YASKAWA

YASKAWA AC Drive Z1000

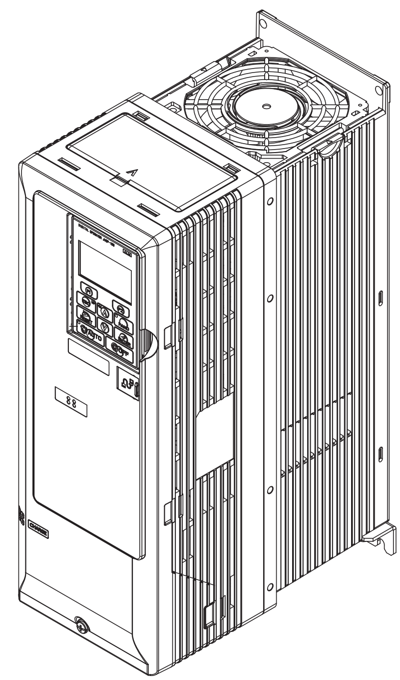
AC Drive for HVAC Fan and Pump

Programming Manual

Type: CIMR-ZU□A□

Models: 200 V Class: 2.2 to 110 kW (3 to 150 HP)
400 V Class: 2.2 to 370 kW (3 to 500 HP)

To properly use the product, read this manual thoroughly and retain for easy reference, inspection, and maintenance. Ensure the end user receives this manual.



MANUAL NO. SIEP C710616 45C

This Page Intentionally Blank

Table of Contents

This Page Intentionally Blank

i

Preface & General Safety

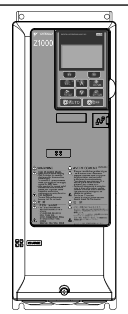
This section provides safety messages pertinent to this product that, if not heeded, may result in fatality, personal injury, or equipment damage. Yaskawa is not responsible for the consequences of ignoring these instructions.

i.1 Preface

Yaskawa manufactures products used as components in a wide variety of industrial systems and equipment. The selection and application of Yaskawa products remain the responsibility of the equipment manufacturer or end user. Yaskawa accepts no responsibility for the way its products are incorporated into the final system design. Under no circumstances should any Yaskawa product be incorporated into any product or design as the exclusive or sole safety control. Without exception, all controls should be designed to detect faults dynamically and fail safely under all circumstances. All systems or equipment designed to incorporate a product manufactured by Yaskawa must be supplied to the end user with appropriate warnings and instructions as to the safe use and operation of that part. Any warnings provided by Yaskawa must be promptly provided to the end user. Yaskawa offers an express warranty only as to the quality of its products in conforming to standards and specifications published in the Yaskawa manual. NO OTHER WARRANTY, EXPRESS OR IMPLIED, IS OFFERED. Yaskawa assumes no liability for any personal injury, property damage, losses, or claims arising from misapplication of its products.

◆ Applicable Documentation

The following manuals are available for Z1000-series drives:

<table>
<tr><td rowspan="4"></td><td>Z1000-Series AC Drive Programming Manual (SIEPC71061645)</td></tr>
<tr><td>This manual provides detailed information on parameter settings, drive functions, maintenance, and MEMOBUS/Modbus specifications. Use this manual to expand drive functionality. This manual is available for download on our documentation website, www.yaskawa.com.</td></tr>
<tr><td>Z1000-Series AC Drive User Manual (TOEPC71061645)</td></tr>
<tr><td>Read this manual first. This manual is packaged together with the product and contains basic information required to install and wire the drive. It also gives detailed information on fault diagnostics, parameter settings, and BACnet specifications. The purpose of this manual is to prepare the drive for a trial run with an application and for basic operation. This manual is available for download on our documentation website, www.yaskawa.com.</td></tr>
</table>

◆ Symbols

Note: Indicates a supplement or precaution that does not cause drive damage.

TERMS **Indicates a term or definition used in this manual.**

◆ Terms and Abbreviations

TERMS

- **Drive:** Yaskawa Z1000-Series Drive
- **H:** Hexadecimal Number Format
- **IGBT:** Insulated Gate Bipolar Transistor
- **kbps:** Kilobits per Second
- **MAC:** Media Access Control
- **r/min:** Revolutions per Minute
- **V/f:** V/f Control
- **OLV/PM:** Open Loop Vector Control for PM
- **PM motor:** Permanent Magnet Synchronous motor (an abbreviation for IPM motor or SPM motor)
- **IPM motor:** Interior Permanent Magnet Motor (e.g., Yaskawa SSR1 Series and SST4 Series motors)
- **SPM motor:** Surface mounted Permanent Magnet Motor (e.g., Yaskawa SMRA Series motors)

◆ Trademarks

- APOGEE® FLN is a registered trademark of Siemens Building Technologies, Inc.
- APOGEE® Anywhere™ is a trademark of Siemens Building Technologies, Inc.
- BACnet is a trademark of the American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE).
- GPD is a trademark of Yaskawa, Inc.
- Metasys® N2 is a trademark of Johnson Controls, Inc.
- MODBUS® is a registered trademark of Schneider Automation, Inc.
- Other companies and product names mentioned in this manual are trademarks of those companies.

i.2 General Safety

◆ Supplemental Safety Information

General Precautions
• The diagrams in this manual may be indicated without covers or safety shields to show details. Replace the covers or shields before operating the drive and run the drive according to the instructions described in this manual. • Any illustrations, photographs, or examples used in this manual are provided as examples only and may not apply to all products to which this manual is applicable. • The products and specifications described in this manual or the content and presentation of the manual may be changed without notice to improve the product and/or the manual. • When ordering a new copy of the manual due to damage or loss, contact your Yaskawa representative or the nearest Yaskawa sales office and provide the manual number shown on the front cover. • If nameplate becomes worn or damaged, order a replacement from your Yaskawa representative or the nearest Yaskawa sales office.

⚠ WARNING

Read and understand this manual before installing, operating or servicing this drive. The drive must be installed according to this manual and local codes.

The following conventions are used to indicate safety messages in this manual. Failure to heed these messages could result in serious or fatal injury or damage to the products or to related equipment and systems.

⚠ DANGER

Indicates a hazardous situation, which, if not avoided, will result in death or serious injury.

⚠ WARNING

Indicates a hazardous situation, which, if not avoided, could result in death or serious injury.

WARNING! *may also be indicated by a bold key word embedded in the text followed by an italicized safety message.*

⚠ CAUTION

Indicates a hazardous situation, which, if not avoided, could result in minor or moderate injury.

CAUTION! *may also be indicated by a bold key word embedded in the text followed by an italicized safety message.*

NOTICE

Indicates a property damage message.

NOTICE: *may also be indicated by a bold key word embedded in the text followed by an italicized safety message.*

◆ Safety Messages

⚠ DANGER

Heed the safety messages in this manual.

Failure to comply will result in death or serious injury.

The operating company is responsible for any injuries or equipment damage resulting from failure to heed the warnings in this manual.

Electrical Shock Hazard

Do not connect or disconnect wiring while the power is on.

Failure to comply will result in death or serious injury.

Before servicing, disconnect all power to the equipment. The internal capacitor remains charged even after the power supply is turned off. After shutting off the power, wait for at least the amount of time specified on the drive before touching any components.

⚠ WARNING

Sudden Movement Hazard

System may start unexpectedly upon application of power, resulting in death or serious injury.

Clear all personnel from the drive, motor and machine area before applying power. Secure covers, couplings, shaft keys and machine loads before applying power to the drive.

Electrical Shock Hazard

Do not attempt to modify or alter the drive in any way not explained in this manual.

Failure to comply could result in death or serious injury.

Yaskawa is not responsible for any modification of the product made by the user. This product must not be modified.

Do not allow unqualified personnel to use equipment.

Failure to comply could result in death or serious injury.

Maintenance, inspection, and replacement of parts must be performed only by authorized personnel familiar with installation, adjustment and maintenance of AC drives.

Do not remove covers or touch circuit boards while the power is on.

Failure to comply could result in death or serious injury.

Make sure the protective earthing conductor complies with technical standards and local safety regulations.

Because the leakage current exceeds 3.5 mA, IEC 61800-5-1 states that either the power supply must be automatically disconnected in case of discontinuity of the protective earthing conductor or a protective earthing conductor with a cross-section of at least 10 mm^2 (Cu) or 16 mm^2 (Al) must be used. Failure to comply may result in death or serious injury.

Always use appropriate equipment for Ground Fault Circuit Interrupters (GFCIs).

The drive can cause a residual current with a DC component in the protective earthing conductor. Where a residual current operated protective or monitoring device is used for protection in case of direct or indirect contact, always use a type B GFCI according to IEC 60755.

Fire Hazard

Install adequate branch circuit protection according to applicable local codes and this manual.

Failure to comply could result in fire and damage to the drive or injury to personnel. The device is suitable for use on a circuit capable of delivering not more than 100,000 RMS symmetrical amperes, 240 Vac (200 V class) and 480 Vac (400 V class), when protected by branch circuit protection devices specified in this manual.

⚠ WARNING

Branch circuit protection shall be provided by any of the following: Non-time delay Class J, T, or CC fuses sized at 300% of the drive input rating, or Time delay Class J, T, or CC fuses sized at 175% of the drive input rating, or MCCB sized at 200% maximum of the drive input rating.

Do not use an improper voltage source.

Failure to comply could result in death or serious injury by fire.

Verify that the rated voltage of the drive matches the voltage of the incoming power supply before applying power.

⚠ CAUTION

Crush Hazard

Do not carry the drive by the front cover.

Failure to comply may result in minor or moderate injury from the main body of the drive falling.

NOTICE

Observe proper electrostatic discharge procedures (ESD) when handling the drive and circuit boards.

Failure to comply may result in ESD damage to the drive circuitry.

Do not perform a withstand voltage test on any part of the drive.

Failure to comply could result in damage to the sensitive devices within the drive.

Do not operate damaged equipment.

Failure to comply could result in further damage to the equipment.

Do not connect or operate any equipment with visible damage or missing parts.

Do not expose the drive to halogen group disinfectants.

Failure to comply may cause damage to the electrical components in the drive.

Do not pack the drive in wooden materials that have been fumigated or sterilized.

Do not sterilize the entire package after the product is packed.

Do not use screws of different sizes in SW1 and SW2.

Failure to comply may cause overheating and electrical damage.

This Page Intentionally Blank

1

Parameter Details

1.1 A: Initialization

The initialization group contains parameters associated with initial drive setup, including parameters involving the display language, access levels, initialization, and password.

◆ A1: Initialization

■ A1-00: Language Selection

Selects the display language for the HOA keypad.

Note: This parameter is not reset when the drive is initialized using parameter A1-03.

No.	Parameter Name	Setting Range	Default
A1-00	Language Selection	0, 1, 3, 5, 6	0

Setting 0: English

Setting 1: Japanese

Setting 3: French

Setting 5: Spanish

Setting 6: Portuguese

■ A1-01: Access Level Selection

Allows or restricts access to drive parameters.

No.	Parameter Name	Setting Range	Default
A1-01	Access Level Selection	0 to 2	2

Setting 0: Operation Only

Access to only parameters A1-01, A1-04, and all U monitor parameters.

Setting 1: User Parameters

Access to only a specific list of parameters set to A2-01 through A2-32. These User Parameters can be accessed using the Setup Mode of the HOA keypad.

Setting 2: Advanced Access Level (A)

All parameters can be viewed and edited.

Notes on Parameter Access

- If the drive parameters are password protected by A1-04 and A1-05, parameters A1-00 through A1-03, and all A2 parameters cannot be modified.
- If a digital input terminal programmed for “Program lockout” (H1-□□ = 1B) is enabled, parameter values cannot be modified, even if A1-01 is set to 1 or 2.
- If parameters are changed via serial communication, it will not be possible to edit or change parameter settings with the HOA keypad until an Enter command is issued to the drive from the serial communication.

■ A1-02: Control Method Selection

Selects the Control Method (also referred to as the control mode) that the drive uses to operate the motor. Parameter A1-02 determines the control mode for the motor.

Note: When changing control modes, all parameter settings depending upon the setting of A1-02 will be reset to the default.

No.	Parameter Name	Setting Range	Default
A1-02	Control Method Selection	0, 5	0

Setting 0: V/f Control for Induction Motors

Use this mode for simple speed control and for multiple motor applications with low demands to dynamic response or speed accuracy. The speed control range is 1:40.

Setting 5: Open Loop Vector Control for PM

Use this mode when running a PM motor in variable torque applications that benefit from energy efficiency. The drive can control an SPM or IPM motor with a speed range of 1:20 in this control mode.

■ A1-03: Initialize Parameters

Resets parameters to default values. After initialization, the setting for A1-03 automatically returns to 0.

No.	Parameter Name	Setting Range	Default
A1-03	Initialize Parameters	0, 1110, 2220, 3330, 3410, 3420	0

Setting 0: No Initialize

Setting 1110: User Initialize

Resets parameters to the values selected by the user as User Settings. User Settings are stored when parameter o2-03 is set to “1: Set defaults”.

Note: User Initialization resets all parameters to a user-defined set of default values previously saved to the drive. Set parameter o2-03 to 2 to clear the user-defined default values.

Setting 2220: 2-Wire Initialization

Resets parameters to default settings with digital inputs S1 and S2 configured as Forward run and Reverse run, respectively. *Refer to Setting 40, 41: Forward Run, Reverse Run Command for 2-Wire Sequence on page 79* for more information on digital input functions.

Setting 3330: 3-Wire Initialization

Resets parameters to default settings with digital inputs S1, S2, and S5 configured as Run, Stop, and Forward/Reverse respectively. *Refer to Setting 0: 3-Wire Sequence on page 74* for more information on digital input functions.

Setting 3410: HVAC Initialization

Resets parameters to default settings. The following parameters are not reset:

H1-03: b1 (Customer Safeties)

H1-04: b2 (BAS Interlock)

H1-05: AF (Emergency Override Forward Run)

H2-03: b2 (BAS Interlock Relay Contact)

Note: After performing an HVAC Initialization, H1-03 to H1-05 and H2-03 will be displayed in the Modified Parameters list.

Setting 3420: OEM Bypass Initialization

Resets parameters to default settings. The following parameters are not reset:

H1-03: A7 (BP Customer Safeties)

H1-04: A6 (BP BAS Interlock)

H1-05: A4 (BP Emergency Override)

H1-06: AE (BP Bypass Run)

H2-01: A4 (BP Drive Relay)

H2-02: A5 (BP Bypass Relay)

H2-03: A6 (BP BAS Interlock)

o1-16: 2 (Drive/Bypass)

Note: After performing an OEM Bypass Initialization, H1-03 to H1-05, H2-01 to H2-03, and o1-16 will be displayed in the Modified Parameters list.

Notes on Parameter Initialization

The parameters shown in *Table 1.1* will not be reset when the drive is initialized by setting A1-03 = 2220 or 3330. Although the control mode in A1-02 is not reset when A1-03 is set to 2220 or 3330, it may change when an application preset is selected.

Table 1.1 Parameters Not Changed by Drive Initialization

No.	Parameter Name
A1-00	Language Selection
A1-02	Control Method Selection
E1-03	V/f Pattern Selection
F6-08	Communication Parameter Reset

No.	Parameter Name
L8-35	Installation Selection
o2-04	Drive/kVA Selection

■ A1-04, A1-05: Password and Password Setting

Parameter A1-04 enters the password when the drive is locked; parameter A1-05 is a hidden parameter that sets the password.

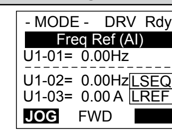
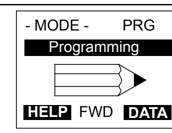
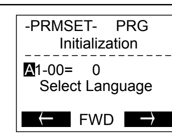
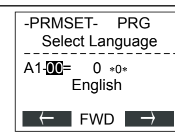
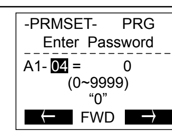
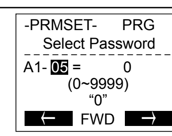
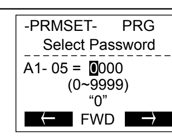
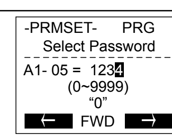
No.	Parameter Name	Setting Range	Default
A1-04	Password	0000 to 9999	0000
A1-05	Password Setting		

How to Use the Password

The user can set a password in parameter A1-05 to restrict access to the drive. The password must be entered to A1-04 to unlock parameter access (i.e., parameter setting A1-04 must match the value programmed into A1-05). The following parameters cannot be viewed or edited until the value entered to A1-04 correctly matches the value set to A1-05: A1-01, A1-02, A1-03, A1-06, and A2-01 through A2-33.

The instructions below demonstrate how to set password “1234”. An explanation follows on how to enter that password to unlock the parameters.

Table 1.2 Setting the Password for Parameter Lock

	Step		Display/Result
1.	Turn on the power to the drive. The initial display appears.	➡	
2.	Press ∧ or ∨ until the Parameter Setting Mode screen appears.	➡	
3.	Press ENTER to enter the parameter menu tree.	➡	
4.	Select the flashing digits by pressing F1, F2, or > RESET.	➡	
5.	Select A1-04 by pressing ∧ .	➡	
6.	Press ∧ while holding down OFF at the same time. A1-05 will appear. **Note:** A1-05 is hidden and will not display by pressing only ∧ .	➡	
7.	Press ENTER.	➡	
8.	Use F1, F2, > RESET, ∨ and ∧ to enter the password.	➡	

Step			Display/Result
9.	Press ENTER to save what was entered.	➡	Entry Accepted
10.	The display automatically returns to the display shown in step 6.	➡	-PRMSET- PRG Select Password A1- 05 = 0 (0~9999) "0" ← FWD →

Table 1.3 Check if A1-02 is Locked (continuing from step 10 above)

Step			Display/Result
1.	Press V to display A1-02.	➡	-PRMSET- PRG Control Method A1-02= 0 *0* V/f Control ← FWD →
2.	Press ENTER, making sure that the setting values cannot be changed.		
3.	Press ESC to return to the first display.	➡	- MODE - PRG Programming HELP FWD DATA

Table 1.4 Enter the Password to Unlock Parameters (continuing from step 3 above)

Step			Display/Result
1.	Press ENTER to enter the parameter setup display.	➡	-PRMSET- PRG Initialization A1-00= 0 Select Language ← FWD →
2.	Press F1, F2, RESET to select the flashing digits as shown.	➡	-PRMSET- PRG Select Language A1-00= 0 *0* English ← FWD →
3.	Press Λ to scroll to A1-04 and ENTER.	➡	-PRMSET- PRG Enter Password A1- 04 = 0 (0~9999) "0" ← FWD →
4.	Enter the password "1234".	➡	-PRMSET- PRG Enter Password A1-04= 1234 V/f Control ← FWD →
5.	Press ENTER to save the new password.	➡	Entry Accepted
6.	Drive returns to the parameter display.	➡	-PRMSET- PRG Enter Password A1- 04 = 0 (0~9999) "0" ← FWD →
7.	Press V and scroll to A1-02.	➡	-PRMSET- PRG Control Method A1-02= 0 *0* V/f Control ← FWD →

Step			Display/Result
8.	Press ENTER to display the value set to A1-02. If the first “0” blinks, parameter settings are unlocked.	➡	-PRMSET- PRG Control Method A1-02= 0 *0* V/f Control ← FWD →
9.	Use RESET and ∧ to change the value if desired (though changing the control mode at this point is not typically done).	➡	-PRMSET- PRG Control Method A1-02= 5 *0* PM OpenLoop Vect ← FWD →
10.	Press ENTER to save the setting, or press ESC to return to the previous display without saving changes.	➡	Entry Accepted
11.	The display automatically returns to the parameter display.	➡	-PRMSET- PRG Initialization A1-00= 0 Select Language ← FWD →

Note:
1. Parameter settings can be edited after entering the correct password.
2. Performing a 2-Wire or 3-Wire initialization resets the password to “0000”.

■ A1-06: Application Preset

Several Application Presets are available to facilitate drive setup for commonly used applications. Selecting one of these Application Presets automatically assigns functions to the input and output terminals and sets a predefined group of parameters to values appropriate for the selected application.

In addition, the parameters most likely to be changed are assigned to the group of User Parameters, A2-01 through A2-16. User Parameters are part of the Setup Group, which provides quicker access by eliminating the need to scroll through multiple menus.

◆ A2: User Parameters

■ A2-01 to A2-32: User Parameters 1 to 32

The user can select up to 32 parameters and assign them to parameters A2-01 through A2-32 to provide quicker access by eliminating the need to scroll through multiple menus. The User Parameter list can also save the most recently edited parameters.

No.	Parameter Name	Setting Range	Default
A2-01 to A2-32	User Parameters 1 to 32	A1-00 to S6-07	Determined by A1-06 <1>

<1> A1-06 determines how parameters edited by the user are saved to the list of User Parameters, A2-01 through A2-32.

Saving User Parameters

To save specific parameters to A2-01 through A2-32, set parameter A1-01 to 2 to allow access to all parameters, then enter the parameter number to one of the A2-☐☐ parameters to assign it to the list of User Parameters. Finally, set A1-01 to 1 to restrict access so users can only set and refer to the parameters saved as User Parameters.

■ A2-33: User Parameter Automatic Selection

Determines whether recently edited parameters are saved to the second half of the User Parameters (A2-17 to A2-32) for quicker access.

No.	Parameter Name	Setting Range	Default
A2-33	User Parameter Automatic Selection	0, 1	Determined by A1-06

Setting 0: Do not save list of recently edited parameters

Set A2-33 to 0 to manually select the parameters listed in the User Parameter group.

Setting 1: Save list of recently edited parameters

Set A2-33 to 1 to automatically save recently edited parameters to A2-17 through A2-32. A total of 16 parameters are saved with the most recently edited parameter set to A2-17, the second most recently to A2-18, and so on. Access the User Parameters using the Setup Mode of the HOA keypad.

1.2 b: Application

◆ b1: Operation Mode Selection

■ b1-01: Frequency Reference Selection for AUTO Mode

Selects the frequency reference source 1.

Note: If a Run command is input to the drive, but the frequency reference entered is 0 or below the minimum frequency, the AUTO or HAND indicator LED on the HOA keypad will light and the OFF indicator will flash.

No.	Parameter Name	Setting Range	Default
b1-01	Frequency Reference Selection for AUTO Mode	0 to 3	1

Setting 0: HOA Keypad

Using this setting, the frequency reference can be input by:

- switching between the multi-speed references from d1-01 to d1-04.
- entering the frequency reference on the operator keypad.

Setting 1: Terminals (Analog Input Terminals)

Using this setting, an analog frequency reference can be entered as a voltage or current signal from terminals A1 or A2.

Voltage Input

Voltage input can be used at any of the two analog input terminals. Make the settings as described in ***Table 1.5*** for the input used.

Table 1.5 Analog Input Settings for Frequency Reference Using Voltage Signals

Terminal	Signal Level	Parameter Settings				Notes
		Signal Level Selection	Function Selection	Gain	Bias	
A1	0 to 10 V with Zero Limit	H3-01 = 0	H3-02 = 0 (Frequency Reference Bias)	H3-03	H3-04	Set Jumper S1 on the terminal board to "V" for voltage input.
A1	0 to 10 V without Zero Limit	H3-01 = 1				
A2	0 to 10 V with Zero Limit	H3-09 = 0	H3-10 = 0 (Frequency Reference Bias)	H3-11	H3-12	
A2	0 to 10 V without Zero Limit	H3-09 = 1				

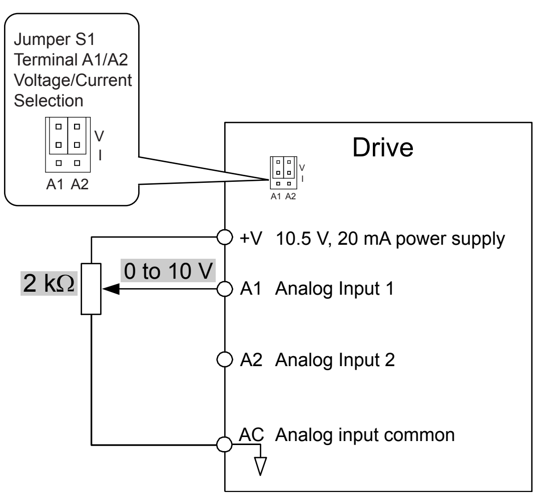


Figure 1.1 Setting the Frequency Reference as a Voltage Signal at Terminal A1

Use the wiring example shown in ***Figure 1.1*** for any other analog input terminals. When using input terminals A1 and A2, make sure Jumper S1 is set for voltage input.

Current Input

Input terminals A1 and A2 can accept a current input signal. Refer to ***Table 1.6*** to set terminals A1 and A2 for current input.

Table 1.6 Analog Input Settings for Frequency Reference Using a Current Signal

Terminal	Signal Level	Parameter Settings				Notes
		Signal Level Selection	Function Selection	Gain	Bias	
A1	4 to 20 mA	H3-01 = 2	H3-02 = 0 (Frequency Reference Bias)	H3-03	H3-04	Make sure to set Jumper S1 on the terminal board to “I” for current input.
	0 to 20 mA	H3-01 = 3				
A2	4 to 20 mA	H3-09 = 2	H3-10 = 0 (Frequency Bias)	H3-11	H3-12	
	0 to 20 mA	H3-09 = 3				

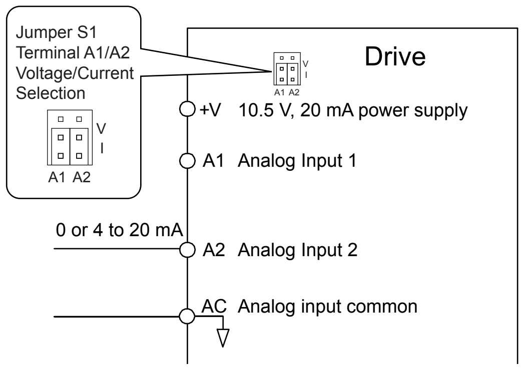


Figure 1.2 Setting the Frequency Reference as a Current Signal to Terminal A2

Switching between Main/Auxiliary Frequency References

The frequency reference input can be switched between the analog terminals A1 and A2 using multi-speed inputs. ***Refer to Multi-Step Speed Selection on page 58*** for details on using this function.

Setting 2: Serial Communication (APOGEE FLN, BACnet, MEMOBUS/Modbus, Metasys N2)

This setting requires entering the frequency reference via the RS-422/RS-485 serial communications port (control terminals R+, R-, S+, and S-). ***Refer to MEMOBUS/Modbus Configuration on page 332*** for instructions.

Setting 3: Option Card

This setting requires entering the frequency reference via an option board plugged into connector CN5 on the drive control board. Consult the option card manual for instructions on integrating the drive with the communication system.

Note: If the frequency reference source is set for Option PCB (b1-01 = 3), but an option board is not installed, an oPE05 Programming Error will be displayed on the HOA keypad and the drive will not run.

■ b1-02: Run Command Selection for AUTO Mode

Determines the Run command selection for AUTO mode.

No.	Parameter Name	Setting Range	Default
b1-02	Run Command Selection for AUTO Mode	1 to 3	1

Setting 1: Control Circuit Terminal

This setting requires entering the Run command via the digital input terminals using one of following sequences:

- 2-Wire sequence 1:

  Two inputs (FWD/Stop-REV/Stop). Set A1-03 to 2220 to initialize the drive and preset terminals S1 and S2 to these functions. This is the default setting of the drive. ***Refer to Setting 40, 41: Forward Run, Reverse Run Command for 2-Wire Sequence on page 79***.
- 2-Wire sequence 2:

  Two inputs (Start/Stop-FWD/REV). ***Refer to Setting 42, 43: Run and Direction Command for 2-Wire Sequence 2 on page 79***.
- 3-Wire sequence:

Parameter Details 1

Three inputs (Start-Stop-FWD/REV). Set A1-03 to 3330 to initialize the drive and preset terminals S1, S2, and S5 to these functions. ***Refer to Setting 0: 3-Wire Sequence on page 74***.

Setting 2: Serial Communication (APOGEE FLN, BACnet, MEMOBUS/Modbus, Metasys N2)

This setting requires entering the Run command via serial communications by connecting the RS-422/RS-485 serial communication cable to control terminals R+, R-, S+, and S- on the terminal block. ***Refer to MEMOBUS/Modbus Configuration on page 332*** for instructions.

Setting 3: Option Card

This setting requires entering the Run command via the communication option board by plugging a communication option board into the CN5 port on the control PCB. Refer to the option card manual for instructions on integrating the drive into the communication system.

Note: If b1-02 is set to 3, but an option card is not installed in CN5, an oPE05 Programming Error will be displayed on the HOA keypad and the drive will not run.

■ b1-03: Stopping Method Selection

Selects how the drive stops the motor when the Run command is removed or when a Stop command is entered.

No.	Parameter Name	Setting Range	Default
b1-03	Stopping Method Selection	0 to 3	1

Setting 0: Ramp to Stop

When the Run command is removed, the drive will decelerate the motor to stop. The deceleration rate is determined by the active deceleration time. The default deceleration time is set to parameter C1-02.

When the output frequency falls below the level set in parameter b2-01, the drive will start DC injection or Short Circuit Braking depending on the selected control mode. ***Refer to b2-01: DC Injection Braking Start Frequency on page 29*** for details.

Setting 1: Coast to Stop

When the Run command is removed, the drive will shut off its output and the motor will coast (uncontrolled deceleration) to stop. The stopping time is determined by the inertia and the friction in the driven system.

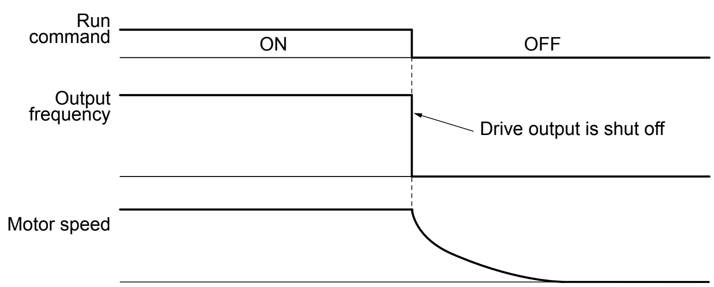


Figure 1.3 Coast to Stop

Note: After a stop is initiated, any subsequent Run command entered will be ignored until the minimum baseblock time (L2-03) has expired. Do not enter Run command until it has come to a complete stop. Use DC Injection at Start (***Refer to b2-03: DC Injection Braking Time at Start on page 30***) or Speed Search (***Refer to b3: Speed Search on page 31***) to restart the motor before it has completely stopped.

Setting 2: DC Injection Braking to Stop

When the Run command is removed, the drive will enter baseblock (turn off its output) for the minimum baseblock time (L2-03). When the minimum baseblock time has expired, the drive will inject the amount DC current set in parameter b2-02 into the motor windings to brake the motor. The stopping time in DC Injection Braking to Stop is significantly faster compared to Coast to Stop.

Note: This function is not available in OLV/PM control mode (A1-02 = 5).

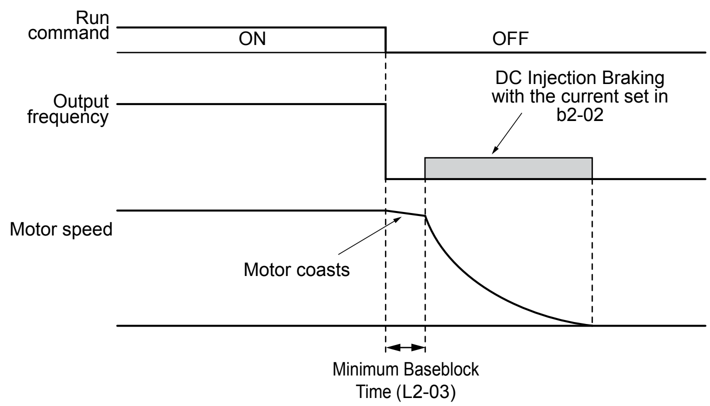


Figure 1.4 DC Injection Braking to Stop

DC Injection Braking time is determined by the value set to b2-04 and the output frequency at the time the Run command is removed. It can be calculated by:

$$\text{DC Injection brake time} = \frac{\text{(b2-04) x 10 x Output frequency}}{\text{Max. output frequency (E1-04)}}$$

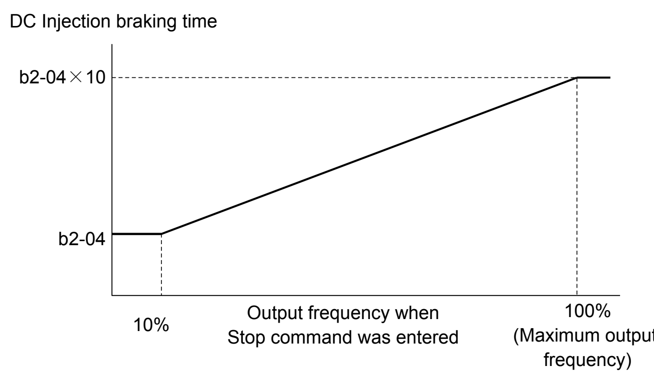


Figure 1.5 DC Injection Braking Time Depending on Output Frequency

Note: If an overcurrent (oC) fault occurs during DC Injection Braking to Stop, lengthen the minimum baseblock time (L2-03) until the fault no longer occurs.

Setting 3: Coast with Timer

When the Run command is removed, the drive will turn off its output and the motor will coast to stop. The drive will not start if a Run command is input before the time *t* (C1-02) has expired. Cycle the Run command that was activated during time *t* after *t* has expired to start the drive.

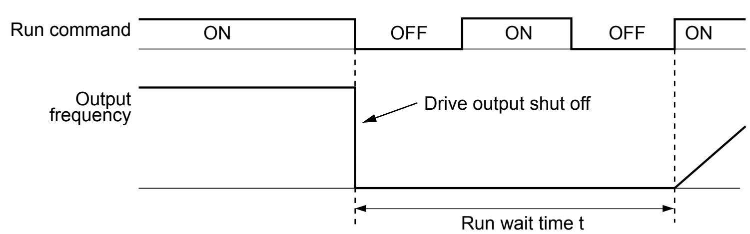


Figure 1.6 Coast with Timer

The wait time *t* is determined by the output frequency when the Run command is removed and by the active deceleration time.

Parameter Details

1

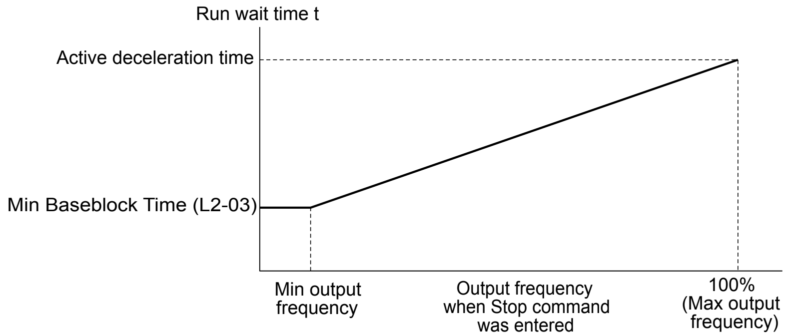


Figure 1.7 Run Wait Time Depending on Output Frequency

■ b1-04: Reverse Operation Selection

Enables and disables Reverse operation. For some applications, reverse motor rotation is not appropriate and may cause problems (e.g., air handling units, pumps, etc.).

No.	Parameter Name	Setting Range	Default
b1-04	Reverse Operation Selection	0, 1	1

Setting 0: Reverse Enabled

Possible to operate the motor in both forward and reverse directions.

Setting 1: Reverse Disabled

Drive disregards a Reverse run command or a negative frequency reference.

■ b1-08: Run Command Selection in Programming Mode

As a safety precaution, the drive will not normally respond to a Run command input when the HOA keypad is being used to adjust parameters in Programming Mode (Verify Menu, Setup Mode, Parameter Settings Mode, and Auto-Tuning Mode). If required by the application, set b1-08 to allow the drive to run while in Programming Mode.

No.	Parameter Name	Setting Range	Default
b1-08	Run Command Selection in Programming Mode	0 to 2	0

Setting 0: Run Command Is Not Accepted in Programming Mode

A Run command is not accepted while the HOA keypad is in Programming Mode.

Setting 1: Run Command Is Accepted in Programming Mode

A Run command is accepted in any HOA keypad mode.

Setting 2: Prohibit Entering Programming Mode during Run

It is not possible to enter the Programming Mode as long as the drive output is active. The Programming Mode cannot be displayed during Run.

■ b1-11: Drive Delay Time Setting

If a time is set to b1-11, the drive will delay executing a Run command until the set time has expired. During Drive Delay Time execution, the HOA keypad will display “WrUn”. Both Alarm and Run indicators will blink while the drive waits to execute the Run command.

No.	Parameter Name	Setting Range	Default
b1-11	Drive Delay Time Setting	0 to 600 s	0

■ b1-14: Phase Order Selection

Sets the phase order for drive output terminals U/T1, V/T2, and W/T3.

Switching motor phases will reverse the direction of the motor.

No.	Parameter Name	Setting Range	Default
b1-14	Phase Order Selection	0, 1	0

Setting 0: Standard

Setting 1: Switch Phase Order

The direction of the motor is reversed.

■ b1-17: Run Command at Power Up

Determines whether an external Run command that is active during power up will start the drive.

No.	Parameter Name	Setting Range	Default
b1-17	Run Command at Power Up	0, 1	1

Setting 0: Disregarded

A new Run command must be issued after power up. Cycle the Run command to start the drive.

Note: For safety reasons, the drive is initially programmed not to accept a Run command at power up (b1-17 = 0). If a Run command is issued at power up, the RUN indicator LED will flash quickly.

Setting 1: Allowed

The motor will start immediately after a power up if a Run command is already enabled.

WARNING! *Sudden Movement Hazard. If b1-17 is set to 1 and an external Run command is active during power up, the motor will begin rotating as soon as the power is switched on. Proper precautions must be taken to ensure that the area around the motor is safe prior to powering up the drive. Failure to comply may cause serious injury.*

◆ b2: DC Injection Braking and Short Circuit Braking

These parameters determine operation of the DC Injection Braking, Zero Speed Control, and Short Circuit Braking features.

■ b2-01: DC Injection Braking Start Frequency

Active when “Ramp to Stop” is selected as the stopping method (b1-03 = 0).

No.	Name	Setting Range	Default
b2-01	DC Injection Braking Start Frequency	0.0 to 10.0 Hz	Determined by A1-02

The function triggered by parameter b2-01 depends on the control mode that has been selected.

V/f (A1-02 = 0)

For these control modes, parameter b2-01 sets the starting frequency for DC Injection Braking at Stop. When the output frequency falls below the setting of b2-01, DC Injection Braking is enabled for the time set in parameter b2-04.

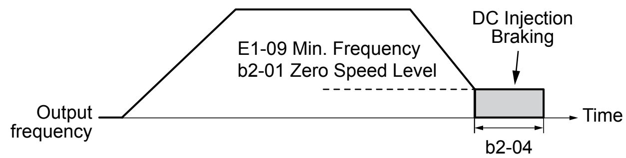


Figure 1.8 DC Injection Braking at Stop for V/f

Note: If b2-01 is set to a smaller value than parameter E1-09 (minimum frequency), then DC Injection Braking will begin as soon as the frequency falls to the value set to E1-09.

OLV/PM (A1-02 = 5)

For these control modes, parameter b2-01 sets the starting frequency for Short-Circuit Braking at stop. When the output frequency falls below the setting of b2-01, Short-Circuit Braking is enabled for the time set in parameter b2-13. If DC Injection Braking time is enabled at stop, then DC Injection Braking is performed for the time set in b2-04 after Short-Circuit Braking is complete.

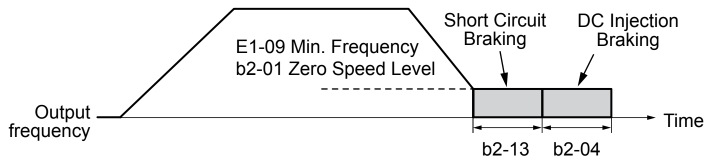


Figure 1.9 Short-Circuit Braking at Stop in OLV/PM

Note: If b2-01 is set to a smaller value than parameter E1-09 (minimum frequency), then DC Injection Braking will begin as soon as the frequency falls to the value set to E1-09.

■ b2-02: DC Injection Braking Current

Sets the DC Injection Braking current as a percentage of the drive rated current. The carrier frequency is automatically reduced to 1 kHz when this parameter is set to more than 50%.

No.	Name	Setting Range	Default
b2-02	DC Injection Braking Current	0 to 100%	50%

The level of DC Injection Braking current affects the strength of the magnetic field attempting to lock the motor shaft. Increasing the current level will increase the amount of heat generated by the motor windings. Do not set this parameter higher than the level necessary to hold the motor shaft.

■ b2-03: DC Injection Braking Time at Start

Sets the time of DC Injection Braking at start. Used to stop a coasting motor before restarting it or to apply braking torque at start. Disabled when set to 0.00 s.

No.	Name	Setting Range	Default
b2-03	DC Injection Braking Time at Start	0.00 to 10.00 s	0.00 s

Note: Before starting an uncontrolled rotating motor (e.g., a fan motor driven by windmill effect), use DC Injection or Speed Search to stop the motor or detect motor speed before starting it. Otherwise, motor stalling and other faults can occur.

■ b2-04: DC Injection Braking Time at Stop

Sets the time of DC Injection Braking at stop. Used to completely stop a motor with high inertia load after ramp down. Increase the value if the motor still coasts by inertia after it should have stopped. Disabled when set to 0.00 s.

No.	Name	Setting Range	Default
b2-04	DC Injection Braking Time at Stop	0.00 to 10.00 s	0.00 s

■ b2-09: Motor Pre-Heat Current 2

Determines the percentage of motor rated output current that will be sued for the motor pre-heat function. Thid function can be useful in applications whre the motor sits for extended periods of time in humid conditions. Motor pre-heating can only be initiated by closing a digital input programmed as a Motor Pre-Heat 2 (H1-□□ = 50).

No.	Name	Setting Range	Default
b2-09	Motor Pre-Heat Current 2	0 to 100%	5%

■ b2-12: Short Circuit Brake Time at Start

Short Circuit Braking can be used in OLV/PM. Shorting all three motor phases produces a braking torque in the motor and can stop a coasting motor before starting it again. Disabled when set to 0.00 s.

No.	Name	Setting Range	Default
b2-12	Short Circuit Brake Time at Start	0.00 to 25.50 s	0.00 s

Note: Short Circuit Braking cannot prevent a PM motor from being rotated by an external force. Use DC Injection to prevent the load from rotating the motor.

■ b2-13: Short Circuit Brake Time at Stop

The Short Circuit Braking described for parameter b2-12 can also be applied at the end of deceleration to completely stop high inertia loads. Short Circuit Braking is initiated for the time set in b2-13 when the output frequency falls below the higher of the values b1-02 and E1-09. Disabled when set to 0.00 s.

No.	Name	Setting Range	Default
b2-13	Short Circuit Brake Time at Stop	0.00 to 25.50 s	0.50 s

■ b2-18: Short Circuit Braking Current

Sets the current level for Short Circuit Braking operation as a percentage of the motor rated current. The Short Circuit Braking current cannot be higher than 120%, although a higher current level can be set using b2-18.

No.	Name	Setting Range	Default
b2-18	Short Circuit Braking Current	0.0 to 200.0%	100.0%

◆ b3: Speed Search

The Speed Search function allows the drive to detect the speed of a rotating motor shaft that is driven by external forces and start the motor operation directly from the detected speed without first stopping the machine.

Example: When a momentary loss of power occurs, the drive output shuts off and the motor coasts. When power returns, the drive can find the speed of the coasting motor and restart it directly.

For PM motors, only parameter b3-01 is needed to enable Speed Search.

For induction motors, the drive offers two types of Speed Search than can be selected by parameter b3-24 (Speed Estimation and Current Detection). Both methods are explained below and followed by a description of all relevant parameters.

■ Current Detection Speed Search (b3-24 = 0)

Current Detection Speed Search detects the motor speed by looking at motor current in IM motors. When Speed Search is started it reduces the output frequency starting from either the maximum output frequency or the frequency reference while increasing the output voltage using the time set in parameter L2-04. As long as the current is higher than the level set to b3-02, the output frequency is lowered using the time constant set to b3-03. If the current falls below b3-02, the drive assumes that the output frequency and motor speed are the same and accelerates or decelerates to the frequency reference.

Be aware that sudden acceleration may occur when using this method of Speed Search with relatively light loads.

Figure 1.10 illustrates Current Detection Speed Search operation after a momentary power loss (L2-01 must be set to 1 or 2):

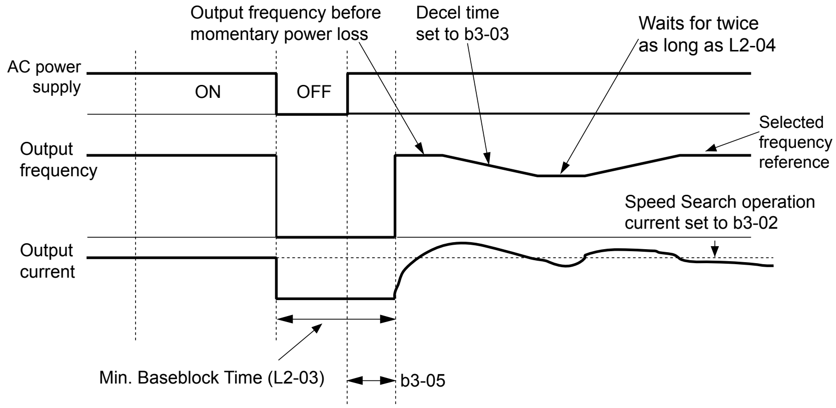


Figure 1.10 Current Detection Speed Search after Power Loss

Note: After power is restored, the drive waits until the time set to b3-05 has passed before performing Speed Search. Thereby the Speed Search may start not at the end of L2-03 but even later.

When Speed Search is applied automatically with the Run command, the drive waits for the minimum baseblock time set to L2-03 before starting Speed Search. If L2-03 is lower than the time set to parameter b3-05, then b3-05 is used as the wait time.

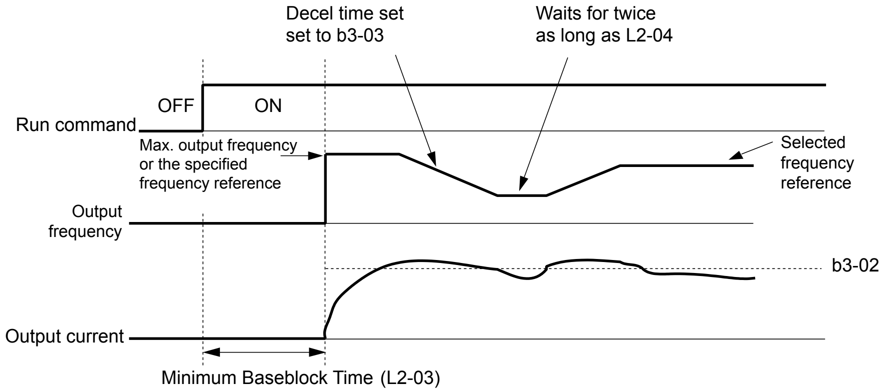


Figure 1.11 Current Detection Speed Search at Start or Speed Search Command by Digital Input

Notes on Using Current Detection Type Speed Search

- Shorten the Speed Search deceleration time set to b3-03 if an oL1 fault occurs while performing Current Detection Speed Search.
- Current Detection Speed Search is not available when using OLV Control for PM motors.
- Increase the minimum baseblock time set to L2-03 if an overcurrent or overvoltage fault occurs when performing Speed Search after power is restored following a momentary power loss.

■ Speed Estimation Type Speed Search (b3-24 = 1)

This method can be used for a single induction motor connected to a drive. Do not use this method if the motor is one or more frame size smaller than the drive, at motor speeds above 200 Hz, or when using a single drive to operate more than one motor.

Speed Estimation is executed in the two steps described below:

Step 1: Back EMF Voltage Estimation

This method is used by Speed Search after baseblock (e.g., a power loss where the drive CPU continued to run and the Run command was kept active). Here, the drive estimates the motor speed by analyzing the back EMF voltage and outputs the estimated frequency and increases the voltage using the time constant set in parameter L2-04. After that, the motor is accelerated or decelerated to the frequency reference starting from the detected speed. If there is not enough residual voltage in the motor windings to perform the calculations described above, the drive will automatically proceed to step 2.

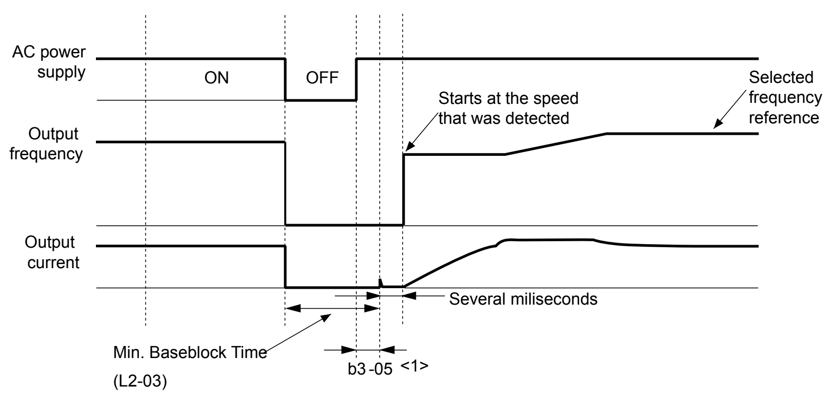


Figure 1.12 Speed Search after Baseblock

<1> After AC power is restored, the drive will wait for at least the time set to b3-05. If the power interruption is longer than the minimum baseblock time set to L2-03, the drive will wait until the time set to b3-05 has passed after power is restored before starting Speed Search.

Step 2: Current Injection

Current Injection is performed when there is insufficient residual voltage in the motor after extended power losses, when Speed Search is applied with the Run command (b3-01 = 1), or when an External search command is used.

This feature injects the amount of DC current set to b3-06 to the motor and detects the speed by measuring the current feedback. The drive then outputs the detected frequency and increases the voltage using the time constant set to parameter L2-04 while looking at the motor current.

The output frequency is reduced if the current is higher than the level in b3-02. When the current falls below b3-02, the motor speed is assumed to be found and the drive starts to accelerate or decelerate to the frequency reference.

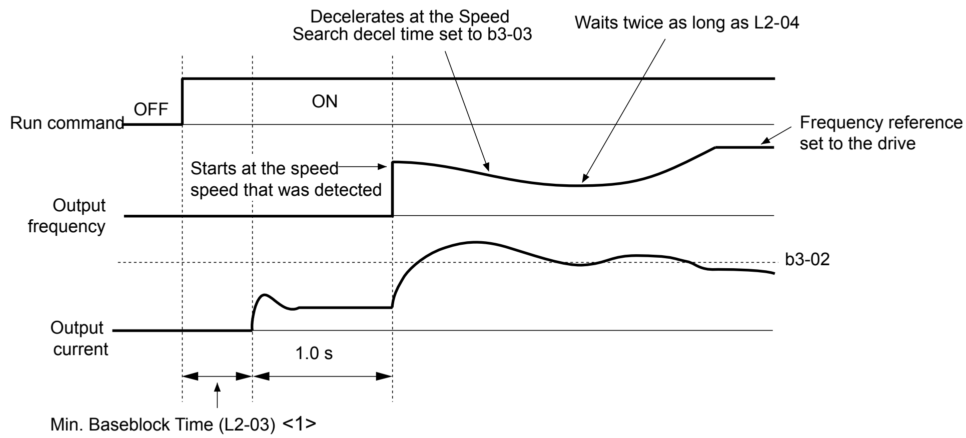


Figure 1.13 Speed Search at Start

<1> The wait time for Speed Search (b3-05) determines the lower limit.

Notes on Using Speed Estimation Speed Search

- Perform Rotational Auto-Tuning for V/f Control (T1-01 = 3) prior to using Speed Estimation in V/f Control and perform Stationary Auto-Tuning for Line-to-Line Resistance (T1-01 = 2) again if the there is a change in the cable length between the drive and motor.
- Use Current Detection to search for speeds beyond 200 Hz if the application is running multiple motors from the same drive or if the motor is considerably smaller than the capacity of the drive.
- Speed Estimation may have trouble finding the actual speed if the motor cable is very long. Use Current Detection in these instances.
- Use Current Detection instead of Speed Estimation when operating motors smaller than 1.5 kW because Speed Estimation might not be able to detect the speed or rotation of these smaller motors, in which case Speed Estimation would stop the motor.
- Use Short Circuit Braking instead of Speed Search when using OLV/PM with a long motor cable.
- Use Short Circuit Braking instead of Speed Search when attempting to find the speed of a motor coasting faster than 200 Hz in OLV/PM.

■ Speed Search Activation

Speed Search can be activated using any of the methods 1 through 5 described below. The Speed Search type must be selected in parameter b3-24 independent of the activation method.

Method 1. Automatically activate Speed Search with every Run command. External Speed Search commands are ignored.

Method 2. Activate Speed Search using the digital input terminals.

Use the input functions for H1-□□ in *Table 1.7*.

Table 1.7 Speed Search Activation by Digital Inputs

Setting	Description	b3-24 = 0	b3-24 = 1
61	External Search Command 1	Closed: Activate Current Detection Speed Search from the maximum output frequency (E1-04).	Activate Speed Estimation Speed Search
62	External Search Command 2	Closed: Activate Current Detection Speed Search from the frequency reference.	

To activate Speed Search by a digital input, the input must be set together with the Run command or the Run command must be entered after giving the Speed Search command.

Method 3. After automatic fault restart.

Parameter Details

1

When the number of maximum fault restarts in parameter L5-01 is set higher than 0, the drive will automatically perform Speed Search as specified by b3-24 following a fault.

Method 4. After momentary power loss.

This mode requires that the Power Loss Ride-Thru function is enabled during CPU operation (L2-01 = 1 or 2). ***Refer to L2-01: Momentary Power Loss Operation Selection on page 102***.

Method 5. After external baseblock is released.

The drive will resume the operation starting with Speed Search if the Run command is present and the output frequency is above the minimum frequency when the Baseblock command (H1-☐☐ = 8 or 9) is released.

■ b3-01: Speed Search Selection at Start

Determines if Speed Search is automatically performed when a Run command is issued.

No.	Parameter Name	Setting Range	Default
b3-01	Speed Search Selection at Start	0, 1	Determined by A1-02

Setting 0: Disabled

This setting starts operating the drive at the minimum output frequency when the Run command is entered. If external Speed Search 1 or 2 is already enabled by a digital input, the drive will start operating with Speed Search.

Setting 1: Enabled

This setting performs Speed Search when the Run command is entered. The drive begins running the motor after Speed Search is complete.

■ b3-02: Speed Search Deactivation Current

Sets the operating current for Speed Search as a percentage of the drive rated current. Normally there is no need to change this setting. Lower this value if the drive has trouble restarting.

No.	Name	Setting Range	Default
b3-02	Speed Search Deactivation Current	0 to 200%	Determined by A1-02

Note: When parameter A1-02 = 0 (V/f Control) the factory default setting is 120.

■ b3-03: Speed Search Deceleration Time

Sets the output frequency reduction ramp used by Current Detection Speed Search (b3-24 = 0) and by the Current Injection Method of Speed Estimation (b3-24 = 1). The time entered into b3-03 will be the time to decelerate from maximum frequency (E1-04) to minimum frequency (E1-09).

No.	Name	Setting Range	Default
b3-03	Speed Search Deceleration Time	0.1 to 10.0 s	2.0 s

■ b3-04: V/f Gain during Speed Search

During Speed Search, the output voltage calculated from the V/f pattern is multiplied with this value. Changing this value can help reduce the output current during Speed Search.

No.	Name	Setting Range	Default
b3-04	V/f Gain during Speed Search	10 to 100%	Determined by o2-04

■ b3-05: Speed Search Delay Time

In cases where an output contactor is used between the drive and the motor, the contactor must be closed before Speed Search can be performed. This parameter can be used to delay the Speed Search operation, giving the contactor enough time to close completely.

No.	Name	Setting Range	Default
b3-05	Speed Search Delay Time	0.0 to 100.0 s	0.2 s

■ b3-06: Output Current 1 during Speed Search

Sets the current injected to the motor at the beginning of Speed Estimation Speed Search as a factor of the motor rated current set in E2-01. If the motor speed is relatively slow when the drive starts to perform Speed Search after a long period of baseblock, it may be helpful to increase the setting value. The output current during Speed Search is automatically limited by the drive rated current.

No.	Name	Setting Range	Default
b3-06	Output Current 1 during Speed Search	0.0 to 2.0	Determined by o2-04

Note: Use Current Detection Speed Search if Speed Estimation is not working correctly even after adjusting b3-06.

■ b3-07: Output Current 2 during Speed Search (Speed Estimation Type)

Sets the amount of output current during Speed Estimation Speed Search as a coefficient for the no-load current (output current during Speed Search is automatically limited by the drive rated current).

Increase this setting value in increments of 0.1 if the drive fails to perform Speed Estimation.

No.	Name	Setting Range	Default
b3-07	Output Current 2 during Speed Search (Speed Estimation Type)	0.0 to 5.0	1.0

■ b3-08: Current Control Gain during Speed Search (Speed Estimation Type)

Sets the proportional gain for the current controller during Speed Search.

No.	Name	Setting Range	Default
b3-08	Current Control Gain during Speed Search (Speed Estimation Type)	0.00 to 6.00	Determined by A1-02 and o2-04

■ b3-09: Current Control Integral Time during Speed Search (Speed Estimation Type)

Sets the Integral Time for the current controller during Speed Search.

No.	Name	Setting Range	Default
b3-09	Current Control Integral Time during Speed Search (Speed Estimation Type)	0.0 to 1000.0 ms	Determined by A1-02

■ b3-10: Speed Search Detection Compensation Gain

Sets the gain for the detected motor speed of the Speed Estimation Speed Search. Increase the setting only if an overvoltage fault occurs when the drive restarts the motor.

No.	Name	Setting Range	Default
b3-10	Speed Search Detection Compensation Gain	1.00 to 1.20	1.05

■ b3-11: Speed Search Method Switching Level (Speed Estimation Type)

Within the type of the speed measurement, the search method can be switched automatically by the amount of remaining voltage in the motor. This parameter sets the switching level. (200 V class at 100% = 200 V, and 400 V class at 100% = 400 V).

No.	Name	Setting Range	Default
b3-11	Speed Search Method Switching Level (Speed Estimation Type)	0.5 to 100.0%	5.0%

■ b3-12: Minimum Current Detection Level during Speed Search

Sets the minimum current detection level during Speed Search. Increase this setting value in increments of 0.1 if the drive fails to perform Speed Estimation.

No.	Name	Setting Range	Default
b3-12	Minimum Current Detection Level during Speed Search	2.0 to 10.0	Determined by o2-04

b3-14: Bi-Directional Speed Search Selection

Sets how the drive determines the motor rotation direction when performing Speed Estimation Speed Search.

No.	Parameter Name	Setting Range	Default
b3-14	Bi-Directional Speed Search Selection	0, 1	1

Setting 0: Disabled

The drive uses the frequency reference to determine the direction of motor rotation to restart the motor.

Setting 1: Enabled

The drive detects the motor rotation direction to restart the motor.

b3-17: Speed Search Restart Current Level

Sets the current level at which Speed Estimation is restarted as a percentage of drive rated current to avoid overcurrent and overvoltage problems since a large current can flow into the drive if the difference between the estimated frequency and the actual motor speed is too big when performing Speed Estimation.

No.	Name	Setting Range	Default
b3-17	Speed Search Restart Current Level	0 to 200%	110%

b3-18: Speed Search Restart Detection Time

Sets the time for which the current must be above the level set in b3-17 before restarting Speed Search.

No.	Name	Setting Range	Default
b3-18	Speed Search Restart Detection Time	0.00 to 1.00 s	0.10 s

b3-19: Number of Speed Search Restarts

Sets the number of times the drive should attempt to find the speed and restart the motor. If the number of restart attempts exceeds the value set to b3-19, the SEr fault will occur and the drive will stop.

No.	Name	Setting Range	Default
b3-19	Number of Speed Search Restarts	0 to 10	3

b3-24: Speed Search Method Selection

Sets the Speed Search method used.

No.	Parameter Name	Setting Range	Default
b3-24	Speed Search Method Selection	0, 1	0

Setting 0: Current Detection

Setting 1: Speed Estimation

Note: *Refer to Current Detection Speed Search (b3-24 = 0) on page 31* and *Refer to Speed Estimation Type Speed Search (b3-24 = 1) on page 32* for explanations of the Speed Search methods.

b3-25: Speed Search Wait Time

Sets the wait time between Speed Search restarts. Increase the wait time if problems occur with overcurrent, overvoltage, or if the SEr fault occurs.

No.	Name	Setting Range	Default
b3-25	Speed Search Wait Time	0.0 to 300.0 s	0.5 s

■ b3-27: Start Speed Search Select

Selects a condition to activate Speed Search Selection at Start (b3-01) or External Speed Search Command 1 or 2 from the multi-function input.

No.	Name	Setting Range	Default
b3-27	Start Speed Search Select	0, 1	0

Setting 0: Triggered when a Run Command Is Issued (Normal)

Setting 1: Triggered when an External Baseblock Is Released

◆ b4: Delay Timers

The timer function is independent of drive operation and can delay the switching of a digital output triggered by a digital input signal and help eliminate chattering switch noise from sensors. An on-delay and off-delay can be set separately.

To enable the timer function, set a multi-function input to “Timer input” (H1-□□ = 18) and set a multi-function output to “Timer output” (H2-□□ = 12). Only one timer can be used.

■ b4-01, b4-02: Timer Function On-Delay, Off-Delay Time

b4-01 sets the on-delay time for switching the timer output. b4-02 sets the off-delay time for switching the timer output.

No.	Name	Setting Range	Default
b4-01	Timer Function On-Delay Time	0.0 to 3000.0 s	0.0 s
b4-02	Timer Function Off-Delay Time	0.0 to 3000.0 s	0.0 s

■ Timer Function Operation

The timer function switches on when the timer function input closes for longer than the value set to b4-01. The timer function switches off when the timer function input is open for longer than the value set to b4-02. *Figure 1.14* illustrates the timer function operation:

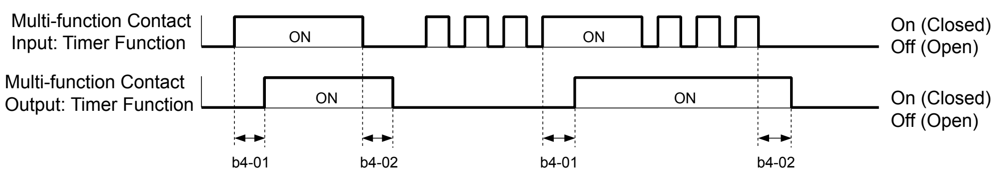


Figure 1.14 Timer Operation

◆ b5: PI Control

The drive has a built-in Proportional + Integral (PI) controller that uses the difference between the target value and the feedback value to adjust the drive output frequency to minimize deviation and provide accurate closed loop control of system variables such as pressure or temperature.

■ P Control

The output of P control is the product of the deviation and the P gain so that it follows the deviation directly and linearly. With P control, only an offset between the target and feedback remains.

■ I Control

The output of I control is the integral of the deviation. It minimizes the offset between target and feedback value that typically remains when pure P control is used. The integral time (I time) constant determines how fast the offset is eliminated.

■ PI Operation

To better demonstrate PI functionality, the diagram below illustrates how the PI output changes when the PI input (deviation) jumps from 0 to a constant level.

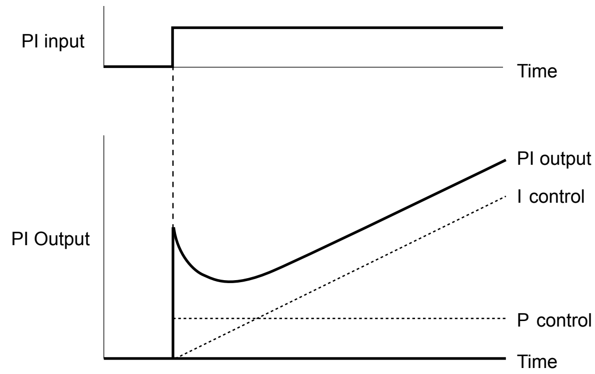


Figure 1.15 PI Operation

■ Using PI Control

Applications for PI control are listed in the following table.

Application	Description	Sensors Used
Speed Control	Machinery speed is fed back and adjusted to meet the target value. Synchronous control is performed using speed data from other machinery as the target value	Tachometer
Pressure	Maintains constant pressure using pressure feedback.	Pressure sensor
Fluid Control	Keeps flow at a constant level by feeding back flow data.	Flow rate sensor
Temperature Control	Maintains a constant temperature by controlling a fan with a thermostat.	Thermocoupler, Thermistor

■ PI Setpoint Input Methods

The PI setpoint input depends on the PI function setting in parameter b5-01.

If parameter b5-01 is set to 1 or 2, the frequency reference in b1-01 or one of the inputs listed in *Table 1.8* becomes the PI setpoint.

If b5-01 is set to 3 or 4, then the PI setpoint can be input from one of the sources listed in *Table 1.8*.

Table 1.8 PI Setpoint Sources

PI Setpoint Source	Settings
Analog Input A1	Set H3-02 = C
Analog Input A2	Set H3-10 = C
MEMOBUS/Modbus Register 0006 H	Set bit 1 in register 000F H to 1 and input the setpoint to register 0006 H
Parameter b5-19	Set parameter b5-18 = 1 and input the PI setpoint to b5-19

Note: A duplicate allocation of the PI setpoint input will cause an oPE alarm.

■ PI Feedback Input Methods

Input one feedback signal for normal PI control or input two feedback signals for controlling a differential process value.

Normal PI Feedback

Input the PI feedback signal from one of the sources listed below:

Table 1.9 PI Feedback Sources

PI Feedback Source	Settings
Analog Input A1	Set H3-02 = B
Analog Input A2	Set H3-10 = B

Note: A duplicate allocation of the PI feedback input will cause an oPE alarm.

Differential Feedback

The second PI feedback signal for differential feedback can come from the sources listed below. The differential feedback function is automatically enabled when a differential feedback input is assigned.

Table 1.10 PI Differential Feedback Sources

PI Differential Feedback Source	Settings
Analog Input A1	Set H3-02 = 16
Analog Input A2	Set H3-10 = 16

Note: A duplicate allocation of the PI differential feedback input will cause an oPE alarm.

■ PI Block Diagram

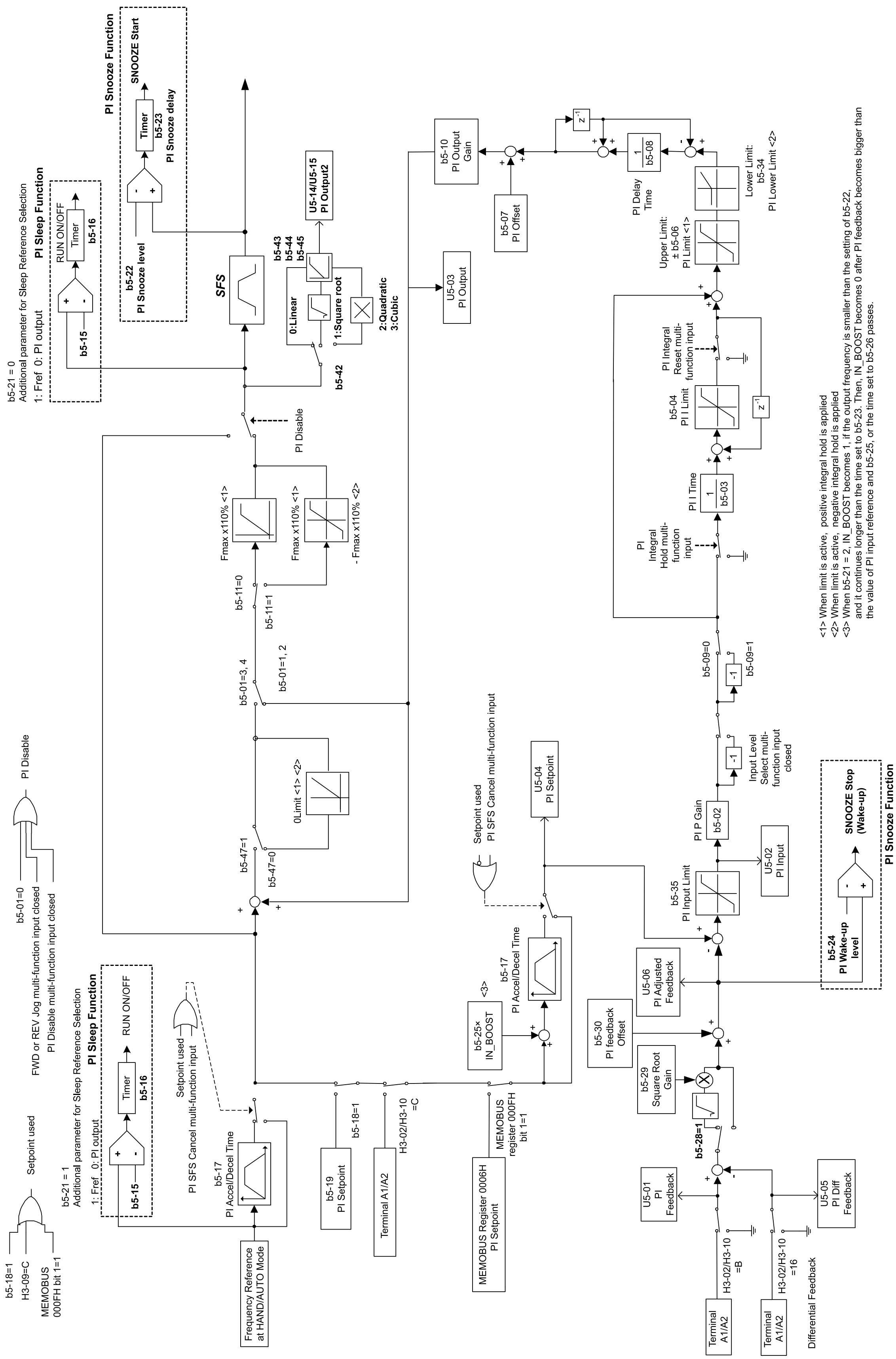


Figure 1.16 PI Block Diagram

■ b5-01: PI Function Setting

Enables or disables the PI operation and selects the PI operation mode.

No.	Parameter Name	Setting Range	Default
b5-01	PI Function Setting	0, 1, 3	0

Setting 0: PI Disabled

Setting 1: Output Frequency = PI Output 1

The PI controller is enabled and the PI output builds the frequency reference.

Setting 3: Output Frequency = Frequency Reference + PI Output 1

The PI controller is enabled and the PI output is added to the frequency reference.

■ b5-02: Proportional Gain Setting (P)

Sets the P gain applied to the PI input. Larger values will tend to reduce the error but may cause oscillations if set too high, while lower values may allow too much offset between the setpoint and feedback.

No.	Name	Setting Range	Default
b5-02	Proportional Gain Setting (P)	0.00 to 25.00	2.00

■ b5-03: Integral Time Setting (I)

Sets the time constant used to calculate the integral of the PI input. The shorter the integral time set to b5-03, the faster the offset will be eliminated. If the integral time is set too short, however, overshoot or oscillation may occur. To turn off the integral time, set b5-03 to 0.00.

No.	Name	Setting Range	Default
b5-03	Integral Time Setting (I)	0.0 to 360.0 s	0.5 s

■ b5-04: Integral Limit Setting

Sets the maximum output possible from the integral block as a percentage of the maximum frequency (E1-04).

No.	Name	Setting Range	Default
b5-04	Integral Limit Setting	0.0 to 100.0%	100.0%

Note: On some applications, especially those with rapidly varying loads, the output of the PI function may show a fair amount of oscillation. Program b5-04 to apply a limit to the integral output and suppress this oscillation.

■ b5-06: PI Output Limit

Sets the maximum output possible from the entire PI controller as a percentage of the maximum frequency (E1-04).

No.	Name	Setting Range	Default
b5-06	PI Output Limit	0.0 to 100.0%	100.0%

■ b5-07: PI Offset Adjustment

Sets the offset added to the PI controller output as a percentage of the maximum frequency (E1-04).

No.	Name	Setting Range	Default
b5-07	PI Offset Adjustment	-100.0 to 100.0%	0.0%

■ b5-08: PI Primary Delay Time Constant

Sets the time constant for the filter applied to the output of the PI controller. Normally, change is not required.

No.	Name	Setting Range	Default
b5-08	PI Primary Delay Time Constant	0.00 to 10.00 s	0.00 s

Note: Useful when there is a fair amount of oscillation or when rigidity is low. Set to a value larger than the cycle of the resonant frequency. Increasing this time constant may reduce the responsiveness of the drive.

■ b5-09: PI Output Level Selection

Reverses the sign of the PI controller output signal. Normally a positive PI input (feedback smaller than setpoint) leads to positive PI output.

No.	Parameter Name	Setting Range	Default
b5-09	PI Output Level Selection	0, 1	0

Setting 0: Normal Output

A positive PI input causes an increase in the PI output (direct acting).

Setting 1: Reverse Output

A positive PI input causes a decrease in the PI output (reverse acting).

■ b5-10: PI Output Gain Setting

Applies a gain to the PI output and can be helpful when the PI function is used to trim the frequency reference (b5-01 = 3 or 4).

No.	Name	Setting Range	Default
b5-10	PI Output Gain Setting	0.00 to 25.00	1.00

■ b5-11: PI Output Reverse Selection

Determines whether a negative PI output reverses the direction of drive operation. This parameter has no effect when the PI function trims the frequency reference (b5-01 = 3) and the PI output will not be limited (same as b5-11 = 1).

No.	Parameter Name	Setting Range	Default
b5-11	PI Output Reverse Selection	0, 1	0

Setting 0: Reverse Disabled

Negative PI output will be limited to 0 and the drive output will be stopped.

Setting 1: Reverse Enabled

Negative PI output will cause the drive to run in the opposite direction.

■ PI Feedback Loss Detection

The PI feedback loss detection function detects broken sensors or broken sensor wiring. It should be used when PI control is enabled to prevent critical machine conditions (e.g., acceleration to max. frequency) caused by a feedback loss.

Feedback loss can be detected in two ways:

- **Feedback Low Detection**

  Detected when the feedback falls below a certain level for longer than the specified time. This function is set up using parameters b5-12 to b5-14.
- **Feedback High Detection**

  Detected when the feedback rises above a certain level for longer than the specified time. This function is set up using parameters b5-12, b5-36, and b5-37.

The following figure illustrates the working principle of feedback loss detection when the feedback signal is too low. Feedback high detection works in the same way.

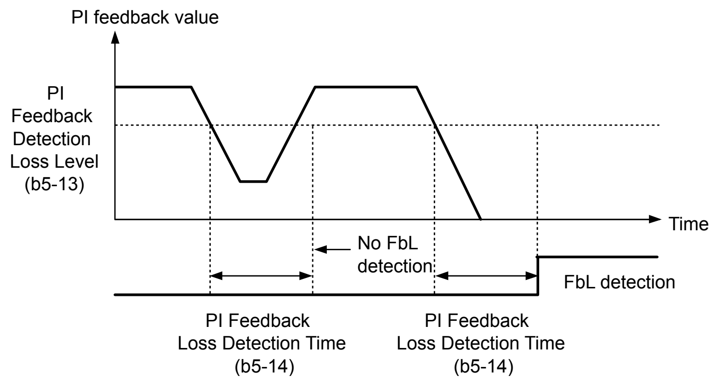


Figure 1.17 PI Feedback Loss Detection

■ b5-12: PI Feedback Loss Detection Selection

Enables or disables the feedback loss detection and sets the operation when a feedback loss is detected.

No.	Parameter Name	Setting Range	Default
b5-12	PI Feedback Loss Detection Selection	0 to 5	0

Note: b5-12 setting range is 0 to 2 in drive software PRG: 1013 and earlier.

Setting 0: Digital Output Only (Remains active when PI is disabled by digital input)

A digital output set for “PI feedback low” (H2-□□ = 3E) will be triggered if the PI feedback value is below the detection level set to b5-13 for the time set to b5-14 or longer. A digital output set for “PI feedback high” (H2-□□ = 3F) will be triggered if the PI feedback value is beyond the detection level set to b5-36 for longer than the time set to b5-37. Neither a fault nor an alarm is displayed on the HOA keypad and the drive will continue operation. The output resets when the feedback value leaves the loss detection range. Detection remains active when PI is disabled by digital input (H1-□□ = 19).

Setting 1: Feedback Loss Alarm (Remains active when PI is disabled by digital input)

If the PI feedback value falls below the level set to b5-13 for longer than the time set to b5-14, a “FBL - Feedback Low” alarm will be displayed and a digital output set for “PI feedback low” (H2-□□ = 3E) will be triggered. If the PI feedback value exceeds the level set to b5-36 for longer than the time set to b5-37, a “FBH - Feedback High” alarm will be displayed and a digital output set for “PI feedback high” (H2-□□ = 3F) will be triggered. Both events trigger an alarm output (H1-□□ = 10). The drive will continue operation. The alarm and outputs reset when the feedback value leaves the loss detection range. Detection remains active when PI is disabled by digital input (H1-□□ = 19).

