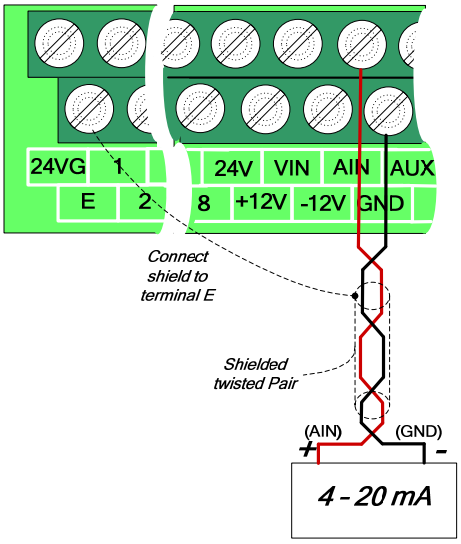
Fig's 2.5.1a, 2.5.1b and 2.5.1c show the analog feedback schemes (*10VDC or 4-20mA)* for the MA7200 PLUS **3 - 75 HP**.

Fig. 2.5.1a 0 - +10 VDC Analog Feedback (Notes 1&2)



0 - +10 VDC FEEDBACK VOLTAGE SOURCE

Fig. 2.5.1b 4 - 20 mA Analog Feedback (Notes 1&2)



4 - 20 mA FEEDBACK CURRENT SOURCE

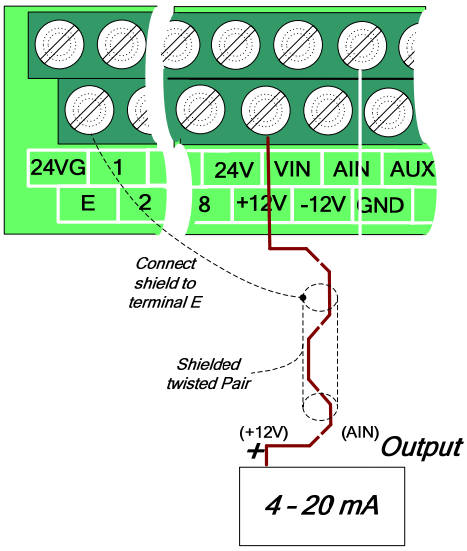
NOTES:

1 - Before connecting any feedback device, be sure to read the manufacturers instructions thoroughly as wiring color codes and connections may vary.

2 - Fig's 2.5.1a and 2.5.1b show typical connections for 0 - +10VDC and 4 - 20 mA feedback devices. The wiring color codes red and black and the connections shown are for illustrative purposes and may be different for a particular feedback device.

3 - As an example Fig. 2.5.1c shows the connections for a 4-20 mA pressure transducer used in water pump applications. Note that the color code is brown and white and the connections are to +12 and AIN .

Fig. 2.5.1c 4 - 20 mA Analog Feedback (Note 3)



4 - 20 mA Pressure Transducer

Fig. 2.5.1 (3 –75HP) MA7200 PLUS Analog Feedback Control Terminal Connections

2.6 MA7200 PLUS Initial Power up and Operational check

In this section the inverter will be powered up and the Fan or Pump motor operation will be initially tested for direction and function.

SAFETY FIRST!

***Step 1* - Before Starting the Inverter**

- Verify that the correct inverter size for the motor was received free of damage. To ensure personnel safety and to avoid equipment damage, follow the precautions and the installation procedures for mounting, wiring, and operating environment as covered in other sections of this manual.

  CAUTION - ***To avoid damage to the inverter when removing the inverter cover and/or LCD Operator, refer to Appendix C for the proper procedure.***

- In accordance with applicable codes make electrical connections to the motor and input power terminals. ***(Refer to the block diagram, Fig. A-2.11.1 for 1- 2 HP or, Fig. A-2.12.1 for 3 - 75 HP)***. *No other external connections should be made at this time, as the initial control will be from the Keypad.*

***Step 2* - Apply Power to the Drive**

- Apply AC power to the Inverter and observe the LCD Display Line 1. It should read; "**Freq. Cmd 000.00Hz**". Line 2 should read; "**TECO**". The red LED on the ***STOP*** key should be *ON*. The ***DRIVE*** and ***FWD*** LED's should be *ON*. (See Fig. 2.6.1 below)

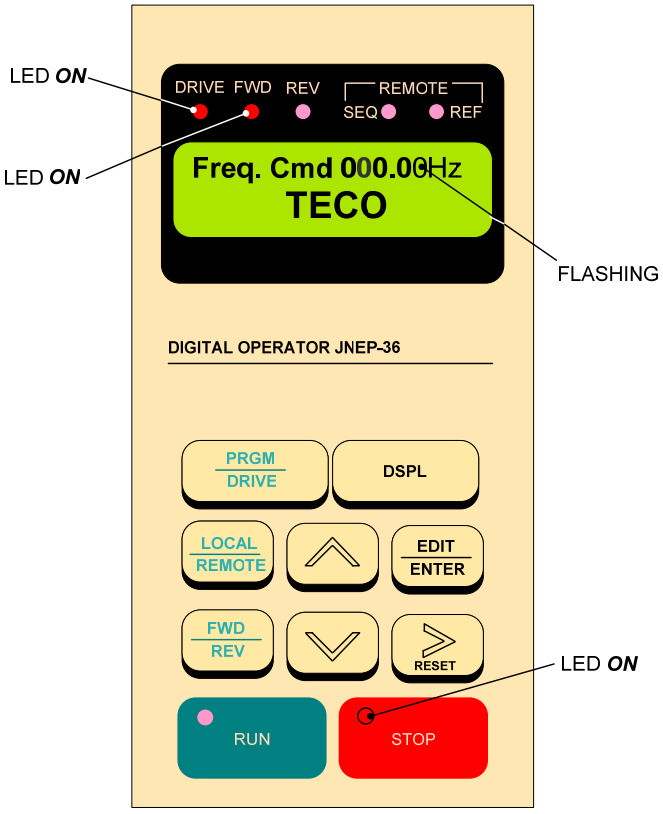


Fig. 2.6.1 MA7200 PLUS Digital Operator

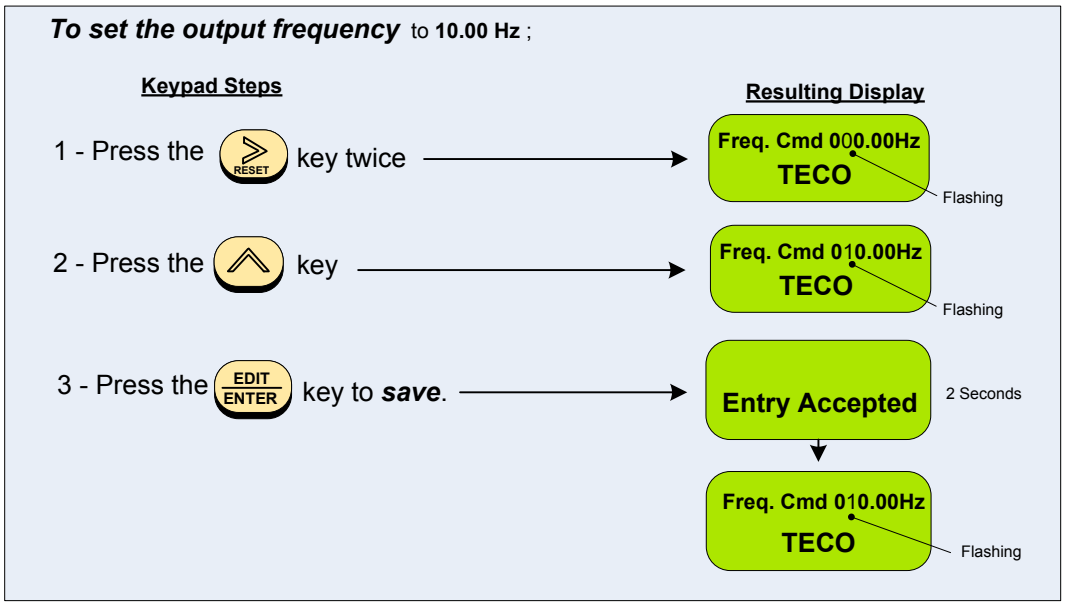
***Step 3* - Set Drive to Run Mode**

- If the red ***DRIVE*** LED is not on with AC power up, press the ***PGRM / DRIVE*** key until the red ***Drive*** LED is *on*. The Inverter is now in the **RUN** mode.

Cont.

