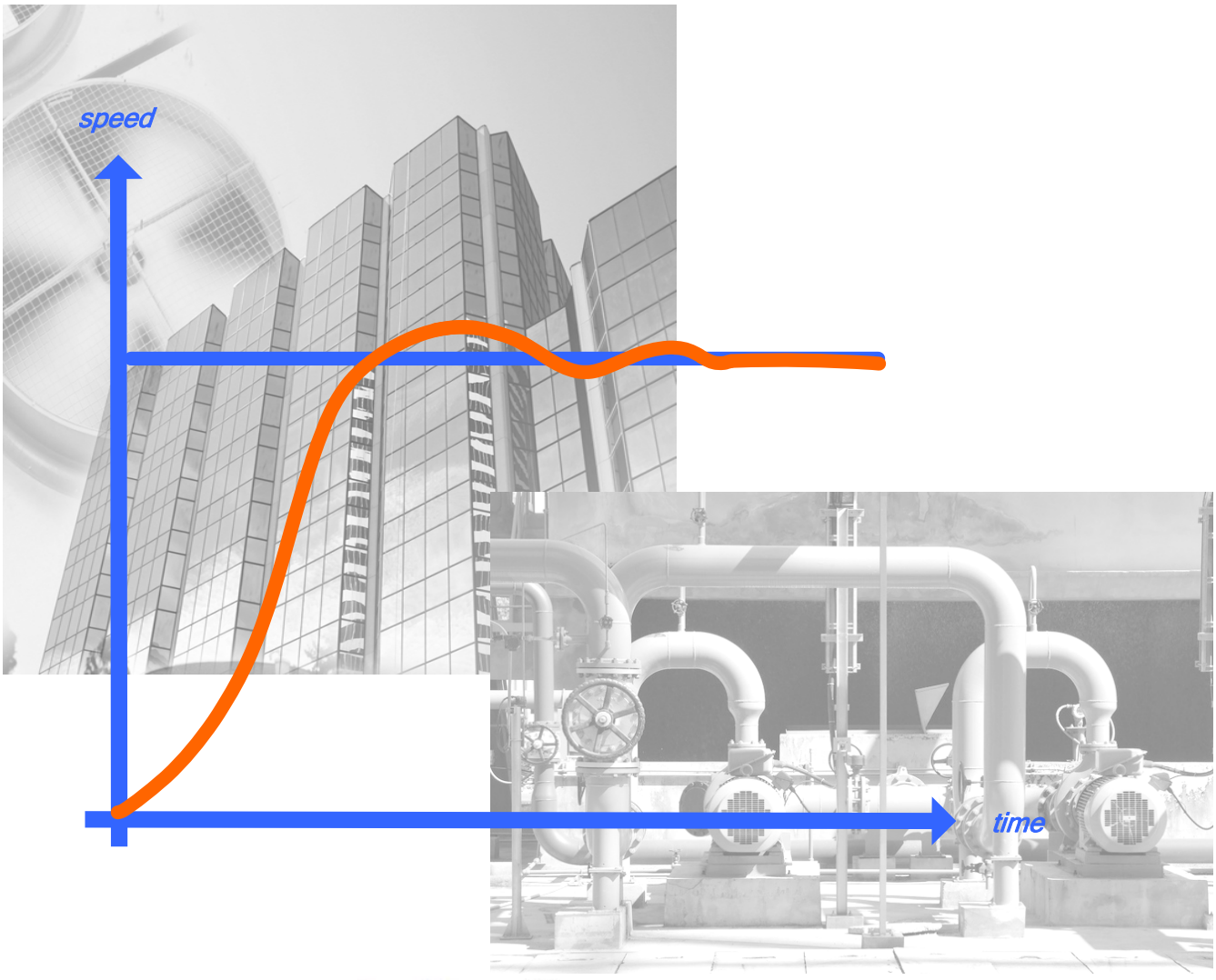
MA7200 PLUS INVERTER SERIES Supplement

For Fan and Pump Applications



TECO Westinghouse

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NOTES

MA7200 PLUS Parameters for Fan and Pump Applications

Introduction

This supplement is used in conjunction with the MA7200 Manual and describes the parameters that were added mainly for fan and pump applications. All of the features and modes of operation, such as vector, CT and PG feedback for the MA7200 remain unchanged.

The following features are provided by the MA7200 PLUS Inverter Series.

- ***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).
- ***External PID Function*** (Using terminal AO1 or AO2 as output).
- ***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 in this supplement. 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. The main PID loop is used for applications directly affecting the operation of the inverter with the motor. The external PID loop, which is a new feature of the MA7200 PLUS, is available to control a non drive function. An example of an external PID loop may be a temperature controller that needs to regulate temperature in a particular process independently from the main drive and motor functions. Note that some of the control inputs and parameters when used by the main PID loop are not available for the external PID loop. This will be covered more in detail in Section 2.

Sections 3, 4, and 5 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 supplement.

Section 6 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 7, 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 1 and 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 guide. However, Modbus addresses are given for the parameters in Sections 1 and 2. For further information on serial communication control or special external control, the user is referred to the MA7200 Installation and Operating Manual.

Section 1 - P parameters (P1 thru P5) and Engineering Unit Selection Summary.

Table 1 summarizes the P parameters and will be explained more in detail in the next section.
Table 2 summarizes the Engineering Units that can be used and displayed.

Table 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

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
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 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.

Table 2 - 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

Section 2 - 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 supplement, the user can refer to the MA7200 Drive manual for further detailed information on the other parameters covered.

2.1 - 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

Note 1 - The table at the end of this section 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.

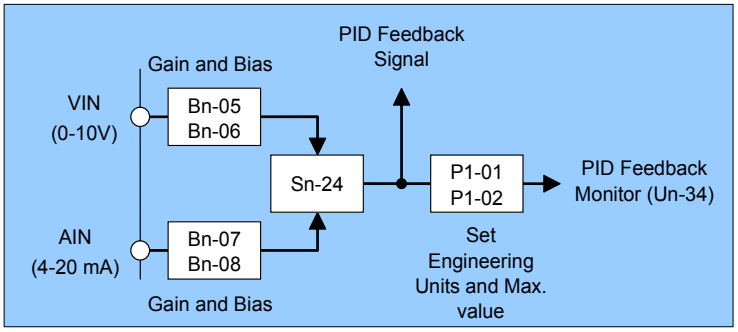
- P1-01Engineering Unit is used to setup engineering units for normal and PID operation. It also sets the display format and maximum value of the following parameters.
  1 - Set point frequency command (An)
  2 - The parameters for the engineering units.
  3 - PID feedback monitor point Un-34.
- When P1-01 is set to 00, parameter Cn-28 can be used to set the display format of the frequency commands (see MA7200 Drive manual for more details). When P1-01 is set to a value of 01 to 25, parameter Cn-28 is ineffective.
- The following table shows the display format and maximum value according to the setting of P1-01.

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 diagram below)



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

2.2 - Programmable Local/Remote Switch

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. 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

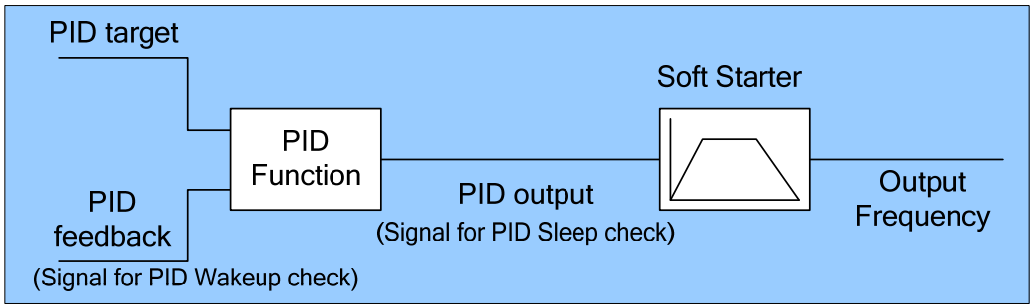
- When P1-03 is enabled, the inverter is in remote mode after power-on and the Local / Remote switch is effective only when the inverter is in stop mode.
- Generally, the local / remote switch is used when Sn-04 and Sn-05 = 0 at the same time (*either the RUN source or Frequency source is controlled 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).

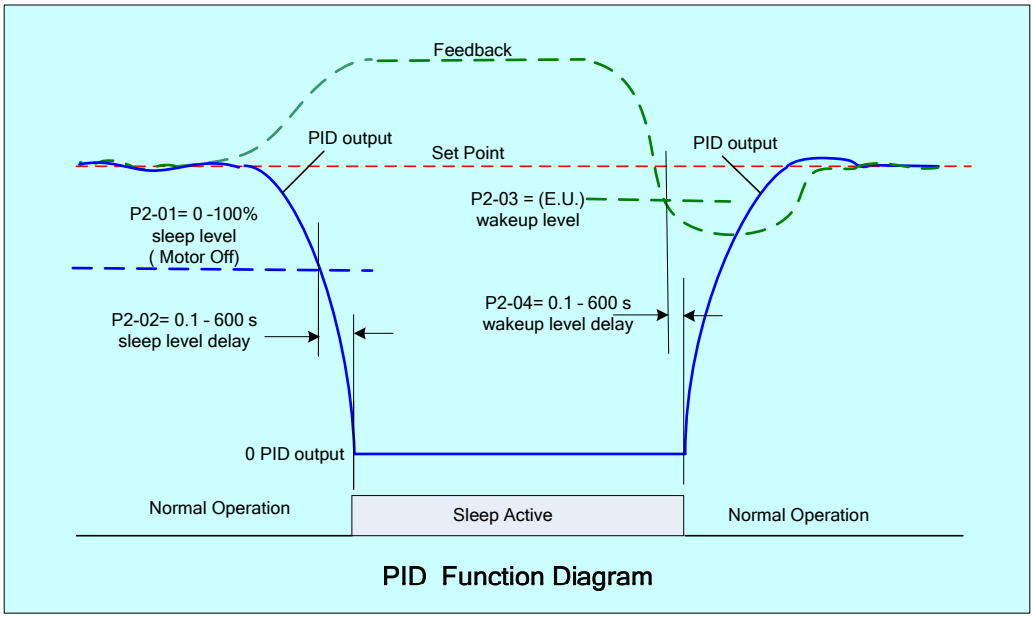
2.3 - PID Sleep Function

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

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
-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.
- Below is a block diagram and graph illustrating the PID sleep function.





PID Function Diagram

- 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.

2.4 - External PID Function (Input and Output Terminal)

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.

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 serve to further illustrate the terminals that are available to the external PID loop under the conditions specified.

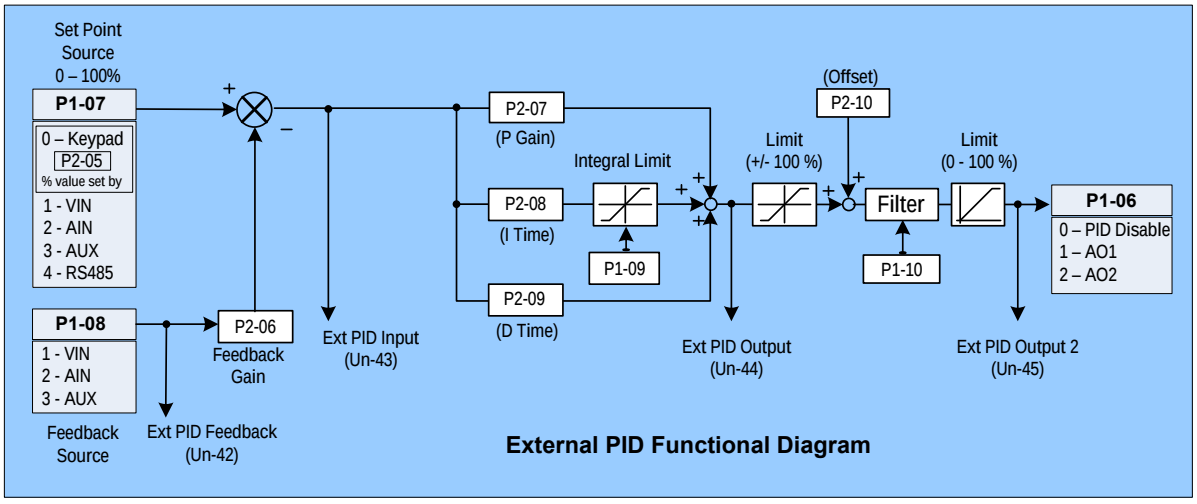
Terminals available for external PID while (main) PID is *DISABLED* (Sn-64 = 0)				
Sn-05 Setting	*Sn-24 Setting*	*Sn-29 Setting*	*Terminals Available to Ext. PID*	*Comment*
1	0	0	AIN, AUX	VIN (0-10V) is used as the Frequency command
	1		VIN, AUX	AIN (0/4-20mA) is used as the Frequency command
	2 or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

2.5 - External PID Function (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
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			



External PID Functional 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).
- 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.

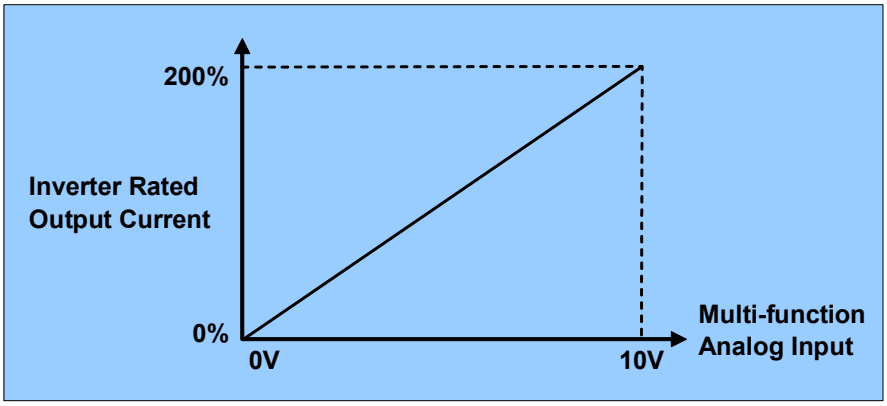
2.6 - Load Loss Detection Function

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.