Setting 2: Feedback Loss Fault (Remains active when PI is disabled by digital input)

If the PI feedback value falls below the level set to b5-13 for longer than the time set to b5-14, a “FbL - Feedback Low” fault will be displayed. If the PI feedback value exceeds the level set to b5-36 for longer than the time set to b5-37, a “FbH - Feedback High” fault will be displayed. Both events trigger a fault output (H1-□□ = E) and cause the drive to stop the motor. Detection remains active when PI is disabled by digital input (H1-□□ = 19).

Setting 3: Digital Output Only

A digital output set for “PI feedback low” (H2-□□ = 3E) will be triggered if the PI feedback value is below the detection level set to b5-13 for the time set to b5-14 or longer. A digital output set for “PI feedback high” (H2-□□ = 3F) will be triggered if the PI feedback value is beyond the detection level set to b5-36 for longer than the time set to b5-37. Neither a fault nor an alarm is displayed on the HOA keypad and the drive will continue operation. The output resets when the feedback value leaves the loss detection range. Detection is disabled when PI is disabled by digital input (H1-□□ = 19).

Setting 4: Feedback Loss Alarm

If the PI feedback value falls below the level set to b5-13 for longer than the time set to b5-14, a “FBL - Feedback Low” alarm will be displayed and a digital output set for “PI feedback low” (H2-□□ = 3E) will be triggered. If the PI feedback value exceeds the level set to b5-36 for longer than the time set to b5-37, a “FBH - Feedback High” alarm will be displayed and a digital output set for “PI feedback high” (H2-□□ = 3F) will be triggered. Both events trigger an alarm output (H1-□□ = 10). The drive will continue operation. The alarm and outputs reset when the feedback value leaves the loss detection range. Detection is disabled when PI is disabled by digital input (H1-□□ = 19).

Setting 5: Feedback Loss Fault

If the PI feedback value falls below the level set to b5-13 for longer than the time set to b5-14, a “FbL - Feedback Low” fault will be displayed. If the PI feedback value exceeds the level set to b5-36 for longer than the time set to b5-37, a “FbH - Feedback High” fault will be displayed. Both events trigger a fault output (H1-☐☐ = E) and cause the drive to stop the motor. Detection is disabled when PI is disabled by digital input (H1-☐☐ = 19).

■ b5-13: PI Feedback Low Detection Level

Sets the feedback level used for PI feedback low detection. The PI feedback must fall below this level for longer than the time set to b5-14 before feedback loss is detected.

No.	Name	Setting Range	Default
b5-13	PI Feedback Low Detection Level	0 to 100%	0%

■ b5-14: PI Feedback Low Detection Time

Sets the time that the PI feedback has to fall below b5-13 before feedback loss is detected.

No.	Name	Setting Range	Default
b5-14	PI Feedback Low Detection Time	0.0 to 25.5 s	1.0 s

■ b5-36: PI Feedback High Detection Level

Sets the feedback level used for PI feedback high detection. The PI feedback must exceed this level for longer than the time set to b5-37 before feedback loss is detected.

No.	Name	Setting Range	Default
b5-36	PI Feedback High Detection Level	0 to 100%	100%

■ b5-37: PI Feedback High Detection Time

Sets the time that the PI feedback must exceed the value set to b5-36 before feedback loss is detected.

No.	Name	Setting Range	Default
b5-37	PI Feedback High Detection Time	0.0 to 25.5 s	1.0 s

■ PI Sleep/Snooze

The PI Sleep/Snooze function stops the drive when the PI output or the frequency reference falls below the PID Sleep/Snooze operation level for a certain time. The drive will resume operating when the PI output or frequency reference rise above the PI Sleep/Snooze operation level for the specified time. An example of PI Sleep/Snooze operation appears in the figure below.

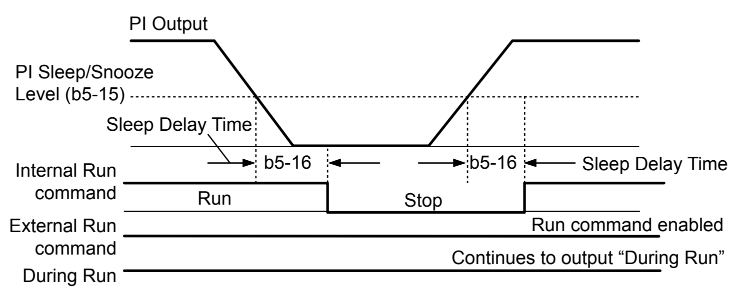


Figure 1.18 PI Sleep/Snooze Operation

Notes on Using the PI Sleep/Snooze Function

- The PI Sleep/Snooze function is active even when PI control is disabled.
- The PI Sleep/Snooze function stops the motor according to the stopping method set to b1-03.

The PI Snooze Function is a variation on the Sleep Function. Set b5-21 to 2 to select the PI Snooze function. After selecting the Snooze Function, the drive monitors the output frequency. If the output frequency drops below the PI Snooze Level (b5-22), and stays below that level for at least the time set to b5-23, PI Snooze Delay Time, the drive output shuts off.

The Snooze Function differs from the Sleep Function in that the feedback must drop below the level set to b5-24, PI Snooze Deactivation Level, before normal drive output will begin again. Immediately prior to Snooze Function activation, the PI Setpoint can be temporarily increased to create an overshoot of the intended PI Setpoint. The temporary boost is determined by parameter b5-25, PI Boost Setting Level.

After reaching the temporary boost level (or exceeding the time set to b5-26, PI Maximum Boost Time), the drive output shuts off (snoozes) and the intended PI Setpoint returns. From this point on, the Snooze Function operates normally and the drive output returns when the feedback level drops below b5-24.

The parameters necessary to control the PI Sleep/Snooze Function are explained below.

■ b5-15: PI Sleep Function Start Level

Sets the level that triggers PI Sleep/Snooze.

The drive goes into Sleep/Snooze mode if the PI output or frequency reference is smaller than b5-15 for longer than the time set to b5-16. The drive resumes operation when the PI output or frequency reference is above b5-15 for longer than the time set to b5-16.

No.	Name	Setting Range	Default
b5-15	PI Sleep Function Start Level	0.0 to 240.0 Hz	0.0 Hz

■ b5-16: PI Sleep Delay Time

Sets the delay time to activate or deactivate the PI Sleep/Snooze function.

No.	Name	Setting Range	Default
b5-16	PI Sleep Delay Time	0.0 to 25.5 s	0.0 s

■ b5-17: PI Accel/Decel Time

The PI acceleration/deceleration time is applied on the PI setpoint value.

When the setpoint changes quickly, the normal C1-□□ acceleration times reduce the responsiveness of the system as they are applied after the PI output. The PI accel/decel time helps avoid the hunting and overshoot and undershoot that can result from the reduced responsiveness.

The PI acceleration/deceleration time can be canceled using a digital input programmed for “PI SFS cancel” (H1-□□ = 34).

No.	Name	Setting Range	Default
b5-17	PI Accel/Decel Time	0.0 to 6000.0 s	0.0 s

■ b5-18: PI Setpoint Selection

Enables or disables parameter b5-19 for PI setpoint.

No.	Parameter Name	Setting Range	Default
b5-18	PI Setpoint Selection	0, 1	0

Setting 0: Disabled

Parameter b5-19 is not used as the PI setpoint.

Setting 1: Enabled

Parameter b5-19 is used as PI setpoint.

■ b5-19: PI Setpoint Value

Used as the PI setpoint if parameter b5-18 = 1.

No.	Name	Setting Range	Default
b5-19	PI Setpoint Value	0.00 to 600.00%	0.00%

Note: Unit and resolution for b5-19 is determined by b5-20, b5-39, and b5-46.

The following conditions apply to drives with software PRG: 1014 and later. Parameter b5-19 is internally limited to b5-38. Changing b5-20, b5-38 and b5-39 will not automatically update the value of b5-19.

■ b5-20: PI Setpoint Scaling

Determines the units for the PI Setpoint Value (b5-19) and monitors U5-01 and U5-04.

No.	Parameter Name	Setting Range	Default
b5-20	PI Setpoint Scaling	0 to 3	1

Setting 0: Hz

The setpoint and PI monitors are displayed in Hz with a resolution of 0.01 Hz.

Setting 1: %

The setpoint and PI monitors are displayed as a percentage with a resolution of 0.01%.

Setting 2: r/min

The setpoint and PI monitors are displayed in r/min with a resolution of 1 r/min.

Setting 3: User Defined

Parameters b5-38 and b5-39 determine the units and resolution used to display the values the setpoint in b5-19, and PI monitors U5-01 and U5-04.

■ b5-21: PI Sleep Input Source

Selects the Sleep Function characteristic action. When b5-21 is set to 1, the Sleep Function Start Level (b5-15) is compared to the output of the drive (Speed Command after PI Block). Use this setting for open loop control.

The Sleep Function Start Level (b5-15) can be compared to the drive input or setpoint by setting b5-21 to 0.

When b5-21 is set to 2, a variation of the Sleep Function called “Snooze” is enabled. See parameters b5-22 to b5-27 for details.

No.	Parameter Name	Setting Range	Default
b5-21	PI Sleep Input Source	0 to 2	1

Setting 0: PI Setpoint

Setting 1: SFS Input

Setting 2: Snooze

■ b5-22: PI Snooze Level

Sets the PI Snooze function start level as a percentage of maximum frequency.

No.	Parameter Name	Setting Range	Default
b5-22	PI Snooze Level	0 to 100%	0%

■ b5-23: PI Snooze Delay Time

Sets the PI Snooze function delay time in seconds.

No.	Parameter Name	Setting Range	Default
b5-23	PI Snooze Level	0 to 2600 s	0 s

■ b5-24: PI Snooze Deactivation Level

When the PI feedback drops below this level, normal operation starts again. Sets as a percentage of maximum frequency.

No.	Parameter Name	Setting Range	Default
b5-24	PI Snooze Wake-up Level	0 to 100%	0%

■ b5-25: PI Setpoint Boost Setting

Temporary increase of PI setpoint to create an overshoot of the intended PI setpoint.

No.	Parameter Name	Setting Range	Default
b5-25	PI Boost Setting Level	0 to 100%	0%

■ b5-26: PI Maximum Boost Time

Associated with the Snooze Function. In cases where the temporary PI Setpoint (intended PI setpoint + PI Setpoint Boost) cannot be reached within the PI Maximum Boost Time (b5-26), the Setpoint Boost is interrupted and the Drive output is turned off.

No.	Parameter Name	Setting Range	Default
b5-26	PI Maximum Boost Time	0 to 2600 s	0 s

■ b5-27: PI Snooze Feedback Level

The second method of initiating the Snooze Function. The drive output shuts off when the PI feedback level exceeds the PI Snooze Feedback Level (b5-27).

Normal drive and PI operation return after the PI feedback drops below the PI Snooze Deactivation Level (b5-24). Snooze activates when both b5-22 and b5-27 conditions are met. There is no time delay for deactivation.

Sets as a percentage of maximum frequency.

No.	Parameter Name	Setting Range	Default
b5-27	PI Snooze Feedback Level	0 to 100%	60%

■ b5-28: PI Feedback Function Selection

When b5-28 is set to 1, the square root of the PI feedback is compared to the PI Setpoint to determine appropriate drive output to properly regulate the system.

This is helpful in cases where the measured feedback is pressure, but the PI loop needs to regulate flow.

No.	Parameter Name	Setting Range	Default
b5-28	PI Feedback Function Selection	0, 1	0

0: Disabled

1: Square Root

■ b5-29: PI Square Root Gain

A multiplier applied to the square root of the feedback. If the PI Function is regulating the flow of a closed loop system by using a pressure feedback, it may be convenient to view the square root of the PI output using monitor U1-37.

No.	Parameter Name	Setting Range	Default
b5-29	PI Square Root Gain	0.00 to 2.00	0.00

■ b5-30: PI Feedback Offset

Sets PI feedback Offset as a percentage of maximum frequency.

No.	Parameter Name	Setting Range	Default
b5-30	PI Feedback Offset	0.00 to 100.00%	0.00%

■ b5-34: PI Output Lower Limit

Sets the minimum possible PI controller output as a percentage of the maximum output frequency (E1-04). The lower limit is disabled when set to 0.00%

No.	Name	Setting Range	Default
b5-34	PI Output Lower Limit	-100.0 to 100.0%	0.0%

■ b5-35: PI Input Limit

Sets the maximum allowed PI input as a percentage of the maximum output frequency (E1-04). Parameter b5-35 acts as a bipolar limit.

No.	Name	Setting Range	Default
b5-35	PI Input Limit	0 to 1000.0%	1000.0%

■ b5-38, b5-39: PI Setpoint User Display, PI Setpoint Display Digits

When parameter b5-20 is set to 3, parameters b5-38 and b5-39 set a user-defined display for the PI setpoint (b5-19) and PI feedback monitors (U5-01, U5-04).

Parameter b5-38 determines the display value when the maximum frequency is output and parameter b5-39 determines the number of digits. The setting value is equal to the number of decimal places.

No.	Name	Setting Range	Default
b5-38	PI Setpoint User Display	1 to 60000	Determined by b5-20
b5-39	PI Setpoint Display Digits	0 to 3	Determined by b5-20

■ b5-40: Frequency Reference Monitor Content During PI

Sets the content of the frequency reference monitor display (U1-01) when PI control is active.

No.	Name	Setting Range	Default
b5-40	Frequency Reference Monitor Content During PI	0, 1	0

Setting 0: Frequency Reference after PI

Monitor U1-01 displays the frequency reference increased or reduced for the PI output.

Setting 1: Frequency Reference

Monitor U1-01 displays the frequency reference value.

■ b5-41: PI Unit Selection

Sets the display units in U5-14 and U5-15.

No.	Name	Setting Range	Default
b5-41	PI Unit Selection	0 to 14	0

Setting 0: WC (Inch of Water)
Setting 1: PSI (Pounds per Square Inch)
Setting 2: GPM (Gallons per Minute)
Setting 3: F (Degrees Fahrenheit)
Setting 4: CFM (Cubic Feet per Minute)
Setting 5: CMH (Cubic Meters per Hour)
Setting 6: LPH (Liters per Hour)
Setting 7: LPS (Liters per Second)
Setting 8: Bar (Bar)
Setting 9: Pa (Pascal)
Setting 10: C (Degrees Celsius)
Setting 11: Mtr (Meters)
Setting 12: Ft (Feet)
Setting 13: LPM (Liters per Minute)
Setting 14: CMM (Cubic Meters per Minute)

■ b5-42: PI Output Monitor Calculation Method

No.	Name	Setting Range	Default
b5-42	PI Output Monitor Calculation Method	0 to 3	0

Setting 0: Linear

The monitor displays PI output.

Setting 1: Square Root

The monitor displays square root PI output.

Setting 2: Quadratic

The monitor displays 1/(PI output)^2

Setting 3: Cubic

The monitor displays 1/(PI output)^3

■ b5-43/b5-44: Custom PI Output Monitor Setting 1/2

Set the maximum monitor value at maximum frequency. U5-14 and U5-15 show Custom PI output. U5-14 shows the upper 4 digits and U5-15 shows the lower 4 digits. It shows 999999.99 maximum.

No.	Name	Setting Range	Default
b5-43	Custom PI Output Monitor Setting 2	0 to 9999	0
b5-44	Custom PI Output Monitor Setting 2	0.00 to 99.99	0.00

■ b5-45: Custom PI Output Monitor Setting 3

b5-14 shows Custom PI Output. b5-45 sets the minimum display value at zero speed. This function is effective when b5-42 is set to 0 (Linear).

No.	Name	Setting Range	Default
b5-45	Custom PI Output Monitor Setting 3	0	999.9

■ b5-46: PI Setpoint Monitor Unit Selection

Sets the HOA keypad display units in U5-01 and U5-04 when b5-20 is set to 3.

No.	Name	Setting Range	Default
b5-46	PI Setpoint Monitor Unit Selection	0 to 14	0

Setting 0: WC (Inch of Water)

Setting 1: PSI (Pounds per Square Inch)

Setting 2: GPM (Gallons per Minute)

Setting 3: F (Degrees Fahrenheit)

Setting 4: CFM (Cubic Feet per Minute)

Setting 5: CMH (Cubic Meters per Hour)

Setting 6: LPH (Liters per Hour)

Setting 7: LPS (Liters per Second)

Setting 8: Bar (Bar)

Setting 9: Pa (Pascal)

Setting 10: C (Degrees Celsius)

Setting 11: Mtr (Meters)

Setting 12: Ft (Feet)

Setting 13: LPM (Liters per Minute)

Setting 14: CMM (Cubic Meters per Minute)

■ b5-47: Reverse Operation Selection 2 by PI Output

Determines whether a negative PI output reverses the direction of drive operation. When the PI function is used to trim the frequency reference (b5-01 = 3), this parameter has no effect and the PI output will not be limited (same as b5-11 = 1).

No.	Name	Setting Range	Default
b5-47	Reverse Operation Selection 2 by PI Output	0, 1	1

Setting 0: Reverse Disabled

Negative PI output will be limited to zero and the drive output will be stopped.

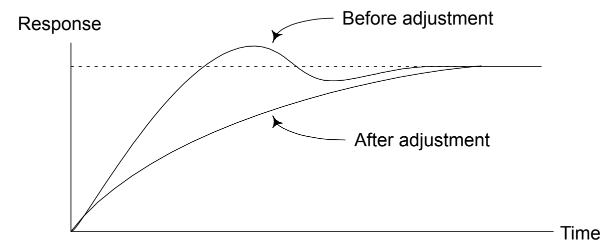
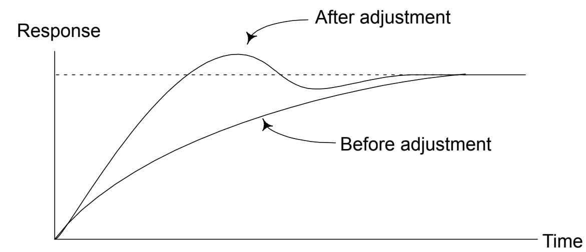
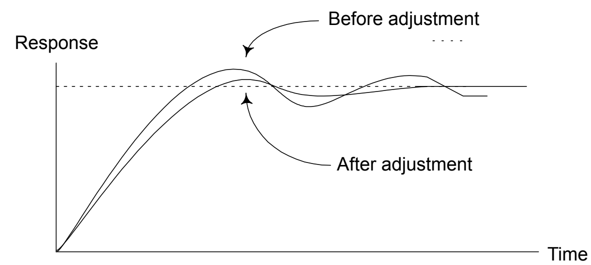
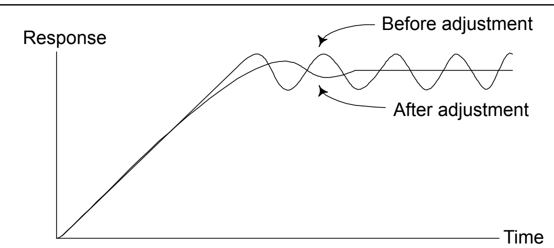
Setting 1: Reverse Enabled

Negative PI output will cause the drive to run in the opposite direction.

■ Fine-Tuning PI

Follow the directions below to fine tune PI control parameters:

Table 1.11 PI Fine Tuning

Goal	Tuning Procedure	Result
Suppress overshoot	Increase the integral time (b5-03)	
Achieve stability quickly while allowing some overshoot	Decrease the integral time (b5-03)	
Suppress long cycle oscillations (longer than the integral time setting)	Increase the integral time (b5-03)	
Suppress short cycle oscillations	If oscillations are a problem, reduce the proportional gain (b5-02) or increase the PI primary delay time (b5-08)	

◆ b8: Energy Saving

The Energy Saving feature improves overall system operating efficiency by operating the motor at its most efficient level.

Note:
1. Energy Saving is not designed for applications that experience instantaneous heavy loads or applications that rarely operate with light load conditions.
2. Energy Saving is mainly designed for applications with variable torque, however Energy Saving is not appropriate for applications where the load may suddenly increase.
3. The performance of the Energy Saving function depends on the accuracy of the motor data. Always perform Auto-Tuning and correctly enter the motor data before using this function.

■ b8-01: Energy Saving Control Selection

Enables or disables the Energy Saving function.

No.	Parameter Name	Setting Range	Default
b8-01	Energy Saving Control Selection	0, 1	Determined by A1-02

Setting 0: Disabled

Setting 1: Enabled

■ b8-04: Energy Saving Coefficient Value (V/f)

Fine tunes Energy Saving control. Adjust this setting while viewing the output power monitor (U1-08) and running the drive with a light load.

A low setting results in less output voltage and less energy consumption. If the value is set too low the motor may stall. The default setting depends on the capacity of the drive.

No.	Name	Setting Range	Default
b8-04	Energy Saving Coefficient Value	0.00 to 655.00	Determined by E2-11, and o2-04

Note: The default value changes if the motor rated capacity set to E2-11 is changed. The Energy Saving coefficient is set automatically when Auto-Tuning for Energy Saving is performed.

■ b8-05: Power Detection Filter Time (V/f)

Determines how often in milliseconds the output power is measured. The Energy Saving function continuously searches out the lowest output voltage to achieve minimum output power.

Reducing this setting increases the response time. If the filter time is too short, the motor may become unstable with a lighter load.

No.	Name	Setting Range	Default
b8-05	Power Detection Filter Time	0 to 2000 ms	20 ms

■ b8-06: Search Operation Voltage Limit (V/f)

Sets the voltage limit for the Speed Search optimal output voltage detection as a percentage of the maximum output voltage. The drive will keep the output voltage above this level during the search operation to prevent motor stalling.

Note: If set too low, the motor may stall when the load is suddenly increased. Disabled when set to 0. Setting this value to 0 does not disable Energy Saving.

No.	Name	Setting Range	Default
b8-06	Search Operation Voltage Limit	0 to 100%	0%

1.3 C: Tuning

C parameters set the characteristics for acceleration, deceleration, and S-curves. Other parameters in the C group cover settings for slip compensation, torque compensation, and carrier frequency.

◆ C1: Acceleration and Deceleration Times

■ C1-01 to C1-04: Accel, Decel Times 1 and 2

Four different sets of acceleration and deceleration times can be set in the drive by digital inputs, motor selection, or switched automatically.

Acceleration time parameters always set the time to accelerate from 0 Hz to the maximum output frequency (E1-04). Deceleration time parameters always set the time to decelerate from maximum output frequency to 0 Hz. C1-01 and C1-02 are the default active accel/decel settings.

No.	Parameter Name	Setting Range	Default
C1-01	Acceleration Time 1	0.1 to 6000.0 s	30.0 s
C1-02	Deceleration Time 1		
C1-03	Acceleration Time 2		
C1-04	Deceleration Time 2		

Switching Acceleration Times by Digital Input

Accel/decel times 1 are active by default if no input is set.

Table 1.12 Accel/Decel Time Selection by Digital Input

Accel/Decel Time Sel. 1 H1-□□ = 7	Active Times	
	Acceleration	Deceleration
0	C1-01	C1-02
1	C1-03	C1-04

Figure 1.19 shows an operation example for changing accel/decel. times. The example below requires that the stopping method be set for “Ramp to stop” (b1-03 = 0).

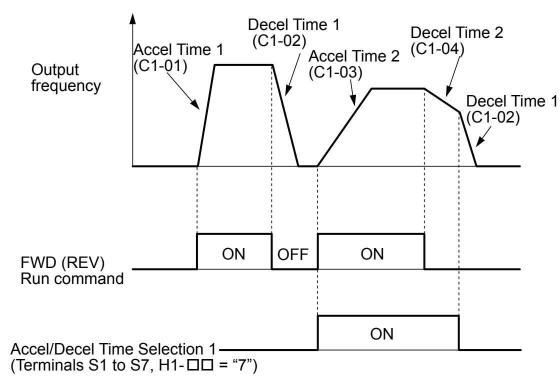


Figure 1.19 Timing Diagram of Accel/Decel Time Change

Switching Accel/Decel Times by a Frequency Level

The drive can switch between different acceleration and deceleration times automatically. The drive will switch from accel/decel time 2 in C1-03 and C1-04 to the default accel/decel time in C1-01 and C1-02 when the output frequency exceeds the frequency level set in parameter C1-11. When the frequency falls below this level, the accel/decel times are switched back. *Figure 1.20* shows an operation example.

Note: Acceleration and deceleration times selected by digital inputs have priority over the automatic switching by the frequency level set to C1-11. For example, if accel/decel time 2 is selected, the drive will use only accel/decel time 2; it will not switch from accel/decel time 2 to the selected time.

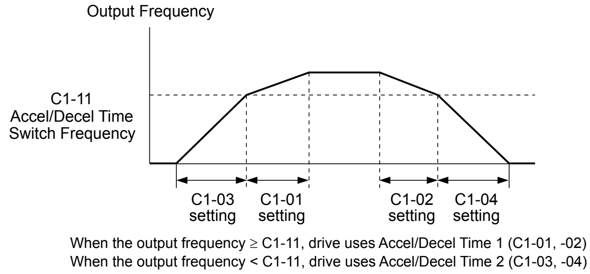


Figure 1.20 Accel/Decel Time Switching Frequency

■ C1-11: Accel/Decel Time Switching Frequency

Sets the frequency at which the drive switches between accel/decel time settings. ***Refer to Switching Accel/Decel Times by a Frequency Level on page 52*** for details.

No.	Parameter Name	Setting Range	Default
C1-11	Accel/Decel Time Switching Frequency	0.0 to 240.0 Hz	0.0 Hz

Note: Setting C1-11 to 0.0 disables this function.

■ C1-09: Fast Stop Time

Sets a special deceleration used when a select group of faults occur or when closing a digital input configured as H1-□□ = 15 (N.O. input) or 17 (N.C. input). A momentary closure of the digital input will trigger the Fast Stop operation; it does not have to be closed continuously.

The drive cannot be restarted after initiating a Fast Stop operation until after completing deceleration, clearing the Fast Stop input, and cycling the Run command.

A digital output programmed for “During Fast Stop” (H2-□□ = 4C) will be closed as long as Fast Stop is active.

No.	Parameter Name	Setting Range	Default
C1-09	Fast Stop Time	0.1 to 6000.0 s	10.0 s

NOTICE: *Rapid deceleration can trigger an overvoltage fault. The drive output shuts off when faulted and the motor coasts. Set an appropriate Fast Stop time to C1-09 to avoid this uncontrolled motor state and to ensure that the motor stops quickly and safely.*

◆ C2: S-Curve Characteristics

Use S-curve characteristics to smooth acceleration and deceleration and minimize abrupt shock to the load. Set S-curve characteristic time during acceleration/deceleration at start and acceleration/deceleration at stop. Increase the value set to C2-01 if the STo fault (Hunting Detection) occurs when starting a PM motor.

■ C2-01 and C2-02: S-Curve Characteristics

C2-01 and C2-02 set separate S-curves for each section of the acceleration or deceleration.

No.	Parameter Name	Setting Range	Default
C2-01	S-Curve Characteristic at Accel Start	0.00 to 10.00 s	Determined by A1-02
C2-02	S-Curve Characteristic at Accel End		0.20 s

Figure 1.21 illustrates S-curve application.

Parameter Details

1

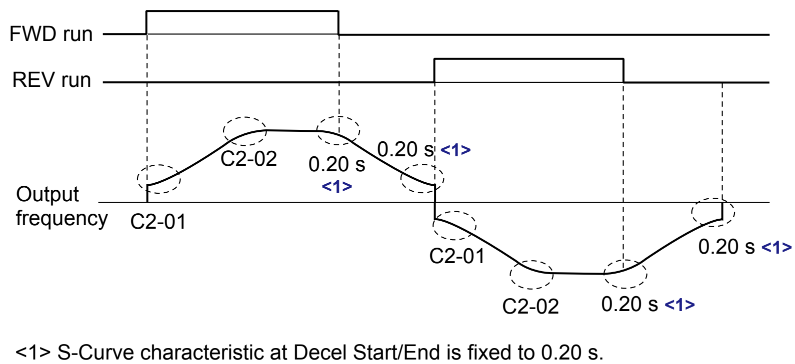


Figure 1.21 S-Curve Timing Diagram - FWD/REV Operation

Setting the S-curve will increase the acceleration and deceleration times.

Actual accel time = accel time setting + (C2-01 + C2-02) / 2

◆ C4: Torque Compensation

The torque compensation function compensates for insufficient torque production at start-up or when a load is applied.

Note: Set the motor parameters and V/f pattern properly before setting torque compensation parameters.

■ C4-01: Torque Compensation Gain

Sets the gain for the torque compensation function.

No.	Parameter Name	Setting Range	Default
C4-01	Torque Compensation Gain	0.00 to 2.50	Determined by A1-02

Torque Compensation in V/f and OLV/PM:

The drive calculates the motor primary voltage loss using the output current and the termination resistor value (E2-05 for IM motors, E5-05 for PM motors) and adjusts the output voltage to compensate insufficient torque at start or when load is applied. The effects of this voltage compensation can be increased or decreased using parameter C4-01.

Adjustment

Although this parameter rarely needs to be changed, it may be necessary to adjust the torque compensation gain in small steps of 0.05 in the following situations:

- Increase this setting when using a long motor cable.
- Decrease this setting when motor oscillation occurs.

Adjust C4-01 so the output current does not exceed the drive rated current.

Note: Refrain from adjusting this parameter in OLV/PM. Setting this value too high can cause overcompensation and motor oscillation.

■ C4-02: Torque Compensation Primary Delay Time

Sets the delay time used for applying torque compensation.

No.	Parameter Name	Setting Range	Default
C4-02	Torque Compensation Primary Delay Time	0 to 60000 ms	Determined by A1-02 and o2-04

Adjustment

Although C4-02 rarely needs to be changed, adjustments may be necessary in the following situations:

- Increase this setting if the motor vibrates.
- Decrease this setting if the motor responds too slowly to changes in the load.

◆ C6: Carrier Frequency

■ C6-02: Carrier Frequency Selection

Sets the switching frequency of the drive output transistors. Changes to the switching frequency lower audible noise and reduce leakage current.

Note: Increasing the carrier frequency above the default value automatically lowers the drive current rating. ***Refer to Rated Current Depending on Carrier Frequency on page 56***.

No.	Parameter Name	Setting Range	Default
C6-02	Carrier Frequency Selection	1 to 9; A to F	Determined by A1-02 and o2-04

Settings:

C6-02	Carrier Frequency	C6-02	Carrier Frequency	C6-02	Carrier Frequency
1	2.0 kHz	5	12.5 kHz	9	Swing PWM 3
2	5.0 kHz	6	15.0 kHz	A	Swing PWM 4
3	8.0 kHz	7	Swing PWM 1	B to E	No setting possible
4	10.0 kHz	8	Swing PWM 2	F	User defined

Note: Swing PWM uses a carrier frequency of 2.0 kHz as a base, then applies a special PWM pattern to reduce the audible noise.

Guidelines for Carrier Frequency Parameter Setup

Symptom	Remedy
Speed and torque are unstable at low speeds	Lower the carrier frequency.
Noise from the drive affects peripheral devices	
Excessive leakage current from the drive	
Wiring between the drive and motor is too long <1>	
Audible motor noise is too loud	Increase the carrier frequency or use Swing PWM.

<1> The carrier frequency may need to be lowered if the motor cable is too long. Refer to the following table.

Wiring Distance	Up to 50 m	Up to 100 m	Greater than 100 m
Recommended setting value for C6-02	1 to F (up to 15 kHz)	1 to 2 (up to 5 kHz), 7 (Swing PWM)	1 (up to 2 kHz), 7 (Swing PWM)

Note: The maximum cable length is 100 m when using OLV/PM (A1-02 = 5).

■ C6-03, C6-04, C6-05: Carrier Frequency Upper Limit, Lower Limit, Proportional Gain

Note: C6-04 and C6-05 are available in V/f Control mode only.

These parameters set a user-defined or a variable carrier frequency. Set C6-02 to F to set the upper and lower limits and the carrier frequency proportional gain.

No.	Parameter Name	Setting Range	Default
C6-03	Carrier Frequency Upper Limit	1.0 to 15.0 kHz	Determined by C6-02
C6-04	Carrier Frequency Lower Limit (V/f Control only)	1.0 to 15.0 kHz	
C6-05	Carrier Frequency Proportional Gain (V/f Control only)	0 to 99	

Setting a Fixed User-Defined Carrier Frequency

A carrier frequency between the fixed selectable values can be entered in parameter C6-03 when C6-02 is set to F.
In V/f Control, adjust parameter C6-04 to the same value as C6-03.

Setting a Variable Carrier Frequency (V/f Control)

In V/f Control, the carrier frequency can be set up to change linearly with the output frequency by setting the upper and lower limits for the carrier frequency and the carrier frequency proportional gain (C6-03, C6-04, C6-05) as shown in ***Figure 1.22***.

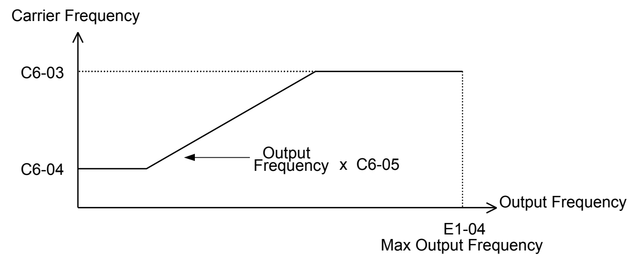


Figure 1.22 Carrier Frequency Changes Relative to Output Frequency

Note: When C6-05 is set lower than 7, C6-04 is disabled and the carrier frequency will be fixed to the value set in C6-03.

■ Rated Current Depending on Carrier Frequency

The table below shows the drive output current depending on the carrier frequency settings.

The 2 kHz values shown in *Table 1.13* are equal to the drive rated current shown on the drive nameplate. Increasing the carrier frequency above 2 kHz will reduce the rated output current of the drive as shown in *Table 1.13*.

Table 1.13 Carrier Frequency and Current Derating

Model	Rated Current (A)				
	2 kHz	5 kHz	8 kHz	10 kHz	12.5 kHz
Three-Phase 200 V Class					
2A0011	10.6	10.6	8.9	7.8	6.4
2A0017	16.7	16.7	14.0	12.2	10.0
2A0024	24.2	24.2	20	17.7	14.5
2A0031	30.8	30.8	26	23	18.5
2A0046	46.2	46.2	39	34	28
2A0059	59.4	59.4	50	44	36
2A0075	74.8	74.8	63	55	45
2A0088	88	88	74	65	53
2A0114	114	114	96	84	68
2A0143	143	143	114	95	–
2A0169	169	169	135	113	–
2A0211	211	211	169	141	–
2A0273	273	273	218	182	–
2A0343	343	274	–	–	–
2A0396	396	317	–	–	–
Three-Phase 400 V Class					
4A0005	4.8	4.8	4.0	3.5	2.9
4A0008	7.6	7.6	6.4	5.6	4.6
4A0011	11	11	9.2	8.1	6.6
4A0014	14	14	11.8	10.3	8.4
4A0021	21	21	17.6	15.4	12.6
4A0027	27	27	23	20	16.2
4A0034	34	34	29	25	20
4A0040	40	40	34	29	24
4A0052	52	52	44	38	31
4A0065	65	65	55	48	39
4A0077	77	77	65	57	46
4A0096	96	96	81	70	58
4A0124	124	124	99	83	–
4A0156	156	156	125	104	–
4A0180	180	180	144	120	–

Model	Rated Current (A)				
	2 kHz	5 kHz	8 kHz	10 kHz	12.5 kHz
4A0240	240	240	192	160	–
4A0302	302	302	242	201	–
4A0361	361	289	–	–	–
4A0414	414	331	–	–	–
4A0480	480	384	–	–	–
4A0590	590	472	–	–	–

1.4 d: Reference Settings

The figure below gives an overview of the reference input, selections, and priorities.

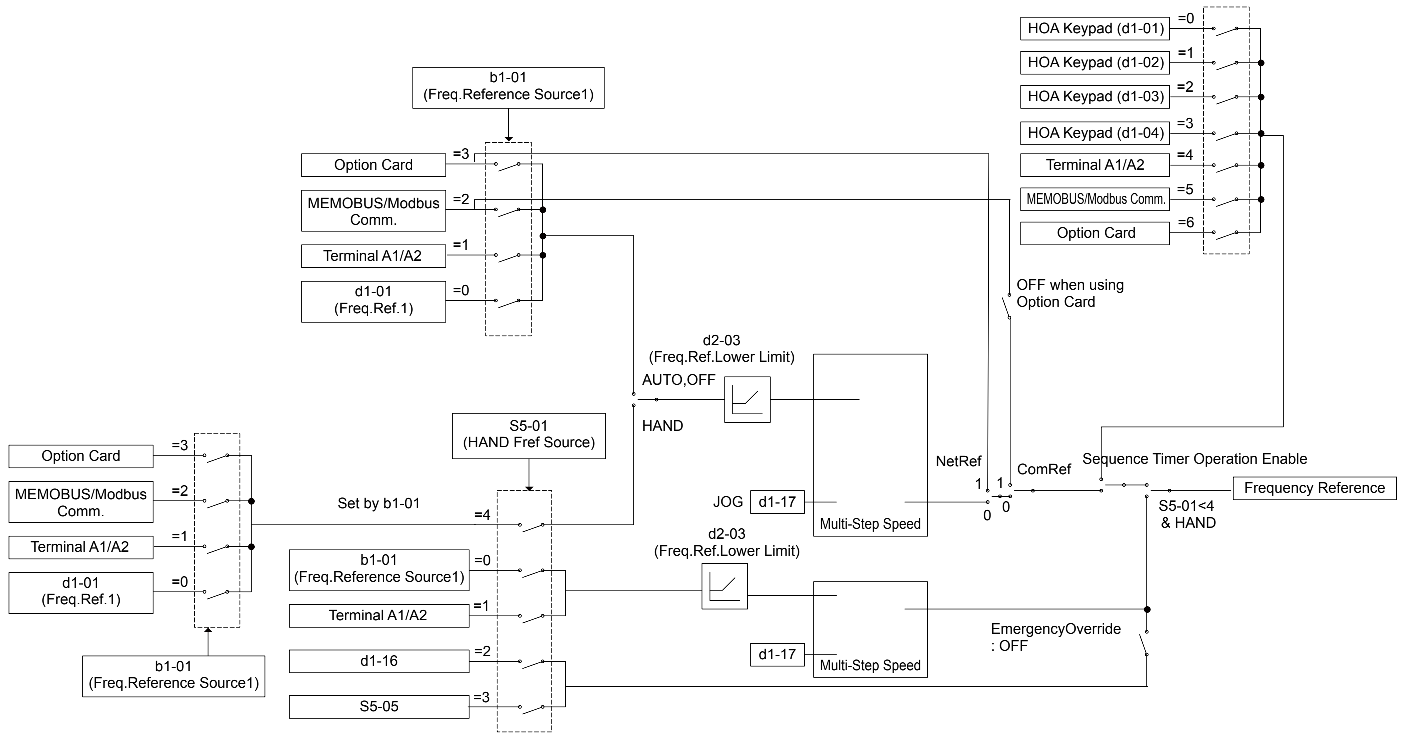


Figure 1.23 Frequency Reference Setting Hierarchy

◆ d1: Frequency Reference

■ d1-01 to d1-04, d1-16, and d1-17: Frequency References 1 to 4, 16, and Jog Frequency Reference

The drive lets the user switch between up to 5 preset frequency references during run (including the Jog reference) through the digital input terminals. The drive uses the acceleration and deceleration times that have been selected when switching between each frequency reference.

The Jog frequency overrides all other frequency references and must be selected by a separate digital input.

The multi-speed references 1 and 2 can be provided by analog inputs.

No.	Parameter Name	Setting Range	Default
d1-01 to d1-04	Frequency Reference 1 to 4	0.00 to 240.00 Hz <1> <2>	0.00 Hz <2>
d1-16	Frequency Reference 16	0.00 to 240.00 Hz <1> <2>	0.00 Hz <2>
d1-17	Jog Frequency Reference	0.00 to 240.00 Hz <1> <2>	6.00 Hz <2>

<1> The upper limit is determined by the maximum output frequency (E1-04) and upper limit for the frequency reference (d2-01).

<2> Setting units are determined by parameter o1-03. The default is “Hz” (o1-03 = 0).

Multi-Step Speed Selection

To use several speed references for a multi-step speed sequence, set the H1-□□ parameters to 3 and 4. To assign the Jog reference to a digital input, set H1-□□ to 6.

Notes on using analog inputs as Multi-Speed 1 and 2:

- The first frequency reference (Multi-Speed 1) comes from the source specified in b1-01. When using an analog input terminal to supply the frequency reference, assign the frequency reference source to the control terminals (b1-01 = 1).
- When an analog input is set to “Auxiliary frequency 1” (H3-02 or H2-06 = 2), the value set to this input will be used as the Multi-Step Speed 2 instead of the value set to parameter d1-02. If no analog inputs are set for “Auxiliary frequency 1”, then d1-02 becomes the reference for Multi-Step Speed 2.

Select the different speed references as shown in ***Table 1.14***. ***Figure 1.24*** illustrates the multi-step speed selection.

Table 1.14 Multi-Step Speed Reference and Terminal Switch Combinations

Reference	Multi-Step Speed H1-□□ = 3	Multi-Step Speed 2 H1-□□ = 4	Jog Reference H1-□□ = 6
Frequency Reference 1 (set in b1-01)	OFF	OFF	OFF
Frequency Reference 2 (d1-02 or input terminal A1, A2)	ON	OFF	OFF
Frequency Reference 3 (d1-03 or input terminal A1, A2)	OFF	ON	OFF
Frequency Reference 4 (d1-04)	ON	ON	OFF
Jog Frequency Reference (d1-17) <1>	–	–	ON

<1> The Jog frequency overrides all other frequency references.

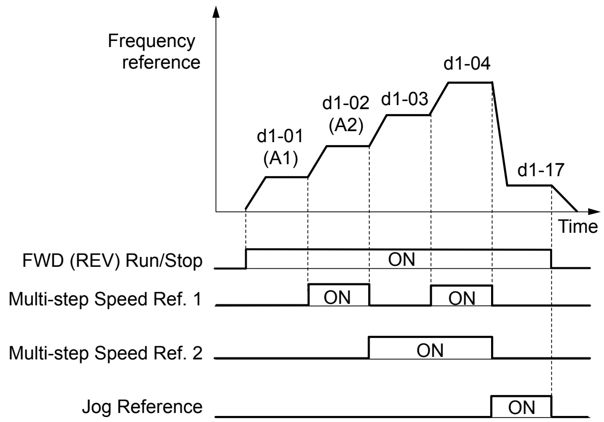


Figure 1.24 Preset Reference Timing Diagram

◆ d2: Frequency Upper/Lower Limits

Upper and lower frequency limits prevent motor speed from going above or below levels that may cause resonance or equipment damage.

■ d2-01: Frequency Reference Upper Limit

Sets the maximum frequency reference as a percentage of the maximum output frequency. This limit applies to all frequency references.

Even if the frequency reference is set to a higher value, the drive internal frequency reference will not exceed this value.

No.	Parameter Name	Setting Range	Default
d2-01	Frequency Reference Upper Limit	0.0 to 110.0%	100.0%

■ d2-02: Frequency Reference Lower Limit

Sets the minimum frequency reference as a percentage of the maximum output frequency. This limit applies to all frequency references.

If a lower reference than this value is entered, the drive will run at the limit set to d2-02. If the drive is started with a lower reference than d2-02, it will accelerate up to d2-02.

No.	Parameter Name	Setting Range	Default
d2-02	Frequency Reference Lower Limit	0.0 to 110.0%	0.0%

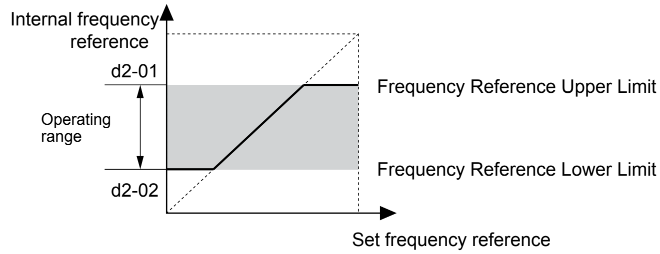


Figure 1.25 Frequency Reference: Upper and Lower Limits

■ d2-03: Master Speed Reference Lower Limit

Sets a lower limit as a percentage of the maximum output frequency that will only affect a frequency reference entered from the analog input terminals (A1 or A2) as the master speed reference. This is unlike parameter d2-02, which affects all frequency references regardless of their source.

Note: When lower limits are set to both parameters d2-02 and d2-03, the drive uses the greater of those two values as the lower limit.

No.	Parameter Name	Setting Range	Default
d2-03	Master Speed Reference Lower Limit	0.0 to 110.0%	0.0%

◆ d3: Jump Frequency

■ d3-01 to d3-04: Jump Frequencies 1, 2, 3 and Jump Frequency Width

The Jump frequencies are frequency ranges at which the drive will not operate. The drive can be programmed with three separate Jump frequencies to avoid operating at speeds that cause resonance in driven machinery. If the speed reference falls within a Jump frequency dead band, the drive will clamp the frequency reference just below the dead band and only accelerate past it when the frequency reference rises above the upper end of the dead band.

Setting parameters d3-01 through d3-03 to 0.0 Hz disables the Jump frequency function.

No.	Parameter Name	Setting Range	Default
d3-01	Jump Frequency 1	0.0 to 240.0 Hz	0.0 Hz
d3-02	Jump Frequency 2	0.0 to 240.0 Hz	0.0 Hz
d3-03	Jump Frequency 3	0.0 to 240.0 Hz	0.0 Hz
d3-04	Jump Frequency Width	0.0 to 20.0 Hz	1.0 Hz

Figure 1.26 shows the relationship between the Jump frequency and the output frequency.

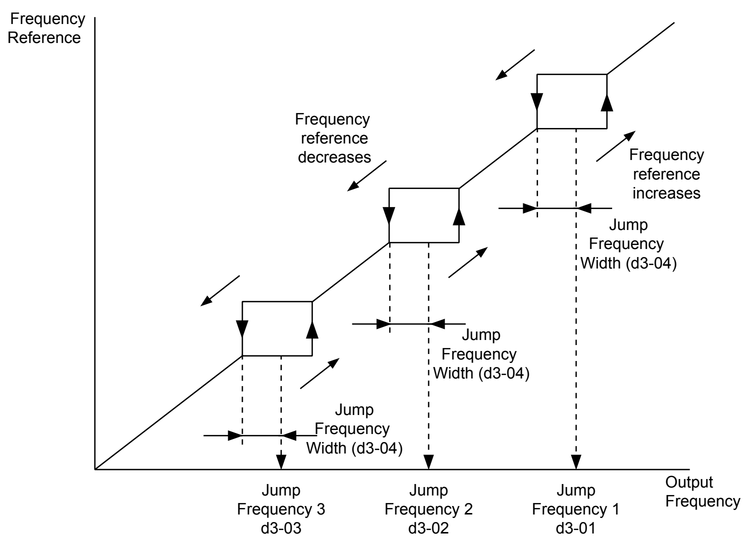


Figure 1.26 Jump Frequency Operation

Note: 1. The drive will use the active accel/decel time to pass through the specified dead band range, but will not allow continuous operation in that range.

2. When setting more than one Jump frequency, make sure that d3-01≥ d3-02 ≥ d3-03.

◆ d4: Frequency Reference Hold and Up/Down 2 Function

■ d4-01: Frequency Reference Hold Function Selection

This parameter is effective when either of the digital input functions listed below are used:

- Accel/decel ramp hold function (H1-□□= A)
- Up/Down function (H1-□□ = 10 and 11)

No.	Parameter Name	Setting Range	Default
d4-01	Frequency Reference Hold Function Selection	0, 1	0

The operation depends on the function used with parameter d4-01.

Setting 0: Disabled

- Acceleration hold

  The hold value will be reset to 0 Hz when the Stop command is entered or the drive power is switched off. The active frequency reference will be the value the drive uses when it restarts.

- Up/Down

  The frequency reference value will be reset to 0 Hz when the Stop command is entered or the drive power is switched off. The drive will start from 0 Hz when it is restarted.

Setting 1: Enabled

- Acceleration hold

  The last hold value will be saved when the Run command or the drive power is switched off and the drive will use the saved value as the frequency reference when it restarts. Make sure to continuously enable the multi-function input terminal set for "Accel/decel ramp hold" (H1-□□ = A) or the hold value will be cleared when the power is switched on.

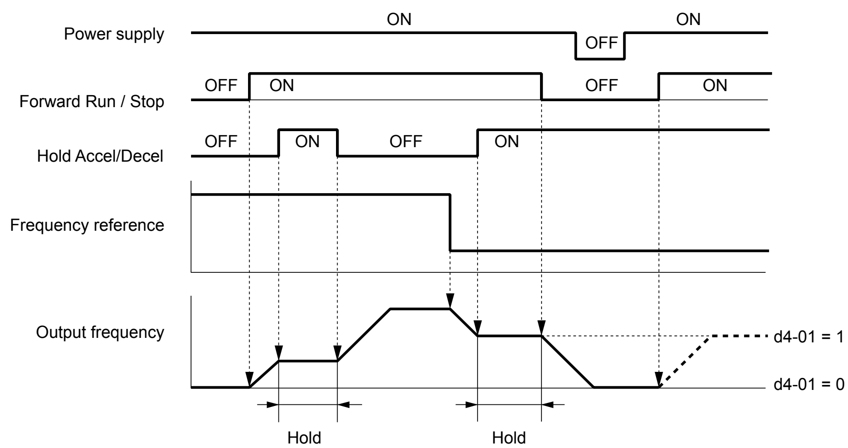


Figure 1.27 Frequency Reference Hold with Accel/Decel Hold Function

- Up/Down

  The frequency reference value will be saved when the Run command or the drive power is switched off. The drive will use the frequency reference that was saved when it restarts.

Clearing the Saved Value

Depending on which function is used, it is possible to clear the saved frequency reference value by:

- Releasing the input programmed for Acceleration hold.
- Setting an Up or Down command while no Run command is active.

■ d4-10: Up/Down Frequency Reference Limit Selection

Selects how the lower frequency limit is set when using the Up/Down function. ***Refer to Settings 10 and 11: Up/Down Function on page 75*** for details on the Up/Down function in combination with frequency reference limits.

No.	Parameter Name	Setting Range	Default
d4-10	Up/Down Frequency Reference Limit Selection	0, 1	0

Parameter Details

1

Setting 0: Lower Limit is Determined by d2-02 or Analog Input

The lower frequency reference limit is determined by the higher value of either parameter d2-02 or an analog input (A1, and A2) that is programmed for "Frequency bias".

Note: For example, if the command to switch the external reference (H1-☐☐ = 2) is used to switch between the Up/Down function and an analog input as the reference source, the analog value becomes the lower reference limit when the Up/Down command is active. Change d4-10 to 1 to make the Up/Down function independent of the analog input value.

Setting 1: Lower Limit is Determined by Parameter d2-02

Only parameter d2-02 sets the lower frequency reference limit.

◆ d6: Field Weakening

■ d6-01: Field Weakening Level

Sets the drive output voltage for the Field Weakening function as a percentage of the maximum output voltage. Enabled when a multi-function input is set for Field Weakening (H1-☐☐ = 63).

No.	Parameter Name	Setting Range	Default
d6-01	Field Weakening Level	0 to 100%	80%

■ d6-02: Field Weakening Frequency Limit

Sets the lower limit of the frequency range where Field Weakening control is valid. The Field Weakening command is valid only at frequencies above this setting and only when the output frequency matches the frequency reference (speed agree).

No.	Parameter Name	Setting Range	Default
d6-02	Field Weakening Frequency Limit	0.0 to 240.0 Hz	0.0 Hz

◆ d7: Offset Frequency

■ d7-01 to d7-03: Offset Frequency 1 to 3

Three different offset values can be added to the frequency reference. They can be selected using digital inputs programmed for Offset frequency 1, 2, and 3 (H1-☐☐ = 44, 45, 46). The selected offset values are added together if multiple inputs are closed simultaneously.

No.	Parameter Name	Setting Range	Default
d7-01	Offset Frequency 1	-100.0 to 100.0%	0%
d7-02	Offset Frequency 2	-100.0 to 100.0%	0%
d7-03	Offset Frequency 3	-100.0 to 100.0%	0%

Figure 1.28 illustrates the Offset frequency function.

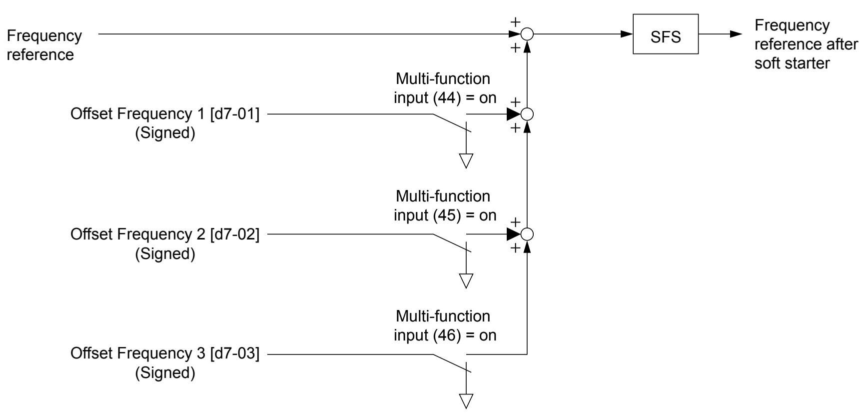


Figure 1.28 Offset Frequency Operation

1.5 E: Motor Parameters

E parameters cover V/f pattern and motor data settings.

◆ E1: V/f Pattern for Motor 1

■ E1-01: Input Voltage Setting

Adjusts the levels of some protective features of the drive (overvoltage, Stall Prevention, etc.). Set this parameter to the nominal voltage of the AC power supply.

NOTICE: *Set parameter E1-01 to match the input voltage of the drive. Drive input voltage (not motor voltage) must be set in E1-01 for the protective features to function properly. Failure to set the correct drive input voltage will result in improper drive operation.*

No.	Parameter Name	Setting Range	Default
E1-01	Input Voltage Setting	190 to 240 V <1>	230 V <1>

<1> Values shown are specific to 200 V class drives. Double the value for 400 V class drives.

E1-01 Related Values

The input voltage setting determines the overvoltage and undervoltage detection levels, the KEB function, and the overvoltage suppression function.

Voltage	Setting Value of E1-01	(Approximate Values) Uv Detection Level (L2-05)
200 V Class	All settings	190 V
400 V Class	Setting > 460 V	440 V
	Setting ≥ 400 V	380 V
	Setting < 400 V	350 V

■ V/f Pattern Settings (E1-03)

The drive uses a V/f pattern to adjust the output voltage relative to the frequency reference. There are 15 different predefined V/f patterns (setting 0 to E) from which to select, each with varying voltage profiles, saturation levels (frequency at which maximum voltage is reached), and maximum frequencies. Additionally, one custom V/f pattern is available (setting F) that requires the user to create the pattern using parameters E1-04 through E1-10.

■ E1-03: V/f Pattern Selection

Selects the V/f pattern for the drive and motor from 15 predefined patterns or creates a custom V/f pattern.

No.	Parameter Name	Setting Range	Default
E1-03	V/f Pattern Selection	0 to F <1>	F <2>

<1> Settings 0 through E are not available in OLV/PM (A1-02 = 5).

<2> Parameter is not reset to the default value when the drive is initialized using A1-03.

Setting a Predefined V/f Pattern (Setting 0 to F)

Choose the V/f pattern that best meets the application demands from the table below. These settings are available only in V/f Control modes. Set the correct value to E1-03. Parameters E1-04 to E1-13 can only be monitored, not changed.

Note:
1. Setting an improper V/f pattern may result in low motor torque or increased current due to overexcitation.
2. Drive initialization does not reset parameter E1-03.

Table 1.15 Predefined V/f Patterns

Setting	Specification	Characteristic	Application
0	50 Hz	Constant torque	For general purpose applications. Torque remains constant regardless of changes to speed.
1	60 Hz		
2	60 Hz (with 50 Hz base)		
3	72 Hz (with 60 Hz base)		

Setting	Specification	Characteristic	Application
4	50 Hz, Variable torque 1	Variable torque	For fans, pumps, and other applications where the required torque changes as a function of the speed.
5	50 Hz, Variable torque 2		
6	50 Hz, Variable torque 3		
7	50 Hz, Variable torque 4		
8	50 Hz, Mid starting torque	High starting torque	Select high starting torque when: • Wiring between the drive and motor exceeds 150 m. • A large amount of starting torque is required. • An AC reactor is installed.
9	50 Hz, High starting torque		
A	60 Hz, Mid starting torque		
B	60 Hz, High starting torque		
C	90 Hz (with 60 Hz base)	Constant output	Output voltage is constant when operating at greater than 60 Hz.
D	120 Hz (with 60 Hz base)		
E	180 Hz (with 60 Hz base)		
F <1>	60 Hz	Variable torque	Used for variable torque applications. The default setting is the same as V/f pattern Setting 7.

<1> Setting F enables a custom V/f pattern by changing parameters E1-04 to E1-13. When the drive is shipped, the default values for parameters E1-04 to E1-13 are equal to predefined V/f pattern 1.

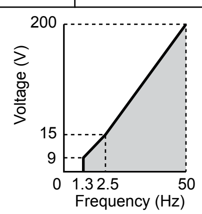
The following tables show details on predefined V/f patterns.

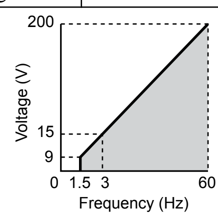
Predefined V/f Patterns for Models 2A0011 to 2A0024 and 4A0005 to 4A0011

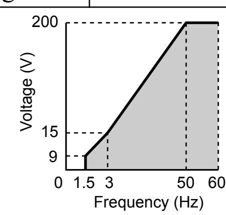
The values in the following graphs are specific to 200 V class drives. Double the values for 400 V class drives.

Table 1.16 Constant Torque Characteristics, Settings 0 to 3

Setting = 0	50 Hz	Setting = 1	60 Hz	Setting = 2	60 Hz	Setting = 3	72 Hz







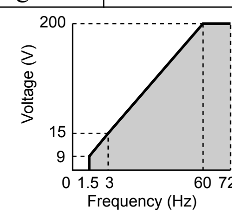
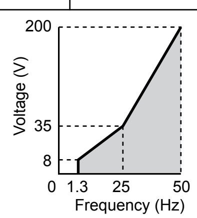
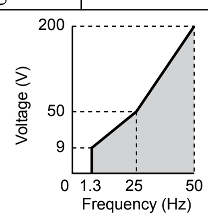
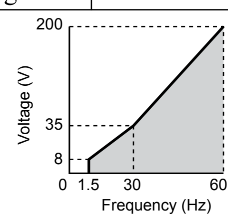


Table 1.17 Variable Torque Characteristics, Settings 4 to 7

Setting = 4	50 Hz	Setting = 5	50 Hz	Setting = 6	60 Hz	Setting = 7	60 Hz







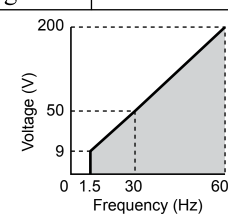
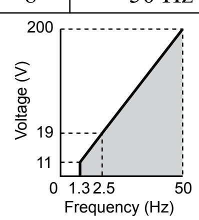
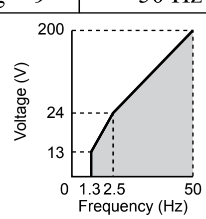
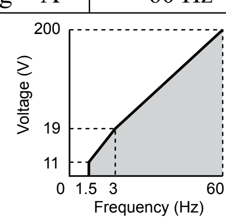


Table 1.18 High Starting Torque, Settings 8 to B

Setting = 8	50 Hz	Setting = 9	50 Hz	Setting = A	60 Hz	Setting = B	60 Hz







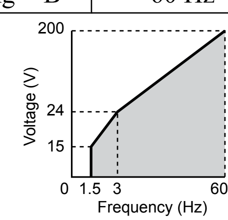
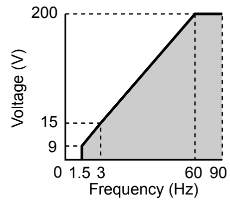
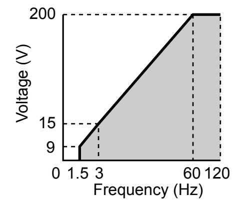
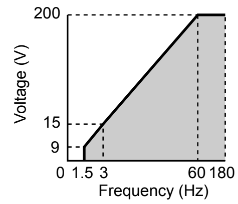
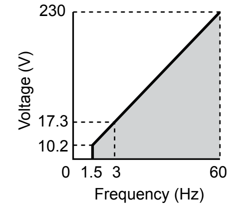


Table 1.19 Rated Output Operation, Settings C to F

<table>
<tr><td>Setting = C</td><td>90 Hz</td><td>Setting = D</td><td>120 Hz</td><td>Setting = E</td><td>180 Hz</td><td>Setting = F</td><td>60 Hz</td></tr>
<tr>
<td colspan="2">
</td>
<td colspan="2">
</td>
<td colspan="2">
</td>
<td colspan="2">
</td>
</tr>
</table>

Predefined V/f Patterns for Models 2A0031 to 2A0211 and 4A0014 to 4A0096

The values in the following graphs are specific to 200 V class drives. Double the values for 400 V class drives.

Table 1.20 Rated Torque Characteristics, Settings 0 to 3

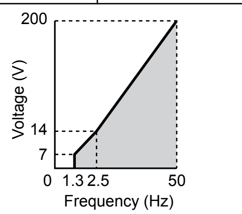
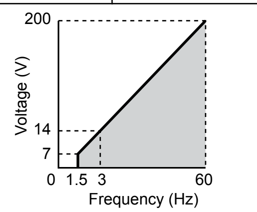
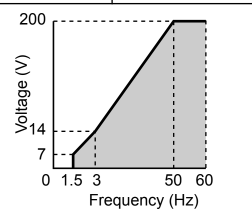
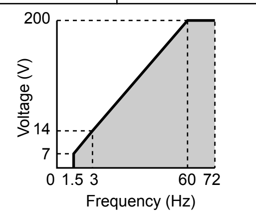
<table>
<tr><td>Setting = 0</td><td>50 Hz</td><td>Setting = 1</td><td>60 Hz</td><td>Setting = 2</td><td>60 Hz</td><td>Setting = 3</td><td>72 Hz</td></tr>
<tr>
<td colspan="2">
</td>
<td colspan="2">
</td>
<td colspan="2">
</td>
<td colspan="2">
</td>
</tr>
</table>

Table 1.21 Variable Torque Characteristics, Settings 4 to 7

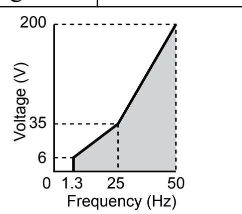
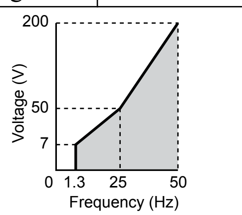
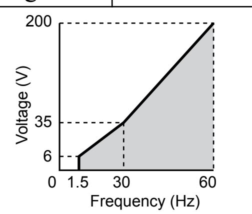
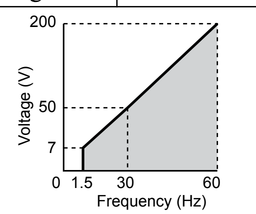
<table>
<tr><td>Setting = 4</td><td>50 Hz</td><td>Setting = 5</td><td>50 Hz</td><td>Setting = 6</td><td>60 Hz</td><td>Setting = 7</td><td>60 Hz</td></tr>
<tr>
<td colspan="2">
</td>
<td colspan="2">
</td>
<td colspan="2">
</td>
<td colspan="2">
</td>
</tr>
</table>

Table 1.22 High Starting Torque, Settings 8 to B

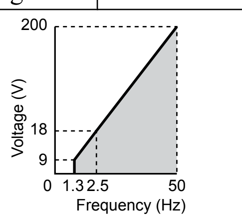
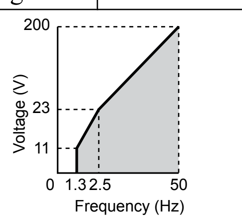
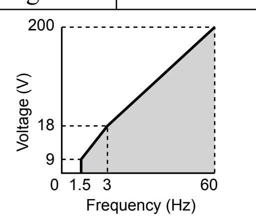
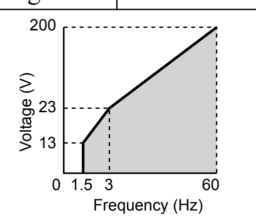
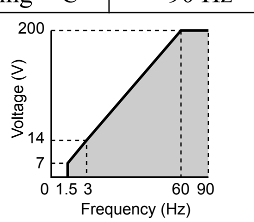
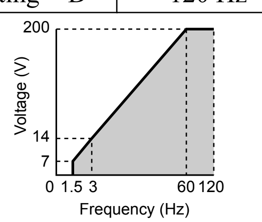
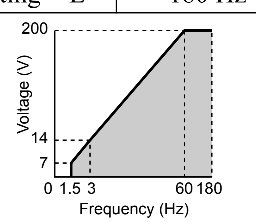
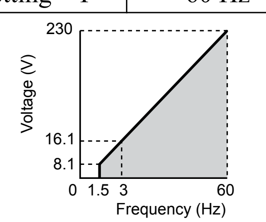
<table>
<tr><td>Setting = 8</td><td>50 Hz</td><td>Setting = 9</td><td>50 Hz</td><td>Setting = A</td><td>60 Hz</td><td>Setting = B</td><td>60 Hz</td></tr>
<tr>
<td colspan="2">
</td>
<td colspan="2">
</td>
<td colspan="2">
</td>
<td colspan="2">
</td>
</tr>
</table>

Table 1.23 Constant Output, Settings C to F

<table>
<tr><td>Setting = C</td><td>90 Hz</td><td>Setting = D</td><td>120 Hz</td><td>Setting = E</td><td>180 Hz</td><td>Setting = F</td><td>60 Hz</td></tr>
<tr>
<td colspan="2">
</td>
<td colspan="2">
</td>
<td colspan="2">
</td>
<td colspan="2">
</td>
</tr>
</table>

Predefined V/f Patterns for Models 2A0273 to 2A0396 and 4A0124 to 4A0590

The values in the following graphs are specific to 200 V class drives. Double the values for 400 V class drives.

Table 1.24 Rated Torque Characteristics, Settings 0 to 3

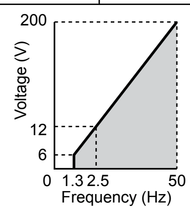
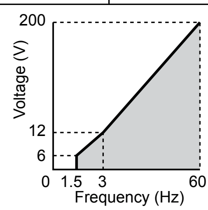
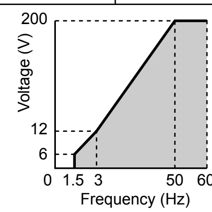
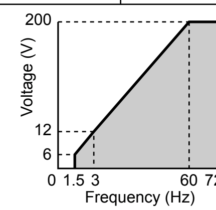
<table>
<tr><td>Setting = 0</td><td>50 Hz</td><td>Setting = 1</td><td>60 Hz</td><td>Setting = 2</td><td>60 Hz</td><td>Setting = 3</td><td>72 Hz</td></tr>
<tr><td colspan="2">
</td><td colspan="2">
</td><td colspan="2">
</td><td colspan="2">
</td></tr>
</table>

Table 1.25 Variable Torque Characteristics, Settings 4 to 7

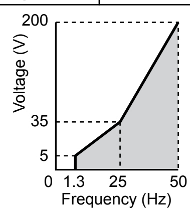
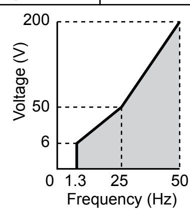
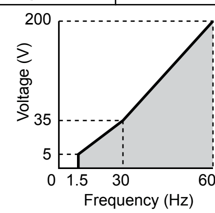
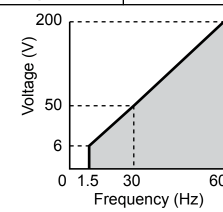
<table>
<tr><td>Setting = 4</td><td>50 Hz</td><td>Setting = 5</td><td>50 Hz</td><td>Setting = 6</td><td>60 Hz</td><td>Setting = 7</td><td>60 Hz</td></tr>
<tr><td colspan="2">
</td><td colspan="2">
</td><td colspan="2">
</td><td colspan="2">
</td></tr>
</table>

Table 1.26 High Starting Torque, Settings 8 to B

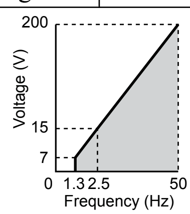
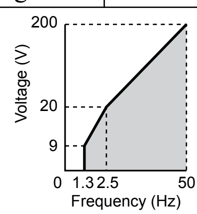
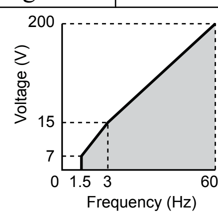
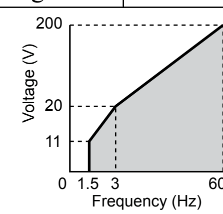
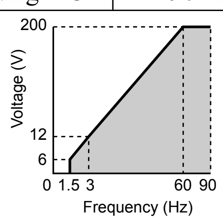
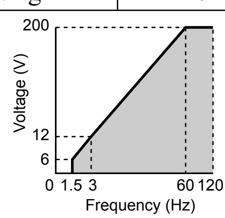
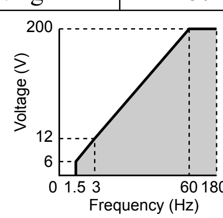
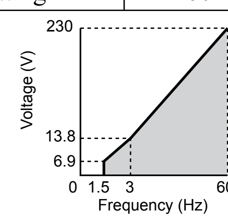
<table>
<tr><td>Setting = 8</td><td>50 Hz</td><td>Setting = 9</td><td>50 Hz</td><td>Setting = A</td><td>60 Hz</td><td>Setting = B</td><td>60 Hz</td></tr>
<tr><td colspan="2">
</td><td colspan="2">
</td><td colspan="2">
</td><td colspan="2">
</td></tr>
</table>

Table 1.27 Constant Output, Settings C to F

<table>
<tr><td>Setting = C</td><td>90 Hz</td><td>Setting = D</td><td>120 Hz</td><td>Setting = E</td><td>180 Hz</td><td>Setting = F</td><td>60 Hz</td></tr>
<tr><td colspan="2">
</td><td colspan="2">
</td><td colspan="2">
</td><td colspan="2">
</td></tr>
</table>

Setting a Custom V/f Pattern (Setting F: Default)

Setting parameter E1-03 to F allows the user to set up a custom V/f pattern by changing parameters E1-04 to E1-13.

When initialized, the default values for parameters E1-04 to E1-13 will be equal to Predefined V/f pattern 1.

■ V/f Pattern Settings E1-04 to E1-13

If E1-03 is set to a preset V/f pattern (i.e., a value other than F), the user can monitor the V/f pattern in parameters E1-04 through E1-13. To create a new V/f pattern, set E1-03 to F. *Refer to V/f Pattern on page 67* for an example custom V/f pattern.

Note: Certain E1-□□ parameters might not be visible depending on the control mode. *Refer to Parameter List on page 207* for details.

No.	Parameter Name	Setting Range	Default
E1-04	Maximum Output Frequency	40.0 to 240.0 Hz	<1>
E1-05	Maximum Voltage	0.0 to 255.0 V <2>	<1>
E1-06	Base Frequency	0.0 to 240.0 kHz	<1>
E1-07	Middle Output Frequency	0.0 to 240.0 kHz	<1>

No.	Parameter Name	Setting Range	Default
E1-08	Middle Output Frequency Voltage	0.0 to 255.0 V <2>	<1>
E1-09	Minimum Output Frequency	0.0 to 240.0 kHz	<1>
E1-10	Minimum Output Frequency Voltage	0.0 to 255.0 V <2>	<1>
E1-11	Middle Output Frequency 2	0.0 to 240.0 kHz	0.0 Hz <3>
E1-12	Middle Output Frequency Voltage 2	0.0 to 255.0 V <2>	0.0 V <3>
E1-13	Base Voltage	0.0 to 255.0 V <2>	0.0 V

<1> Default setting is determined by the control mode.

<2> Values shown are specific to 200 V class drives. Double the value for 400 V class drives.

<3> Parameter ignored when E1-11 and E1-12 are set to 0.0.

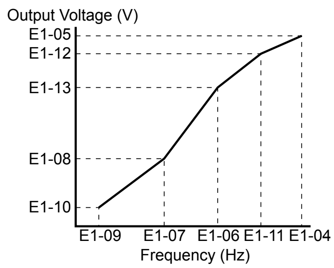


Figure 1.29 V/f Pattern

Note:
1. The following condition must be true when setting up the V/f pattern: E1-09 ≤ E1-07 < E1-06 ≤ E1-11 ≤ E1-04
2. To make the V/f pattern a straight line below E1-06, set E1-09 equal to E1-07. In this case the E1-08 setting is disregarded.
3. E1-03 is unaffected when the drive is initialized, but E1-04 through E1-13 return to their default values.
4. Only use E1-11, E1-12, and E1-13 to fine-tune the V/f pattern in the constant output range. These parameters rarely need to be changed.

◆ E2: Motor 1 Parameters

These parameters contain the motor data needed for motor 1. Enter the motor data into these parameters when Auto-Tuning cannot be performed.

Note: The function for switching between two motors cannot be used with a PM motor. E2-□□ parameters are hidden when OLV/PM control mode is selected (A1-02 = 5).

■ E2-01: Motor Rated Current

Provides motor control, protects the motor, and calculates torque limits. Set E2-01 to the full load amps (FLA) stamped on the motor nameplate.

No.	Parameter Name	Setting Range	Default
E2-01	Motor Rated Current	10% to 200% of the drive rated current	Determined by o2-04

Note:
1. The number of decimal places in the parameter value depends on the drive model. This value has two decimal places (0.01 A) if the drive is set for a maximum applicable motor capacity up to and including 11 kW, 2A0031, 4A0021 (input voltage of 460 V or higher) or 4A0027 (input voltage of lower than 460 V) and one decimal place (0.1 A) if the maximum applicable motor capacity is higher than 11 kW, 2A0046, 4A0027 (input voltage 460 V or higher) or 4A0034 (input voltage lower than 460 V).
2. An oPE02 error will occur if the motor rated current in E2-01 is set lower than the motor no-load current in E2-03. Set E2-03 correctly to prevent this error.

■ E2-02: Motor Rated Slip

Sets the motor rated slip in Hz to provide motor control, protect the motor, and calculate torque limits.

No.	Parameter Name	Setting Range	Default
E2-02	Motor Rated Slip	0.00 to 20.00 Hz	Determined by o2-04

If Auto-Tuning cannot be performed, calculate the motor rated slip using the information written on the motor nameplate and the formula below:

E2-02 = f - (n × p)/120

(f: rated frequency (Hz), n: rated motor speed (r/min), p: number of motor poles)

Parameter Details

1

■ E2-03: Motor No-Load Current

Set the no-load current for the motor in amperes when operating at the rated frequency and the no-load voltage. The drive sets E2-03 during the Auto-Tuning process (Rotational Auto-Tuning and Stationary Auto-Tuning 1, 2). The motor no-load current listed in the motor test report can also be entered to E2-03 manually. Contact the motor manufacturer to receive a copy of the motor test report.

No.	Parameter Name	Setting Range	Default
E2-03	Motor No-Load Current	0 to [E2-01] (unit: 0.01 A)	Determined by o2-04

Note: The number of decimal places in the parameter value depends on the drive model. This value has two decimal places (0.01 A) if the drive is set for a maximum applicable motor capacity up to and including 11 kW, and one decimal place (0.1 A) if the maximum applicable motor capacity is higher than 11 kW.

■ E2-04: Number of Motor Poles

Set the number of motor poles to E2-04. If Auto-Tuning completes successfully, the value entered to T1-06 will automatically be saved to E2-04.

No.	Parameter Name	Setting Range	Default
E2-04	Number of Motor Poles	2 to 48	4

■ E2-05:Motor Line-to-Line Resistance

Sets the line-to-line resistance of the motor stator winding. If Auto-Tuning completes successfully, this value is automatically calculated. Enter this value as line-to-line and not for each motor phase.

If Auto-Tuning is not possible, contact the motor manufacturer to find out the line-to-line resistance or measure it manually. When using the manufacturer motor test report, calculate E2-05 by one of the formulas below:

- E-type insulation: Multiply 0.92 times the resistance value (Ω) listed on the test report at 75 °C.
- B-type insulation: Multiply 0.92 times the resistance value (Ω) listed on the test report at 75 °C.
- F-type insulation: Multiply 0.87 times the resistance value (Ω) listed on the test report at 115 °C.

No.	Parameter Name	Setting Range	Default
E2-05	Motor Line-to-Line Resistance	0.000 to 65.000 Ω	Determined by o2-04

■ E2-10: Motor Iron Loss for Torque Compensation

Sets the motor iron loss in watts.

No.	Parameter Name	Setting Range	Default
E2-10	Motor Iron Loss for Torque Compensation	0 to 65535 W	Determined by o2-04

■ E2-11: Motor Rated Power

Sets the motor rated power in kW. If Auto-Tuning completes successfully, the value entered to T1-02 will automatically be saved to E2-11.

No.	Parameter Name	Setting Range	Default
E2-11	Motor Rated Power	0.00 to 370.00 kW	Determined by o2-04

■ Setting Motor Parameters Manually

Follow the instructions below when setting motor-related parameters manually instead of Auto-Tuning. Refer to the motor test report included with the motor to ensure the correct data is entered into the drive.

Set the Motor Rated Current

Enter the motor rated current listed on the nameplate of the motor to E2-01.

Set the Motor Rated Slip

Calculate the motor rated slip using the base speed listed on the motor nameplate. Refer to the formula below, then enter that value to E2-02.