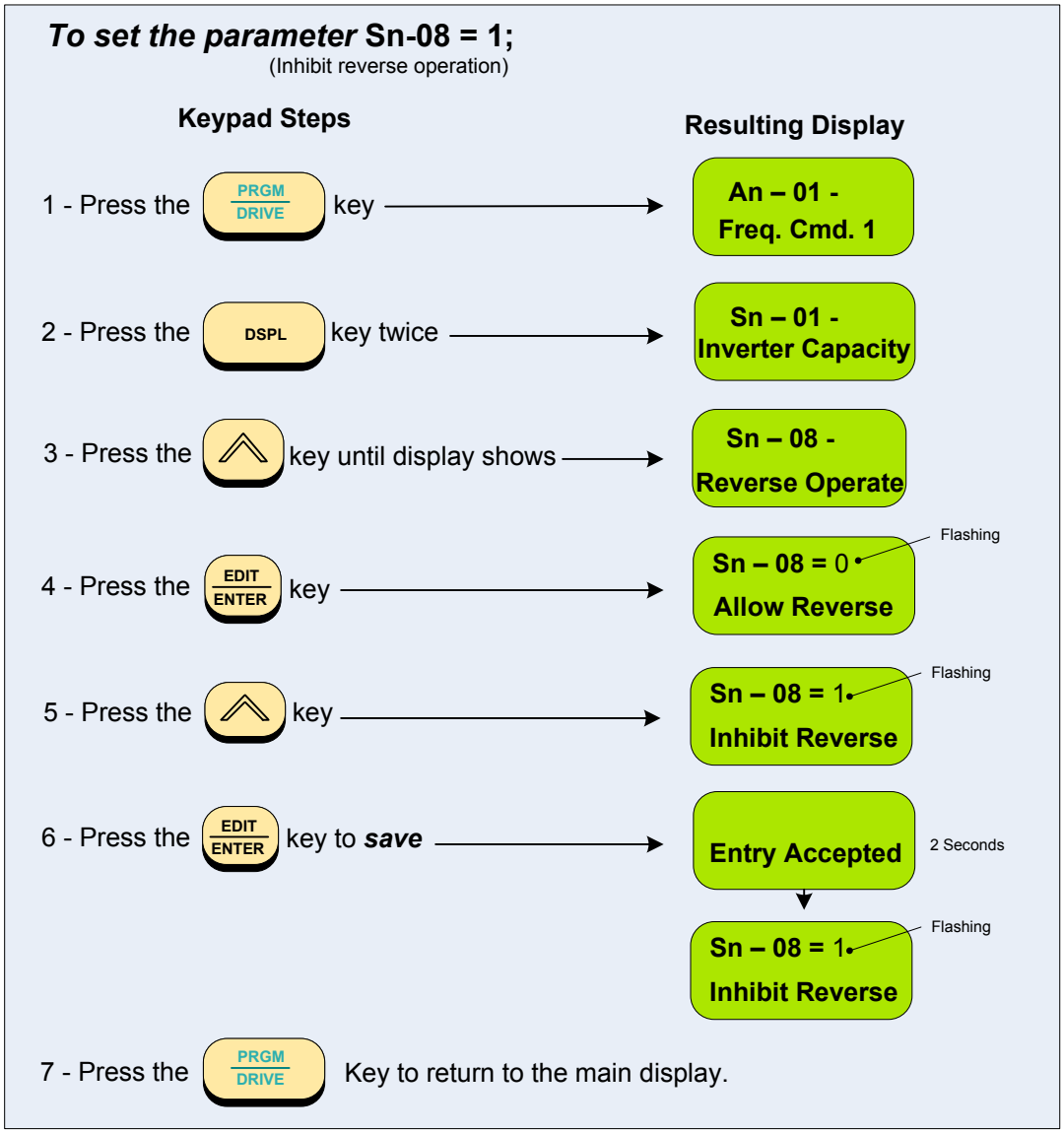
***Step 4* - Check Fan or Pump Motor Operation**

- Enter **10.00Hz** for the frequency reference and set parameter ***Sn-08 = 1*** to disable Reverse Direction operation. ***Note***: *The output from the inverter is displayed in **Hz** as factory default. If desired, the output may be displayed in other **units** such as (%) of full speed, or **engineering** units such as PSI etc.*



NOTES

Cont.



- Press the ***RUN*** key, and check the fan or pump direction of rotation. If the direction is not correct, press the ***STOP*** key and wait until the fan or pump has come to a complete *stop.* Next, *Power Down the inverter.*

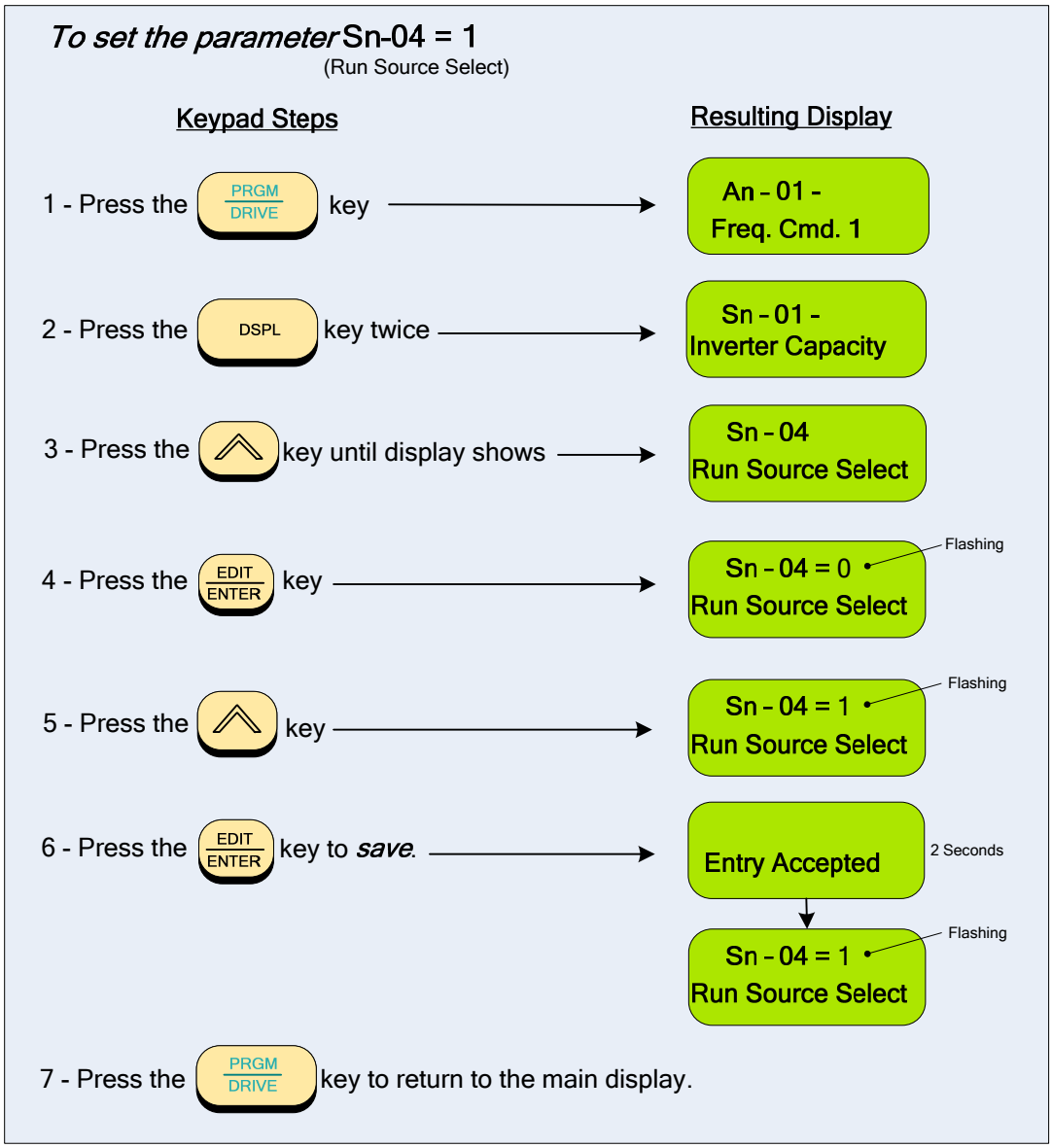
Danger
After the power has been turned OFF, wait at least 5 minutes until the charge indicator extinguishes completely before touching any wiring, circuit boards or components.

- Reverse any ***two*** of the fan or pump motor connections at the inverter (U(T1),V(T2), or W(T3)). Next, following ***STEP 2,*** *Power-up* the inverter; the motor direction should now be correct.

Step 5 **- Start / Stop Control Method**

The start / stop method of control is set by parameter ***(Sn – 04)*** and is initially set to ***= 0 (keypad)*****,** as factory default**.** If *External* contact control is desired then ***power down*** the drive and make the connections to the control terminals following the previous wiring diagram A-2.13.1a or A-2.14.1a. After ***power-up***, set Sn-01 = 1 (External Contact) using the following keypad navigation procedure.