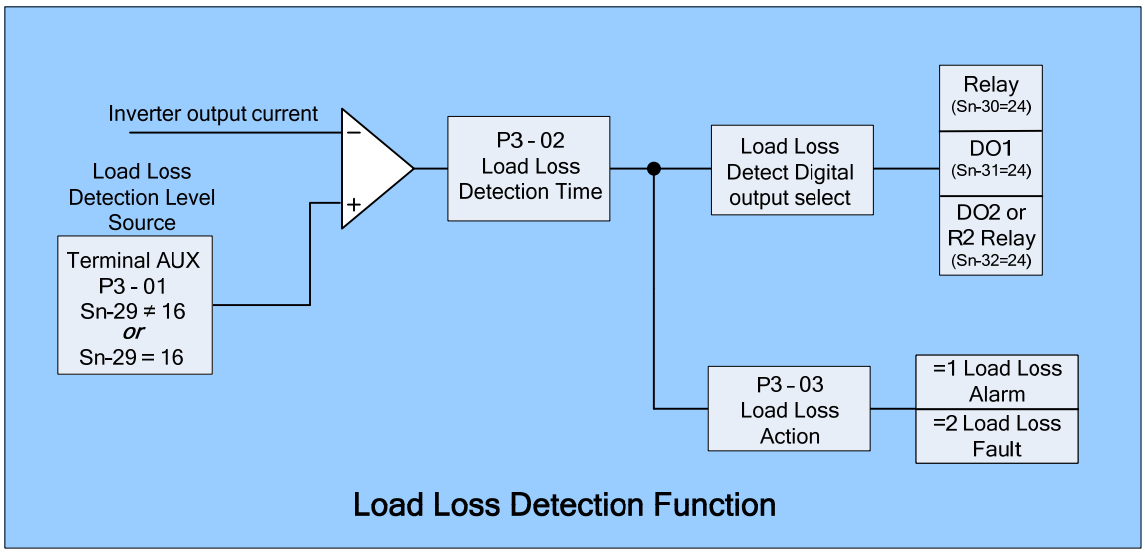
- P3-01 Load Loss Detect Level is set as a percentage of inverter rated current. When Sn-29 = 16, the Load Loss Detect Level is determined by the voltage applied to the AUX input terminal as shown below.

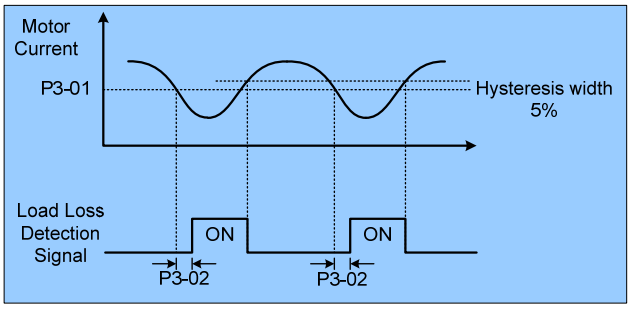


- When the inverter output current falls below the Load Loss Detect Level for a time exceeding the programmed Load Loss Detect Time P3-02, the inverter status will be as set by parameter P3-03 Load Loss Action as shown in the following table. Also, if any of the Multi-Function Outputs Sn-30 (Relay),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

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 a block diagram and graph illustrating the Load Loss Detection Function.





2.7 - Over Feedback Function for PID Feedback Signal

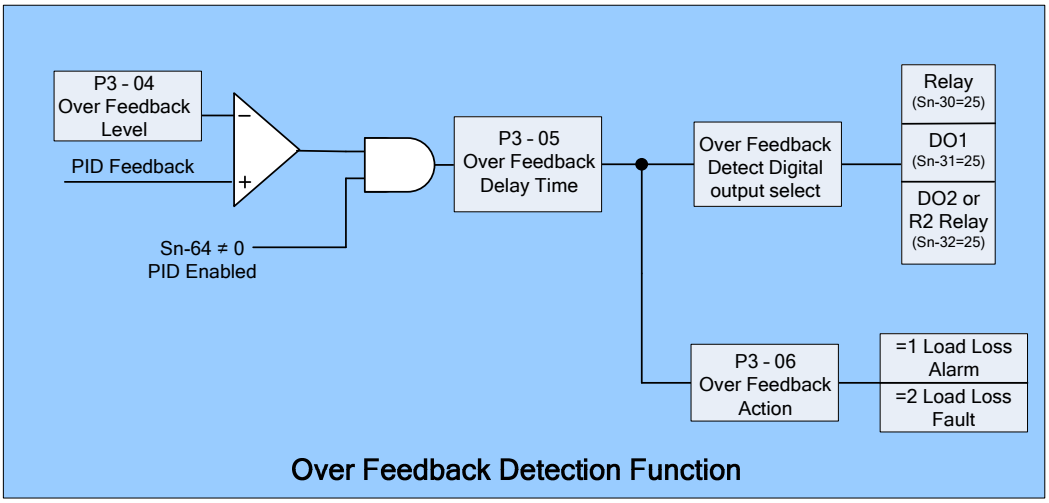
Parameter No.	LCD Display	Setting Range	Factory Setting	Change During Operation	Modbus Address
P3-04	P3-04 Over Feedback Level	*000.00 - 099.99%	000.00%	NO	0x0803
P3-05	P3-05 Over Fbk. Delay Time	0000.0 - 6000.0s	0003.0s	NO	0x0804
P3-06	P3-06 Over Fbk. Action	0: None 1: Over Feedback Alarm 2: Over Feedback 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. 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.

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

- Below a block diagram illustrating the Over Feedback Detection Function.



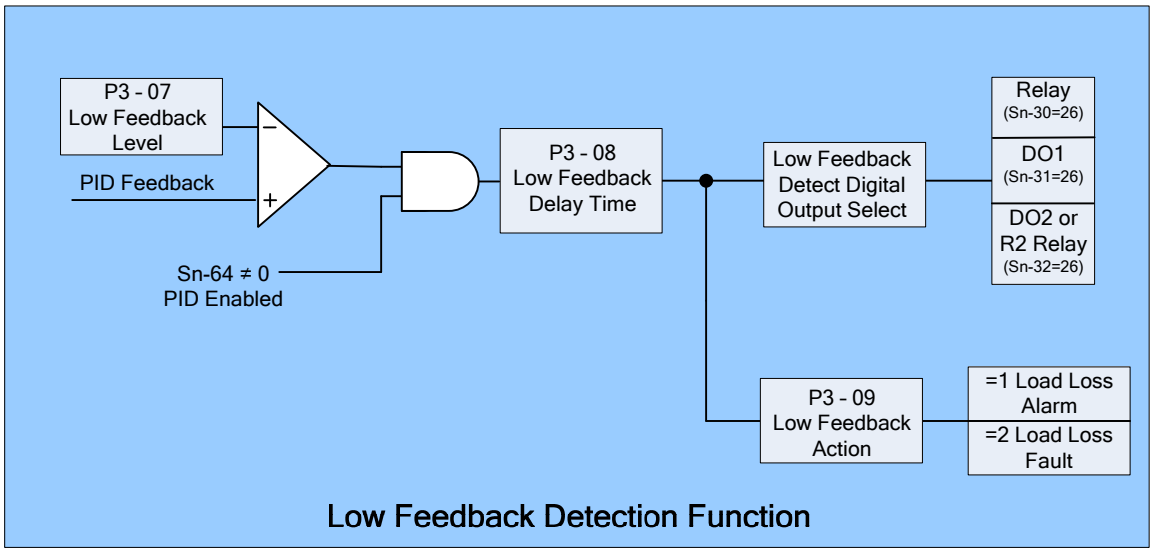
Over Feedback Detection Function

2.8 - Low Feedback Function for PID Feedback Signal

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			

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

- Below is a diagram of the Low Feedback Detection Function.



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. 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.

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

2.9 - Low Suction Detection Function

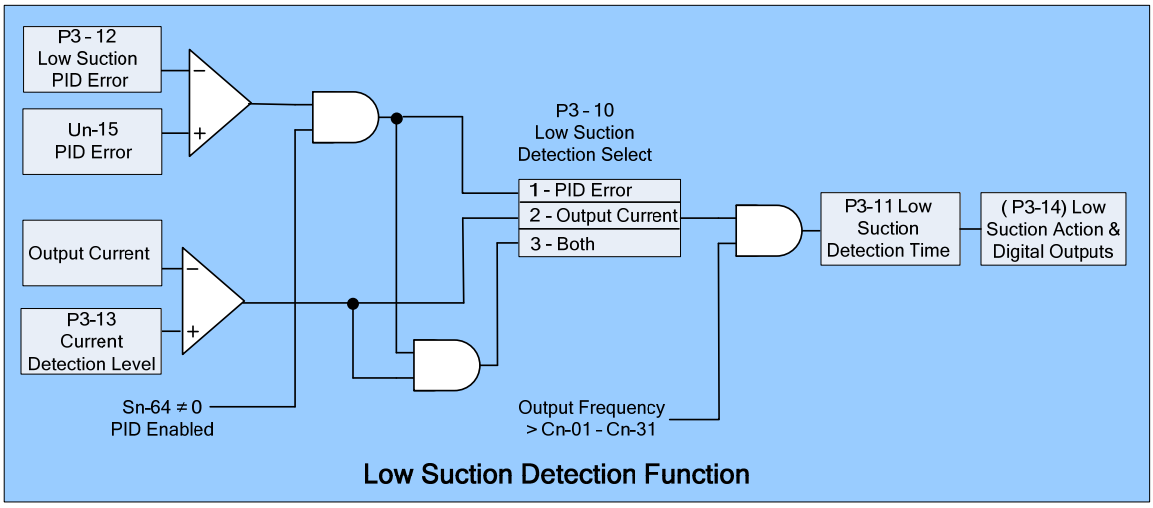
Parameter No.	LCD Display	Setting Range	Factory Setting	Change During Operation	Modbus Address
P3-10	P3-10 Low Suction Detect	1: PID Error 2: Current 3: Error and Current	1	NO	0x0809
P3-11	P3-11 Low Suc. Det. Time	000 - 300s	100s	NO	0x080A
P3-12	P3-12 Low Suc. PID Error	01 - 30%	10%	NO	0x080B
P3-13	P3-13 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			

- 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 Detect is used to select which signal is used for low suction detection as shown in the following table.

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.

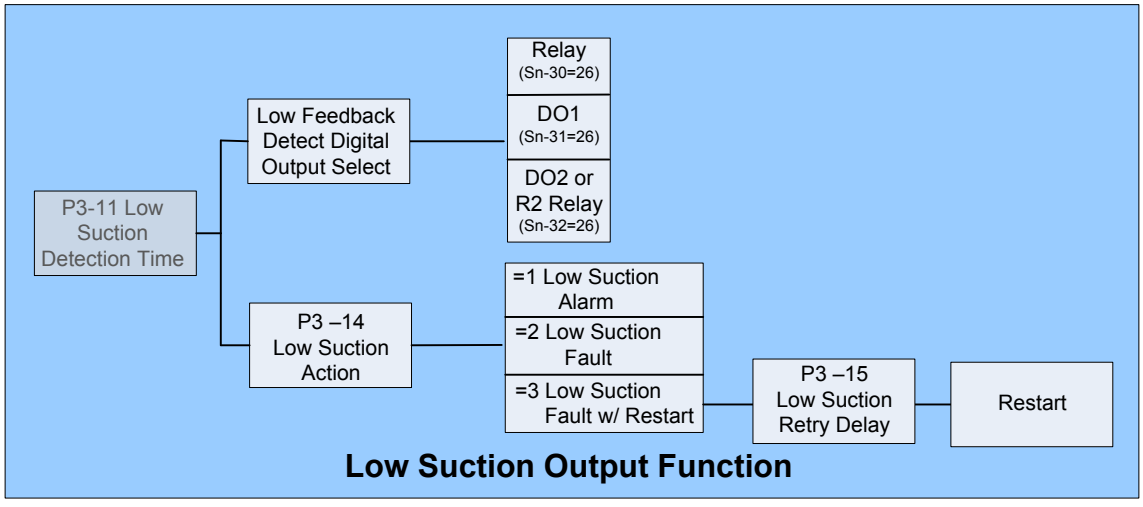
- In order to generate a Low Suction Detection output, the following conditions must be satisfied for the time specified by P3-11Low Suction Det. Time.
  1. Sn-64 ≠ 0 (PID is enabled) and the Un-15 PID Input (PID Error) is higher than P3-12 Low Suc. PID Error set level.
  2. The output frequency is > Cn-01 (Max. Output Frequency) - Cn-31(Frequency Agree Detection Width)



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 table.

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)



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

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.

2.10- Flow Meter Display

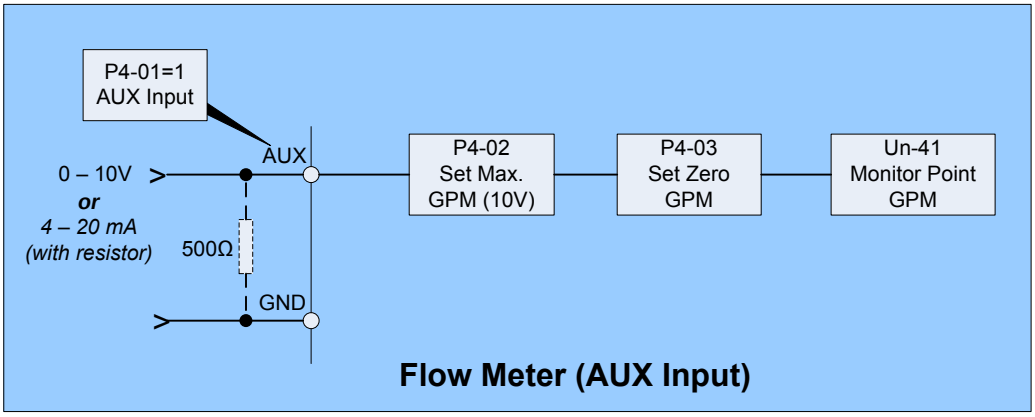
Parameter No.	LCD Display	Setting Range	Factory Setting	Change During Operation	Modbus Address
P4-01	P4-01 Flow Meter Function	0: None 1: Aux Input 2: Pulse Train Input	0	NO	0x0880
P4-02	P4-02 Max Flow for 10V AUX	00000 – 50000 GPM	01000 GPM	NO	0x0881
P4-03	P4-03 No Flow point for AUX	0.0 - 5.0V	0.0V	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 shows the P4-01 function and the parameters used with selection 1 or 2.