Motor rated slip = rated frequency [Hz] – base speed [r/min] × (no. of motor poles) / 120

Set the No-Load Current

Enter the no-load current at rated frequency and rated voltage to E2-03. This information is not usually listed on the nameplate. Contact the motor manufacturer if the data cannot be found.

The default setting of the no-load current is for performance with a 4-pole Yaskawa motor.

Set the Line-to-Line Resistance

E2-05 is normally set during Auto-Tuning. If Auto-Tuning cannot be performed, contact the motor manufacturer to determine the correct resistance between motor lines. The motor test report can also be used to calculate this value using the formulas below:

- E-type insulation: Multiply 0.92 times the resistance value (Ω) listed on the test report at 75 °C.
- B-type insulation: Multiply 0.92 times the resistance value (Ω) listed on the test report at 75 °C.
- F-type insulation: Multiply 0.87 times the resistance value (Ω) listed on the test report at 115 °C.

Set the Motor Iron Loss for Torque Compensation

Only required when using V/f Control. Enter this value in watts to E2-10. The drive uses this setting to improve the precision of torque compensation.

◆ E5: PM Motor Settings

These parameters set the motor data of a PM motor.

Perform Auto-Tuning for PM motors. The motor data can be entered manually, if known.

Note:
1. E5-□□ parameters are visible only when a OLV/PM motor control mode is selected (A1-02 = 5).
2. E5-□□ parameters are not reset when the drive is initialized using parameter A1-03.

■ E5-02: Motor Rated Power

Sets the rated power of the motor. Determined by the value set to T2-04 during Stationary Auto-Tuning for PM motors.

No.	Parameter Name	Setting Range	Default
E5-02	Motor Rated Power	0.10 to 370.00 kW	Determined by o2-04

■ E5-03: Motor Rated Current

Sets the motor rated current in amps. Automatically set when the value is entered to T2-06 during Auto-Tuning.

No.	Parameter Name	Setting Range	Default
E5-03	Motor Rated Current	10 to 200% of drive rated current	Determined by o2-04

Note: The number of decimal places in the parameter value depends on the drive model. This value has two decimal places (0.01 A) if the drive is set for a maximum applicable motor capacity up to and including 11 kW, and one decimal place (0.1 A) if the maximum applicable motor capacity is higher than 11 kW.

■ E5-04: Number of Motor Poles

Sets the number of motor poles. Automatically set when the value is entered to T2-08 during Auto-Tuning.

No.	Parameter Name	Setting Range	Default
E5-04	Number of Motor Poles	2 to 48	Determined by o2-04

■ E5-05: Motor Stator Resistance (r1)

Set the resistance for one motor phase. Do not enter the line-to-line resistance into E5-05 when measuring the resistance manually.

No.	Parameter Name	Setting Range	Default
E5-05	Motor Stator Resistance	0.000 to 65.000 Ω	Determined by o2-04

■ E5-06: Motor d-Axis Inductance (Ld)

Sets the d-Axis inductance in 0.01 mH units.

No.	Parameter Name	Setting Range	Default
E5-06	Motor d-Axis Inductance	0.00 to 300.00 mH	Determined by o2-04

■ E5-07: Motor q-Axis Inductance (Lq)

Sets the q-Axis inductance in 0.01 mH units.

No.	Parameter Name	Setting Range	Default
E5-07	Motor q-Axis Inductance	0.00 to 600.00 mH	Determined by o2-04

■ E5-09: Motor Induction Voltage Constant 1 (Ke)

Sets the induced peak voltage per phase in units of 0.1 mV/(rad/s) [electrical angle]. Set this parameter when using an IPM motor with variable torque.

No.	Parameter Name	Setting Range	Default
E5-09	Motor Induction Voltage Constant 1	0.0 to 2000.0 mV/(rad/s)	Determined by o2-04

Note: Set E5-24 to 0 when setting E5-09. However, setting both E5-09 and E5-24 to 0 will trigger an alarm. An alarm will also be triggered if neither E5-09 nor E5-24 are set to 0.

■ E5-24: Motor Induction Voltage Constant 2 (Ke)

Set the induced phase-to-phase rms voltage in units of 0.1 mV/(r/min) [mechanical angle]. Set this parameter when using an SPM Motor.

No.	Parameter Name	Setting Range	Default
E5-24	Motor Induction Voltage Constant 2	0.0 to 6500.0 mV/(r/min)	Determined by o2-04

Note: Set E5-24 to 0.0 when setting E5-09. However, setting both E5-09 and E5-24 to 0.0 will trigger an alarm. An alarm will also be triggered if neither E5-09 nor E5-24 are set to 0.0.

1.6 F: Option Settings

◆ F6: Communication Option Card

Parameters F6-01 through F6-03 and F6-06 through F6-08 are used for EtherNet/IP and LONWORKS options.

■ F6-01: Communications Error Operation Selection

Determines drive operation when a communication error occurs.

No.	Parameter Name	Setting Range	Default
F6-01	Communications Error Operation Selection	0 to 3	1

Setting 0: Ramp to stop (uses the deceleration time set to C1-02)

Setting 1: Coast to stop

Setting 2: Fast Stop (uses the Fast Stop time set to C1-09)

Setting 3: Alarm only (continue operation)

■ F6-02: External Fault from Comm. Option Detection Selection

Determines the detection method of an external fault initiated by a communication option (EF0).

No.	Parameter Name	Setting Range	Default
F6-02	External Fault from Comm. Option Detection Selection	0, 1	0

Setting 0: Always detected

Setting 1: Detection during Run only

■ F6-03: External Fault from Comm. Option Operation Selection

Determines drive operation when an external fault is initiated by a communication option (EF0).

No.	Parameter Name	Setting Range	Default
F6-03	External Fault from Comm. Option Operation Selection	0 to 3	1

Setting 0: Ramp to stop

Setting 1: Coast to stop

Setting 2: Fast Stop

Setting 3: Alarm only (continue operation)

■ F6-06: Torque Reference/Torque Limit Selection from Comm. Option

Selects whether torque reference and torque limit values are assigned to the drive from the network.

No.	Parameter Name	Setting Range	Default
F6-06	Torque Reference/Torque Limit Selection from Comm. Option	0, 1	0

Setting 0: Enabled

Setting 1: Disabled

■ F6-07: NetRef/ComRef Function Selection

Selects the treatment of multi-step speed inputs when the NetRef command is set.

No.	Parameter Name	Setting Range	Default
F6-07	NetRef/ComRef Function Selection	0, 1	0

Setting 0: Multi-step speed operation disabled

Multi-step speed input frequency references are disabled when the NetRef command is selected.

Setting 1: Multi-step speed operation enabled

Multi-step speed inputs are still active and can override the frequency reference from the communications option even when the NetRef command is selected.

■ F6-08: Reset Communication Parameters

Determines whether F6-□□ communication-related parameters are reset after initialization.

No.	Parameter Name	Setting Range	Default
F6-08	Reset Communication Parameters	0, 1	0

Setting 0: Do not reset F6-□□ parameters after initialization using A1-03

Setting 1: Reset F6-□□ parameters after initialization using A1-03

Note: F6-08 is not reset when the drive is initialized.

◆ F7: Communication Option Card

Parameters F7-01 to F7-42 are used for the Modbus TCP/IP and EtherNet/IP options.

1.7 H: Terminal Functions

H parameters assign functions to the external terminals.

◆ H1: Multi-Function Digital Inputs

■ H1-01 to H1-07: Functions for Terminals S1 to S7

These parameters assign functions to the multi-function digital inputs. The various functions and settings are listed in *Table 1.28*.

No.	Parameter Name	Setting Range	Default
H1-01	Multi-Function Digital Input Terminal S1 Function Selection	1 to B2	40 (F) <1> : Forward Run Command (2-Wire sequence)
H1-02	Multi-Function Digital Input Terminal S2 Function Selection	1 to B2	41 (F) <1> : Reverse Run Command (2-Wire sequence)
H1-03	Multi-Function Digital Input Terminal S3 Function Selection	0 to B2	24: External Fault
H1-04	Multi-Function Digital Input Terminal S4 Function Selection	0 to B2	14: Fault Reset
H1-05	Multi-Function Digital Input Terminal S5 Function Selection	0 to B2	3 (0) <1> : Multi-Step Speed Reference 1
H1-06	Multi-Function Digital Input Terminal S6 Function Selection	0 to B2	4 (3) <1> : Multi-Step Speed Reference 2
H1-07	Multi-Function Digital Input Terminal S7 Function Selection	0 to B2	6 (4) <1> : Jog Reference Selection

<1> Number appearing in parenthesis is the default value after performing a 3-Wire initialization.

Table 1.28 Multi-Function Digital Input Terminal Settings

Setting	Function	Page
0	3-Wire Sequence	74
3	Multi-Step Speed Reference 1	74
4	Multi-Step Speed Reference 2	
6	Jog reference Selection	74
7	Accel/Decel Time Selection 1	75
8	Baseblock Command (N.O.)	75
9	Baseblock Command (N.C.)	
A	Accel/Decel Ramp Hold	75
B	Drive Overheat Alarm (oH2)	75
C	Analog Terminal Input Selection	75
F	Through Mode	75
10	Up Command	75
11	Down Command	
12	Forward Jog	77
13	Reverse Jog	
14	Fault Reset	77
15	Fast Stop (N.O.)	77
17	Fast Stop (N.C.)	77
18	Timer Function Input	77
19	PID Disable	77
1B	Program Lockout	78
1E	Reference Sample Hold	78
20 to 2F	External Fault	78
30	PID Integral Reset	79
31	PID Integral Hold	79
34	PID Soft Starter Cancel	79
35	PID Input Level Selection	79
40	Forward Run Command (2-Wire sequence)	79
41	Reverse Run Command (2-Wire sequence)	
42	Run Command (2-Wire sequence 2)	79
43	FWD/REV Command (2-Wire sequence 2)	
44	Offset Frequency 1	80
45	Offset Frequency 2	
46	Offset Frequency 3	
47	Node Setup	80
49	GF1 Error (N.O., N.C.)	80
4A		
50	Motor Pre-Heat 2	80
51	Sequence Timer Disable	80
52	Sequence Timer Cancel	80
60	Motor Pre-Heat 1	80
61	External Speed Search Command 1	80
62	External Speed Search Command 2	80
63	Field Weakening	80
65	KEB Ride-Thru 1 (N.C.)	80
66	KEB Ride-Thru 1 (N.O.)	
67	Communications Test Mode	81
68	High Slip Braking	81
69	Jog 2	81
6A	Drive Enabled	81
6D	AUTO Mode Select	81
6E	HAND Mode Select	81
70	Drive Enable2	81
7A	KEB Ride-Thru 2 (N.C.)	81
7B	KEB Ride-Thru 2 (N.O.)	
7C	Short Circuit Braking (N.O.)	82
7D	Short Circuit Braking (N.C.)	
A4	BP Emergency Override	82
A5	BP Drive/Bypass Selection	82

Setting	Function	Page
A6	BP BAS Interlock	*82*
A7	BP Customer Safeties	*82*
A8	PI2 Disable (N.O.)	*82*
A9	PI2 Disable (N.C.)	*82*
AA	PI2 Inverse Operation	*82*
AB	PI2 Integral Reset	*82*
AC	PI2 Integral Hold	*82*
AD	Select PI2 Parameters	*82*
AE	BP Bypass Run	*82*
AF	Emergency Override Forward Run	*82*
B0	Emergency Override Reverse Run	*82*
B1	Customer Safeties	*83*
B2	BAS Interlock	*83*

Setting 0: 3-Wire Sequence

The digital input programmed for 3-Wire control becomes the forward/reverse directional input, S1 becomes the Run command input, and S2 becomes the Stop command input.

The drive starts the motor when the input S1 set for the Run command closes for longer than 2 ms. The drive stops the operation when the Stop input S2 releases for 2 ms. When the digital input programmed for a forward/reverse operation is open, the drive is set for forward operation. When the digital input is closed, the drive is set for reverse operation.

Note: Input the Run and Stop commands via S1 and S2 when selecting a 3-Wire sequence.

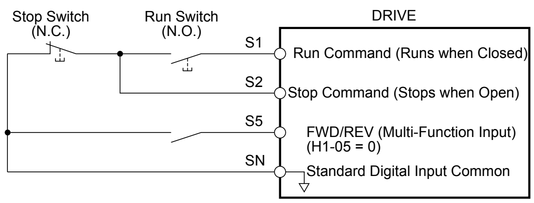


Figure 1.30 3-Wire Sequence Wiring Diagram

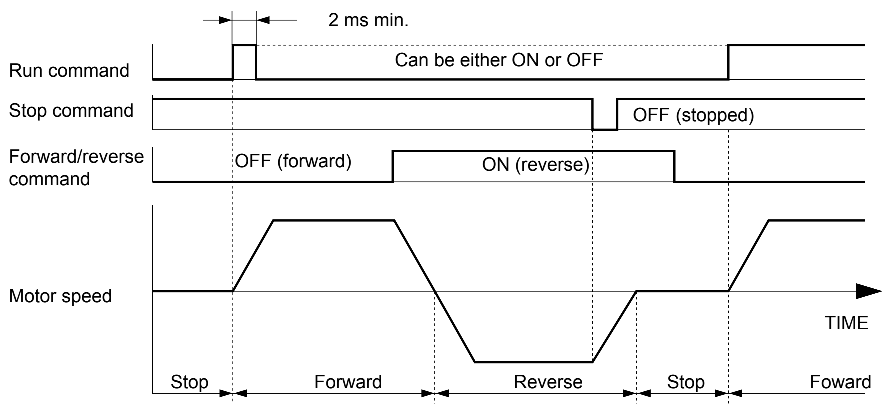


Figure 1.31 3-Wire Sequence

Note:
1. The Run command must be closed for more than 2 ms.
2. If the Run command is active at power up and b1-17 = 0 (Run command at power up not accepted), the Run LED will flash to indicate that protective functions are operating. If required by the application, set b1-17 to 1 to automatically issue the Run command upon drive power up.

WARNING! *Sudden Movement Hazard. Ensure start/stop and safety circuits are wired properly and in the correct state before applying power to the drive. Failure to comply could result in death or serious injury from moving equipment.*

WARNING! *Sudden Movement Hazard. The drive may start unexpectedly in reverse direction after power up if it is wired for 3-Wire sequence but set up for 2-Wire sequence (default). Make sure b1-17 is set to "0" (drive does not accept a Run command active at power up). When initializing the drive use 3-Wire initialization. Failure to comply could result in death or serious injury from moving equipment.*

Settings 3 and 4: Multi-Step Speed Reference 1 and 2

Switches multi-step speed frequency references d1-01 to d1-04 by digital inputs. ***Refer to d1: Frequency Reference on page 58*** for details.

Setting 6: Jog Reference Selection

The Jog frequency set in parameter d1-17 becomes the frequency reference when the input terminal closes. ***Refer to d1: Frequency Reference on page 58*** for details.

Setting 7: Accel/Decel Time Selection 1

Switches between accel/decel times 1 (C1-01 and C1-02) and 2 (C1-03 and C1-04). *Refer to C1-01 to C1-04: Accel, Decel Times 1 and 2 on page 52* for details.

Settings 8 and 9: Baseblock Command (N.O., N.C.)

When the drive receives a baseblock command, the output transistors stop switching, the motor coasts to stop, and a bb alarm flashes on the HOA keypad to indicate baseblock. When baseblock ends while a Run command is active, the drive performs Speed Search to restart the motor.

DIgital Input Function	Drive Operation	
	Input Open	Input Closed
Setting 8 (N.C.)	Baseblock (Interrupt output)	Normal operation
Setting 9 (N.O.)	Normal operation	Baseblock (Interrupt output)

WARNING! *Sudden Movement Hazard. When using a mechanical holding brake with the drive in a lifting application, close the brake when the drive output is cut off by a baseblock command triggered by one of the input terminals. Failure to comply will result in a slipping load from the motor suddenly coasting when the baseblock command is entered and may cause serious injury or death.*

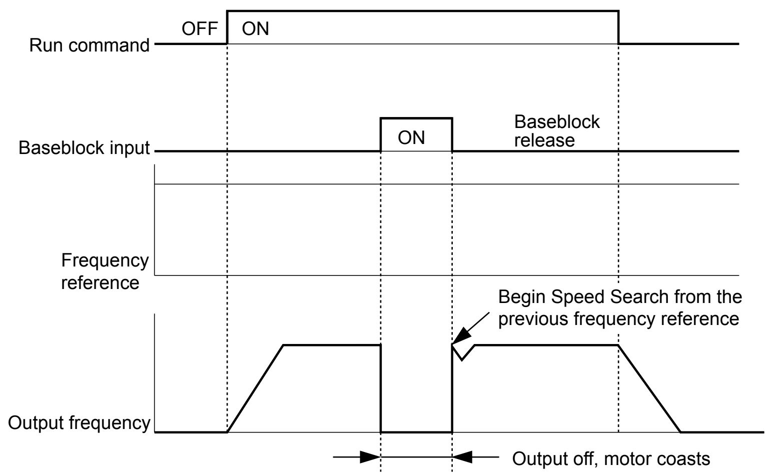


Figure 1.32 Baseblock Operation During Run

Setting A: Accel/Decel Ramp Hold

When the digital input programmed for the Accel/decel ramp hold function closes, the drive locks (holds) the output frequency. Acceleration or deceleration resumes when the input is reopened.

If the Accel/decel ramp hold function is enabled (d4-01 = 1), the drive saves the output frequency to memory when the Ramp Hold input is closed. When the drive is restarted after stop or after power supply interruption, the saved output frequency becomes the frequency reference (provided that the Accel/decel ramp hold input is still closed). *Refer to d4-01: Frequency Reference Hold Function Selection on page 61* for details.

Setting B: Drive Overheat Alarm (oH2)

Triggers an oH2 alarm when the contact closes. Drive operation is not affected because this is an alarm.

Setting C: Analog Terminal Input Selection (Terminals A1 and A2)

When closed, the terminals specified in H3-14 are enabled. When open, the drive disregards the input signal to the analog terminals.

Setting F: Through Mode

Select this setting when using the terminal in a pass-through mode. When set to F, an input does not trigger any function in the drive. Setting F, however, still allows the input status to be read out by a PLC via a communication option or APOGEE FLN, BACnet, MEMOBUS/Modbus, or Metasys N2 communications.

Settings 10 and 11: Up/Down Function

The Up/Down function allows the frequency reference to be set by two push buttons when one digital input is programmed as the Up input (H1-□□= 10) to increase the frequency reference and the other digital input is programmed as the Down input (H1-□□= 11) to decrease the frequency reference.

The Up/Down function takes priority over the frequency references from the HOA keypad, the analog inputs, and the pulse input (b1-01 = 0, 1, 4). When using the Up/Down function, references provided by these sources will be disregarded.

The inputs operate as shown in the table below:

Status		Drive Operation
Up (10)	Down (11)	
Open	Open	Hold current frequency reference
Closed	Open	Increase frequency reference
Open	Closed	Decrease frequency reference
Closed	Closed	Hold current frequency reference

Note: **1.** An oPE03 alarm occurs when only one of the Up/Down functions is programmed to a digital input.

2. An oPE03 alarm occurs when the Up/Down function is assigned to the terminals and a different digital input is programmed for the Accel/decel ramp hold function. Refer to the Troubleshooting chapter in the User Manual packaged with the drive for more information on alarms.

3. The Up/Down function can only be used for External reference 1. Consider this when using Up/Down and the external reference switching command (H1-☐☐ = 2).

Using the Up/Down Function with Frequency Reference Hold (d4-01)

- If the frequency reference hold function is disabled (d4-01 = 0), the Up/Down frequency reference will be reset to 0 when the Run command is cleared or the power is cycled.
- When d4-01 = 1, the drive will save the frequency reference set by the Up/Down function. When the Run command or the power is cycled, the drive will restart with the saved reference value. Close the Up or Down input without an active Run command to reset the saved value. ***Refer to d4-01: Frequency Reference Hold Function Selection on page 61***.

Using the Up/Down Function with Frequency Reference Limits

Parameter d2-01 determines the upper frequency reference limit.

The value for the lower frequency reference limit depends on the parameter d4-10 setting. This value can be set by an analog input or parameter d2-02. When a Run command is applied, the lower limits function as follows:

- If the lower limit is set by d2-02 only, the drive accelerates to this limit as soon as a Run command is entered.
- If the lower limit is determined by an analog input only, the drive accelerates to the limit when both the Run command and an Up or Down command are active. The drive will not start running if only the Run command is active.
- If the lower limit is set by both an analog input and d2-02, and the analog limit is higher than the d2-02 value, the drive accelerates to the d2-02 value when a Run command is input. When the d2-02 value is reached, the drive accelerates to the analog limit only if an Up or Down command is set.

Figure 1.33 shows an Up/Down function example with a lower frequency reference limit set by d2-02, and the frequency reference hold function both enabled and disabled.

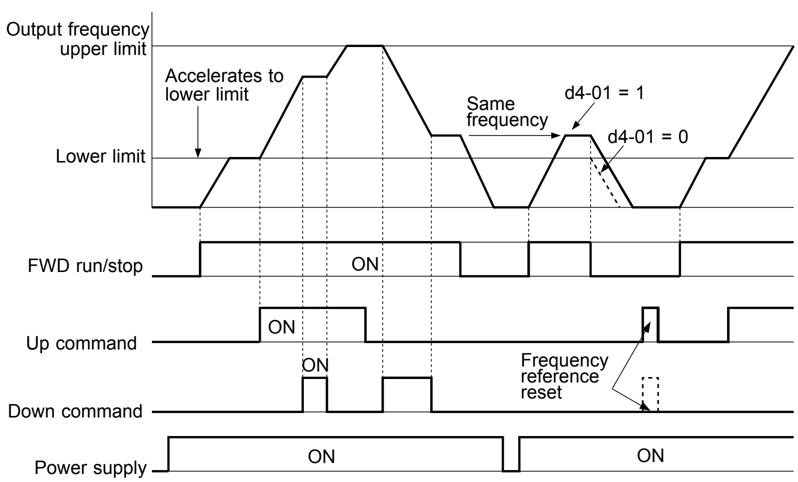


Figure 1.33 Up/Down Command Operation

Settings 12 and 13: Forward Jog, Reverse Jog

Digital inputs programmed as Forward Jog (H1-□□ = 12) and Reverse Jog (H1-□□ = 13) will be Jog inputs that do not require a Run command. Closing the terminal set for Forward Jog input will cause the drive to ramp to the Jog frequency reference (d1-17) in the forward direction. The Reverse Jog will cause the same action in the reverse direction. The Forward Jog and Reverse Jog command can be set independently.

Note: The Forward Jog and Reverse Jog commands override all other frequency references. However, if the drive is set to prohibit reverse rotation (b1-04 = 1), activating Reverse Jog will have no effect. Inputting both the Forward Jog and Reverse Jog are simultaneously for 500 ms or longer will trigger an alarm will and the drive will ramp to stop.

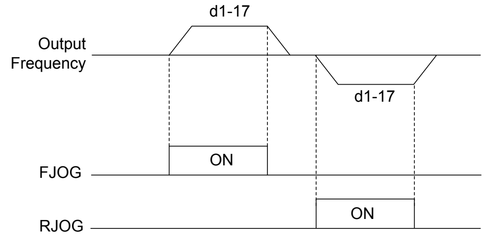


Figure 1.34 FJOG/RJOG Operation

Setting 14: Fault Reset

When the drive detects a fault condition, the fault output contact closes, the drive output shuts off, and the motor coasts to stop (specific stopping methods can be selected for some faults such as L1-04 for motor overheat). After removing the Run command, clear the fault either by pressing the RESET key on the HOA keypad or closing a digital input configured as a Fault Reset (H1-□□ = 14).

Note: Remove the Run command prior to resetting a fault. Fault Reset commands are ignored while the Run command is present.

Settings 15 and 17: Fast Stop (N.O., N.C.)

The Fast Stop function operates similar to an emergency stop input to the drive. If a Fast Stop command is input while the drive is running, the drive decelerates to a stop in the deceleration time set to C1-09 (*Refer to C1-09: Fast Stop Time on page 53*). The drive can only be restarted after bringing the drive to a complete stop, turning off the Fast Stop input, and switching off the Run command.

- To trigger the Fast Stop function with an N.O. switch, set H1-□□ = 15.
- To trigger the Fast Stop function with an N.C. switch, set H1-□□ = 17.

Figure 1.35 shows an operation example of Fast Stop.

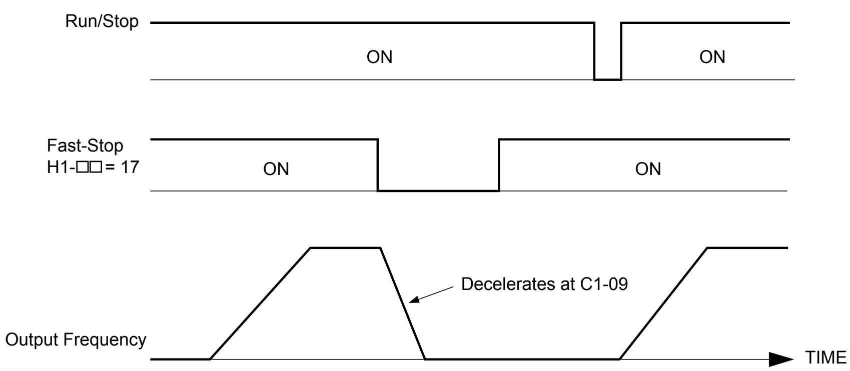


Figure 1.35 Fast Stop Sequence

NOTICE: *Rapid deceleration can trigger an overvoltage fault. When faulted, the drive output shuts off, and the motor coasts. To avoid this uncontrolled motor state and to ensure that the motor stops quickly and safely, set an appropriate Fast Stop time to C1-09.*

Setting 18: Timer Function Input

This setting configures a digital input terminal as the input for the timer function. Use this setting combination with the timer function output (H2-□□ = 12). *Refer to b4: Delay Timers on page 37* for details.

Setting 19: PI Disable

Close a digital input to indefinitely disable the PI function. When the input is released, the drive resumes PI operation. *Refer to PI Block Diagram on page 40*.

Parameter Details

1

Setting 1B: Program Lockout

Parameter values cannot be changed when an input is programmed for Program Lockout and the input is open. It is still possible, however, to view and monitor parameter settings.

Setting 1E: Reference Sample Hold

This function allows the user to sample an analog frequency reference signal being input to terminal A1 or A2 and hold the frequency reference at the sampled level. When the Analog Frequency Reference Sample/Hold function is held for at least 100 ms, the drive reads the analog input and changes the frequency reference to the newly sampled speed as illustrated in *Figure 1.36*.

When the power is shut off and the sampled analog frequency reference is cleared, the frequency reference is reset to 0.

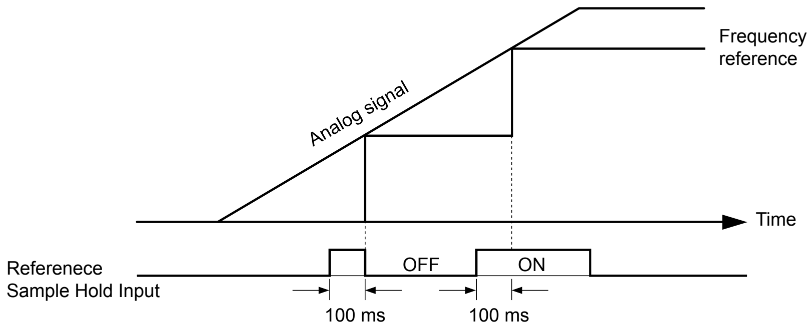


Figure 1.36 Analog Frequency Reference Sample/Hold

An oPE03 error will occur when one of the following functions is used simultaneously with the Analog frequency reference sample/hold command:

- Hold accel/decel stop (setting: A)
- Up command, Down command (setting: 10, 11)
- Offset frequency (setting: 44 to 46)

Setting 20 to 2F: External Fault

The External fault command stops the drive when problems occur with external devices.

To use the External fault command, set one of the multi-function digital inputs to a value between 20 and 2F. The HOA keypad will display EF□ where □ is the number of the terminal to which the external fault signal is assigned.

For example, if an external fault signal is input to terminal S3, “EF3” will be displayed.

Select the value to be set in H1-□□ from a combination of any of the following three conditions:

- Signal input level from peripheral devices (N.O., N.C.)
- External fault detection method
- Operation after external fault detection

The following table shows the relationship between the conditions and the value set to H1-□□:

Terminal statuses, detection conditions, and stopping methods marked with an “O” are applicable to the corresponding settings.

Setting	Terminal Status <1>		Detection Conditions <2>		Stopping Method			
	N.O.	N.C.	Always Detected	Detected during Run only	Ramp to Stop (fault)	Coast to Stop (fault)	Fast Stop (fault)	Alarm Only (continue running)
20	O		O		O			
21		O	O		O			
22	O			O	O			
23		O		O	O			
24	O		O			O		
25		O	O			O		
26	O			O		O		
27		O		O		O		
28	O		O				O	

Setting	Terminal Status <1>		Detection Conditions <2>		Stopping Method			
	N.O.	N.C.	Always Detected	Detected during Run only	Ramp to Stop (fault)	Coast to Stop (fault)	Fast Stop (fault)	Alarm Only (continue running)
29		O	O				O	
2A	O			O			O	
2B		O		O			O	
2C	O		O					O
2D		O	O					O
2E	O			O				O
2F		O		O				O

<1> Determine the terminal status for each fault, i.e., whether the terminal is normally open or normally closed.

<2> Determine whether detection for each fault should be enabled only during run or always detected.

Setting 30: PI Integral Reset

Configuring one of the digital inputs for PI integral reset (H1-□□ = 30) resets the value of the integral component in PI control to 0 when the terminal is closed. ***Refer to PI Block Diagram on page 40*** for more details.

Setting 31: PI Integral Hold

Configuring a digital input for Integral Hold (H1-□□ = 31) locks the value of the integral component of the PI control as long as the input is active. The PI controller resumes integral operation from the hold value as soon as the integral hold input is released. ***Refer to PI Block Diagram on page 40*** for more information on this function.

Setting 34: PI Soft Starter Cancel

A digital input configured as a PI soft starter cancel input (H1-□□ = 34) enables or disables the PI soft starter and cancels the PI accel/decel time (b5-17). ***Refer to PI Block Diagram on page 40***.

Setting 35: PI Input Level Selection

Allows an input terminal to switch the sign of the PI input. ***Refer to PI Block Diagram on page 40*** for details.

Setting 40, 41: Forward Run, Reverse Run Command for 2-Wire Sequence

Configures the drive for a 2-Wire sequence.

When an input terminal set to 40 closes, the drive operates in the forward direction. When an input set for 41 closes, the drive operates in reverse. Closing both inputs simultaneously will result in an external fault.

Note: 1. This function cannot be used simultaneously with settings 42 and 43.
2. The same functions are assigned to terminals S1 and S2 when the drive is initialized for 2-Wire sequence.

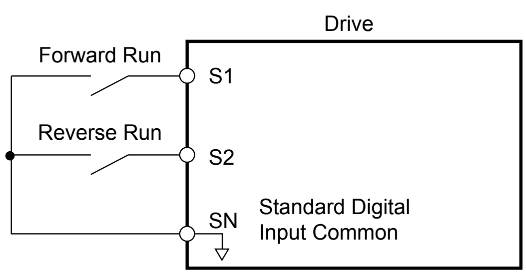


Figure 1.37 Example Wiring Diagram for 2-Wire Sequence

Setting 42, 43: Run and Direction Command for 2-Wire Sequence 2

Sets the drive for 2-Wire sequence 2.

When an input terminal programmed for 42 closes, the drive will operate in the selected direction. The drive will stop when the input opens.

The input programmed for 43 selects the direction. If the input is open, forward direction is selected. If the input is closed, reverse direction is selected.

Note: This function cannot be used simultaneously with settings 40 and 41.

Settings 44, 45, and 46: Offset Frequency 1, 2, 3

These inputs add offset frequencies d7-01, d7-02, and d7-03 to the frequency reference. ***Refer to d7-01 to d7-03: Offset Frequency 1 to 3 on page 62*** for details.

Setting 47: Node Setup

If the SI-S3 option card is connected, closing this terminal sets a node address for operation on a CANopen network.

Settings 49 and 4A: GF1 Error (N.O., N.C.)

These input functions will stop the drive when a GF1 error is detected when set together with F6-86 (GF1 Error Detection Selection) and F6-87 (GF1 Error Operation Selection).

Setting 50: Motor Pre-Heat 2

Sets the DC preheat current as a percentage of motor rated current (E2-01). ***Refer to Setting 60: Motor Pre-Heat 1 on page 80*** details.

Setting 51: Sequence Timer Disable

Drive ignores sequence timers and runs normally (based on b1-02/b1-16 source).

Setting 52: Sequence Timer Cancel

The sequence timers are canceled.

Setting 60: Motor Pre-Heat 1

A DC current can be circulated through the motor windings to create heat and prevent moisture from condensing on the wire.

Motor Pre-Heating can only be initiated by closing a digital input programmed as a Motor Pre-Heat input (H1-☐☐ = 60). The level of the DC current used by the Motor Pre-Heat function is determined by b2-09.

A Run input will be given priority over a Motor Pre-Heat input and when the Run command is removed, the motor pre-heating will resume if the Motor Pre-Heat input is still closed.

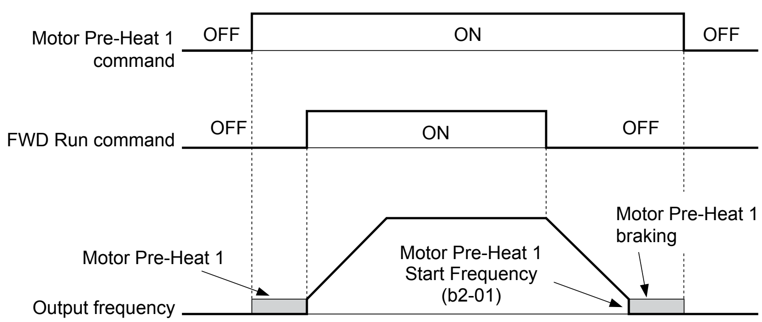


Figure 1.38 Motor Pre-Heat 1 Input Timing Diagram

Setting 61, 62: External Speed Search Command 1, 2

These input functions enable Speed Search even if parameter b3-01 = 0 (no Speed Search at start). ***Refer to Speed Search Activation on page 33*** for details on how to use the input signals. ***Refer to b3: Speed Search on page 31*** for more about Speed Search.

Note: Simultaneously assigning Speed Search 1 and Speed Search 2 to the input terminals will trigger an oPE03 error.

Setting 63: Field Weakening

Enabled in V/f Control. When this input is closed, Field Weakening is performed.

Setting 65, 66: KEB Ride-Thru 1 (N.C.), 2 (N.O.)

Enables the KEB Ride-Thru function selected in parameter L2-29.

DIgital Input Function	Drive Operation	
	Input Open	Input Closed
Setting 65 (N.C.)	KEB Ride-Thru Deceleration	Normal operation
Setting 66 (N.O.)	Normal operation	KEB Ride-Thru Deceleration

Note: Simultaneously assigning KEB Ride-Thru 1 and KEB Ride-Thru 2 to the input terminals will trigger an oPE03 error.

Setting 67: Communication Test Mode

The drive has a built-in function to self-diagnose serial communications operation. The test involves wiring the send and receive terminals of the RS-422/RS-485 port together. The drive transmits data and then confirms that the communications are received normally. *Refer to Self-Diagnostics on page 293* for details on how to use this function.

Setting 68: High Slip Braking

Closing an input programmed for this function triggers High Slip Braking (available only in V/f control mode). After starting HSB, bring the drive to a complete stop and remove the HSB command before restarting. *Refer to n3: High Slip Braking (HSB) and Overexcitation Braking on page 123*.

Setting 69: Jog 2

The Jog 2 function applies to 3-Wire control only. If a digital input is configured as Jog 2 (H1-□□ = 69) when the drive is not in 3-Wire Control, an oPE03 fault will occur.

The Jog 2 input causes the drive to ramp to the Jog Frequency Reference (d1-17) in the direction dictated by the Fwd/Rev input of the 3-Wire Control mode. Acceleration to and from the Jog Frequency Reference is determined by the active Accel/Decel parameters.

Setting 6A: Drive Enable

A digital input configured as a “Drive enable” (H1-□□ = 6A) will prevent the drive from executing a Run command until the input is closed. When the input is open, the HOA keypad will display “dnE” to indicate that the drive is disabled.

If a Run command is enabled before the terminal set for “Drive enable” closes, then the drive will not run until the Run command is cycled (i.e., a new Run command is required). If the input is opened while the drive is running, the drive will stop according to the stop method set to b1-03 (*Refer to b1-03: Stopping Method Selection on page 26*).

Setting 6D: AUTO Mode Select

Sets the behavior when AUTO Mode is selected.

Legacy Operation Mode (S5-04 = 0)	
Open	Drive is in OFF or HAND mode
Closed	Drive is in AUTO mode (when HAND Mode Select input is open)
Normal Operation Mode (S5-04 = 1)	
Open	HAND reference is selected (based on S5-01)
Closed	AUTO reference is selected (based on b1-01)

Setting 6E: HAND Mode Select

Sets the behavior when HAND Mode is selected.

Legacy Operation Mode (S5-04 = 0)	
Open	Drive is in OFF or AUTO mode
Closed	Drive is in HAND mode (when AUTO Mode Select input is open)
Normal Operation Mode (S5-04 = 1)	
Open	HAND reference is selected (based on S5-01)
Closed	AUTO reference is selected (based on b1-01)

Setting 70: Drive Enable2

A digital input configured as a Drive Enable2 input (H1-□□ = 70) prevents the drive from executing a Run command until the Drive Enable2 input is closed. When the Drive Enable2 input is open and a Run command is closed, the digital operator will display “dnE”.

The Run command does not need to be cycled after the Drive Enable2 input is closed. The drive will run when both the Run and Drive Enable2 inputs are closed. If the Drive Enable2 input is opened while the drive is running, the drive will stop using the method set by parameter b1-03.

Setting 7A, 7B: KEB Ride-Thru 2 (N.C., N.O.)

An input terminal set to 7A or 7B can trigger Single Drive KEB Ride-Thru during deceleration. L2-29 is disregarded if this is enabled.

Digital Input Function	Drive Operation	
	Input Open	Input Closed
Setting 7A (N.C.)	Single Drive KEB Ride-Thru 2	Normal operation
Setting 7B (N.O.)	Normal operation	Single Drive KEB Ride-Thru 2

Note: Simultaneously assigning KEB Ride-Thru 1 and KEB Ride-Thru 2 to the input terminals will trigger an oPE03 error.

Setting 7C, 7D: Short Circuit Braking (N.O., N.C.) (OLV/PM)

Activates Short Circuit Braking in OLV/PM control mode. By linking all three phases of a PM motor, Short Circuit Braking creates a braking torque to stop a rotating motor or prevent a motor from coasting due to external forces (such as the windmill effect in fan applications). Parameter b2-18 limits the current during Short Circuit Braking.

DIgital Input Function	Drive Operation	
	Input Open	Input Closed
Setting 7C (N.O.)	Normal operation	Short Circuit Braking
Setting 7D (N.C.)	Short-Circuit Braking	Normal operation

Setting A4: BP Emergency Override

When this input is closed the drive will switch into override. If the drive is running the drive will stop running and the motor will be switched to line voltage. If the drive is not running and dampers are present, they will be actuated. Upon completion of damper actuation the motor will be run on line voltage.

Setting A5: BP Drive/Bypass Select

Note: An oPE27 (BP Program Error) will occur if one of the digital inputs is set to A5 and parameter o1-13 or o1-14 is set to 2 (Drive/Bypass).

Status	Description
Open	Bypass mode
Closed	Drive mode

Setting A6: BP BAS Interlock

Indicates that the dampers are open.

Setting A7: BP Customer Safeties

Indicates that customer safeties are in place.

Setting A8: PI2 Disable (N.O.)

Disables the secondary PI controller. Output behavior depends on the setting of S3-12

Setting A9: PI2 Disable (N.C.)

Enables the secondary PI controller (when open, output behavior depends on the setting of S3-12).

Setting AA: PI2 Inverse Operation

Changes the sign of the secondary PI controller input (reverse acting PI control).

Setting AB: PI2 Integral Reset

Resets the secondary PI controller integral value.

Setting AC: PI2 Integral Hold

Locks the value of the secondary PI controller integral value.

Setting AD: Select PI2 Parameters

Uses the secondary PI controller Proportional and Integral adjustments (S3-06 and S3-07) instead of the primary PI controller Proportional and Integral adjustments (b5-02 and b5-03). Only valid when S3-01 = 0 (secondary PI controller disabled).

Note: This multi-function input has no effect on the secondary PI controller. It is only used for the primary PI controller (b5-☐☐).

Setting AE: BP Bypass Run

Commands a Run in Bypass mode via closing the BP Bypass Relay multi-function output.

Setting AF: Emergency Override Forward Run

Enables Emergency Override Forward Run.

Setting B0: Emergency Override Reverse Run

Enables Emergency Override Reverse Run.

Setting B1: Customer Safeties

The Customer Safeties multi-function input functionality is identical to Bypass Drive Enable (Setting 70: Drive Enable 2), except for the following:

- When the input is open, the stopping method is forced to Coast to Stop
- If the input is open when the Run command is present, a “SAFE” alarm is displayed instead of the “dnE” alarm.

Setting B2: BAS Interlock

The BAS Interlock multi-function input functionality is identical to Bypass Drive Enable (Setting 70: Drive Enable 2), except for the following:

- When the input is open, the stopping method is forced to Coast to Stop
- If the input is open when the Run command is present, the “inTLK” message is displayed instead of the “dnE” alarm
- The state of the BAS Interlock multi-function input has no effect on the Emergency Override multi-function inputs (H1-□□ = AF, B0). The Emergency Override command will be accepted if the BAS Interlock digital input is open or closed.

◆ H2: Multi-Function Digital Outputs

■ H2-01 to H2-03: Terminal M1-M2, M3-M4, and M5-M6 Function Selection

The drive has three multi-function output terminals. *Table 1.29* lists the functions available for theses terminals using H2-01, H2-02, and H2-03.

No.	Parameter Name	Setting Range	Default
H2-01	Terminal M1-M2 Function Selection (relay)	0 to 1B2	E: Fault
H2-02	Terminal M3-M4 Function Selection (relay)	0 to 1B2	0: During Run
H2-03	Terminal M5-M6 Function Selection (relay)	0 to 1B2	A: Run Command Source

Table 1.29 Multi-Function Digital Output Terminal Settings

Setting	Function	Page	Setting	Function	Page
0	During Run	84	2F	Maintenance Period	89
1	Zero Speed	84	37	During Frequency Output	89
2	Speed Agree 1	84	38	Drive Enabled	90
3	User-Set Speed Agree 1	85	39	Watt Hour Pulse Output	90
4	Frequency Detection 1	85	3A	Drive Overheat Alarm (oH2)	90
5	Frequency Detection 2	85	3D	During Speed Search	90
6	Drive Ready	86	3E	PID Feedback Low	90
7	DC Bus Undervoltage	86	3F	PID Feedback High	90
8	During Baseblock (N.O.)	86	4A	During KEB Operation	90
9	Frequency Reference Source	86	4B	During Short Circuit Braking	90
A	Run Command Source	86	4C	During Fast Stop	90
B	Torque Detection 1 (N.O.)	87	4D	oH Pre-Alarm Time Limit	90
C	Frequency Reference Loss	87	50	Waiting for Run	90
E	Fault	87	51	Sequence Timer 1 Active	90
F	Through Mode	87	52	Sequence Timer 2 Active	90
10	Minor Fault	87	53	Sequence Timer 3 Active	90
11	Fault Reset Command Active	87	54	Sequence Timer 41 Active	91
12	Timer Output	87	58	Underload Detection	91
13	Speed Agree 2	87	60	Internal Cooling Fan Alarm	91
14	User-Set Speed Agree 2	88	71	Secondary PI Feedback Low	91
15	Frequency Detection 3	88	72	Secondary PI Feedback High	91
16	Frequency Detection 4	88	A4	BP Drive Relay	91
17	Torque Detection 1 (N.C.)	87	A5	BP Bypass Relay	91
1B	During Baseblock (N.C.)	89	A6	BP BAS Interlock Relay	91
1E	Restart Enabled	89	A9	Relay Operator Control	91
1F	Motor Overload Alarm (oL1)	89	B2	BAS Interlock Relay Contact	91
20	Drive Overheat Pre-Alarm (oH)	89	100 to 1B2	Functions 0 to b2 with Inverse Output	91

Setting 0: During Run

Output closes when the drive is outputting a voltage.

Status	Description
Open	Drive is stopped.
Closed	A Run command is input or the drive is in deceleration or DC injection.

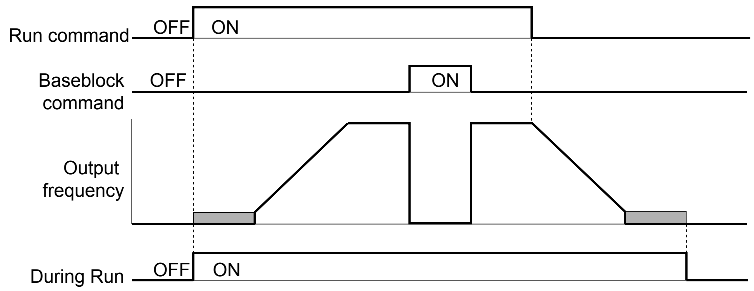


Figure 1.39 During Run Time Chart

Setting 1: Zero Speed

Terminal closes when the output frequency or motor speed falls below the minimum output frequency set to E1-09 or b2-01.

Status	Description
Open	Output frequency is above the minimum output frequency set to E1-09 or b2-01
Closed	Output frequency is less than the minimum output frequency set to E1-09 or b2-01

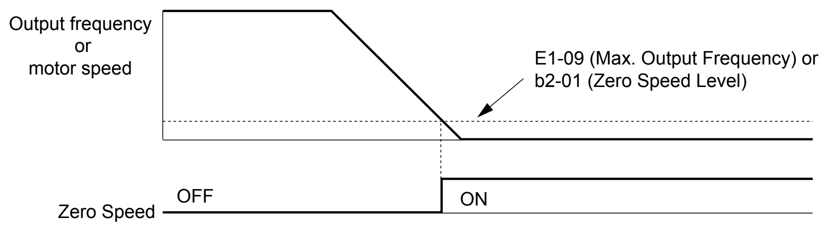


Figure 1.40 Zero-Speed Time Chart

Setting 2: Speed Agree 1 (f_{ref}/f_{out} Agree 1)

Closes when the actual output frequency or motor speed is within the Speed Agree Width (L4-02) of the current frequency reference regardless of the direction.

Status	Description
Open	Output frequency or motor speed does not match the frequency reference while the drive is running.
Closed	Output frequency or motor speed is within the range of frequency reference ±L4-02.

Note: Detection works in forward and reverse.

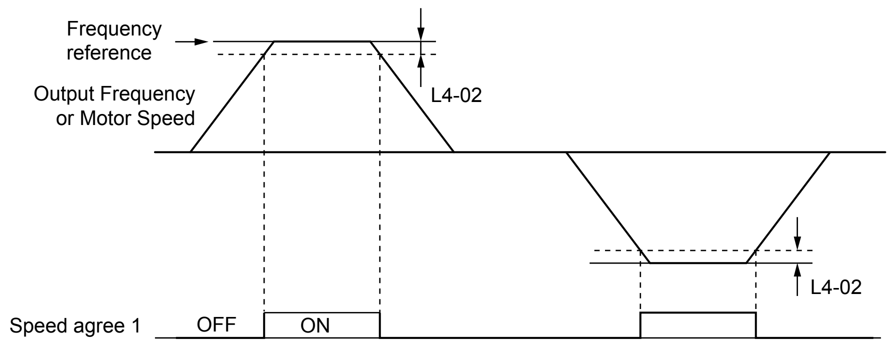


Figure 1.41 Speed Agree 1 Time Chart

Refer to L4-01, L4-02: Speed Agreement Detection Level and Detection Width on page 110 for more details.

Setting 3: User-Set Speed Agree 1 (f_{ref}/f_{set} Agree 1)

Closes when the actual output frequency or motor speed and the frequency reference are within the speed agree width (L4-02) of the programmed speed agree level (L4-01).

Status	Description
Open	Output frequency or motor speed and frequency reference are not both within the range of L4-01 ±L4-02.
Closed	Output frequency or motor speed and the frequency reference are both within the range of L4-01 ±L4-02.

Note: Frequency detection works in forward and reverse. The value of L4-01 is used as the detection level for both directions.

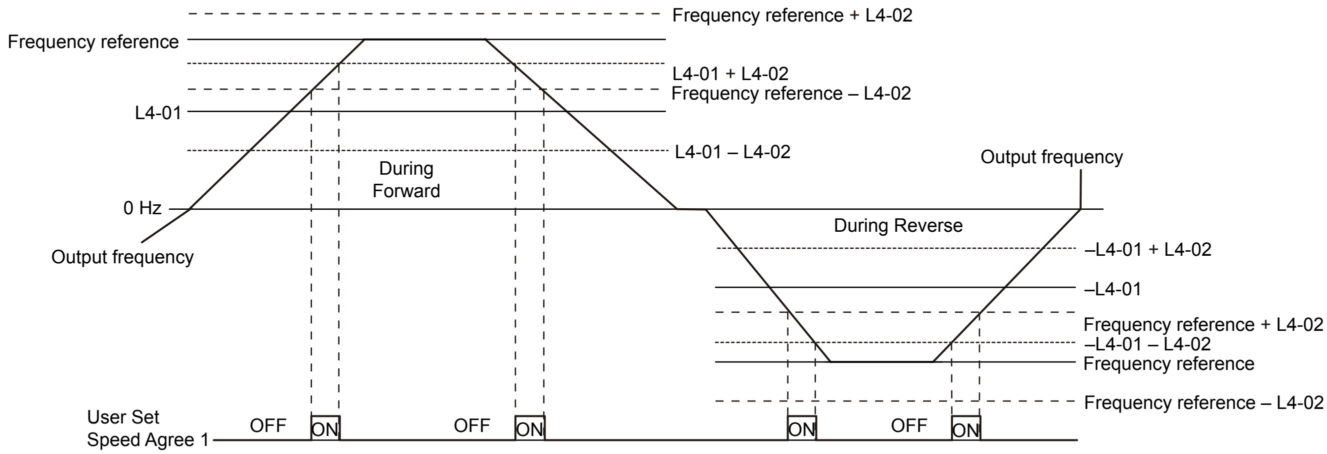


Figure 1.42 User Set Speed Agree 1 Time Chart

Refer to L4-01, L4-02: Speed Agreement Detection Level and Detection Width on page 110 for more instructions.

Setting 4: Frequency Detection 1

The output opens when the output frequency or motor speed rises above the detection level set in L4-01 plus the detection width set in L4-02. The terminal remains open until the output frequency or motor speed fall below the level set in L4-01.

Status	Description
Open	Output frequency or motor speed exceeded L4-01 + L4-02.
Closed	Output frequency or motor speed is below L4-01 or has not exceeded L4-01 + L4-02.

Note: Frequency detection works in forward and reverse. The value of L4-01 is used as the detection level for both directions.

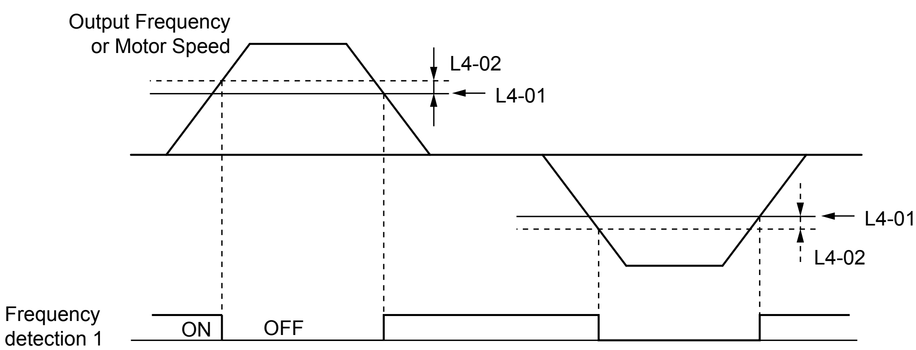


Figure 1.43 Frequency Detection 1 Time Chart

Refer to L4-01, L4-02: Speed Agreement Detection Level and Detection Width on page 110 for more details.

Setting 5: Frequency Detection 2

The output closes when the output frequency or motor speed is above the detection level set in L4-01. The terminal remains closed until the output frequency or motor speed fall below L4-01 minus the setting of L4-02.

Status	Description
Open	Output frequency or motor speed is below L4-01 minus L4-02 or has not exceeded L4-01.
Closed	Output frequency or motor speed exceeded L4-01.

Note: Frequency detection works in forward and reverse. The value of L4-01 is used as the detection level for both directions.

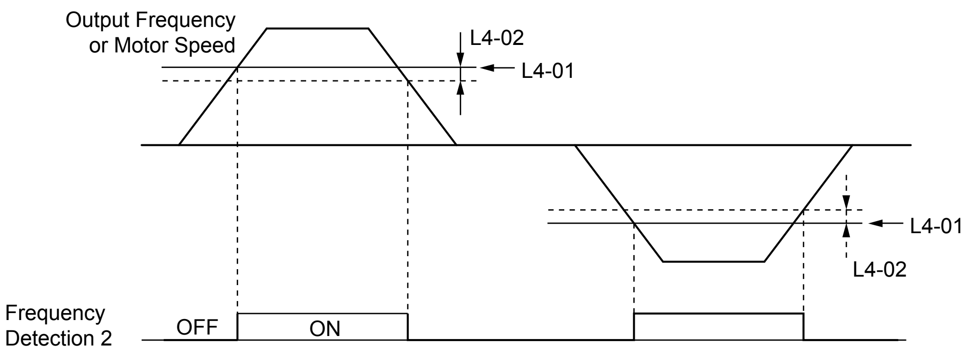


Figure 1.44 Frequency Detection 2 Time Chart

Refer to L4-01, L4-02: Speed Agreement Detection Level and Detection Width on page 110 for more details.

Setting 6: Drive Ready

The output closes when the drive is ready to operate the motor. The terminal will not close under the conditions listed below, and any Run commands will be disregarded.

- When the power is shut off
- During a fault
- When the internal power supply of the drive has malfunctioned
- When a parameter setting error makes it impossible to run
- Although stopped, an overvoltage or undervoltage situation occurs
- While editing a parameter in the Programming Mode (when b1-08 = 0)

Setting 7: DC Bus Undervoltage

The output closes when the DC bus voltage or control circuit power supply drops below the trip level set in L2-05. A fault in the DC bus circuit will also cause the terminal set for “DC bus undervoltage” to close.

Status	Description
Open	DC bus voltage is above the level set to L2-05.
Closed	DC bus voltage has fallen below the trip level set to L2-05.

Setting 8: During Baseblock (N.O.)

The output closes to indicate that the drive is in a baseblock state. While in baseblock, output transistors do not switch and no main circuit voltage is output.

Status	Description
Open	Drive is not in a baseblock state.
Closed	Baseblock is being executed.

Setting 9: Frequency Reference Source

Displays the currently selected frequency reference source.

Status	Description
Open	Frequency reference is provided from External reference 1 (b1-01) or External reference 2 (b1-15).
Closed	Frequency reference is being sourced from the HOA keypad.

Setting A: Run Command Source

Displays the currently selected Run command source.

Status	Description
Open	Run command is provided from External reference 1 (b1-02) or 2 (b1-16).
Closed	Run command is being sourced from the HOA keypad.

Setting B and 17: Torque Detection 1 (N.O., N.C.)

These digital output functions signal an overtorque or undertorque situation to an external device.

Set up the torque detection levels and select the output function from the table below. *Refer to L6: Torque Detection on page 114* for details.

Setting	Status	Description
B	Closed	Torque detection 1 (N.O.): Output current/torque exceeds (overtorque detection) or is below (undertorque detection) the torque value set in parameter L6-02 for longer than the time specified in parameter L6-03.
17	Open	Torque detection 1 (N.C.): Output current/torque exceeds (overtorque detection) or is below (undertorque detection) the torque value set in parameter L6-02 for longer than the time specified in parameter L6-03.

Setting C: Frequency Reference Loss

An output set for this function closes when frequency reference loss is detected. *Refer to L4-05: Frequency Reference Loss Detection Selection on page 111* for details.

Setting E: Fault

The output closes when the drive faults (excluding CPF00 and CPF01 faults).

Setting F: Through Mode

Select this setting when using the terminal in a pass-through mode. When set to F, an output does not trigger any function in the drive. Setting F, however, still allows the output status to be read by a PLC via a communication option or MEMOBUS/ Modbus communications.

Setting 10: Minor Fault

The output closes when a minor fault condition is present.

Setting 11: Fault Reset Command Active

The output closes when there is an attempt to reset a fault situation from the control circuit terminals, via serial communications, or using a communications option card.

Setting 12: Timer Output

This setting configures a digital output terminal as the output for the timer function. *Refer to b4: Delay Timers on page 37* for details.

Setting 13: Speed Agree 2 (f_{ref} /f_{out} Agree 2)

The output closes when the actual output frequency or motor speed is within the speed agree width (L4-04) of the current frequency reference, regardless of the direction.

Status	Description
Open	Output frequency or motor speed does not match the frequency reference while the drive is running.
Closed	Output frequency or motor speed is within the range of frequency reference ±L4-04.

Note: Detection works in forward and reverse.

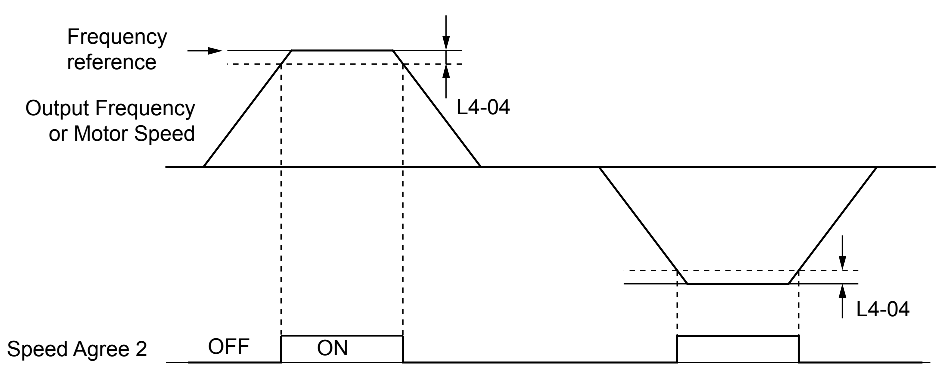


Figure 1.45 Speed Agree 2 Time Chart

Refer to L4-03, L4-04: Speed Agreement Detection Level and Detection Width (+/-) on page 110 for more details.

Setting 14: User-Set Speed Agree 2 (f_{ref} /f_{set} Agree 2)

The output closes when the actual output frequency or motor speed and the frequency reference are within the speed agree width (L4-04) of the programmed speed agree level (L4-03).

Status	Description
Open	Output frequency or motor speed and frequency reference are both outside the range of L4-03 ±L4-04.
Closed	Output frequency or motor speed and the frequency reference are both within the range of L4-03 ±L4-04.

Note: The detection level L4-03 is a signed value; detection works in the specified direction only.

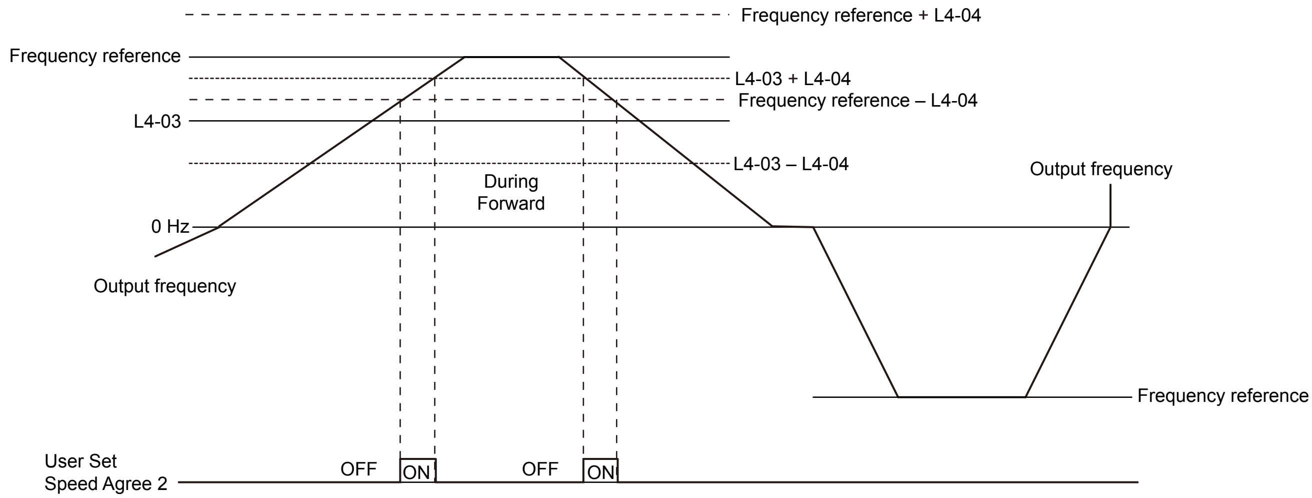


Figure 1.46 User-Set Speed Agree 2 Example with a Positive L3-04 Value

Refer to L4-03, L4-04: Speed Agreement Detection Level and Detection Width (+/-) on page 110 for more details.

Setting 15: Frequency Detection 3

The output opens when the output frequency or motor speed rises above the detection level set in L4-03 plus the detection with set in L4-04. The terminal remains open until the output frequency or motor speed falls below the level set in L4-03. The detection level L4-03 is a signed value; detection works in the specified direction only.

Status	Description
Open	Output frequency or motor speed exceeded L4-03 plus L4-04.
Closed	Output frequency or motor speed is below L4-03 or has not exceeded L4-03 plus L4-04.

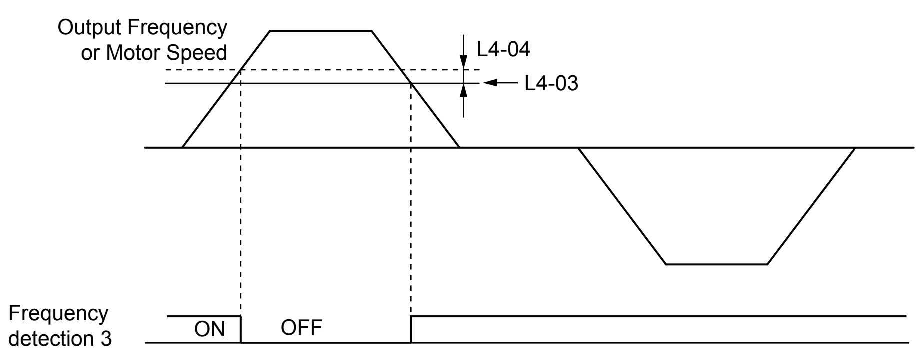


Figure 1.47 Frequency Detection 3 Example with a Positive L3-04 Value

Refer to L4-03, L4-04: Speed Agreement Detection Level and Detection Width (+/-) on page 110 for more details.

Setting 16: Frequency Detection 4

The output closes when the output frequency or motor speed is above the detection level set in L4-03. The terminal remains closed until the output frequency or motor speed falls below L4-03 minus the setting of L4-04.

Status	Description
Open	Output frequency or motor speed is below L4-03 minus L4-04 or has not exceeded L4-03.
Closed	Output frequency or motor speed exceeded L4-03.

Note: The detection level L4-03 is a signed value; detection works in the specified direction only.

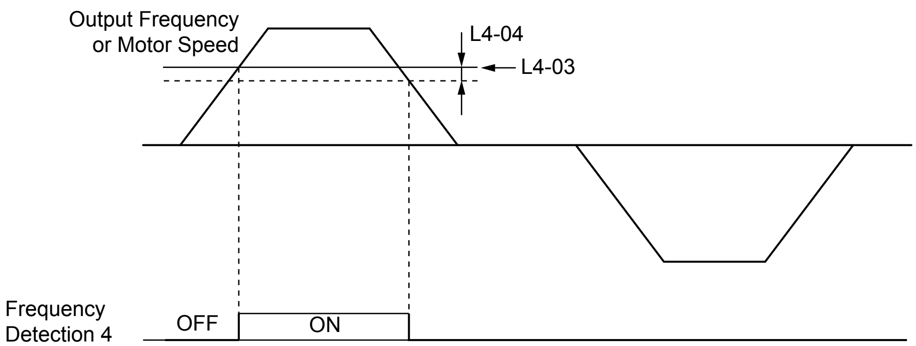


Figure 1.48 Frequency Detection 4 Example with Positive L3-04 Value

Refer to L4-03, L4-04: Speed Agreement Detection Level and Detection Width (+/-) on page 110 for more details.

Setting 1B: During Baseblock (N.C.)

The output opens to indicate that the drive is in a baseblock state. While Baseblock is executed, output transistors do not switch and no main circuit voltage is output.

Status	Description
Open	Baseblock is being executed.
Closed	Drive is not in a baseblock state.

Setting 1E: Restart Enabled

An output set for “Restart enabled” closes when the drive attempts to restart after a fault has occurred.

The fault restart function allows the drive to automatically clear a fault. The terminal set to 1E will close after the fault is cleared and the drive has attempted to restart. If the drive cannot successfully restart within the number of attempts permitted by L5-01, a fault will be triggered and the terminal set to 1E will open. ***Refer to L5: Fault Restart on page 111*** for details on automatic restart.

Setting 1F: Motor Overload Alarm (oL1)

The output closes when the motor overload level estimated by the oL1 fault detection exceeds 90% of the oL1 detection level. ***Refer to L1-01: Motor Overload Protection Selection on page 99***.

Setting 20: Drive Overheat Pre-Alarm (oH)

The output closes when the drive heatsink temperature reaches the level specified by parameter L8-02. ***Refer to L8-02: Overheat Alarm Level on page 116*** for details on drive overheat detection.

Setting 2F: Maintenance Period

The output closes when the cooling fan, DC bus capacitors, or DC bus pre-charge relay may require maintenance as determined by the estimated performance life span of those components. Components performance life is displayed as a percentage on the HOA keypad screen.

Setting 37: During Frequency Output

The output closes when the drive is outputting a frequency.

Status	Description
Open	Drive is stopped or one of the following functions is being performed: baseblock, DC Injection Braking, Short Circuit Braking.
Closed	Drive is outputting frequency.

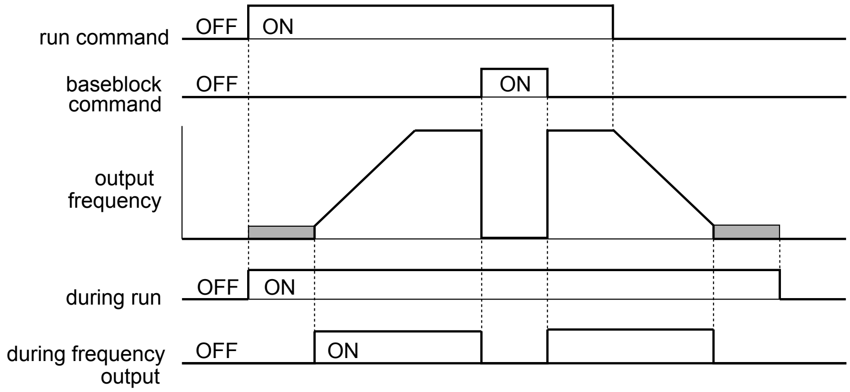


Figure 1.49 During Frequency Output Time Chart

Setting 38: Drive Enable

Reflects the status of a digital input configured as a “Drive enable” input (H1-□□ = 6A). If that digital input closes, then the digital output set for “Drive enable” will also close.

Setting 39: Watt Hour Pulse Output

Outputs a pulse to indicate the watt hours.

Setting 3A: Drive Overheat Alarm (oH2)

Output closes when an external device triggers an overheat warning in the drive.

Setting 3D: During Speed Search

The output terminal closes while Speed Search is being performed. *Refer to b3: Speed Search on page 31* for details.

Setting 3E: PID Feedback Low

The output terminal closes when a PID feedback loss is detected. The feedback is considered to be lost if it falls below the level set to b5-13 for longer than the time set to b5-14. *Refer to PI Feedback Loss Detection on page 42* for details.

Setting 3F: PID Feedback High

The output terminal closes when a PID feedback loss is detected. The feedback is considered to be lost if it rises beyond the level set to b5-36 for longer than the time set to b5-37. *Refer to PI Feedback Loss Detection on page 42* for details.

Setting 4A: During KEB Operation

The output terminal closes while KEB is being performed.

Setting 4B: During Short Circuit Braking

The output terminal closes while Short Circuit Braking is being executed.

Setting 4C: During Fast Stop

The output terminal closes when a Fast Stop is being executed. *Refer to Settings 15 and 17: Fast Stop (N.O., N.C.) on page 77*.

Setting 4D: oH Pre-Alarm Time Limit

The output terminal closes when the drive is reducing the speed due to a drive overheat alarm (L8-03 = 4) and the overheat alarm has not disappeared after 10 frequency reduction operation cycles. *Refer to L8-03: Overheat Pre-Alarm Operation Selection on page 117* for a more detailed description.

Setting 50: Waiting to Run (WrUn)

The drive will delay executing a Run command until the time set to b1-11 has expired.

Setting 51: Sequence Timer 1 Active

Sequence Timer 1 is active.

Setting 52: Sequence Timer 2 Active

Sequence Timer 2 is active.

Setting 53: Sequence Timer 3 Active

Sequence Timer 3 is active.

Setting 54: Sequence Timer 4 Active

Sequence Timer 4 is active.

Setting 58: Underload Detection

Underload is detected when the output current falls below the underload detection level defined by L6-14 and L6-02.

Setting 60: Internal Cooling Fan Alarm

The output closes when the drive internal cooling fan has failed.

Setting 71: Secondary PI Feedback Low

The PI2 feedback level is too low.

Setting 72: Secondary PI Feedback High

The PI2 feedback level is too high.

Setting A4: BP Drive Relay

Line voltage is being supplied to the drive, and the motor is being run via the drive.

Note: Available in V/f control mode.

Setting A5: BP Bypass Relay

Line voltage is being supplied directly to the motor.

Note: Available in V/f control mode.

Setting A6: BP BAS Interlock Relay

Actuation signal for options dampers.

Note: Available in V/f control mode.

Setting A9: Relay Operator Control

F1 (F2) key toggle relay is output.

Setting B2: BAS Interlock Relay Contact

Drive is running (not closed during Motor Preheat unless Run command is present). Actuation signal for damper.

Setting 100 to 1B2: Functions 0 to B2 with Inverse Output

These settings have the same function as settings 0 to B2, but with inverse output. Set as 1☐☐, where the “1” indicates inverse output and the last two digits specify the setting number of the function.

Examples:

- Set 108 for inverse output of “8: During Baseblock (N.O.)”.
- Set 14A for inverse output of “4A: During KEB Operation”.

◆ H3: Multi-Function Analog Inputs

The drive is equipped with three multi-function analog input terminals: A1 and A2. ***Refer to Multi-Function Analog Input Terminal Settings on page 94*** for a listing of the functions that can be set to these terminals.

■ H3-01: Terminal A1 Signal Level Selection

Selects the input signal level for analog input A1. Set jumper S1 on the terminal board accordingly for voltage input or current input.

No.	Name	Setting Range	Default
H3-01	Terminal A1 Signal Level Selection	0 to 3	0

Setting 0: 0 to 10 V with Zero Limit

The input level is 0 to 10 Vdc with zero limit. The minimum input level is limited to 0%, so that a negative input signal due to gain and bias settings will be read as 0%.

Setting 1: 0 to 10 V without Zero Limit

The input level is 0 to 10 Vdc without zero limit. If the resulting voltage is negative after being adjusted by gain and bias settings, then the motor will rotate in reverse.

Setting 2: 4 to 20 mA Current Input

The input level is 4 to 20 mA. Negative input values by negative bias or gain settings are limited to 0%.

Setting 3: 0 to 20 mA Current Input

The input level is 0 to 20 mA. Negative input values by negative bias or gain settings are limited to 0%.

■ H3-02: Terminal A1 Function Selection

Selects the input signal level for analog input A1. ***Refer to Multi-Function Analog Input Terminal Settings on page 94*** for instructions on adjusting the signal level.

No.	Name	Setting Range	Default
H3-02	Terminal A1 Function Selection	0 to 41	0

■ H3-03, H3-04: Terminal A1 Gain and Bias Settings

Parameter H3-03 sets the level of the selected input value that is equal to 10 Vdc (20 mA) input at terminal A1 (gain).

Parameter H3-04 sets the level of the selected input value that is equal to 0 V (4 mA, 0 mA) input at terminal A1 (bias).

Use both parameters to adjust the characteristics of the analog input signal to terminal A1.

No.	Name	Setting Range	Default
H3-03	Terminal A1 Gain Setting	-999.9 to 999.9%	100.0%
H3-04	Terminal A1 Bias Setting	-999.9 to 999.9%	0.0%

Setting Examples

- Gain H3-03 = 200%, bias H3-04 = 0, terminal A1 as frequency reference input (H3-02 = 0):

  A 10 Vdc input is equivalent to a 200% frequency reference and 5 Vdc is equivalent to a 100% frequency reference. Since the drive output is limited by the maximum frequency parameter (E1-04), the frequency reference will be equal to E1-04 above 5 Vdc.

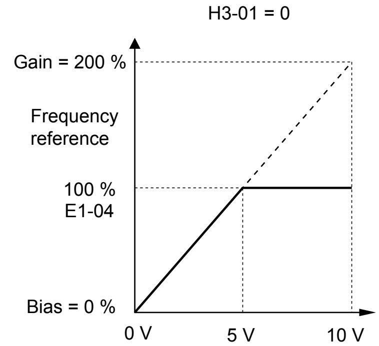


Figure 1.50 Frequency Reference Setting by Analog Input with Increased Gain

- Gain H3-03 = 100%, bias H3-04 = -25%, terminal A1 as frequency reference input:
  An input of 0 Vdc will be equivalent to a -25% frequency reference.
  When parameter H3-01 = 0, the frequency reference is 0% between 0 and 2 Vdc input.

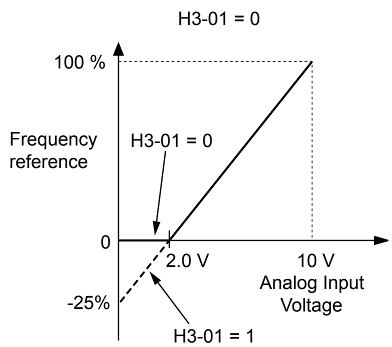


Figure 1.51 Frequency Reference Setting by Analog Input with Negative Bias

■ H3-09: Terminal A2 Signal Level Selection

Selects the input signal level for analog input A2. Set Jumper S1 on the terminal board accordingly for a voltage input or current input.

No.	Name	Setting Range	Default
H3-09	Terminal A2 Signal Level Selection	0 to 3	2

Setting 0: 0 to 10 V with Zero Limit

The input level is 0 to 10 Vdc. Negative input values will be limited to 0. ***Refer to Setting 0: 0 to 10 V with Zero Limit on page 92***.

Setting 1: 0 to 10 V without Zero Limit

The input level is 0 to 10 Vdc. Negative input values will be accepted. ***Refer to Setting 1: 0 to 10 V without Zero Limit on page 92***.

Setting 2: 4 to 20 mA Current Input

The input level is 4 to 20 mA. Negative input values by negative bias or gain settings will be limited to 0%.

Setting 3: 0 to 20 mA Current Input

The input level is 0 to 20 mA. Negative input values by negative bias or gain settings will be limited to 0%.

■ H3-10: Terminal A2 Function Selection

Determines the function assigned to analog input terminal A2. ***Refer to Multi-Function Analog Input Terminal Settings on page 94*** for a list of functions and descriptions.

No.	Name	Setting Range	Default
H3-10	Terminal A2 Function Selection	0 to 26	0

■ H3-11, H3-12: Terminal A2 Gain and Bias Setting

Parameter H3-11 sets the level of the input value selected that is equal to 10 Vdc input or 20 mA input to terminal A2.

Parameter H3-12 sets the level of the input value selected that is equal to 0 V, 4 mA or 0 mA input at terminal A2.

Use both parameters to adjust the characteristics of the analog input signal to terminal A2. The setting works in the same way as parameters H3-03 and H3-04 for analog input A1.

No.	Name	Setting Range	Default
H3-11	Terminal A2 Gain Setting	-999.9 to 999.9%	100.0%
H3-12	Terminal A2 Bias Setting	-999.9 to 999.9%	0.0%

■ H3-13: Analog Input Filter Time Constant

Parameter H3-13 sets the time constant for a first order filter that will be applied to the analog inputs.

An analog input filter prevents erratic drive control when using a “noisy” analog reference. Drive operation becomes more stable as the programmed time becomes longer, but it also becomes less responsive to rapidly changing analog signals.

No.	Name	Setting Range	Default
H3-13	Analog Input Filter Time Constant	0.00 to 2.00 s	0.03 s

■ H3-14: Analog Input Terminal Enable Selection

When one of the multi-function digital input parameters is set for “Analog input enable” (H1-□□ = C), the value set to H3-14 determines which analog input terminals are enabled and which terminals are disabled when the input is closed. All analog input terminals will be enabled all of the time if H1-□□ is not set to C.