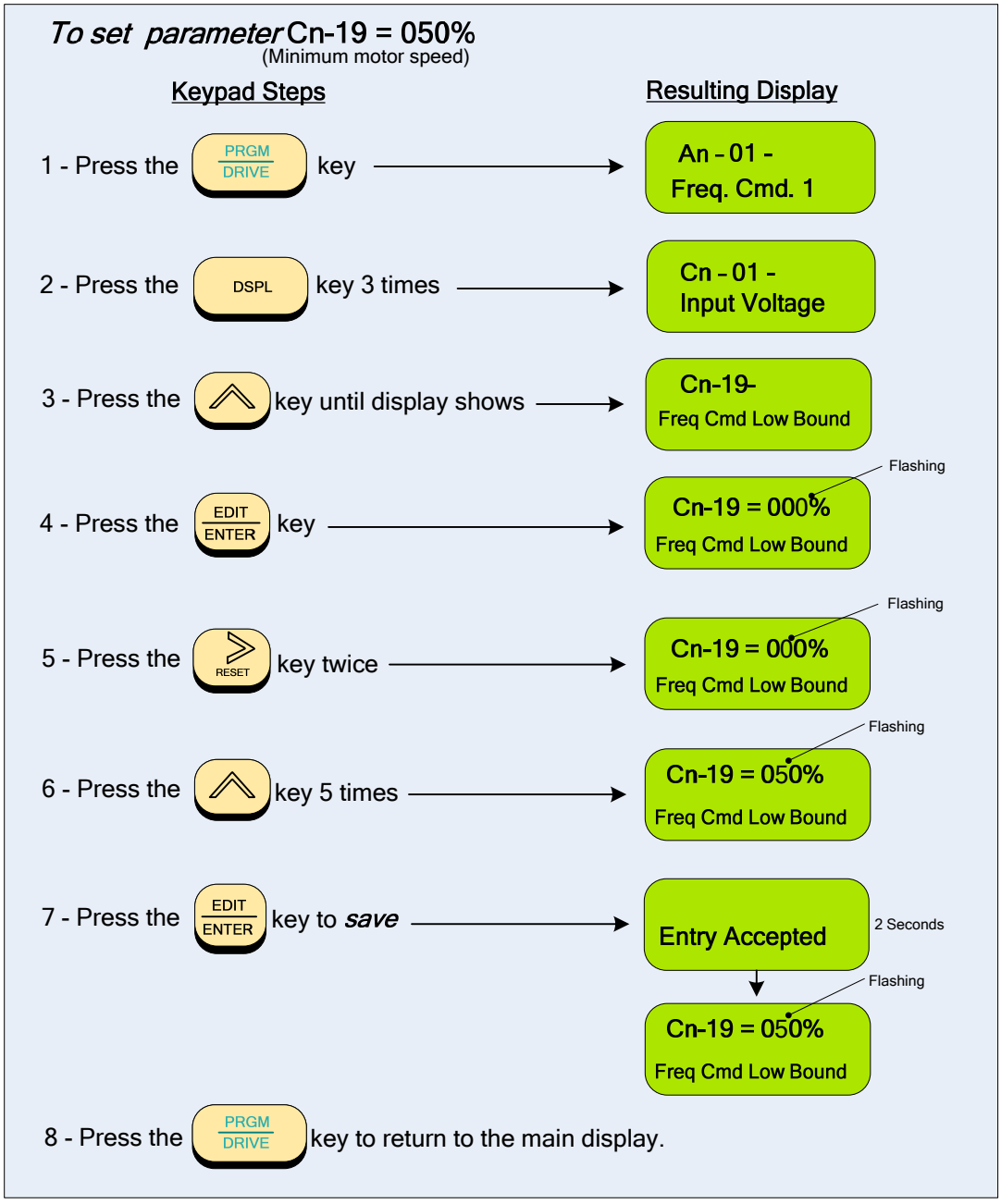
Cont.



***Step 6* – Setting Minimum Speed in Pump Applications**

- In the case of pump applications, it is normally required to limit the minimum speed that the pump will operate regardless of the input speed command. The pump minimum speed is usually specified either by the pump manufacturer or the application. Once this value has been established, the minimum output frequency of the inverter and thus the minimum motor (pump) speed can be set by parameter ***Cn-19.*** This parameter sets the minimum inverter frequency output, and thus a minimum motor (pump) speed to a ***percentage*** of the maximum output command frequency.
- The following is an example of setting the minimum motor (pump) speed to ***1800 RPM,*** which is ***50%*** of the maximum pump speed, ***3600 RPM***.

Cont.



2.7 Setting Up a Simple Main PID Loop

In this section the setting up of a simple PID loop will be covered. The purpose here, is to familiarize the user with the various parameters that are used in the PID set up. The PID method of control covered will consist basically of a ***set-point*** (operating point, e.g. Flow, Pressure etc.) entered through the keypad (*Sn-05=0 Factory Default*) and a 0-10V analog transducer **feedback** signal (Sn-24=0) connected to the control terminals. These two signals are then compared, and through PID processing, correct for any load or environmental changes to maintain the ***set-point***. Only the **(P)** *proportiona*l and **(I)** *integra*l parameters will be set and adjusted through the keypad to optimize performance. The parameter **(D)** *derivative* will not be discussed or used in this guide as the factory setting is usually sufficient for Fan and Pump applications.

Note- Although this PID setup procedure is mainly for Fan and Pump control it can be applied to any PID set-up

Cont.

***Step 1* – Connect a 0-10V Feedback Device**

In this step the external wiring connections will be made for the analog feedback device.

- ***Before removing any covers or making any external control connections, Power Down the inverter.***

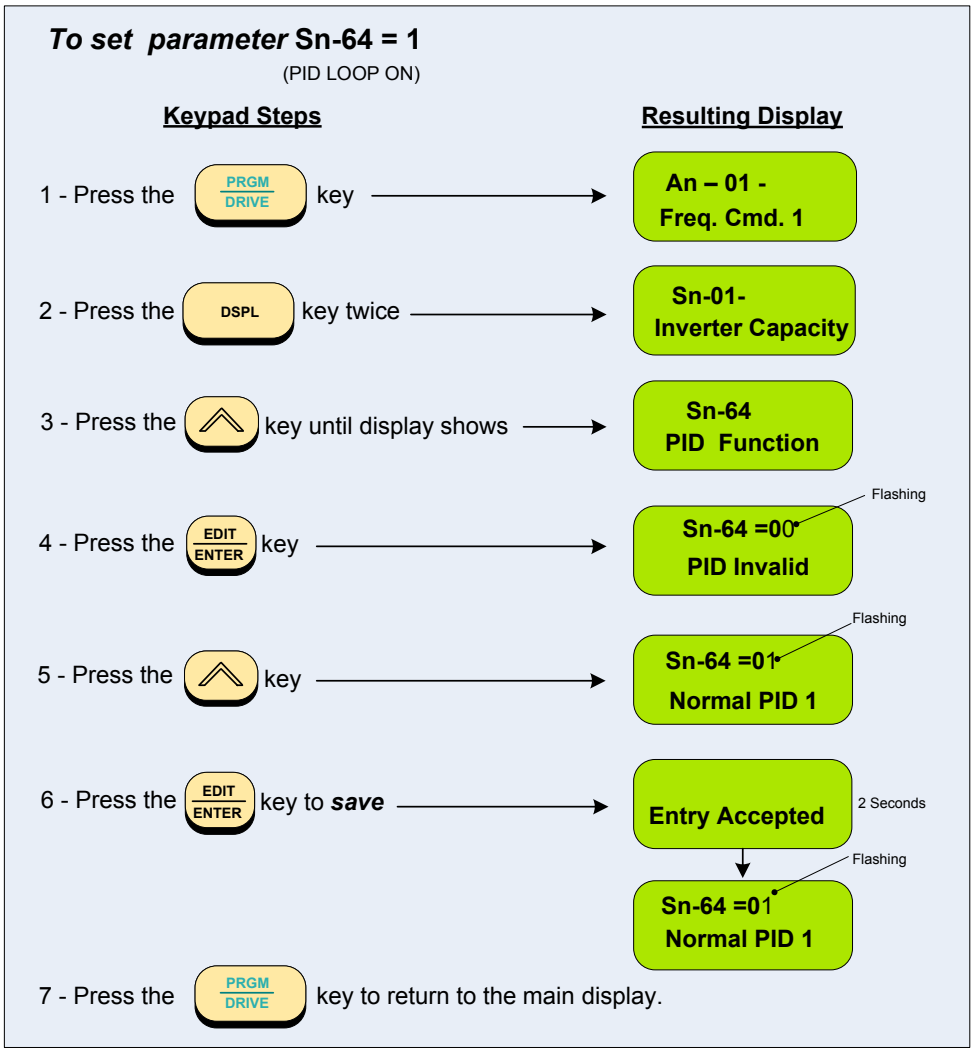
Danger

After the power has been turned OFF, wait at least 5 minutes until the charge indicator extinguishes completely before touching any wiring, circuit boards or components.