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)

- 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.
- Below is a diagram of the flow meter function when Flow Meter Selection P4-01 is set to =1 (AUX input).



Flow Meter (AUX Input)

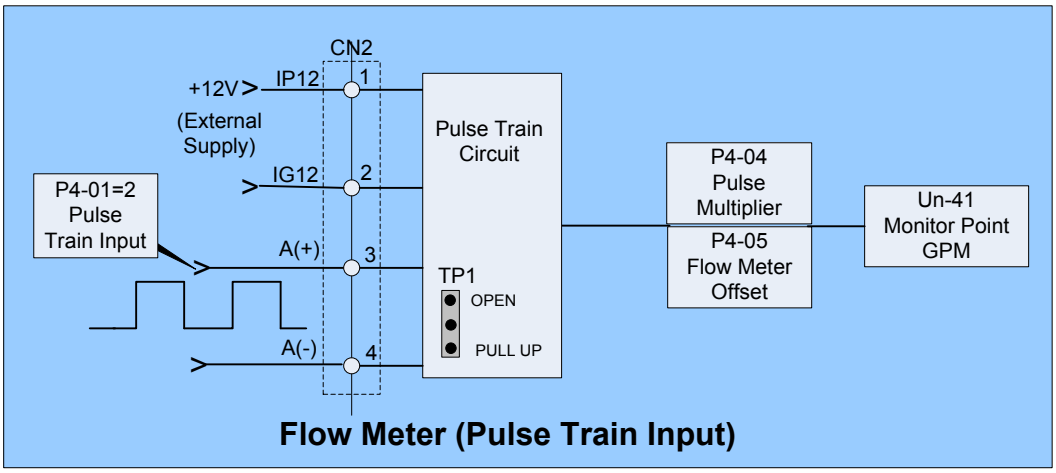
- When P4-01 is set to =1(AUX Input), the Flow Meter signal is input to terminal AUX and parameters P4-02 (Max Flow for 10V AUX) and P4-03 (AUX for No Flow) are used to set flow meter functions. Also, the parameters below will be set automatically.
  1. Parameters P4-04 and P4-05.
  2. AUX Function Selection (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 max. flow would be as set in the previous example by P4-02.

- Below is a diagram of the flow meter function while Flow Meter Selection P4-01 is set to 2 (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.
- 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.

2.11 - 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)

Section 3 - MA7200 PLUS Block Diagrams

Fig. 3.1 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 guide to give the user the ability to successfully start up a Fan or Pump application. More detailed information is available in the **MA7200 PLUS Manual** to which the user may refer.

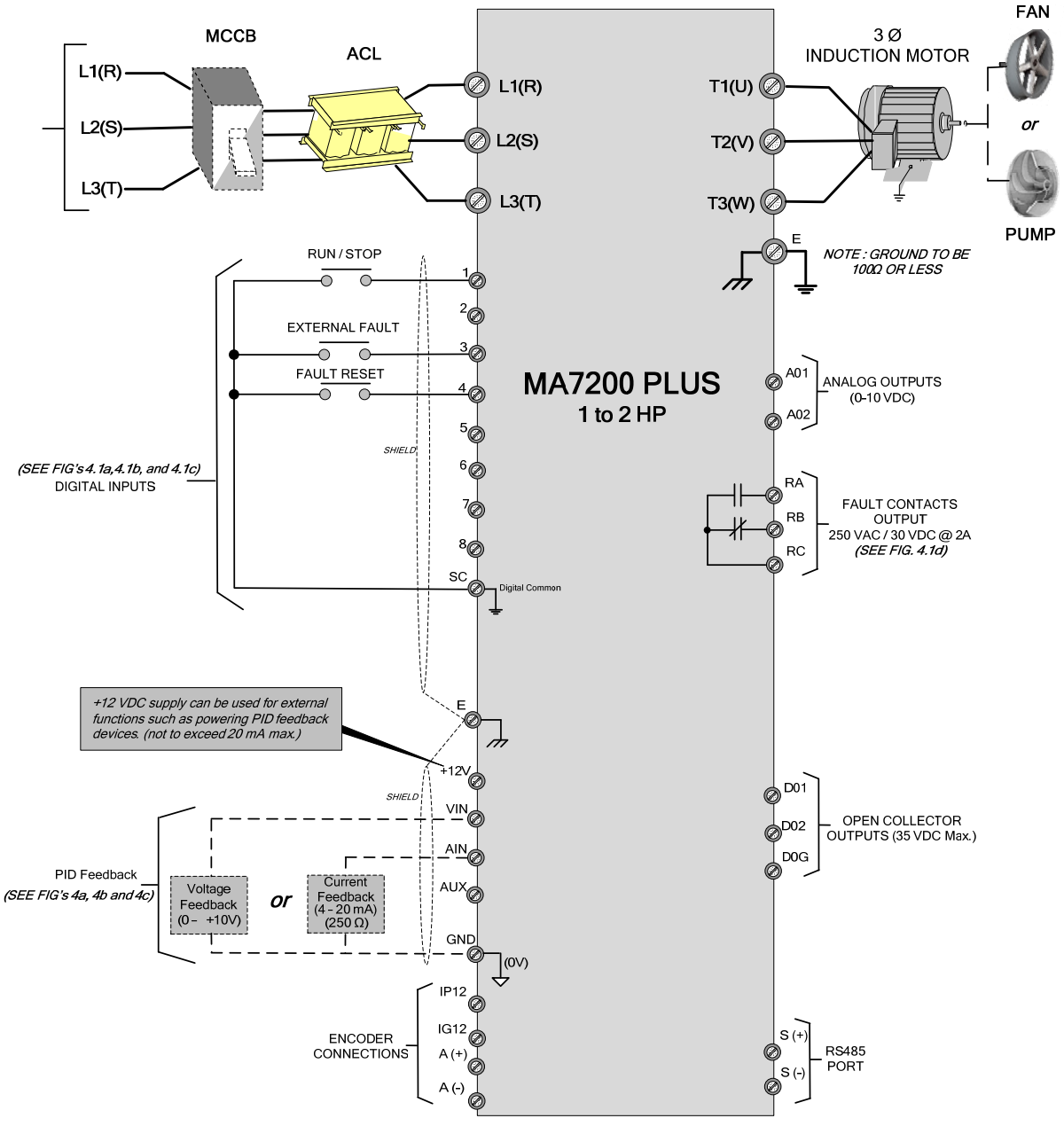


Fig. 3.1 MA7200 PLUS 1 to 2 HP FAN or PUMP Application Diagram

Fig. 3.2 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. More detailed information is available in the **MA7200 PLUS Manual** to which the user may refer.

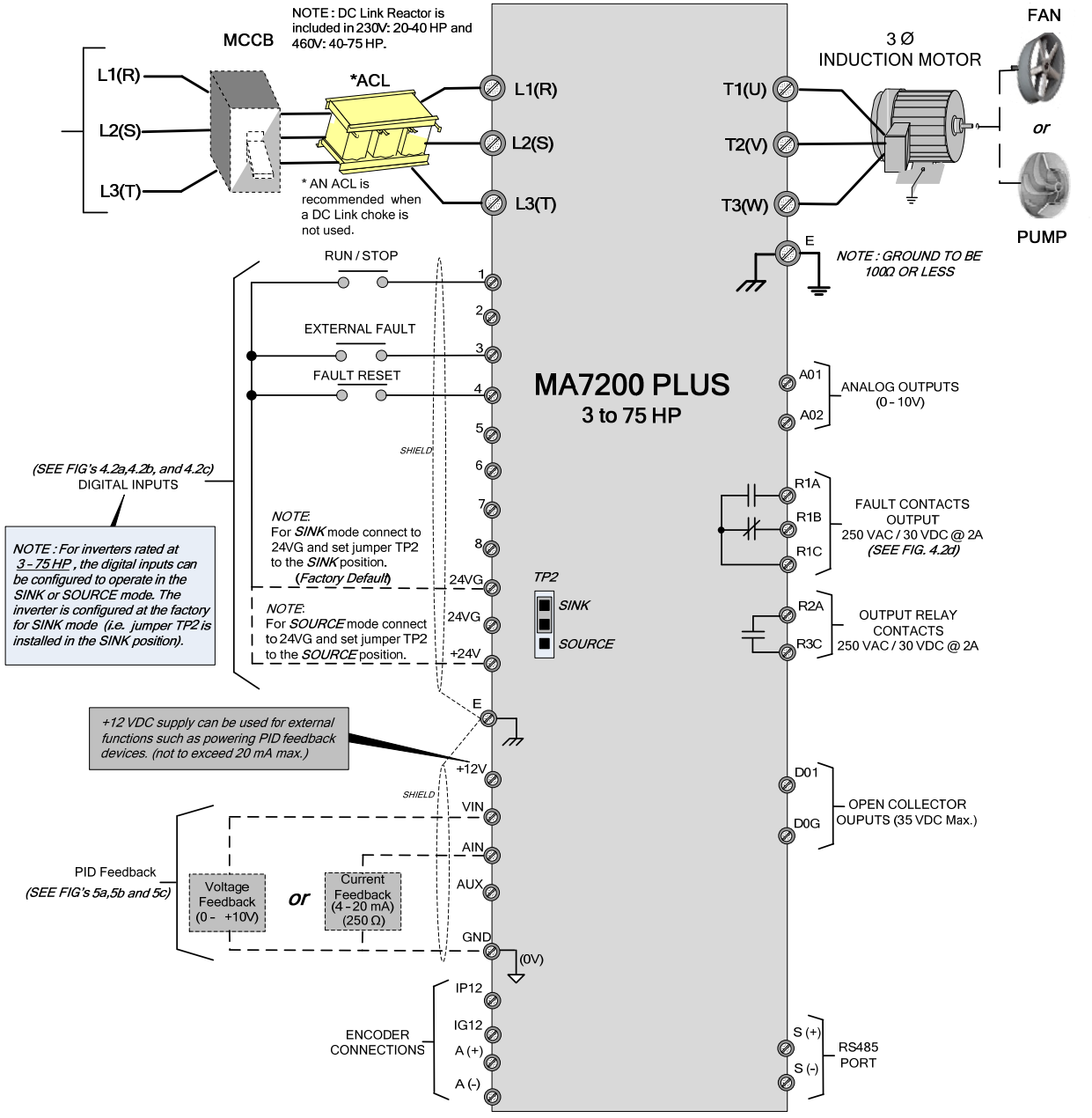
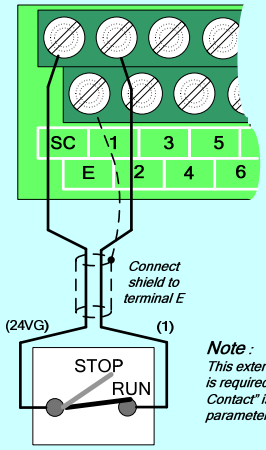


Fig. 3.2 MA7200 3 to 75 HP FAN or PUMP Application Diagram

Section 4 – MA7200 PLUS Digital Input / Output Control Terminal Connections

Fig's 4.1a, 4.1b and 4.1c 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 the **MA7200 PLUS Manual** if additional information is required. Fig.4.1d shows an example for the use of the ***Fault Output Relay***.

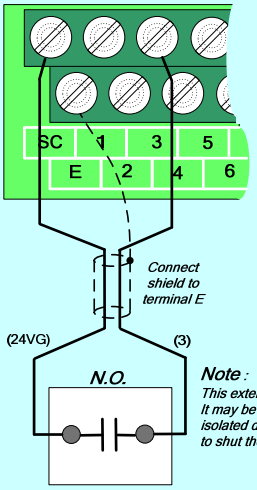
Fig. 4.1a Start / Stop Switch Connection



Note :
This external Start / Stop switch is required when "External Contact" is selected in parameter Sn-04 .

START / STOP SWITCH

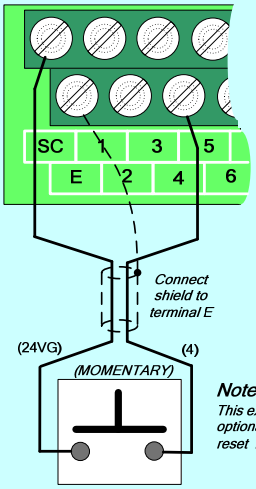
Fig. 4.1b External Fault Contact Connection



Note :
This external Fault input is optional. It may be provided from any external isolated dry contact source that is required to shut the inverter down.

EXTERNAL FAULT CONTACT

Fig. 4.1c Fault Reset Switch Connection

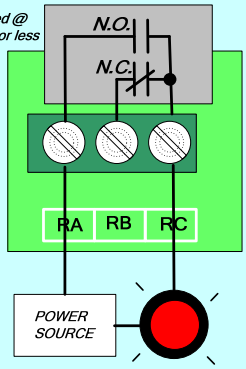


Note :
This external Fault Reset input is optional. The Fault may be also reset from the keypad.

FAULT RESET SWITCH

Fig. 4.1d Fault Output Contacts

Note :
Relay contacts are rated @ 250 VAC, 30 VDC, 2A or less

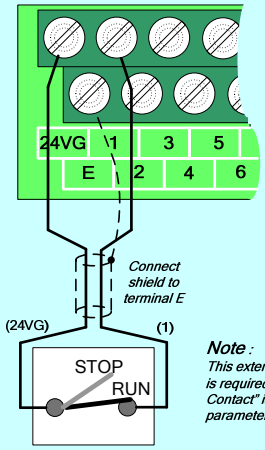


NOTE:
This is an example of the use of the Fault contacts. They could also be used to shut down equipment etc.

External warning device such as a flashing lamp or buzzer

Fig's 4.2a, 4.2b and 4.2c 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.4.2d shows an example for the use of the ***Fault Output Relay***.