No.	Name	Setting Range	Default
H3-14	Analog Input Terminal Enable Selection	1 to 3	2

Setting 1: A1 Only Enabled

Setting 2: A2 Only Enabled

Setting 3: Terminals A1 and A2

■ H3-16 and H3-17: Terminal A1/A2 Offset

Set the offset level of the selected input value to terminals A1 or A2 that is equal to 0 Vdc input. These parameters rarely require adjustment.

No.	Name	Setting Range	Default
H3-16	Terminal A1 Offset	-500 to 500	0
H3-17	Terminal A2 Offset	-500 to 500	0

■ Multi-Function Analog Input Terminal Settings

See *Table 1.30* for information on how H3-02 and H3-10 determine functions for terminals A1 and A2.

Note: The scaling of all input functions depends on the gain and bias settings for the analog inputs. Set these to appropriate values when selecting and adjusting analog input functions.

Table 1.30 Multi-Function Analog Input Terminal Settings

Setting	Function	Page	Setting	Function	Page
0	Frequency Bias	95	9	Output Frequency Lower Limit Level	96
1	Frequency Gain	95	B	PI Feedback	96
2	Auxiliary Frequency Reference 1	95	C	PI Setpoint	96
3	Auxiliary Frequency Reference 2	95	D	Frequency Bias	96
4	Output Voltage Bias	95	E	Motor Temperature (PTC Input)	96
5	Accel/Decel Time Gain	95	F	Through Mode	96
6	DC Injection Braking Current	95	16	Differential PI Feedback	96
7	Overtorque/Undertorque Detection Level	96	25	Secondary PI Setpoint	–
8	Stall Prevention Level During Run	96	26	Secondary PI Feedback	–

Setting 0: Frequency Bias

The input value of an analog input set to this function will be added to the analog frequency reference value. When the frequency reference is supplied by a different source other than the analog inputs, this function will have no effect. Use this setting also when only one of the analog inputs is used to supply the frequency reference.

By default, analog inputs A1 and A2 are set for this function. Simultaneously using A1 and A2 increases the frequency reference by the total of all inputs.

Example: If the analog frequency reference from analog input terminal A1 is 50% and a bias of 20% is applied by analog input terminal A2, the resulting frequency reference will be 70% of the maximum output frequency.

Setting 1: Frequency Gain

The input value of an analog input set to this function will be multiplied with the analog frequency reference value.

Example: If the analog frequency reference from analog input terminal A1 is 80% and a gain of 50% is applied from analog input terminal A2, the resulting frequency reference will be 40% of the maximum output frequency.

Setting 2: Auxiliary Reference 1

Sets the auxiliary frequency reference 1 when multi-step speed operation is selected. ***Refer to Multi-Step Speed Selection on page 58*** for details.

Setting 3: Auxiliary Reference 2

Sets the auxiliary frequency reference 2 when multi-step speed operation is selected. ***Refer to Multi-Step Speed Selection on page 58*** for details.

Setting 4: Output Voltage Bias

Voltage bias boosts the output voltage of the V/f curve as a percentage of the maximum output voltage (E1-05). Available only when using V/f Control.

Setting 5: Accel/Decel Time Gain

Adjusts the gain level for the acceleration and deceleration times set to parameters C1-01 through C1-08.

The drive acceleration time is calculated by multiplying the gain level to C1-☐☐ as follows:

C1-☐☐ × Accel/decel time gain = Drive accel/decel time

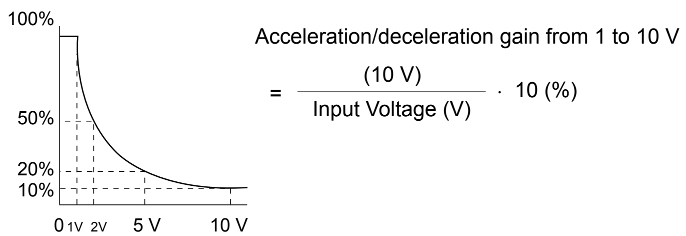


Figure 1.52 Accel/Decel Time Gain with Analog Input Terminal

Setting 6: DC Injection Braking Current

The current level used for DC Injection Braking is set as a percentage of the drive rated current.

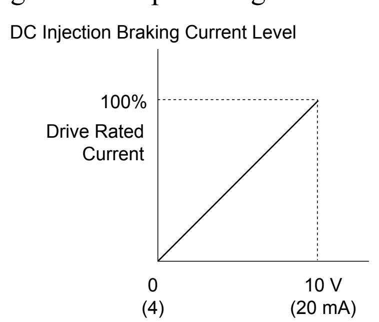


Figure 1.53 DC Injection Braking Current Using an Analog Input Terminal

Parameter Details

1

Setting 7: Torque Detection Level

Using this setting, the overtorque/undertorque detection level for torque detection 1 (L6-01) can be set by an analog input. The analog input replaces the level set to L6-02. An analog input of 100% (10 V or 20 mA) sets a torque detection level equal to 100% drive rated current/motor rated torque. Adjust the analog input gain if higher detection level settings are required. *Refer to L6: Torque Detection on page 114* for details on torque detection.

Setting 8: Stall Prevention Level

Allows an analog input signal to adjust the Stall Prevention level. *Figure 1.54* shows the setting characteristics. The drive will use the lower value of the Stall Prevention level set to L3-06 or the level coming from the selected analog input terminal.

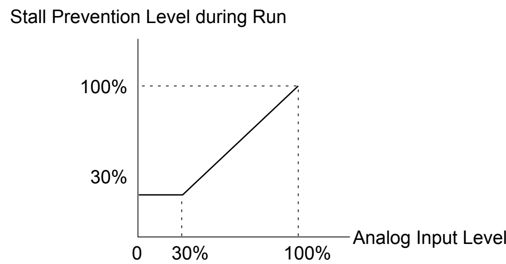


Figure 1.54 Stall Prevention During Run Using an Analog Input Terminal

Setting 9: Output Frequency Lower Limit Level

The user can adjust the lower limit of the output frequency using an analog input signal.

Setting B: PI Feedback

Supplies the PI feedback value. This setting requires PI operation to be enabled in b5-01. *Refer to PI Feedback Input Methods on page 39*.

Setting C: PI Setpoint

Supplies the PI setpoint value and makes the frequency reference selected in parameter b1-01 no longer the PI setpoint. PI operation to be enabled in b5-01 to use this setting. *Refer to PI Setpoint Input Methods on page 38*.

Setting D: Frequency Bias

The input value of an analog input set to this function will be added to the frequency reference. This function can be used with any frequency reference source.

Setting E: Motor Temperature

In addition to motor overload fault detection oL1, it is possible to use a PTC (Positive Temperature Coefficient) thermistor for motor insulation protection.

Setting F: Through Mode

When set to F, an input does not affect any drive function, but the input level can still be read out by a PLC via APOGEE FLN, BACnet, MEMOBUS/Modbus, or Metasys N2 communications.

Setting 16: Differential PI Feedback

If an analog value is set for this function, the PI controller is set for differential feedback. The difference of the PI feedback input value and the differential feedback input value builds the feedback value used to calculate the PI input. *Refer to PI Feedback Input Methods on page 39*.

◆ H4: Multi-Function Analog Outputs

These parameters assign functions to analog output terminals FM and AM for monitoring a specific aspect of drive performance.

■ H4-01, H4-04: Multi-Function Analog Output Terminal FM, AM Monitor Selection

Sets the desired drive monitor parameter U□-□□ to output as an analog value via terminal FM and AM. *Refer to U: Monitor Parameters on page 157* for a list of all monitors. The “Analog Output Level” column indicates whether a monitor can be used for analog output.

Example: Enter “103” for U1-03.

No.	Name	Setting Range	Default
H4-01	Multi-Function Analog Output Terminal FM Monitor Selection	000 to 655	102
H4-04	Multi-Function Analog Output Terminal AM Monitor Selection	000 to 655	103

A setting of 031 or 000 applies no drive monitor to the analog output. With this setting, terminal functions as well as FM and AM output levels can be set by a PLC via a communication option or MEMOBUS/Modbus (through mode).

■ H4-02, H4-03: Multi-Function Analog Output Terminal FM Gain and Bias H4-05, H4-06: Multi-Function Analog Output Terminal AM Gain and Bias

Parameters H4-02 and H4-05 set the terminal FM and AM output signal level when the value of the selected monitor is at 100%. Parameters H4-03 and H4-06 set the terminal FM and AM output signal level when the value of the selected monitor is at 0%. Both are set as a percentage, where 100% equals 10 Vdc or 20 mA analog output and 0% equals 0 V or 4 mA. The output voltage of both terminals is limited to +/-10 Vdc.

The output signal range can be selected between 0 to +10 Vdc or -10 to +10 Vdc, or 4 to 20 mA using parameter H4-07 and H4-08. *Figure 1.55* illustrates how gain and bias settings work.

No.	Name	Setting Range	Default
H4-02	Multi-Function Analog Output Terminal FM Gain	-999.9 to 999.9%	100.0%
H4-03	Multi-Function Analog Output Terminal FM Bias	-999.9 to 999.9%	0.0%
H4-05	Multi-Function Analog Output Terminal AM Gain	-999.9 to 999.9%	50.0%
H4-06	Multi-Function Analog Output Terminal AM Bias	-999.9 to 999.9%	0.0%

Using Gain and Bias to Adjust Output Signal Level

When viewing a gain setting parameter (H4-02 or H4-05) on the HOA keypad, the analog output will supply a voltage signal equal to 100% of the monitor value (including changes made from bias and gain settings). When viewing a bias setting parameter (H4-03 or H4-06), the analog output voltage will supply a signal equal to 0% monitor value.

Example 1: Set H4-02 to 50% for an output signal of 5 V at terminal FM when the monitored value is at 100%.

Example 2: Set H4-02 to 150% for an output signal of 10 V at terminal FM when the monitored value is at 76.7%.

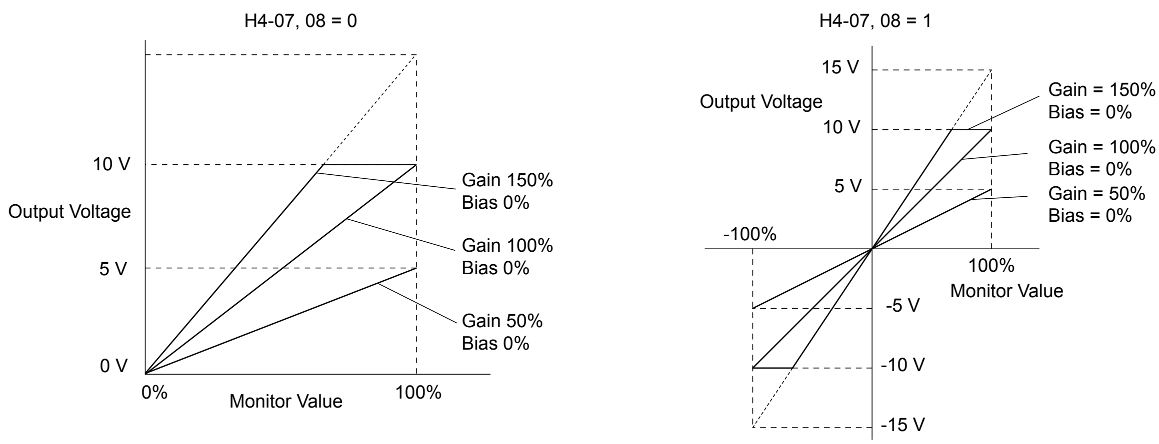


Figure 1.55 Analog Output Gain and Bias Setting Example 1 and 2

Example 3: Set H4-03 to 30% for an output signal of 3 V at terminal FM when the monitored value is at 0%.

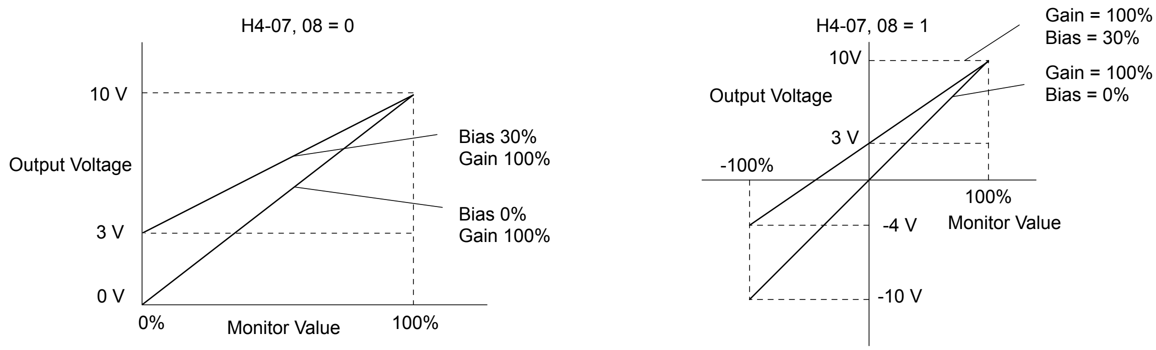


Figure 1.56 Analog Output Gain and Bias Setting Example 3

■ H4-07, H4-08: Multi-Function Analog Output Terminal FM, AM Signal Level Selection

Sets the voltage output level of U parameter (monitor parameter) data to terminal FM and terminal AM using parameters H4-07 and H4-08.

Set jumper S5 on the terminal board accordingly when changing these parameters.

No.	Name	Setting Range	Default
H4-07	Multi-Function Analog Output Terminal FM Signal Level Selection	0 to 2	0
H4-08	Multi-Function Analog Output Terminal AM Signal Level Selection	0 to 2	0

Setting 0: 0 to 10 V

Setting 1: -10 V to 10 V

Setting 2: 4 to 20 mA

◆ H5: Serial Communication (APOGEE FLN, BACnet, MEMOBUS/Modbus, and Metasys N2)

Serial communication is possible in the drive using the built-in RS-422/RS-485 port (terminals R+, R-, S+, S-) and programmable logic controllers (PLCs) or similar devices running the APOGEE FLN, BACnet, MEMOBUS/Modbus, and Metasys N2 protocols.

The H5-□□ parameters set the drive for APOGEE FLN, BACnet, MEMOBUS/Modbus, and Metasys N2 communications. Refer to the different communication protocol chapters for detailed descriptions of the H5-□□ parameters.

1.8 L: Protection Functions

◆ L1: Motor Protection

■ L1-01: Motor Overload Protection Selection

The drive has an electronic overload protection function that estimates the motor overload level based on output current, output frequency, thermal motor characteristics, and time. When the drive detects a motor overload an oL1 fault is triggered and the drive output shuts off.

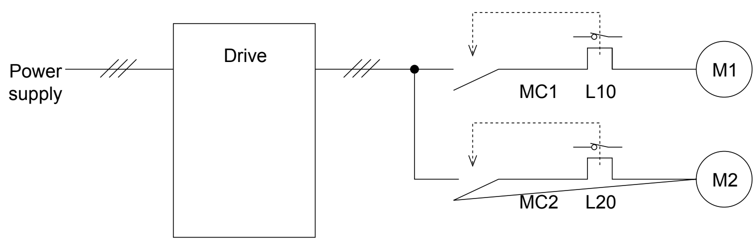
L1-01 sets the overload protection function characteristics according to the motor being used.

No.	Name	Setting Range	Default
L1-01	Motor Overload Protection Selection	0, 1, 4	Determined by A1-02

Note:
1. When the motor protection function is enabled (L1-01≠ 0), an oL1 alarm can be output through one of the multi-function outputs by setting H2-01 to 1F. The output closes when the motor overload level reaches 90% of the oL1 detection level.
2. Set L1-01 to a value between 1 and 5 when running a single motor from the drive to select a method to protect the motor from overheat. An external thermal relay is not necessary.

Setting 0: Disabled (Motor Overload Protection Is not Provided)

Use this setting if no motor overheat protection is desired or if multiple motors are connected to a single drive. If multiple motors are connected to a single drive, install a thermal relay for each motor as shown in *Figure 1.57*.



MC1, MC2: Magnetic contactors
L10, L20: Thermal relays

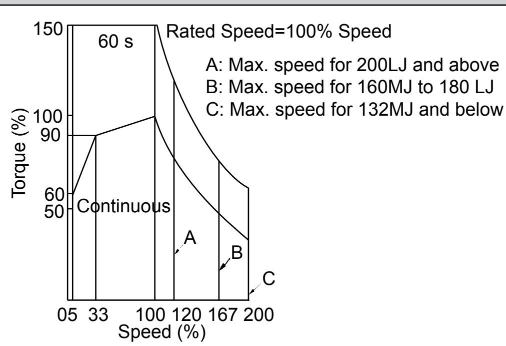
Figure 1.57 Example of Protection Circuit Design for Multiple Motors

NOTICE: *Thermal protection cannot be provided when running multi-motors simultaneously with the same drive, or when using motors with a relatively high current rating compared to other standard motors (such as a submersible motor). Failure to comply could result in motor damage. Disable the electronic overload protection of the drive (L1-01 = "0: Disabled") and protect each motor with individual motor thermal overloads.*

Note: Close MC1 and MC2 before operating the drive. MC1 and MC2 cannot be switched off during run.

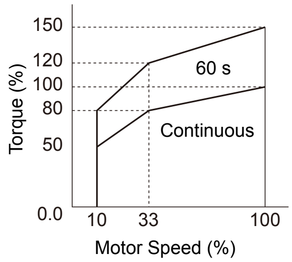
Setting 1: General-Purpose Motor (Standard Self-Cooled)

Because the motor is self-cooled, the overload tolerance drops when the motor speed is lowered. The drive appropriately adjusts the electrothermal trigger point according to the motor overload characteristics, protecting the motor from overheat throughout the entire speed range.

Overload Tolerance	Cooling Ability	Overload Characteristics
	Motor designed to operate from line power. Motor cooling is most effective when running at rated base frequency (check the motor nameplate or specifications).	Continuous operation at less than line power frequency with 100% load can trigger motor overload protection (oL1). A fault is output and the motor will coast to stop.

Setting 4: PM Derated Torque Motor

Use this setting when operating a PM motor. PM motors for derated torque have a self-cooling design and the overload tolerance drops as the motor slows. Electronic thermal overload is triggered in accordance with the motor overload characteristics, providing overheat protection across the entire speed range.

Overload Tolerance	Cooling Ability	Overload Characteristics
	Motor is designed to produce 100% torque at base speed. Built with effective cooling capabilities.	Reaching 100% when operating at below the base frequency causes a motor overload fault (oL1). The drive fault output closes and the motor coasts to stop.

■ L1-02: Motor Overload Protection Time

Sets the detection time of motor overheat due to overload. This setting rarely requires adjustment, but should correlate with the motor overload tolerance protection time for performing a hot start.

No.	Name	Setting Range	Default
L1-02	Motor Overload Protection Time	0.1 to 50.0 minutes	1.0 minute

Defaulted to operate with an allowance of 150% overload operation for one minute in a hot start.

Figure 1.58 illustrates an example of the electrothermal protection operation time using a general-purpose motor operating at the value of E1-06, Motor Base Speed, with L1-02 set to one minute.

During normal operation, motor overload protection operates in the area between a cold start and a hot start.

- Cold start: Motor protection operation time in response to an overload situation that was suddenly reached when starting a stationary motor.
- Hot start: Motor protection operation time in response to an overload situation that occurred during sustained operation at rated current.

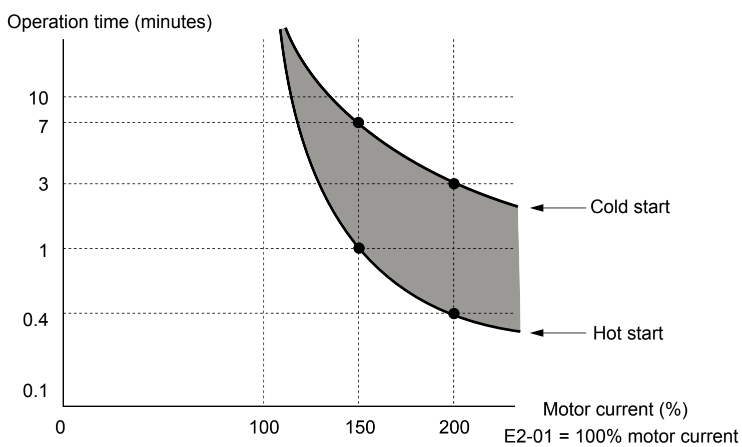


Figure 1.58 Motor Protection Operation Time

■ Motor Protection Using a Positive Temperature Coefficient (PTC) Thermistor

Connect a motor PTC to an analog input of the drive for motor overheat protection.

When the PTC input signal reaches the motor overheat alarm level, an oH3 alarm will be triggered and the drive will continue operation as selected in L1-03. When the PTC input signal reaches the overheat fault level, an oH4 fault will be triggered, a fault signal will be output, and the drive will stop the motor using the stopping method determined in L1-04.

Figure 1.59 shows a PTC connection example for analog input A2. When using analog input A2, be sure to set Jumper S1 on the control board for voltage input when using this function.

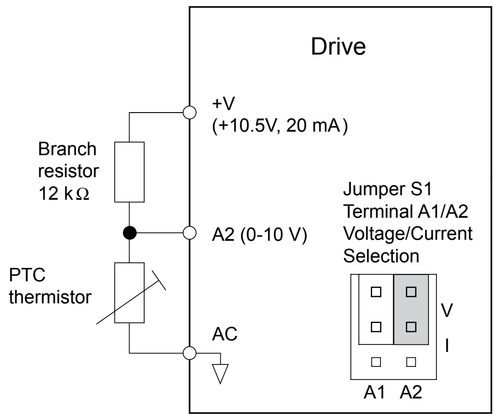


Figure 1.59 Connection of a Motor PTC

The PTC must exhibit the characteristics shown in ***Figure 1.60*** for one motor phase. The motor overload protection of the drive expects 3 of these PTCs to be connected in a series.

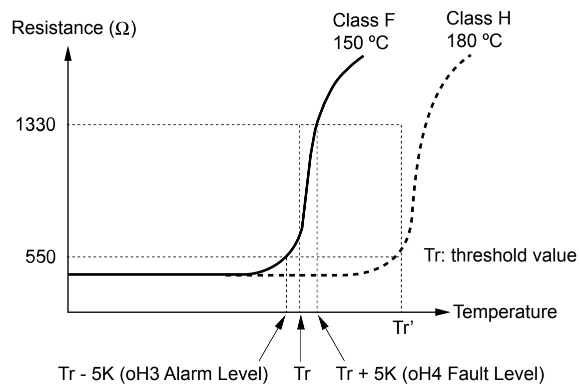


Figure 1.60 Motor PTC Characteristics

Set up overheat detection using a PTC using parameters L1-03, L1-04, and L1-05 as explained in the following sections.

■ L1-03: Motor Overheat Alarm Operation Selection (PTC input)

Sets the drive operation when the PTC input signal reaches the motor overheat alarm level (oH3).

No.	Name	Setting Range	Default
L1-03	Motor Overheat Alarm Operation Selection (PTC input)	0 to 3	3

Setting 0: Ramp to Stop

The drive stops the motor using the deceleration time 1 set in parameter C1-02.

Setting 1: Coast to Stop

The drive output is switched off and the motor coasts to stop.

Setting 2: Fast Stop

The drive stops the motor using the Fast Stop time set in parameter C1-09.

Setting 3: Alarm Only

The operation is continued and an oH3 alarm is displayed on the HOA keypad.

■ L1-04: Motor Overheat Fault Operation Selection (PTC input)

Sets the drive operation when the PTC input signal reaches the motor overheat fault level (oH4).

No.	Name	Setting Range	Default
L1-04	Motor Overheat Fault Operation Selection (PTC input)	0 to 2	1

Setting 0: Ramp to Stop

The drive stops the motor using the deceleration time 1 set in parameter C1-02.

Setting 1: Coast to Stop

The drive output is switched off and the motor coasts to stop.

Setting 2: Fast Stop

The drive stops the motor using the Fast Stop time set in parameter C1-09.

■ L1-05: Motor Temperature Input Filter Time (PTC input)

Sets a filter on the PTC input signal to prevent erroneous detection of a motor overheat fault.

No.	Name	Setting Range	Default
L1-05	Motor Temperature Input Filter Time (PTC input)	0.00 to 10.00 s	0.20 s

■ L1-13: Continuous Electrothermal Operation Selection

Determines whether to hold the current value of the electrothermal motor protection (L1-01) when the power supply is interrupted.

No.	Name	Setting Range	Default
L1-13	Continuous Electrothermal Operation Selection	0 to 2	1

Setting 0: Disabled

Setting 1: Enabled

Setting 2: Enable Using Real Time Clock (HOA Keypad)

Stores value and integrates (resets) down the oL value based on real time.

◆ L2: Momentary Power Loss Ride-Thru

■ L2-01: Momentary Power Loss Operation Selection

When a momentary power loss occurs (DC bus voltage falls below the level set in L2-05), the drive can automatically return to the operation it was performing prior to the power loss based on certain conditions.

No.	Name	Setting Range	Default
L2-01	Momentary Power Loss Operation Selection	0 to 2	0

Setting 0: Disabled

If power is not restored within 15 ms, a Uv1 fault will result and the motor coasts to stop.

Setting 1: Recover within L2-02

When a momentary power loss occurs, the drive output will be shut off. If the power returns within the time set to parameter L2-02, the drive will perform Speed Search and attempt to resume operation. If the power does not return within this time, it will trigger a Uv1 fault.

Setting 2: Recover as long as CPU Has Power

When a momentary power loss occurs, the drive output will be shut off. If the power returns and the drive control circuit has power, the drive will attempt to perform Speed Search and resume the operation. This will not trigger a Uv1 fault.

Notes on Settings 1 and 2

- “Uv” will flash on the operator while the drive is attempting to recover from a momentary power loss. A fault signal is not output at this time.
- When using a magnetic contactor between the motor and the drive, keep the magnetic contactor closed as long as the drive attempts to restart with Speed Search.

■ L2-02: Momentary Power Loss Ride-Thru Time

Sets the maximum time allowed to ride through a power loss. If power loss operation exceeds this time, the drive will attempt to accelerate back to the frequency reference. This parameter is valid if L2-01 = 1.

Note: The amount of time the drive is capable of recovering after a power loss is determined by the capacity of the drive. Drive capacity determines the upper limit for L2-02.

No.	Name	Setting Range	Default
L2-02	Momentary Power Loss Ride-Thru Time	0.0 to 25.5 s	Determined by o2-04

■ L2-03: Momentary Power Loss Minimum Baseblock Time

Sets the minimum baseblock time when power is restored following a momentary power loss. This determines the time the drive waits for the residual voltage in the motor to dissipate. Increase this setting if overcurrent or overvoltage occurs at the beginning of Speed Search, after a power loss, or during DC Injection Braking.

No.	Name	Setting Range	Default
L2-03	Momentary Power Loss Minimum Baseblock Time	0.1 to 5.0 s	Determined by o2-04

■ L2-04: Momentary Power Loss Voltage Recovery Ramp Time

Sets the time for the drive to restore the output voltage to the level specified by the V/f pattern after Speed Search. The setting value determines the time for the voltage to go from 0 V to the maximum voltage.

No.	Name	Setting Range	Default
L2-04	Momentary Power Loss Voltage Recovery Ramp Time	0.0 to 5.0 s	Determined by o2-04

■ L2-05: Undervoltage Detection Level (Uv)

Determines the voltage at which a Uv1 fault is triggered or at which the KEB function is activated. This setting rarely needs to be changed.

No.	Name	Setting Range	Default
L2-05	Undervoltage Detection Level	150 to 220 Vdc <1>	Determined by A1-02, E1-01, and o2-04 <2>

<1> Values are specific to 200 V class drives. Double the value for 400 V class drives.

<2> The default setting for 400 V class drives depends on whether the drive input voltage is over 400 V or under 400 V.

Note:
1. Install an AC reactor option on the input side of the power supply when setting L2-05 below the default value to prevent damage to drive circuitry.
2. If using KEB Ride-Thru and L2-05 is set too low, then undervoltage in the DC bus (Uv1) will be triggered before KEB Ride-Thru can be executed. Take caution not to set this value too low.

■ L2-06: KEB Deceleration Time

Sets the time to decelerate from the frequency reference at the time KEB Ride-Thru was initiated to zero speed.

No.	Name	Setting Range	Default
L2-06	KEB Deceleration Time	0.00 to 6000.0 s	0.00 s

■ L2-07: KEB Acceleration Time

Sets the time to reaccelerate from the speed when KEB was deactivated to the frequency reference.

When set to 0.0 s, the drive will accelerate to speed according to the active deceleration time set by C1-01 or C1-03.

No.	Name	Setting Range	Default
L2-07	KEB Acceleration Time	0.00 to 6000.0 s	0.00 s

■ L2-08: Frequency Gain at KEB Start

When the KEB Ride-Thru command is input, the output frequency is reduced in a single step to quickly get the motor into a regenerative state. Calculate the amount of this frequency reduction using the formula below. L2-08 can only be used with induction motors.

Amount of reduction = Slip frequency prior to KEB × (L2-08) × 2

No.	Name	Setting Range	Default
L2-08	Frequency Gain at KEB Start	0 to 300%	100%

■ L2-10: KEB Detection Time (Minimum KEB Time)

Determines the duration of KEB Ride-Thru operation after it is triggered.

No.	Name	Setting Range	Default
L2-10	KEB Detection Time	0 to 2000 ms	50 ms

■ L2-11: DC Bus Voltage Setpoint during KEB

Determines the setpoint (target value) for the DC bus voltage during Single KEB Ride-Thru 2. For Single KEB Ride-Thru 1 and System KEB Ride-Thru, parameter L2-11 defines the voltage level to end KEB Ride-Thru.

No.	Name	Setting Range	Default
L2-11	DC Bus Voltage Setpoint during KEB	150 to 400 Vdc <1>	Determined by E1-01

<1> Values are specific to 200 V class drives. Double the value for 400 V class drives.

■ L2-29: KEB Method Selection

Selects the way the Kinetic Energy Buffering function operates.

Note: If a multi function input is set for Single KEB Ride-Thru 2 (H1-□□ = 7A, 7B), the setting of L2-29 is disregarded and the KEB mode equal to L2-29 = 1 is automatically selected.

No.	Name	Setting Range	Default
L2-29	KEB Method Selection	0, 1	0

Setting 0: Single Drive KEB Ride-Thru 1

Setting 1: Single Drive KEB Ride-Thru 2

◆ L3: Stall Prevention

The motor may experience excessive slip because it cannot keep up with the frequency reference when the load is too high or acceleration and deceleration times are too short. If the motor slips during acceleration, it usually causes an overcurrent fault (oC), drive overload (oL2), or motor overload (oL1). If the motor slips during deceleration, it can cause excessive regenerative power to flow back into the DC bus capacitors, and eventually cause the drive to fault out from overvoltage (oV). The Stall Prevention Function prevents the motor from stalling and while allowing the motor to reach the desired speed without requiring the user to change the acceleration or deceleration time settings. The Stall Prevention function can be set separately for acceleration, operating at constant speeds, and deceleration.

■ L3-01: Stall Prevention Selection during Acceleration

Stall Prevention during acceleration prevents tripping with overcurrent (oC), motor overload (oL1), or drive overload (oL2) faults common when accelerating with heavy loads or short acceleration times.

L3-01 determines the type of Stall prevention the drive should use during acceleration.

No.	Name	Setting Range	Default
L3-01	Stall Prevention Selection during Acceleration	0 to 2 <1>	1

<1> Setting 2 is not available for OLV/PM.

Setting 0: Disabled

No Stall Prevention is provided. If the acceleration time is too short, the drive may not be able to get the motor up to speed fast enough, causing an overload fault.

Setting 1: Enabled

Enables Stall Prevention during acceleration. Operation varies depending on the control mode.

- V/f Control:

  Acceleration is reduced when the output current value exceeds 85% of the level set to parameter L3-02 for a longer than the time set to L3-27. The acceleration stops when the current exceeds L3-02. Acceleration continues when the current falls below L3-02 for longer than the time set to L3-27.

  The Stall Prevention level is automatically reduced in the constant power range. ***Refer to L3-03: Stall Prevention Limit during Acceleration on page 106***.

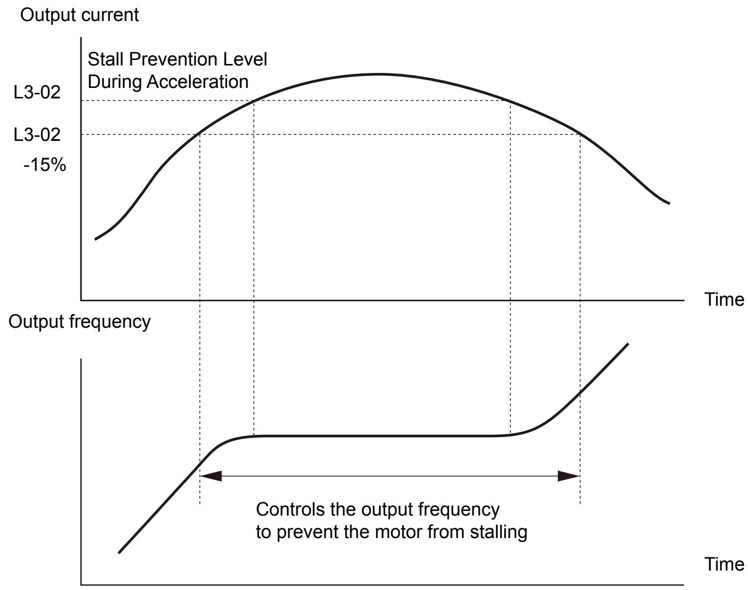


Figure 1.61 Stall Prevention During Acceleration for Induction Motors

- Open Loop Vector Control for PM:

  Acceleration stops when the output current reaches the level set to parameter L3-02. When the time set to parameter L3-27 passes, the drive decelerates using the deceleration time set to L3-22 (*Refer to L3-22: Deceleration Time at Stall Prevention during Acceleration on page 106*). Deceleration stops when the current falls below 85% of L3-02,. The drive will attempt to reaccelerate after the time set to L3-27.

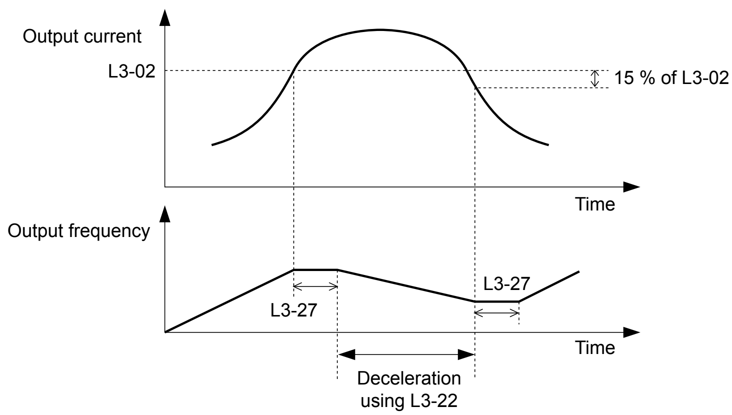


Figure 1.62 Stall Prevention During Acceleration for Permanent Magnet Motors

Setting 2: Intelligent Stall Prevention

The drive disregards the selected acceleration time and attempts to accelerate in the minimum time. The acceleration rate is adjusted so the current does not exceed the value set to parameter L3-02.

■ L3-02: Stall Prevention Level during Acceleration

Sets the output current level at which the Stall Prevention during acceleration is activated.

No.	Name	Setting Range	Default
L3-02	Stall Prevention Level during Acceleration	0 to 150% <1>	<1>

<1> The upper limit and default value is determined by parameter L8-38, Carrier Frequency Derating Selection.

- Lower L3-02 if stalling occurs when using a motor that is relatively small compared to the drive.
- Also set parameter L3-03 when operating the motor in the constant power range.

■ L3-03: Stall Prevention Limit during Acceleration

The Stall Prevention level is automatically reduced when the motor is operated in the constant power range. L3-03 sets the lower limit for this reduction as a percentage of the drive rated current.

No.	Name	Setting Range	Default
L3-03	Stall Prevention Limit during Acceleration	0 to 100%	50%

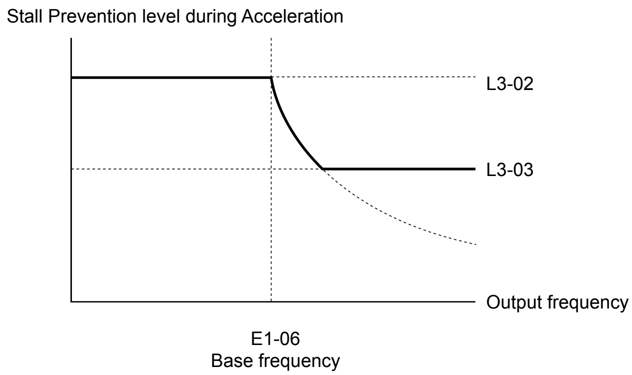


Figure 1.63 Stall Prevention Level and Limit During Acceleration

■ L3-22: Deceleration Time at Stall Prevention during Acceleration

Sets the brief deceleration time used when stalling occurs while accelerating a PM motor. When set to 0, this function is disabled and the drive decelerates at the selected deceleration time when stalling occurs.

The function is effective only in OLV/ PM control and when parameter L3-01 is set to 1.

No.	Name	Setting Range	Default
L3-22	Deceleration Time at Stall Prevention During Acceleration	0.0 to 6000.0 s	0.0 s

■ L3-04: Stall Prevention Selection during Deceleration

Stall Prevention during deceleration controls the deceleration based on the DC bus voltage and prevents an overvoltage fault caused by high inertia or rapid deceleration.

No.	Name	Setting Range	Default
L3-04	Stall Prevention Selection During Deceleration	0, 1, 2, 4, 5 <1>	1

<1> Settings 4 and 5 are not available in OLV/PM.

Setting 0: Disabled

The drive decelerates according to the set deceleration time. With high inertia loads or rapid deceleration, an overvoltage fault may occur. If an overvoltage fault occurs, use dynamic braking options or switch to another L3-04 selection.

Setting 1: General-Purpose Stall Prevention

The drive tries to decelerate within the set deceleration time. The drive pauses deceleration when the DC bus voltage exceeds the Stall Prevention level and then continues deceleration when the DC bus voltage drops below that level. Stall Prevention may be triggered repeatedly to avoid an overvoltage fault. The DC bus voltage level for Stall Prevention depends on the input voltage setting E1-01.

Drive Input Voltage	Stall Prevention Level during Deceleration
200 V Class	377 Vdc
400 V Class	754 Vdc

Note: This method may lengthen the total deceleration time compared to the set value. If this is not appropriate for the application consider using a dynamic braking option.

Figure 1.64 illustrates the function of Stall Prevention during deceleration.

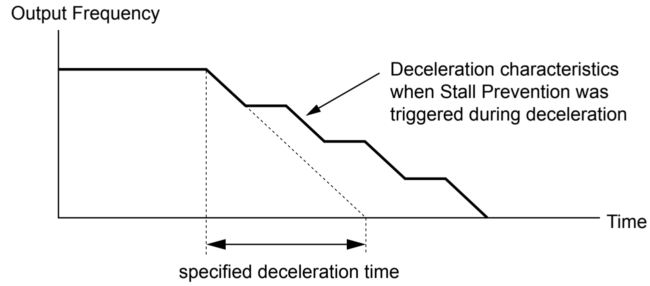


Figure 1.64 Stall Prevention During Deceleration

Setting 2: Intelligent Stall Prevention

The drive adjusts the deceleration rate so the DC bus voltage is kept at the level set to parameter L3-17. This produces the shortest possible deceleration time while protecting the motor from stalling. The selected deceleration time is disregarded and the achievable deceleration time cannot be smaller than 1/10 of the set deceleration time.

This function uses the following parameters for adjusting the deceleration rate:
- DC bus voltage gain (L3-20)
- Deceleration rate calculations gain (L3-21)
- Inertia calculations for motor acceleration time (L3-24)
- Load inertia ratio (L3-25)

Note: The deceleration time is not constant. Do not use Intelligent Stall Prevention in applications where stopping accuracy is a concern.

Setting 4: Overexcitation Deceleration 1

Overexcitation Deceleration 1 (increasing the motor flux) is faster than deceleration with no Stall Prevention (L3-04 = 0). Setting 4 changes the selected decel time and functions to provide protection from an overvoltage trip. *Refer to Overexcitation Deceleration (Induction Motors) on page 123* for details.

Setting 5: Overexcitation Deceleration 2

Overexcitation Deceleration 2 slows down the motor while trying to maintain the DC bus voltage at the level set to parameter L3-17. This function shortens the achievable deceleration time more than by using Overexcitation Deceleration 1. Setting 5 will shorten/lengthen the decel time to maintain the L3-17 bus level. *Refer to Overexcitation Deceleration (Induction Motors) on page 123* for details.

■ L3-05: Stall Prevention Selection during Run

Determines how Stall Prevention works during Run. Stall Prevention during run prevents the motor from stalling by automatically reducing the speed when a transient overload occurs while the motor is running at constant speed.

No.	Name	Setting Range	Default
L3-05	Stall Prevention Selection During Run	0 to 2	1

Note: Stall Prevention during run is disabled when the output frequency is 6 Hz or lower regardless of the L3-05 and L3-06 settings.

Setting 0: Disabled

Drive runs at the set frequency reference. A heavy load may cause the motor to stall and trip the drive with an oC or oL fault.

Setting 1: Decelerate Using C1-02

If the current exceeds the Stall Prevention level set in parameter L3-06, the drive will decelerate at decel time 1 (C1-02). When the current level drops below the value of L3-06 minus 2% for 100 ms, the drive accelerates back to the frequency reference at the active acceleration time.

Setting 2: Decelerate Using C1-04

Same as setting 1 except the drive decelerates at decel time 2 (C1-04).

■ L3-06: Stall Prevention Level during Run

Sets the current level to trigger Stall Prevention during run. Depending on the setting of parameter L3-23, the level is automatically reduced in the constant power range (speed beyond base speed).

The Stall Prevention level can be adjusted using an analog input. *Refer to Multi-Function Analog Input Terminal Settings on page 94* for details.

No.	Name	Setting Range	Default
L3-06	Stall Prevention Level During Run	30 to 150 <1>	<1>

<1> The upper limit and default for this setting is determined by L8-38.

■ L3-23: Automatic Reduction Selection for Stall Prevention during Run

Reduces the Stall Prevention during run level in the constant power range.

No.	Name	Setting Range	Default
L3-23	Automatic Reduction Selection for Stall Prevention During Run	0, 1	0

Setting 0: Disabled

The level set in L3-06 is used throughout the entire speed range.

Setting 1: Enabled

The Stall Prevention level during run is reduced in the constant power range. The lower limit will be 40% of L3-06.

■ Overvoltage Suppression Function

Suppresses overvoltage faults by decreasing the regenerative torque limit and slightly increasing the output frequency when the DC bus voltage rises.

The regenerative torque limit and the output frequency are adjusted during ov suppression so that the DC bus voltage does not exceed the level set to parameter L3-17. In addition to the parameters explained below, ov suppression also uses these settings for frequency adjustment:

- DC bus voltage gain (L3-20)
- Deceleration rate calculations gain (L3-21)
- Inertia calculations for motor acceleration time (L3-24)
- Load inertia ratio (L3-25)

Note:
1. The motor speed will exceed the frequency reference when overvoltage suppression is triggered. Consequently, overvoltage suppression is not appropriate in applications that require a perfect match between the frequency reference and the motor speed.
2. Disable overvoltage suppression when using a braking resistor.
3. Overvoltage may still occur if there is a sudden increase to a regenerative load.
4. This function is enabled only when operating just below the maximum frequency. Overvoltage suppression does not increase the output frequency beyond the maximum frequency. If the application requires this, increase the maximum frequency and change the base frequency setting.

■ L3-11: Overvoltage Suppression Function Selection

Enables or disables the overvoltage suppression function.

No.	Name	Setting Range	Default
L3-11	Overvoltage Suppression Function Selection	0, 1	0

Setting 0: Disabled

The regenerative torque limit and the output frequency are not adjusted. A regenerative load may trip the drive with an overvoltage fault. Use this setting if dynamic braking options are installed.

Setting 1: Enabled

When the DC bus voltage rises due to regenerative load, an overvoltage fault is prevented by decreasing the regenerative torque limit and increasing the output frequency.

■ L3-17: Target DC Bus Voltage for Overvoltage Suppression and Stall Prevention

Sets the target DC bus voltage level used by the overvoltage suppression function (L3-11 = 1), Intelligent Stall Prevention during deceleration (L3-04 = 2).

No.	Name	Setting Range	Default
L3-17	Target DC Bus Voltage for Overvoltage Suppression and Stall Prevention	150 to 400 Vdc <1>	370 Vdc <1> <2>

<1> Values are specific to 200 V class drives. Double the value for 400 V class drives.

<2> This value is initialized when E1-01 is changed.

■ L3-20: DC Bus Voltage Adjustment Gain

Determines the proportional gain used by overvoltage suppression (L3-11 = 1), Single Drive KEB 2 (L2-29 = 1), KEB Ride-Thru 2 (H1-□□ = 7A or 7B) ,and Intelligent Stall Prevention during deceleration (L3-04 = 2) to control the DC bus voltage.

Note: This function is available in OLV/PM control mode.

No.	Name	Setting Range	Default
L3-20	DC Bus Voltage Adjustment Gain	0.00 to 5.00	Determined by A1-02

Adjustment for Single Drive KEB 2 (L2-29 = 1) and Intelligent Stall Prevention During Deceleration

- Increase this setting slowly in steps of 0.1 if overvoltage or undervoltage occurs at the beginning of deceleration.
- Decrease this setting if there is a fair amount of speed or torque ripple.

Adjustment for Overvoltage Suppression

- Increase this setting slowly in steps of 0.1 if overvoltage suppression is enabled (L3-11 = 1) and a sudden increase in a regenerative load causes an overvoltage fault.
- Decrease this setting if there is a fair amount of speed or torque ripple.

■ L3-21: Accel/Decel Rate Calculation Gain

Determines the proportional gain used by overvoltage suppression (L3-11 = 1), Single Drive KEB 2 (L2-29 = 1), and Intelligent Stall Prevention during deceleration (L3-04 = 2) to calculate acceleration and deceleration rates.

No.	Name	Setting Range	Default
L3-21	Accel/Decel Rate Calculation Gain	0.00 to 200.00	1.00

Adjustment for Single Drive KEB 2 (L2-29 = 1) and Intelligent Stall Prevention During Deceleration

- Reduce L3-21 in steps of 0.05 if there is a fairly large speed or current ripple.
- Small reductions of L3-21 can help solve problems with overvoltage and overcurrent.
- Decreasing this setting too much can cause slow DC bus voltage control response and may also lengthen deceleration times beyond optimal levels.

Adjustment for Overvoltage Suppression

- Increase this setting in steps of 0.1 if overvoltage occurs as a result of a regenerative load when overvoltage suppression is enabled (L3-11 = 1).
- Decrease L3-21 in steps of 0.05 if there is a fairly large speed ripple when overvoltage suppression is enabled.

■ L3-24: Motor Acceleration Time for Inertia Calculations

Sets the time to accelerate the motor from stop to the maximum speed at motor rated torque. Set this parameter when using Single Drive KEB 2 (L2-29 = 1), Intelligent Stall Prevention during deceleration (L3-04 = 2), or the overvoltage suppression function (L3-11 = 1).

Note: This function is available in OLV/PM control mode.

No.	Name	Setting Range	Default
L3-24	Motor Acceleration Time for Inertia Calculations	0.001 to 10.000 s	Determined by o2-04

Make the calculations in the formula below:

$$\text{L3-24} = \frac{2 \cdot \pi \cdot J\,[\text{kgm}^2] \cdot n_{rated}[\text{r/min}]}{60 \cdot T_{rated}[\text{Nm}]}$$

Calculate the rated torque in the formula below:

$$T_{rated}[\text{Nm}] = \frac{60 \cdot P_{Motor}[\text{kW}] \cdot 10^3}{2 \cdot \pi \cdot n_{rated}[\text{r/min}]}$$

Parameter Details

1

■ L3-25: Load Inertia Ratio

Determines the ratio between the rotor inertia and the load. Set this parameter when using Single Drive KEB 2 (L2-29 = 1), Intelligent Stall Prevention during deceleration (L3-04 = 2), or the overvoltage suppression function (L3-11 = 1).

Note: This function is available in OLV/PM control mode.

No.	Name	Setting Range	Default
L3-25	Load Inertia Ratio	0.0 to 1000.0	1.0

When set incorrectly, a fairly large current ripple can result during Single Drive KEB 2 (L2-29 = 1). This may cause overvoltage suppression (L3-11 = 1) or other faults such as ov, Uv1, and oC.

Calculate parameter L3-25 in the formula below:

$$\text{L3-25} = \frac{\text{Machine Inertia}}{\text{Motor Inertia}}$$

■ L3-26: Additional DC Bus Capacitors

Sets the capacity of any additionally installed DC bus capacitors. This data is used in calculations for Single Drive KEB Ride-Thru 2. Adjust this setting only if external capacity is connected to the DC bus and Single Drive KEB 2 is used.

No.	Name	Setting Range	Default
L3-26	Additional DC Bus Capacitors	0 to 65000 μF	0 μF

■ L3-27: Stall Prevention Detection Time

Sets a delay time from when the Stall Prevention level is reached and the actual Stall Prevention function is activated.

No.	Name	Setting Range	Default
L3-27	Stall Prevention Detection Time	0 to 5000 ms	50 ms

◆ L4: Speed Detection

These parameters set up the speed agree and speed detection functions that can be assigned to the multi-function output terminals.

The speed is detected using the motor speed when A1-02 = 3 or 7.

■ L4-01, L4-02: Speed Agreement Detection Level and Detection Width

Parameter L4-01 sets the detection level for the digital output functions Speed agree 1, User-set speed agree 1, Frequency detection 1, and Frequency detection 2.

Parameter L4-02 sets the hysteresis level for these functions.

No.	Name	Setting Range	Default
L4-01	Speed Agreement Detection Level	0.0 to 240.0 Hz	0.0 Hz
L4-02	Speed Agreement Detection Width	0.0 to 20.0 Hz	2.0 Hz

Refer to H2-01 to H2-03: Terminal M1-M2, M3-M4, and M5-M6 Function Selection on page 83, Settings 2, 3, 4, and 5.

■ L4-03, L4-04: Speed Agreement Detection Level and Detection Width (+/-)

Parameter L4-03 sets the detection level for the digital output functions Speed agree 2, User-set speed agree 2, Frequency detection 3, and Frequency detection 4.

Parameter L4-04 sets the hysteresis level for these functions.

No.	Name	Setting Range	Default
L4-03	Speed Agreement Detection Level (+/-)	-240.0 to 240.0 Hz	0.0 Hz
L4-04	Speed Agreement Detection Width (+/-)	0.0 to 20.0 Hz	2.0 Hz

Refer to H2-01 to H2-03: Terminal M1-M2, M3-M4, and M5-M6 Function Selection on page 83, Settings 13, 14, 15, and 16.

■ L4-05: Frequency Reference Loss Detection Selection

The drive can detect a loss of an analog frequency reference from input A1 or A2. Frequency reference loss is detected when the frequency reference drops below 10% of the reference or below 5% of the maximum output frequency within 400 ms.

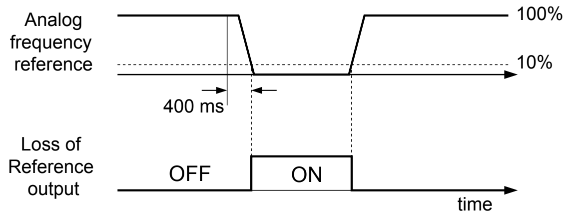


Figure 1.65 Loss of Reference Function

Set H2-01 or H2-02 to C for a digital output to trigger when frequency reference loss occurs. *Refer to Setting C: Frequency Reference Loss on page 87* for details on setting the output function.

Parameter L4-05 selects the operation when a frequency reference loss is detected.

No.	Name	Setting Range	Default
L4-05	Frequency Reference Loss Detection Selection	0, 1	1

Setting 0: Stop

Drive follows the frequency reference (which is no longer present) and stops the motor.

Setting 1: Continue Operation with Reduced Frequency Reference

The drive will continue operation at the percent of the previous frequency value set to parameter L4-06. When the external frequency reference value is restored, the operation is continued with the frequency reference.

■ L4-06: Frequency Reference at Reference Loss

Sets the frequency reference level at which the drive runs when L4-05 = 1 and when detecting a reference loss. The value is set as a percentage of the frequency reference before the loss was detected.

No.	Name	Setting Range	Default
L4-06	Frequency Reference at Reference Loss	0.0 to 100.0%	80.0%

■ L4-07: Speed Agreement Detection Selection

Determines when frequency detection is active using parameters L4-01 through L4-04.

No.	Name	Setting Range	Default
L4-07	Speed Agreement Detection Selection	0, 1	0

Setting 0: No Detection during Baseblock

Setting 1: Detection always Enabled

◆ L5: Fault Restart

After a fault has occurred, Fault Restart attempts to automatically restart the motor and continue operation instead of stopping.

The drive can perform a self-diagnostic check and resume the operation after a fault has occurred. If the self-check is successful and the cause of the fault has disappeared, the drive restarts by first performing Speed Search (*Refer to b3: Speed Search on page 31* for details).

Note:
1. The wiring sequence should remove the Forward/Reverse command when a fault is triggered and output is shut off.
2. When the Forward/Reverse command is removed, the drive can perform a self-diagnostic check and attempt to restart the fault automatically.

WARNING! *Sudden Movement Hazard. Do not use the fault restart function in lifting applications. Fault restart may cause the machine to drop the load, which could result in death or serious injury.*

The drive can attempt to restart itself following the faults listed below.

Fault	Name	Fault	Name
GF	Ground Fault	oL4	Overtorque 2
LF	Output Open Phase	ov	DC Bus Overvoltage
oC	Overcurrent	PF	Input Phase Loss
oH1	Drive Overheat	rH	Braking Resistor Fault
oL1	Motor Overload	rr	Braking Transistor Fault
oL2	Drive Overload	Uv1	DC Bus Undervoltage <1>
oL3	Overtorque 1	STo	Pull-Out Detection

<1> When L2-01 is set to 0 through 2 (continue operation during momentary power loss).

Use parameters L5-01 to L5-05 to set up automatic fault restart.

Set H2-01, H2-02, or H2-03 to 1E. to output a signal during fault restart.

■ L5-01: Number of Auto Restart Attempts

Sets the number of times that the drive may attempt to restart itself.

Parameter L5-05 determines the method of incrementing the restart counter. When the counter reaches the number set to L5-01, the operation stops and the fault must be manually cleared and reset.

The restart counter is incremented at each restart attempt, regardless of whether the attempt was successful. When the counter reaches the number set to L5-01, the operation stops and the fault must be manually cleared and reset.

The number of fault restarts is reset to zero when:

- The drive operates normally for 10 minutes following a fault restart.
- A fault is cleared manually after protective functions are triggered.
- The power supply is cycled.

No.	Name	Setting Range	Default
L5-01	Number of Auto Restart Attempts	0 to 10 Times	0 Times

■ L5-02: Auto Restart Fault Output Operation Selection

Determines if a fault output is triggered (H2-□□ = E) when the drive attempts to restart.

No.	Name	Setting Range	Default
L5-02	Auto Restart Fault Output Operation Selection	0, 1	0

Setting 0: No Fault Output

Setting 1: Fault Output Is Set

■ L5-03: Time to Continue Making Fault Restarts (enabled only when L5-05 = 0)

Although the drive will continue to execute fault restarts, this parameter will cause a fault if a fault restart cannot occur after the time set to L5-03 passes.

All major faults will cause the drive to stop. For some faults it is possible to configure the drive to attempt a restart automatically. After the fault occurs, the drive baseblocks for L2-03 seconds. After the baseblock is removed, the drive checks if a fault condition still exists. If no fault condition exists, the drive will attempt to restart the motor. If the restart is successful, the drive performs a Speed Search (Regardless of the status of b3-01 "Speed Search Selection") from the set speed command and the Auto Restart Attempts count is increased by one. Even if the restart fails, the restart count is increased by one as long as the drive attempted to rotate the motor. The restart count will not be incremented if the restart is not attempted due to a continuing fault condition, (i.e., an ov fault). The drive waits L5-03 seconds before attempting another restart.

No.	Name	Setting Range	Default
L5-03	Time to Continue Making Fault Restarts	0.00 to 600.0 s	180.0 s

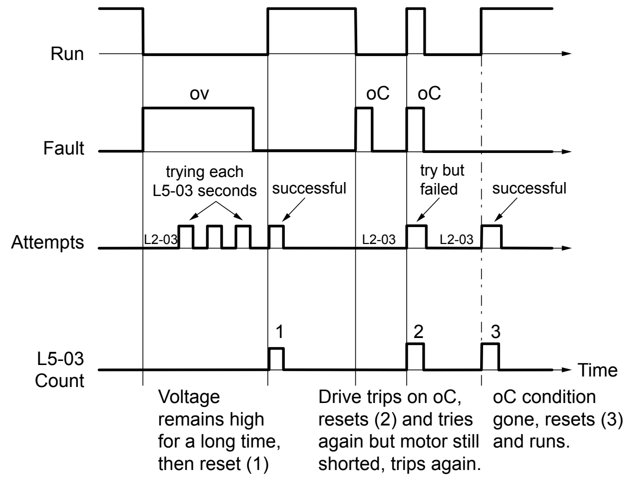


Figure 1.66 Automatic Restart Timing Diagram

The auto restart count is reset back to 0 if any of the following occur:

- No further faults for 10 minutes after the last retry.
- The drive power is turned off (the drive must be without power long enough to let control power dissipate).
- The RESET key is pushed after the last reset attempt.

The setting of parameter L5-02 determines whether the fault output (MA-MB) will be closed during an auto restart attempt.

The setting of L5-02 can be important when using the drive with other equipment.

The following faults will allow the Auto Restart function to initiate:

- oC (Overcurrent)
- LF (Output Phase Loss)
- PF (Input Phase Loss)
- oL1 (Motor Overload)
- oL3 (Overtorque Detection 1)
- oL2 (Drive Overload)
- ov (Overvoltage)
- GF (Ground Fault)
- Uv1 (Undervoltage)
- oH1 (Heatsink Overheat)

In order for auto restart after a Uv1 fault, Momentary Power Loss Ride-thru must be enabled (L2-01= 1: “Power Loss Ridethru Time”). Setting H2-01, H2-02 or H2-03 to 1E configures a digital output as “Restart Enabled” to signal if an impending auto restart is possible.

■ L5-04: Fault Reset Interval Time

Determines the amount of time to wait between restart attempts when parameter L5-05 is set to 1.

No.	Name	Setting Range	Default
L5-04	Fault Reset Interval Time	0.5 to 600.0 s	10.0 s

■ L5-05: Fault Reset Operation Selection

No.	Name	Setting Range	Default
L5-05	Fault Reset Operation Selection	0, 1	1

Setting 0: Count Successful Restarts

The drive will continuously attempt to restart. If it restarts successfully, the restart counter is increased. This operation is repeated each time a fault occurs until the counter reaches the value set to L5-01.

Setting 1: Count Restart Attempts

The drive will attempt to restart using the time interval set to parameter L5-04. A record is kept of the number of attempts to restart to the drive, regardless of whether those attempts were successful. When the number of attempted restarts exceeds the value set to L5-01, the drive stops attempting to restart.

◆ L6: Torque Detection

The drive provides two independent torque detection functions that trigger an alarm or fault signal when the load is too heavy (oL), or suddenly drops (UL). These functions are set up using the L6-□□ parameters. Program the digital outputs as shown below to indicate the underload or overload condition to an external device:

Note: When overtorque occurs in the application, the drive may stop due to overcurrent (oC) or overload (oL1). To prevent the drive from stopping, use torque detection to indicate an overload situation to the controller before oC or oL1 occur. Use undertorque detection to discover application problems like a torn belt, a pump shutting off, or other similar trouble.

H2-01, H2-02, H2-03 Setting	Description
B	Torque detection 1, N.O. (output closes when overload or underload is detected)
17	Torque detection 1, N.C. (output opens when overload or underload is detected)
18	Torque detection 2, N.O. (output closes when overload or underload is detected)
19	Torque detection 2, N.C. (output opens when overload or underload is detected)

Figure 1.67 and *Figure 1.68* illustrate the functions of overtorque and undertorque detection.

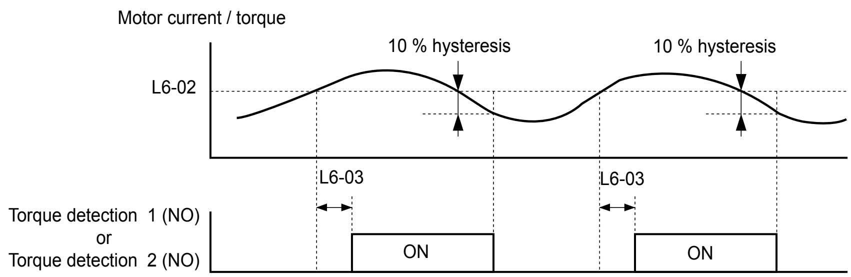


Figure 1.67 Overtorque Detection Operation

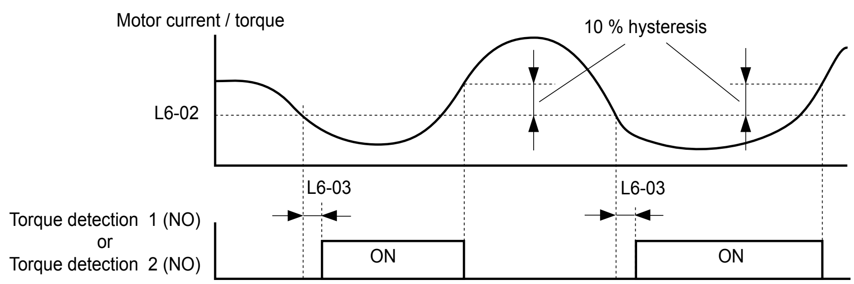


Figure 1.68 Undertorque Detection Operation

Note:
1. The torque detection function uses a hysteresis of 10% of the drive rated output current and motor rated torque.
2. The level is set as a percentage of the drive rated output current.

■ L6-01: Torque Detection Selection

The torque detection function is triggered when the current or torque exceed the levels set to L6-02 for longer than the time set to L6-03. L6-01 selects the conditions for detection and the operation that follows.

No.	Name	Setting Range	Default
L6-01	Torque Detection Selection 1	0 to 12	0

Setting 0: Disabled

Setting 1: oL3 at Speed Agree (Alarm)

Overtorque detection is active only when the output speed is equal to the frequency reference (i.e., no detection during acceleration and deceleration). The operation continues after detecting overtorque and triggering an oL3 alarm.

Setting 2: oL3 at Run (Alarm)

Overtorque detection works as long as the Run command is active. The operation continues after detecting overtorque and triggering an oL3 alarm.

Setting 3: oL3 at Speed Agree (Fault)

Overtorque detection is active only when the output speed is equal to the frequency reference (i.e., no detection during acceleration and deceleration). The operation stops and triggers an oL3 fault.

Setting 4: oL3 at Run (Fault)

Overtorque detection works as long as a Run command is active. The operation stops and triggers an oL3 fault.

Setting 5: UL3 at Speed Agree (Alarm)

Undertorque detection is active only when the output speed is equal to the frequency reference (i.e., no detection during acceleration and deceleration). The operation continues after detecting overtorque and triggering a UL3 alarm.

Setting 6: UL3 at Run (Alarm)

Undertorque detection works as long as the Run command is active. The operation continues after detecting overtorque and triggering a UL3 alarm.

Setting 7: UL3 at Speed Agree (Fault)

Undertorque detection is active only when the output speed is equal to the frequency reference (i.e., no detection during acceleration and deceleration). The operation stops and triggers a UL3 fault.

Setting 8: UL3 at Run (Fault)

Undertorque detection works as long as a Run command is active. The operation stops and triggers a UL3 fault.

Setting 9: UL6 at Speed Agree (Alarm)

Motor Underload detection is active only when the output speed is equal to the frequency reference (i.e., no detection during acceleration and deceleration). The operation continues after detection and triggers a UL6 alarm.

Setting 10: UL6 at Run (Alarm)

Motor Underload detection works as long as the Run command is active. The operation continues after detection and triggers a UL6 alarm.

Setting 11: UL6 at Speed Agree (Fault)

Motor Underload detection is active only when the output speed is equal to the frequency reference (i.e., no detection during acceleration and deceleration). The operation stops and triggers a UL6 fault.

Setting 12: UL6 at Run (Fault)

Motor Underload detection works as long as a Run command is active. The operation stops and triggers a UL6 fault.

■ L6-02: Torque Detection Level

Sets the detection levels for torque detection function 1 as a percentage of the drive rated output current.

No.	Name	Setting Range	Default
L6-02	Torque Detection Level 1	0 to 300%	15%

Note: The torque detection level 1 (L6-02) can also be supplied by an analog input terminal set to H3-□□ = 7. Here, the analog value has priority and the setting in L6-02 is disregarded.

■ L6-03: Torque Detection Time

Determines the time required to trigger an alarm or fault after exceeding the level in L6-02.

No.	Name	Setting Range	Default
L6-03	Torque Detection Time 1	0.0 to 10.0 s	10.0 s

■ L6-13: Motor Underload Protection Selection

Sets Motor Underload Protection (UL6) based on motor load and determines whether the level of L6-02 refers to fbase or fmax.

Selects the operation of underload detection UL6. Underload is detected when the output current falls below the underload detection level defined by L6-14 and L2-02.

No.	Name	Setting Range	Default
L6-13	Motor Underload Protection Selection	0, 1	0

Setting 0: Fbase Motor Load Enabled

Setting 1: Fmax Base Motor Load Enabled

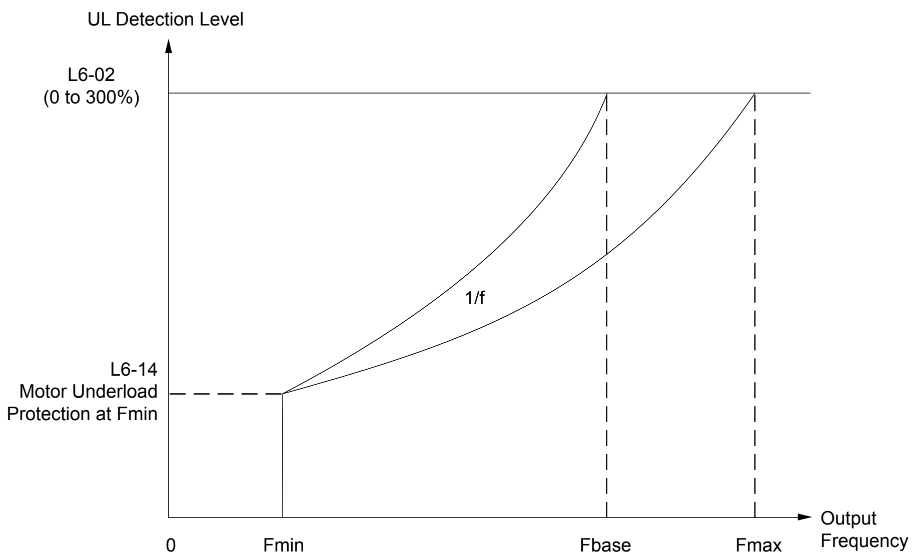


Figure 1.69 Motor Underload Protection

■ L6-14: Motor Underload Protection Level at Minimum Frequency

Sets the UL6 detection level at minimum frequency by percentage of drive rated current

No.	Name	Setting Range	Default
L6-14	Motor Underload Protection Level at Minimum Frequency	0 to 300%	15%

◆ L8: Drive Protection

■ L8-02: Overheat Alarm Level

Sets the overheat alarm (oH) detection level.

The drive outputs an alarm when the heatsink temperature exceeds the overheat alarm level. If the drive is set to continue operation after this alarm occurs (L8-03 = 4) and the temperature reaches the overheat fault level, the drive will trigger an oH1 fault and stop operation.

When an output terminal is set for the oH pre-alarm (H2-☐☐ = 20), the switch will close when the heatsink temperature rises above L8-02.

No.	Name	Setting Range	Default
L8-02	Overheat Alarm Level	50 to 130 °C	Determined by o2-04

■ L8-03: Overheat Pre-Alarm Operation Selection

Sets the operation when an overheat pre-alarm is detected.

Note: Change L8-03 setting only when necessary.

No.	Name	Setting Range	Default
L8-03	Overheat Pre-Alarm Operation Selection	0 to 4	4

Setting 0: Ramp to Stop

If an overheat alarm occurs, the drive decelerates to stop using the currently selected deceleration time. If a digital output is programmed for “fault” (H2-☐☐ = E), this output will be triggered.

Setting 1: Coast to Stop

If an overheat alarm occurs, the drive switches off the output and the motor coasts to stop. If a digital output is programmed for “fault” (H2-☐☐ = E), this output will be triggered.

Setting 2: Fast Stop

If an overheat alarm occurs, the drive decelerates to stop using the Fast Stop time (C1-09). If a digital output is programmed for “fault” (H2-☐☐ = E), this output will be triggered.

Setting 3: Alarm Only

If an overheat alarm occurs, an alarm is output and the drive continues operation.

Setting 4: Operation with Reduced Speed

If an overheat alarm occurs, the operation continues with the speed reduced to the level set to parameter L8-19. If the oH alarm is still present after 10 s, the speed is reduced again. The amount of speed reduction depends on how often the alarm repeats. If the oH alarm disappears while the drive is operating at a reduced speed, the drive will switch to the previous speed in 10 s increments until reaching base frequency. *Figure 1.70* explains the operation with reduced speed during an oH alarm. A digital output programmed for 4D is switched when the oH alarm is still active after ten reduction cycles.

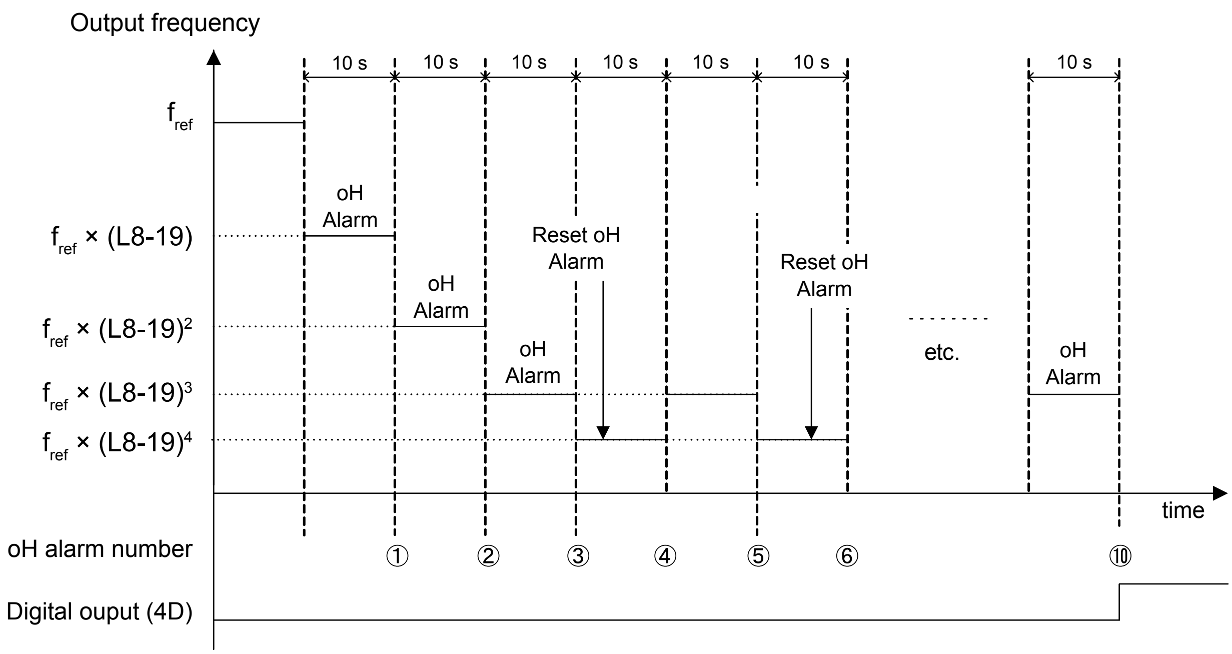


Figure 1.70 Output Frequency Reduction During Overheat Alarm

■ L8-19: Frequency Reduction Rate during Overheat Pre-Alarm

Specifies the output frequency reduction when L8-03 is set to 4 and an oH alarm is present. Set as a factor of the maximum output frequency.

No.	Name	Setting Range	Default
L8-19	Frequency Reduction Rate During Overheat Pre-Alarm	0.0 to 100.0%	20.0%

■ L8-05: Input Phase Loss Protection Selection

Enables or disables the input phase loss detection.

No.	Name	Setting Range	Default
L8-05	Input Phase Loss Protection Selection	0, 1	1

Setting 0: Disabled

Setting 1: Enabled

Enables input phase loss detection. Since measuring the DC bus ripple detects input phase loss, a power supply voltage imbalance or main circuit capacitor deterioration may also trigger a phase loss fault (PF).

Detection is disabled if:

- The drive is decelerating.
- No Run command is active.
- Output current is less than or equal to 30% of the drive rated current.

■ L8-06: Input Phase Loss Detection Level

Sets the Input Phase Loss Detection (PF) Level.

Triggers PF fault when there is an imbalance larger than the value set to L8-06 in the drive input power voltage.

Detection Level = 100% = Voltage Class × $\sqrt{2}$

No.	Name	Setting Range	Default
L8-06	Input Phase Loss Detection Level	0.0 to 25.0%	Determined by o2-04

■ L8-07: Output Phase Loss Protection Selection

Enables or disables the output phase loss detection triggered when the output current falls below 5% of the drive rated current.

Note:
1. Output phase loss detection can mistakenly be triggered if the motor rated current is very small compared to the drive rating. Disable this parameter in such cases.
2. Output phase loss detection is not possible when the drive is running a PM motor with light load.

No.	Name	Setting Range	Default
L8-07	Output Phase Loss Protection Selection	0 to 2	1

Setting 0: Disabled

Setting 1: Fault when One Phase Is Lost

An output phase loss fault (LF) is triggered when one output phase is lost. The output shuts off and the motor coasts to stop.

Setting 2: Fault when Two Phases Are Lost

An output phase loss fault (LF) is triggered when two or more output phases are lost. The output shuts off and the motor coasts to stop.

■ L8-09: Output Ground Fault Detection Selection

Enables or disables the output ground fault detection.

No.	Name	Setting Range	Default
L8-09	Output Ground Fault Detection Selection	0, 1	Determined by o2-04

Setting 0: Disabled

Ground faults are not detected.

Setting 1: Enabled

A ground fault (GF) is triggered when high leakage current or a ground short circuit occurs in one or two output phases.

■ L8-10: Heatsink Cooling Fan Operation Selection

Selects the heatsink cooling fan operation.

No.	Name	Setting Range	Default
L8-10	Heatsink Cooling Fan Operation Selection	0, 1	0

Setting 0: Run with Timer

The fan is switched on when a Run command is active and switched off with the delay set to parameter L8-11 after releasing the Run command. This setting extends the fan lifetime.

Setting 1: Run Always

The fan runs when power is supplied to the drive.

■ L8-11: Heatsink Cooling Fan Off-Delay Time

Sets the cooling fan switch off-delay time if parameter L8-10 is set to 0.

No.	Name	Setting Range	Default
L8-11	Heatsink Cooling Fan Off-Delay Time	0 to 300 s	300 s

■ L8-12: Ambient Temperature Setting

Automatically adapts the drive rated current to safe values when used with parameter L8-35. This eliminates the need to reduce the drive rated current when the temperature where the drive is mounted is above the specified values.

No.	Name	Setting Range	Default
L8-12	Ambient Temperature Setting	40 to 60 °C	40 °C

■ L8-15: oL2 Characteristics Selection at Low Speeds

Selects whether the drive overload capability (oL fault detection level) is reduced at low speeds to prevent premature output transistor failures.

Note: Contact Yaskawa for consultation before disabling this function. Disabling this function may shorten the operating life of the power transistors.

No.	Name	Setting Range	Default
L8-15	oL2 Characteristics Selection at Low Speed	0, 1	1

Setting 0: Protection Disabled at Low Speed

The overload protection level is not reduced. Frequently operating the drive with high output current at low speed can lead to premature drive faults.

Setting 1: Protection Enabled at Low Speed

The overload protection level (oL2 fault detection level) is automatically reduced at speeds below 6 Hz. At zero speed, the overload is derated by 50%.

■ L8-18: Software Current Limit Selection

Enables or disables the Software Current Limit (CLA) protection function to prevent main circuit transistor failures caused by high current.

Note: Do not change this setting unless absolutely necessary. Leave the Software CLA enabled for proper drive protection and operation.

No.	Name	Setting Range	Default
L8-18	Software Current Limit Selection	0, 1	0

Setting 0: Software CLA Disabled

The drive may trip on an oC fault if the load is too heavy or the acceleration is too short.

Setting 1: Software CLA Enabled

When the Software CLA current level is reached, the drive reduces the output voltage to reduce the current. Normal operation continues when the current level drops below the Software CLA level.

■ L8-27: Overcurrent Detection Gain

Adjusts the overcurrent detection level in OLV/PM control mode. A setting of 100% is equal to the motor rated current. When the drive rated current is considerably higher than the motor rated current, use this parameter to decrease the overcurrent level and prevent motor demagnetization from high current.