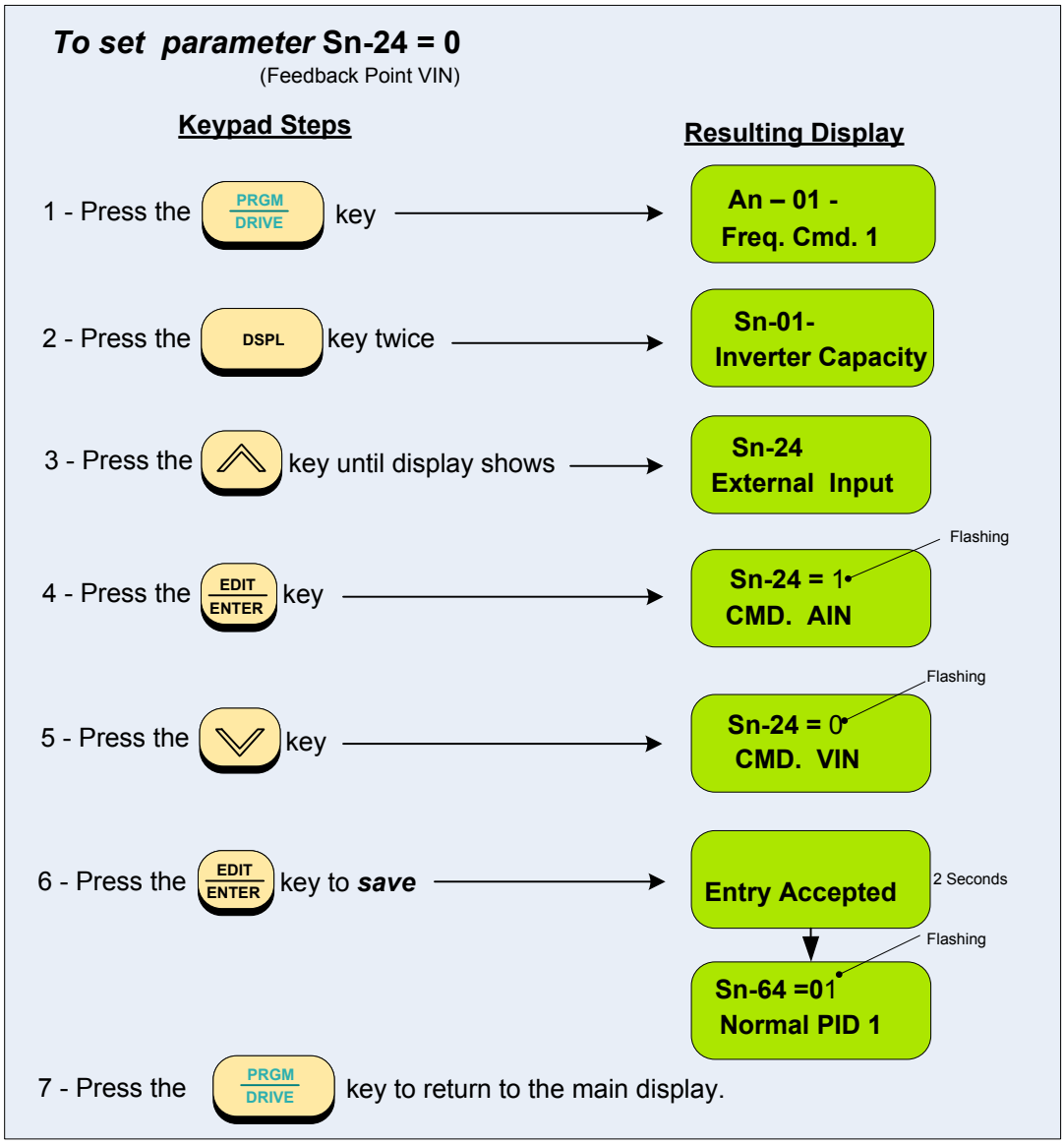
- Remove the cover from the inverter and following the previous analog feedback diagrams 2.4.1a or 2.5.1, make the connections for the feedback device to the control terminals.
- ***Power -up*** the drive and proceed to the next Step.

***Step 2* - Setting up the Main PID control loop, and Feedback input.**

- Before selecting the parameter(s), **ensure the inverter is in the *STOP* mode.**
- To activate the main PID control parameter ***(Sn-64)*** must be set to **1**.
- The Feedback Input parameter ***(Sn –24)*** is set to **1 (AIN, 4-20 mA),** as factory default. To select (**VIN, 0-10 Vdc**), ***(Sn-24)*** must be set to ***0.*** To set the parameter(s), follow the navigation procedure below.



Cont.



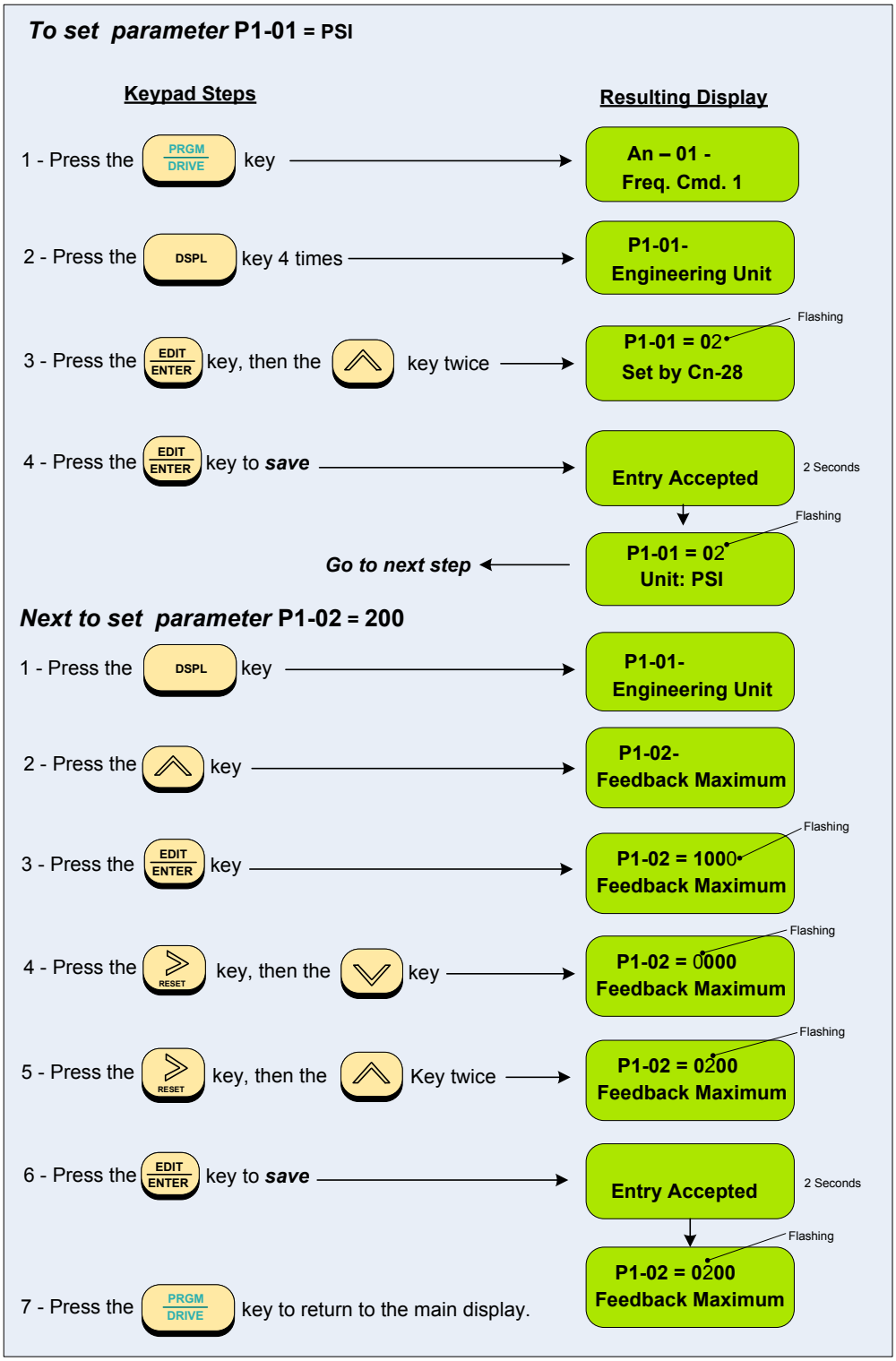
***Step 3* - Select Feedback Engineering Units (P1-01) and Scaling (P1-02)**

- Initially the display will read *output frequency* in *(Hz)* as the *factory default* and is set by parameter **(*Cn-28=0*).** If ***(Cn-28)*** is changed to (***1),*** then the display will read out in ***(%).*** The setting of ***(Cn-28)*** is only ***valid*** if ***(P1-01=0),*** which is the *factory default*. Other engineering units may be selected by parameter setting ***(P1-01)*** as described on the following page.