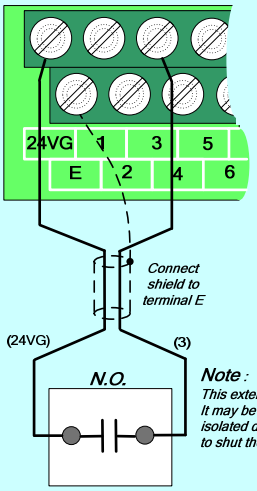
Fig. 4.2a Start / Stop Switch Connection



Note :
This external Start / Stop switch is required when "External Contact" is selected in parameter Sn-04 .

START / STOP SWITCH

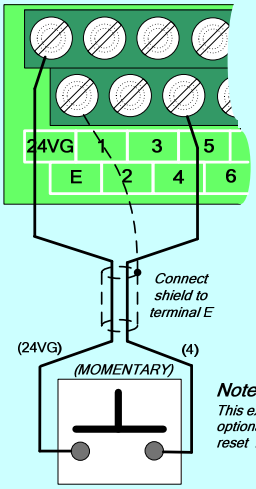
Fig. 4.2b External Fault Contact Connection



Note :
This external Fault input is optional. It may be provided from any external isolated dry contact source that is required to shut the inverter down.

EXTERNAL FAULT CONTACT

Fig. 4.2c Fault Reset Switch Connection

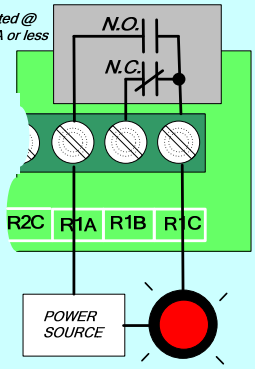


Note :
This external Fault Reset input is optional. The Fault may be also reset from the keypad.

FAULT RESET SWITCH

Fig. 4.2d Fault Output Contacts

Note :
Relay contacts are rated @ 250 VAC, 30 VDC, 2A or less



NOTE:
This is an example of the use of the Fault contacts. They could also be used to shut down equipment etc.

External warning device such as a flashing lamp or buzzer

Section 5 - MA7200 PLUS Analog Feedback Control Terminal Connections

Fig's 5.1a,5.1b and 5.1c, show the analog feedback schemes (*10VDC or 4-20mA)* for the MA7200 PLUS **1- 2 HP**.

Fig. 5.1a 0 - +10 VDC Analog Feedback
(Notes 1&2)

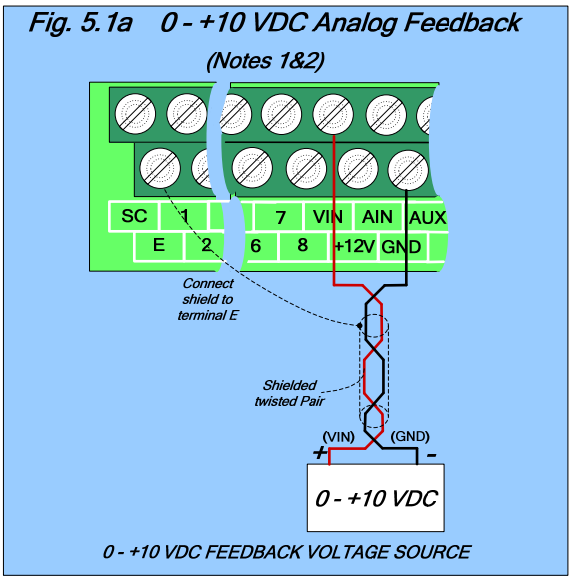
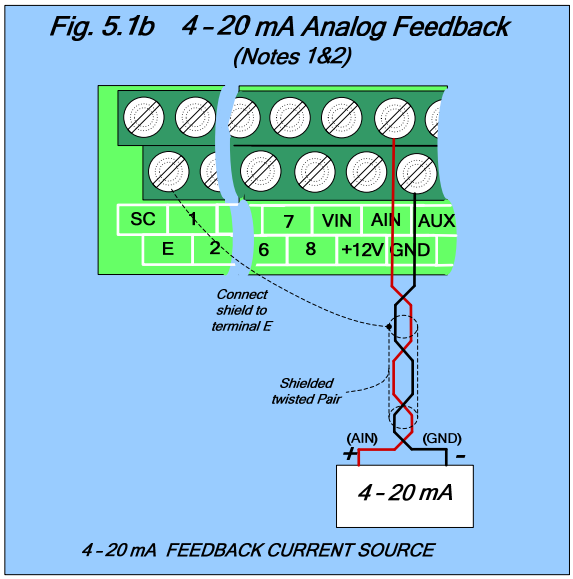


Fig. 5.1b 4 - 20 mA Analog Feedback
(Notes 1&2)



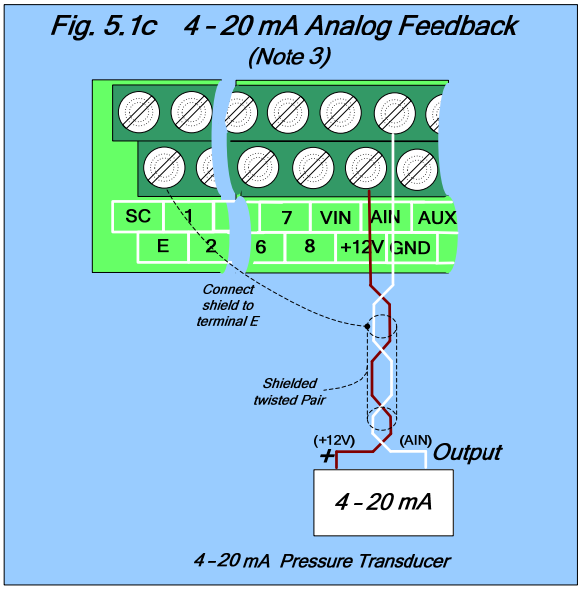
NOTES:

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 4a and 4b 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. 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 .

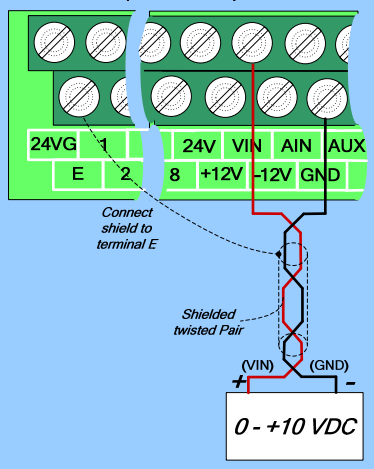
Fig. 5.1c 4 - 20 mA Analog Feedback
(Note 3)



Fig's 5.2a,5.2b and 5.2c, show the analog feedback schemes (*10VDC or 4-20mA)* for the MA7200 PLUS **3 - 75 HP**.

Fig. 5.2a 0 - +10 VDC Analog Feedback

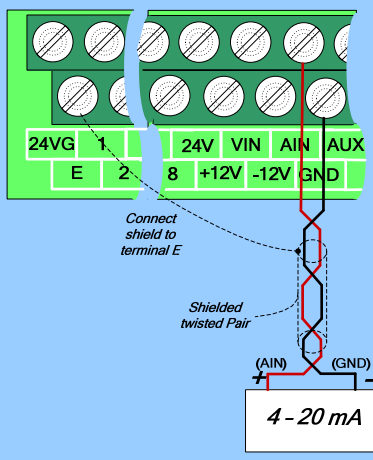
(Notes 1&2)



0 - +10 VDC FEEDBACK VOLTAGE SOURCE

Fig. 5.2b 4 - 20 mA Analog Feedback

(Notes 1&2)



4 - 20 mA FEEDBACK CURRENT SOURCE

NOTES:

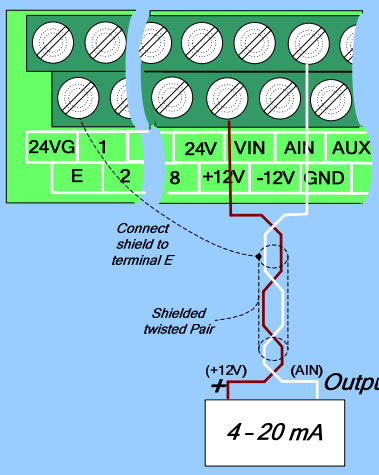
1 - Before connecting any feedback device, be sure to read the manufacturers instructions thoroughly as wiring color codes and connections may vary.

2 - Fig's 5a and 5b 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. 5.2c 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. 5.2c 4 - 20 mA Analog Feedback

(Note 3)



4 - 20 mA Pressure Transducer

Section 6 – 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**

• Referring to the MA7200 Instruction Manual, please review and 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.

CAUTION - ***To avoid damage to the inverter when removing the inverter cover and/or LCD Operator, refer to Appendix A for the proper procedure.***

• In accordance applicable codes make electrical connections to the motor and input power terminals. ***(Refer to the block diagram Fig. 3.1 for 1- 2 HP, or Fig.3.2 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 000.0Hz**". 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. 6.1 below)

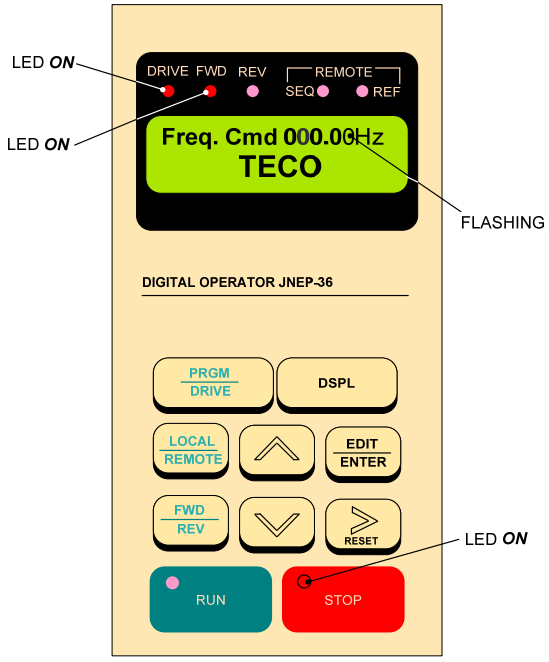


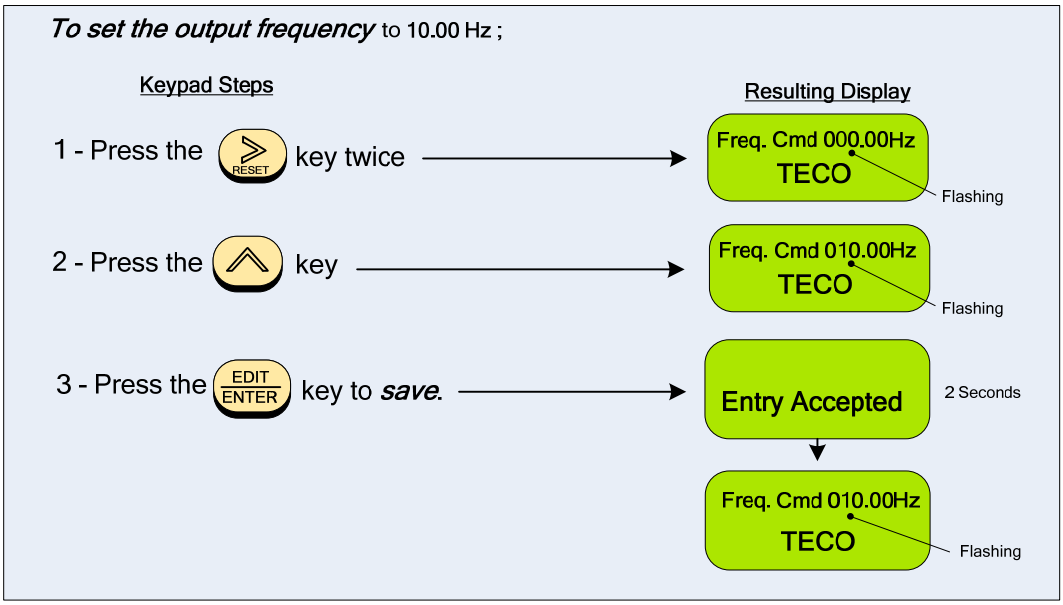
Fig. 6.1 MA7200 PLUS Keypad

***Step 3* - Set Drive to Run Mode**

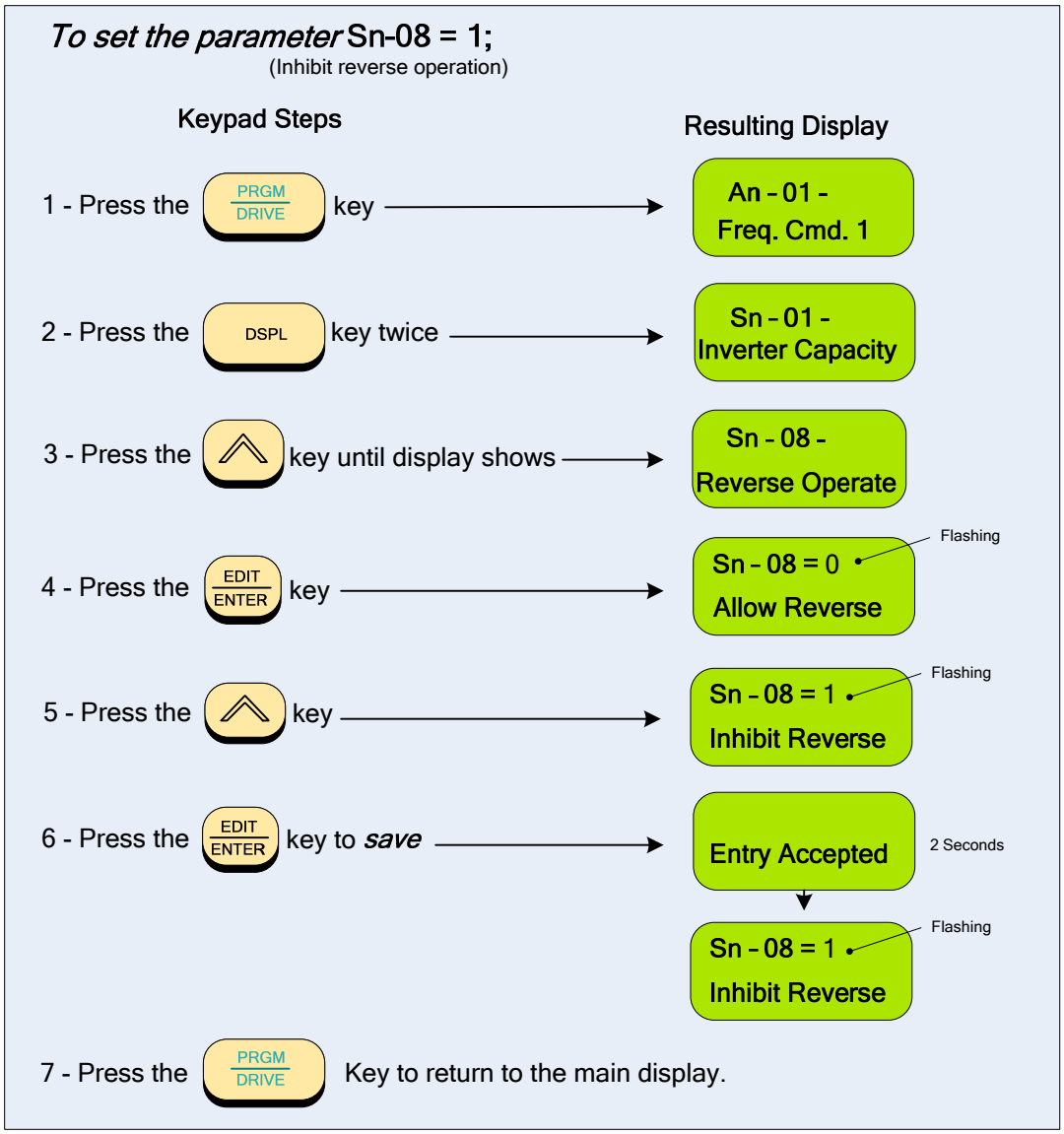
- If the red ***DRIVE*** LED is not on with AC power up, press the ***PGRM / DRIVE*** key until the red ***Drive*** LED is *on*. The Inverter is now in the **RUN** mode.