Overcurrent detection uses the lower value between the overcurrent level for the drive and the motor rated current multiplied by L8-27.

No.	Name	Setting Range	Default
L8-27	Overcurrent Detection Gain	0.0 to 300.0%	300.0%

■ L8-29: Current Unbalance Detection (LF2)

Enables or disables output current unbalance detection in OLV/PM control mode. Current unbalance can heat a PM motor and demagnetize the magnets. The current unbalance detection function monitors output current and triggers the LF2 fault to prevent such motor damage.

No.	Name	Setting Range	Default
L8-29	Current Unbalance Detection (LF2)	0, 1	1

Setting 0: Disabled

No current unbalance protection is provided to the motor.

Setting 1: Enabled

The LF2 fault is triggered if an output current unbalance is detected. Drive output shuts off and the motor coasts to stop.

■ L8-32: Main Contactor and Cooling Fan Power Supply Failure Selection

Determines drive operation when a FAn fault occurs.

No.	Name	Setting Range	Default
L8-32	Main Contactor and Cooling Fan Power Supply Failure Selection	0 to 4	1

Setting 0: Ramp to Stop

The drive stops the motor using the deceleration time set in parameter C1-02.

Setting 1: Coast to Stop

The drive output is switched off and the motor coasts to a stop.

Setting 2: Fast stop

The drive stops the motor using the Fast stop time set in parameter C1-09.

Setting 3: Alarm only

The operation is continued and a FAn alarm is displayed on the HOA keypad.

Setting 4: Operation with Reduced Speed

The operation is continued, but the speed is reduced to the level set in parameter L8-19.

Note: “FAn” is detected as an error when Settings 0 or 2 are selected; it is detected as an alarm when Settings 3 or 4 are selected.

■ L8-35: Installation Method Selection

Selects the type of installation for the drive and changes the drive overload (oL2) limits accordingly.

Note:
1. Initialization does not reset this parameter.
2. The value is preset to the appropriate value when the drive is shipped. Change the value only when using Side-by-Side installation or when mounting a standard drive with the heatsink outside the cabinet.

No.	Name	Setting Range	Default
L8-35	Installation Method Selection	0, 2, 3	Determined by o2-04 <1>

<1> Default setting is determined by drive model.
Setting 2: Models 2A0011 to 2A0211 and 4A0005 to 4A0096
Setting 0: Models 2A0273 to 2A0396 and 4A0124 to 4A0590.

Setting 0: IP00/Open-Chassis Enclosure

For an Open Type enclosure drive installed with at a minimum of 30 mm space to the next drive or a cabinet wall.

Setting 2: IP20/NEMA Type 1 Enclosure

For drives compliant with IP20/NEMA Type 1 enclosure specifications.

Setting 3: External Heatsink Installation

For standard drives mounted with the heatsink outside the cabinet or enclosure panel.

■ L8-38: Carrier Frequency Reduction Selection

Selects the operation of the carrier frequency reduction function. Reduces the carrier frequency when the output current exceeds a certain level. This temporarily increases the overload capability (oL2 detection), allowing the drive to run through transient load peaks without tripping.

No.	Name	Setting Range	Default
L8-38	Carrier Frequency Reduction Selection	0 to 2	Determined by A1-02 and o2-04

Setting 0: Disabled

No carrier frequency reduction at high current.

Setting 1: Enabled for Output Frequencies below 6 Hz

The carrier frequency is reduced at speeds below 6 Hz when the current exceeds 100% of the drive rated current. The drive returns to the normal carrier frequency when the current falls below 88% or the output frequency exceeds 7 Hz.

Setting 2: Enabled for Entire Frequency Range

The carrier frequency is reduced at the following speeds:

- Below 6 Hz when the current exceeds 100% of the drive rated current.
- Above 7 Hz when the current exceeds 112% of the drive rated current.

The drive uses the delay time set in parameter L8-40 and a hysteresis of 12% when switching the carrier frequency back to the set value.

■ L8-40: Carrier Frequency Reduction Off-Delay Time

Sets a hold time before returning to the original carrier frequency setting after the carrier frequency has been temporarily derated as determined by L8-38. The carrier frequency reduction function is disabled when this value is 0.00 s.

No.	Name	Setting Range	Default
L8-40	Carrier Frequency Reduction Off-Delay Time	0.00 to 2.00 s	0.50 s

■ L8-41: High Current Alarm Selection

Triggers a high current alarm (HCA) when the output current exceeds 150% of the drive rated current.

No.	Name	Setting Range	Default
L8-41	High Current Alarm Selection	0, 1	0

Setting 0: Disabled

No alarm is detected.

Setting 1: Enabled

An alarm is triggered when the output current exceeds 150% of the drive rated current. A digital output set for an alarm (H2-□□ = 10) will close.

■ L8-97: Carrier Frequency Reduction Rate during oH Pre-Alarm

Derates the carrier frequency to the level set to L8-39 during oH pre-alarm.

No.	Name	Setting Range	Default
L8-97	Carrier Frequency Reduction Rate during oH Pre-Alarm	0, 1	0

Setting 0: Disabled

Setting 1: Enabled

1.9 n: Special Adjustments

These parameters control a variety of specialized adjustments and functions, including Hunting Prevention, High Slip Braking, resistance between motor lines, and PM motor control functions.

◆ n1: Hunting Prevention

Hunting Prevention prevents the drive from hunting as a result of low inertia and operating with light load. Hunting often occurs with a high carrier frequency and an output frequency below 30 Hz.

■ n1-01: Hunting Prevention Selection

Enables or disables the Hunting Prevention function.

Note: This function is available only when using V/f Control. Disable Hunting Prevention when drive response is more important than suppressing motor oscillation. This function may be disabled without problems in applications with high inertia loads or relatively heavy loads.

No.	Name	Setting Range	Default
n1-01	Hunting Prevention Selection	0, 1	1

Setting 0: Disabled

Setting 1: Enabled

■ n1-02: Hunting Prevention Gain Setting

Sets the gain for the Hunting Prevention Function.

No.	Name	Setting Range	Default
n1-02	Hunting Prevention Gain Setting	0.00 to 2.50	1.00

Although this parameter rarely needs to be changed, it may require adjustment in the following situations:
- If the motor vibrates while lightly loaded and n1-01 = 1, increase the gain by 0.1 until vibration ceases.
- If the motor stalls while n1-01 = 1, decrease the gain by 0.1 until the stalling ceases.

■ n1-03: Hunting Prevention Time Constant

Determines the responsiveness of the Hunting Prevention function (affects the primary delay time for Hunting Prevention).

No.	Name	Setting Range	Default
n1-03	Hunting Prevention Time Constant	0 to 500 ms	Determined by o2-04

Although this parameter rarely needs to be changed, it may require adjustment in the following situations:
- Increase this value for applications with a large load inertia. A higher setting leads to slower response, which can result in oscillation at lower frequencies.
- Lower this setting if oscillation occurs at low speed.

■ n1-05: Hunting Prevention Gain while in Reverse

This parameter functions the same as n1-02, except it is used when rotating in reverse. See the explanation for n1-02.

Note: n1-02 is enabled for forward and reverse operation when n1-05 = 0.0 ms.

No.	Name	Setting Range	Default
n1-05	Hunting Prevention Gain while in Reverse	0.00 to 2.50	0.00

◆ n3: High Slip Braking (HSB) and Overexcitation Braking

■ High Slip Braking (V/f)

HSB works in V/f Control only and decreases the stopping time compared to normal deceleration without using dynamic braking options. HSB reduces the output frequency in large steps to stop the motor and produce a high slip, which dissipates the regenerative energy created from decelerating the load in the motor windings. Due to the increased temperature of the motor windings, do not use HSB to frequently stop the motor. The duty cycle should be around 5% or lower.

Notes on using High Slip Braking

- The set deceleration time is ignored during HSB. Use Overexcitation Deceleration 1 (L3-04 = 4) or a dynamic braking option to stop the motor within a specified time.
- Braking time varies based on the load inertia and motor characteristics.
- Enabling HSB and KEB Ride-Thru simultaneously will trigger an oPE03 error.
- HSB must be triggered by a digital input set to H1-□□ = 68. After the HSB command is given, the drive will not restart until the motor is completely stopped and the Run command is cycled.
- Use parameters n3-01 through n3-04 to adjust HSB.

■ n3-01: High Slip Braking Deceleration Frequency Width

Sets the step width for frequency reduction during HSB. Increase n3-01 if DC bus overvoltage (ov) occurs during HSB.

No.	Name	Setting Range	Default
n3-01	High Slip Braking Deceleration Frequency Width	1 to 20%	5%

■ n3-02: High Slip Braking Current Limit

Sets the maximum current to be output during an HSB stop as a percentage of motor rated current (E2-01). Reducing the current limit increases the deceleration time. This value must not exceed the current rating of the drive.

- Lower this setting if overvoltage occurs during HSB.
- Lower this setting if motor current is too high during HSB. High current can damage the motor due to overheat.
- The default setting is 120%.

No.	Name	Setting Range	Default
n3-02	High Slip Braking Current Limit	0 to 200%	Determined by L8-38

■ n3-03: High Slip Braking Dwell Time at Stop

When the motor reaches a relatively low speed at the end of HSB, the output frequency is kept at the minimum output frequency set to E1-09 for the time set to n3-03. Increase this time if the inertia is very high and the motor coasts after HSB is complete.

No.	Name	Setting Range	Default
n3-03	High Slip Braking Dwell Time at Stop	0.0 to 10.0 s	1.0 s

■ n3-04: High Slip Braking Overload Time

Sets the time required for an HSB overload fault (oL7) to occur when the drive output frequency does not change during an HSB stop due to excessive load inertia or the load rotating the motor. To protect the motor from overheat, the drive trips with an oL7 fault if these conditions last longer than the time set in n3-04.

No.	Name	Setting Range	Default
n3-04	High Slip Braking Overload Time	30 to 1200 s	40 s

■ Overexcitation Deceleration (Induction Motors)

Increases the flux during deceleration and allows shorter deceleration time settings without the use of a braking resistor. Enabled by setting L3-04 to 4 or 5. *Refer to L3-04: Stall Prevention Selection during Deceleration on page 106*.

Notes on Overexcitation Deceleration

- Frequently applying Overexcitation Deceleration raises the motor temperature because regenerative energy is mainly dissipated as heat in the motor. In cases where frequent application is required, make sure the motor temperature does not exceed the maximum allowable value or consider using a braking resistor option in lieu of Overexcitation Deceleration.
- During Overexcitation Deceleration 2, Hunting Prevention in V/f Control is disabled.

- Do not use Overexcitation Deceleration in combination with a braking resistor option.
- Overexcitation Deceleration can be most efficiently used in a V/f Control.
- Overexcitation Deceleration cannot be used with PM motors.

Parameter Adjustments

- Use parameters n3-13 through n3-23 to adjust Overexcitation Deceleration.
- When repetitive or long Overexcitation Deceleration causes motor overheat, lower the overexcitation gain (n3-13) and reduce the overslip suppression current level (n3-21).
- During Overexcitation Deceleration 1 (L3-04 = 4), the drive decelerates at the active deceleration time (C1-02 or C1-04). Set this time so no overvoltage (ov) fault occurs.
- During Overexcitation Deceleration 2 (L3-04 = 5), the drive decelerates using the active deceleration time while adjusting the deceleration rate to keep the DC bus voltage at the level set to L3-17. The actual stopping time will be longer or shorter than the set deceleration time depending on the motor characteristics and the load inertia. Increase the deceleration time if overvoltage occurs (ov).
- Entering a Run command during Overexcitation Deceleration cancels overexcitation operation and the drive reaccelerates to the specified speed.

■ n3-13: Overexcitation Deceleration Gain

Multiplies a gain to the V/f pattern output value during Overexcitation Deceleration to determine the level of overexcitation. The drive returns to the normal V/f value after the motor has stopped or when it is accelerating to the frequency reference.

No.	Name	Setting Range	Default
n3-13	Overexcitation Deceleration Gain	1.00 to 1.40	1.10

The optimum setting for n3-13 depends on the motor flux saturation characteristics.

- Gradually increase the gain to 1.25 to 1.30 to improve the braking power of Overexcitation Deceleration.
- Lower n3-13 when flux saturation characteristics cause overcurrent. A high setting sometimes causes overcurrent (oC), motor overload (oL1), or drive overload (oL2). Lowering n3-21 can also help remedy these problems.

■ n3-21: High Slip Suppression Current Level

If the motor current exceeds the value set to n3-21 during Overexcitation Deceleration due to flux saturation, the drive automatically reduces the overexcitation gain. Parameter n3-21 is set as a percentage of the drive rated current.

Set this parameter to a relatively low value to optimize deceleration. If overcurrent, oL1, or oL2 occur during Overexcitation Deceleration, reduce the high slip suppression current level.

No.	Name	Setting Range	Default
n3-21	High Slip Suppression Current Level	0 to 150%	100%

■ n3-23: Overexcitation Operation Selection

Limits the Overexcitation Deceleration operation selected in parameter L3-04 to forward only or reverse only.

No.	Name	Setting Range	Default
n3-23	Overexcitation Operation Selection	0 to 2	0

Setting 0: Overexcitation Operation as Selected in L3-04 in Forward and Reverse Direction

Setting 1: Overexcitation Operation as Selected in L3-04 in Forward Direction Only

Setting 2: Overexcitation Operation as Selected in L3-04 in Reverse Direction Only

◆ n8: PM Motor Control Tuning

These parameters adjust the control performance in the vector control modes for permanent magnet motors.

■ n8-45: Speed Feedback Detection Control Gain (OLV/PM)

Sets the gain for internal speed feedback detection control. Although this parameter rarely needs to be changed, adjustment may be necessary under the following conditions:

- Increase this setting if motor oscillation or hunting occurs.
- Decrease this setting in increments of 0.05 to decrease drive responsiveness.

No.	Name	Setting Range	Default
n8-45	Speed Feedback Detection Control Gain	0.00 to 10.00	0.80

■ n8-47: Pull-In Current Compensation Time Constant (OLV/PM)

Sets the time constant for pull-in current to match the actual current.

Although this setting rarely needs to be changed, adjustment may be necessary under the following conditions:

- Increase this setting when it takes too long for the reference value of the pull-in current to match the target value.
- Decrease this setting if motor oscillation occurs.

No.	Name	Setting Range	Default
n8-47	Pull-In Current Compensation Time Constant	0.0 to 100.0 s	5.0 s

■ n8-48: Pull-In Current (OLV/PM)

Sets the d-Axis current during no-load operation at a constant speed. Set as a percentage of the motor rated current.

- Increase this setting when hunting occurs or the motor speed is unstable while running at a constant speed.
- Slightly reduce this value if there is too much current when driving a light load at a constant speed.

No.	Name	Setting Range	Default
n8-48	Pull-In Current	20 to 200%	30%

■ n8-49: d-Axis Current for High Efficiency Control (OLV/PM)

Sets the d-Axis current reference when running with high load at constant speed. When using an IPM motor, this parameter uses the reluctance torque to increase the efficiency and reduce energy consumption. Set this parameter to 0 when using an SPM motor.

Although this setting rarely needs to be changed, adjustment may be necessary under the following conditions:

- Lower the setting if motor operation is unstable when driving heavy loads.
- If motor parameters (E5-☐☐) have been changed, this value will be reset to 0 and will require readjustment.

No.	Name	Setting Range	Default
n8-49	d Axis Current for High Efficiency Control	-200.0 to 0.0%	Determined by o2-04

■ n8-51: Acceleration/Deceleration Pull-In Current (OLV/PM)

Sets the pull-in current during acceleration and deceleration as a percentage of the motor rated current (E5-03).

Adjustment may be necessary under the following conditions:

- Increase this setting when a large amount of starting torque is required.
- Lower this setting if there is excessive current during acceleration.

No.	Name	Setting Range	Default
n8-51	Acceleration/Deceleration Pull-In Current	0 to 200%	50%

■ n8-54: Voltage Error Compensation Time Constant (OLV/PM)

Sets the time constant for voltage error compensation.

Adjustment may be necessary under the following conditions:

- Adjust the value when hunting occurs at low speed.
- Increase the value in steps of 0.1 when hunting occurs with sudden load changes. Set n8-51 to 0 to disable the compensation if increasing n8-54 does not help.
- Increase the value when oscillations occur at start.

No.	Name	Setting Range	Default
n8-54	Voltage Error Compensation Time Constant	0.00 to 10.00	1.00

■ n8-55: Load Inertia (OLV/PM)

Sets the ratio between motor inertia and the inertia of the connected machinery. If this value is set too low, the motor may not start very smoothly and trigger an STo (Motor Step-Out) fault.

Increase this setting for large inertia loads or to improve speed control response. A high setting with low inertia load may cause oscillation.

No.	Name	Setting Range	Default
n8-55	Load Inertia	0 to 3	0

Setting 0: Below 1:10

The inertia ratio between the motor and the load is lower than 1:10.

Setting 1: Between 1:10 and 1:30

The inertia ratio between the motor and the load is between 1:10 and 1:30. Set n8-55 to 1 if an STo fault occurs as a result of impact load or sudden acceleration/deceleration when n8-55 = 0.

Setting 2: Between 1:30 and 1:50

The inertia ratio between the motor and the load is between 1:30 and 1:50. Set n8-55 to 2 if an STo fault occurs as a result of impact load or sudden acceleration/deceleration when n8-55 = 1.

Setting 3: Beyond 1:50

The inertia ratio between the motor and the load is higher than 1:50. Set n8-55 to 3 if an STo fault occurs as a result of impact load or sudden acceleration/deceleration when n8-55 = 2.

■ n8-62: Output Voltage Limit

Sets the output voltage limit to prevent voltage saturation. Do not set this value higher than the actual input voltage.

No.	Name	Setting Range	Default
n8-62	Output Voltage Limit	0.0 to 230.0 Vac <1>	200 Vac <1>

<1> Values shown are specific to 200 V class drives. Double value for 400 V class drives.

■ n8-65: Speed Feedback Detection Control Gain during ov Suppression (OLV/PM)

Sets the gain for internal speed feedback detection control when overvoltage suppression is active. Although this setting rarely needs to be changed, adjustment may be necessary under the following conditions:

- Increase this setting if motor oscillation or hunting occurs when ov suppression is active.
- Decrease this setting in increments of 0.05 to decrease the drive responsiveness during ov suppression.

No.	Name	Setting Range	Default
n8-65	Speed Feedback Detection Control Gain during ov Suppression (OLV/PM)	0.00 to 10.00	1.50

1.10 o: Operator-Related Settings

These parameters control the various functions, features, and display of the HOA keypad.

◆ o1: HOA Keypad Display Selection

These parameters determine the data display on the HOA keypad.

■ o1-01: Drive Mode Unit Monitor Selection

The frequency reference display appears when the drive is powered up. Pressing the up arrow key will display the following data: frequency reference → rotational direction → output frequency → output current → o1-01 selection.

Parameter o1-01 selects the content of the last monitor in this sequence.

No.	Name	Setting Range	Default
o1-01	Drive Mode Unit Monitor Selection	104 to 699 U1-04 (Control Mode) to U6-99 (Option Monitors 20) <1>	106 (U1-06)

<1> U2-□□ and U3-□□ parameters cannot be selected.

■ o1-02: User Monitor Selection after Power Up

Selects which monitor parameter is displayed upon power up by entering the 1- □□ part of U1-□□. Certain monitors are not available in some control modes. *Refer to U: Monitor Parameters on page 157* for a list of monitors.

No.	Name	Setting Range	Default
o1-02	User Monitor Selection after Power Up	1 to 5	1

Setting 1: Frequency Reference (U1-01)

Setting 2: Motor Direction

Setting 3: Output Frequency (U1-02)

Setting 4: Output Current (U1-03)

Setting 5: User Monitor

The monitor value selected by o1-01 will be displayed.

■ o1-03: HOA Keypad Display Selection

Sets the units used to display the frequency reference and output frequency. Set o1-03 to 3 for user-set units before setting parameters o1-10 and o1-11.

No.	Name	Setting Range	Default
o1-03	HOA Keypad Display Selection	0 to 3	0

Setting 0: 0.01 Hz Units

Setting 1: 0.01% Units (100% = Max Output Frequency)

Setting 2: r/min Units (Calculated by the Max Output Frequency and the Number of Motor Poles)

Setting 3: User-set Units (Use o1-10, o1-11)

Set the value used for the maximum frequency reference to o1-10. Set the placement of the decimal point in this number to o1-11.

For example, to have the maximum output frequency displayed as “100.00”, set o1-10 = 1000 and o1-11 = 2 (i.e., 1000 with 2 decimal points).

Note:

1. Parameter o1-03 allows the programmer to change the units used in the following parameters and monitors:
   U1-01: frequency reference
   U1-02: output frequency
   U1-16: output frequency after softstarter (accel/decel ramp generator)
   d1-01 to d1-17: frequency references
2. Setting o1-03 to 2 requires entering the number of motor poles to E2-04 and E5-04.

■ o1-06: User Monitor Selection Mode

Normally the monitors shown directly below the active monitor are the next two sequential monitors. If o1-06 (User Monitor Selection Mode) is set to 1: “3 Mon Selectable”, those two monitors are locked as specified by parameters o1-07 and o1-08 and will not change as the top parameter is scrolled with the Up/Down Arrow keys.

No.	Name	Setting Range	Default
o1-06	User Monitor Selection Mode	0, 1	0

Setting 0: 3 Monitor Sequential (Displays the Next 2 Sequential Monitors)

Setting 1: 3 Monitor Selectable (o1-07, and o1-08 Selected Monitor Is Shown)

■ o1-07: Second Line Monitor Selection

Selects which monitor will be displayed in the second line. The monitor parameter number is entered into the spaces provided: U□-□□.

For example, set “403” to display monitor parameter U4-03.

No.	Name	Setting Range	Default
o1-07	Second Line Monitor Selection	101 to 699	102

■ o1-08: Third Line Monitor Selection

Selects which monitor will be displayed in the third line. The monitor parameter number is entered into the spaces provided: U□-□□.

For example, set “403” to display monitor parameter U4-03.

No.	Name	Setting Range	Default
o1-08	Third Line Monitor Selection	101 to 699	103

■ o1-09: Frequency Reference Display Units

Sets unit display for the frequency reference parameters and frequency related monitors when o1-03 > 40.

No.	Name	Setting Range	Default
o1-09	Frequency Reference Display Units	0 to 16	16

Setting 0: Inch of Water (WC)

Setting 1: Pounds per Square Inch (PSI)

Setting 2: Gallons per Minute (GPM)

Setting 3: Degrees Fahrenheit (F)

Setting 4: Cubic Feet per Minute (CFM)

Setting 5: Cubic Meters per Hour (CMH)

Setting 6: Liters per Hour (LPH)

Setting 7: Liters per Second (LPS)

Setting 8: Bar (Bar)

Setting 9: Pascals (Pa)

Setting 10: Degrees Celsius (C)

Setting 11: Meters (Mtr)

Setting 12: Ft (Feet)

Setting 13: Liters per Minute (LPM)

Setting 14: Cubic Meters per Minute (CMM) No unit

Setting 15: Custom Units (Determined by o1-12)

Setting 16: None

■ o1-10: User-Set Display Units Maximum Value

Determines the display value that is equal to the maximum output frequency.

No.	Name	Setting Range	Default
o1-10	User-Set Display Units Maximum Value	1 to 60000	Determined by o1-03

■ o1-11: User-Set Display Units Decimal Display

Determines how many decimal points should be used to set and display the frequency reference.

No.	Name	Setting Range	Default
o1-11	User-Set Display Units Decimal Display	0 to 3	Determined by o1-03

Setting 0: No Decimal Point

Setting 1: One Decimal Point

Setting 2: Two Decimal Points

Setting 3: Three Decimal Points

■ o1-13 to o1-15: Frequency Reference and Frequency Related Monitor Custom Units 1 to 3

Sets the customer specified unit display for the frequency reference parameters and frequency related monitors when o1-03 is set to 3 and o1-09 is set to 15 as custom units.

The custom units consist of three characters selected from o1-13 to o1-15. Each character is selected by ASCII code from 30Hex to 7AHex.

No.	Name	Setting Range	Default
o1-13	Frequency Reference and Frequency Related Monitor Custom Units 1	30H to 7AH	41H
o1-14	Frequency Reference and Frequency Related Monitor Custom Units 2		
o1-15	Frequency Reference and Frequency Related Monitor Custom Units 3		

■ o1-16, o1-17: F1/F2 Key Function Selection

The HOA Keypad multi-function keys F1 and F2 can be set for different HVAC specific functions. Selects the functions of the F1/F2 keys and the LCD display text above the F1/F2 keys.

Note: Parameters o1-16 and o1-17 cannot be set to the same value (except for setting 0).

No.	Name	Setting Range	Default
o1-16	F1 Key Function Selection	0 to 4	0
o1-17	F2 Key Function Selection		0

Setting 0: Standard

Setting 1: Monitor

Setting 2: Drive/Bypass (DRV/BYP)

Setting 3: Bypass Run (RUN BYP)

Setting 4: Toggle Relay Output (RLY)

■ o1-18, o1-19: User-Defined Parameter Upper/Lower

Allows the user to set values that can be used as reference information.

No.	Name	Setting Range	Default
o1-18	User-Defined Parameter Upper	0 to 999	0
o1-19	User-Defined Parameter Lower		

◆ o2: HOA Keypad Functions

These parameters determine the functions assigned to the operator keys.

■ o2-02: OFF Key Function Selection

Determines if the OFF key on the HOA keypad will stop drive operation when the drive is controlled from a remote source (i.e., not from HOA keypad).

No.	Name	Setting Range	Default
o2-02	OFF Key Function Selection	0, 1	1

Setting 0: Disabled

Setting 1: Enabled

The OFF key will terminate drive operation even if the Run command source is not assigned to the HOA keypad. Cycle the Run command to restart the drive if the drive has been stopped by pressing the OFF key.

■ o2-03: User Parameter Default Value

After completely setting up drive parameters, save the values as user-set defaults with parameter o2-03. After saving the values, parameter A1-03 (Initialize Parameters) will offer the choice of "1110: User Initialize". Selecting 1110 resets all parameters to the user-set default values. ***Refer to A1-03: Initialize Parameters on page 19*** for details on drive initialization.

No.	Name	Setting Range	Default
o2-03	User Parameter Default Value	0 to 2	0

Setting 0: No Change (Awaiting Command)

Setting 1: Set User Initialize Values

The current parameter settings are saved as user-set default for a later User Initialization. Setting o2-03 to 1 and pressing the ENTER key saves the values and returns the display to 0.

Setting 2: Clear User Initialize Values

All user-set defaults for “User Initialize” are cleared. Setting o2-03 to 2 and pressing the ENTER key erases the values and returns the display to 0.

■ o2-04: Drive Model Selection

Set this parameter when replacing the control board or the terminal board. ***Refer to Defaults by Drive Model on page 266*** for information on drive model selection.

NOTICE: *Drive performance will suffer and protective functions will not operate properly if the correct drive capacity is not set to o2-04.*

No.	Name	Setting Range	Default
o2-04	Drive Model Selection	-	Determined by drive capacity

Note: Change o2-04 setting only when necessary.

■ o2-05: Frequency Reference Setting Method Selection

Determines if the ENTER key must be pressed after changing the frequency reference using the HOA keypad while in Drive Mode.

No.	Name	Setting Range	Default
o2-05	Frequency Reference Setting Method Selection	0, 1	0

Setting 0: ENTER Key Required

The ENTER key must be pressed every time the frequency reference is changed using the HOA keypad for the drive to accept the change.

Setting 1: ENTER Key not Required

The output frequency changes immediately when the reference is changed by the up or down arrow keys on the HOA keypad. The ENTER key does not need to be pressed. The frequency reference (Fref) is saved to memory after remaining unchanged for 5 seconds.

■ o2-06: Operation Selection when HOA Keypad is Disconnected

Determines whether the drive will stop when the HOA keypad is removed in HAND mode or when b1-02 or b1-16 is set to 0. When the operator is reconnected, the display will indicate that it was disconnected.

No.	Name	Setting Range	Default
o2-06	HOA Keypad Disconnection Operation	0, 1	1

Setting 0: Continue Operation

The operation continues.

Setting 1: Trigger a Fault

The operation stops and triggers an oPr fault. The motor coasts to stop.

■ o2-07: Motor Direction at Power Up when Using Operator

Determines the direction the motor will rotate after the drive is powered up and the Run command is given from the HOA keypad.

Note: This parameter is effective only when the Run command is set to be given from the HOA keypad (b1-02, b1-16 = 0).

No.	Name	Setting Range	Default
o2-07	Motor Direction at Power Up when Using Operator	0, 1	0

Setting 0: Forward

Setting 1: Reverse

■ o2-19: Selection of Parameter Write during Uv

Selects whether parameter settings can be changed during a DC bus undervoltage condition. Used with 24 V Power Supply option (PS-A10LB, PS-A10HB).

No.	Name	Setting Range	Default
o2-19	Selection of Parameter Write during Uv	0, 1	0

Setting 0: Disabled

Setting 1: Enabled

◆ o3: Copy Function

These parameters control the Copy function of the HOA keypad. The Copy function stores parameter settings into the memory of the HOA keypad to facilitate the transfer of those settings to other drives that are the same model, capacity, and same control mode setting.

■ o3-01: Copy Function Selection

Instructs the drive to Read, Write, or Verify parameter settings.

No.	Name	Setting Range	Default
o3-01	Copy Function Selection	0 to 3	0

Setting 0: Copy Select (No Function)

Setting 1: INV --> OP READ

Copies all parameters from the drive to the HOA keypad.

Note: The copy protection for the HOA keypad is enabled by default. Set o3-01 to 1 to unlock copy protection.

Setting 2: OP --> INV WRITE

Copies all parameters from the HOA keypad to the drive.

Setting 3: OP<-->INV VERIFY

Compares the parameters in the drive with the parameter settings saved on the HOA keypad for matches.

■ o3-02: Copy Allowed Selection

Allows and restricts the use of the Copy function.

No.	Name	Setting Range	Default
o3-02	Copy Allowed Selection	0, 1	0

Setting 0: Disabled

Setting 1: Enabled

◆ o4: Maintenance Monitor Settings

■ o4-01: Cumulative Operation Time Setting

Sets the cumulative operation time of the drive. The user can also manually set this parameter to begin keeping track of operation time from some desired value. Total operation time can be viewed in monitor U4-01.

Note: The value in o4-01 is set in 10 h units. For example, a setting of 30 will set the cumulative operation time counter to 300 h. 300 h will also be displayed in monitor U4-01.

No.	Name	Setting Range	Default
o4-01	Cumulative Operation Time Setting	0 to 9999 h	0 h

■ o4-02: Cumulative Operation Time Selection

Selects the conditions for how the drive keeps track of its total operation time. This time log can be viewed in monitor U4-01.

No.	Name	Setting Range	Default
o4-02	Cumulative Operation Time Selection	0, 1	1

Setting 0: Power on Time

The drive logs the time it is connected to a power supply, regardless of whether the motor is running.

Setting 1: Run Time

The drive logs the time that the output is active including when the Run command is active (even if the motor is not rotating) and when there is voltage output.

■ o4-03: Cooling Fan Operation Time Setting

Sets the value for how long the cooling fan has been operating. This value can be viewed in monitor U4-03. Parameter o4-03 also sets the base value used for the cooling fan maintenance, which is displayed in U4-04. Reset this parameter to 0 after replacing the cooling fan.

Note:
1. The value in o4-03 increases after every 10 hours of use. A setting of 30 will set the cooling fan operation time counter to 300 h. “300” will be displayed in monitor U4-03.
2. The cooling fan may require maintenance at an earlier date in harsher environments.

No.	Name	Setting Range	Default
o4-03	Cooling Fan Operation Time Setting	0 to 9999 h	0 h

■ o4-05: Capacitor Maintenance Setting

Sets value of the maintenance monitor for the DC bus capacitors displayed in U4-05 as a percentage of the total expected performance life. Reset this value to 0 after replacing the DC bus capacitors.

Note: The actual maintenance time will depend on the environment where the drive is used.

No.	Name	Setting Range	Default
o4-05	Capacitor Maintenance Setting	0 to 150%	0%

■ o4-07: DC Bus Pre-Charge Relay Maintenance Setting

Sets the value of the softcharge bypass relay maintenance time displayed in U4-06 as a percentage of the total expected performance life. Reset this value to 0 after replacing the bypass relay.

Note: The actual maintenance time will depend on the environment where the drive is used.

No.	Name	Setting Range	Default
o4-07	DC Bus Pre-charge Relay Maintenance Setting	0 to 150%	0%

■ o4-11: U2, U3 Initialization

Resets the fault trace and fault history monitors (U2-□□ and U3-□□). Initializing the drive using A1-03 does not reset these monitors.

No.	Name	Setting Range	Default
o4-11	U2, U3 Initialization	0, 1	0

Setting 0: No Action

The drive keeps the previously saved record concerning fault trace and fault history.

Setting 1: Reset Fault Data

Resets the data for the U2-□□ and U3-□□ monitors. Setting o4-11 to 1 and pressing the ENTER key erases fault data and returns the display to 0.

■ o4-12: kWh Monitor Initialization

Resets the kWh monitors U4-10 and U4-11. Initializing the drive or cycling the power does not reset these monitors.

No.	Name	Setting Range	Default
o4-12	kWh Monitor Initialization	0, 1	0

Setting 0: No Action

The kWh data are maintained.

Setting 1: Reset kWh Data

Resets the kWh counter. The monitors U4-10 and U4-11 will display “0” after they are initialized. Setting o4-12 to 1 and pressing the ENTER erases kWh data and returns the display to 0.

■ o4-13: Number of Run Commands Counter Initialization

Resets the Run command counter displayed in U4-02. Initializing the drive or cycling the power does not reset this monitor.

No.	Name	Setting Range	Default
o4-13	Number of Run Commands Counter Initialization	0, 1	0

Setting 0: No Action

The Run command data are kept.

Setting 1: Number of Run Commands Counter

Resets the Run command counter. The monitor U4-02 will show 0. Setting o4-13 to 1 and pressing the ENTER key erases the counter value and returns the display to 0.

■ o4-17: Real Time Clock Setting

The time setting screen will appear.

Z1000 Software Version	No. (Addr. Hex)	LCD Display	Name	Description	Values
PRG: 1012 and earlier	o4-17 (3100)	Set Time 0: Disabled 1: Enabled	Set/Reset Real-time Clock	Sets the current date and time for the Real-Time Clock. 0: Disabled 1: Enabled	Default: 0 Range: 0, 1
PRG: 1013 and later	o4-17 (3100)	Set Time 0: — — 1: Set 2: Reset	Set/Reset Real-time Clock	Sets the current date and time for the Real-Time Clock. 0: — — No Setting 1: Real-Time Clock Set 2: Real-Time Clock Reset	Default: 0 Range: 0 to 2

1.11 S: Special Parameters

◆ S1: Dynamic Audible Noise Control Function

The Dynamic Audible Noise Control Function reduces audible noise by suppressing the output voltage.

This function is available when using V/f Control mode and can help to quickly restore output voltage after an impact has caused a sudden increase in the time constant. Dynamic Audible Noise Control is useful in applications where load impact is common.

Energy Saving (b8-01 = 1) and Dynamic Audible Noise Control (S1-01 = 1) cannot be used simultaneously.

Procedure

1. Set S1-01 to 1 to enable Dynamic Audible Noise Control.

Note: 1. When S1-01 is set to 1, the tolerance to impact loading is reduced when compared to V/f Control (without Energy Saving).
2. Disable Dynamic Audible Noise Control for applications without an impact load.

2. Responsiveness is increased because the addition of a load causes the level of the current to rise.

   Increase the value of S1-02. The flux will become stronger and the torque will rise, but load movement will be minimized by the Dynamic Audible Noise Control function.

   Set S1-03 and S1-04 to a small value. Voltage is recovered quicker during impact load conditions. Under certain conditions voltage stability may become poor.

   Lower the value of S1-05. The voltage level will drop and speed up voltage restoration when the load is increased.
3. Increase the value of S1-03 to increase the effectiveness of Dynamic Audible Noise Control if the output voltage remains high.
4. Decrease the value of S1-06 to increase drive response to an impact load.
5. When the output voltage is unstable, increase the difference between S1-03 and S1-04 and increase S1-05 and S1-06 to slow the load response.

■ S1-01: Dynamic Audible Noise Control Selection

Reduces audible noise by decreasing the output voltage in variable torque applications with light loads.

Note: Setting b8-01 to 1 and S1-01 to 1 will trigger an oPE16 error.

No.	Name	Setting Range	Default
S1-01	Dynamic Audible Noise Control Selection	0 or 1	1

Setting 0: Disabled

Setting 1: Enabled

■ S1-02: Voltage Reduction Rate

Sets the rate at which the output voltage will be reduced as a percentage of the V/f pattern when operating with no load.

No.	Name	Setting Range	Default
S1-02	Voltage Reduction Rate	50.0 to 100.0%	50.0%

■ S1-03: Voltage Restoration Level

Sets the level when the drive should start restoring the voltage as a percentage of the drive rated torque.

The voltage is reduced when the torque output has decreased to the level set in S1-03.

The method used to reduce the voltage level is selected in accordance with the characteristics of the voltage reduction rate defined by the S1-03 and S1-04 settings.

Note: Setting S1-04 to a value less than that of S1-03 + 10.0 will trigger an oPE02 error.

No.	Name	Setting Range	Default
S1-03	Voltage Restoration Level	0.0 to 90.0%	20.0%

■ S1-04: Voltage Restoration Complete Level

Sets the level at which voltage restoration for the V/f pattern is complete as a percentage of the drive rated torque. If the output torque rises above the value of S1-04, then the voltage will be controlled in a manner specified by the V/f pattern setting.

Note: Setting S1-04 to a value less than that of S1-03 + 10.0 will trigger an oPE02 error.

No.	Name	Setting Range	Default
S1-04	Voltage Restoration Complete Level	S1-03 + 10.0 to 100.0%	50.0%

■ S1-05: Voltage Restoration Sensitivity Time Constant

Sets the level of sensitivity of the output torque as well as that of the LPF time constant for the voltage reduction rate. The level of sensitivity can be adjusted in accordance with the load response.

The LPF time constant is used to calculate the value of the output torque sensitivity time constant.

The voltage reduction rate is based on the torque output. Select LPF to prevent voltage fluctuation.

The Dynamic Audible Noise Control Function outputs the rate of voltage reduction as a percentage within the allowable range (Max: 100%, Min: S1-02 value).

No.	Name	Setting Range	Default
S1-05	Voltage Restoration Sensitivity Time Constant	0.000 to 3.000 s	1.000 s

■ S1-06: Voltage Restoration Time Constant at Impact

Sets the voltage restoration time constant if an impact load is added.

Sets the time constant that enables the voltage level to rise if the speed suddenly changes upon impact.

No.	Name	Setting Range	Default
S1-06	Voltage Restoration Time Constant at Impact	0.000 to 1.000 s	0.050 s

◆ S2: Sequence Timers

■ Programmable Run Timers for Real Time Clock (RTC)

Programmable run timers allow the drive to start and stop automatically at specified times. The timers can be configured to run daily, on weekdays, on weekends, or only on specific days of the week.

Sequence Timer 1

When the current time reaches the value set in parameter S2-01 (Sequence Timer 1 Start Time), the drive will execute the action set in parameter S2-04 (Sequence Timer 1 Selection), provided the current day is selected via S2-03 (Sequence Timer 1 Day Selection). The drive will stop executing the S2-04 action when the S2-02 (Sequence Timer 1 Stop Time) is reached.

When S2-04 = 0 or the Disable Sequence Timers multi-function input (H1-☐☐= 50) is closed, Sequence Timer 1 has no effect on the drive Run command. The drive runs normally based on the status of the selected run source (b1-02/b1-16). If S2-04 = 1 or 2 and the Disable Sequence Timers input is open, the drive will run during the Sequence Timer 1 active time, provided the drive has a valid Run command. The frequency reference that is used is set by S2-05 (Sequence Timer 1 Reference Source). When S2-04 = 2, PI control is disabled.

If the Cancel Active Sequence Timer multi-function input (H1-☐☐ = 51) transitions from open to closed while Sequence Timer 1 is active, the timer will be disabled until the next scheduled sequence timer occurrence. Sequence Timer 1 can be re-enabled by cycling the drive Run command. The Sequence Timer 1 multi-function output (H2-☐☐ = 50) will close while Sequence Timer 1 is active regardless of the S2-04 selection.

When S2-01 = S2-02, Sequence Timer 1 is active continuously for the days selected in S2-03. The timer will start at the S2-01/ S2-02 time on the first day and stop at the same time on the last day. If only one day is selected in S2-03, the timer will stop at 11:59 on that day.

When S2-04 = 1 or 2, Sequence Timer 1 is active and the drive is running, the HOA Keypad will display "Sequence Timer 1 RUN". When the drive has a run command, S2-04 = 1 or 2 and Sequence Timer 1 is not active, the HOA Keypad will display "Sequence Timer OFF".

When the drive has a run command, S2-04 = 1 or 2 and Sequence Timer 1 is not active, the drive should not fault on undervoltage or overvoltage conditions (should be Alarm only).

Note: When S2-03 > 0 and the digital operator is disconnected, an oPr fault will be triggered, regardless of the setting of o2-06 (Operation Selection when Digital Operator is Disconnected).

Sequence Timers 2 to 4

These timers operate identically to Sequence Timer 1. Parameters S2-06 to S2-20 configure Sequence Timers 2 to 4.

Priority

If multiple sequence timers overlap, the timer with the lowest number has priority.

Sequence Timer 1 = highest priority

Sequence Timer 4 = lowest priority

Examples of Sequence Timers

If multiple sequence timers overlap, the timer with the lowest number has priority.

Sequence Timer 1 = highest priority

Sequence Timer 4 = lowest priority

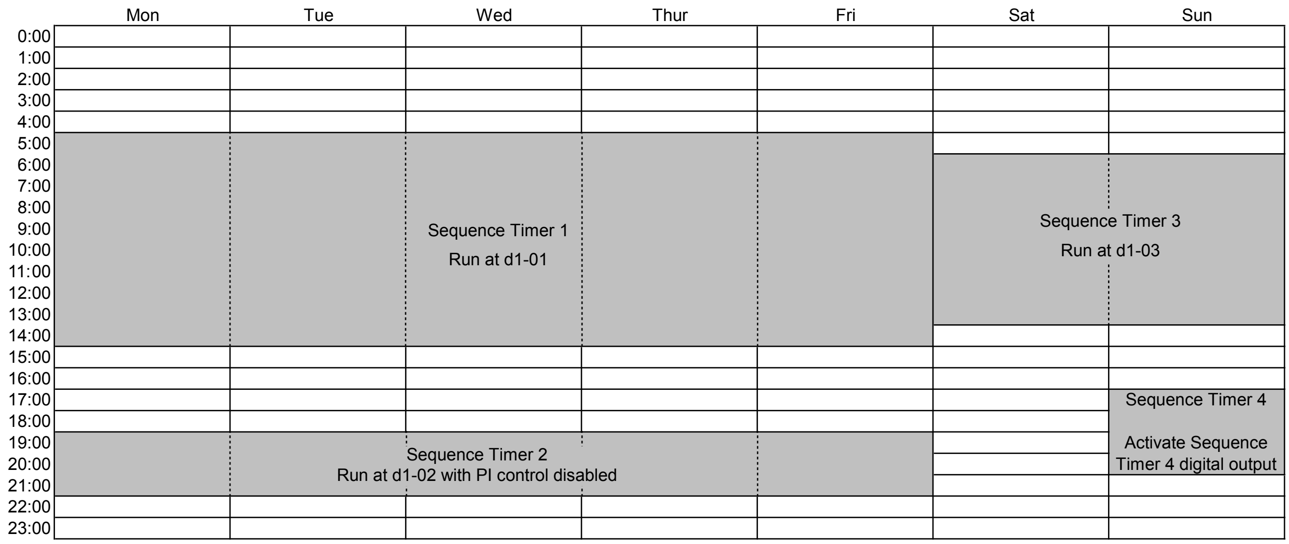


Figure 1.71 Sequence Timer Example 1

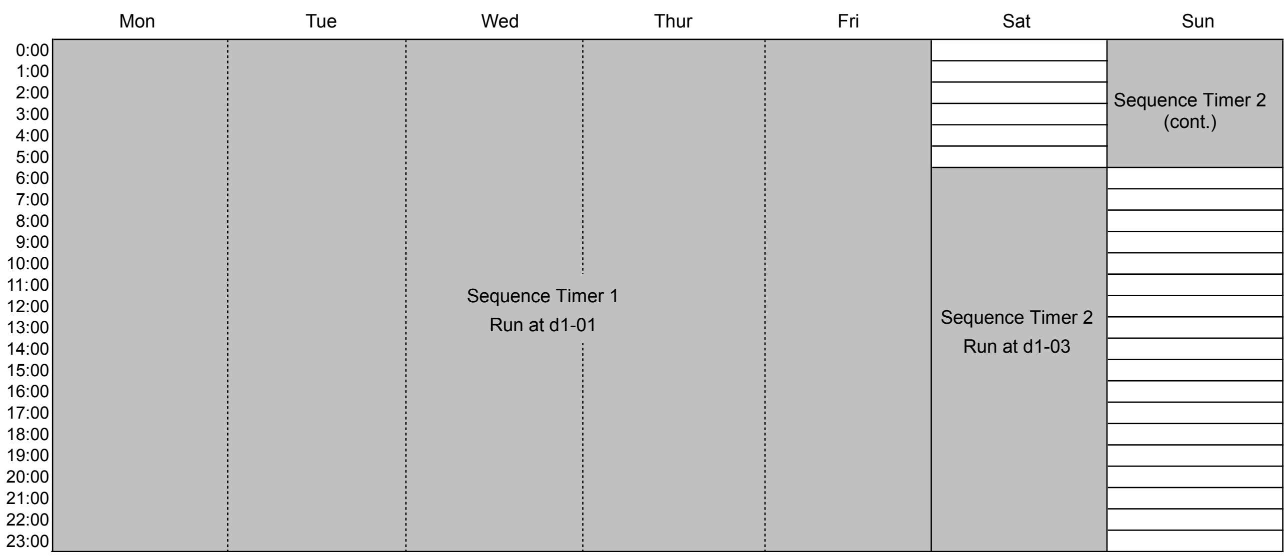


Figure 1.72 Sequence Timer Example 2

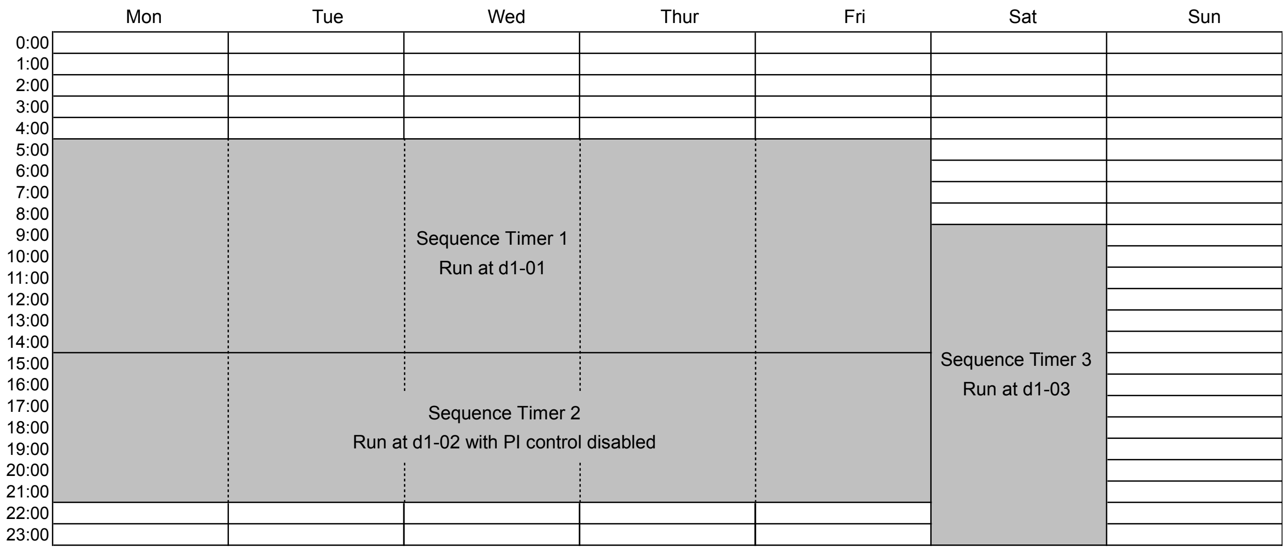


Figure 1.73 Sequence Timer Example 3

■ S2-01/S2-06/S2-11/S2-16: Sequence Timers 1 to 4 Start Time

Sets the start times for timers 1 to 4. The values must be set less than or equal to S2-02/S2-07/S2-12/S2-17.

No.	Name	Setting Range	Default
S2-01	Sequence Timer 1 Start Time	00:00 to 24:00	00:00
S2-06	Sequence Timer 2 Start Time	00:00 to 24:00	00:00
S2-11	Sequence Timer 3 Start Time	00:00 to 24:00	00:00
S2-16	Sequence Timer 4 Start Time	00:00 to 24:00	00:00

■ S2-02/S2-07/S2-12/S2-17: Sequence Timers 1 to 4 Stop Time

Sets the stop times for timers 1 to 4. The values must be set greater than or equal to S2-01/S2-06/S2-11/S2-16.

No.	Name	Setting Range	Default
S2-02	Sequence Timer 1 Stop Time	00:00 to 24:00	00:00
S2-07	Sequence Timer 2 Stop Time	00:00 to 24:00	00:00
S2-12	Sequence Timer 3 Stop Time	00:00 to 24:00	00:00
S2-17	Sequence Timer 4 Stop Time	00:00 to 24:00	00:00

■ S2-03/S2-08/S2-13/S2-18: Sequence Timers 1 to 4 Day Selection

Sets the days for which sequence timers 1 to 4 are active.

No.	Name	Setting Range	Default
S2-03	Sequence Timer 1 Day Selection	0 to 10	0
S2-08	Sequence Timer 2 Day Selection	0 to 10	0
S2-13	Sequence Timer 3 Day Selection	0 to 10	0
S2-18	Sequence Timer 4 Day Selection	0 to 10	0

Setting 0: Timer Disabled

Setting 1: Daily

Setting 2: Mon - Fri

Setting 3: Sat - Sun

Setting 4: Monday

Setting 5: Tuesday

Setting 6: Wednesday

Setting 7: Thursday

Setting 8: Friday

Setting 9: Saturday

Setting 10: Sunday

■ S2-04/S2-09/S2-14/S2-19: Sequence Timers 1/2/3/4 Selection

Sets the action that occurs when sequence timers 1 to 4 are active.

No.	Name	Setting Range	Default
S2-04	Sequence Timer 1 Selection	0 to 2	0
S2-09	Sequence Timer 2 Selection	0 to 2	0
S2-14	Sequence Timer 3 Selection	0 to 2	0
S2-19	Sequence Timer 4 Selection	0 to 2	0

Setting 0: Digital Output Only

Setting 1: Run

Setting 2: Run - PI Disable

■ S2-05/S2-10/S2-15/S2-20: Sequence Timers 1/2/3/4 Reference Source

Selects the frequency reference source used for running the drive when sequence timers 1 to 4 are active (only applicable when S2-04/S2-09/S2-14/S2-19 are set to 1 or 2).

No.	Name	Setting Range	Default
S2-05	Sequence Timer 1 Reference Source	0 to 6	0
S2-10	Sequence Timer 2 Reference Source	0 to 6	0
S2-15	Sequence Timer 3 Reference Source	0 to 6	0
S2-20	Sequence Timer 4 Reference Source	0 to 6	0

Setting 0: Operator (d1-01)
Setting 1: Operator (d1-02)
Setting 2: Operator (d1-03)
Setting 3: Operator (d1-04)
Setting 4: Terminals
Setting 5: Serial Communication
Setting 6: Option Card

◆ S3: Secondary PI (PI2) Control

The drive has a built in PI (Proportional + Integral) controller that can be used for closed loop control of system variables such as pressure or temperature. The difference between the target and the feedback value (deviation) is fed into the PI controller and the PI controller outputs the frequency to U5-☐☐ for monitoring. *Refer to b5: PI Control on page 37* for details.

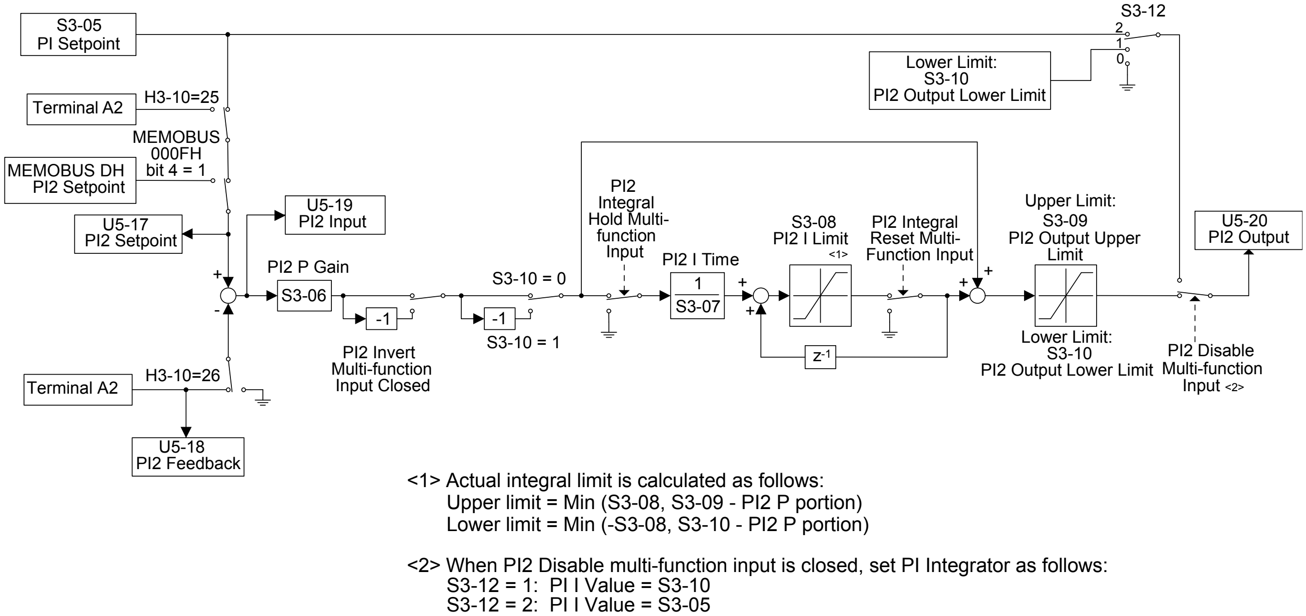


Figure 1.74 PI2 Block Diagram

■ S3-01: Secondary PI Enable Selection

Determines when the secondary PI controller is enabled.

No.	Name	Setting Range	Default
S3-01	Secondary PI Enable Selection	0 to 3	0

Setting 0: Secondary PI Disabled
Setting 1: Always
Setting 2: Drive Running
Setting 3: Motor Running

Available when the drive is not at zero speed, not in base block, and not in DC injection.

■ S3-02: Secondary PI User Display

Sets the scale value of 100% PI input. The decimal place shifts based on S3-03.

No.	Name	Setting Range	Default
S3-02	Secondary PI User Display	0 to 60000	1000 <1>

<1> Unit is determined by S3-03.

Parameter Details
1

■ S3-03: Secondary PI Display Digits

Sets the decimal place display for secondary PI units.

No.	Name	Setting Range	Default
S3-03	Secondary PI Display Digits	0 to 3	2

Setting 0: No Decimal Places

Setting 1: One Decimal Place

Setting 2: Two Decimal Places

Setting 3: Three Decimal Places

■ S3-04: Secondary PI Unit Selection

Sets units for secondary PI control function.

No.	Name	Setting Range	Default
S3-04	Secondary PI Unit Selection	0 to 15	15

Setting 0: Inch of Water (WC)

Setting 1: Pounds per Square Inch (PSI)

Setting 2: Gallons per Minute (GPM)

Setting 3: Degrees Fahrenheit (F)

Setting 4: Cubic Feet per Minute (CFM)

Setting 5: Cubic Meters per Hour (CMH)

Setting 6: Liters per Hour (LPH)

Setting 7: Liters per Second (LPS)

Setting 8: Bar (Bar)

Setting 9: Pascals (Pa)

Setting 10: Degrees Celsius (C)

Setting 11: Meters (Mtr) (Ft: Feet)

Setting 12: Liters per Minute (LPM)

Setting 13: Cubic Meters per Minute (CMM)

Setting 14: No Unit

Setting 15: Percentage (%)

■ S3-05: Secondary PI Setpoint Value

Sets the secondary PI controller target value

No.	Name	Setting Range	Default
S3-05	Secondary PI Setpoint Value	0.00 to 600.00 <1>	0.00 <2>

<1> Upper limit is S3-02, decimal place holder is determined by S3-03.

<2> Unit is determined by S3-04.

■ S3-06: Secondary PI Proportional Gain Setting

Sets the proportional gain of the secondary PI controller. A setting of 0.00 disables P control.

No.	Name	Setting Range	Default
S3-06	Secondary PI Proportional Gain Setting	0.00 to 25.00	1.00

■ S3-07: Secondary PI Integral Time Setting

Sets the integral time for the secondary PI controller. A setting of 0.0s disables integral control.

No.	Name	Setting Range	Default
S3-07	Secondary PI Integral Time Setting	0.0 to 360.0 s	1.0 s

■ S3-08: Secondary PI Integral Limit Setting

Sets the maximum output possible from the integrator.

No.	Name	Setting Range	Default
S3-08	Secondary PI Integral Limit Setting	0.0 to 100.0%	100.0%

■ S3-09: Secondary PI Output Upper Limit

Sets the maximum output possible from the secondary PI controller.

No.	Name	Setting Range	Default
S3-09	Secondary PI Output Upper Limit	0 to 100.0%	100.0%

■ S3-10: Secondary PI Output Lower Limit

Sets the minimum output possible from the secondary PI controller.

No.	Name	Setting Range	Default
S3-10	Secondary PI Output Lower Limit	-100.00 to 100.00	0.00%

■ S3-11: Secondary PI Output Level Selection

Sets the secondary PI controller output direction.

No.	Name	Setting Range	Default
S3-11	Secondary PI Output Level Selection	0 or 1	0

Setting 0: Normal Output (Direct Acting)

Setting 1: Reverse Output (Reverse Acting)

■ S3-12: Secondary PI Disable Mode

Selects the secondary PI controller output when disabled.

No.	Name	Setting Range	Default
S3-12	Secondary PI Disable Mode	0 to 2	0

Setting 0: No Output (0%)

Setting 1: Lower Limit (S3-10)

Setting 2: Setpoint

■ S3-13: Secondary PI Low Feedback Detection Level

Sets the secondary PI low feedback detection level.

No.	Name	Setting Range	Default
S3-13	Secondary PI Low Feedback Detection Level	0.00 to 600.00 <1>	0.00 <2>

<1> Upper limit is S3-02, decimal place holder is determined by S3-03.

<2> Unit is determined by S3-04.

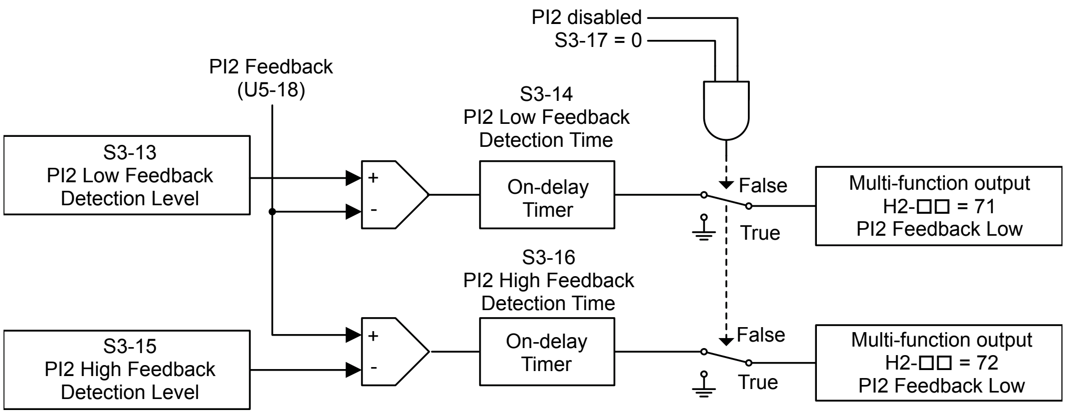


Figure 1.75 PI Low Feedback Detection Level

■ S3-14: Secondary PI Low Feedback Detection Time

Sets the secondary PI low feedback detection delay time in seconds.

No.	Name	Setting Range	Default
S3-14	Secondary PI Low Feedback Detection Time	0.0 to 25.5 s	1.0 s

■ S3-15: Secondary PI High Feedback Level

Sets the secondary PI high feedback detection level.

No.	Name	Setting Range	Default
S3-15	Secondary PI High Feedback Level	0.00 to 600.00 <1>	300.0 <2>

<1> Upper limit is S3-02, decimal place holder is determined by S3-03.

<2> Unit is determined by S3-04.

■ S3-16: Secondary PI High Feedback Detection Time

Sets the secondary PI high feedback detection delay time in seconds.

No.	Name	Setting Range	Default
S3-16	Secondary PI High Feedback Detection Time	0.0 to 25.5 s	1.0 s

■ S3-17: Secondary PI Feedback Detection Selection

Selects when secondary PI controller low and high feedback detection is active.

No.	Name	Setting Range	Default
S3-17	Secondary PI Feedback Detection Selection	0 or 1	0

Setting 0: Secondary PI Enabled

Setting 1: Always

◆ S4: Bypass Operation

The Drive/Bypass functionality allows the drive to control contactors that switch the motor voltage source between the drive and line voltage. A digital input can force the drive to go into Bypass mode and cause the motor to run on line voltage (full speed).

A second digital input (override) will run the motor on line voltage provided that dampers open feedback is present. The drive can switch to running the motor on line voltage if a fault occurs in the drive and also be configured to switch to Bypass for energy saving purposes if it is running near full speed for a set amount of time.

■ Enabling Programmable Bypass Logic

The programmable bypass logic is enabled when the following digital inputs are assigned: A4 (BP Emergency Override), A5 (BP Drive/Bypass Select), and A7 (BP Customer Safeties), and the following digital outputs are assigned:
A4 (BP Drive Relay Contact), and A5 (BP Bypass Relay Contact)

Note:
1. If o1-16 or o1-17 are set to 2 (Drive/Bypass), it is not necessary to set digital output A5.
2. If o1-16 or o1-17 are set to 3 (Bypass Run Command), it is not necessary to set digital output 84.

When Bypass functionality is enabled, the drive can allow the motor to run off of line voltage instead of the drive output. The drive will only run in Drive or Bypass mode if a Run command is entered. The drive must also be configured to 2-Wire control to enable Bypass functionality. Each time the drive performs a switch from Drive mode to Bypass mode it will follow the procedure outlined below.

Immediate Transfer to Bypass

Three conditions: Emergency Override (Smoke Purge), Transfer on Fault Required, and Energy Saving Transfer, require the drive to perform an immediate transfer to bypass.

To protect system hardware, this transfer cannot happen instantly. When an immediate transfer is required, the drive will block the output. After the L2-03 time (Minimum Baseblock Time) elapses, the BP Drive Relay Contact opens to disconnect the drive from the motor. The drive then allows the Minimum Baseblock Time (L2-03) to elapse before closing the BP Bypass Relay Contact. This causes the motor to operate on line voltage.

This process ensures that any residual field present in the motor is allowed to dissipate before the voltage source is changed.

Transfer to Drive Operation

When this occurs, the drive will open the BP Bypass Relay Contact, wait until the Minimum Baseblock Time (L2-03) elapses, close the BP Drive Relay Contact and wait for the L2-03 time to elapse again. After the drive is connected to the motor, it will remove the Baseblock condition, perform a speed search, catch the spinning motor, and ramp to the desired output frequency.

■ Programmable Bypass Logic

When the Drive/Bypass MFDI (H1-☐☐ = A5) is closed and a Run command is entered, the drive switches to Drive mode and allows the drive to run the motor. ***Refer to Transfer to Drive Operation on page 143*** for details.

If the Drive/Bypass Select digital input is opened and the Bypass Run command is given, the drive switches to Bypass mode and allows the motor to run on line voltage. ***Refer to Immediate Transfer to Bypass on page 143*** for details.

When Drive/Bypass MFDI (H1-☐☐ = A5) is open, but no Run command is present, the HOA keypad displays “Bypass Select Off”.

When Drive/Bypass MFDI (H1-☐☐ = A5) is open and the BP Bypass Relay Contact is closed, the HOA keypad displays “Bypass Select Run”.

When o1-16 or o1-17 is set to 2 (Drive/Bypass), the HOA keypad DRV/BYP multi-function key selects the bypass operating mode instead of the Drive/Bypass MFDI.

When o1-16 or o1-17 is set to 3 (Bypass Run Command), the HOA keypad RUN BYP multi-function key is used to run in Bypass mode instead of the Bypass Run Command MFDI.

Safety Circuit

The Customer Safeties Relay must to be closed for drive or bypass operation to be functional. If the Customer Safeties Relay is open, the drive will not run in Drive or Bypass mode.

The Customer Safeties Alarm “SAFE Customer Safety” displays when the BP Customer Safeties MFDI (H1-☐☐ = A7) is open.

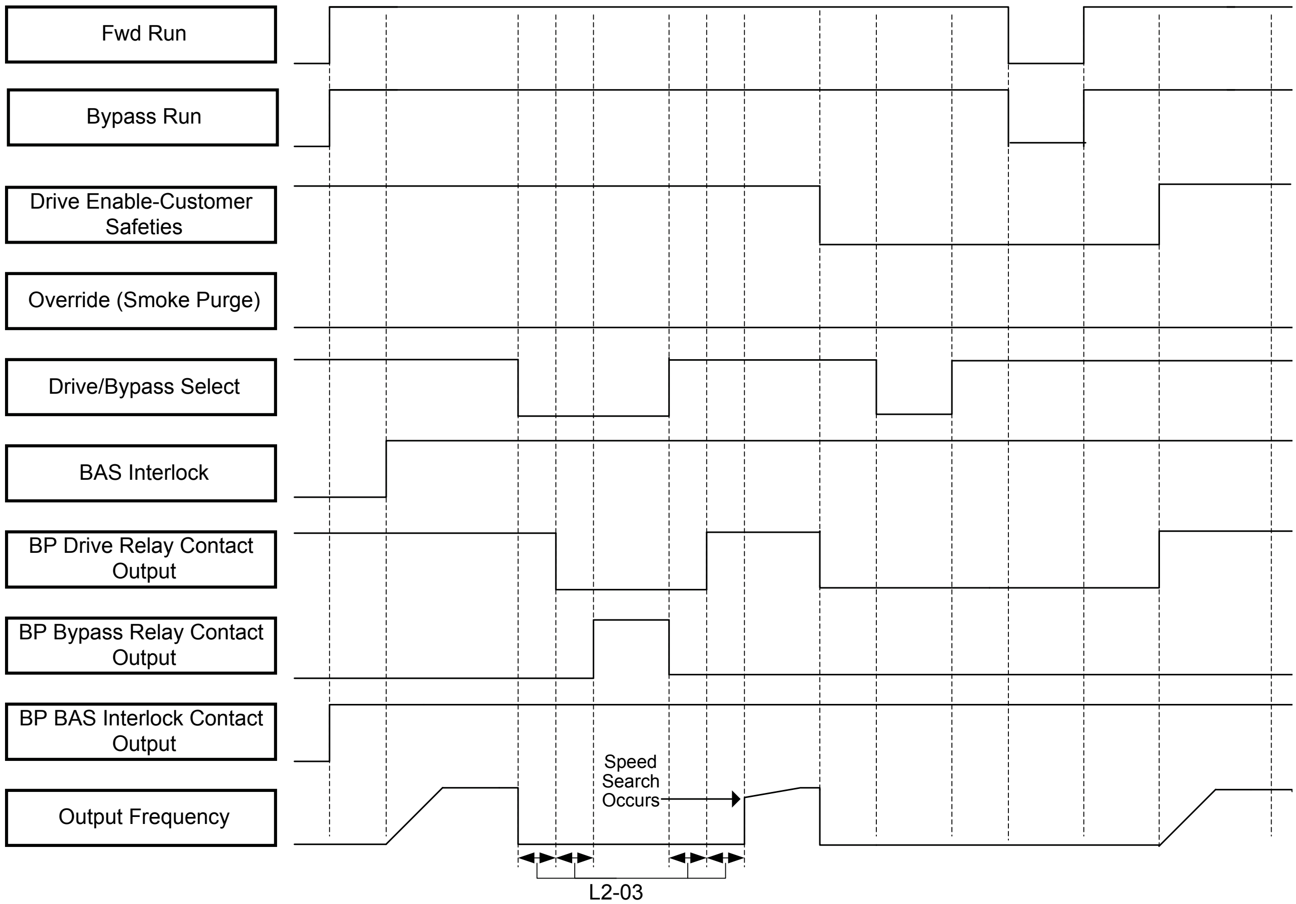


Figure 1.76 Transfer to Bypass and Safety Circuit

Emergency Override

When the Emergency Override (Smoke Purge) digital input is closed, the drive will perform the transfer. *Refer to Immediate Transfer to Bypass on page 143* for details.

If programmed, the BP BAS Interlock Relay Contact will close before the transfer occurs. During the transfer process, and if BAS Interlocks are present, the BAS Interlock Input MFDI must be closed before the drive will close the bypass contactor to run the motor on line voltage.

When the Emergency Override MFDI is closed, the state of BP Drive/Bypass Select MFDI, Run command, Bypass Run command and BP Customer Safeties MFDI have no impact on the operation of the system. When Emergency Override opens, the drive operates based on the other digital input commands. If the drive is commanded to run, the drive will perform the switch. *Refer to Transfer to Drive Operation on page 143* for details.

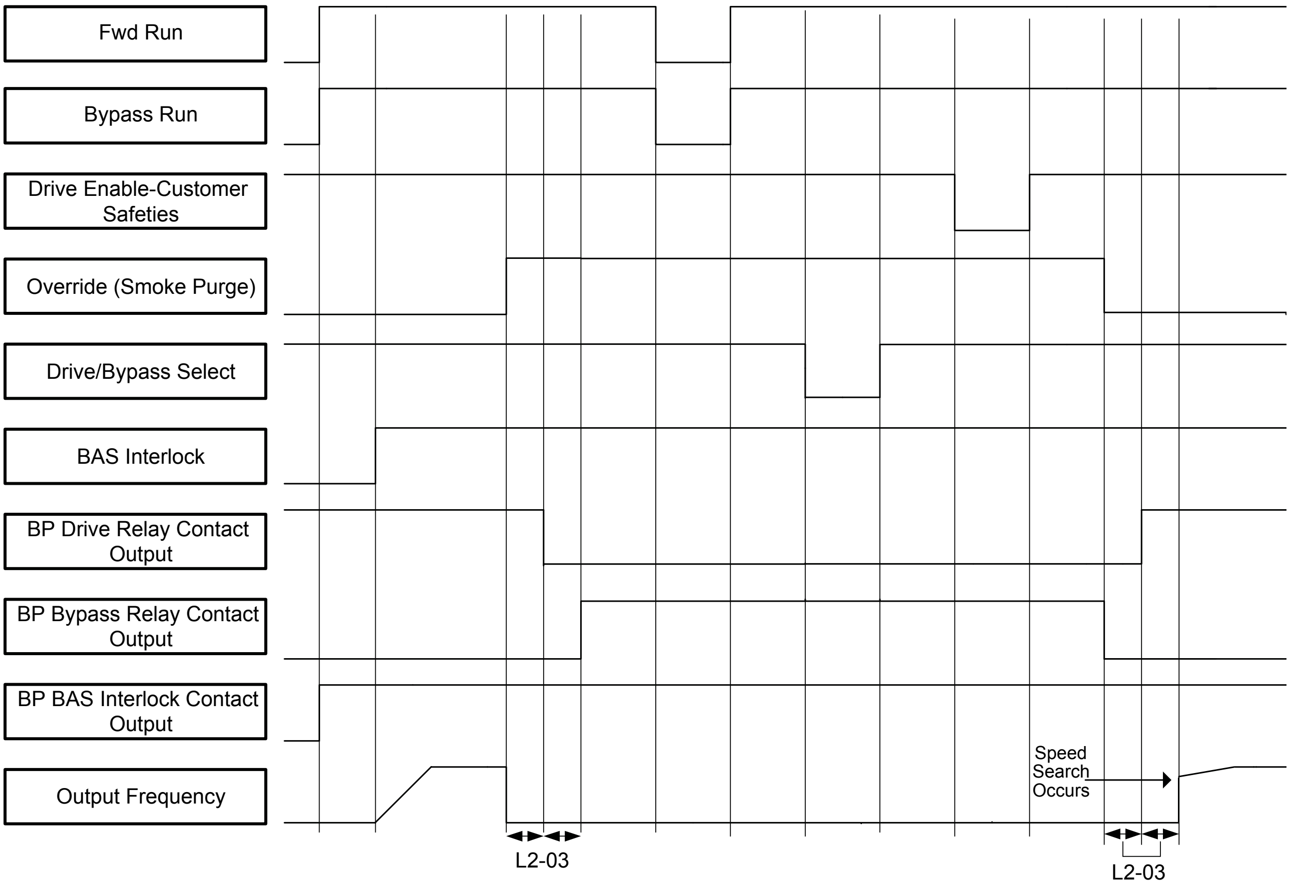


Figure 1.77 Emergency Override

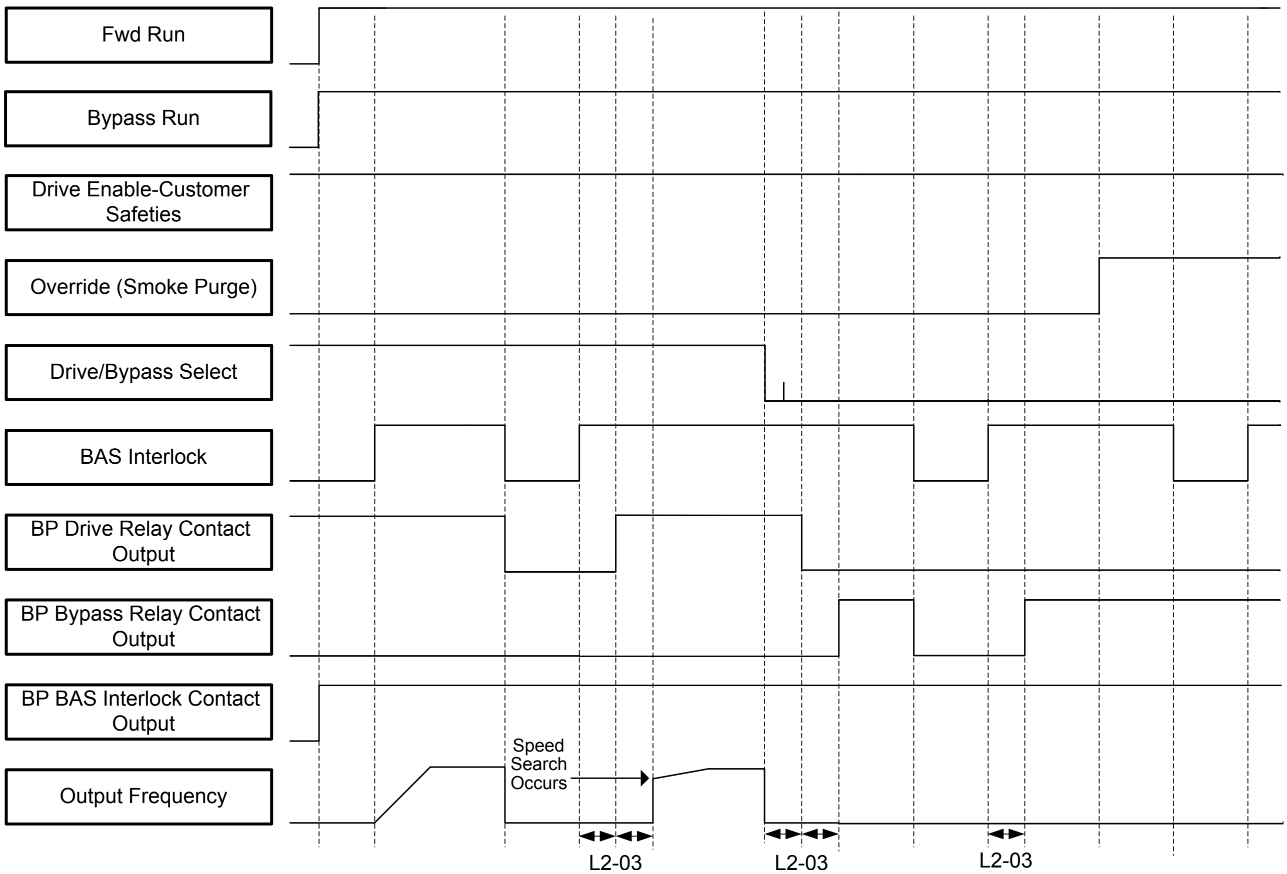


Figure 1.78 BAS Interlock

Transfer on Fault

When the bypass functionality is enabled and the BP Auto Transfer on Fault Enable (S4-01) is enabled, the drive can perform a transfer to bypass upon a drive fault. If the drive is running when a fault occurs, an immediate transfer to bypass will occur. *Refer to Immediate Transfer to Bypass on page 143* for details.