- In this step, the feedback engineering units that the system is controlling such as *CFM* in Fan applications or *PSI* in the case of Pumps can be selected by parameter ***(P1-01)***. *(See Section 1 for additional selections)*. The *maximum* value that the engineering units will be in any given application is set by parameter ***(P1-02)***. These selections will now be displayed on the digital operator.

Example: A pump application that has a feeedback transducer with a maximum value of 150 PSI i.e. 150 PSI = 10 Vdc, can be set as follows.

Cont.

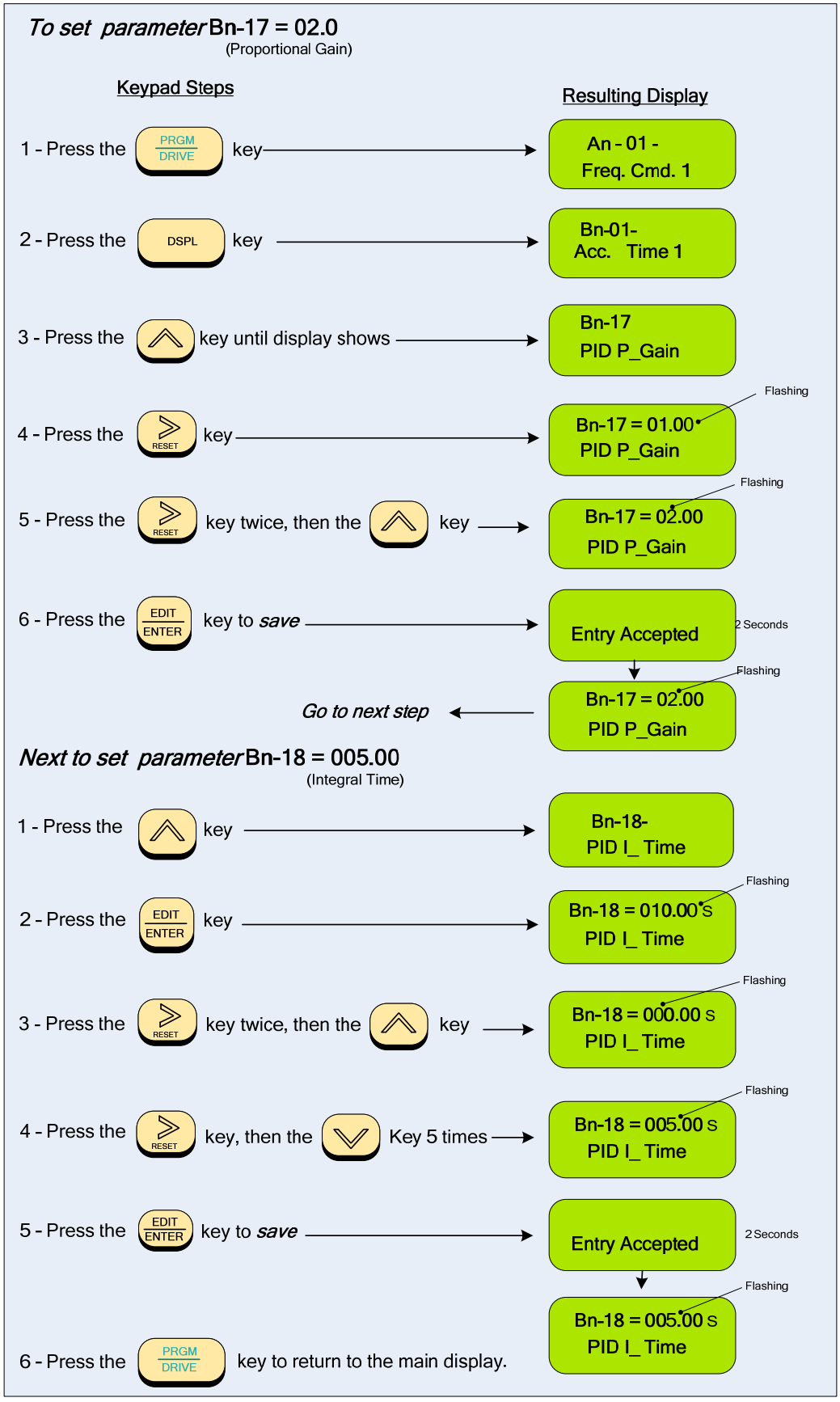


Note: Once P1-01 is set to a non-zero value, then Cn-28 is no longer valid.

***Step 4* – Setting PID Parameters; Proportional Gain (Bn-17) and Integral Time (Bn-18)**

- ***Proportional Gain Bn-17 = 2.0*** and the ***Integral Time Bn-18 = 5.0s***. To change these parameters, follow the keypad navigation procedure on the next page.

Cont.