***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



- 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

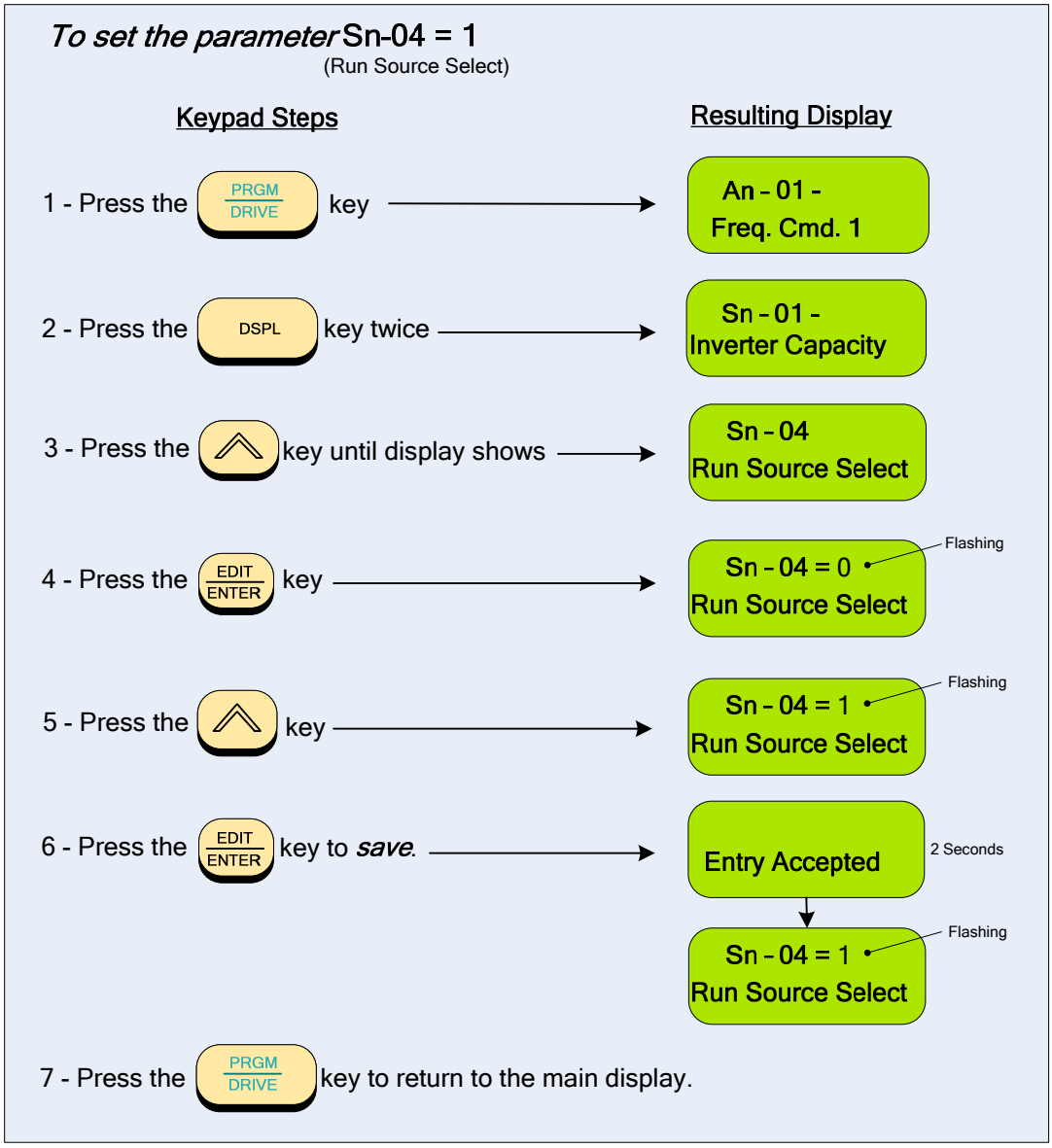
After the power has been turned OFF, wait at least 5 minutes until the charge indicator extinguishes completely before touching any wiring, circuit boards or components.

- 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**

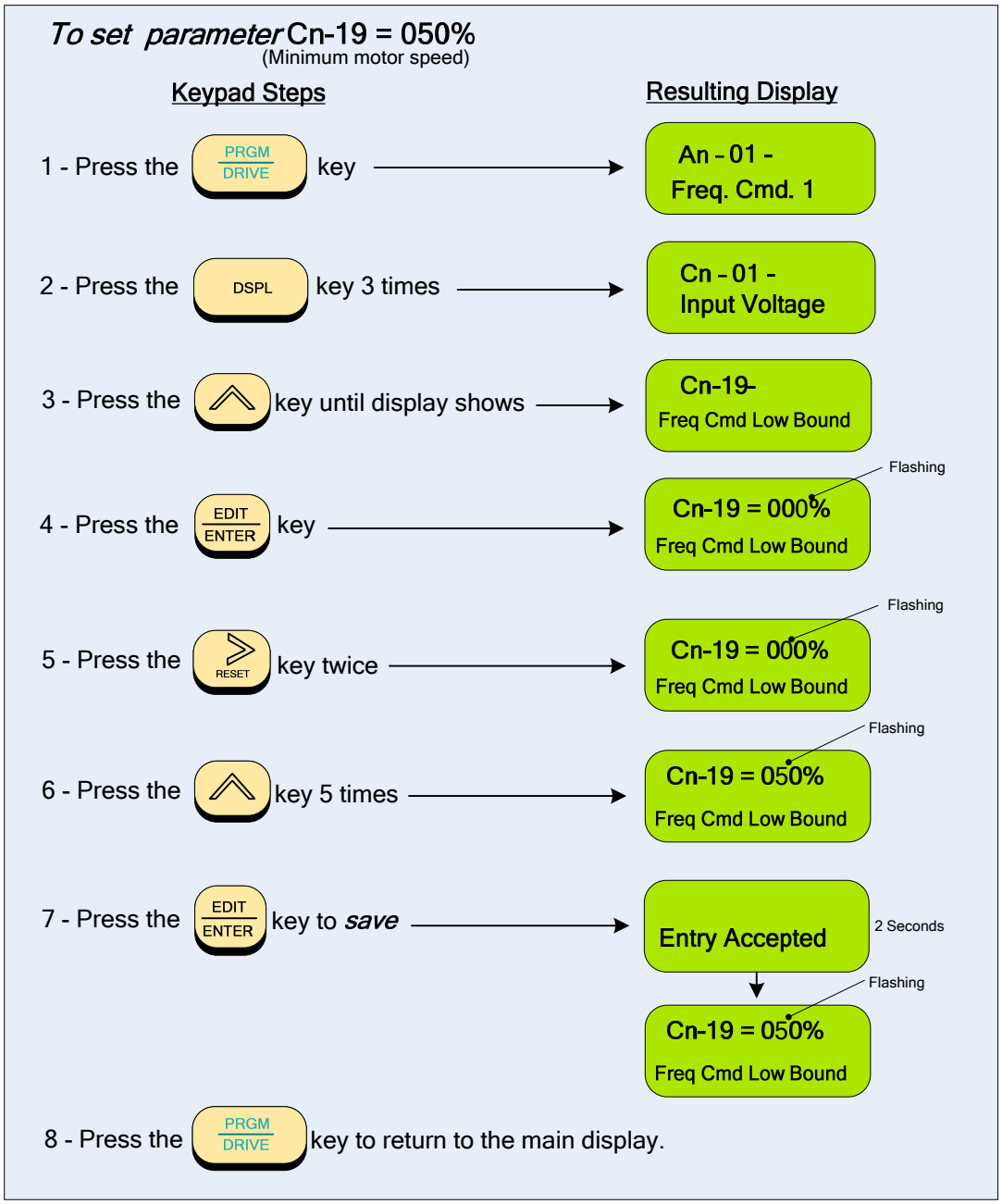
- The start / stop method of control is set by parameter ***(Sn – 04)*** and is initially set to ***= 0 (keypad),*** as factory default**.** If *External* contact control is desired then ***power down*** the drive and make the connections to the control terminals following the wiring diagram 4.1a or 4.2a in

Section 4. After ***power-up***, set Sn-01 = 1 (External Contact) following the keypad navigation procedure below.



***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***.


To set parameter Cn-19 = 050%
(Minimum motor speed)
Keypad Steps
Resulting Display
1 - Press the PRGM DRIVE key
An - 01 - Freq. Cmd. 1
2 - Press the DSPL key 3 times
Cn - 01 - Input Voltage
3 - Press the key until display shows
Cn-19- Freq Cmd Low Bound
4 - Press the EDIT ENTER key
Flashing
Cn-19 = 000% Freq Cmd Low Bound
5 - Press the RESET key twice
Flashing
Cn-19 = 000% Freq Cmd Low Bound
6 - Press the key 5 times
Flashing
Cn-19 = 050% Freq Cmd Low Bound
7 - Press the EDIT ENTER key to save
Entry Accepted
2 Seconds
Flashing
Cn-19 = 050% Freq Cmd Low Bound
8 - Press the PRGM DRIVE key to return to the main display.

Section 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.

Step 7 – 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

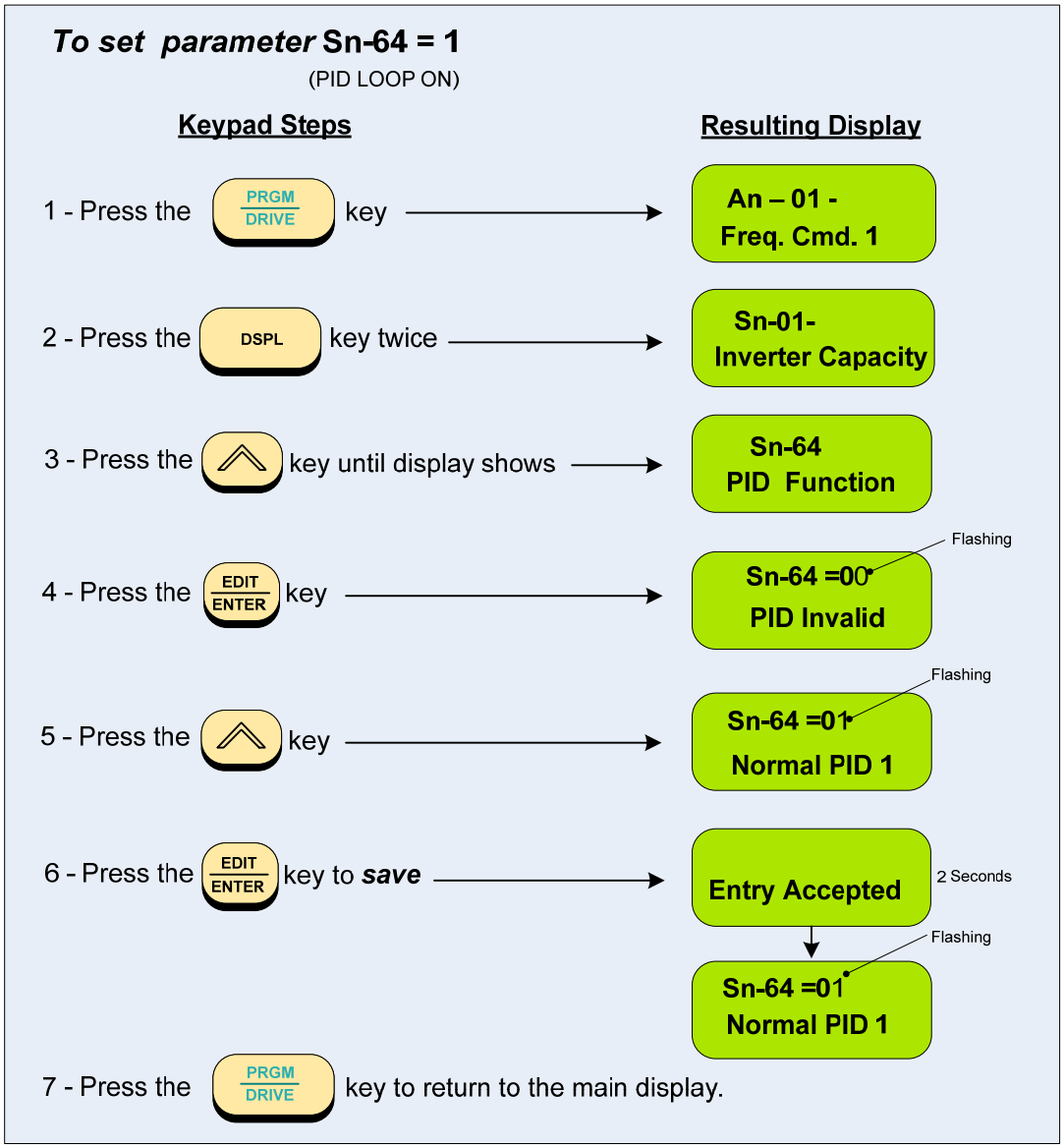
After the power has been turned OFF, wait at least 5 minutes until the charge indicator extinguishes completely before touching any wiring, circuit boards or components.