The drive will keep the BP Bypass Relay Contact closed until the run command is removed, the BP Customer Safeties is opened, or the BAS Interlock Input MFDI is programmed and opens. When the fault is manually reset, the drive performs the switch. *Refer to Transfer to Drive Operation on page 143* for details.

This functionality also requires that Auto-Restart Retries is set to zero (L5-01 = 0) to ensure that the drive does not attempt an automatic fault retry.

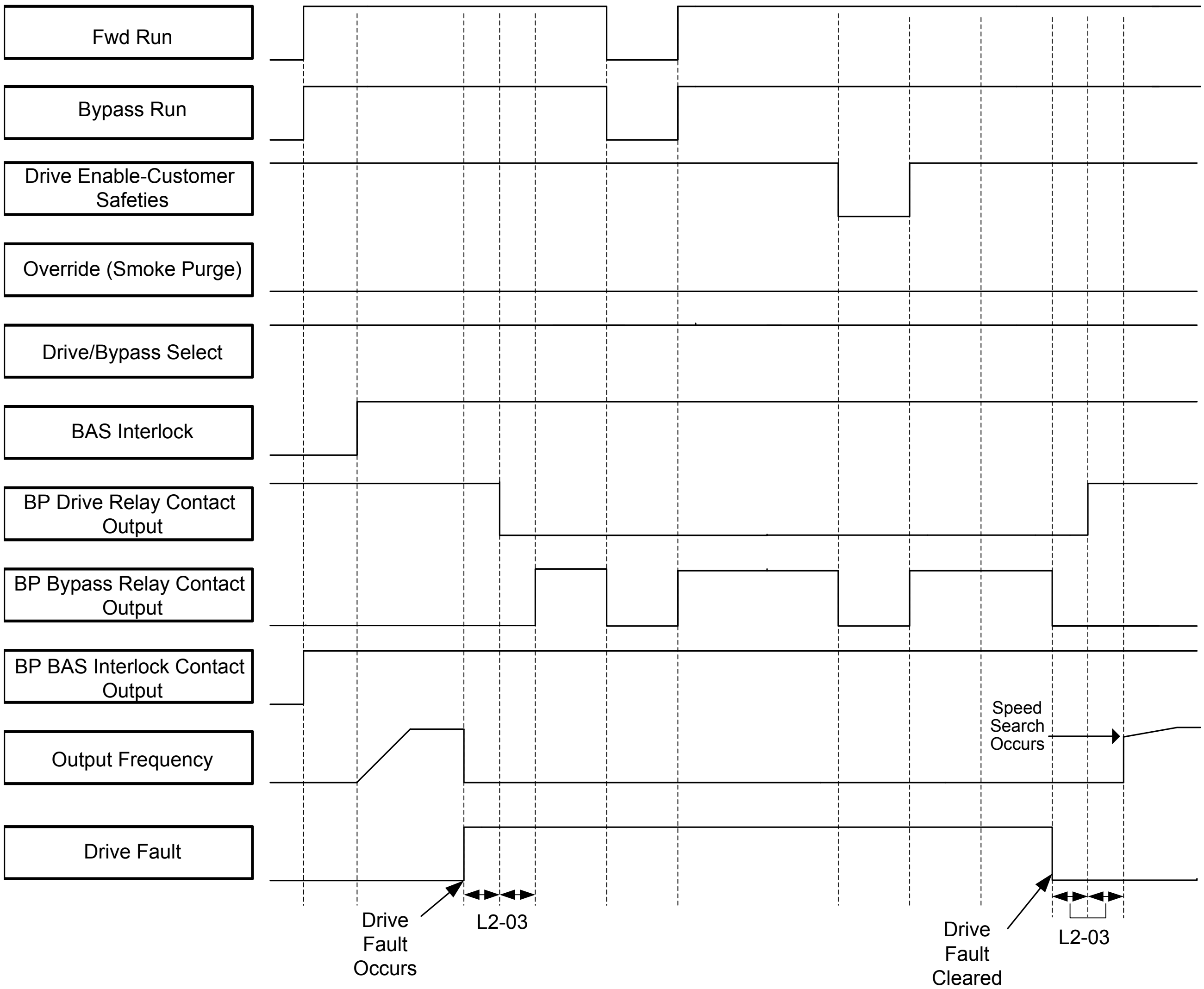


Figure 1.79 Transfer on Fault

Energy Savings Mode

When the BP Energy Save Bypass Trigger Level (S4-02) is greater than 0, the Energy Savings Mode is enabled. If the drive is running at a speed, as determined by SFS output equal to or greater than Maximum Output Frequency minus BP Energy Save Bypass Trigger Level (E1-04 - S4-02) for the time specified in BP Energy Save Bypass Timer (S4-03), the drive output frequency ramps to Maximum Output Frequency plus BP Energy Save Bypass Speed Increase (E1-04 + S4-04).

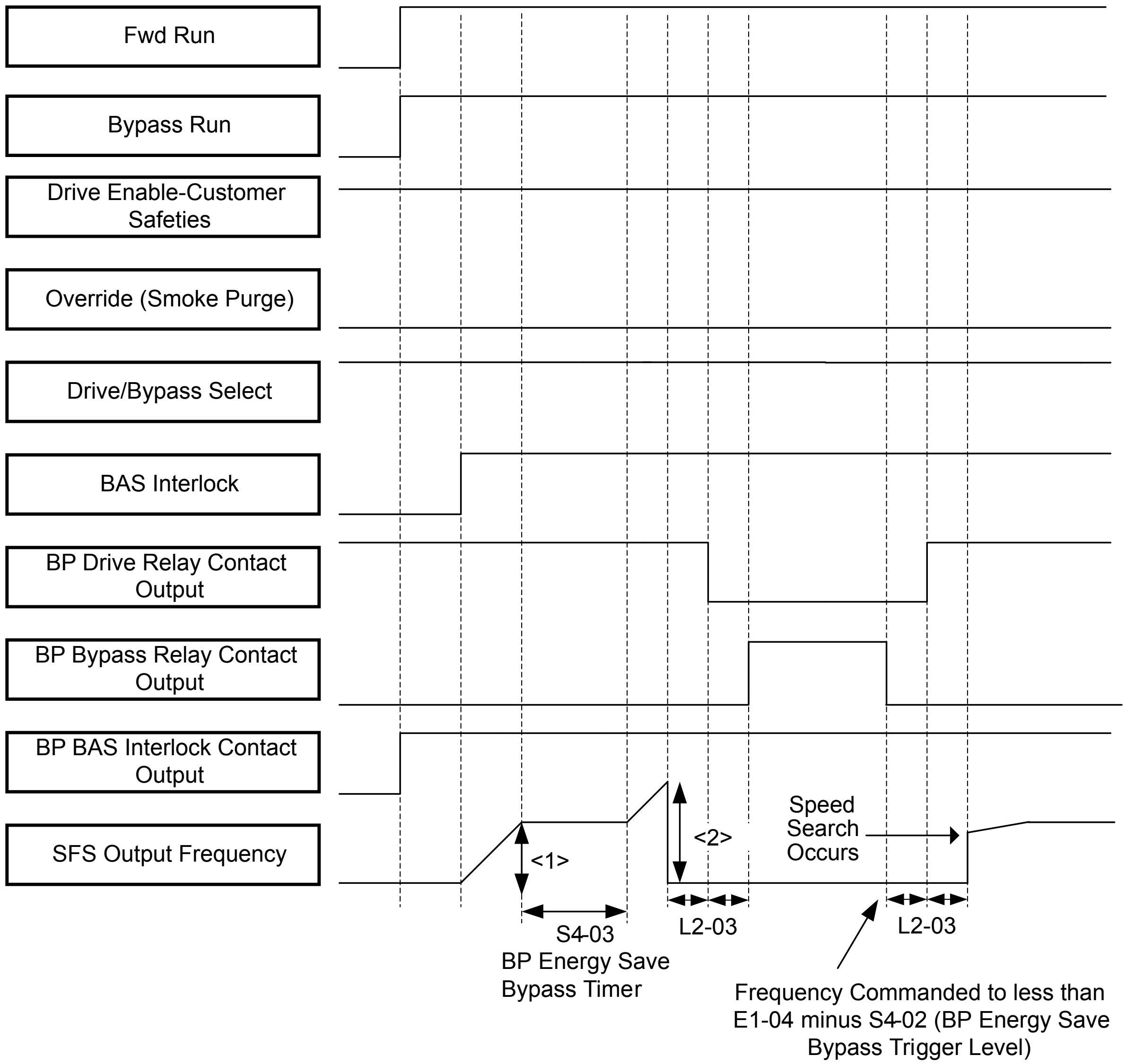
When the SFS output frequency is equal to Maximum Output Frequency plus BP Energy Save Bypass Speed Increase (E1-04 + S4-04), the drive will perform an immediate transfer to bypass. *Refer to Immediate Transfer to Bypass on page 143* for details.

The drive will continue to run on line voltage until the frequency command drops below E1-04 - S4-02 (Maximum Output Frequency minus BP Energy Save Bypass Trigger Level). When this occurs, the drive performs the switch. *Refer to Transfer to Drive Operation on page 143* for details.

The BP BAS Interlock Open message will display when the drive is waiting for the BAS feedback before issuing an internal Run command or closing the BP Bypass Relay Contact.

Parameter Details

1



<1> E1-04 minus S4-02 (BP Energy Save Bypass Trigger Level)

<2> E1-04 plus S4-04 (BP Energy Save Bypass Speed Increase)

Figure 1.80 Energy Savings Mode

■ S4-01: BP Auto Transfer on Fault Enable

Enables Auto-Transfer when a fault occurs.

No.	Name	Setting Range	Default
S4-01	BP Auto Transfer on Fault Enable	0 or 1	0

Setting 0: No Transfer after Fault

Setting 1: Transfer to Bypass after Fault

■ S4-02: BP Energy Save Bypass Trigger Level

Delta used to determine when to switch into Energy Save Bypass. This allows for lower frequency output values to also trigger Energy Save Bypass functionality. A transfer to bypass occurs after the drive reaches the programmed output frequency (E1-04 to S4-02) for the time specified in the BP Energy Save Bypass Timer (S4-03). Additionally, if frequency input is set below E1-04 to S4-02, the drive exits Energy Save Bypass. Setting S4-02 to 0 disables Energy Save Bypass functionality.

No.	Name	Setting Range	Default
S4-02	BP Energy Save Bypass Trigger Level	0 to 20 Hz	0 Hz

■ S4-03: BP Energy Save Bypass Timer

Sets the time in seconds that the drive should run at the specified speed before entering Energy Save Bypass mode.

No.	Name	Setting Range	Default
S4-03	BP Energy Save Bypass Timer	10 to 60000 s	60 s

■ S4-04: BP Energy Save Bypass Speed Increase

Sets the value in Hz that the drive will increase the output frequency above E1-04 before performing an Energy Save transfer to bypass.

No.	Name	Setting Range	Default
S4-04	BP Energy Save Bypass Speed Increase	0 to 10 Hz	6 Hz

◆ S5: HOA Keypad Parameters

■ S5-01: HAND Frequency Reference Selection

Selects the speed command input source in HAND mode.

No.	Name	Setting Range	Default
S5-01	HAND Frequency Reference Selection	0 to 4	0

Setting 0: HOA Keypad

Setting 1: Terminals

Setting 2: d1-16

Setting 3: S5-05

Setting 4: Determined by b1-01

■ S5-02: HAND/AUTO During Run Selection

Selects if drive will permit switching between HAND and AUTO modes while running.

No.	Name	Setting Range	Default
S5-02	HAND/AUTO During Run Selection	0 or 1	1

Setting 0: Disabled

Setting 1: Enabled

■ S5-03: HAND Mode PI Selection

Selects whether PI control is enabled or disabled when in HAND mode.

No.	Name	Setting Range	Default
S5-03	HAND Mode PI Selection	0 or 1	1

Setting 0: Disabled

Setting 1: Enabled

■ S5-04: HAND Mode Behavior Selection

Selects the behavior of HAND mode.

No.	Name	Setting Range	Default
S5-04	HAND Mode Behavior Selection	0 to 2	1

Setting 0: Legacy Operation Mode

When S5-04 = 0 (Legacy operation mode), the HAND/OFF/AUTO functionality for both the HOA keypad and multifunction inputs.

Setting 1: Normal Operation Mode

When S5-04 = 1 (Normal operation mode), the functionality is as follows:

- AUTO mode: Drive frequency reference and run command are based on b1-01/b1-02.
- OFF mode: Drive is stopped and cannot run (except via Emergency Override multi-function input). Frequency reference is based on b1-01.
- HAND mode: Drive runs at frequency reference selected via S5-01.

The AUTO, OFF and HAND states are selected either via the HOA keypad or multi-function inputs.

Parameter S5-01 selects the HAND mode frequency reference source. When S5-01 is set to 2, d1-16 is used as the HAND mode reference. When S5-01 is set to 3, S5-05 is used. When S5-01 is set to 4, the frequency reference selected via b1-01 is used as the HAND mode reference.

The only difference between d1-16 and S5-05 is that the unit for d1-16 changes based on o1-03, o1-10 and o1-11. However, the unit for S5-05 is fixed at Hz.

Parameter S5-03 selects whether PI control is enabled or disabled in HAND mode.

Note: The drive will always be in AUTO mode at power up with S5-04 = 1.

Table 1.31 HAND/AUTO Multi-Function Inputs, Standard Behavior (S5-04 = 1 or 2)

AUTO Mode Selection (H1-□□ = 6D)	HAND Mode Selection (H1-□□ = 6E)	Operation Mode	Frequency Reference	Run Command
Open	Open	OFF	Based on b1-01	OFF
Open	Closed	HAND	Based on S5-01	OFF
Closed	Open	AUTO	Based on b1-01	Based on b1-02
Closed	Closed	OFF	Based on b1-01	OFF

When the AUTO and HAND multi-function inputs (setting 6D and 6E) are used, the HAND and AUTO keys on the HOA keypad do not function.

If S5-04 is set to 1 or 2, the AUTO and HAND multi-function inputs (setting 6D and 6E) can only be used together or an oPE03 error will occur.

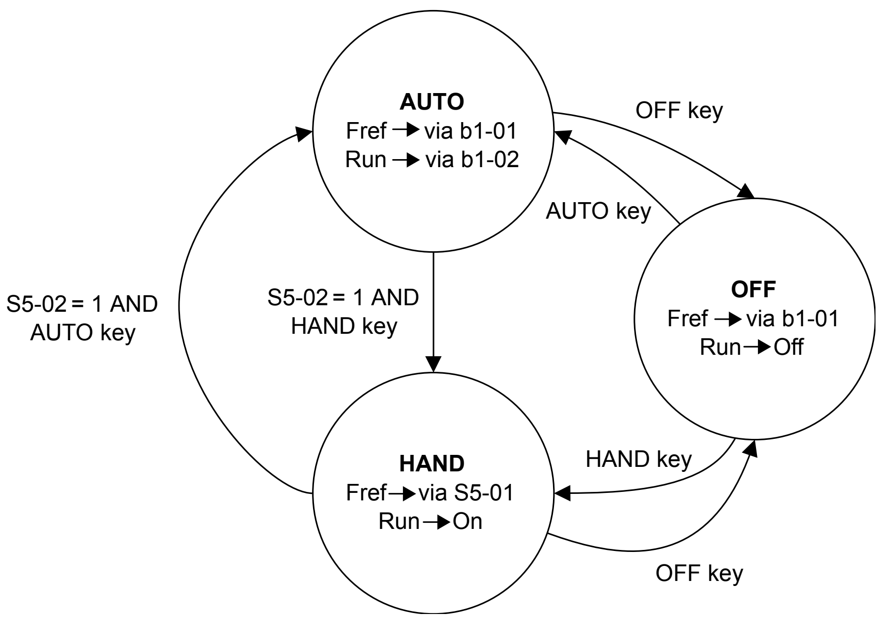


Figure 1.81 Standard Behavior (S5-04 = 1 or 2)

Table 1.32 HAND/AUTO Multi-Function Inputs, Legacy Behavior (S5-04 = 0)

AUTO Mode Selection (H1-□□ = 6D)	HAND Mode Selection (H1-□□ = 6E)	Frequency Reference	Run Command
Open	-	Based on S5-01	Based on b1-02
Closed	-	Based on b1-02	
-	Open	Based on b1-02	
-	Closed	Based on S5-01	

If S5-04 is set to 0, the AUTO and HAND multi-function inputs (setting 6D and 6E) can only be used individually or an oPE03 error will occur.

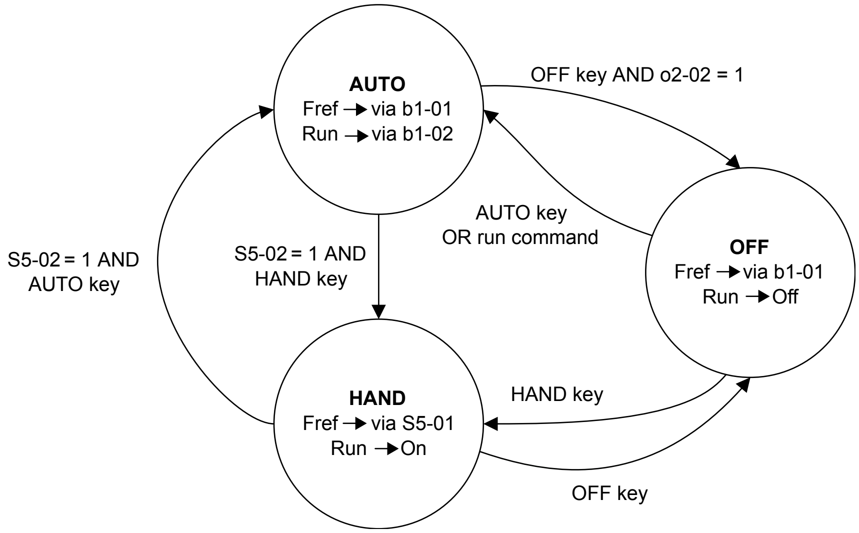


Figure 1.82 Legacy Behavior (S5-04 = 0)

Setting 2: Normal Operation Mode with Memory

When switching AUTO/HAND modes from the HOA keypad, the drive will memorize the operation mode when the power to the drive is shut off. This will be the initial operating mode when power is reapplied.

When switching AUTO/HAND modes from a Multi-Function Input, the drive will start with the Multi-Function Input setting.

HAND mode: The drive starts with the OFF mode when cycling the power to the drive.

AUTO mode: The drive starts with the AUTO mode when cycling the power to the drive.

OFF mode: The drive starts with the OFF mode when cycling the power to the drive.

■ S5-05: HAND Frequency Reference 1

Sets the frequency reference used in HAND mode when S5-01 is set to 3.

Note: Setting units and range are determined by parameters o1-03, o1-10, and o1-11.

No.	Name	Setting Range	Default
S5-05	HAND Frequency Reference 1	0.00 to 240.00 Hz	0.00 Hz

■ S5-07: HAND Key Function Selection (HOA Keypad)

Determines whether the HAND key on the HOA keypad will be enabled for switching between HAND and AUTO.

No.	Name	Setting Range	Default
S5-07	HAND Key Function Selection (HOA Keypad)	0, 1	1

Setting 0: Disabled

Setting 1: Enabled

◆ S6: Phase Order Selections

■ S6-01: Emergency Override Speed

Sets the speed command used in emergency override mode when S6-02 = 0.

No.	Name	Setting Range	Default
S6-01	Emergency Override Speed	0.00 to 240.00 Hz	0.00 Hz

■ S6-02: Emergency Override Reference Selection

Selects the frequency reference source for the Emergency Override function (H1-□□= AF or B0). Emergency Override ignores faults such as oL2, oH1, oL1/oL2/oL3, EF□□, oH1/oH3/oH4, LL3, rH, oPr, CPF, PI faults, LF/LF2, UL3, PF, and any other faults, if possible.

Note: In drive software versions PRG:1013 and earlier, if the CALL alarm is displayed, the Emergency Override Forward (H1-0□ = AF) and Emergency Override Reverse (H1-0□ = B0) inputs are ignored. In drive software versions PRG:1014 and later, the Emergency Override inputs will function even if the CALL alarm is displayed.

No.	Name	Setting Range	Default
S6-02	Emergency Override Reference Selection	0, 1	0

Setting 0: Use S6-01 Reference

Setting 1: Use AUTO Reference

■ S6-03: ov2 Detect Time

Sets the detection time of ov2 in 0.1 s increments.

No.	Name	Setting Range	Default
S6-03	ov2 Detect Time	0.0 to 1200.0 s	10.0 s

■ S6-04: Main Contactor and Cooling Fan Power Supply Failure

Determines the action the drive should take when a fault occurs with the external cooling fan.

No.	Name	Setting Range	Default
S6-04	Main Contactor and Cooling Fan Power Supply Failure	0 to 2	1

Setting 0: Ramp to Stop

Setting 1: Coast to Stop

Setting 2: Fast Stop (Decelerate to Stop Using the Detection Time Set in C1-09)

■ S6-07: Output Phase Loss Detection Level for Dynamic Audible Noise Control

Sets the output phase loss detection level for Dynamic Audible Noise Control. Decrease the setting in steps of 10% when output phase loss is detected erroneously. This setting rarely needs to be changed.

No.	Name	Setting Range	Default
S6-07	Output Phase Loss Detection Level for Dynamic Audible Noise Control	10.0 to 100.0%	100.0%

1.12 T: Motor Tuning

Auto-Tuning automatically sets and tunes parameters required for optimal motor performance.

◆ T1: Parameter Settings during Induction Motor Auto-Tuning

The T1-□□ parameters set the Auto-Tuning input data for induction motor tuning.

Note: For motors operating in the field weakening range, first perform the Auto-Tuning with the base data. After Auto-Tuning is complete, change E1-04, Maximum Output Frequency, to the desired value.

■ T1-01: Auto-Tuning Mode Selection

Sets the type of Auto-Tuning to be used. Refer to the User Manual packaged with the drive for details on the different types of Auto-Tuning.

No.	Name	Setting Range	Default
T1-01	Auto-Tuning Mode Selection	2, 3 (V/f)	2 (V/f)

Setting 2: Stationary Auto-Tuning for Line-to-Line Resistance

Setting 3: Rotational Auto-Tuning for V/f Control Energy Saving

■ T1-02: Motor Rated Power

Sets the motor rated power according to the motor nameplate value.

Note: Use the following formula to convert HP to kW: kW = HP x 0.746.

No.	Name	Setting Range	Default
T1-02	Motor Rated Power	0.00 to 650.00 kW	Determined by o2-04

■ T1-03: Motor Rated Voltage

Sets the motor rated voltage according to the motor nameplate value. Enter the voltage base speed when the motor operates above base speed. Enter the voltage needed to operate the motor under no-load conditions at rated speed to T1-03.

No.	Name	Setting Range	Default
T1-03	Motor Rated Voltage	0.0 to 255.0 V <1>	200.0 V <1>

<1> Values shown are specific to 200 V class drives. Double value for 400 V class drives.

■ T1-04: Motor Rated Current

Sets the motor rated current according to the motor nameplate value. Enter the current at the motor base speed.

No.	Name	Setting Range	Default
T1-04	Motor Rated Current	10.0 to 300.0% of drive rated current	Determined by o2-04

■ T1-05: Motor Base Frequency

Sets the motor rated frequency according to the motor nameplate value. If a motor with an extended speed range is used or the motor is used in the field weakening area, enter the maximum frequency to E1-04 after Auto-Tuning is complete.

No.	Name	Setting Range	Default
T1-05	Motor Base Frequency	0.0 to 240.0 Hz	60.0 Hz

■ T1-06: Number of Motor Poles (T1-01 = 0, 1, 3, 4)

Sets the number of motor poles according to the motor nameplate value.

No.	Name	Setting Range	Default
T1-06	Number of Motor Poles	2 to 48	4

■ T1-07: Motor Base Speed (T1-01 = 0, 1, 3, 4)

Sets the motor rated speed according to the motor nameplate value. Enter the speed at base frequency when using a motor with an extended speed range or if using the motor in the field weakening area.

No.	Name	Setting Range	Default
T1-07	Motor Base Speed	0 to 14400 r/min	1750 r/min

■ T1-11: Motor Iron Loss

Provides iron loss information to determine the Energy Saving coefficient. T1-11 will first display the value for the motor iron loss that the drive automatically calculated when the motor capacity was entered to T1-02. Enter the motor iron loss value listed to T1-11 if the motor test report is available.

No.	Name	Setting Range	Default
T1-11	Motor Iron Loss	0 to 65535 W	14 W

■ T1-12: T1 Tuning Start

Set T1-12 to 0 to start IM Auto-Tuning.

No.	Name	Setting Range	Default
T1-12	T1 Tuning Start	0	–

◆ T2: Parameter Settings during PM Motor Auto-Tuning

The T2-□□ parameters are used to set the Auto-Tuning input data for PM motor tuning.

■ T2-01: PM Motor Auto-Tuning Mode Selection

No.	Name	Setting Range	Default
T2-01	PM Motor Auto-Tuning Mode Selection	0	0

Setting 0: PM Motor Parameter Settings

■ T2-03: PM Motor Type

Selects the type of PM motor the drive will operate.

No.	Name	Setting Range	Default
T2-03	PM Motor Type	0, 1	1

Setting 0: IPM motor

Setting 1: SPM motor

■ T2-04: PM Motor Rated Power

Specifies the motor rated power in kilowatts.

No.	Name	Setting Range	Default
T2-04	PM Motor Rated Power	0.00 to 650.00 kW	Determined by o2-04 and C6-01

■ T2-05: PM Motor Rated Voltage

Sets the motor rated voltage.

No.	Name	Setting Range	Default
T2-05	PM Motor Rated Voltage	0.0 to 255.0 V <1>	200.0 V <1>

<1> Values shown are specific to 200 V class drives; double the value for 400 V class drives.

T2-06: PM Motor Rated Current

Enter the motor rated current in amps.

No.	Name	Setting Range	Default
T2-06	PM Motor Rated Current	0.0% to 300.0% of the drive rated current.	Determined by o2-04

T2-07: PM Motor Base Frequency

Enter the motor base frequency in Hz.

Note: T2-07 will be displayed when in OLV/PM.

No.	Name	Setting Range	Default
T2-07	PM Motor Base Frequency	0.0 to 240.0 Hz	87.5 Hz

T2-08: Number of PM Motor Poles

Enter the number of motor poles.

No.	Name	Setting Range	Default
T2-08	Number of PM Motor Poles	2 to 48	6

T2-10: PM Motor Stator Resistance

Enter the motor stator resistance per motor phase.

No.	Name	Setting Range	Default
T2-10	PM Motor Stator Resistance	0.000 to 65.000 Ω	Determined by T2-02

T2-11: PM Motor d-Axis Inductance

Enter the d-Axis inductance per motor phase.

No.	Name	Setting Range	Default
T2-11	PM Motor d-Axis Inductance	0.00 to 600.00 mH	Determined by T2-02

T2-12: PM Motor q-Axis Inductance

Enter the q-Axis inductance per motor phase.

No.	Name	Setting Range	Default
T2-12	PM Motor q-Axis Inductance	0.00 to 600.00 mH	Determined by T2-02

T2-13: Induced Voltage Constant Unit Selection

Selects the units used for setting the induced voltage coefficient.

No.	Name	Setting Range	Default
T2-13	Induced Voltage Constant Unit Selection	0, 1	0

Setting 0: mV (r/min)

Setting 1: mV (rad/sec)

Note: If T2-13 is set to 0, then the drive will use E5-24 (Motor Induction Voltage Constant 2), and will automatically set E5-09 (Motor Induction Voltage Constant 1) to 0.0. If T2-13 is set to 1, then the drive will use E5-09 and will automatically set E5-25 to 0.0.

T2-14: PM Motor Induced Voltage Constant (Ke)

Enter the motor induced voltage constant (Ke).

No.	Name	Setting Range	Default
T2-14	PM Motor Induced Voltage Constant	0.1 to 2000.0	Determined by T2-02

T2-15: Pull-In Current Level for PM Motor Tuning

Sets the amount of pull-in current. Set as a percentage of the motor rated current.

No.	Name	Setting Range	Default
T2-15	Pull-In Current Level for PM Motor Tuning	0 to 120%	30%

T2-18: T2 Tuning Start

Set T2-18 to 0 to start PM motor Auto-Tuning.

No.	Name	Setting Range	Default
T2-18	T2 Tuning Start	0	–

1.13 U: Monitor Parameters

Monitor parameters let the user view various aspects of drive performance using the HOA keypad display. Some monitors can be output from terminals FM and AM by assigning the specific monitor parameter number (U□-□□) to H4-01 and H4-04. *Refer to H4-01, H4-04: Multi-Function Analog Output Terminal FM, AM Monitor Selection on page 96* for details on assigning functions to an analog output.

◆ U1: Operation Status Monitors

Status monitors display drive status data such as output frequency and output current. *Refer to U1: Operation Status Monitors on page 256* for a complete list of U1-□□ monitors and descriptions.

◆ U2: Fault Trace

Use these monitor parameters to view the status of various drive aspects when a fault occurs.

This information is helpful for determining the cause of a fault. *Refer to U2: Fault Trace on page 257* for a complete list of U2-□□ monitors and descriptions.

U2-□□ monitors are not reset when the drive is initialized. *Refer to o4-11: U2, U3 Initialization on page 133* for instructions on how to reset these monitor values.

Note: Fault histories are not kept when CPF00, CPF01, CPF06, CPF24, oFA00, oFb00, oFC00, Uv1, Uv2, or Uv3 occur.

◆ U3: Fault History

These parameters display faults that have occurred during operation as well as the drive operation time when those faults occurred. *Refer to U3: Fault History on page 258* for a complete list of U3-□□ monitors and descriptions.

U3-□□ monitors are not reset when the drive is initialized. *Refer to o4-11: U2, U3 Initialization on page 133* for instructions on how to reset these monitor values.

Note: Fault histories are not kept when CPF00, CPF01, CPF06, CPF24, oFA00, oFb00, oFC00, Uv1, Uv2, or Uv3 occur.

◆ U4: Maintenance Monitors

Maintenance monitors show:

- Runtime data of the drive and cooling fans and number of Run commands issued
- Maintenance data and replacement information for various drive components
- kWh data
- Highest peak current that has occurred and output frequency at the time the peak current occurred
- Motor overload status information
- Detailed information about the present Run command and frequency reference source selection

Refer to U4: Maintenance Monitors on page 260 for a complete list of U4-□□ monitors and descriptions.

◆ U5: PI Monitors

These monitors display various aspects of PI control. *Refer to PI Block Diagram on page 40* for details on how these monitors display PI data. *Refer to U5: PI Monitors on page 261* for a complete list of U5-□□ monitors and descriptions.

◆ U6: Operation Status Monitors

These monitors display reference data for the output voltage and vector control and the offset value added to the frequency reference by the frequency offset function. *Refer to Settings 44, 45, and 46: Offset Frequency 1, 2, 3 on page 80* for details.

Refer to U6: Operation Status Monitors on page 262 for a complete list of U6-□□ monitors and descriptions.

This Page Intentionally Blank

2

Periodic Inspection & Maintenance

This chapter describes the periodic inspection and maintenance of the drive to ensure that it receives the proper care to maintain overall performance.

2.1 Section Safety

DANGER

Electrical Shock Hazard

Do not connect or disconnect wiring while the power is on.

Failure to comply will result in death or serious injury.

Before servicing, disconnect all power to the equipment. The internal capacitor remains charged even after the power supply is turned off. The charge indicator LED will extinguish when the DC bus voltage is below 50 Vdc. To prevent electric shock, wait for at least the time specified on the warning label once all indicators are OFF, and then measure the DC bus voltage level to confirm it has reached a safe level.

Never connect or disconnect wiring, remove connectors or option cards, or replace the cooling fan while the power is on.

Failure to comply will result in death or serious injury.

Before servicing, disconnect all power to the equipment. The internal capacitor remains charged even after the power supply is turned off.

WARNING

Electrical Shock Hazard

Do not operate equipment with covers removed.

Failure to comply could result in death or serious injury.

The diagrams in this section may show drives without covers or safety shields to show details. Be sure to reinstall covers or shields before operating the drives and run the drives according to the instructions described in this manual.

Always ground the motor-side grounding terminal.

Improper equipment grounding could result in death or serious injury by contacting the motor case.

Do not remove covers or touch circuit boards while the power is on.

Failure to comply could result in death or serious injury.

Do not allow unqualified personnel to perform work on the drive.

Failure to comply could result in death or serious injury.

Installation, maintenance, inspection, and servicing must be performed only by authorized personnel familiar with installation, adjustment, and maintenance of AC drives.

Do not perform work on the drive while wearing loose clothing, jewelry or without eye protection.

Failure to comply could result in death or serious injury.

Remove all metal objects such as watches and rings, secure loose clothing, and wear eye protection before beginning work on the drive.

Do not touch any terminals before the capacitors have fully discharged.

Failure to comply could result in death or serious injury.

Before wiring terminals, disconnect all power to the equipment. The internal capacitor remains charged even after the power supply is turned off. After shutting off the power, wait for at least the amount of time specified on the drive before touching any components.

Fire Hazard

Tighten all terminal screws to the specified tightening torque.

Loose electrical connections could result in death or serious injury by fire due to overheating of electrical connections.

Do not use an improper voltage source.

Failure to comply could result in death or serious injury by fire.

Verify that the rated voltage of the drive matches the voltage of the incoming power supply before applying power.

⚠ WARNING

Do not use improper combustible materials.

Failure to comply could result in death or serious injury by fire.

Attach the drive to metal or other noncombustible material.

Properly handle the HOA keypad battery.

Improper use of the battery may cause fire by explosion and personal injury.

Correctly install the battery, paying attention to polarity (+/-).

Do not attempt to charge the battery or improperly disassemble the HOA keypad.

NOTICE

Observe proper electrostatic discharge procedures (ESD) when handling the drive and circuit boards.

Failure to comply may result in ESD damage to the drive circuitry.

Follow cooling fan replacement instructions. The cooling fan cannot operate properly when it is installed incorrectly and could seriously damage the drive.

Follow the instructions in this manual to replace the cooling fan, making sure that the label is on top before inserting the cooling fan into the drive. To ensure maximum useful product life, replace both cooling fans when performing maintenance.

Never connect or disconnect the motor from the drive while the drive is outputting voltage.

Improper equipment sequencing could result in damage to the drive.

Do not use unshielded cable for control wiring.

Failure to comply may cause electrical interference resulting in poor system performance. Use shielded, twisted-pair wires and ground the shield to the ground terminal of the drive.

Do not allow unqualified personnel to use the product.

Failure to comply could result in damage to the drive or braking circuit.

Maintenance, inspection, and replacement of parts must be performed only by authorized personnel familiar with installation, adjustment and maintenance of AC drives.

Do not modify the drive circuitry.

Failure to comply could result in damage to the drive and will void warranty.

Yaskawa is not responsible for any modification of the product made by the user. This product must not be modified.

Check all the wiring to ensure that all connections are correct after installing the drive and connecting any other devices.

Failure to comply could result in damage to the drive.

Comply with proper wiring practices.

The motor may run in reverse if the phase order is backward.

Connect motor input terminals U, V and W to drive output terminals U/T1, V/T2, and W/T3. The phase order for the drive and motor should match.

Frequently switching the drive power supply to stop and start the motor can damage the drive.

To get the full performance life out of the electrolytic capacitors and circuit relays, refrain from switching the drive power supply off and on more than once every 30 minutes. Frequent use can damage the drive. Use the drive to stop and start the motor.

Do not operate damaged equipment.

Failure to comply could result in further damage to the equipment.

Do not connect or operate any equipment with visible damage or missing parts.

NOTICE
Do not heat or throw the battery into fire.
The battery remains in use even when power to the drive has been shut off. Be sure to also remove the battery in the HOA keypad when the drive will be shut off for long periods of time.
A dead battery left inside the HOA keypad may leak and damage the keypad and drive. Be sure to replace the battery with a new one immediately after the expected lifespan has passed or when the “bAT” error is displayed on the HOA keypad.
Be sure to observe the Perchlorate Best Management Practices (BMPs).
BMPs apply to primary lithium (manganese dioxide) coin batteries sold or distributed in California. Perchlorate Material special handling may apply, please refer to: www.dtsc.ca.gov/hazardouswaste/perchlorate.

2.2 Inspection

Power electronics have limited life and may exhibit changes in characteristics or performance deterioration after years of use under normal conditions. To help avoid such problems, it is important to perform preventive maintenance and periodic inspection on the drive.

Drives contain a variety of power electronics such as power transistors, semiconductors, capacitors, resistors, fans, and relays. The electronics in the drive serve a critical role in maintaining proper motor control.

Follow the inspection lists provided in this chapter as a part of a regular maintenance program.

Note: The drive will require more frequent inspection if it is placed in harsh environments, such as:

- High ambient temperatures
- Frequent starting and stopping
- Fluctuations in the AC supply or load
- Excessive vibrations or shock loading
- Dust, metal dust, salt, sulfuric acid, chlorine atmospheres
- Poor storage conditions.

Perform the first equipment inspection one to two years after installation.

◆ Recommended Daily Inspection

Table 2.1 outlines the recommended daily inspection for Yaskawa drives. Check the following items on a daily basis to avoid premature deterioration in performance or product failure. Copy this checklist and mark the “Checked” column after each inspection.

Table 2.1 General Recommended Daily Inspection Checklist

Inspection Category	Inspection Points	Corrective Action	Checked
Motor	Inspect for abnormal oscillation or noise coming from the motor.	• Check the load coupling. • Measure motor vibration. • Tighten all loose components.	
Cooling	Inspect for abnormal heat generated from the drive or motor and visible discoloration.	Check for the following: • Excessive load. • Loose connections. • Dirty heatsink or motor. • Ambient temperature.	
	Inspect drive cooling fan and circulation fan operation.	Check for the following: • Clogged or dirty fan. • Correct Fan operation parameter setting.	
Environment	Verify the drive environment complies with the specifications listed in the Specifications chapter in the User Manual packaged with the drive.	Eliminate the source of contaminants or correct poor environment.	
Load	The drive output current should not be higher than the motor or drive rating for an extended period of time.	Check for the following: • Excessive load. • Correct motor parameter settings.	
Power Supply Voltage	Check main power supply and control voltages.	• Correct the voltage or power supply to within nameplate specifications. • Verify all main circuit phases.	

◆ Recommended Periodic Inspection

Table 2.2 outlines the recommended periodic inspections for Yaskawa drive installations. Although periodic inspections should generally be performed once a year; the drive may require more frequent inspection in harsh environments or with rigorous use. Operating and environmental conditions, along with experience in each application, will determine the actual inspection frequency for each installation. Periodic inspection will help to avoid premature deterioration in performance or product failure. Copy this checklist and mark the "Checked" column after each inspection.

■ Periodic Inspection

WARNING! *Electrical Shock Hazard. Do not inspect, connect, or disconnect any wiring while the power is on. Failure to comply can result in serious personal injury. Before servicing, disconnect all power to the equipment. The internal capacitor remains charged even after the power supply is turned off. The charge indicator LED will extinguish when the DC bus voltage is below 50 Vdc. To prevent electric shock, wait for at least the time specified on the warning label; after all indicators are OFF, measure for unsafe voltages to confirm the drive is safe prior to servicing.*

Table 2.2 Periodic Inspection Checklist

Inspection Area	Inspection Points	Corrective Action	Checked
Main Circuit Periodic Inspection			
General	• Inspect equipment for discoloration from overheating or deterioration. • Inspect for damaged or deformed parts.	• Replace damaged components as required. • The drive has few serviceable parts and may require complete drive replacement.	
	Inspect for dirt, foreign particles, or dust collection on components.	• Inspect enclosure door seal if used. • Use dry air to clear away foreign matter. Use a pressure of 39.2×10^4 to 58.8×10^4 Pa (4 - 6 kg•cm^2) (57 to 85 psi). • Replace components if cleaning is not possible.	
Conductors and Wiring	• Inspect wiring and connections for discoloration, damage, or heat stress. • Inspect wire insulation and shielding for wear.	Repair or replace damaged wiring.	
Terminals	Inspect terminals for stripped, damaged, or loose connections.	Tighten loose screws and replace damaged screws or terminals.	
Relays and Contactors	• Inspect contactors and relays for excessive noise during operation. • Inspect coils for signs of overheating such as melted or cracked insulation.	• Check coil voltage for overvoltage or undervoltage conditions. • Replace damaged removable relays, contactors, or circuit board.	
Braking Resistors	Inspect for discoloration of heat stress on or around resistors.	• Minor discoloration may be acceptable. • Check for loose connections if discoloration exists.	
Electrolytic Capacitor	• Inspect for leaking, discoloration, or cracks. • Check if the cap has come off, for any swelling, or if the sides have burst open.	The drive has few serviceable parts and may require complete drive replacement.	
Diode, IGBT (Power Transistor)	Inspect for dust or other foreign material collected on the surface.	Use dry air to clear away foreign matter. Use a pressure of 39.2×10^4 to 58.8×10^4 Pa (4 - 6 kg•cm^2) (57 to 85 psi).	
Motor Periodic Inspection			
Operation Check	Check for increased vibration or abnormal noise.	Stop the motor and contact qualified maintenance personnel as required.	
Control Circuit Periodic Inspection			
General	• Inspect terminals for stripped, damaged, or loose connections. • Make sure all terminals have been properly tightened.	• Tighten loose screws and replace damaged screws or terminals. • If terminals are integral to a circuit board, then board or drive replacement may be required.	
Circuit Boards	Check for any odor, discoloration, and rust. Make sure connections are properly fastened and that no dust or oil mist has accumulated on the surface of the board.	• Fix any loose connections. • If an antistatic cloth or vacuum plunger cannot be used, replace the board. • Do not use any solvents to clean the board. • Use dry air to clear away foreign matter. Use a pressure of 39.2×10^4 to 58.8×10^4 Pa (4 - 6 kg•cm^2) (57 to 85 psi). The drive has few serviceable parts and may require complete drive replacement.	

Inspection Area	Inspection Points	Corrective Action	Checked
Cooling System Periodic Inspection			
Cooling Fan, Circulation Fan, Control Board Cooling Fan	• Check for abnormal oscillation or unusual noise. • Check for damaged or missing fan blades.	• Replace as required. • ***Refer to Drive Cooling Fans on page 169*** for information on cleaning or replacing the fan.	
Heatsink	Inspect for dust or other foreign material collected on the surface.	Use dry air to clear away foreign matter. Use a pressure of 39.2×10^4 to 58.8×10^4 Pa (4 - 6 kg•cm^2) (57 to 85 psi).	
Air Duct	Inspect air intake and exhaust openings. They must be free from obstruction and properly installed.	• Visually inspect the area. • Clear obstructions and clean air duct as required.	
Display Periodic Inspection			
HOA Keypad	• Make sure data appears on the display properly. • Inspect for dust or other foreign material that may have collected on surrounding components.	• Contact the nearest sales office if there is any trouble with the display or keypad. • Clean the HOA keypad.	

2.3 Periodic Maintenance

The drive has Maintenance Monitors that keep track of component wear. This feature provides advance maintenance warning and eliminates the need to shut down the entire system for unexpected problems. The drive allows the user to check predicted maintenance periods for the components listed below.

- Cooling Fan, Circulation Fan, Control Board Cooling Fan
- Electrolytic Capacitors
- Inrush Prevention Circuit
- IGBTs

For replacement parts, contact the distributor where the drive was purchased or contact Yaskawa directly.

◆ Replacement Parts

Table 2.3 contains the estimated performance life of components that require replacement during the life of the drive. Only use Yaskawa replacement parts for the appropriate drive model and revision.

Table 2.3 Estimated Performance Life

Component	Estimated Performance Life
Cooling Fan, Circulation Fan	5 years
Electrolytic Capacitors	5 years <1>

<1> The drive has few serviceable parts and may require complete drive replacement.

NOTICE: *Estimated performance life based on specific usage conditions. These conditions are provided for the purpose of replacing parts to maintain performance. Some parts may require more frequent replacement due to poor environments or rigorous use.*
Usage conditions for estimated performance life:
Ambient temperature: Yearly average of 30 °C (IP20/NEMA Type 1 enclosure, external heatsink) or 40 °C (IP00/Open-Type enclosure)
Load factor: 80% maximum
Operation time: 24 hours a day

■ Performance Life Monitors Maintenance Monitors

The drive calculates the maintenance period for components that may require replacement during the life of the drive. A percentage of the maintenance period is displayed on the HOA keypad by viewing the appropriate monitor parameter.

When the maintenance period reaches 100%, there is increased risk that the drive may malfunction. Yaskawa recommends checking the maintenance period regularly to ensure maximum performance life.

Refer to Recommended Periodic Inspection on page 164 for more details.

Table 2.4 Performance Life Monitors Used for Component Replacement

Parameter	Component	Contents
U4-03	Cooling Fan Circulation Fan Control Board Cooling Fan	Displays the accumulated operation time of the fan, from 0 to 99999 hours. This value is automatically reset to 0 once it reaches 99999.
U4-04		Displays the accumulated fan operation time as a percentage of the specified maintenance period.
U4-05	DC Bus Capacitors	Displays the accumulated time the capacitors are used as a percentage of the specified maintenance period.
U4-06	Inrush (pre-charge) Relay	Displays the number of times the drive is powered up as a percentage of the performance life of the inrush circuit.

■ Alarm Outputs for Maintenance Monitors

An output can be set up to inform the user when a specific components has neared its expected performance life.

When one of multi-function digital output terminals has been assigned the maintenance monitor function (H2-□□ = 2F), the terminal will close when the cooling fan, DC bus capacitors, or DC bus pre-charge relay reach 90% of the expected performance life, or when the IGBTs have reached 50% of their expected performance life. Additionally the HOA keypad will display an alarm like shown in ***Table 2.5*** to indicate the specific components that may need maintenance.

Table 2.5 Maintenance Alarms

HOA Keypad Alarm Display		Function	Corrective Action
LT-1 <1>	LT-1	The cooling fans have reached 90% of their designated life time.	Replace the cooling fan.
LT-2 <1>	LT-2	The DC bus capacitors have reached 90% of their designated life time.	Contact a Yaskawa representative or the nearest Yaskawa sales office on possible drive replacement.
LT-3 <1>	LT-3	The DC bus charge circuit has reached 90% of its designated life time.	Contact a Yaskawa representative or the nearest Yaskawa sales office on possible drive replacement.

<1> This alarm message will be output only if the Maintenance Monitor function is assigned to one of the digital outputs (H2-□□ = 2F). The alarm will also trigger a digital output that is programmed for alarm indication (H2-□□ = 10).

<2> This alarm message will always be output, even if the Maintenance Monitor function is not assigned to any of the digital outputs (H2-□□ = 2F). The alarm will also trigger a digital output that is programmed for alarm indication (H2-□□ = 10).

■ Related Drive Parameters

Use parameters o4-03, o4-05, o4-07, and o4-09 to reset a Maintenance Monitor to zero after replacing a specific component. ***Refer to Parameter List on page 207*** for details on parameter settings.

NOTICE: *If these parameters are not reset after the corresponding parts have been replaced, the Maintenance Monitor function will continue to count down the performance life from the value that was reached with the old part. If the Maintenance Monitor is not reset, the drive will not have the correct value of the performance life for the new component.*

2.4 HOA Keypad Battery Replacement

The HOA keypad contains a monitor battery that allows the user to check drive functions. The battery requires periodic replacement because the lifespan of the battery is shorter than the performance life of the HOA keypad.

WARNING! *Fire Hazard. Properly handle the HOA keypad battery. Improper use of the battery may cause fire by explosion and injury. Correctly install the battery, paying attention to polarity (+/-). Do not charge the battery or improperly disassemble the HOA keypad.*

When replacing the battery, use a Hitachi Maxell CR1220 Lithium Manganese Dioxide Battery or an equivalent battery with the following specifications:

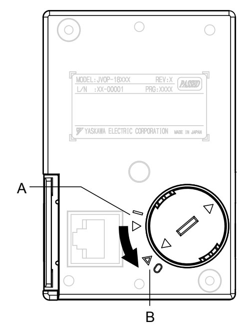
- Nominal Voltage 3 V
- Operating Temperature Range -20 °C to +85 °C
- Nominal battery life of 2 years (ambient temperature of +20 °C).

NOTICE: *Do not heat or throw the battery into fire. The battery remains in use even when power to the drive has been shut off. Be sure to also remove the battery in the HOA keypad when the drive will be shut off for long periods of time.*
A dead battery left inside the HOA keypad may leak and damage the keypad and drive. Replace the battery with a new one immediately after the expected lifespan has passed or when the “bAT” error is displayed on the HOA keypad.

NOTICE: *Observe Perchlorate Best Management Practices (BMPs). BMPs apply to primary lithium (manganese dioxide) coin batteries sold or distributed in California. Perchlorate Material special handling may apply, please refer to: www.dtsc.ca.gov/hazardouswaste/perchlorate.*

◆ Replacing the Battery

1. Shut off the power to the drive and remove the HOA keypad.
2. Insert the tip of a straight-edge screwdriver into the slot in the middle of the battery cover and turn the cover counter-clockwise to remove the cover.



A – Closed **B – Open**

Figure 2.1 Remove the Battery Cover

3. Remove the battery from the HOA keypad.
4. Correctly install the new battery.

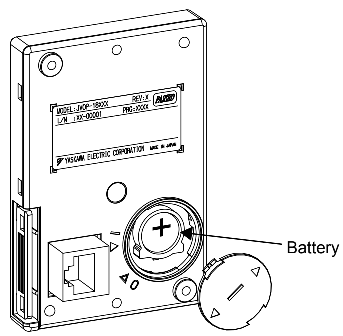


Figure 2.2 Install the Battery

5. Replace the battery cover on the HOA keypad, insert the tip of a straight-edge screwdriver, and turn the cover clockwise to close.
6. Replace the HOA keypad onto the drive.
7. Apply power to the drive and set o4-17 to 1 to set the Real Time Clock (RTC). Refer to the User Manual packaged with the drive for details on setting the RTC.

2.5 Drive Cooling Fans

NOTICE: *Follow cooling fan replacement instructions. The cooling fan cannot operate properly when installed incorrectly and could seriously damage the drive. To ensure maximum useful product life, replace all cooling fans when performing maintenance.*

Contact a Yaskawa representative or the nearest Yaskawa sales office to order replacement cooling fans as required.

For drives with multiple cooling fans, replace all the fans when performing maintenance to ensure maximum product performance life.

◆ Number of Cooling Fans

Model	Cooling Fans	Circulation Fans	Control Board Cooling Fans	Page
Three-Phase 200 V Class				
2A0011	1	–	–	172
2A0017	1	–	–	
2A0024	1	–	–	
2A0031	1	–	–	
2A0046	1	–	–	
2A0059	1	–	–	
2A0075	2	–	–	176
2A0088	2	–	–	
2A0114	2	–	–	
2A0143	2	–	–	186
2A0169	2	–	–	
2A0211	2	–	–	
2A0273	2	–	–	
2A0343	3	1	–	198
2A0396	3	1	–	
Three-Phase 400 V Class				
4A0005	1	–	–	172
4A0008	1	–	–	
4A0011	1	–	–	
4A0014	1	–	–	
4A0021	1	–	–	
4A0027	1	–	–	
4A0034	1	–	–	
4A0040	1	–	–	
4A0052	2	–	–	176
4A0065	2	–	–	
4A0077	2	–	–	
4A0096	2	–	–	
4A0124	1	–	–	180
4A0156	2	–	–	186
4A0180	2	–	–	
4A0240	2	–	–	
4A0302	2	–	–	192
4A0361	3	1	–	200
4A0414	3	2	2	202
4A0480	3	2	2	
4A0590	3	2	2	

◆ Cooling Fan Component Names

WARNING! *Electrical Shock Hazard. Do not connect or disconnect wiring while the power is on. Failure to comply can result in serious personal injury. Before servicing the drive, disconnect all power to the equipment. The internal capacitor remains charged even after the power supply is turned off. After shutting off the power, wait for at least the amount of time specified on the drive before touching any components.*

CAUTION! *Burn Hazard. Do not touch a hot drive heatsink. Failure to comply could result in minor or moderate injury. Shut off the power to the drive when replacing the cooling fan. To prevent burns, wait at least 15 minutes and ensure the heatsink has cooled down.*

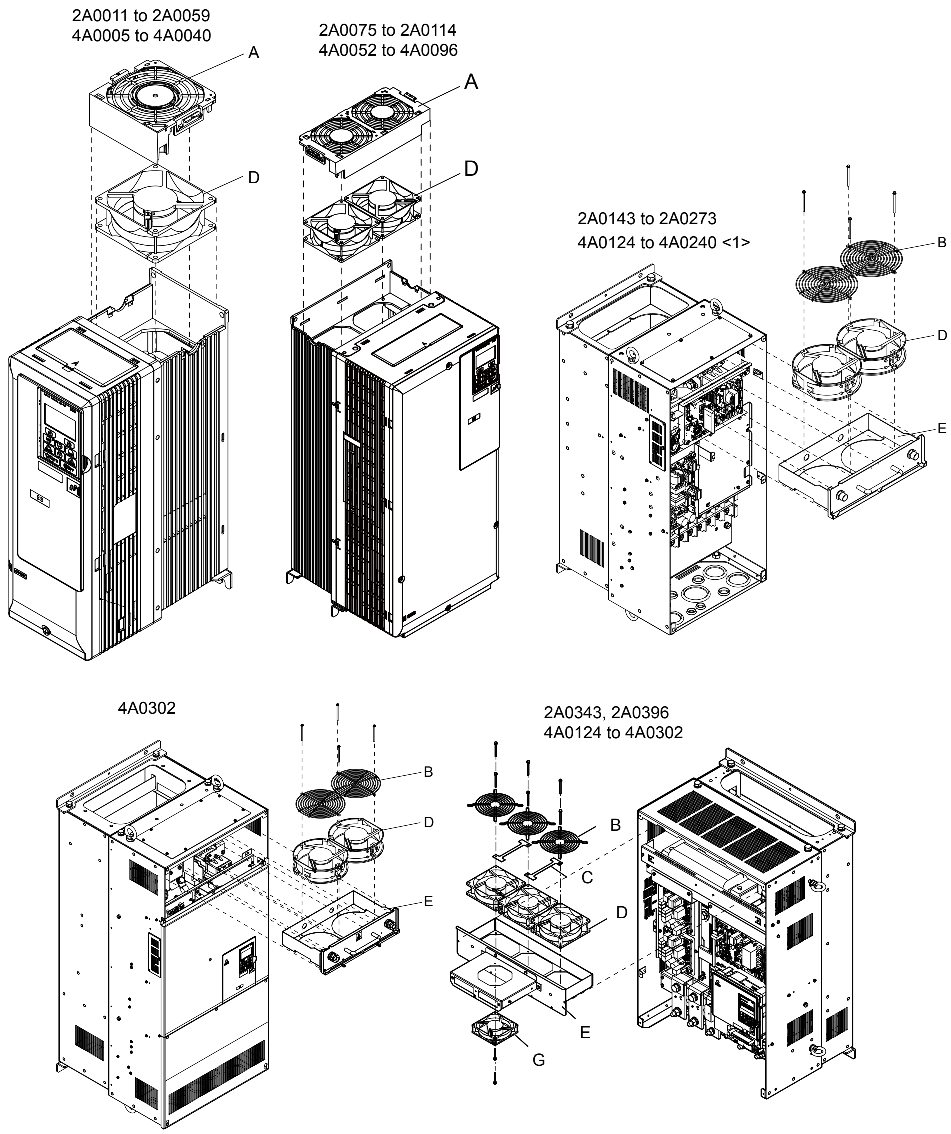
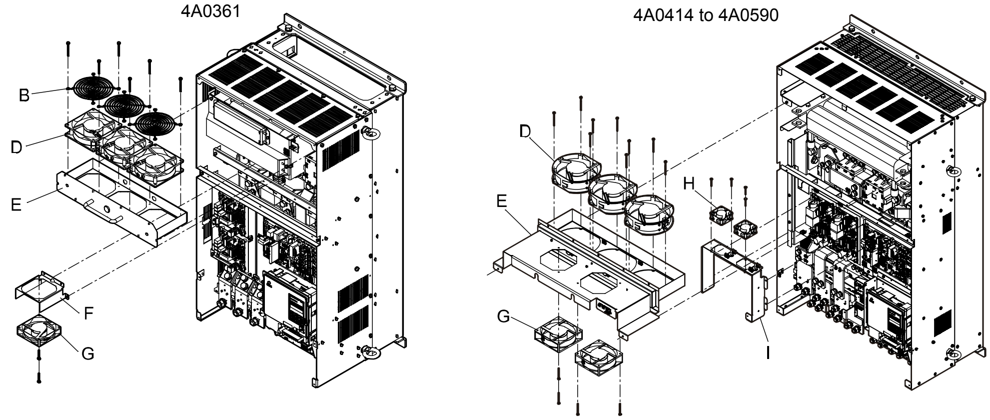


Figure 2.3 Cooling Fan Component Names

<1> Drive model 4A0124 has a single cooling fan.

Remaining models can be found on the following page.



A – Fan finger guard
B – Fan guard
C – Cable cover
D – Cooling fan
E – Fan bracket
F – Circulation fan base
G – Circulation fan
H – Circuit board cooling fan
I – Circuit board cooling fan unit case

Figure 2.4 Cooling Fan Component Names (Continued)

◆ Cooling Fan Replacement: 2A0011 to 2A0059 and 4A0005 to 4A0040

WARNING! *Electrical Shock Hazard. Do not connect or disconnect wiring while the power is on. Failure to comply can result in serious personal injury. Before servicing, disconnect all power to the equipment. The internal capacitor remains charged even after the power supply is turned off. The charge indicator LED will extinguish when the DC bus voltage is below 50 Vdc. To prevent electric shock, wait for at least the time specified on the warning label, once all indicators are OFF, measure for unsafe voltages to confirm the drive is safe prior to servicing.*

CAUTION! *Burn Hazard. Do not touch a hot drive heatsink. Failure to comply could result in minor or moderate injury. Shut off the power to the drive when replacing the cooling fan. To prevent burns, wait at least 15 minutes and ensure the heatsink has cooled down.*

NOTICE: *Follow cooling fan replacement instructions. Improper fan replacement could cause damage to equipment. Make sure the fan is facing upwards when installing the replacement fan into the drive. Replace all fans when performing maintenance to help ensure maximum useful product life.*

■ Removing the Cooling Fan Finger Guard and Cooling Fan: 2A0011 to 2A0059 and 4A0005 to 4A0040

1. Depress the right and left sides of the fan cover tabs and pull upward. Remove the fan cover from the top of the drive. The following figure illustrates a drive with a single cooling fan.

Note: The cooling fan and finger guard are mechanically joined.

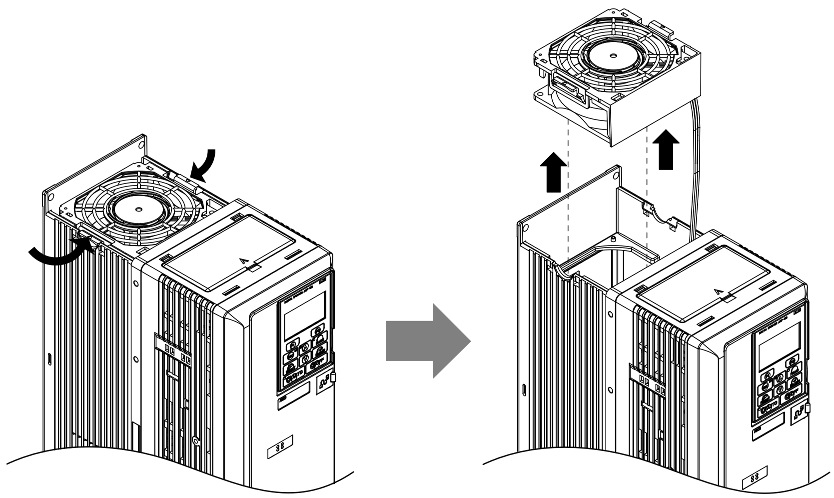


Figure 2.5 Remove the Cooling Fan Finger Guard: 2A0011 to 2A0059 and 4A0005 to 4A0040

2. Unplug the protective tube and relay connector from the cooling fan unit.

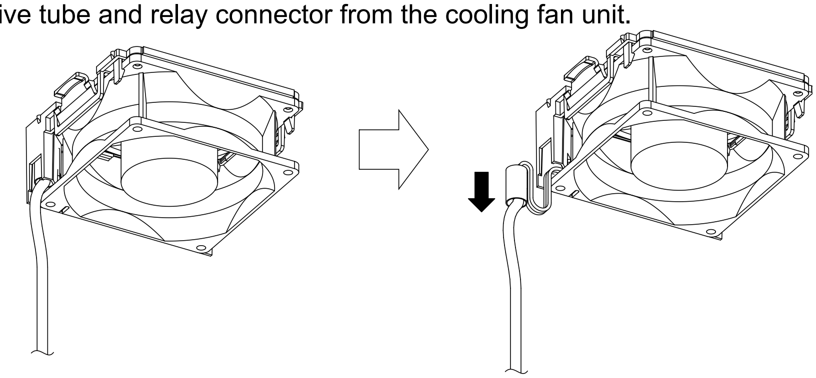
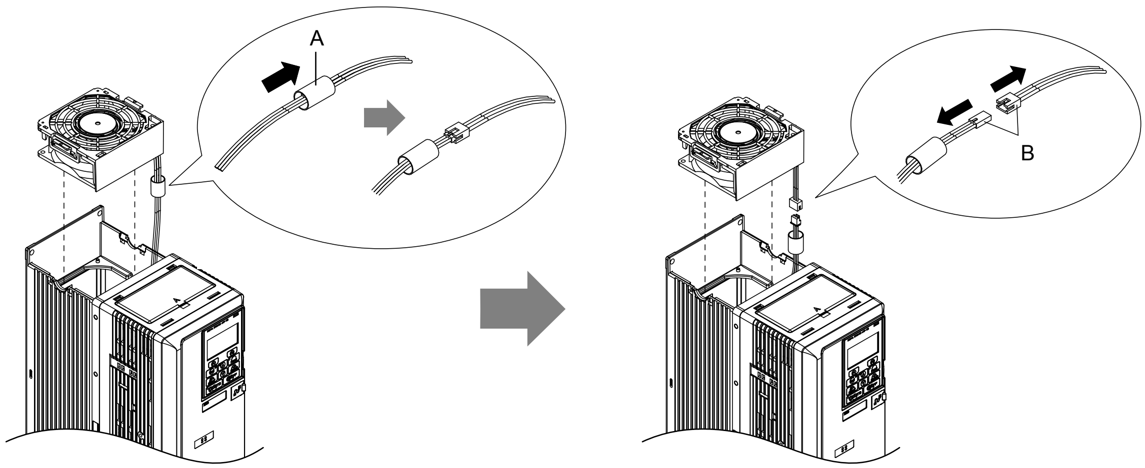


Figure 2.6 Unplug the Protective Tube and Relay Connector: 2A0011 to 2A0059 and 4A0005 to 4A0040

3. Slide the protective tube towards the cooling fan to expose the connector. Unplug the connector.



A – Protective tube **B – Fan connector**

Figure 2.7 Remove the Fan Connector: 2A0011 to 2A0059 and 4A0005 to 4A0040

4. Pull back on the hook to free the cooling fan unit. Lift the cooling fan diagonally to remove it from the drive.

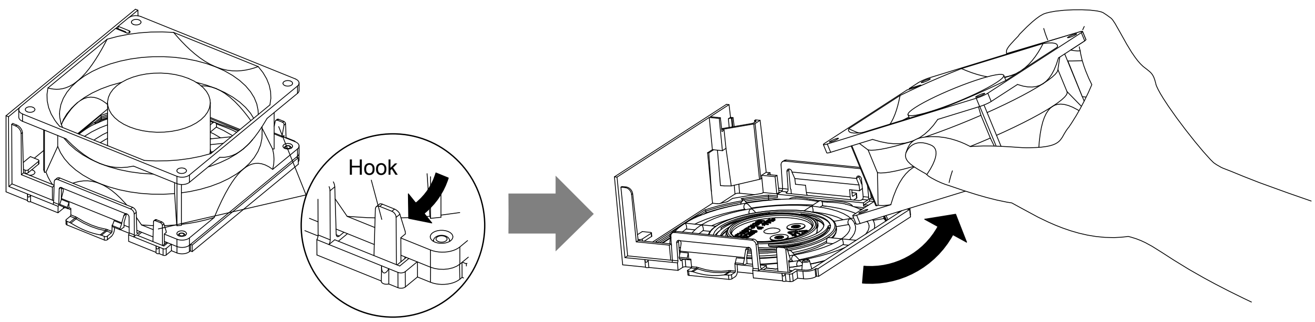


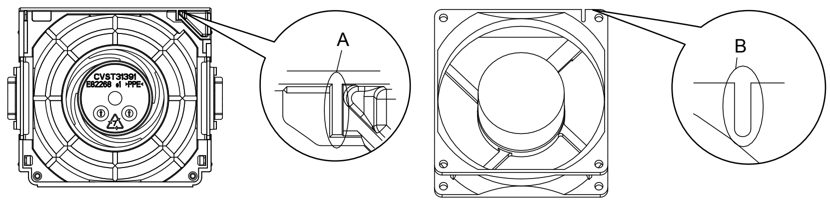
Figure 2.8 Remove the Cooling Fan: 2A0011 to 2A0059 and 4A0005 to 4A0040

■ Installing the Cooling Fan: 2A0011 to 2A0059 and 4A0005 to 4A0040

NOTICE: *Prevent Equipment Damage. Follow cooling fan replacement instructions. Improper cooling fan replacement could result in damage to equipment. When installing the replacement cooling fan into the drive, make sure the fan is facing upwards. To ensure maximum useful product life, replace all cooling fans when performing maintenance.*

Reverse the procedure described above to reinstall the cooling fan.

1. Line up the small alignment notch on the cooling fan and the corresponding protrusion on the fan finger guard.



A – Protrusion

B – Alignment notch

Figure 2.9 Alignment Notch and Protrusion: 2A0011 to 2A0059 and 4A0005 to 4A0040

2. Insert the cooling fan diagonally into the fan finger guard so the bosses and holes match. It should click into place.

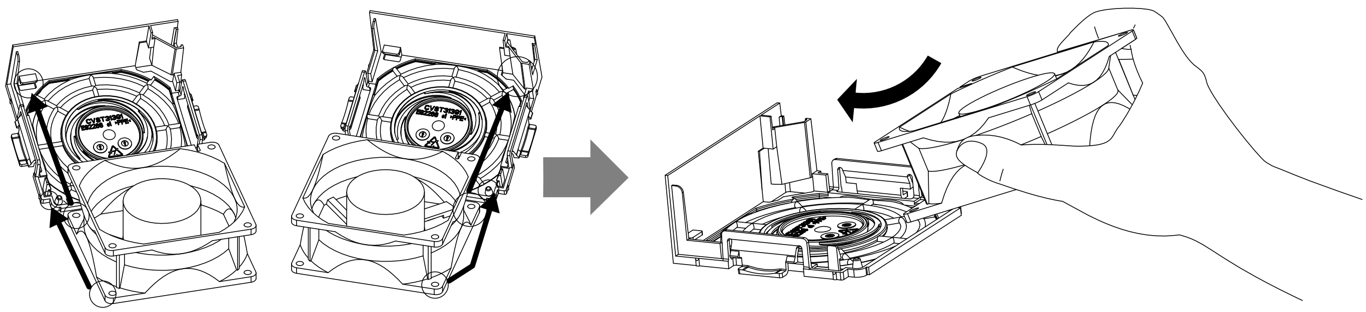
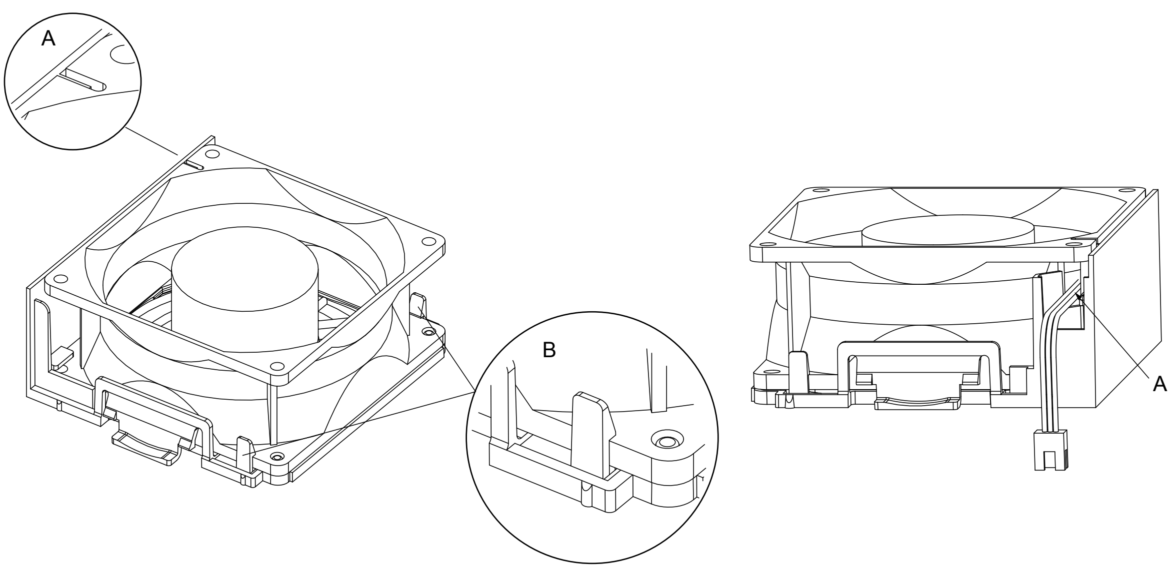


Figure 2.10 Insert the Cooling Fan into the Fan Finger Guard: 2A0011 to 2A0059 and 4A0005 to 4A0040

3. Make sure that the cooling fan has been correctly inserted into the fan finger guard.



A – Alignment notches should fit into the corresponding protrusions.

B – Hooks should hold the cooling fan tightly, and the bosses should align properly with the corresponding holes.

Figure 2.11 Check the Placement of the Fan Finger Guard: 2A0011 to 2A0059 and 4A0005 to 4A0040

4. Plug the fan connector, then slide the protective cover over the connector.

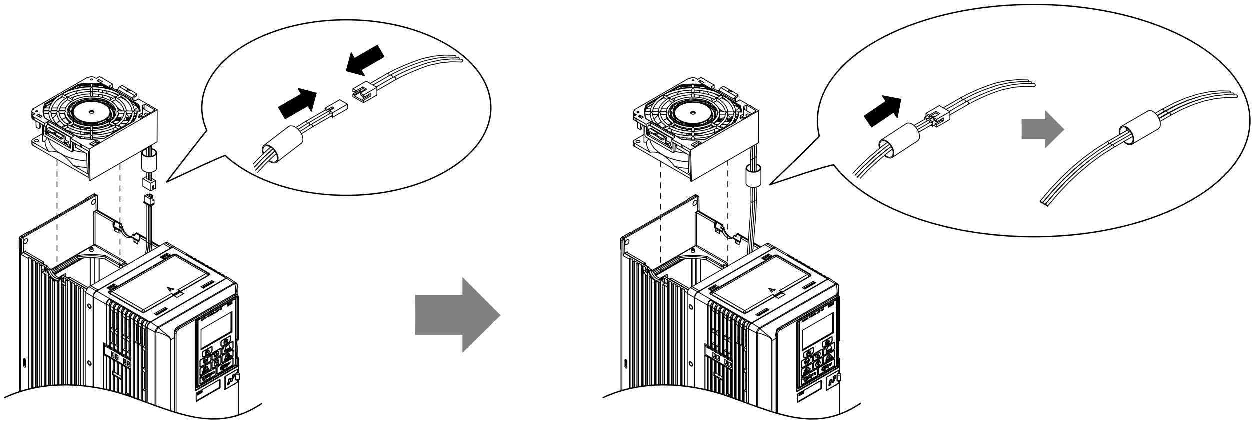


Figure 2.12 Plug the Fan Connector: 2A0011 to 2A0059 and 4A0005 to 4A0040

5. Push the fan connector and protective tube into the fan finger guard.

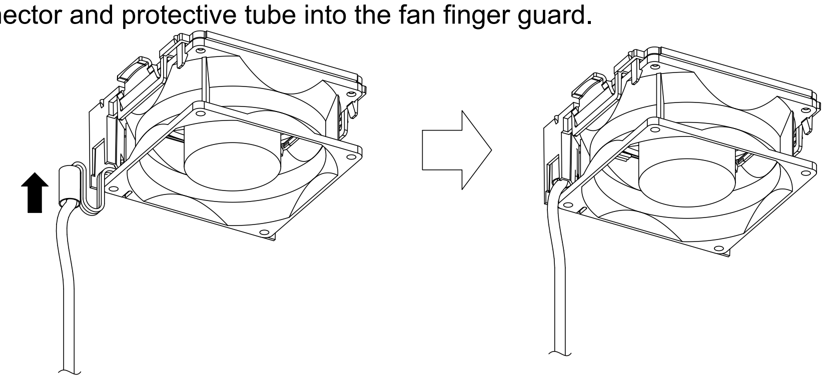


Figure 2.13 Placement of Fan Connector and Protective Tube: 2A0011 to 2A0059 and 4A0005 to 4A0040

6. While pressing in on the hooks on the left and right sides of the fan finger guard, guide the fan finger guard until it clicks into place.

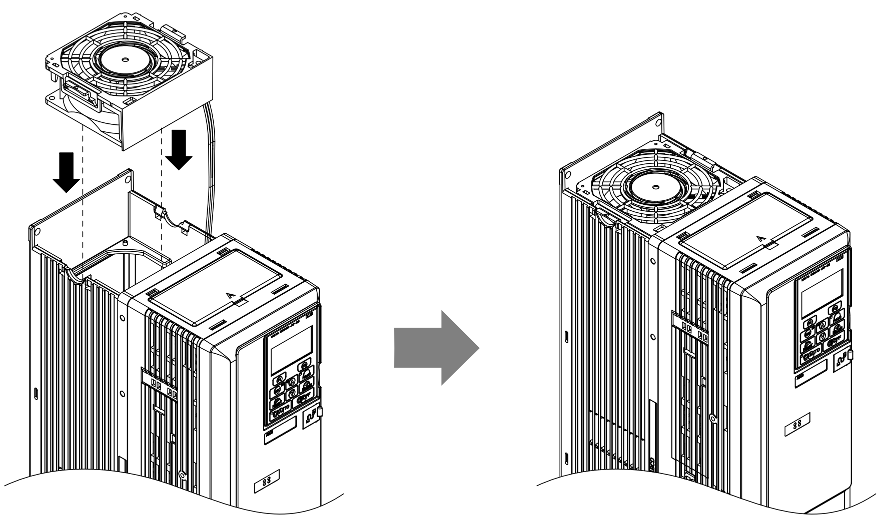


Figure 2.14 Reattach the Cooling Fan and Fan Finger Guard: 2A0011 to 2A0059 and 4A0005 to 4A0040

◆ Cooling Fan Replacement: 2A0075 to 2A0114 and 4A0052 to 4A0096

WARNING! *Electrical Shock Hazard. Do not connect or disconnect wiring while the power is on. Failure to comply can result in serious personal injury. Before servicing, disconnect all power to the equipment. The internal capacitor remains charged even after the power supply is turned off. The charge indicator LED will extinguish when the DC bus voltage is below 50 Vdc. To prevent electric shock, wait for at least the time specified on the warning label, once all indicators are OFF, measure for unsafe voltages to confirm the drive is safe prior to servicing.*

CAUTION! *Burn Hazard. Do not touch a hot drive heatsink. Failure to comply could result in minor or moderate injury. Shut off the power to the drive when replacing the cooling fan. To prevent burns, wait at least 15 minutes and ensure the heatsink has cooled down.*

NOTICE: *Follow cooling fan and circulation fan replacement instructions. Improper fan replacement may cause damage to equipment. When installing the replacement fan into the drive, make sure the fan is facing upwards. Replace all fans when performing maintenance to help ensure maximum useful product life.*

■ Removing the Cooling Fan Finger Guard and Cooling Fan: 2A0075 to 2A0114 and 4A0052 to 4A0096

1. Depress the right and left sides of the fan finger guard tabs and pull upward. Remove the cooling fan and the finger guard from the top of the drive.

Note: The cooling fan and cooling fan finger guard are mechanically joined.