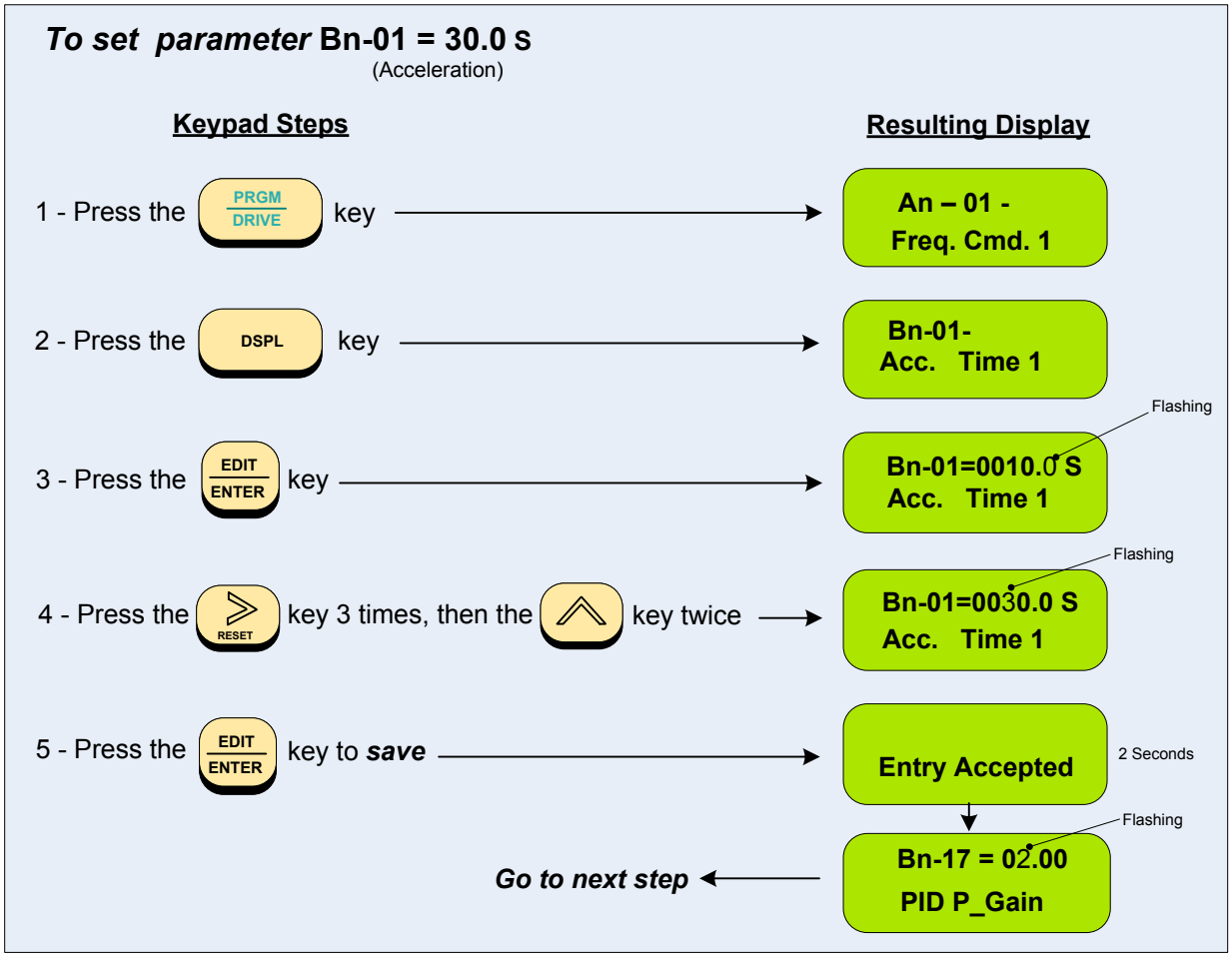

To set parameter Bn-17 = 02.0
(Proportional Gain)
Keypad Steps
Resulting Display
1 - Press the PRGM DRIVE key
An - 01 - Freq. Cmd. 1
2 - Press the DSPL key
Bn-01- Acc. Time 1
3 - Press the key until display shows
Bn-17 PID P_Gain
4 - Press the RESET key
Bn-17 = 01.00 PID P_Gain
Flashing
5 - Press the RESET key twice, then the key
Bn-17 = 02.00 PID P_Gain
Flashing
6 - Press the EDIT ENTER key to save
Entry Accepted
2 Seconds
Go to next step
Bn-17 = 02.00 PID P_Gain
Flashing
Next to set parameter Bn-18 = 005.00
(Integral Time)
1 - Press the key
Bn-18- PID I_ Time
2 - Press the EDIT ENTER key
Bn-18 = 010.00 S PID I_ Time
3 - Press the RESET key twice, then the key
Bn-18 = 000.00 S PID I_ Time
4 - Press the RESET key, then the Key 5 times
Bn-18 = 005.00 S PID I_ Time
5 - Press the EDIT ENTER key to save
Entry Accepted
2 Seconds
6 - Press the PRGM DRIVE key to return to the main display.
Bn-18 = 005.00 S PID I_ Time

***Step 5* – Setting Parameters Acceleration (Bn-01) and Deceleration (Bn-02) Times**

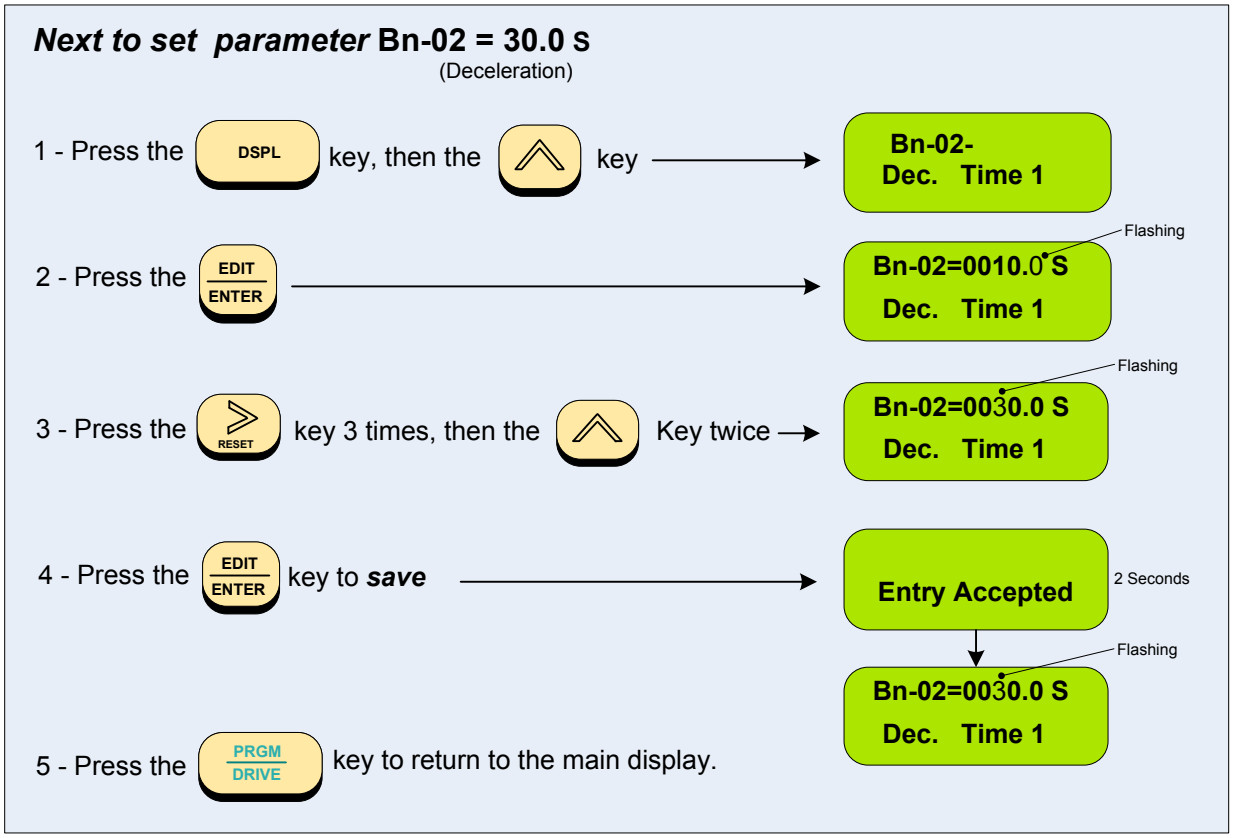
- *Acceleration* and *Deceleration* times as well as the PID control [(*P) Proportional Gain* and/or the *(I) Integral Time (See STEP 10)* directly control the system dynamic response. In general, the longer the acceleration and deceleration time, the slower the system response, and the shorter time, the faster the response. An excessive amount of time can result in sluggish system performance while too short of a time may result in system instability.

  The starting values suggested by this guide normally result in good system performance for the majority of Fan and Pump applications. If the values need to be adjusted, caution should be exercised, and the changes should be in small increments to avoid system instability.

- Parameters ***Bn-01*** *(Acceleration)* and ***Bn-02*** *(Deceleration)* are ***both*** set at the factory for ***10.0 seconds.*** For Fan and Pump applications, the recommended starting values are ***30 seconds.*** To change these parameters, follow the keypad navigation procedure below.



Cont.



***Step 6* – Setting PID Sleep Function Parameters (P1-04), (P2-01), (P2-02), (P2-03) and (P2-04).**
(NOTE: In the case of a Fan application skip this step and go to Step7)

- The *PID Sleep* function is turned on by parameter ***(P1-04)*** when set to ***(=1)***. This allows the system to *turn off* the PID and thus the inverter output so that the pump does not run when the system level (PSI) is above the set-point. This *sleep start level* is set by parameter ***(P2-01)*** in a range from 0 – 100% of the maximum inverter output. When the system level drops below a value *(the units are selected by **Step 9**)* set by parameter ***(P2-03),*** the *sleep wakeup level,* the output of the inverter will turn on. Parameters ***(P2-02)*** and ***(P2-04)*** provide delay times in *seconds* for *sleep start level* and *sleep wakeup level* respectively. Fig. 2.7.1 below will serve to illustrate this.