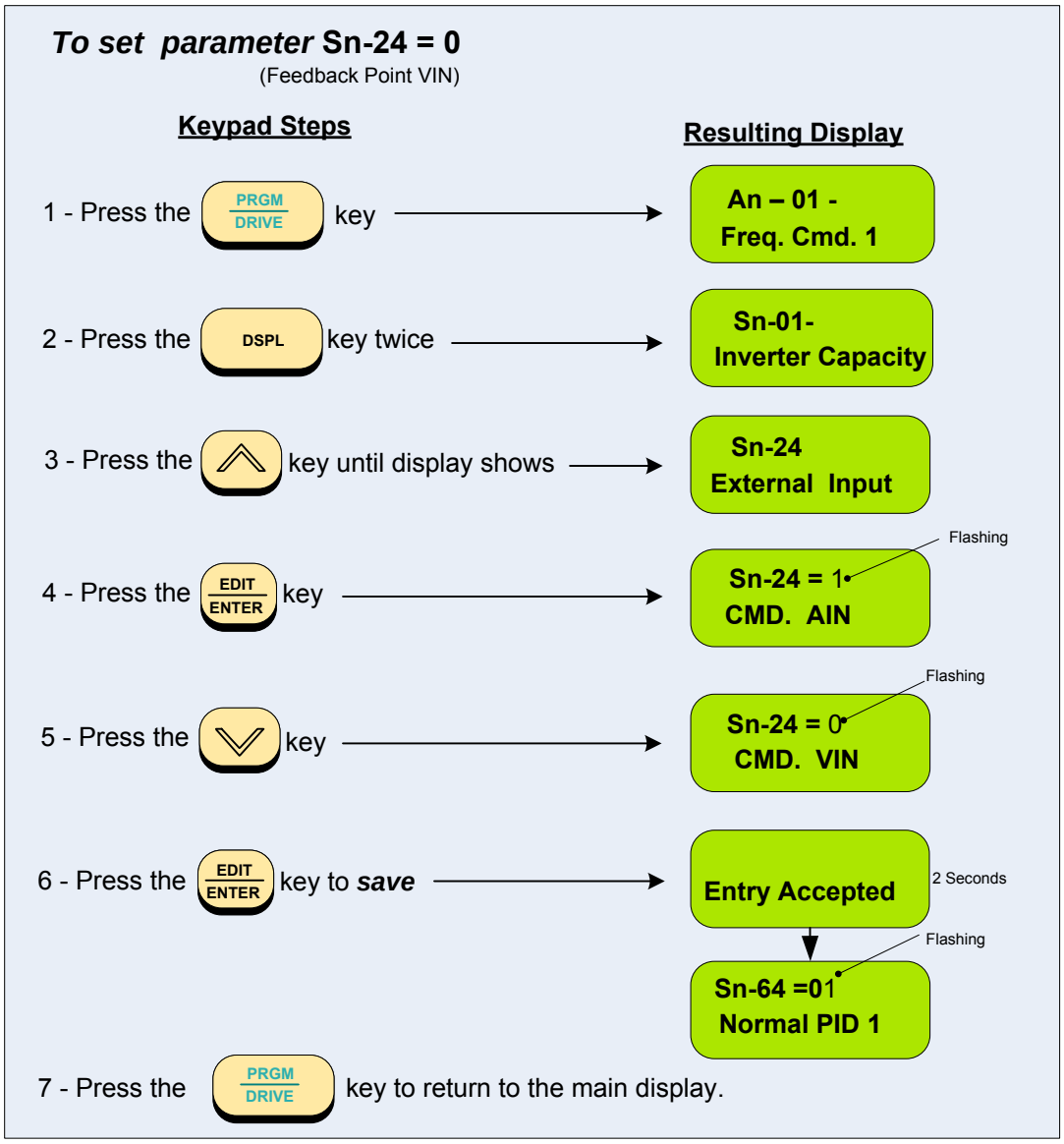
- Remove the cover from the inverter and following the analog feedback diagrams 5.1a or 5.2a covered in Section 5. Make the connections for the feedback device to the control terminals.
- ***Power -up*** the drive and proceed to the next Step.

NOTES

***Step 8* - 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.



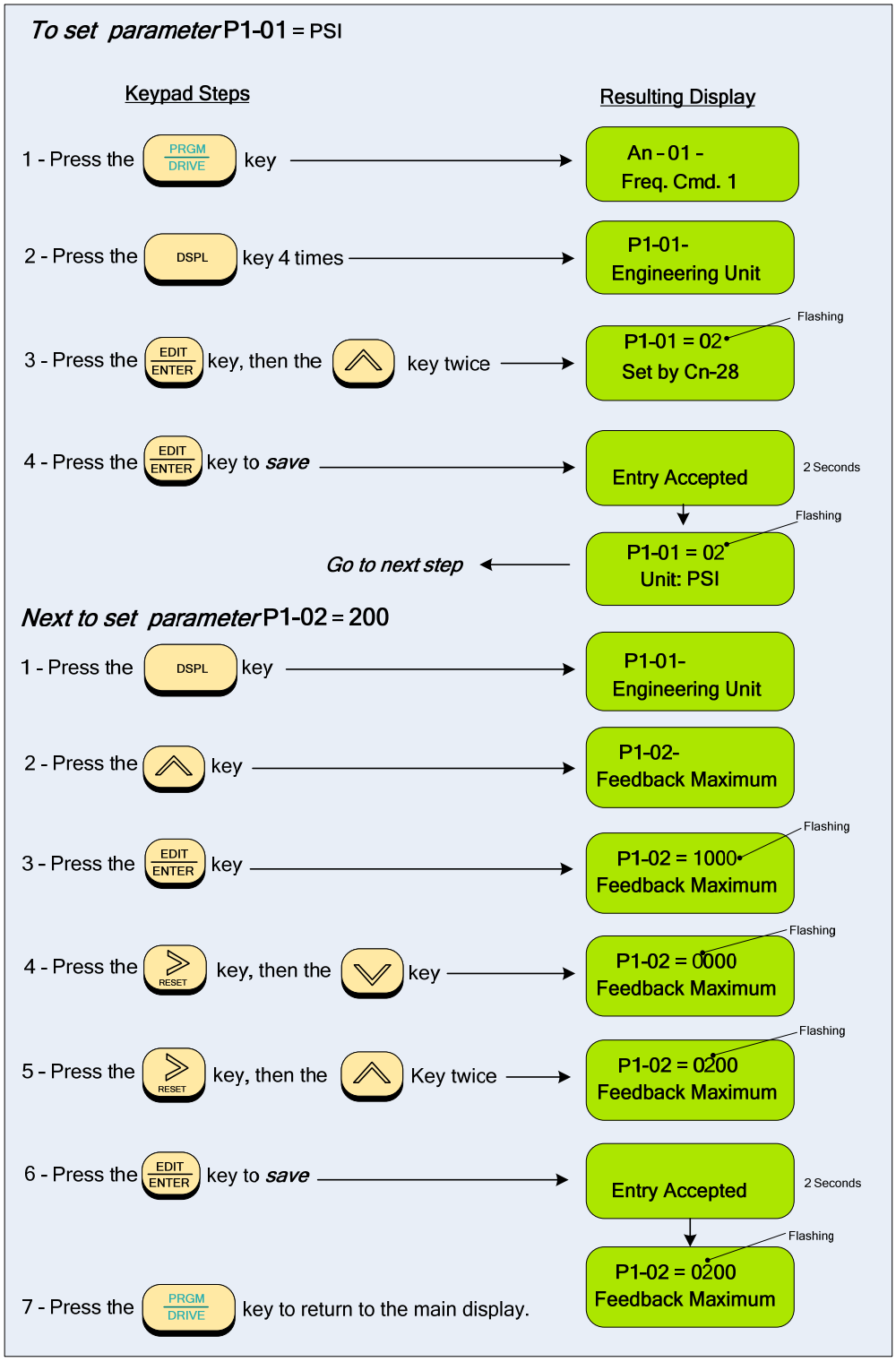


***Step 9* - Select Feedback Engineering Units (P1-01) and Scaling (P1-02)**

- 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.



Note: Once P1-01 is set to a non-zero value, then Cn-28 is no longer valid.

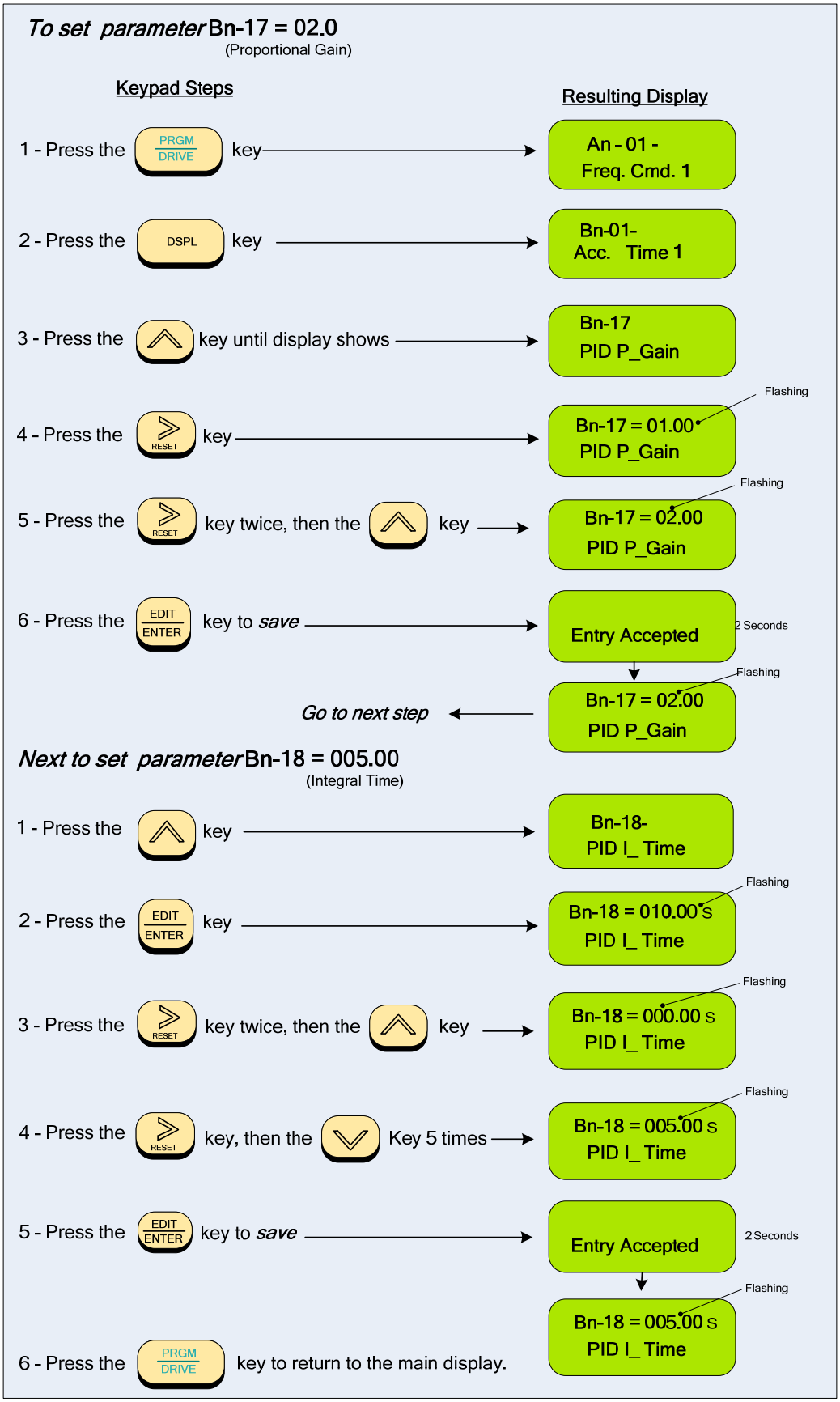
***Step 10* – Setting PID Parameters; Proportional Gain (Bn-17) and Integral Time (Bn-18)**

A Word About PID Control-

The PID control serves to maintain a given process within certain limits whether it be pressure, flow etc. To do this the ***feedback*** signal is compared to the ***set-point*** 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***. The greater the gain the lower the difference. However, in any system as the gain is increased there is a point that the system will become unstable (oscillate). To correct this instability, the response time of the system may be ***slowed*** down by increasing the ***Integral Time*** set by parameter ***Bn-18***. However slowing the system down too much may be unsatisfactory for the process. The end result is that these two parameters in conjunction with the acceleration (***Bn-01***) and deceleration (***Bn-02***) times (see ***STEP 11***) are adjusted to achieve optimum performance for a particular application.

- ***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.

NOTES


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
Bn-17 = 02.00 PID P_Gain
Flashing
Go to next step
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
Flashing
3 - Press the RESET key twice, then the key
Bn-18 = 000.00 S PID I_ Time
Flashing
4 - Press the RESET key, then the Key 5 times
Bn-18 = 005.00 S PID I_ Time
Flashing
5 - Press the EDIT ENTER key to save
Entry Accepted
2 Seconds
Bn-18 = 005.00 S PID I_ Time
Flashing
6 - Press the PRGM DRIVE key to return to the main display.