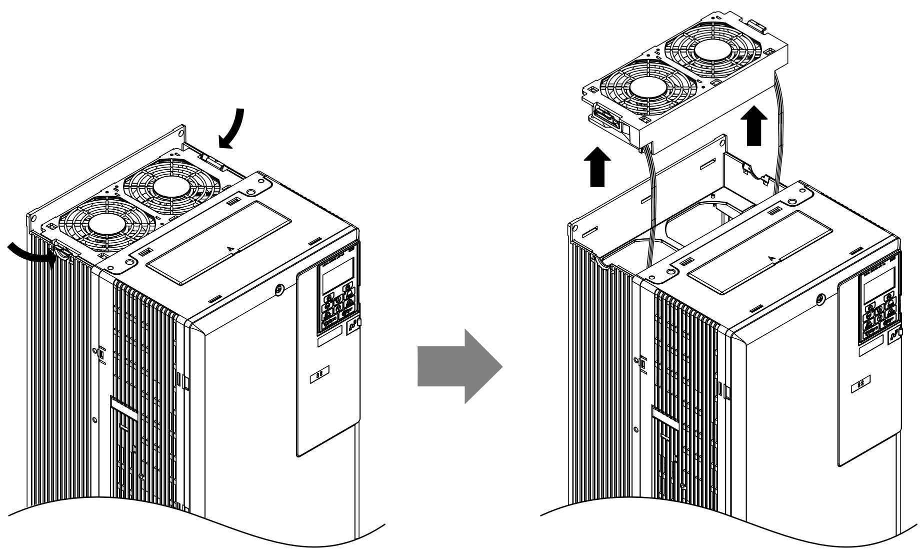


Figure 2.15 Remove the Cooling Fan Finger Guard and Cooling Fan: 2A0075 to 2A0114 and 4A0052 to 4A0096

2. Unplug the protective tube and the fan connector from the cooling fan unit.

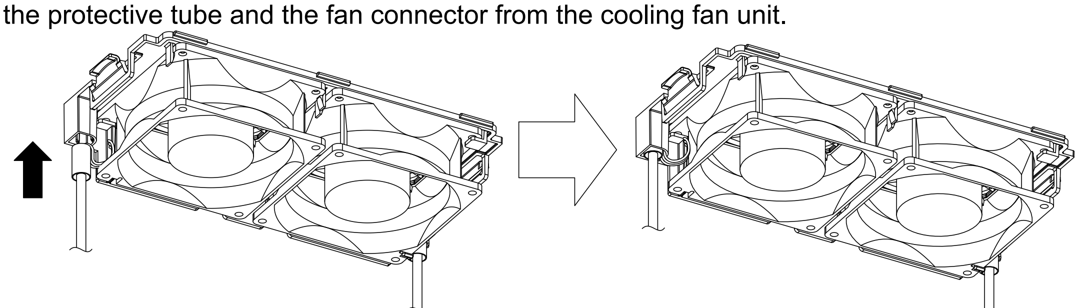
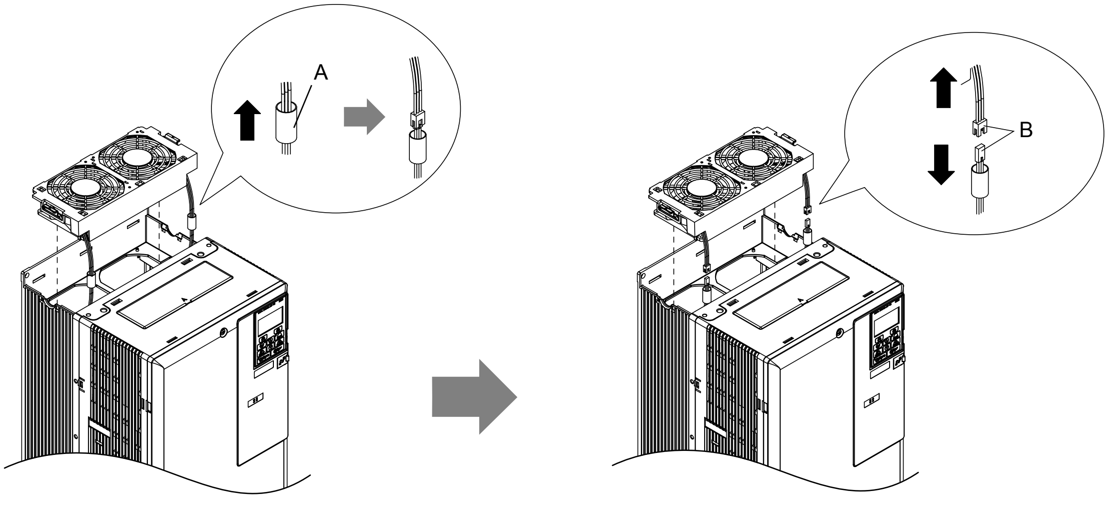


Figure 2.16 Unplug the Protective Tube and Fan Connector: 2A0075 to 2A0114 and 4A0052 to 4A0096

3. Slide the protective tube toward the cooling fan to expose the fan connector, then unplug the connector.



A – Protective tube B – Fan connector

Figure 2.17 Remove the Fan Connector: 2A0075 to 2A0114 and 4A0052 to 4A0096

4. Pull back on the two fan hooks on the **right** side of the cooling fan unit, then lift the **right-side** fan diagonally to remove it from the drive. Repeat the process for the left-side cooling fan unit.

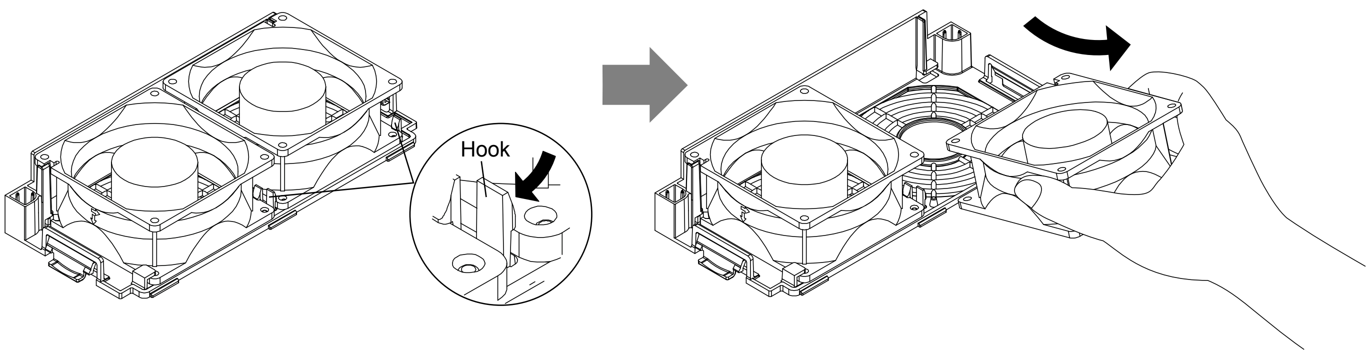


Figure 2.18 Remove the Right-Side Cooling Fan: 2A0075 to 2A0114 and 4A0052 to 4A0096

■ Installing the Cooling Fan: 2A0075 to 2A0114 and 4A0052 to 4A0096

1. Insert the **left-side** cooling fan diagonally into the fan finger guard so that the bosses and holes match. It should click into place.

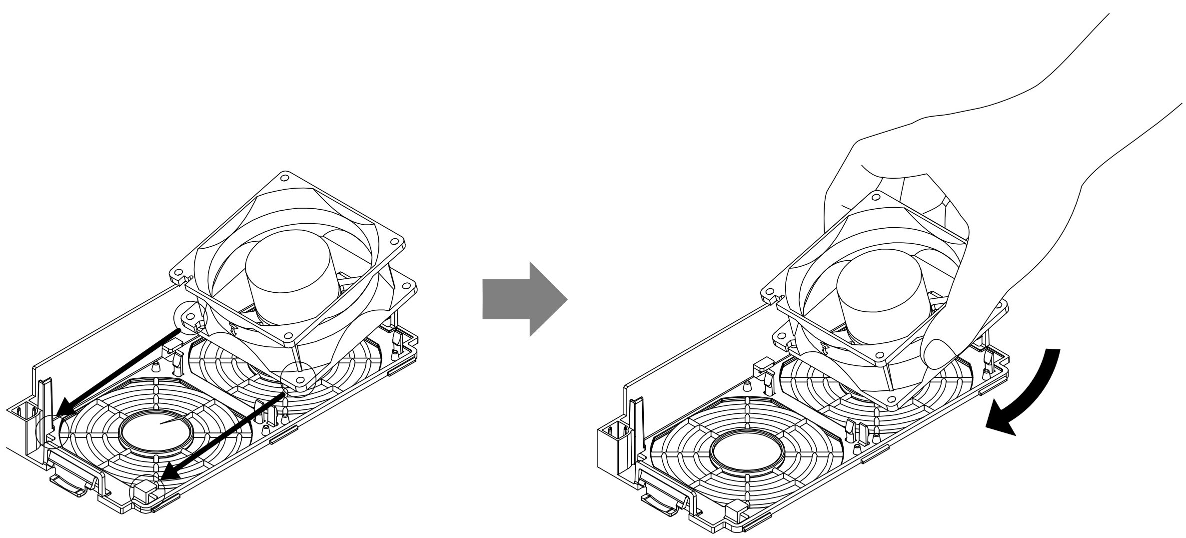
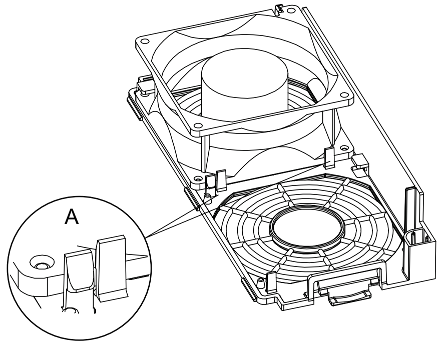


Figure 2.19 Insert the Left-Side Cooling Fan into the Fan Finger Guard: 2A0075 to 2A0114 and 4A0052 to 4A0096

2. Make sure that the **left-side** cooling fan has been inserted correctly into the fan finger guard.



A –Alignment notches should fit into the corresponding protrusions.

Figure 2.20 Check the Placement of the Fan Finger Guard: 2A0075 to 2A0114 and 4A0052 to 4A0096

3. Insert the **right-side** cooling fan diagonally into the fan finger guard. It should click into place.

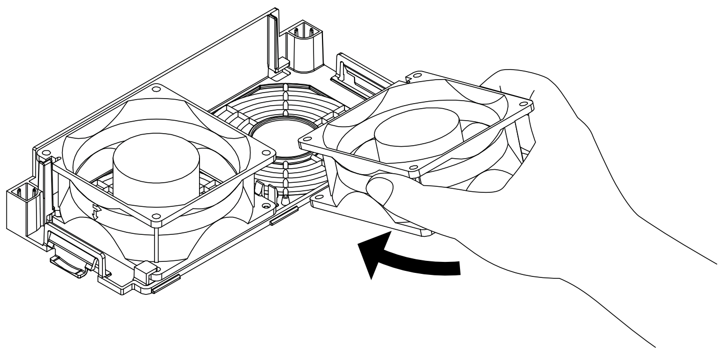
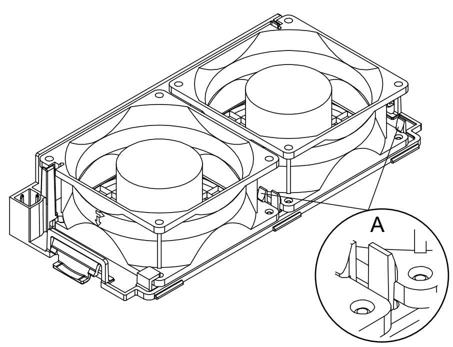


Figure 2.21 Insert the Right-Side Cooling Fan into the Fan Finger Guard: 2A0075 to 2A0114 and 4A0052 to 4A0096

4. Make sure that the **right-side** cooling fan has been inserted correctly into the fan finger guard.



A –Alignment notches should fit into the corresponding protrusions.

Figure 2.22 Check the Placement of the Fan Finger Guard: 2A0075 to 2A0114 and 4A0052 to 4A0096

5. Plug the fan connector, then slide the protective cover over the connector.

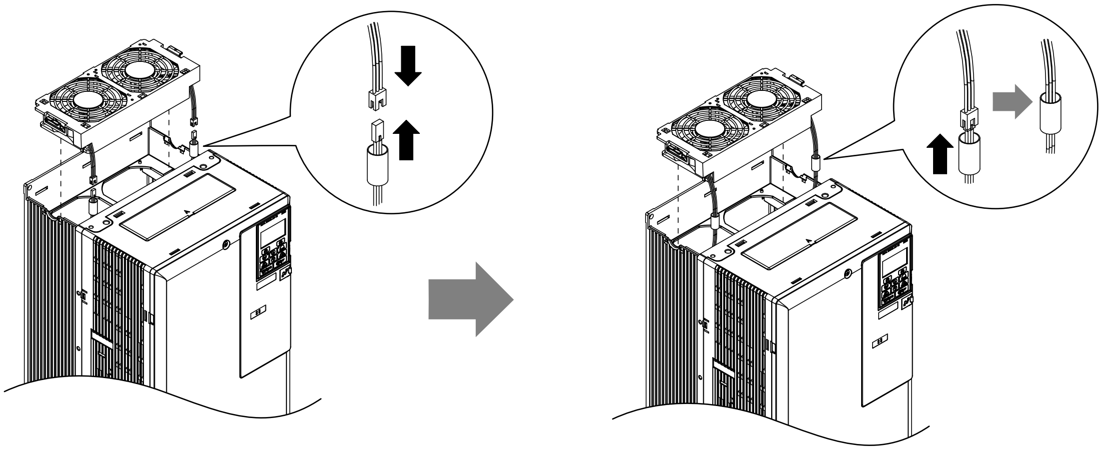


Figure 2.23 Plug the Fan Connector: 2A0075 to 2A0114 and 4A0052 to 4A0096

6. Push the fan connector and protective tube into the fan finger guard.

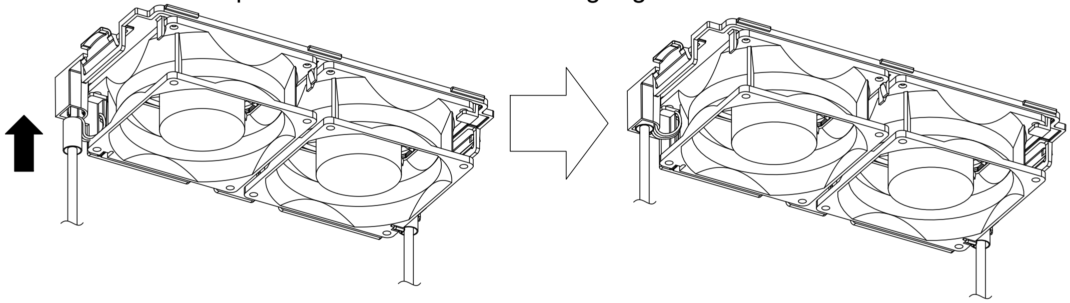


Figure 2.24 Placement of Fan Connector and Protective Tube: 2A0075 to 2A0114 and 4A0052 to 4A0096

7. While pressing in on the hooks on the left and right sides of the fan finger guard, guide the fan finger guard until it clicks into place.

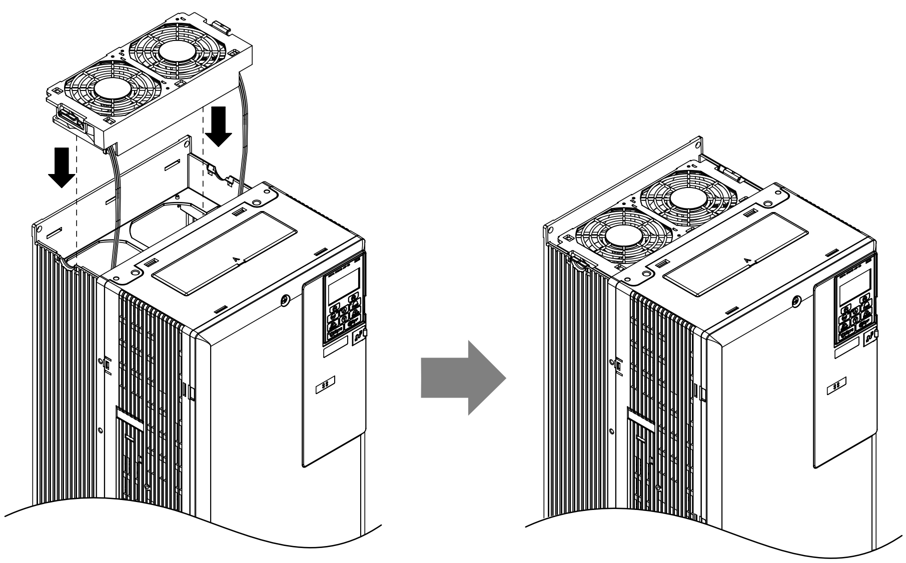


Figure 2.25 Reattach the Cooling Fan and Fan Finger Guard: 2A0075 to 2A0114 and 4A0052 to 4A0096

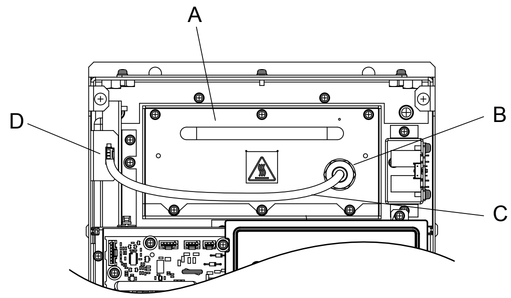
◆ Cooling Fan Replacement: 4A0124

WARNING! *Electrical Shock Hazard. Do not connect or disconnect wiring while the power is on. Failure to comply can result in serious personal injury. Before servicing, disconnect all power to the equipment. The internal capacitor remains charged even after the power supply is turned off. The charge indicator LED will extinguish when the DC bus voltage is below 50 Vdc. To prevent electric shock, wait for at least the time specified on the warning label, once all indicators are OFF, measure for unsafe voltages to confirm the drive is safe prior to servicing.*

CAUTION! *Burn Hazard. Do not touch a hot drive heatsink. Failure to comply could result in minor or moderate injury. Shut off the power to the drive when replacing the cooling fan. To prevent burns, wait at least 15 minutes and ensure the heatsink has cooled down.*

NOTICE: *Follow cooling fan and circulation fan replacement instructions. Improper fan replacement may cause damage to equipment. When installing the replacement fan into the drive, make sure the fan is facing upwards. Replace all fans when performing maintenance to help ensure maximum useful product life.*

■ Removing and Disassembling the Cooling Fan Unit: 4A0124



A – Fan unit
B – Cable gland
C – Fan cable
D – Relay connector

Figure 2.26 Cooling Fan Replacement: 4A0124

1. Remove the terminal cover. Refer to the User Manual packaged with the drive for details on removing the terminal cover.
2. Loosen the four screws on the drive cover.

   CAUTION! *Be sure to keep a firm grip on the drive cover when removing it from the drive. Failure to comply may result in minor or moderate injury from the cover falling.*

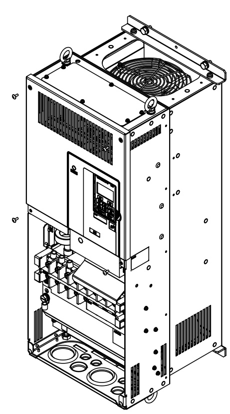


Figure 2.27 Loosen the Screws on the Drive Cover: 4A0124

3. Pull forward on the drive cover to free it from the drive.

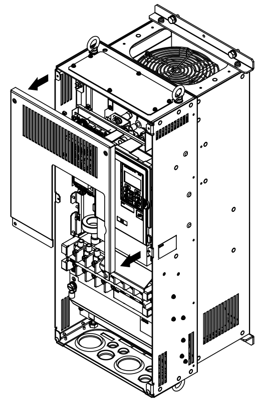
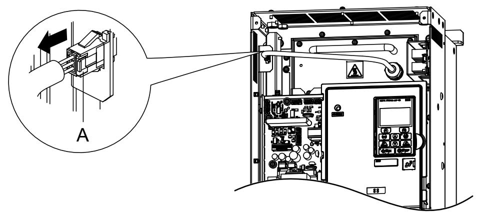


Figure 2.28 Remove the Drive Cover: 4A0124

4. Pull out the relay connector and loosen the cap of the cable gland to remove the fan cable.



A –Relay connector

Figure 2.29 Remove the Relay Connector and Loosen the Cable Gland: 4A0124

5. Remove the screws holding the fan unit in place and slide the cooling fan unit out of the drive.

   CAUTION! *Injury to Personnel. Use two hands to remove the fan unit. Failure to comply may cause the fan unit to fall, resulting in minor to moderate injury.*

Note: Use a magnetized screwdriver when removing the screws to prevent the screws from falling.

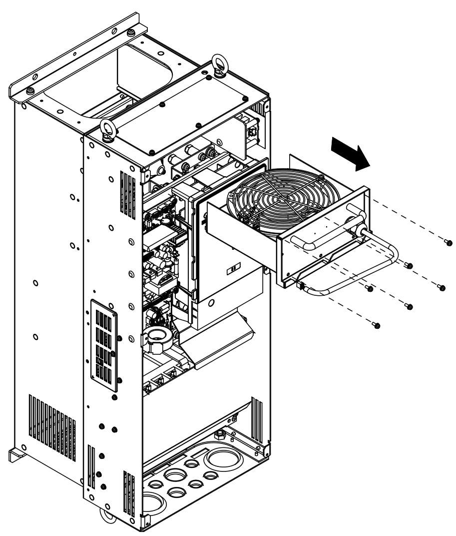
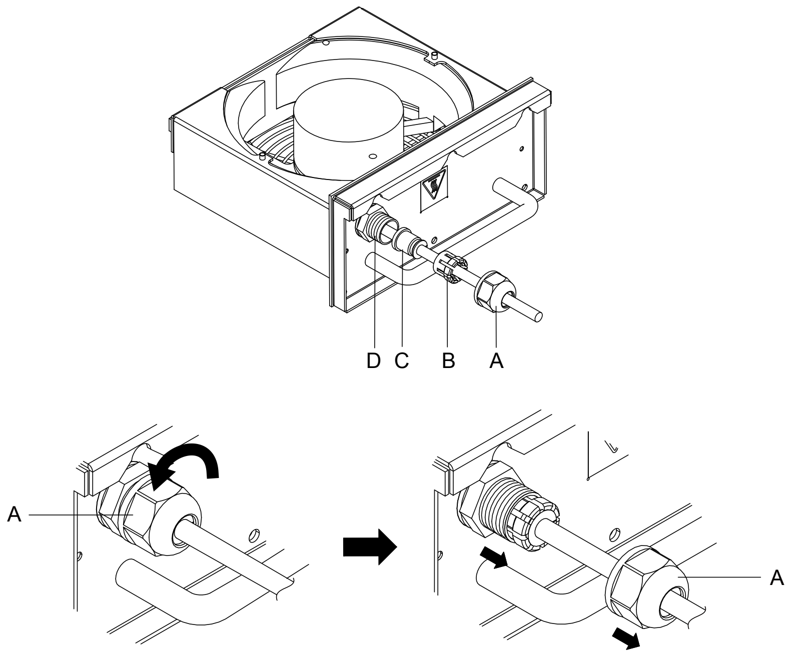


Figure 2.30 Remove the Cooling Fan Unit: 4A0124

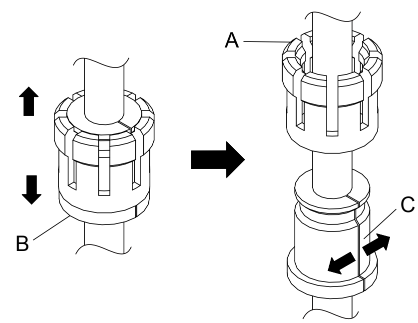
6. Unscrew and remove the sealing nut. Yaskawa recommends using a wrench from AVC Corp. of Japan or equivalent.



A – Sealing nut
B – Clamping claw
C – Sealing insert
D – Cable gland body

Figure 2.31 Cooling Fan Cable Gland: 4A0124

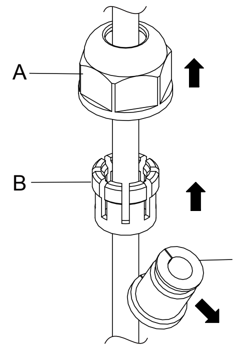
7. Pull the clamp claw and sealing nut insert from the gland body and separate the pieces.



A – Clamping claw
B – Sealing insert
C – Opening

Figure 2.32 Separate the Clamping Claw and Sealing Insert: 4A0124

8. Pull apart the opening on the sealing insert then remove it from the wiring. Slide the sealing nut and clamping claw off the power lines.



A – Sealing nut
B – Sealing insert
C – Clamping claw

Figure 2.33 Remove the Cable Gland: 4A0124

9. Turn the fan unit over and replace the cooling fan. Install the fan so the air flows upward.

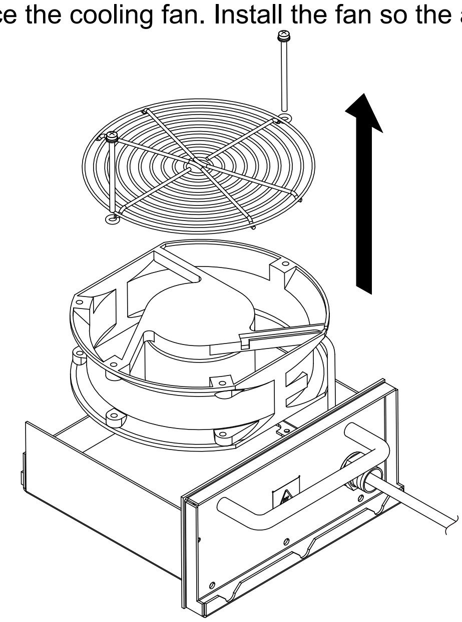
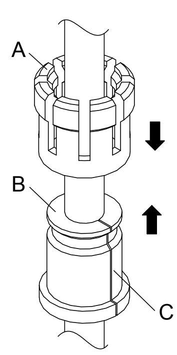


Figure 2.34 Replace the Cooling Fan: 4A0124

■ Installing the Cooling Fan Unit: 4A0124

Note: Do not pinch the fan cable between parts when reassembling the fan unit.

1. Allow the fan cable to pass through the cable gland body, then pull apart the opening in the sealing insert and fit the insert around the cable.

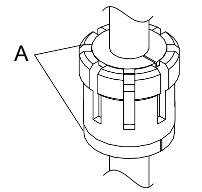


A – Clamping claw
B – Sealing insert
C – Opening

Figure 2.35 Reassemble the Cable Gland: 4A0124

2. Assemble the clamping claw and sealing insert.

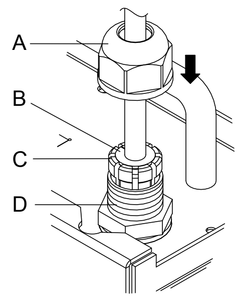
Note: The clamping claw and sealing insert should fit together so that no opening remains and the sealing insert is not deformed.



A –No opening remains and the sealing insert is not deformed.

Figure 2.36 Clamping Claw and Sealing Insert: 4A0124

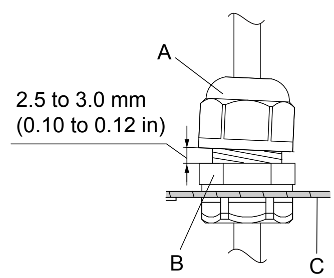
3. Place the clamping claw and sealing insert into the cable gland body then tighten the sealing nut into place.



A – Sealing nut
B – Sealing insert
C – Clamping claw
D – Cable gland body

Figure 2.37 Reassemble the Cable Gland: 4A0124

4. The remaining space between the sealing nut and the clamping claw should be between 2.5 and 3.0 mm (0.10 to 0.12 in).



A – Sealing nut
B – Cable gland body
C – Fan unit

Figure 2.38 Cable Gland: 4A0124

5. Insert the cooling fan into the drive.

Note: Use a magnetized screwdriver when inserting the screws to prevent the screws from falling.

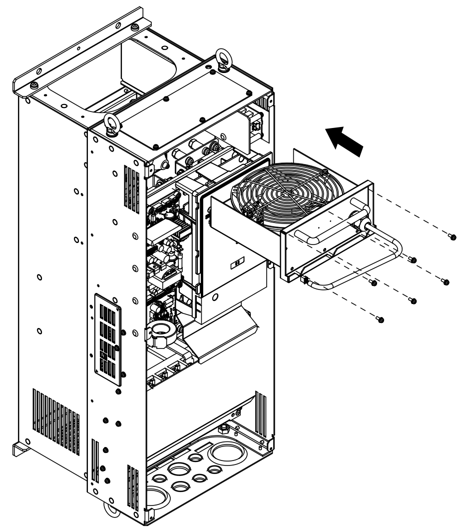


Figure 2.39 Insert the Cooling Fan Unit: 4A0124

6. Reverse procedure steps 2 and 3 in ***Removing and Disassembling the Cooling Fan Unit: 4A0124*** to reattach the drive cover. After reattaching the drive cover, reattach the terminal cover. Refer to the User Manual packaged with the drive for details on reattaching the terminal cover.

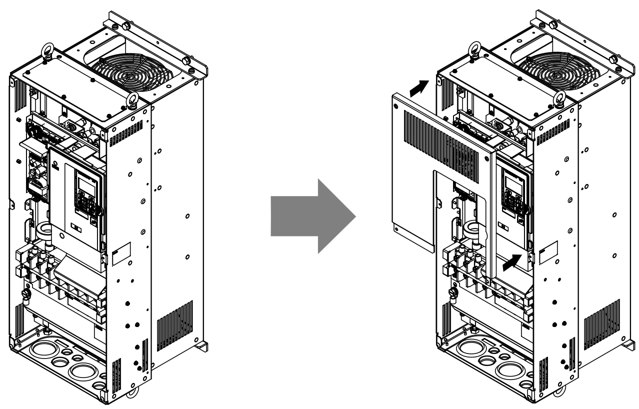


Figure 2.40 Reattach the Drive Cover: 4A0124

7. Turn on the power supply and set o4-03 to 0 to reset the Maintenance Monitor cooling fan operation time.

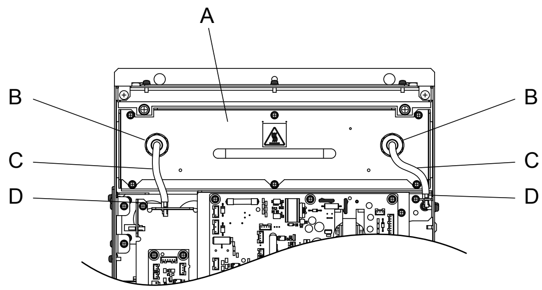
◆ Cooling Fan Replacement: 2A0143 to 2A0273, 4A0156 to 4A0240

WARNING! *Electrical Shock Hazard. Do not connect or disconnect wiring while the power is on. Failure to comply can result in serious personal injury. Before servicing the drive, disconnect all power to the equipment. The internal capacitor remains charged even after the power supply is turned off. After shutting off the power, wait for at least the amount of time specified on the drive before touching any components.*

CAUTION! *Burn Hazard. Do not touch a hot drive heatsink. Failure to comply could result in minor or moderate injury. Shut off the power to the drive when replacing the cooling fan. To prevent burns, wait at least 15 minutes and ensure the heatsink has cooled down.*

NOTICE: *Follow cooling fan and circulation fan replacement instructions. Improper fan replacement may cause damage to equipment. When installing the replacement fan into the drive, make sure the fan is facing upwards. Replace all fans when performing maintenance to help ensure maximum useful product life.*

■ Removing and Disassembling the Cooling Fan Unit: 2A0143 to 2A0273, 4A0156 to 4A0240



A – Fan unit **C – Fan cables**
B – Cable glands **D – Relay connectors**

Figure 2.41 Cooling Fan Replacement: 2A0143 to 2A0273, 4A0156 to 4A0240

1. Remove the terminal cover. Refer to the User Manual packaged with the drive for details on removing the terminal cover.

Note: The number of cover screws differ depending on the drive model.

CAUTION! *Do not completely remove the terminal cover screws, just loosen them. If the cover screws are removed completely, the terminal cover may fall off causing an injury.*

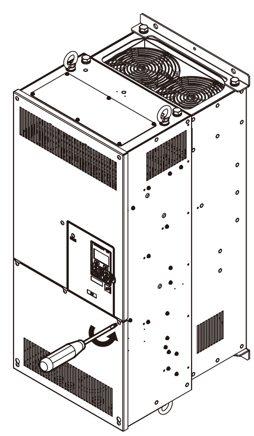


Figure 2.42 Loosen the Screws on the Terminal Cover: 2A0143 to 2A0273, 4A0156 to 4A0240

2. Remove the screws on the drive cover then pull forward on the drive cover to free it from the drive.

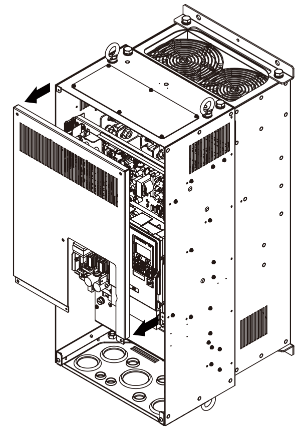
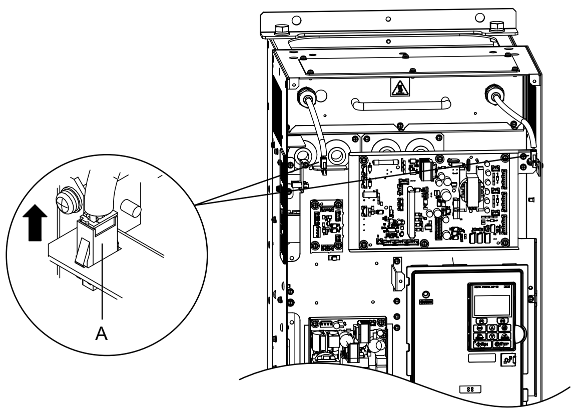


Figure 2.43 Remove the Drive Cover: 2A0143 to 2A0273, 4A0156 to 4A0240

3. Pull out the two relay connectors.



A –Relay connectors

Figure 2.44 Remove the Relay Connectors: 2A0143 to 2A0273, 4A0156 to 4A0240

4. Remove the screws holding the cooling fan unit in place and slide the fan unit out of the drive.

   CAUTION! *Injury to Personnel. Use two hands to remove the fan unit. Failure to comply may cause the fan unit to fall, resulting in minor to moderate injury.*

Note: Use a magnetized screwdriver when removing the screws to prevent the screws from falling.

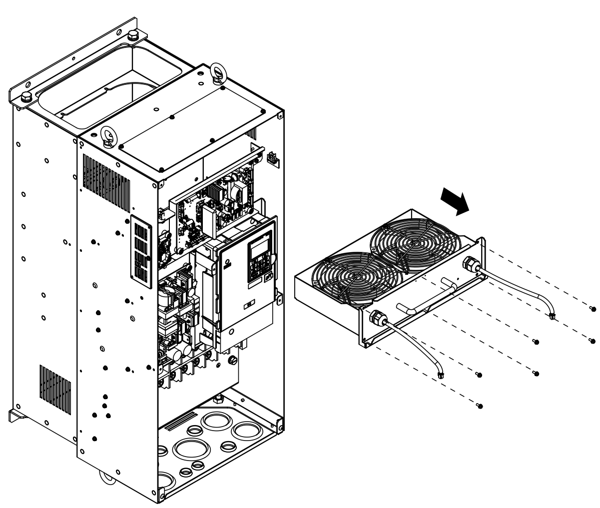
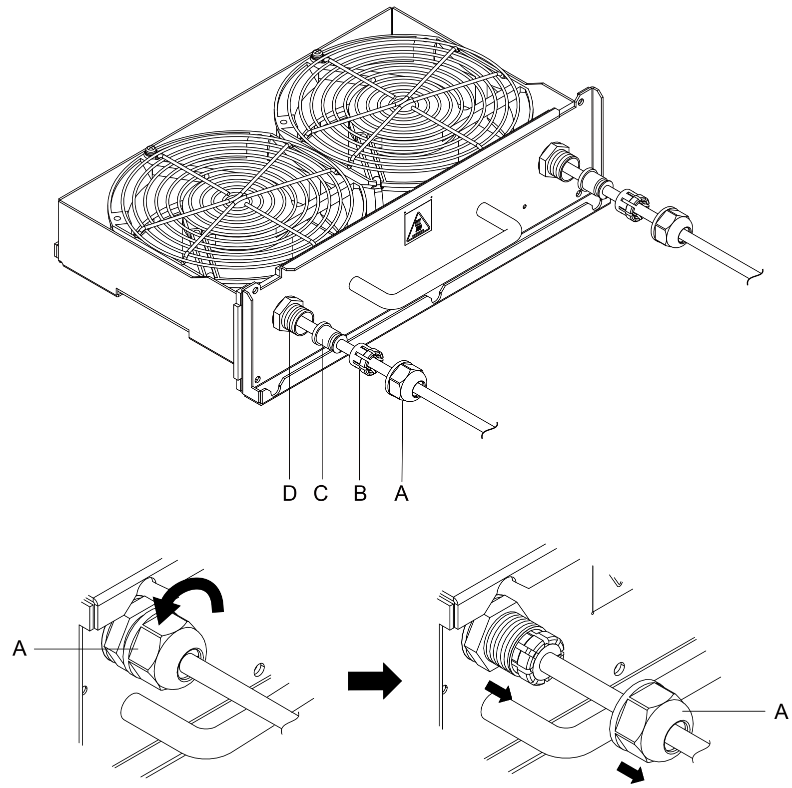


Figure 2.45 Remove the Cooling Fan Unit: 2A0143 to 2A0273, 4A0156 to 4A0240

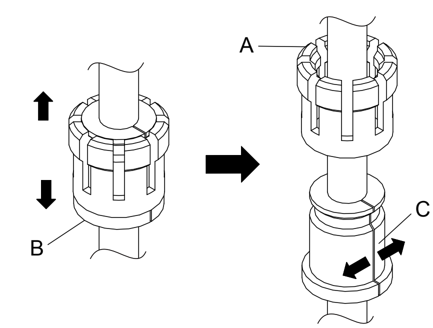
5. Unscrew and remove the sealing nut. Yaskawa recommends using a wrench from AVC Corp. of Japan or equivalent.



A – Sealing nut
B – Clamping claw
C – Sealing insert
D – Cable gland body

Figure 2.46 Cooling Fan Cable Gland: 2A0143 to 2A0273, 4A0156 to 4A0240

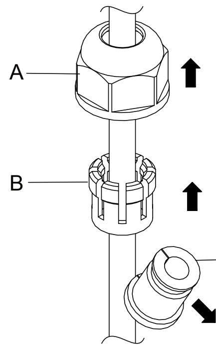
6. Pull the clamp claw and sealing nut insert from the gland body and separate the pieces.



A – Clamping claw
B – Sealing insert
C – Opening

Figure 2.47 Separate the Clamping Claw and Sealing Insert: 2A0143 to 2A0273, 4A0156 to 4A0240

7. Pull apart the opening on the sealing insert then remove it from the wiring. Slide the sealing nut and clamping claw off the power lines.



A – Sealing nut
B – Sealing insert
C – Clamping claw

Figure 2.48 Remove the Cable Gland: 2A0143 to 2A0273, 4A0156 to 4A0240

8. Remove the fan guards and replace the cooling fans. Install the fan so the air flows upward.

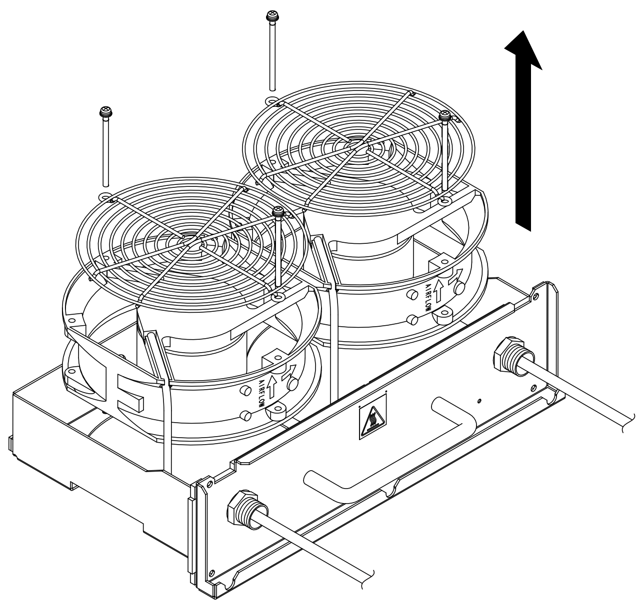


Figure 2.49 Cooling Fan Disassembly: 2A0143 to 2A0273, 4A0156 to 4A0240

■ Installing the Cooling Fan Unit: 2A0143 to 2A0273, 4A0156 to 4A0240

Note: Do not pinch the fan cable between parts when reassembling the fan unit.

1. Route the fan cable as shown in ***Figure 2.50***.

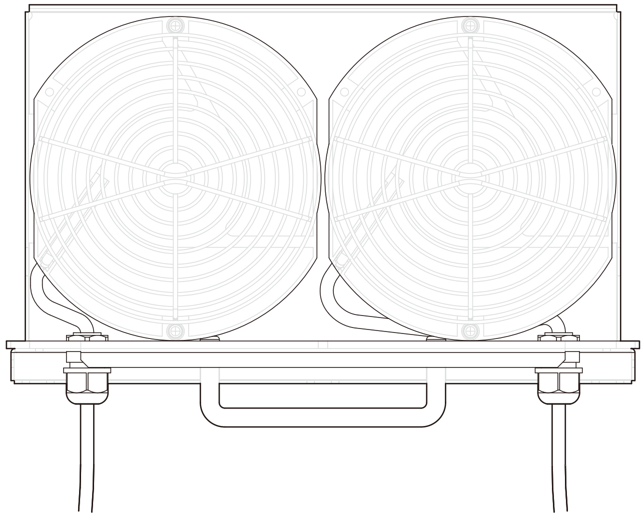
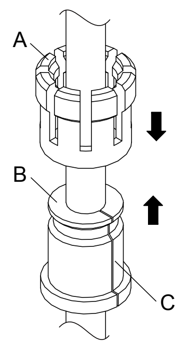


Figure 2.50 Fan Cable Routing: 2A0143 to 2A0273, 4A0156 to 4A0240

2. Allow the fan cable to pass through the cable gland body then pull apart the opening in the sealing insert and fit the insert around the cable.

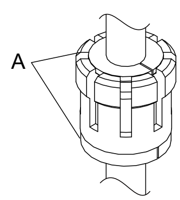


A – Clamping claw
B – Sealing insert
C – Opening

Figure 2.51 Reassemble the Cable Gland: 2A0143 to 2A0273, 4A0156 to 4A0240

3. Assemble the clamping claw and sealing insert.

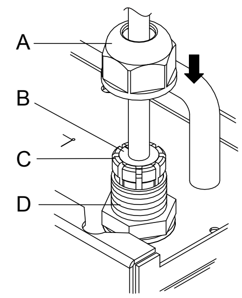
Note: The clamping claw and sealing insert should fit together so that no opening remains and the sealing insert is not deformed.



A –No opening remains and the sealing insert is not deformed.

Figure 2.52 Clamping Claw and Sealing Insert: 2A0143 to 2A0273, 4A0156 to 4A0240

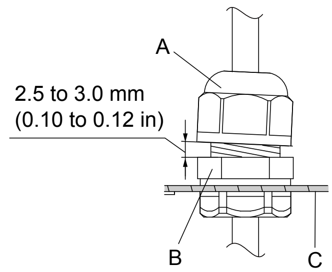
4. Place the clamping claw and sealing insert into the cable gland body then tighten the sealing nut into place.



A – Sealing nut **C – Clamping claw**
B – Sealing insert **D – Cable gland body**

Figure 2.53 Reassemble the Cable Gland: 2A0143 to 2A0273, 4A0156 to 4A0240

5. The remaining space between the sealing nut and the clamping claw should be between 2.5 and 3.0 mm (0.10 to 0.12 in).



A – Sealing nut **C – Fan unit**
B – Cable gland body

Figure 2.54 Cable Gland: 2A0143 to 2A0273, 4A0156 to 4A0240

6. Insert the cooling fan unit into the drive.

Note: Use a magnetized screwdriver when inserting the screws to prevent the screws from falling.

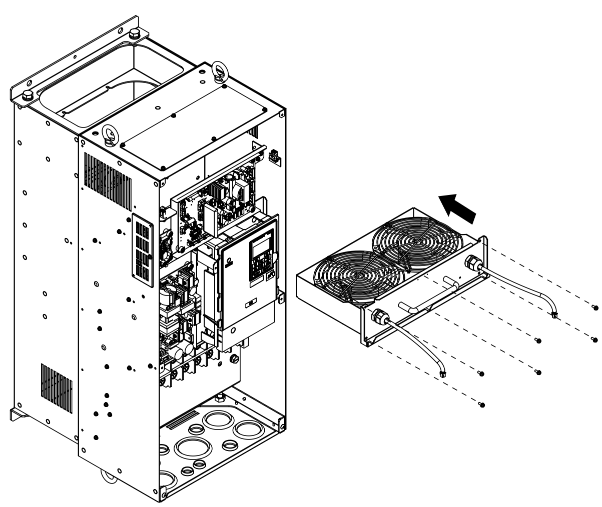


Figure 2.55 Insert the Cooling Fan Unit: 2A0143 to 2A0273, 4A0156 to 4A0240

7. Reverse procedure steps 2 and 3 in ***Removing and Disassembling the Cooling Fan Unit: 2A0143 to 2A0273, 4A0156 to 4A0240*** to reattach the drive cover. After reattaching the drive cover, reattach the terminal cover. Refer to the User Manual packaged with the drive for details on reattaching the terminal cover.

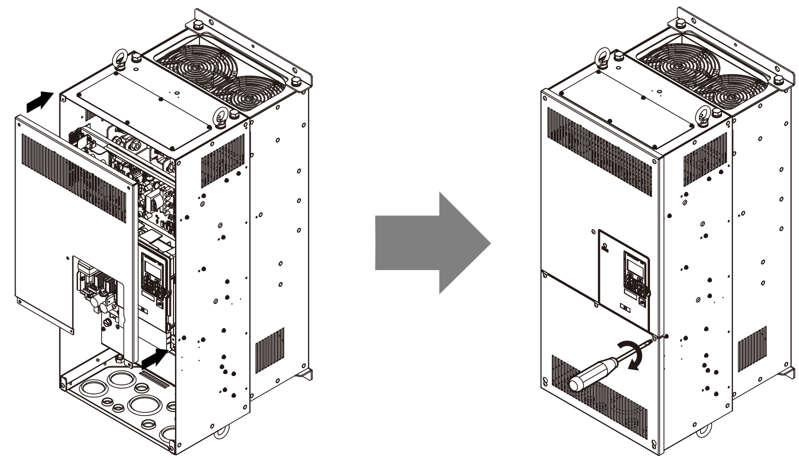


Figure 2.56 Reattach the Drive Cover: 2A0143 to 2A0273, 4A0156 to 4A0240

8. Turn on the power supply and set o4-03 to 0 to reset the Maintenance Monitor cooling fan operation time.

◆ Cooling Fan Replacement: 4A0302

WARNING! *Electrical Shock Hazard. Do not connect or disconnect wiring while the power is on. Failure to comply can result in serious personal injury. Before servicing, disconnect all power to the equipment. The internal capacitor remains charged even after the power supply is turned off. The charge indicator LED will extinguish when the DC bus voltage is below 50 Vdc. To prevent electric shock, wait for at least the time specified on the warning label, once all indicators are OFF, measure for unsafe voltages to confirm the drive is safe prior to servicing.*

CAUTION! *Burn Hazard. Do not touch a hot drive heatsink. Failure to comply could result in minor or moderate injury. Shut off the power to the drive when replacing the cooling fan. To prevent burns, wait at least 15 minutes and ensure the heatsink has cooled down.*

NOTICE: *Follow cooling fan and circulation fan replacement instructions. Improper fan replacement may cause damage to equipment. When installing the replacement fan into the drive, make sure the fan is facing upwards. Replace all fans when performing maintenance to help ensure maximum useful product life.*

■ Removing and Disassembling the Cooling Fan Unit: 4A0302

1. Remove the covers. Refer to the User Manual packaged with the drive for details on removing the drive covers.

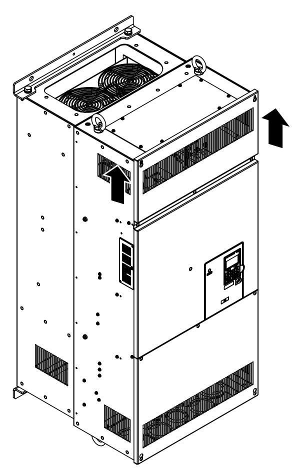
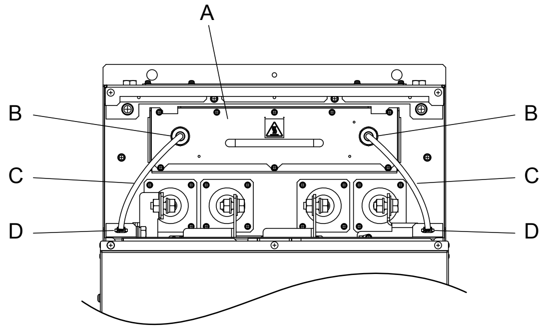


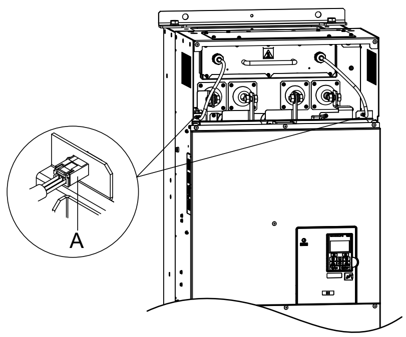
Figure 2.57 Remove the Front Cover: 4A0302



A – Fan unit
B – Cable glands
C – Fan cables
D – Relay connectors

Figure 2.58 Cooling Fan Replacement: 4A0302

2. Pull out the two relay connectors.



A –Relay connectors

Figure 2.59 Remove the Relay Connectors: 4A0302

3. Remove the screws holding the cooling fan unit in place and slide the fan unit out of the drive.

CAUTION! *Injury to Personnel. Use two hands to remove the fan unit. Failure to comply may cause the fan unit to fall, resulting in minor to moderate injury.*

Note: Use a magnetized screwdriver when removing the screws to prevent the screws from falling.

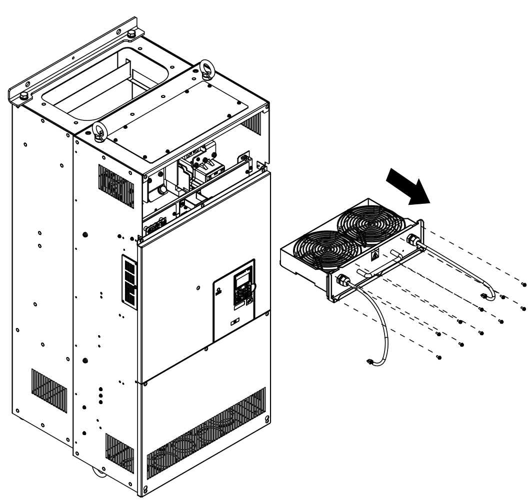
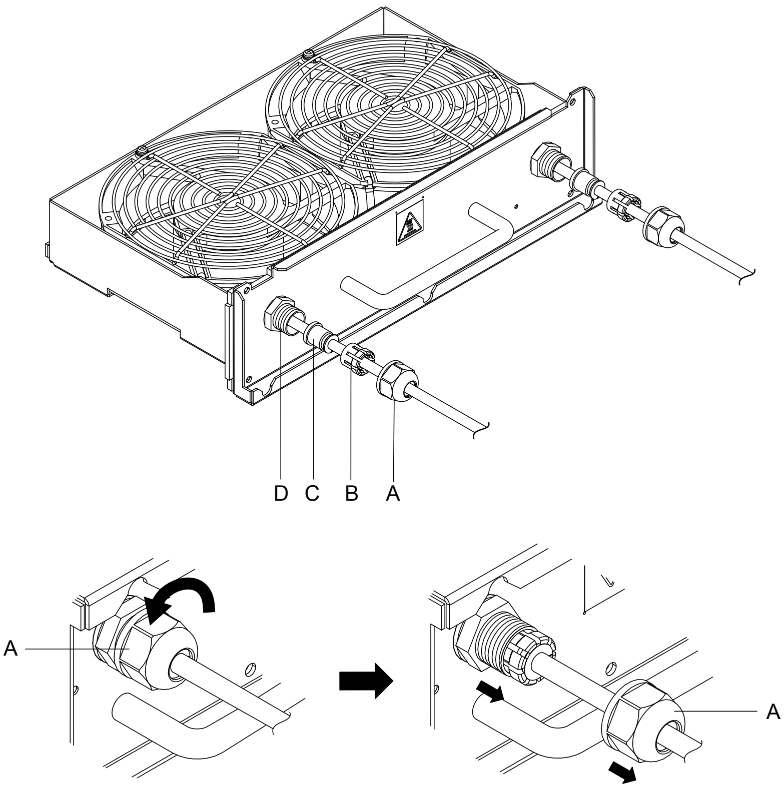


Figure 2.60 Remove the Cooling Fan Unit: 4A0302

4. Unscrew and remove the sealing nut. Yaskawa recommends using a wrench from AVC Corp. of Japan or equivalent.

Periodic Inspection & Maintenance

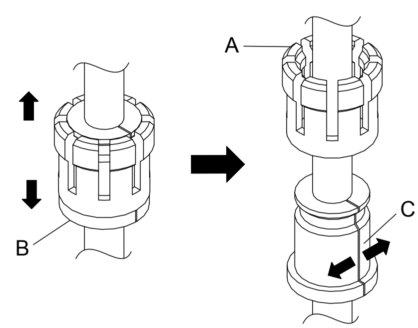
2



A – Sealing nut
B – Clamping claw
C – Sealing insert
D – Cable gland body

Figure 2.61 Cooling Fan Cable Gland: 4A0302

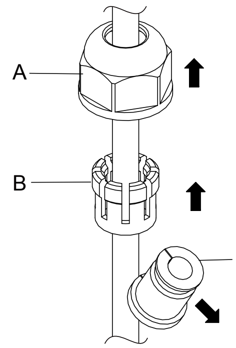
5. Pull the clamp claw and sealing nut insert from the gland body and separate the pieces.



A – Clamping claw
B – Sealing insert
C – Opening

Figure 2.62 Separate the Clamping Claw and Sealing Insert: 4A0302

6. Pull apart the opening on the sealing insert then remove it from the wiring. Slide the sealing nut and clamping claw off the power lines.



A – Sealing nut
B – Sealing insert
C – Clamping claw

Figure 2.63 Remove the Cable Gland: 4A0302

7. Remove the fan guards and replace the cooling fans. Install the fan so the air flows upwards.

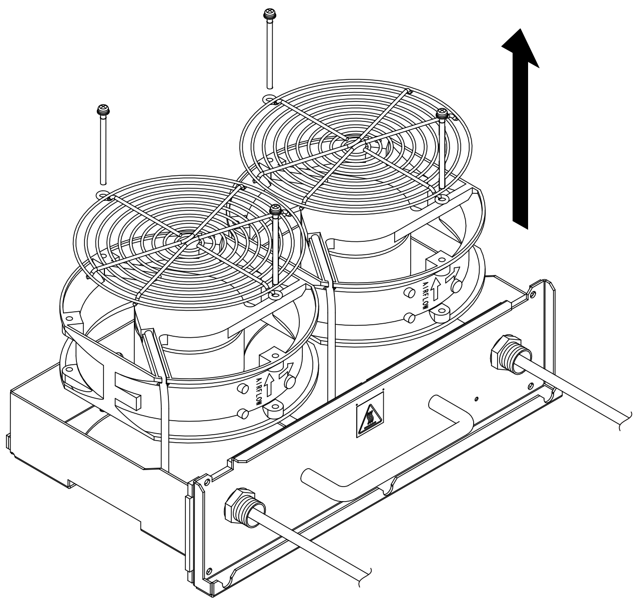


Figure 2.64 Cooling Fan Disassembly: 4A0302

■ Installing the Cooling Fan Unit: 4A0302

Note: Do not pinch the fan cable between parts when reassembling the fan unit.

1. Route the fan cable as shown in *Figure 2.65*.

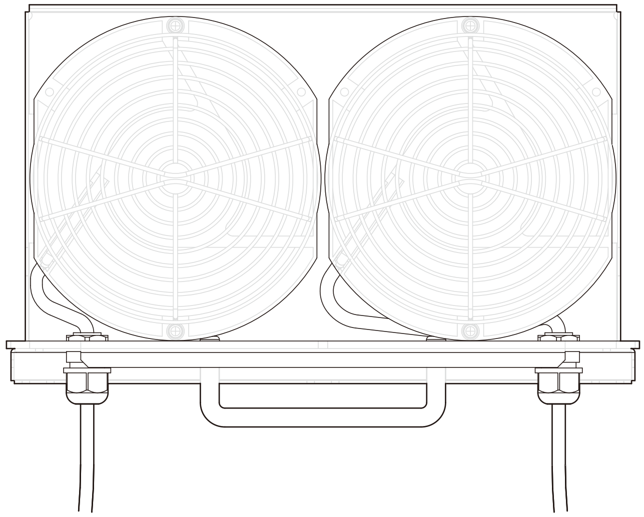
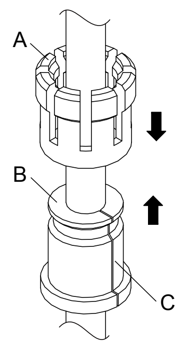


Figure 2.65 Fan Cable Routing: 4A0302

2. Allow the fan cable to pass through the cable gland body then pull apart the opening in the sealing insert and fit the insert around the cable.

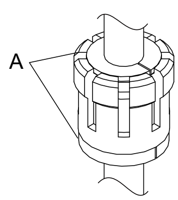


A – Clamping claw
B – Sealing insert
C – Opening

Figure 2.66 Reassemble the Cable Gland: 4A0302

3. Assemble the clamping claw and sealing insert.

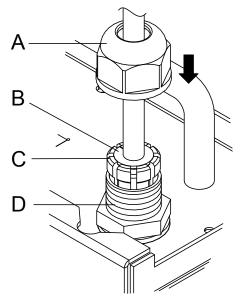
Note: The clamping claw and sealing insert should fit together so that no opening remains and the sealing insert is not deformed.



A –No opening remains and the sealing insert is not deformed.

Figure 2.67 Clamping Claw and Sealing Insert: 4A0302

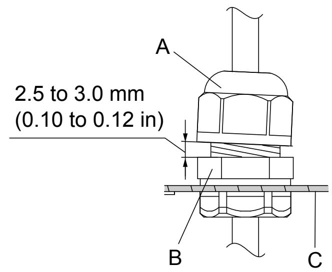
4. Place the clamping claw and sealing insert into the cable gland body then tighten the sealing nut into place.



A – Sealing nut
B – Sealing insert
C – Clamping claw
D – Cable gland body

Figure 2.68 Reassemble the Cable Gland: 4A0302

5. The remaining space between the sealing nut and the clamping claw should be between 2.5 and 3.0 mm (0.10 to 0.12 in).



A – Sealing nut
B – Cable gland body
C – Fan unit

Figure 2.69 Cable Gland: 4A0302

6. Insert the cooling fan unit into the drive.

Note: Use a magnetized screwdriver when inserting the screws to prevent the screws from falling.

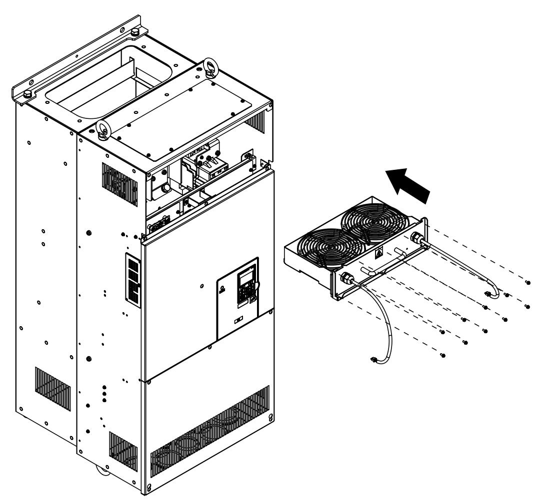


Figure 2.70 Insert the Cooling Fan Unit: 4A0302

7. Reattach the covers.
8. Turn on the power supply and set o4-03 to 0 to reset the Maintenance Monitor cooling fan operation time.

◆ Cooling Fan Replacement: 2A0343 and 2A0396

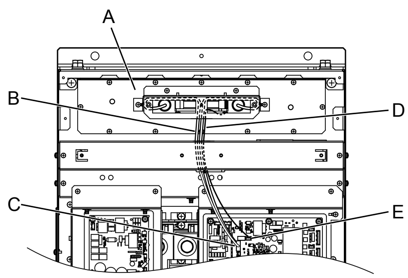
WARNING! *Electrical Shock Hazard. Do not connect or disconnect wiring while the power is on. Failure to comply can result in serious personal injury. Before servicing, disconnect all power to the equipment. The internal capacitor remains charged even after the power supply is turned off. The charge indicator LED will extinguish when the DC bus voltage is below 50 Vdc. To prevent electric shock, wait for at least the time specified on the warning label, once all indicators are OFF, measure for unsafe voltages to confirm the drive is safe prior to servicing.*

CAUTION! *Burn Hazard. Do not touch a hot drive heatsink. Failure to comply could result in minor or moderate injury. Shut off the power to the drive when replacing the cooling fan. To prevent burns, wait at least 15 minutes and ensure the heatsink has cooled down.*

NOTICE: *Follow cooling fan and circulation fan replacement instructions. Improper fan replacement may cause damage to equipment. When installing the replacement fan into the drive, make sure the fan is facing upwards. Replace all fans when performing maintenance to help ensure maximum useful product life.*

■ Removing and Disassembling the Cooling Fan Unit: 2A0343 and 2A0396

1. Remove the terminal cover and front cover.
2. Remove the fan connectors (CN6, CN7).



A – Fan unit
B – Fan relay cable
C – Fan connector (CN6)
D – Circulation fan relay cable
E – Fan connector (CN7)

Figure 2.71 Cooling Fan Replacement: 2A0343 and 2A0396

3. Remove the screws holding the fan unit in place and slide the fan unit out of the drive.

   CAUTION! *Injury to Personnel. Use two hands to remove the fan unit. Failure to comply may cause the fan unit to fall, resulting in minor to moderate injury.*

Note: Use a magnetized screwdriver when removing the screws to prevent the screws from falling.

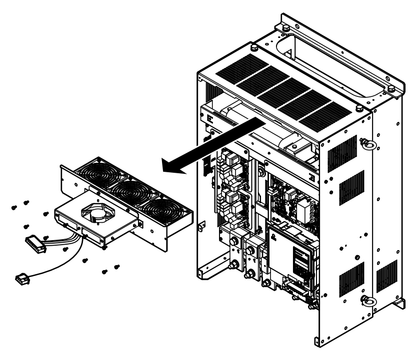
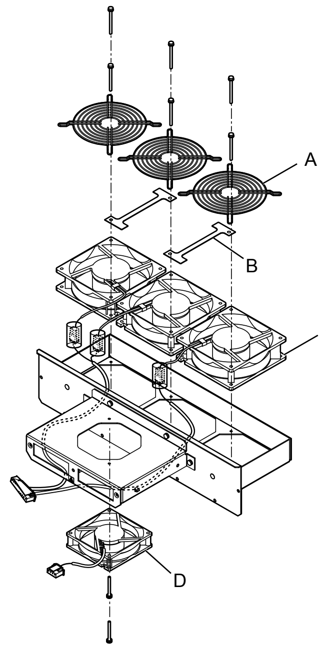


Figure 2.72 Remove the Fan Unit: 2A0343 and 2A0396

4. Remove the fan guard and replace the cooling fans.

Note: Do not pinch the fan cable between parts when reassembling the fan unit.

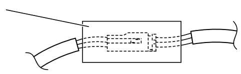


A – Fan guard
B – Cable cover
C – Cooling fan
D – Circulation fan

Figure 2.73 Fan Unit Disassembly: 2A0343 and 2A0396

■ Cooling Fan Wiring: 2A0343 and 2A0396

1. Position the protective tube so the fan connector sits in the center of the protective tube.



2. In the space between fans 1 and 2, place the fan connector for fan B2 in front of the fan connector for fan B1.

3. Place the connector for fan B3 between fans B2 and B3.

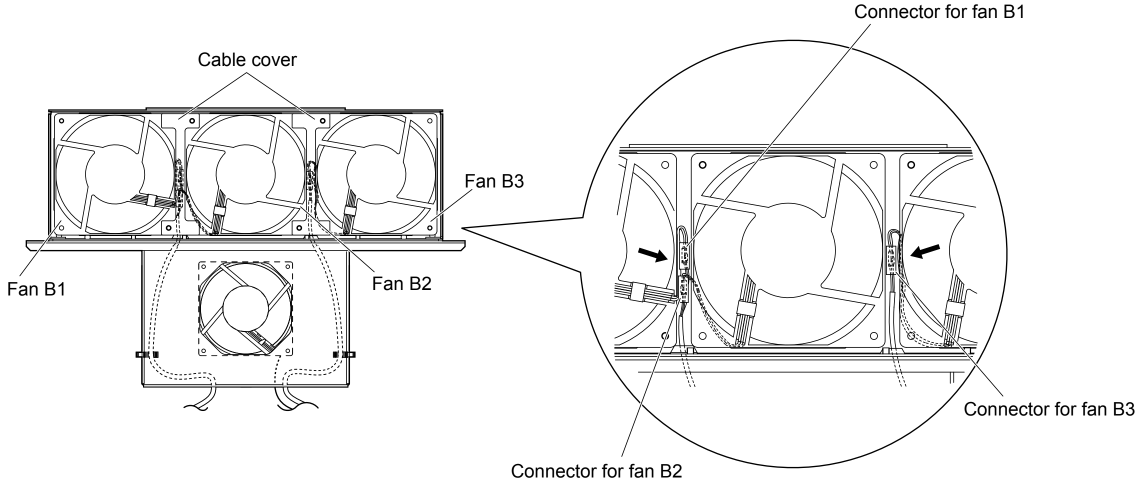


Figure 2.74 Cooling Fan Wiring: 2A0343 and 2A0396

4. Double-check the relay connector to ensure it is properly connected.

5. Reattach the cable cover to its original position and tighten the screws so the fan guard holds the cable cover in place.

Note: Do not pinch the fan cable between parts when reassembling the fan unit.

Periodic Inspection & Maintenance
2

■ Installing the Cooling Fan Unit: 2A0343 and 2A0396

1. Reverse the procedure described above to reinstall the cooling fan unit.

Note: Use a magnetized screwdriver when inserting the screws to prevent the screws from falling.

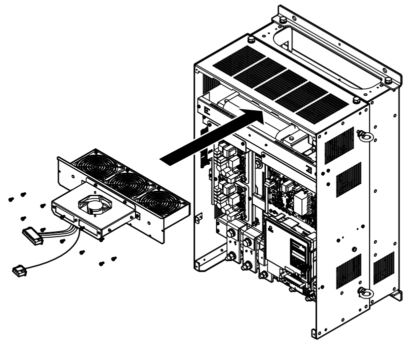


Figure 2.75 Install the Cooling Fan Unit: 2A0343 and 2A0396

2. Reattach the covers and HOA keypad.

3. Turn on the power supply and set o4-03 to 0 to reset the Maintenance Monitor cooling fan operation time.

◆ Cooling Fan Replacement: 4A0361

WARNING! *Electrical Shock Hazard. Do not connect or disconnect wiring while the power is on. Failure to comply can result in serious personal injury. Before servicing the drive, disconnect all power to the equipment. The internal capacitor remains charged even after the power supply is turned off. After shutting off the power, wait for at least the amount of time specified on the drive before touching any components.*

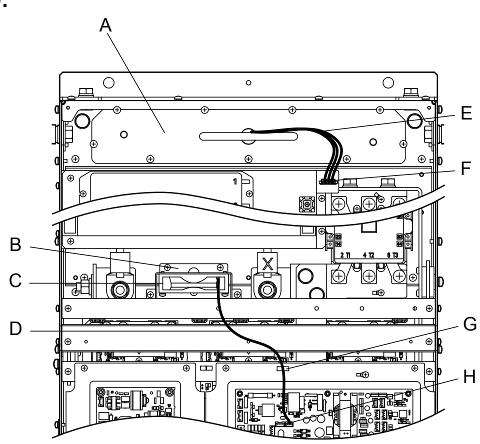
CAUTION! *Burn Hazard. Do not touch a hot drive heatsink. Failure to comply could result in minor or moderate injury. Shut off the power to the drive when replacing the cooling fan. To prevent burns, wait at least 15 minutes and ensure the heatsink has cooled down.*

NOTICE: *Follow cooling fan and circulation fan replacement instructions. Improper fan replacement may cause damage to equipment. When installing the replacement fan into the drive, make sure the fan is facing upwards. Replace all fans when performing maintenance to help ensure maximum useful product life.*

■ Removing and Disassembling the Cooling Fan Unit: 4A0361

1. Remove the terminal cover and front covers 1 and 2.

2. Remove the fan connector (CN6).



A – Fan unit
B – Circulation fan unit
C – Circulation fan
D – Circulation fan relay cable
E – Fan relay cable
F – Fan connector (CN6)
G – Hook
H – Fan connector (CN7)

Figure 2.76 Component Names: 4A0361

3. Remove the circulation fan relay cable from the hook. Remove the fan connector (CN7).

4. Remove the screws holding the fan units in place and slide the fan units out of the drive.

CAUTION! *Injury to Personnel. Use two hands to remove the fan unit. Failure to comply may cause the fan unit to fall, resulting in minor to moderate injury.*

Note: Use a magnetized screwdriver when removing the screws to prevent the screws from falling.

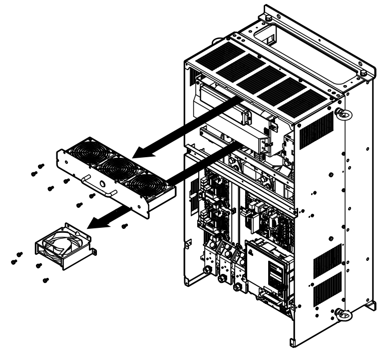
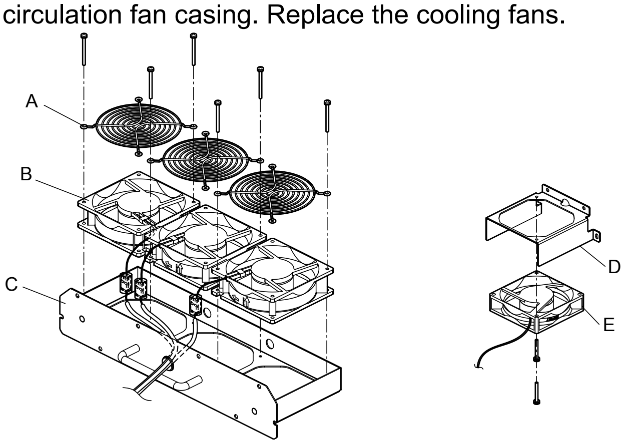


Figure 2.77 Remove the Fan Unit: 4A0361

5. Remove the fan guard and circulation fan casing. Replace the cooling fans.

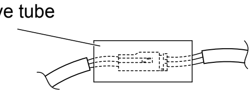


A – Fan guard
B – Cooling fan
C – Fan unit case
D – Circulation fan base
E – Circulation fan

Figure 2.78 Fan Unit Disassembly: 4A0361

■ Cooling Fan Wiring: 4A0361

1. Position the protective tube so the fan connector sits in the center of the protective tube.



2. Place the fan connector covered by the tube as shown in ***Figure 2.79***.

Periodic Inspection & Maintenance

2

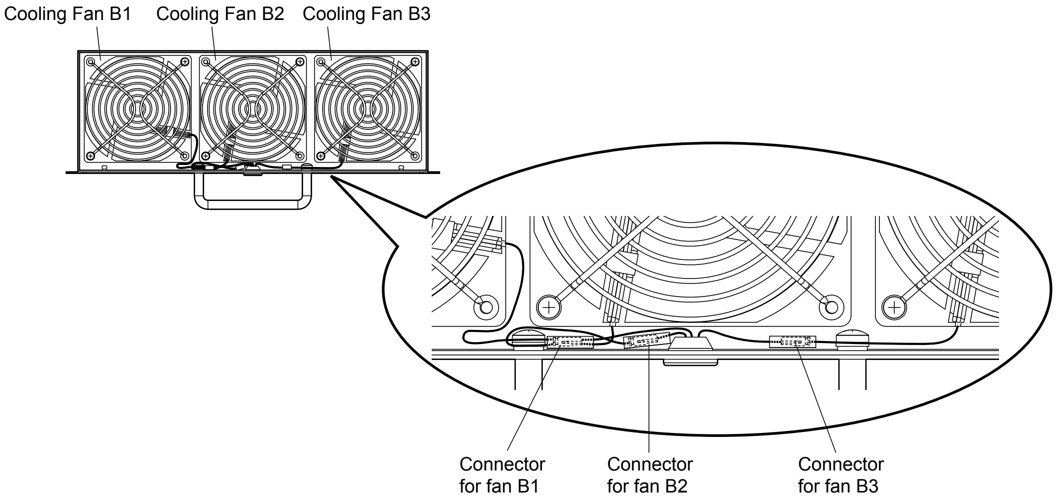


Figure 2.79 Cooling Fan Wiring: 4A0361

3. Double-check the relay connector to ensure that it is properly connected.

■ Installing the Cooling Fan Unit: 4A0361

1. Reverse the procedure described above to reinstall the cooling fan unit.

Note: Use a magnetized screwdriver when inserting the screws to prevent the screws from falling.

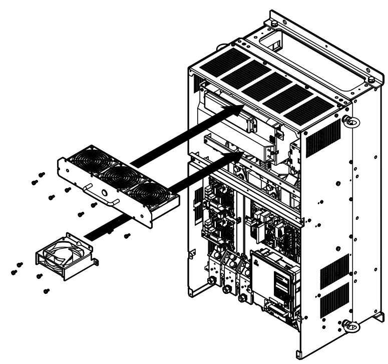


Figure 2.80 Install the Cooling Fan Unit: 4A0361

2. Reattach the covers and HOA keypad.
3. Turn on the power supply and set o4-03 to 0 to reset the Maintenance Monitor cooling fan operation time.

◆ Cooling Fan Replacement: 4A0414 to 4A0590

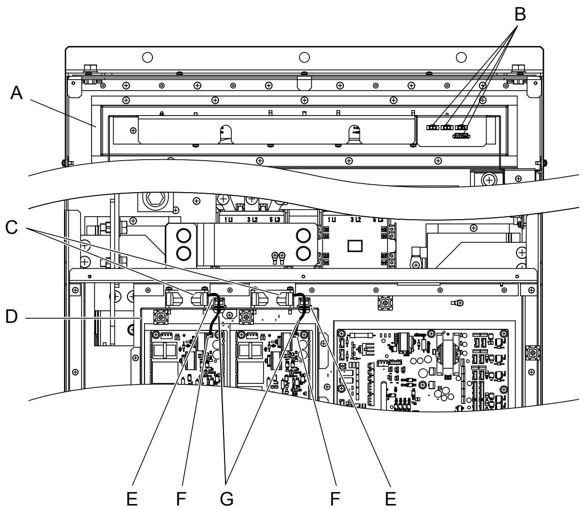
WARNING! *Electrical Shock Hazard. Do not connect or disconnect wiring while the power is on. Failure to comply can result in serious personal injury. Before servicing the drive, disconnect all power to the equipment. The internal capacitor remains charged even after the power supply is turned off. After shutting off the power, wait for at least the amount of time specified on the drive before touching any components.*

CAUTION! *Burn Hazard. Do not touch a hot drive heatsink. Failure to comply could result in minor or moderate injury. Shut off the power to the drive when replacing the cooling fan. To prevent burns, wait at least 15 minutes and ensure the heatsink has cooled down.*

NOTICE: *Follow cooling fan and circulation fan replacement instructions. Improper fan replacement may cause damage to equipment. When installing the replacement fan into the drive, make sure the fan is facing upwards. Replace all fans when performing maintenance to help ensure maximum useful product life.*

■ Removing and Disassembling the Cooling Fan Unit: 4A0414 to 4A0590

1. Remove the terminal cover and front covers 1 and 2.
2. Remove the connectors for the cooling fan relay and the circuit board cooling fan.



A – Fan unit
B – Fan relay connector
C – Circuit board cooling fan
D – Circuit board cooling fan case
E – Hook
F – Circuit board cooling fan connector
G – Circuit board cooling fan cable

Figure 2.81 Component Names: 4A0414 to 4A0590

3. Loosen all nine screws and slide the panel to the right.

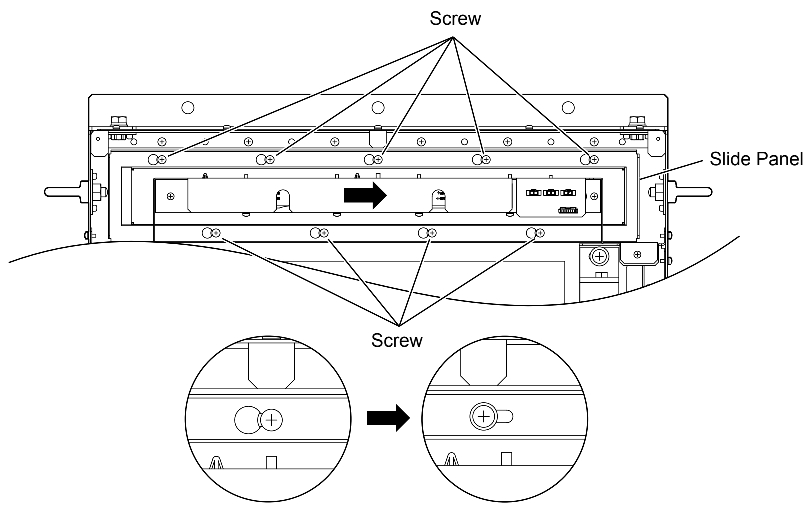


Figure 2.82 Remove the Fan Unit: 4A0414 to 4A0590

4. Remove the slide panel, fan unit, and circuit board cooling fan unit.

CAUTION! *Injury to Personnel. Use two hands to remove the fan unit. Failure to comply may cause the fan unit to fall, resulting in minor to moderate injury.*

Note: Use a magnetized screwdriver when removing the screws to prevent the screws from falling.