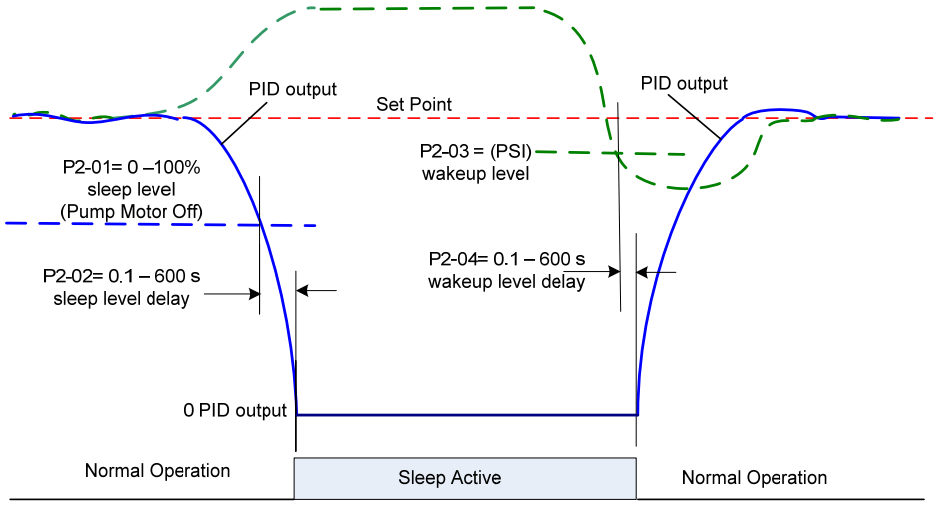
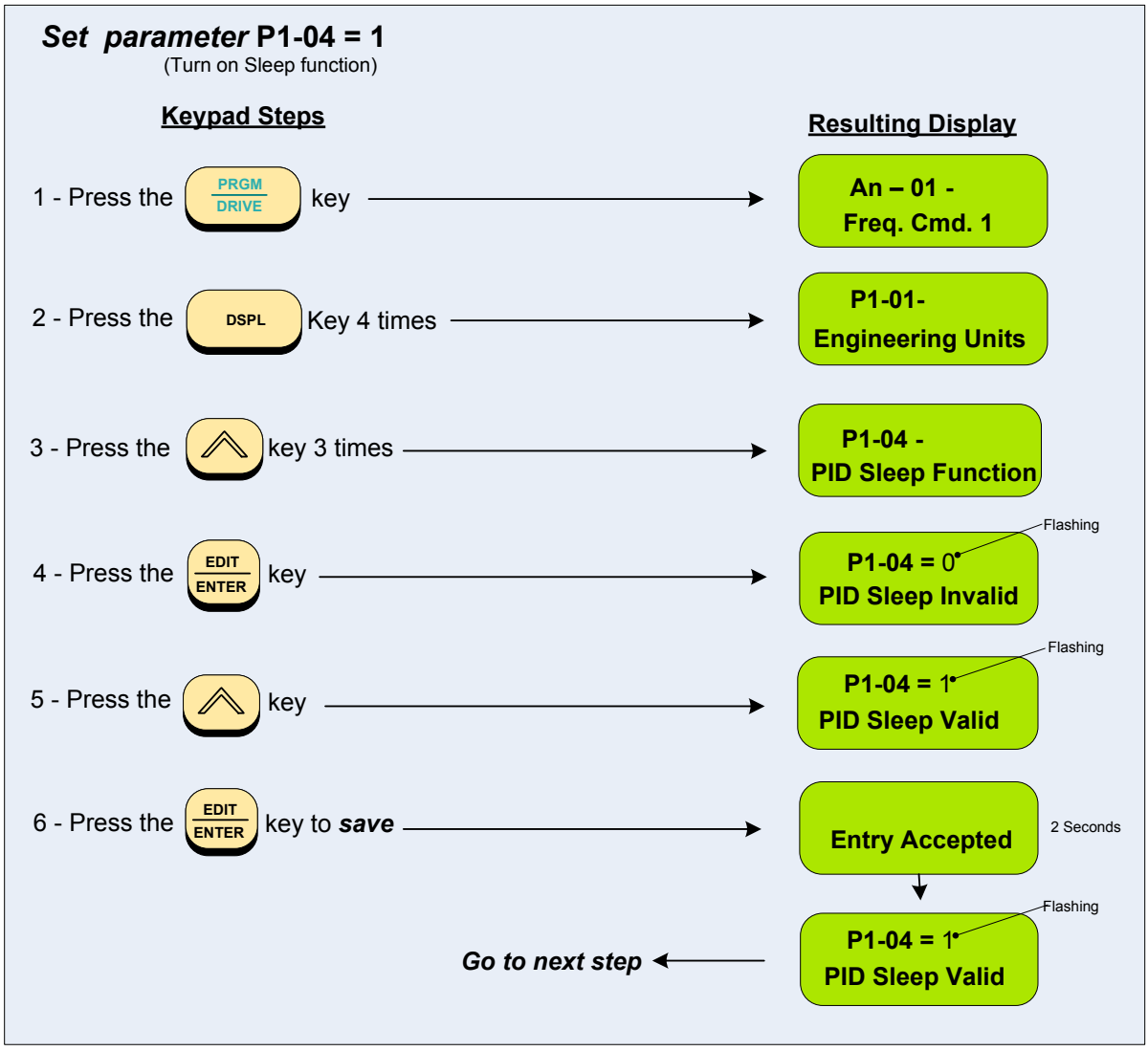


Fig. 2.7.1 PID Sleep Function

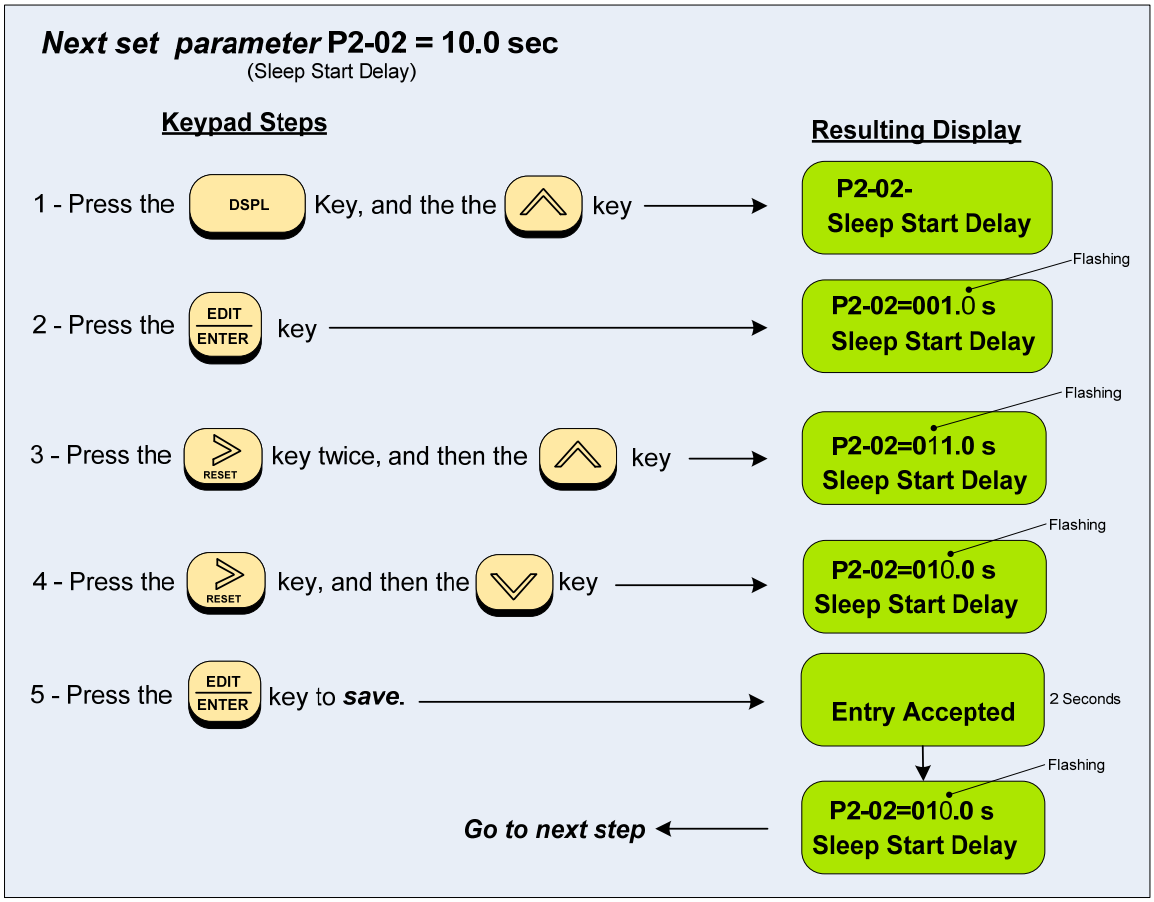
Cont.

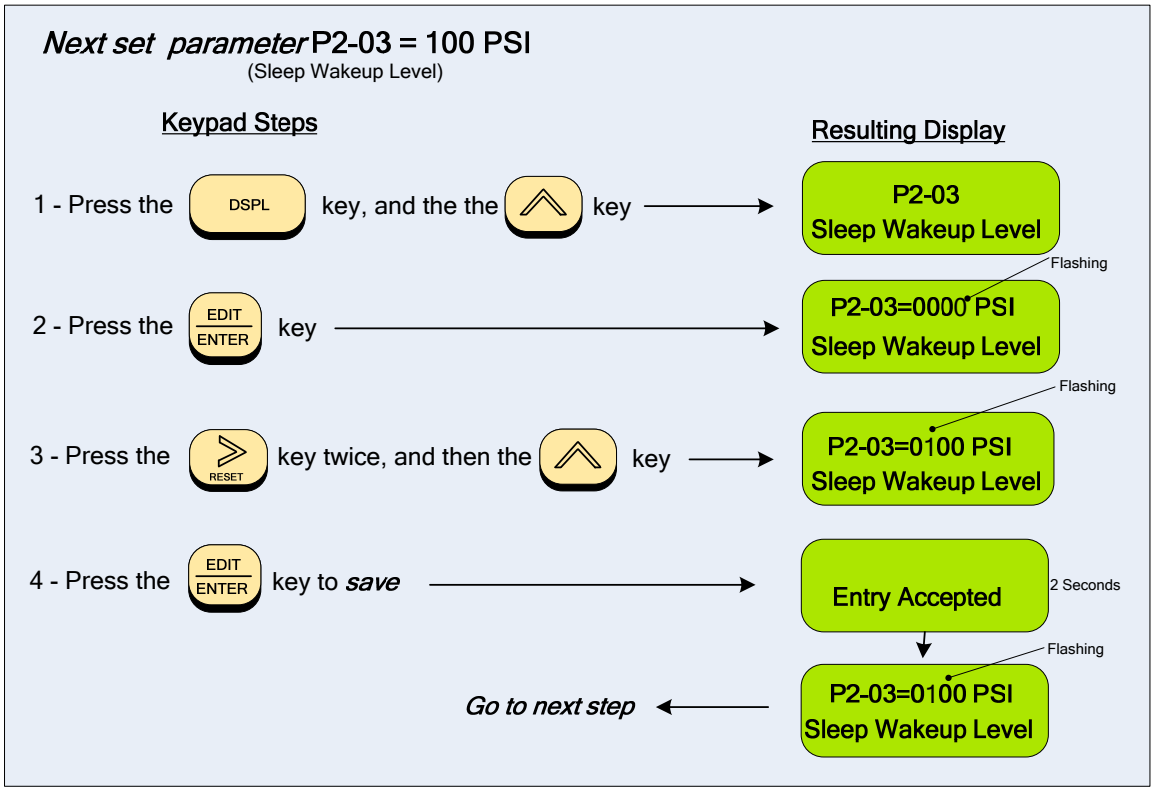
- To further cover the PID Sleep function, the following is an example of the various parameter settings that could be used. In this example the system will have the following specifications:
  - Max. Pump Motor Speed: 3600 RPM.
  - Set Point: 150 PSI.
  - Feedback Transducer Range: 0 – 200 PSI.
  - Pump System Sleep Level: 2160RPM or *60%* of max. speed set by ***(P2-01=060.00).***
    Sleep Level Delay Time: 10 sec. set by ***(P2-02=010.0).***
  - Pump System Wakeup Level: 100 PSI set by ***(P2-03=0100).***
    Wakeup Time: 5 sec. set by ***(P2-04=005.0).***