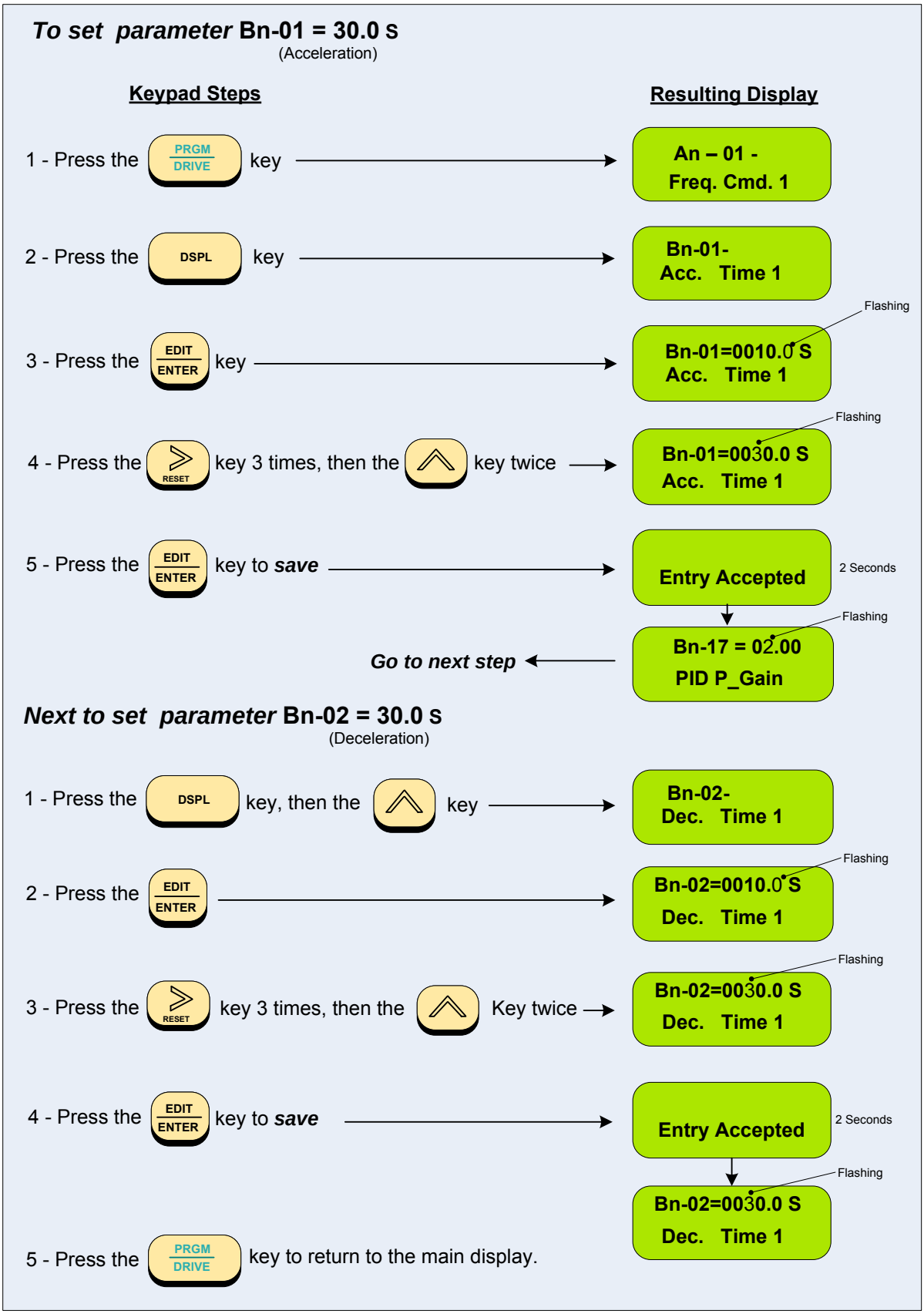
Step 11 **– Setting Parameters Acceleration (Bn-01) and Deceleration (Bn-02) Times**

- *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 on the next page.

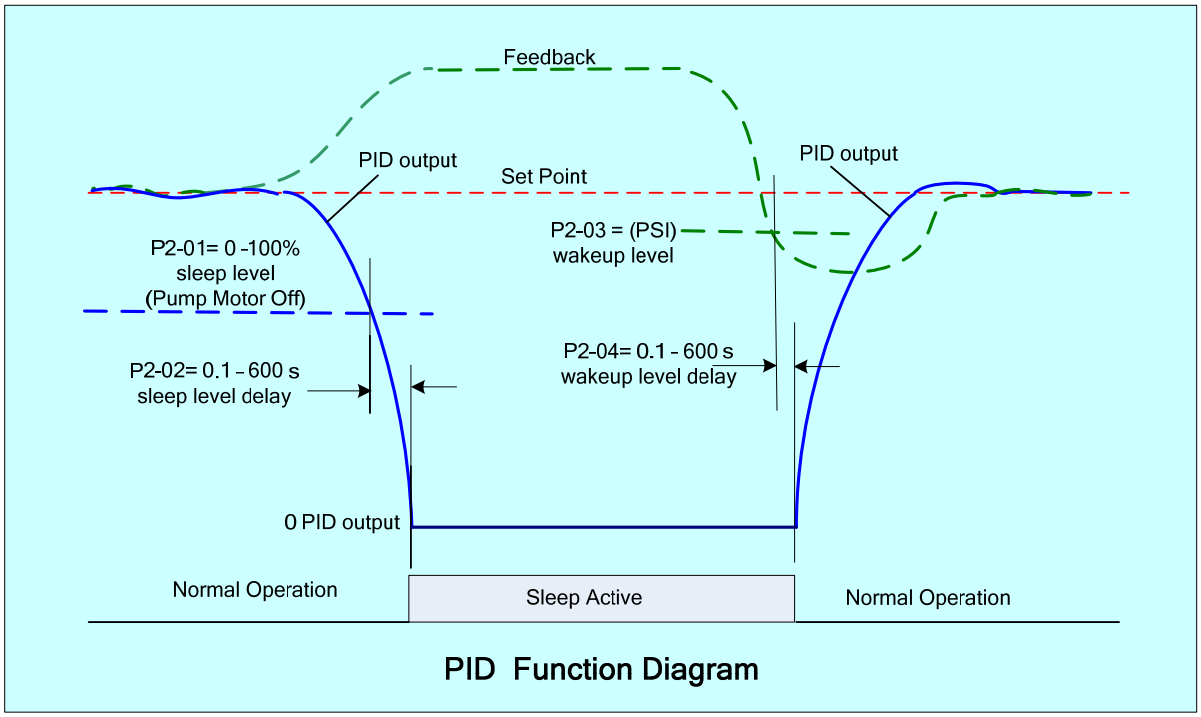
NOTES


To set parameter Bn-01 = 30.0 S
(Acceleration)
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 EDIT ENTER key
Flashing
Bn-01=0010.0 S
Acc. Time 1
4 - Press the RESET key 3 times, then the key twice
Flashing
Bn-01=0030.0 S
Acc. Time 1
5 - Press the EDIT ENTER key to save
Entry Accepted
2 Seconds
Flashing
Bn-17 = 02.00
PID P_Gain
Go to next step
Next to set parameter Bn-02 = 30.0 S
(Deceleration)
1 - Press the DSPL key, then the key
Bn-02-
Dec. Time 1
2 - Press the EDIT ENTER
Flashing
Bn-02=0010.0 S
Dec. Time 1
3 - Press the RESET key 3 times, then the Key twice
Flashing
Bn-02=0030.0 S
Dec. Time 1
4 - Press the EDIT ENTER key to save
Entry Accepted
2 Seconds
Flashing
Bn-02=0030.0 S
Dec. Time 1
5 - Press the PRGM DRIVE key to return to the main display.

Step 12 **– 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 Step13)

- 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. The following diagram will serve to illustrate this.

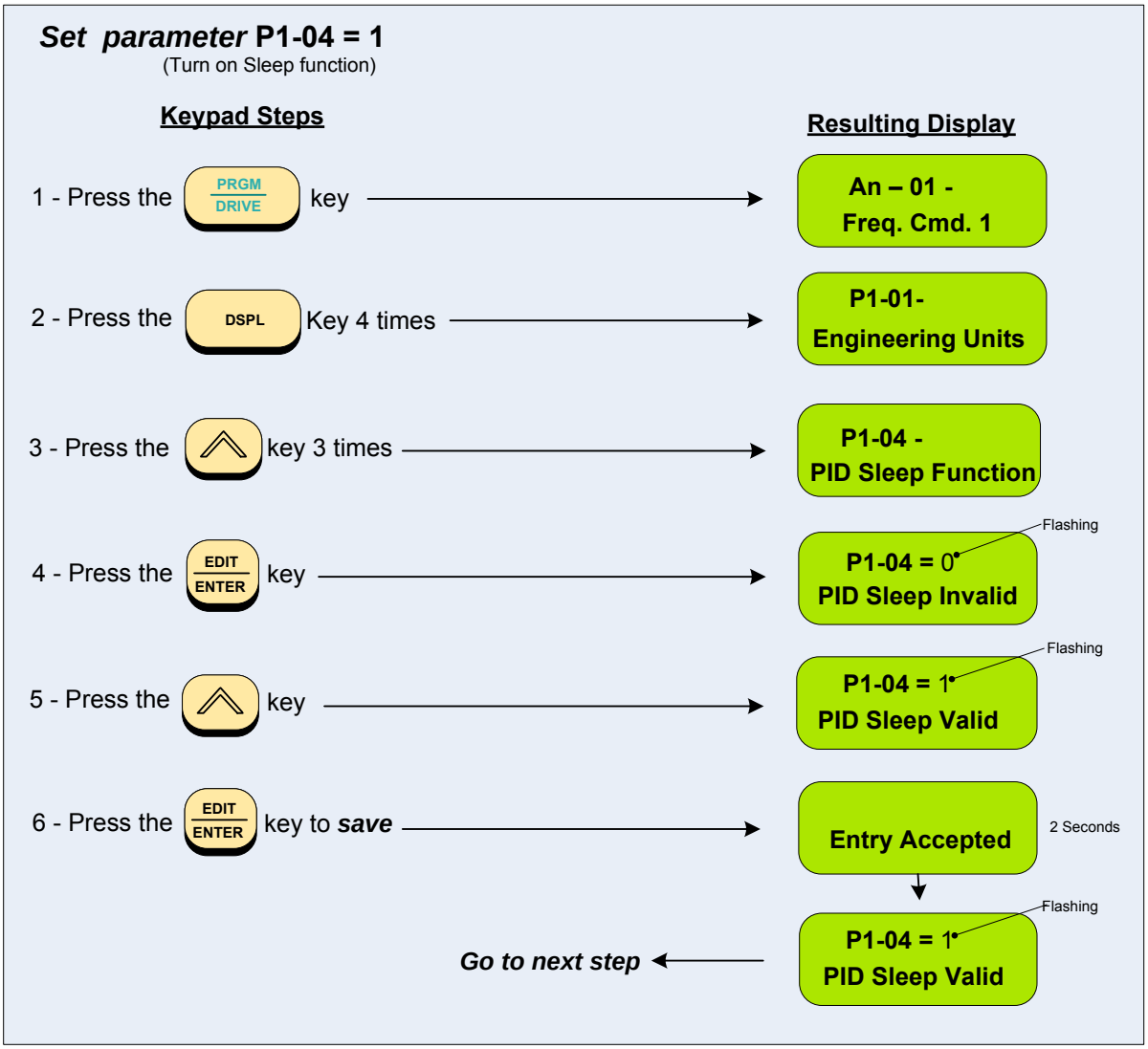


PID Function Diagram

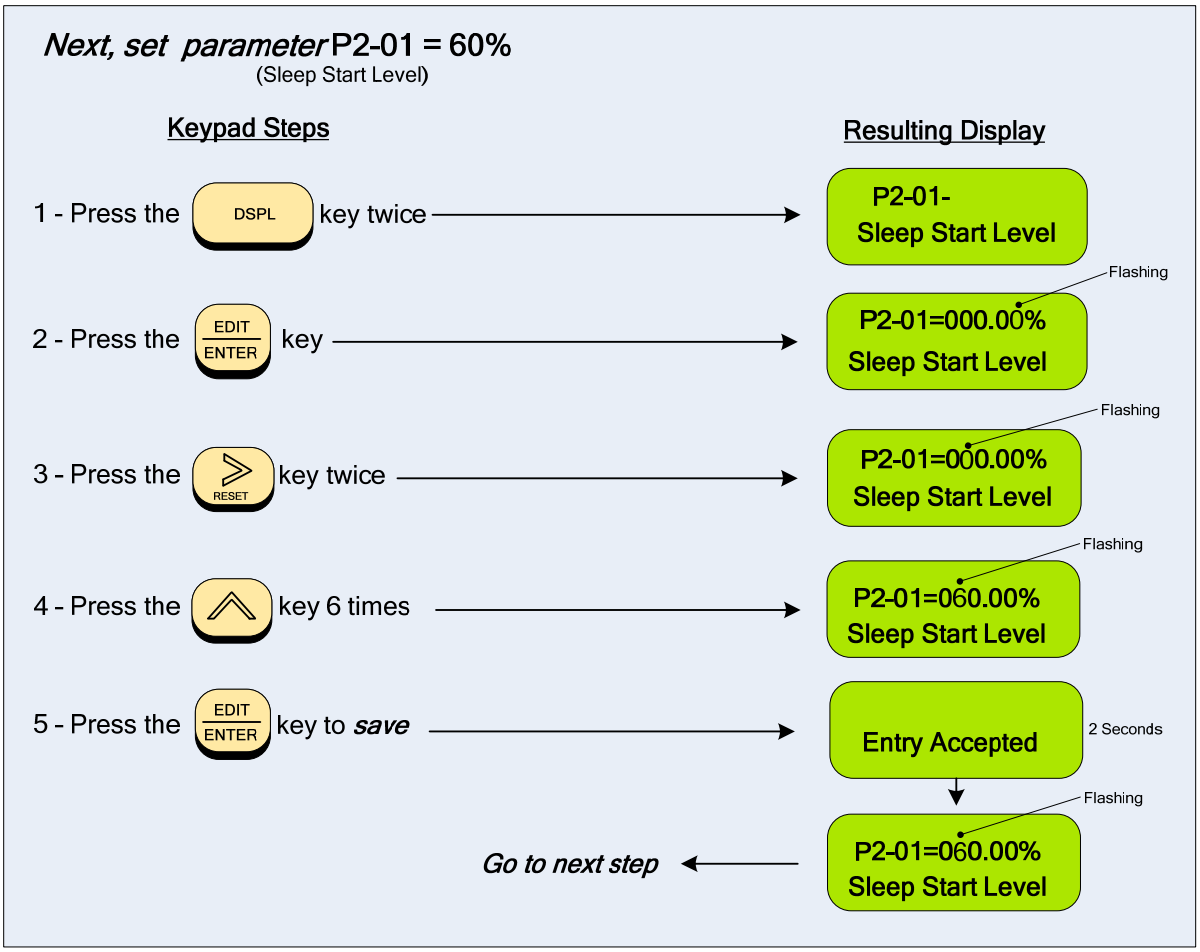
- To further cover the PID Sleep function, the following is an example of the various parameter settings that could be used. In this example the system will have the following specifications:
  - Max. Pump Motor Speed: 3600 RPM.
  - Set Point: 150 PSI.
  - Feedback Transducer Range: 0 – 200 PSI.
  - Pump System Sleep Level: 2160RPM or *60%* of max. speed set by ***(P21-01=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 9,*** set the engineering units to *PSI* (***P1-01=02)*** and then the range to 200 ***(P1-02=0200).***