- Referring to ***Step 3,*** set the engineering units to *PSI* (***P1-01=02)*** and then the range to 200 ***(P1-02=0200).***
- The following shows the keypad navigation sequence in setting the PID parameters.
  NOTE: The inverter must be in the Stop mode in order to turn on the sleep function.

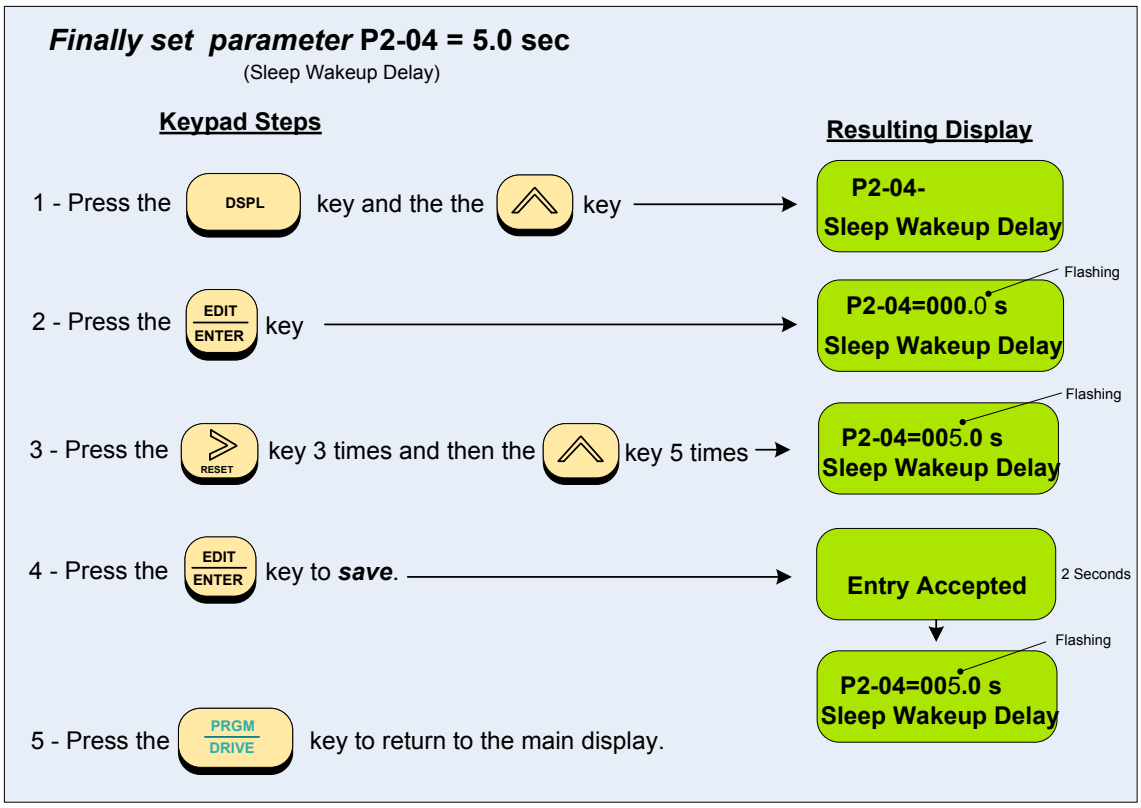


Cont.


Next set parameter P2-02 = 10.0 sec
(Sleep Start Delay)
Keypad Steps
Resulting Display
1 - Press the DSPL Key, and the the key
P2-02-
Sleep Start Delay
2 - Press the EDIT ENTER key
Flashing
P2-02=001.0 s
Sleep Start Delay
3 - Press the RESET key twice, and then the key
Flashing
P2-02=011.0 s
Sleep Start Delay
4 - Press the RESET key, and then the key
Flashing
P2-02=010.0 s
Sleep Start Delay
5 - Press the EDIT ENTER key to save.
Entry Accepted
2 Seconds
Flashing
P2-02=010.0 s
Sleep Start Delay
Go to next step


Next set parameter P2-03 = 100 PSI
(Sleep Wakeup Level)
Keypad Steps
Resulting Display
1 - Press the DSPL key, and the the key
P2-03
Sleep Wakeup Level
2 - Press the EDIT ENTER key
Flashing
P2-03=0000 PSI
Sleep Wakeup Level
3 - Press the RESET key twice, and then the key
Flashing
P2-03=0100 PSI
Sleep Wakeup Level
4 - Press the EDIT ENTER key to save
Entry Accepted
2 Seconds
Flashing
P2-03=0100 PSI
Sleep Wakeup Level
Go to next step

Cont.



***Step 7* – Testing The System**

- The system can now be tested for performance. To do this, set the ***set-point*** through the keypad and run the drive at some low level and check that the motor is operating properly and that the ***feedback*** signal level and polarity are correct.
- Check the system for dynamic operation and make any adjustments necessary for optimum performance. This may require making adjustments to parameters ***Bn-17 proportional gain*** and ***Bn-18 Integral Time. (Refer to Step 4)***

NOTE: Parameters Bn-17 and Bn-18 may be changed through the keypad while the system is operating.

A word of CAUTION ! - The parameter changes should be made in small increments and the results checked to avoid highly unstable and possibly damaging conditions.

- This should complete the example installation of a system with a PID loop.

Warranty

All Low Voltage Motor Control Products, such as Solid State Starters and Inverters, ("products") sold by TECO-Westinghouse Motors Company ("TWMC"), are warranted to be free from defects in material and workmanship for a period of 24 months from the date of shipment. A warranty of 36 months from the date of manufacture is applicable when a TWMC Low Voltage Motor Control Product and a TWMC Inverter Duty motor (per NEMA MG1-31.4.2.2) are purchased together.

This warranty is conditioned upon the installation, operation, and maintenance of the products in accordance with TWMC's recommendations or standard industry practice, and that the products have at all times been operated or used under the normal operating conditions for which they were designed. This warranty will not be applicable to products that have been altered without prior written permission from TWMC.

TWMC shall, at its sole option and expense, repair or replace, F.O.B. warehouse or TWMC designated service center, any such products, which are defective within the warranty period. In the event of warranty claims, TWMC must be notified promptly following any product failure. The product shall be sent to a TWMC authorized service center for diagnosis of the cause of failure. TWMC will not be responsible for any repair that has been performed without prior written permission from TWMC.

The repair or replacement of defective material and workmanship shall constitute complete fulfillment of TWMC's warranty liability, whether the warranty claims are based on contract, tort (including negligence and strict liability), or otherwise. **THERE ARE NO OTHER WARRANTIES, EXPRESS OR IMPLIED, INCLUDING ANY IMPLIED WARRANTY OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE, AND ALL WARRANTIES ARISING FROM COURSE OF DEALING AND USAGE OF TRADE. UNDER NO CIRCUMSTANCES, SHALL TWMC BE LIABLE FOR ANY SPECIAL, INDIRECT, INCIDENTAL OR CONSEQUENTIAL DAMAGES, INCLUDING FREIGHT.**

Warranty Return Procedure

The Product must be returned prepaid to TECO-Westinghouse Motor Company factory. A completed Return Material Authorization (RMA) form with an assigned RMA number must be included in the shipment. Contact the nearest TECO-Westinghouse location or Factory directly for RMA forms.

TECO Westinghouse

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