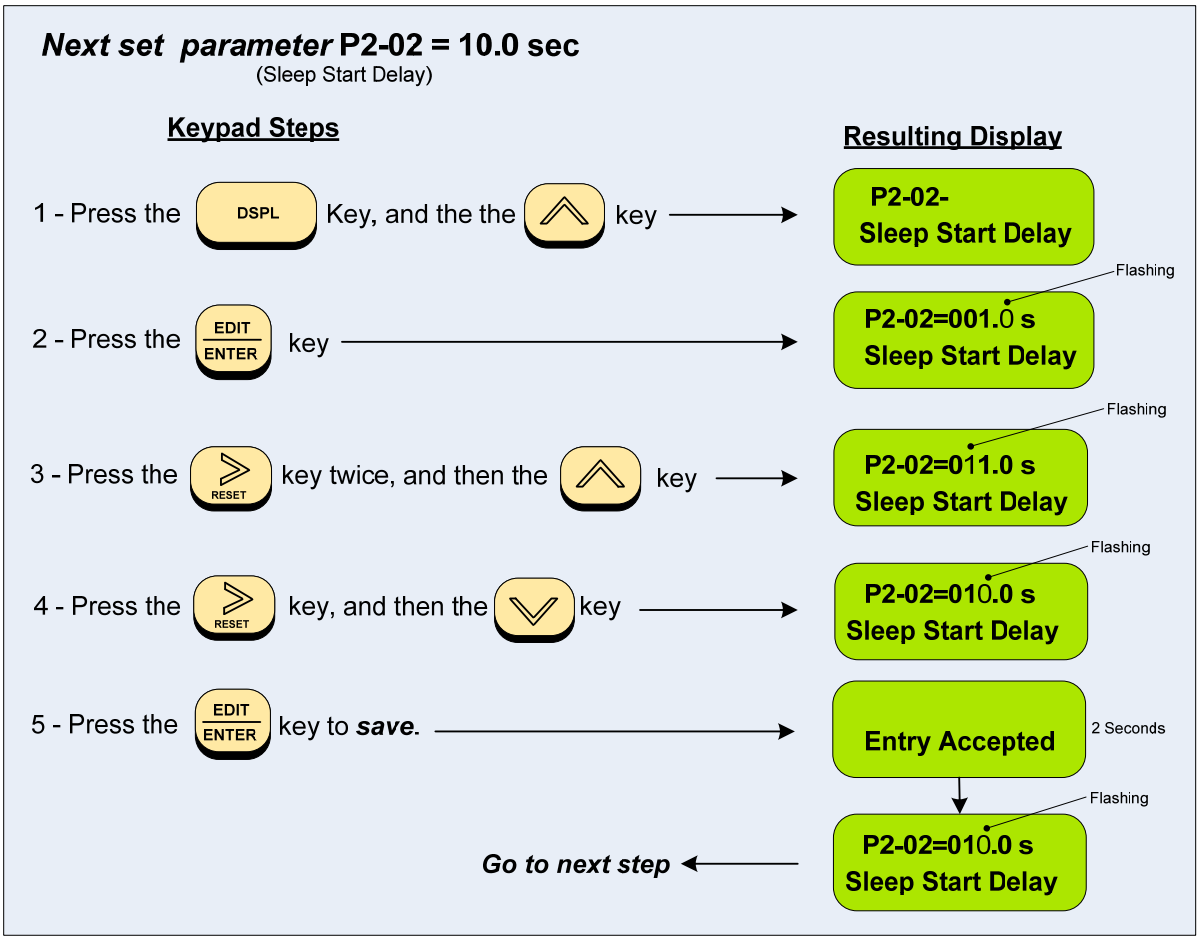
- On the following pages the keypad navigation sequence is shown in setting the PID parameters.
  NOTE: The inverter must be in the Stop mode in order to turn on the sleep function.



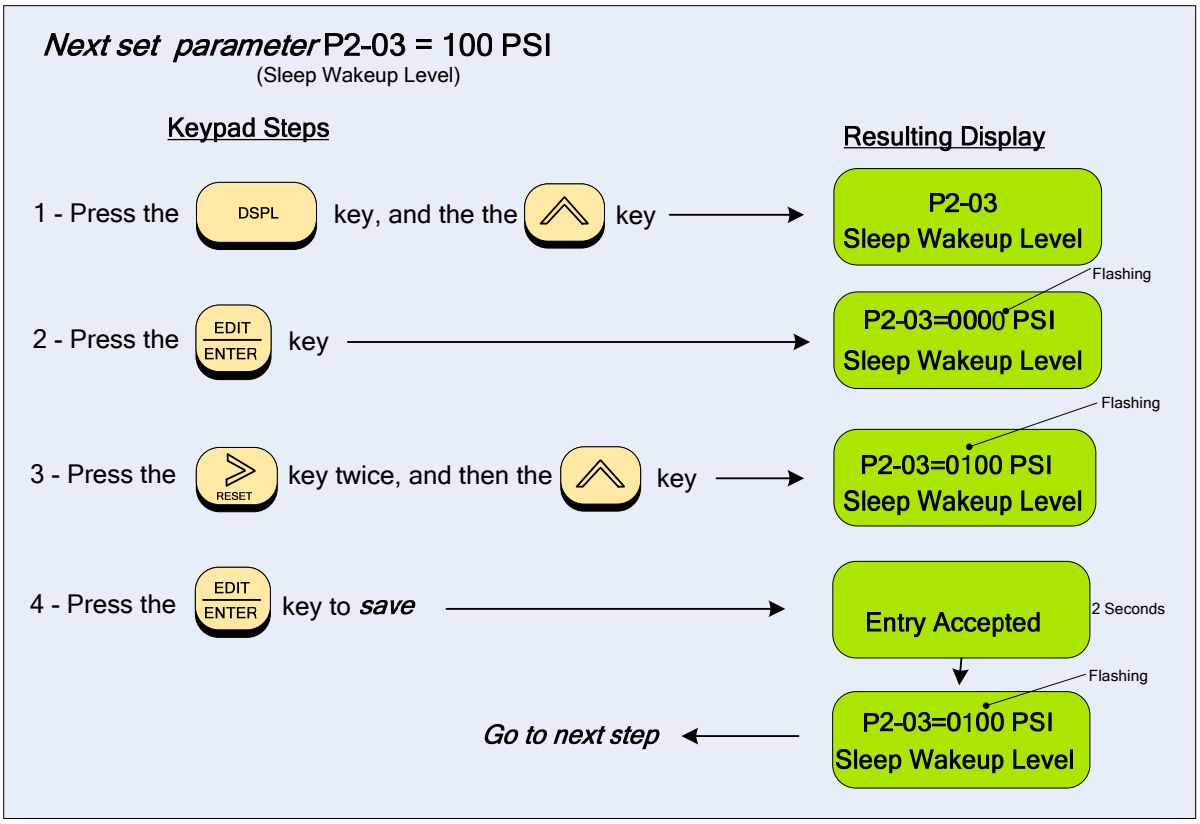
NOTES


Next, set parameter P2-01 = 60%
(Sleep Start Level)
Keypad Steps
Resulting Display
1 - Press the DSPL key twice
P2-01-
Sleep Start Level
2 - Press the EDIT ENTER key
Flashing
P2-01=000.00%
Sleep Start Level
3 - Press the RESET key twice
Flashing
P2-01=000.00%
Sleep Start Level
4 - Press the key 6 times
Flashing
P2-01=060.00%
Sleep Start Level
5 - Press the EDIT ENTER key to save
Entry Accepted
2 Seconds
Flashing
P2-01=060.00%
Sleep Start Level
Go to next step

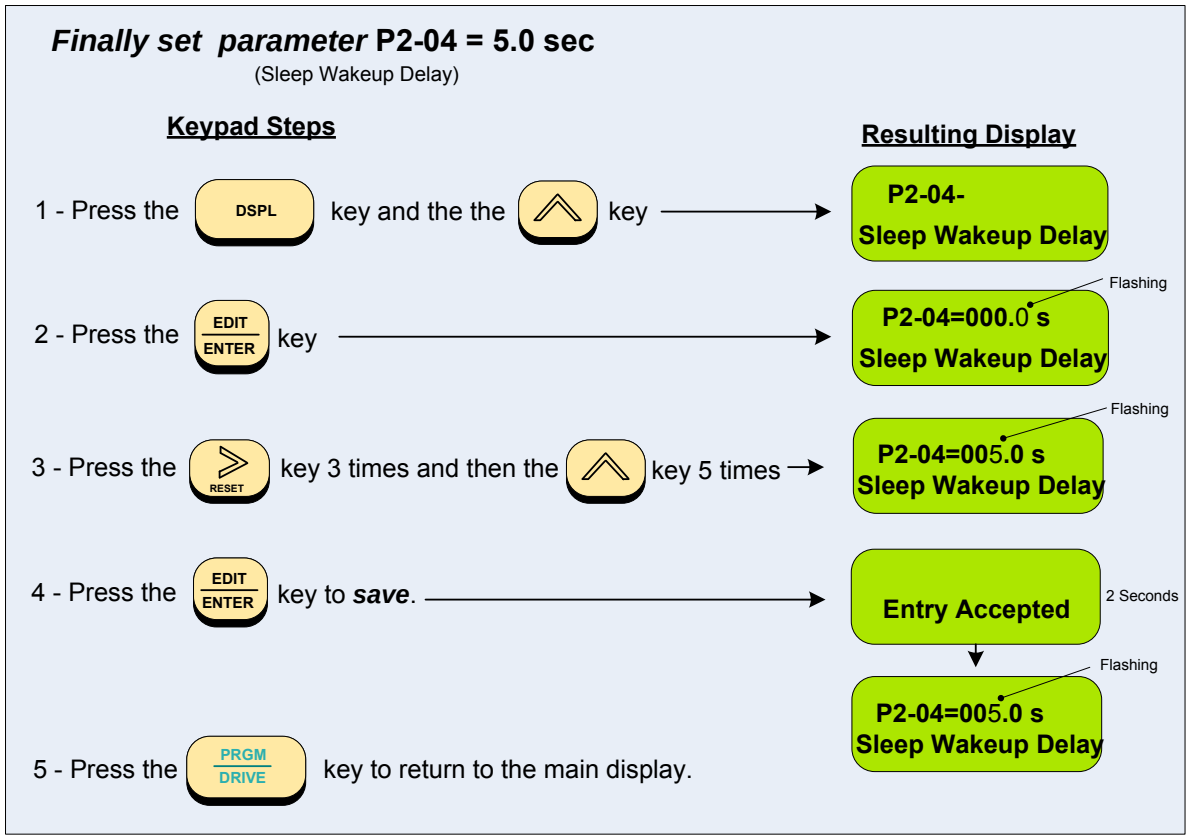
NOTES


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

NOTES


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
Flashing
2 - Press the
EDIT
ENTER
key
P2-03=0000 PSI
Sleep Wakeup Level
Flashing
3 - Press the
RESET
key twice, and then the
key
P2-03=0100 PSI
Sleep Wakeup Level
4 - Press the
EDIT
ENTER
key to *save*
Entry Accepted
2 Seconds
Flashing
Go to next step
P2-03=0100 PSI
Sleep Wakeup Level

NOTES



Step 13 **– Testing The System**

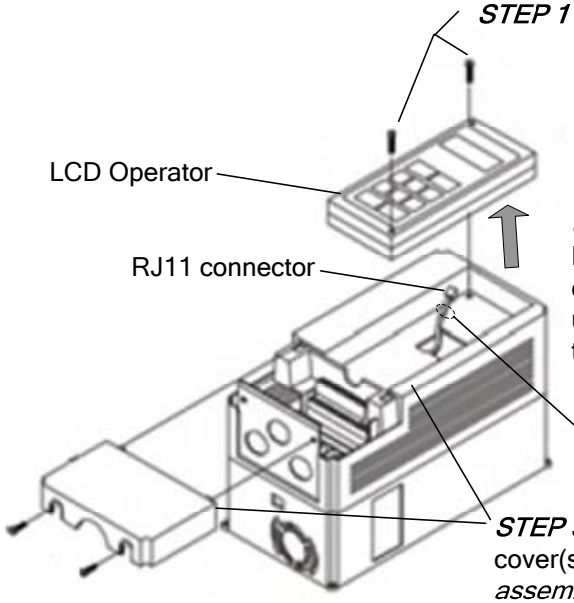
- The system can now be tested for performance. To do this, set the ***set-point*** through the keypad and run the drive at some low level and check that the motor is operating properly and that the ***feedback*** signal level and polarity are correct.
- Check the system for dynamic operation and make 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 10)***

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.

Appendix A - Removing the LCD Digital Operator and Inverter Cover(s)



STEP 1 - Remove the (2) screws

STEP 2 - Gently Lift *UP* the LCD Operator and remove the connecting cable (RJ11) by unplugging it from the back of the LCD Operator.

Connecting cable

STEP 3 - Gently remove the cover(s). ***NOTE:****The cover assemblies are different depending upon the HP rating and the user is referred to the manual received with the inverter.*

NOTES

Appendix B – 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	

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			

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