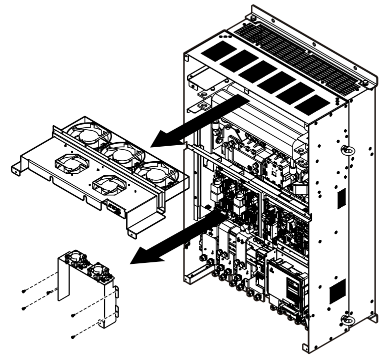
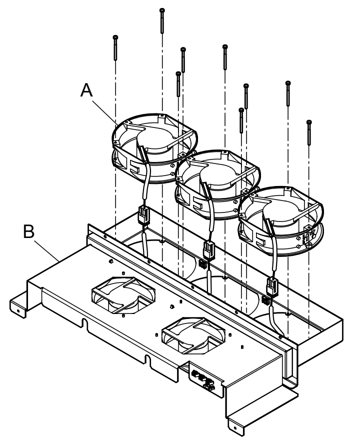


Figure 2.83 Remove the Fan Unit: 4A0414 to 4A0590

5. Replace the cooling fans.

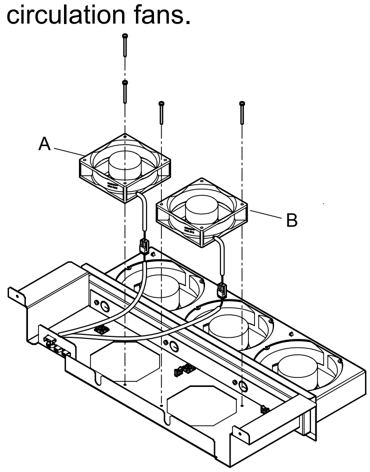
Note: Do not pinch the fan cable between parts when reassembling the fan unit.



A – Cooling fan **B – Fan unit case**

Figure 2.84 Fan Unit Disassembly: 4A0414 to 4A0590

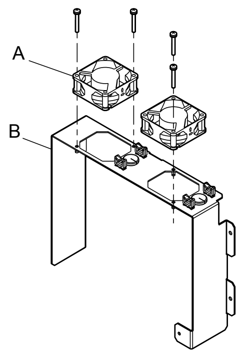
6. Turn the fan unit over and replace the circulation fans.



A – Circulation fan 1 **B – Circulation fan 2**

Figure 2.85 Fan Unit Disassembly: 4A0414 to 4A0590

7. Replace the cooling fans.



A – Circuit board cooling fan **B – Circuit board cooling fan case**

Figure 2.86 Fan Unit Disassembly: 4A0414 to 4A0590

■ Cooling Fan Wiring: 4A0414 to 4A0590

1. Place the cooling fan connectors and guide the lead wires so they are held in place by the cable hooks.

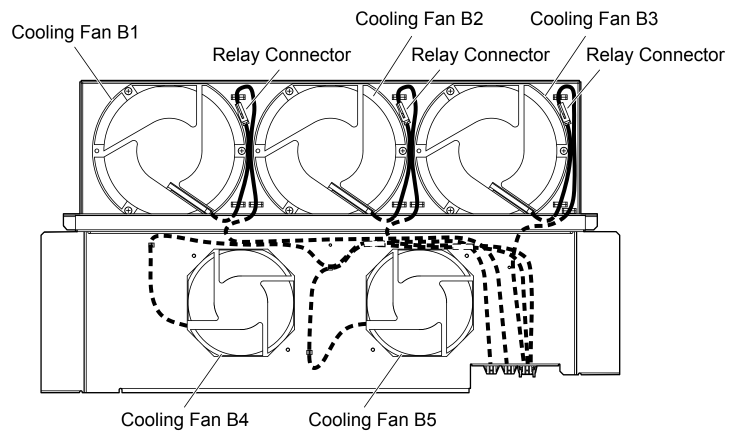


Figure 2.87 Cooling Fan Wiring: 4A0414 to 4A0590

2. Guide the lead wires so that they are held in place by the cable hooks and place the circulation fan connectors between the fan and the fan unit.

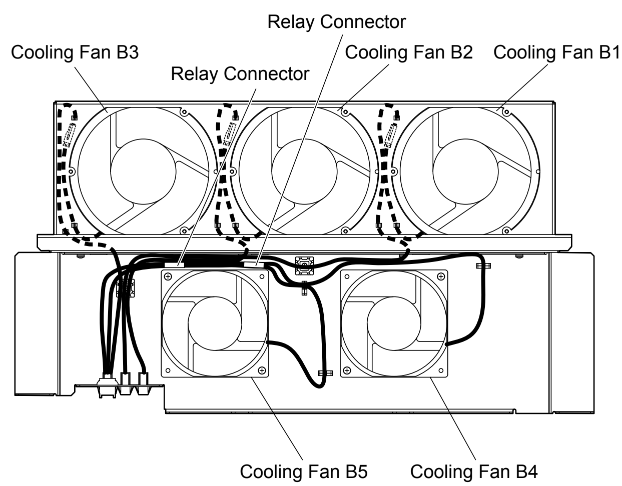
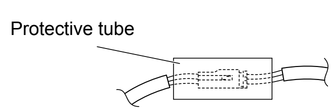


Figure 2.88 Cooling Fan Wiring: 4A0414 to 4A0590

3. Position the protective tube so the fan connector sits in the center of the protective tube. (Circuit board cooling fans only)



4. Guide the lead wires through the provided hooks so the wires are held in place.

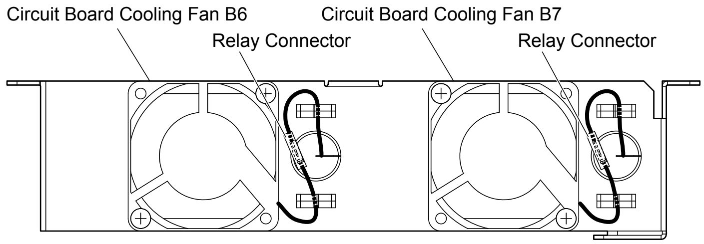


Figure 2.89 Cooling Fan Wiring: 4A0414 to 4A0590

5. Double-check the relay connector to ensure that it is properly connected.

■ Installing the Cooling Fan Unit: 4A0414 to 4A0590

1. Reverse the procedure described above to reinstall the cooling fan unit.

Note: Use a magnetized screwdriver when installing the screws to prevent the screws from falling.

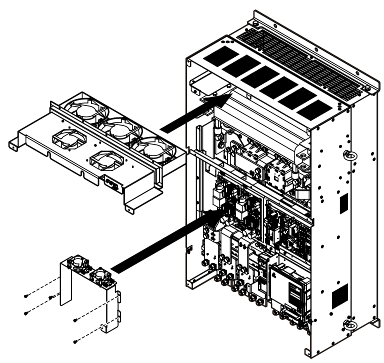


Figure 2.90 Install the Cooling Fan Unit: 4A0414 to 4A0590

2. Reattach the covers and HOA keypad.
3. Turn on the power supply and set o4-03 to 0 to reset the Maintenance Monitor cooling fan operation time.

Appendix: A

Parameter List

This appendix contains a full listing of all parameters and settings available in the drive.

A.1 Understanding Parameter Descriptions

◆ Control Modes, Symbols, and Terms

The table below lists terms and symbols used in this section to indicate parameter availability and control.

Table A.1 Symbols and Icons Used in Parameter Descriptions

Symbol	Description
OLV/PM	Parameter is ONLY available when operating the drive with Open Loop Vector for PM motors.
RUN	Parameter can be changed during run.

A.2 Parameter Groups

Table A.2 Parameter Groups

Parameter Group	Name	Page
A1	Initialization Parameters	210
A2	User Parameters	210
b1	Operation Mode Selection	211
b2	DC Injection Braking and Short Circuit Braking	211
b3	Speed Search	212
b4	Timer Function	213
b5	PI Control	213
b8	Energy Saving	217
C1	Acceleration and Deceleration Times	218
C2	S-Curve Characteristics	218
C4	Torque Compensation	218
C6	Carrier Frequency	219
d1	Frequency Reference	220
d2	Frequency Upper/Lower Limits	220
d3	Jump Frequency	220
d4	Frequency Reference Hold and Up/Down 2 Function	221
d6	Field Weakening	221
d7	Offset Frequency	221
E1	V/f Pattern for Motor 1	222
E2	Motor 1 Parameters	223
E5	PM Motor Settings	223
F6, F7	Communication Option Card	225
H1	Multi-Function Digital Inputs	227
H2	Multi-Function Digital Outputs	231
H3	Multi-Function Analog Inputs	233
H4	Multi-Function Analog Outputs	234
H5	MEMOBUS/Modbus Serial Communication	235
L1	Motor Protection	237
L2	Momentary Power Loss Ride-Thru	237
L3	Stall Prevention	238
L4	Speed Detection	240
L5	Fault Restart	240
L6	Torque Detection	241
L8	Drive Protection	241
n1	Hunting Prevention	243
n3	High Slip Braking (HSB) and Overexcitation Braking	243
n8	PM Motor Control Tuning	244
o1	HOA Keypad Display Selection	245
o2	HOA Keypad Functions	246
o3	Copy Function	247
o4	Maintenance Monitor Settings	247
S1	Stillness Control	248
S2	Sequence Timer Operation	248
S3	Secondary PI Control	250
S4	Bypass Functions	252
S5	HAND Key Functions	252
S6	Phase Order Selection	253
T1	Induction Motor Auto-Tuning	254
T2	PM Motor Auto-Tuning	254
U1	Operation Status Monitors	256
U2	Fault Trace	257
U3	Fault History	258
U4	Maintenance Monitors	260
U5	PI Monitors	261
U6	Operation Status Monitors	262

A.3 A: Initialization Parameters

The A parameter group creates the operating environment for the drive. This includes the parameter Access Level, Motor Control Method, Password, User Parameters and more.

◆ A1: Initialization

No. (Addr. Hex)	Name	LCD Display	Description	Values	Page
A1-00 (100) RUN <1>	Language Selection	Select Language 0: English 1: ニホンゴ (Japanese) 3: Français 5: Español 6: Portuguêse	0: English 1: Japanese 3: French 5: Spanish 6: Portuguese	Default: 0 Range: 0 to 6	18
A1-01 (101) RUN <2>	Access Level Selection	Access Level 0: Operation Only 1: User Parameters 2: Advanced Level	0: View and set A1-01 and A1-04. U□-□□ parameters can also be viewed. 1: User Parameters (access to a set of parameters selected by the user, A2-01 to A2-32) 2: Advanced Access (access to view and set all parameters)	Default: 2 Range: 0 to 2	18
A1-02 (102) <1>	Control Method Selection	Control Method 0: V/F Control 5: PM OpenLoop Vect	0: V/f Control 5: Open Loop Vector Control for PM	Default: 0 Range: 0, 5	18
A1-03 (103)	Initialize Parameters	Init Parameters 0: No Initialize 1110: User Initialize 2220: 2-Wire Initial 3330: 3-Wire Initial 3410: SELVAL HVAC Initialize 3420: SELVAL OEM Bypass Init	0: No initialization 1110: User Initialize (parameter values must be stored using parameter o2-03) 2220: 2-Wire Initialization 3330: 3-Wire Initialization 3410: HVAC Initialization 3420: OEM Bypass Initialization	Default: 0 Range: 0 to 3420	19
A1-04 (104)	Password	Enter Password	When the value set into A1-04 does not match the value set into A1-05, parameters A1-01 through A1-03, A1-06, and A2-01 through A2-33 cannot be changed.	Default: 0000 Min.: 0000 Max.: 9999	20
A1-05 (105)	Password Setting	Select Password	When the value set into A1-04 does not match the value set into A1-05, parameters A1-01 through A1-03, A1-06, and A2-01 through A2-33 cannot be changed.	Default: 0000 Min.: 0000 Max.: 9999	20
A1-06 (127)	Application Preset	Application Sel 0: General 1: Fan General 2: Fan PI 3: Fan ReturnAir/PI 4: Cooling Tower 5: CoolingTower/PI 6: Pump Secondary 7: Pump PI	0: Standard 1: Fan 2: Fan with PI Control 3: Return Fan with PI Control 4: Cooling Tower Fan 5: Cooling Tower Fan with PI Control 6: Pump (Secondary) 7: Pump with PI Control	Default: 0 Range: 0 to 7	22

<1> Parameter setting value is not reset to the default value when the drive is initialized.

<2> Default setting value is dependent on the Application Preset selected with parameter A1-06.

◆ A2: User Parameters

No. (Addr. Hex)	Name	LCD Display	Description	Values	Page
A2-01 to A2-32 (106 to 125)	User Parameters 1 to 32	User Param 1 - 32	Recently edited parameters are listed here. The user can also select parameters to appear here for quicker access.	Default: <1> Range: A1-00 to S6-07	22
A2-33 (126)	User Parameter Automatic Selection	User Parms Sel 0: Disabled 1: Enabled	0: Parameters A2-01 to A2-32 are reserved for the user to create a list of User Parameters. 1: Save history of recently viewed parameters. Recently edited parameters will be saved to A2-17 through A2-32 for quicker access.	Default: 1 <2> Range: 0, 1	23

<1> Default setting value is dependent on the Application Preset selected with parameter A1-06.

<2> Default setting value is dependent on parameter A1-06. Default is 0 when A1-06 = 0, and 1 when A1-06 ≠ 0.

A.4 b: Application

Application parameters configure the source of the Run command, DC Injection Braking, Speed Search, timer functions, PI control, Energy Savings, and a variety of other application-related settings.

◆ b1: Operation Mode Selection

No. (Addr. Hex)	Name	LCD Display	Description	Values	Page
b1-01 (180)	Frequency Reference Selection for AUTO mode	Ref Source 1 0: Operator 1: Analog Input 2: Serial Com 3: Option PCB	0: HOA keypad 1: Terminals (Analog Input Terminals) 2: Serial communications (APOGEE FLN, BACnet, MEMOBUS/Modbus, or Metasys N2) 3: Option card	Default: 1 Range: 0 to 3	24
b1-02 (181)	Run Command Selection for AUTO mode	Run Source 1 1: Digital Inputs 2: Communication 3: Option PCB	1: Control Circuit Terminal 2: Serial communications (APOGEE FLN, BACnet, MEMOBUS/Modbus, or Metasys N2) 3: Option card	Default: 1 Range: 1 to 3	25
b1-03 (182)	Stopping Method Selection	Stopping Method 0: Ramp to Stop 1: Coast to Stop 2: DCInj to Stop 3: Coast w/Timer	0: Ramp to stop 1: Coast to stop 2: DC Injection Braking to stop 3: Coast with timer	Default: 1 Range: 0 to 3	26
b1-04 (183)	Reverse Operation Selection	Reverse Oper 0: Reverse Enabled 1: Reverse Disabled	0: Reverse enabled 1: Reverse disabled	Default: 1 Range: 0, 1	28
b1-08 (187)	Run Command Selection in Programming Mode	RUN dur PRG Mode 0: Run Disabled@PRG 1: ModeRun Enabled@PRG 2: Prg only @ Stop	0: Run command is not accepted while in Programming Mode 1: Run command is accepted while in Programming 2: Prohibit entering Programming Mode during Run	Default: 0 Range: 0 to 2	28
b1-11 (1DF)	Drive Delay Time Setting	Run Delay Time	After a Run command is entered, the drive output waits until this delay time has passed before starting.	Default: 0 s Min.: 0 Max.: 600	28
b1-14 (1C3)	Phase Order Selection	Rotation Sel 0: Standard 1: SwitchPhaseOrder	0: Standard 1: Switch phase order (reverses the direction of the motor)	Default: 0 Range: 0, 1	28
b1-17 (1C6)	Run Command at Power Up	Run Cmd @ Pwr On 0: Cycle Ext Run 1: Accept Ext Run	0: Disregarded. A new Run command must be issued after power up. 1: Allowed. Motor will start immediately after power up if a Run command is already enabled.	Default: 1 Range: 0, 1	29

◆ b2: DC Injection Braking and Short Circuit Braking

No. (Addr. Hex)	Name	LCD Display	Description	Values	Page
b2-01 (189)	DC Injection Braking Start Frequency	DCInj Start Freq	Sets the frequency at which DC Injection Braking starts when “Ramp to stop” (b1-03 = 0) is selected.	Default: <1> Min.: 0.0 Hz Max.: 10.0 Hz	29
b2-02 (18A)	DC Injection Braking Current	DCInj Current	Sets the DC Injection Braking current as a percentage of the drive rated current.	Default: 50% Min.: 0 Max.: 100	30
b2-03 (18B)	DC Injection Braking Time at Start	DCInj Time@Start	Sets DC Injection Braking time at start. Disabled when set to 0.00 seconds.	Default: 0.00 s Min.: 0.00 Max.: 10.00	30
b2-04 (18C)	DC Injection Braking Time at Stop	DCInj Time@Stop	Sets DC Injection Braking time at stop.	Default: 0.00 s Min.: 0.00 Max.: 10.00	30
b2-09 (1E1)	Motor Pre-Heat Current 2	Preheat Current	Determines the percentage of motor rated output current used for the motor pre-heat function.	Default: 5% Min.: 0 Max.: 100	30

No. (Addr. Hex)	Name	LCD Display	Description	Values	Page
b2-12 (1BA)	Short Circuit Brake Time at Start	SC Brake T@Start	OLV/PM Sets the time for Short Circuit Braking operation at start.	Default: 0.00 s Min.: 0.00 Max.: 25.50	30
b2-13 (1BB)	Short Circuit Brake Time at Stop	SC Brake T@Stop	OLV/PM Sets the Short Circuit Braking operation time at stop.	Default: 0.50 s Min.: 0.00 Max.: 25.50	31
b2-18 (177)	Short Circuit Braking Current	Shrt Cir Brk	OLV/PM Determines the current level for Short Circuit Braking. Set as a percentage of the motor rated current.	Default: 100.0% Min.: 0.0 Max.: 200.0	31

<1> Default setting is determined by parameter A1-02, Control Method Selection.

◆ b3: Speed Search

No. (Addr Hex.)	Name	LCD Display	Description	Values	Page
b3-01 (191)	Speed Search Selection at Start	SpdSrch at Star 0: Disabled 1: Enabled	0: Disabled 1: Enabled	Default: <1> Range: 0, 1	34
b3-02 (192)	Speed Search Deactivation Current	SpdSrch DeactCur	Sets the current level at which the speed is assumed to be detected and Speed Search is ended. Set as a percentage of the drive rated current.	Default: <1> Min.: 0% Max.: 200%	34
b3-03 (193)	Speed Search Deceleration Time	SpdSrch Dec Time	Sets output frequency reduction time during Speed Search.	Default: 2.0 s Min.: 0.1 Max.: 10.0	34
b3-04 (194)	V/f Gain during Speed Search	SpdSrch V/f	Determines how much to lower the V/f ratio during Speed Search. Output voltage during Speed Search equals the V/f setting multiplied by b3-04.	Default: <2> Min.: 10% Max.: 100%	34
b3-05 (195)	Speed Search Delay Time	Search Delay	When using an external contactor on the output side, b3-05 delays executing Speed Search after a momentary power loss to allow time for the contactor to close.	Default: 0.2 s Min.: 0.0 Max.: 100.0	34
b3-06 (196)	Output Current 1 during Speed Search	Srch Im Lvl1	Sets the current injected to the motor at the beginning of Speed Estimation Speed Search. Set as a coefficient for the motor rated current.	Default: <2> Min.: 0.0 Max.: 2.0	35
b3-07 (197)	Output Current 2 during Speed Search (Speed Estimation Type)	Srch Im Lvl2	Sets the amount of output current during Speed Estimation Speed Search as a coefficient for the no-load current (output current during Speed Search is automatically limited by the drive rated current). Increase this setting value in increments of 0.1 if the drive fails to perform Speed Estimation.	Default: 1.0 Min.: 0.0 Max.: 5.0	35
b3-08 (198)	Current Control Gain during Speed Search (Speed Estimation Type)	Srch ACR P Gain	Sets the proportional gain for the current controller during Speed Search.	Default: <1> <2> Min.: 0.00 Max.: 6.00	35
b3-09 (199)	Current Control Integral Time during Speed Search (Speed Estimation Type)	Srch ACR I Time	Sets the Integral Time for the current controller during Speed Search.	Default: <1> Min.: 0.0 ms Max.: 1000.0 ms	35
b3-10 (19A)	Speed Search Detection Compensation Gain	Srch Detect Comp	Sets the gain which is applied to the speed detected by Speed Estimation Speed Search before the motor is reaccelerated. Increase this setting if ov occurs when performing Speed Search after a relatively long period of baseblock.	Default: 1.05 Min.: 1.00 Max.: 1.20	35
b3-11 (19B)	Speed Search Method Switching Level (Speed Estimation Type)	Srch Mthd Sw Lvl	Uses the amount of voltage remaining in the motor to automatically switch the search method within the type of speed measurement. (200 V class at 100% = 200 V; 400 V class at 100% = 400 V)	Default: 5.0% Min.: 0.5 Max.: 100.0	35
b3-12 (19C)	Minimum Current Detection Level during Speed Search	Srch I Deadband	Sets the minimum current detection level during Speed Search. Increase this setting value in increments of 0.1 if the drive fails to perform Speed Estimation.	Default: <2> Min.: 2.0 Max.: 10.0	35

No. (Addr Hex.)	Name	LCD Display	Description	Values	Page
b3-14 (19E)	Bi-Directional Speed Search Selection	Bidir Search Sel 0: Disabled 1: Enabled	0: Disabled (uses the direction of the frequency reference) 1: Enabled (drive detects which way the motor is rotating)	Default: <1> Range: 0, 1	36
b3-17 (1F0)	Speed Search Restart Current Level	SrchRestart Lvl	Sets the Speed Search restart current level as a percentage of the drive rated current.	Default: 110% Min.: 0 Max.: 200	36
b3-18 (1F1)	Speed Search Restart Detection Time	SrchRestart Time	Sets the time to detect Speed Search restart.	Default: 0.10 s Min.: 0.00 Max.: 1.00	36
b3-19 (1F2)	Number of Speed Search Restarts	Num of SrchRestr	Sets the number of times the drive can attempt to restart when performing Speed Search.	Default: 3 Min.: 0 Max.: 10	36
b3-24 (1C0)	Speed Search Method Selection	SpdSrch Method 0: CurrentDetection 1: Speed Estimation	0: Current Detection 1: Speed Estimation	Default: 0 Range: 0, 1	36
b3-25 (1C8)	Speed Search Wait Time	SpdSrch WaitTime	Sets the time the drive must wait between each Speed Search restart attempt.	Default: 0.5 s Min.: 0.0 Max.: 300.0	36
b3-27 (1C9)	Start Speed Search Select	Start srch sel 0: Start from 0 1: Start Fref>Fmin	Selects a condition to activate Speed Search Selection at Start (b3-01) or External Speed Search Command 1 or 2 from the multi-function input. 0: Triggered when a Run command is issued. (normal). 1: Triggered when an external baseblock is released.	Default: 0 Range: 0, 1	37

<1> Default setting is determined by parameter A1-02, Control Method Selection.

<2> Default setting is dependent on parameter o2-04, Drive Model Selection.

◆ b4: Timer Function

No. (Addr. Hex)	Name	LCD Display	Description	Values	Page
b4-01 (1A3)	Timer Function On-Delay Time	Delay-ON Timer	Sets the on-delay and off-delay times for a digital timer output (H2-☐☐=12). The output is triggered by a digital input programmed to H1-☐☐=18).	Default: 0.0 s Min.: 0.0 Max.: 3000.0	37
b4-02 (1A4)	Timer Function Off-Delay Time	Delay-OFF Timer		Default: 0.0 s Min.: 0.0 Max.: 3000.0	37

◆ b5: PI Control

No. (Addr. Hex)	Name	LCD Display	Description	Values	Page
b5-01 (1A5)	PI Function Setting	PID Mode 0: Disabled 1: Enabled D=Fdbk 3: Fref+PID D=Fdbk	0: Disabled 1: Enabled (PI output becomes output frequency reference) 3: Enabled (PI output added to frequency reference)	Default: 0 Range: 0, 1, 3	41
b5-02 (1A6) RUN	Proportional Gain Setting (P)	PID Gain	Sets the proportional gain of the PI controller.	Default: 2.00 Min.: 0.00 Max.: 25.00	41
b5-03 (1A7) RUN	Integral Time Setting (I)	PID I Time	Sets the integral time for the PI controller.	Default: 0.5 s Min.: 0.0 Max.: 360.0	41
b5-04 (1A8) RUN	Integral Limit Setting	PID I Limit	Sets the maximum output possible from the integrator as a percentage of the maximum output frequency.	Default: 100.0% Min.: 0.0 Max.: 100.0	41
b5-06 (1AA) RUN	PI Output Limit	PID Limit	Sets the maximum output possible from the entire PI controller as a percentage of the maximum output frequency.	Default: 100.0% Min.: 0.0 Max.: 100.0	41

No. (Addr. Hex)	Name	LCD Display	Description	Values	Page
b5-07 (1AB) RUN	PI Offset Adjustment	PID Offset	Applies an offset to the PI controller output. Set as a percentage of the maximum output frequency.	Default: 0.0% Min.: -100.0 Max.: 100.0	41
b5-08 (1AC) RUN	PI Primary Delay Time Constant	PID Delay Time	Sets a low pass filter time constant on the output of the PI controller.	Default: 0.00 s Min.: 0.00 Max.: 10.00	41
b5-09 (1AD)	PI Output Level Selection	Output Level Sel 0: Normal Character 1: Rev Character	0: Normal output (direct acting) 1: Reverse output (reverse acting)	Default: 0 Range: 0, 1	42
b5-10 (1AE)	PI Output Gain Setting	Output Gain	Sets the gain applied to the PI output.	Default: 1.00 Min.: 0.00 Max.: 25.00	42
b5-11 (1AF)	PI Output Reverse Selection	Output Rev Sel 0: 0 limit 1: Reverse	0: Negative PI output triggers zero limit. 1: Rotation direction reverses with negative PI output. **Note:** When using setting 1, make sure reverse operation is permitted by b1-04.	Default: 0 Range: 0, 1	42
b5-12 (1B0)	PI Feedback Loss Detection Selection	Fb loss Det Sel 0: DO Only - Always 1: Alarm - Always 2: Fault - Always 3: DO Only@PID Enbl 4: Alarm @ PID Enbl 5: Fault @ PID Enbl	0: Digital Output Only (Remains active when PI is disabled by digital input) 1: Alarm output, drive continues operation (Remains active when PI is disabled by digital input) 2: Fault output, drive output is shut off (Remains active when PI is disabled by digital input) 3: Digital output only. No detection when PI is disabled by digital input. 4: Alarm detection. No detection when PI is disabled by digital input. 5: Fault detection. No detection when PI is disabled by digital input.	Default: 0 Range: 0 to 5	43
b5-13 (1B1)	PI Feedback Loss Detection Level	Fb loss Det Lvl	Sets the PI feedback loss detection level as a percentage of the maximum output frequency.	Default: 0% Min.: 0 Max.: 100	44
b5-14 (1B2)	PI Feedback Loss Detection Time	Fb loss Det Time	Sets a delay time for PI feedback loss.	Default: 1.0 s Min.: 0.0 Max.: 25.5	44
b5-15 (1B3)	PI Sleep Function Start Level	PID Sleep Level	Sets the frequency level that triggers the sleep/snooze function.	Default: <1> Min.: 0.0 Hz Max.: 240.0 Hz	45
b5-16 (1B4)	PI Sleep Delay Time	PID Sleep Time	Sets a delay time before the sleep/snooze function is triggered.	Default: 0.0 s Min.: 0.0 Max.: 25.5	45
b5-17 (1B5)	PI Accel/Decel Time	PID Acc/Dec Time	Sets the acceleration and deceleration time to PI setpoint.	Default: 0.0 s Min.: 0.0 Max.: 6000.0	45
b5-18 (1DC)	PI Setpoint Selection	PID Setpoint Sel 0: Disabled 1: Enabled	0: Disabled 1: Enabled	Default: 0 Range: 0, 1	45
b5-19 (1DD)	PI Setpoint Value	PID Setpoint	Sets the PI target value when b5-18 = 1. Set as a percentage of the maximum output frequency.	Default: 0.00% Min.: 0.00 Max.: 600.00 <2>	45
b5-20 (1E2)	PI Setpoint Scaling	PID Disp Scaling 0: 0.01Hz units 1: 0.01% units 2: r/min 3: User Units	0: 0.01 Hz units 1: 0.01% units (100% = max output frequency) 2: r/min (number of motor poles must entered) 3: User-set (set scaling to b5-38 and b5-39)	Default: 1 Range: 0 to 3	45
b5-21 (1E3)	PI Sleep Input Source	PI Sleep Ref 0: PI Setpoint 1: Frequency Ref 2: Snooze Func	Input source selection for Sleep Function mode. 0: PI Setpoint 1: SFS Input 2: Snooze	Default: 1 Range: 0 to 2	46
b5-22 (1E4)	PI Snooze Level	Snooze Level	Sets the PI Snooze Function start level as a percentage of the maximum frequency.	Default: 0% Min.: 0 Max.: 100	46

No. (Addr. Hex)	Name	LCD Display	Description	Values	Page
b5-23 (1E5)	PI Snooze Delay Time	Snooze DelayTime	Sets the PI Snooze Function delay time in seconds.	Default: 0s Min.: 0 Max.: 2600	46
b5-24 (1E6)	PI Snooze Deactivation Level	SnoozeRestartLvl	When the PI feedback level drops below this level, the drive returns to normal operation. Set as a percentage of the maximum frequency.	Default: 0% Min.: 0 Max.: 100	46
b5-25 (1E7)	PI Setpoint Boost Setting	SetpointBoostLvl	Temporarily increases the PI setpoint to create an overshoot of the intended PI setpoint.	Default: 0% Min.: 0 Max.: 100	46
b5-26 (1E8)	PI Maximum Boost Time	SetpointBoostTim	Sets the maximum boost time when PI feedback does not reach boost level. The Snooze Function starts when the PI feedback exceeds the boost setting level or when the boost time expires.	Default: 0s Min.: 0 Max.: 2600	46
b5-27 (1E9)	PI Snooze Feedback Level	Snooze Reset Lvl	Sets the PI feedback level above which Snooze mode is activated. Set as a percentage of the maximum frequency.	Default: 60% Min.: 0 Max.: 100	47
b5-28 (1EA)	PI Feedback Function Selection	PI Fdbk Sqrt Sel 0: Disabled 1: Enabled	0: Disabled 1: Square root	Default: 0 Range: 0, 1	47
b5-29 (1EB)	PI Square Root Gain	PI Fdbk SqrtGain	A multiplier applied to the square root of the feedback.	Default: 0.00 Min.: 0.00 Max.: 2.00	47
b5-30 (1EC)	PI Feedback Offset	PI Fdbk Offset	PI feedback offset set as a percentage of the maximum frequency.	Default: 0.00 Min.: 0.00 Max.: 100.00	47
b5-34 (19F) RUN	PI Output Lower Limit	PID Out Low Lim	Sets the minimum output possible from the PI controller as a percentage of the maximum output frequency.	Default: 0.0% Min.: -100.0 Max.: 100.0	47
b5-35 (1A0) RUN	PI Input Limit	PID Input Limit	Limits the PI control input (deviation signal) as a percentage of the maximum output frequency. Acts as a bipolar limit.	Default: 1000.0% Min.: 0.0 Max.: 1000.0	47
b5-36 (1A1)	PI Feedback High Detection Level	Fb High Det Lvl	Sets the PI feedback high detection level as a percentage of the maximum output frequency.	Default: 100% Min.: 0 Max.: 100	44
b5-37 (1A2)	PI Feedback High Detection Time	Fb High Dly Time	Sets the PI feedback high level detection delay time.	Default: 1.0 s Min.: 0.0 Max.: 25.5	44
b5-38 (1FE)	PI Setpoint User Display	PID UsrDspMaxVal	Sets the display value of U5-01 and U5-04 when the maximum frequency is output.	Default: <3> Min.: 1 Max.: 60000	47
b5-39 (1FF)	PI Setpoint Display Digits	PID UsrDspDigits 0: No Dec (XXXXX) 1: 1 Dec (XXXX.X) 2: 2 Dec (XXX.XX) 3: 3 Dec (XX.XXX)	0: No decimal places 1: One decimal place 2: Two decimal places 3: Three decimal places	Default: <3> Range: 0 to 3	47
b5-40 (17F)	Frequency Reference Monitor Content during PI	Fref Mon Sel@PID 0: Fref Mon w PID 1: Fref Mon w/o PID	0: Display the frequency reference (U1-01) after PI compensation has been added. 1: Display the frequency reference (U1-01) before PI compensation has been added.	Default: 0 Range: 0, 1	48

No. (Addr. Hex)	Name	LCD Display	Description	Values	Page
b5-41 (160)	PI Unit Selection	PI Mon Unit Sel 0: WC 1: PSI 2: GPM 3: °F 4: CFM 5: CMH 6: LPH 7: LPS 8: Bar 9: Pa 10: °C 11: Mtr 12: Ft 13: LPM 14: CMM	0: WC (Inch of water) 1: PSI (Pounds per square inch) 2: GPM (Gallons per minute) 3: F (Degrees Fahrenheit) 4: CFM (Cubic feet per minute) 5: CMH (Cubic meters per hour) 6: LPH (Liters per hour) 7: LPS (Liters per second) 8: Bar (Bar) 9: Pa (Pascal) 10: C (Degrees Celsius) 11: Mtr (Meters) 12: Ft (Feet) 13: LPM (Liters per minute) 14: CMM (Cubic meters per minute)	Default: 0 Range: 0 to 14	48
b5-42 (161) RUN	PI Output Monitor Calculation Method	PI Out Calc Mode 0: Linear 1: Square root 2: 1/f2 3: 1/f3	0: Linear - the monitor displays PI output 1: Square root - the monitor displays square root PI output 2: Quadratic - the monitor displays 1/(PI output) 3: Cubic - the monitor displays 1/(PI output)	Default: 0 Range: 0 to 3	48
b5-43 (162) RUN	Custom PI Output Monitor Setting 1	PI Out MonMax U4	Set maximum monitor value at maximum frequency. U5-07 and U5-08 show Custom PI output. U5-43 shows the upper four digits and U5-44 shows the lower four digits. It shows 999999.99 maximum.	Default: 0 Min.: 0 Max.: 9999	49
b5-44 (163) RUN	Custom PI Output Monitor Setting 2	PI Out MonMax L4	Sets the minimum display value at zero speed. b5-07 and b5-08 show Custom PI output. This function is effective when b5-42 is set to 1 (Linear unit)	Default: 0 Min.: 0 Max.: 99.99	49
b5-45 (164) RUN	Custom PI Output Monitor Setting 3	PI Out MonMin		Default: 0 Min.: 0 Max.: 999.9	49
b5-46 (165)	PI Setpoint Monitor Unit Selection	PI Mon Unit Sel 0: WC 1: PSI 2: GPM 3: °F 4: CFM 5: CMH 6: LPH 7: LPS 8: Bar 9: Pa 10: °C 11: Mtr 12: Ft 13: LPM 14: CMM	0: WC (Inch of water) 1: PSI (Pounds per square inch) 2: GPM (Gallons per minute) 3: F (Degrees Fahrenheit) 4: CFM (Cubic feet per minute) 5: CMH (Cubic meters per hour) 6: LPH (Liters per hour) 7: LPS (Liters per second) 8: Bar (Bar) 9: Pa (Pascal) 10: C (Degrees Celsius) 11: Mtr (Meters) 12: Ft (Feet) 13: LPM (Liters per minute) 14: CMM (Cubic meters per minute)	Default: 0 Range: 0 to 14	49
b5-47 (17D)	Reverse Operation Selection 2 by PI Output	Output Rev Sel2 0: 0 limit 1: Reverse	Reverse operation selection when b5-01 = 3 0: Reverse Disabled 1: Reverse Enabled	Default: 1 Range: 0, 1	49

<1> Default setting is determined by parameter A1-02, Control Method Selection.

<2> Internally limited to the value of b5-38 in drive software versions PRG: 1014 and later. Changing b5-20, b5-38, and b5-39 will not automatically update the value of this parameter.

<3> Default setting is dependent on parameter b5-20, PI Setpoint Scaling.

◆ b8: Energy Saving

No. (Addr. Hex)	Name	LCD Display	Description	Values	Page
b8-01 (1CC)	Energy Saving Control Selection	Energy Save Sel 0: Disabled 1: Enabled	0: Disabled 1: Enabled	Default: <1> Range: 0, 1	
b8-04 (1CF)	Energy Saving Coefficient Value	Energy Save COEF	Determines the level of maximum motor efficiency. Setting range is 0.0 to 2000.0 for drives 3.7 kW and smaller.	Default: <2> <3> Min.: 0.00 Max.: 655.00	51
b8-05 (1D0)	Power Detection Filter Time	kW Filter Time	Sets a time constant filter for output power detection.	Default: 20 ms Min.: 0 Max.: 2000	51
b8-06 (1D1)	Search Operation Voltage Limit	Search V Limit	Sets the limit for the voltage search operation as a percentage of the motor rated voltage.	Default: 0% Min.: 0 Max.: 100	51

<1> Default setting is determined by parameter A1-02, Control Method Selection.

<2> Default setting is determined by parameters A1-02, Control Method Selection, and o2-04, Drive Model Selection.

<3> Parameter value changes automatically if E2-11 is manually changed or changed by Auto-Tuning.

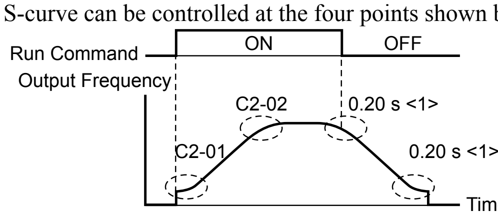
A.5 C: Tuning

C parameters are used to adjust the acceleration and deceleration times, S-curves, torque compensation, and carrier frequency selections.

◆ C1: Acceleration and Deceleration Times

No. (Addr. Hex)	Name	LCD Display	Description	Values	Page
C1-01 (200) RUN	Acceleration Time 1	Accel Time 1	Sets the time to accelerate from 0 to maximum frequency.	Default: 30.0 s Min.: 0.1 Max.: 6000.0	52
C1-02 (201) RUN	Deceleration Time 1	Decel Time 1	Sets the time to decelerate from maximum frequency to 0.		52
C1-03 (202) RUN	Acceleration Time 2	Accel Time 2	Sets the time to accelerate from 0 to maximum frequency.	Default: 30.0 s Min.: 0.1 Max.: 6000.0	52
C1-04 (203) RUN	Deceleration Time 2	Decel Time 2	Sets the time to decelerate from maximum frequency to 0.		52
C1-09 (208)	Fast Stop Time	Fast Stop Time	Sets the time for the Fast Stop function.	Default: 10.0 s Min.: 0.1 Max.: 6000.0	53
C1-11 (20A)	Accel/Decel Time Switching Frequency	Acc/Dec SW Freq	Sets the frequency to switch between accel/decel time settings. Setting units are determined by parameter A1-02, Control Method Selection.	Default: 0.0 Hz Min.: 0.0 Max.: 240.0	53

◆ C2: S-Curve Characteristics

No. (Addr. Hex)	Name	LCD Display	Description	Values	Page
C2-01 (20B)	S-Curve Characteristic at Accel Start	SCrv Acc @ Start	The S-curve can be controlled at the four points shown below. 	Default: <2> Min.: 0.00 s Max.: 10.00 s	53
C2-02 (20C)	S-Curve Characteristic at Accel End	SCrv Acc @ End		Default: 0.20 s Min.: 0.00 Max.: 10.00	53

<1> S-curve characteristics at decel start/end are fixed to 0.20 s.

<2> Default setting is determined by parameter A1-02, Control Method Selection.

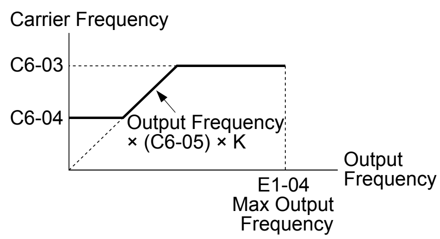
◆ C4: Torque Compensation

No. (Addr. Hex)	Name	LCD Display	Description	Values	Page
C4-01 (215) RUN	Torque Compensation Gain	Torq Comp Gain	Sets the gain for the automatic torque (voltage) boost function and helps to produce better starting torque. Used for motor 1.	Default: <1> Min.: 0.00 Max.: 2.50	54
C4-02 (216) RUN	Torque Compensation Primary Delay Time 1	Torq Comp Time	Sets the torque compensation filter time.	Default: <2> Min.: 0 ms Max.: 60000 ms	54

<1> Default setting is determined by parameter A1-02, Control Method Selection.

<2> Default setting is determined by parameters A1-02, Control Method Selection, and o2-04, Drive Model Selection.

◆ C6: Carrier Frequency

No. (Addr. Hex)	Name	LCD Display	Description	Values	Page
C6-02 (224)	Carrier Frequency Selection	CarrierFreq Sel 1: 2.0 kHz 2: 5.0 kHz 3: 8.0 kHz 4: 10.0 kHz 5: 12.5 kHz 6: 15.0 kHz 7: Swing PWM1 8: Swing PWM2 9: Swing PWM3 A: Swing PWM4 F: Program	1: 2.0 kHz 2: 5.0 kHz 3: 8.0 kHz 4: 10.0 kHz 5: 12.5 kHz 6: 15.0 kHz 7: Swing PWM1 (Audible sound 1) 8: Swing PWM2 (Audible sound 2) 9: Swing PWM3 (Audible sound 3) A: Swing PWM4 (Audible sound 4) B to E: No setting possible F: User-defined (determined by C6-03 through C6-05)	Default: <1> Range: 1 to 9; A, F	55
C6-03 (225)	Carrier Frequency Upper Limit	CarrierFreq Max	Determines the upper and lower limits for the carrier frequency.  	Default: <2> Min.: 1.0 kHz Max.: 15.0 kHz	55
C6-04 (226)	Carrier Frequency Lower Limit	CarrierFreq Min		Default: <2> Min.: 1.0 kHz Max.: 15.0 kHz	55
C6-05 (227)	Carrier Frequency Proportional Gain	CarrierFreq Gain		Default: <2> Min.: 0 Max.: 99	55

<1> Default setting value is dependent on parameters A1-02, Control Method Selection and o2-04, Drive Model Selection.

<2> Default setting value is dependent on parameter C6-02, Carrier Frequency Selection.

A.6 d: References

Reference parameters set the various frequency reference values during operation.

◆ d1: Frequency Reference

No. (Addr. Hex)	Name	LCD Display	Description	Values	Page
d1-01 (280) RUN	Frequency Reference 1	Reference 1	Sets the frequency reference for the drive. Setting units are determined by parameter o1-03.	Default: 0.00 Hz Min.: 0.00 Max.: 240.00 <1>	58
d1-02 (281) RUN	Frequency Reference 2	Reference 2	Sets the frequency reference for the drive. Setting units are determined by parameter o1-03.	Default: 0.00 Hz Min.: 0.00 Max.: 240.00 <1>	58
d1-03 (282) RUN	Frequency Reference 3	Reference 3	Sets the frequency reference for the drive. Setting units are determined by parameter o1-03.	Default: 0.00 Hz Min.: 0.00 Max.: 240.00 <1>	58
d1-04 (283) RUN	Frequency Reference 4	Reference 4	Sets the frequency reference for the drive. Setting units are determined by parameter o1-03.	Default: 0.00 Hz Min.: 0.00 Max.: 240.00 <1>	58
d1-16 (291) RUN	Frequency Reference 16	Reference 16	Sets the frequency reference for the drive. Setting units are determined by parameter o1-03.	Default: 0.00 Hz Min.: 0.00 Max.: 240.00 <1>	58
d1-17 (292) RUN	Jog Frequency Reference	Jog Reference	Sets the Jog frequency reference. Setting units are determined by parameter o1-03.	Default: 6.00 Hz Min.: 0.00 Max.: 240.0 <1>	58

<1> Range upper limit is determined by parameters d2-01, Frequency Reference Upper Limit, and E1-04, Maximum Output Frequency.

◆ d2: Frequency Upper/Lower Limits

No. (Addr. Hex.)	Name	LCD Display	Description	Setting	Page
d2-01 (289)	Frequency Reference Upper Limit	Ref Upper Limit	Sets the frequency reference upper limit as a percentage of the maximum output frequency.	Default: 100.0% Min.: 0.0 Max.: 110.0	59
d2-02 (28A)	Frequency Reference Lower Limit	Ref Lower Limit	Sets the frequency reference lower limit as a percentage of the maximum output frequency.	Default: 0.0% Min.: 0.0 Max.: 110.0	59
d2-03 (293)	Master Speed Reference Lower Limit	Ref1 Lower Limit	Sets the lower limit for frequency references from analog inputs as a percentage of the maximum output frequency.	Default: 0.0% Min.: 0.0 Max.: 110.0	60

◆ d3: Jump Frequency

No. (Addr. Hex)	Name	LCD Display	Description	Values	Page
d3-01 (294)	Jump Frequency 1	Jump Freq 1	Eliminates problems with resonant vibration of the motor/ machine by avoiding continuous operation in predefined frequency ranges. The drive accelerates and decelerates the motor through the prohibited frequency ranges. Setting 0.0 disables this function. Parameters must be set so that d3-01 ≥ d3-02 ≥ d3-03.	Default: 0.0 Hz Min.: 0.0 Max.: 240.0	60
d3-02 (295)	Jump Frequency 2	Jump Freq 2	Eliminates problems with resonant vibration of the motor/ machine by avoiding continuous operation in predefined frequency ranges. The drive accelerates and decelerates the motor through the prohibited frequency ranges. Setting 0.0 disables this function. Parameters must be set so that d3-01 ≥ d3-02 ≥ d3-03.	Default: 0.0 Hz Min.: 0.0 Max.: 240.0	60

No. (Addr. Hex)	Name	LCD Display	Description	Values	Page
d3-03 (296)	Jump Frequency 3	Jump Freq 3	Eliminates problems with resonant vibration of the motor/ machine by avoiding continuous operation in predefined frequency ranges. The drive accelerates and decelerates the motor through the prohibited frequency ranges. Setting 0.0 disables this function. Parameters must be set so that d3-01 ≥ d3-02 ≥ d3-03.	Default: 0.0 Hz Min.: 0.0 Max.: 240.0	60
d3-04 (297)	Jump Frequency Width	Jump Bandwidth	Sets the dead-band width around each selected prohibited frequency reference point.	Default: 1.0 Hz Min.: 0.0 Max.: 20.0	60

◆ d4: Frequency Reference Hold Function

No. (Addr. Hex)	Name	LCD Display	Description	Values	Page
d4-01 (298)	Frequency Reference Hold Function Selection	Fref Hold Sel 0: Disabled 1: Enabled	0: Disabled. Drive starts from zero when the power is switched on. 1: Enabled. At power up, the drive starts the motor at the Hold frequency that was saved.	Default: 0 Range: 0, 1	61
d4-10 (2B6)	Up/Down Frequency Reference Limit Selection	Up/Dn LowLim Sel 0: D2-02 or Analog 1: D2-02 Only	0: The lower limit is determined by d2-02 or an analog input. 1: The lower limit is determined by d2-02.	Default: 0 Range: 0, 1	61

◆ d6: Field Weakening

No. (Addr. Hex)	Name	LCD Display	Description	Values	Page
d6-01 (2A0)	Field Weakening Level	Field-Weak Lvl	Sets the drive output voltage for the Field Weakening function as a percentage of the maximum output voltage. Enabled when a multi-function input is set for Field Weakening (H1-☐☐ = 63).	Default: 80% Min.: 0 Max.: 100	62
d6-02 (2A1)	Field Weakening Frequency Limit	Field-Weak Freq	Sets the lower limit of the frequency range where Field Weakening control is valid. The Field Weakening command is valid only at frequencies above this setting and only when the output frequency matches the frequency reference (speed agree).	Default: 0.0 Hz Min.: 0.0 Max.: 240.0	62

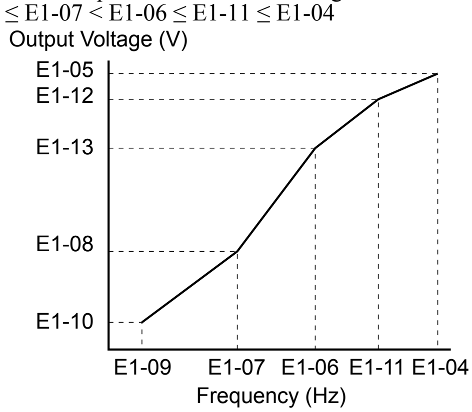
◆ d7: Offset Frequency

No. (Addr. Hex)	Name	LCD Display	Description	Setting	Page
d7-01 (2B2) RUN	Offset Frequency 1	Offset Freq 1	Added to the frequency reference when the digital input "Frequency offset 1" (H1-☐☐ = 44) is switched on.	Default: 0.0% Min.: -100.0 Max.: 100.0	62
d7-02 (2B3) RUN	Offset Frequency 2	Offset Freq 2	Added to the frequency reference when the digital input "Frequency offset 2" (H1-☐☐ = 45) is switched on.	Default: 0.0% Min.: -100.0 Max.: 100.0	62
d7-03 (2B4) RUN	Offset Frequency 3	Offset Freq 3	Added to the frequency reference when the digital input "Frequency offset 3" (H1-☐☐ = 46) is switched on.	Default: 0.0% Min.: -100.0 Max.: 100.0	62

A.7 E: Motor Parameters

◆ E1: V/f Pattern for Motor 1

<table>
<tr><th>No. (Addr. Hex)</th><th>Name</th><th>LCD Display</th><th>Description</th><th>Values</th><th>Page</th></tr>
<tr><td>E1-01
(300)</td><td>Input Voltage Setting</td><td>Input Voltage</td><td>This parameter must be set to the power supply voltage.

WARNING! Electrical Shock Hazard. Drive input voltage (not motor voltage) must be set in E1-01 for the protective features of the drive to function properly. Failure to do so may result in equipment damage and/or death or personal injury.</td><td>Default: 230 V <1>
Min.: 190
Max.: 240 <1></td><td>63</td></tr>
<tr><td>E1-03
(302)</td><td>V/f Pattern Selection</td><td>V/F Selection
0: 50 Hz
1: 60 Hz Saturation
2: 60 Hz Saturation
3: 72 Hz
4: 50 Hz VT1
5: 50 Hz VT2
6: 60 Hz VT1
7: 60 Hz VT2
8: 50 Hz HST1
9: 50 Hz HST2
A: 60 Hz HST1
B: 60 Hz HST2
C: 90 Hz
D: 120 Hz
E: 180 Hz
F: Custom V/F</td><td>0: 50 Hz, Constant torque 1
1: 60 Hz, Constant torque 2
2: 60 Hz, Constant torque 3 (50 Hz base)
3: 72 Hz, Constant torque 4 (60 Hz base)
4: 50 Hz, Variable torque 1
5: 50 Hz, Variable torque 2
6: 60 Hz, Variable torque 3
7: 60 Hz, Variable torque 4
8: 50 Hz, High starting torque 1
9: 50 Hz, High starting torque 2
A: 60 Hz, High starting torque 3
B: 60 Hz, High starting torque 4
C: 90 Hz (60 Hz base)
D: 120 Hz (60 Hz base)
E: 180 Hz (60 Hz base)
F: Custom V/f E1-04 through E1-13 settings define the V/f pattern</td><td>Default: F <2>
Range: 0 to 9; A to F</td><td>63</td></tr>
<tr><td>E1-04
(303)</td><td>Maximum Output Frequency</td><td>Max Frequency</td><td rowspan="10">These parameters are only applicable when E1-03 is set to F. To set linear V/f characteristics, set the same values for E1-07 and E1-09.
In this case, the setting for E1-08 will be disregarded. Ensure that the four frequencies are set according to these rules:
E1-09 ≤ E1-07 < E1-06 ≤ E1-11 ≤ E1-04


Note: E1-07, E1-08, and E1-10 to E1-13 are not available in OLV/PM control mode.</td><td>Default: <3> <4>
Min.: 40.0 Hz
Max.: 240.0 Hz</td><td>66</td></tr>
<tr><td>E1-05
(304)</td><td>Maximum Voltage</td><td>Max Voltage</td><td>Default: <3> <4>
Min.: 0.0 V
Max.: 255.0 V <1></td><td>66</td></tr>
<tr><td>E1-06
(305)</td><td>Base Frequency</td><td>Base Frequency</td><td>Default: <3> <4>
Min.: 0.0 Hz
Max.: 240.0 Hz</td><td>66</td></tr>
<tr><td>E1-07
(306)</td><td>Middle Output Frequency</td><td>Mid Frequency A</td><td>Default: <3>
Min.: 0.0 Hz
Max.: 240.0 Hz</td><td>66</td></tr>
<tr><td>E1-08
(307)</td><td>Middle Output Frequency Voltage</td><td>Mid Voltage A</td><td>Default: <3>
Min.: 0.0 V
Max.: 255.0 V <1></td><td>66</td></tr>
<tr><td>E1-09
(308)</td><td>Minimum Output Frequency</td><td>Min Frequency</td><td>Default: <3> <4>
Min.: 0.0 Hz
Max.: 240.0 Hz</td><td>66</td></tr>
<tr><td>E1-10
(309)</td><td>Minimum Output Frequency Voltage</td><td>Min Voltage</td><td>Default: <3>
Min.: 0.0 V
Max.: 255.0 V <1></td><td>66</td></tr>
<tr><td>E1-11
(30A) <6></td><td>Middle Output Frequency 2</td><td>Mid Frequency B</td><td>Default: 0.0 Hz
Min.: 0.0
Max.: 240.0</td><td>66</td></tr>
<tr><td>E1-12
(30B) <6></td><td>Middle Output Frequency Voltage 2</td><td>Mid Voltage B</td><td>Default: 0.0 V
Min.: 0.0
Max.: 255.0 <1></td><td>66</td></tr>
<tr><td>E1-13
(30C)</td><td>Base Voltage</td><td>Base Voltage</td><td>Default: 0.0 V <5>
Min.: 0.0
Max.: 255.0 <1></td><td>66</td></tr>
</table>

<1> Values shown are specific to 200 V class drives. Double the value for 400 V class drives.
<2> Parameter setting value is not reset to the default value when the drive is initialized.
<3> Default setting is dependent on parameters A1-02, Control Model Selection and o2-04, Drive Model Selection.
<4> Default setting is dependent on parameter o2-04, Drive Model Selection.
<5> When Auto-Tuning is performed, E1-13 and E1-05 will be set to the same value.
<6> Parameter ignored when E1-11 (Motor 1 Mid Output Frequency 2) and E1-12 (Motor 1 Mid Output Frequency Voltage 2) are set to 0.0.

◆ E2: Motor Parameters

No. (Addr. Hex)	Name	LCD Display	Description	Values	Page
E2-01 (30E)	Motor Rated Current	Motor Rated FLA	Sets the motor nameplate full load current in amps. Automatically set during Auto-Tuning.	Default: <1> Min.: 10% of drive rated current Max.: 200% of drive rated current <2>	67
E2-02 (30F)	Motor Rated Slip	Motor Rated Slip	Sets the motor rated slip. Automatically set during Auto-Tuning.	Default: <1> Min.: 0.00 Hz Max.: 20.00 Hz	67
E2-03 (310)	Motor No-Load Current	No-Load Current	Sets the no-load current for the motor. Automatically set during Auto-Tuning.	Default: <1> Min.: 0 A Max.: E2-01 <2>	68
E2-04 (311)	Number of Motor Poles	Number of Poles	Sets the number of motor poles. Automatically set during Auto-Tuning.	Default: 4 Min.: 2 Max.: 48	68
E2-05 (312)	Motor Line-to-Line Resistance	Term Resistance	Sets the phase-to-phase motor resistance. Automatically set during Auto-Tuning.	Default: <1> Min.: 0.000 Ω Max.: 65.000 Ω	68
E2-10 (317)	Motor Iron Loss for Torque Compensation	Motor Iron Loss	Sets the motor iron loss.	Default: <1> Min.: 0 W Max.: 65535 W	68
E2-11 (318)	Motor Rated Power	Mtr Rated Power	Sets the motor rated power in kilowatts (1 HP = 0.746 kW). Automatically set during Auto-Tuning.	Default: <1> Min.: 0.00 kW Max.: 370.00 kW	68

<1> Default setting is dependent on parameter o2-04, Drive Model Selection.
<2> The number of decimal places in the parameter value depends on the drive model. This value has two decimal places (0.01 A) if the drive is set for a maximum applicable motor capacity up to and including 11 kW, 2A0031, 4A0021 (input voltage 460 V or higher) or 4A0027 (input voltage lower than 460 V) and one decimal place (0.1 A) if the maximum applicable motor capacity is higher than 11 kW, 2A0046, 4A0027 (input voltage 460 V or higher) or 4A0034 (input voltage lower than 460 V) .

◆ E5: PM Motor Settings

No. (Addr. Hex)	Name	LCD Display	Description	Values	Page
E5-02 (32A) <1>	Motor Rated Power	PM Mtr Capacity	OLV/PM Sets the rated capacity of the motor.	Default: <2> Min.: 0.10 kW Max.: 370.00 kW	69
E5-03 (32B) <1>	Motor Rated Current	PM Mtr Rated FLA	OLV/PM Sets the motor rated current.	Default: <2> Min: 10% of drive rated current Max: 200% of drive rated current <3>	69
E5-04 (32C) <1>	Number of Motor Poles	PM Motor Poles	OLV/PM Sets the number of motor poles.	Default: <2> Min.: 2 Max.: 48	69

No. (Addr. Hex)	Name	LCD Display	Description	Values	Page
E5-05 (32D) <1>	Motor Stator Resistance	PM Mtr Arm Ohms	OLV/PM Set the resistance for each motor phase.	Default: <2> Min.: 0.000 Ω Max.: 65.000 Ω	69
E5-06 (32E) <1>	Motor d-Axis Inductance	PM Mtr d Induct	OLV/PM Sets the d-Axis inductance for the PM motor.	Default: <2> Min.: 0.00 mH Max.: 300.00 mH	70
E5-07 (32F) <1>	Motor q-Axis Inductance	PM Mtr q Induct	OLV/PM Sets the q-Axis inductance for the PM motor.	Default: <2> Min.: 0.00 mH Max.: 600.00 mH	70
E5-09 (331) <1>	Motor Induction Voltage Constant 1	PM Mtr Ind V 1	OLV/PM Sets the induced peak voltage per phase in units of 0.1 mV/(rad/s) [electrical angle]. Set this parameter when using an IPM motor with variable torque. Set E5-24 to 0 when setting this parameter.	Default: <2> Min.: 0.0 mV/(rad/s) Max.: 2000.0 mV/(rad/s)	70
E5-24 (353) <1>	Motor Induction Voltage Constant 2	PM Mtr Ind V 2	OLV/PM Sets the induced phase-to-phase rms voltage in units of 0.1 mV/(r/min) [mechanical angle].	Default: <2> Min.: 0.0 mV/(r/min) Max.: 6500.0 mV/(r/min)	70

<1> Selections may vary depending on the setting entered to o2-04.

<2> Default setting is dependent on parameter o2-04, Drive Model Selection.

<3> The number of decimal places in the parameter value depends on the drive model. This value has two decimal places (0.01 A) if the drive is set for a maximum applicable motor capacity up to and including 11 kW, and one decimal place (0.1 A) if the maximum applicable motor capacity is higher than 11 kW.

A.8 F: Communication Option Parameters

◆ F6, F7: Communication Option Card

Parameters F6-01 through F6-03 and F6-06 through F6-08 are used for EtherNet/IP, Modbus TCP/IP, and LONWORKS options. F7 parameters are used for the EtherNet/IP and Modbus TCP/IP options.

No. (Addr. Hex)	Name	Description	Values	Page
F6-01 (3A2)	Communications Error Operation Selection	0: Ramp to stop. Decelerate to stop using the deceleration time in C1-02. 1: Coast to stop. 2: Fast Stop. Decelerate to stop using the deceleration time in C1-09. 3: Alarm only. <1>	Default: 1 Range: 0 to 3	71
F6-02 (3A3)	External Fault from Comm. Option Detection Selection	0: Always detected. 1: Detection during run only.	Default: 0 Range: 0, 1	71
F6-03 (3A4)	External Fault from Comm. Option Operation Selection	0: Ramp to stop. Decelerate to stop using the deceleration time in C1-02. 1: Coast to stop. 2: Fast Stop. Decelerate to stop using the deceleration time in C1-09. 3: Alarm only. <1>	Default: 1 Range: 0 to 3	71
F6-06 (3A7)	Torque Reference/Torque Limit Selection from Comm. Option	OLV/PM 0: Disabled. Torque reference/limit from option board disabled. 1: Enabled. Torque reference/limit from option board enabled.	Default: 0 Range: 0, 1	71
F6-07 (3A8)	Multi-Step Speed Enable/ Disable Selection when NefRef/ComRef is Selected	0: Multi-step reference disabled (same as F7) 1: Multi-step reference enabled (same as V7)	Default: 0 Range: 0, 1	71
F6-08 (36A) <2>	Reset Communication Parameters	0: Communication-related parameters (F6-□□) are not reset when the drive is initialized using A1-03. 1: Reset all communication-related parameters (F6-□□) when the drive is initialized using A1-03.	Default: 0 Range: 0, 1	72
F7-01 (3E5) <3> <4> <5>	IP Address 1	Sets the most significant octet of network static IP address.	Default: 192 Min.: 0 Max.: 255	–
F7-02 (3E6) <3> <4> <5>	IP Address 2	Sets the second most significant octet of network static IP address.	Default: 168 Min.: 0 Max.: 255	–
F7-03 (3E7) <3> <4> <5>	IP Address 3	Sets the third most significant octet of network static IP address.	Default: 1 Min.: 0 Max.: 255	–
F7-04 (3E8) <3> <4> <5>	IP Address 4	Sets the fourth most significant octet of network static IP address.	Default: 20 Min.: 0 Max.: 255	–
F7-05 (3E9) <5>	Subnet Mask 1	Sets the most significant octet of network static Subnet Mask.	Default: 255 Min.: 0 Max.: 255	–
F7-06 (3EA) <5>	Subnet Mask 2	Sets the second most significant octet of network static Subnet Mask.	Default: 255 Min.: 0 Max.: 255	–
F7-07 (3EB) <5>	Subnet Mask 3	Sets the third most significant octet of network static Subnet Mask.	Default: 255 Min.: 0 Max.: 255	–
F7-08 (3EC) <5>	Subnet Mask 4	Sets the fourth most significant octet of network static Subnet Mask.	Default: 0 Min.: 0 Max.: 255	–
F7-09 (3ED) <5>	Gateway Address 1	Sets the most significant octet of network Gateway address.	Default: 192 Min.: 0 Max.: 255	–
F7-10 (3EE) <5>	Gateway Address 2	Sets the second most significant octet of network Gateway address.	Default: 168 Min.: 0 Max.: 255	–
F7-11 (3EF) <5>	Gateway Address 3	Sets the third most significant octet of network Gateway address.	Default: 1 Min.: 0 Max.: 255	–

No. (Addr. Hex)	Name	Description	Values	Page
F7-12 (3E0) <5>	Gateway Address 4	Sets the fourth most significant octet of network Gateway address.	Default: 1 Min.: 0 Max.: 255	–
F7-13 (3F1)	Address Mode at Startup	Select the option address setting method 0: Static <4> <5> 1: BOOTP 2: DHCP	Default: 2 Range: 0 to 2	–
F7-14 (3F2)	Duplex Mode Selection	Selects duplex mode setting. 0: Half duplex forced <6> 1: Auto-negotiate duplex mode and communication speed 2: Full duplex forced <6>	Default: 1 Range: 0 to 2	–
F7-15 (3F3) <6>	Communication Speed Selection	Sets the communication speed 10: 10 Mbps 100: 100 Mbps	Default: 10 Range: 10, 100	–
F7-16 (3F4)	Communication Loss Timeout	Sets the timeout value in tenths of a second for communication loss detection. Example: Setting this parameter to 100 represents 10.0 seconds. Setting this parameter to 0 disables the connection timeout.	Default: 0 Min.: 0 Max.: 300	–
F7-17 (3F5)	EtherNet/IP Speed Scaling Factor	Sets the scaling factor for the speed monitor in EtherNet/IP Class ID 2AH Object.	Default: 0 Min.: -15 Max.: 15	–
F7-18 (3F6)	EtherNet/IP Current Scaling Factor	Sets the scaling factor for the output current monitor in EtherNet/IP Class ID 2AH Object.	Default: 0 Min.: -15 Max.: 15	–
F7-19 (3F7)	EtherNet/IP Torque Scaling Factor	Sets the scaling factor for the torque monitor in EtherNet/IP Class ID 2AH Object.	Default: 0 Min.: -15 Max.: 15	–
F7-20 (3F8)	EtherNet/IP Power Scaling Factor	Sets the scaling factor for the power monitor in EtherNet/IP Class ID 2AH Object.	Default: 0 Min.: -15 Max.: 15	–
F7-21 (3F9)	EtherNet/IP Voltage Scaling Factor	Sets the scaling factor for the voltage monitor in EtherNet/IP Class ID 2AH Object.	Default: 0 Min.: -15 Max.: 15	–
F7-22 (3FA)	EtherNet/IP Time Scaling	Sets the scaling factor for the time monitor in EtherNet/IP Class ID 2AH Object.	Default: 0 Min.: -15 Max.: 15	–
F7-23 to F7-32 (3FB to 374)	Dynamic Output Assembly Parameters	Parameters used in Output Assembly 116. Each parameter contains a MEMOBUS/Modbus address. The value received for Output Assembly 116 will be written to this corresponding MEMOBUS/Modbus address. A MEMOBUS/Modbus address value of 0 means that the value received for Output Assembly 116 will not be written to any MEMOBUS/Modbus register.	Default: 0	–
F7-33 to F7-42 (375 to 37E)	Dynamic Input Assembly Parameters	Parameters used in Input Assembly 166. Each parameter contains a MEMOBUS/Modbus address. The value sent for Input Assembly 166 will be read from this corresponding MEMOBUS/Modbus address. A MEMOBUS/Modbus address value of 0 means that the value sent for Input Assembly 166 is not defined by the user, therefore the option default register value will be returned.	Default: 0	–

<1> When using this setting, be sure to take safety measures, such as installing an emergency stop switch when selecting setting 3. The drive will continue to operate when a fault is detected.

<2> Parameter setting value is not reset to the default value when the drive is initialized.

<3> Cycle power for setting changes to take effect.

<4> When setting F7-13 to 0, all IP addresses (F7-01 to F7-04) must be unique.

<5> When setting F7-13 to 0, also set parameters F7-01 to F7-12.

<6> When F7-14 is set to 0 or 2, be sure to also set F7-15.

A.9 H Parameters: Multi-Function Terminals

H parameters assign functions to the multi-function input and output terminals.

◆ H1: Multi-Function Digital Inputs

No. (Addr. Hex)	Name	LCD Display	Description	Values	Page
H1-01 (438)	Multi-Function Digital Input Terminal S1 Function Selection	Term S1 Func Sel	Assigns a function to the multi-function digital inputs. Refer to pages 227 to 230 for descriptions of setting values. **Note:** Set unused terminals to F.	Default: 40 (F) <1> Min.: 1 Max.: B2	73
H1-02 (439)	Multi-Function Digital Input Terminal S2 Function Selection	Term S2 Func Sel	Assigns a function to the multi-function digital inputs. Refer to pages 227 to 230 for descriptions of setting values. **Note:** Set unused terminals to F.	Default: 41 (F) <1> Min.: 1 Max.: B2	73
H1-03 (400)	Multi-Function Digital Input Terminal S3 Function Selection	Term S3 Func Sel	Assigns a function to the multi-function digital inputs. Refer to pages 227 to 230 for descriptions of setting values. **Note:** Set unused terminals to F.	Default: 24 Min.: 0 Max.: B2	73
H1-04 (401)	Multi-Function Digital Input Terminal S4 Function Selection	Term S4 Func Sel	Assigns a function to the multi-function digital inputs. Refer to pages 227 to 230 for descriptions of setting values. **Note:** Set unused terminals to F.	Default: 14 Min.: 0 Max.: B2	73
H1-05 (402)	Multi-Function Digital Input Terminal S5 Function Selection	Term S5 Func Sel	Assigns a function to the multi-function digital inputs. Refer to pages 227 to 230 for descriptions of setting values. **Note:** Set unused terminals to F.	Default: 3 (0) <1> Min.: 0 Max.: B2	73
H1-06 (403)	Multi-Function Digital Input Terminal S6 Function Selection	Term S6 Func Sel	Assigns a function to the multi-function digital inputs. Refer to pages 227 to 230 for descriptions of setting values. **Note:** Set unused terminals to F.	Default: 4 (3) <1> Min.: 0 Max.: B2	73
H1-07 (404)	Multi-Function Digital Input Terminal S7 Function Selection	Term S7 Func Sel	Assigns a function to the multi-function digital inputs. Refer to pages 227 to 230 for descriptions of setting values. **Note:** Set unused terminals to F.	Default: 6 (4) <1> Min.: 0 Max.: B2	73

<1> Value in parenthesis is the default setting when a 3-Wire initialization is performed (A1-03 = 3330).

H1 Multi-Function Digital Input Selections				
H1-□□ Setting	**Function**	**LCD Display**	**Description**	**Page**
0	3-Wire sequence	3-Wire Control	Closed: Reverse rotation (only if the drive is set up for 3-Wire sequence) Terminals S1 and S2 are automatically set up for the Run command and Stop command.	74
3	Multi-Step Speed Reference 1	Multi-Step Ref 1	When input terminals are set to Multi-Step Speed References 1 through 3, switching combinations of those terminals will create a multi-step speed sequence using the frequency references set in d1-01 through d1-08.	74
4	Multi-Step Speed Reference 2	Multi-Step Ref 2	When input terminals are set to Multi-Step Speed References 1 through 3, switching combinations of those terminals will create a multi-step speed sequence using the frequency references set in d1-01 through d1-08.	74
6	Jog reference selection	jog Freq Ref	Closed: Jog frequency reference (d1-17) selected. Jog has priority over all other reference sources.	74
7	Accel/decel time selection 1	Multi-Acc/Dec 1	Used to switch between accel/decel time 1 (set in C1-01, C1-02) and accel/decel time 2 (set in C1-03, C1-04).	75
8	Baseblock command (N.O.)	Ext BaseBlk N.O.	Closed: No drive output	75
9	Baseblock command (N.C.)	Ext BaseBlk N.C.	Open: No drive output	75
A	Accel/decel ramp hold	Acc/Dec RampHold	Open: Accel/decel is not held Closed: The drive pauses during acceleration or deceleration and maintains the output frequency.	75
B	Drive overheat alarm (oH2)	OH2 Alarm Signal	Closed: Closes when an oH2 alarm occurs	75
C	Analog terminal input selection	Term A2 Enable	Open: Function assigned by H3-14 is disabled. Closed: Function assigned by H3-14 is enabled.	75

H1 Multi-Function Digital Input Selections				
H1-□□ Setting	Function	LCD Display	Description	Page
F	Through mode	Term Not Used	Select this setting when using the terminal in a pass-through mode. The terminal does not trigger a drive function, but it can be used as digital input for the controller to which the drive is connected.	75
10	Up command	Up Command 1	The drive accelerates when the Up command terminal closes, and decelerates when the Down command closes. When both terminals are closed or both are open, the drive holds the frequency reference. The Up and Down commands must always be used in conjunction with one another.	75
11	Down command	Down Command 1	The drive accelerates when the Up command terminal closes, and decelerates when the Down command closes. When both terminals are closed or both are open, the drive holds the frequency reference. The Up and Down commands must always be used in conjunction with one another.	75
12	Forward Jog	Forward Jog	Closed: Runs forward at the Jog frequency d1-17.	77
13	Reverse Jog	Reverse Jog	Closed: Runs reverse at the Jog frequency d1-17.	77
14	Fault reset	Fault Reset	Closed: Resets faults if the cause is cleared and the Run command is removed.	77
15	Fast Stop (N.O.)	Fast-Stop N.O.	Closed: Decelerates at the Fast Stop time set to C1-09.	77
17	Fast Stop (N.C.)	Fast-Stop N.C.	Open: Decelerates to stop at the Fast Stop time set to C1-09.	77
18	Timer function input	Timer function	Triggers the timer set up by parameters b4-01 and b4-02. Must be set in conjunction with the timer function output (H2-□□ = 12).	77
19	PI disable	PID Disable	Open: PI control enabled Closed: PI control disabled	77
1B	Program lockout	Program Lockout	Open: Parameters cannot be edited (except for U1-01 if the reference source is assigned to the HOA keypad). Closed: Parameters can be edited and saved.	78
1E	Reference sample hold	Ref Sample Hold	Closed: Samples the analog frequency reference and operates the drive at that speed.	78
20 to 2F	External fault	External fault 20: NO/Always Det, Ramp to Stop 21: NC/Always Det, Ramp to Stop 22: NO/During RUN, Ramp to Stop 23: N.C., During run, ramp to stop 24: NO/ Always Det, Coast to Stop 25: NC/Always Det, Coast to Stop 26: NO/During RUN, Coast to Stop 27: NC/During RUN, Coast to Stop 28: NO/Always Det, Fast-Stop 29: NC/Always Det, Fast-Stop 2A: NO/During RUN, Fast-Stop 2B: NC/During RUN, Fast- Stop 2C: NO/Always Det, Alarm Only 2D: NC/Always Det, Alarm Only 2E: NO/ During RUN, Alarm Only 2F: NC/During RUN, Alarm Only	20: N.O., Always detected, ramp to stop 21: N.C., Always detected, ramp to stop 22: N.O., During run, ramp to stop 23: N.C., During run, ramp to stop 24: N.O., Always detected, coast to stop 25: N.C., Always detected, coast to stop 26: N.O., During run, coast to stop 27: N.C., During run, coast to stop 28: N.O., Always detected, Fast Stop 29: N.C., Always detected, Fast Stop 2A: N.O., During run, Fast Stop 2B: N.C., During run, Fast Stop 2C: N.O., Always detected, alarm only (continue running) 2D: N.C., Always detected, alarm only (continue running) 2E: N.O., During run, alarm only (continue running) 2F: N.C., During run, alarm only (continue running)	78
30	PI integral reset	PID Intgrl Reset	Closed: Resets the PI control integral value.	79
31	PI integral hold	PID Intgrl Hold	Open: Performs integral operation. Closed: Maintains the current PI control integral value.	79
34	PI soft starter cancel	PID SFS Cancel	Open: PI soft starter is enabled. Closed: Disables the PI soft starter b5-17.	79
35	PI input level selection	PID Input Invert	Closed: Inverts the PI input signal.	79

H1 Multi-Function Digital Input Selections				
H1-□□ Setting	Function	LCD Display	Description	Page
40	Forward run command (2-Wire sequence)	FwdRun 2Wire Seq	Open: Stop Closed: Forward run **Note:** Cannot be set together with settings 42 or 43.	79
41	Reverse run command (2-Wire sequence)	RevRun 2WireSeq	Open: Stop Closed: Reverse run **Note:** Cannot be set together with settings 42 or 43.	79
42	Run command (2-Wire sequence 2)	Run/Stp 2WireSeq	Open: Stop Closed: Run **Note:** Cannot be set together with settings 40 or 41.	79
43	FWD/REV command (2-Wire sequence 2)	FWD/REV 2WireSeq	Open: Forward Closed: Reverse **Note:** Determines motor direction, but does not issue a Run command. Cannot be set together with settings 40 or 41.	79
44	Offset frequency 1	Offset Freq 1	Closed: Adds d7-01 to the frequency reference.	80
45	Offset frequency 2	Offset Freq 2	Closed: Adds d7-02 to the frequency reference.	80
46	Offset frequency 3	Offset Freq 3	Closed: Adds d7-03 to the frequency reference.	80
50	Motor Pre-Heat 2	Motor Preheat 2	Closed: Triggers Motor Pre-Heat 2.	80
51	Sequence Timer Disable	SeqTimer Disable	Closed: Drive ignores sequence timers and runs normally.	80
52	Sequence Timer Cancel	SeqTimer Cancel	Closed: Sequence Timer Cancel .	80
60	Motor pre-heat 1	DCInj Activate	Closed: Triggers Motor pre-heat 1.	80
61	External Speed Search command 1	Speed Search 1	Closed: Activates Current Detection Speed Search from the maximum output frequency (E1-04).	80
62	External Speed Search command 2	Speed Search 2	Closed: Activates Current Detection Speed Search from the frequency reference.	80
63	Field weakening	Field Weak	Closed: The drive performs Field Weakening control as set for d6-01 and d6-02.	80
65	KEB Ride-Thru 1 (N.C.)	KEB Ridethru NC	Open: KEB Ride-Thru 1 enabled.	80
66	KEB Ride-Thru 1 (N.O.)	KEB Ridethru NO	Closed: KEB Ride-Thru 1 enabled.	80
67	Communications test mode	Comm Test Mode	Tests the MEMOBUS/Modbus RS-422/RS-485 interface. Displays “PASS” if the test completes successfully.	81
68	High slip braking	HighSlipBraking	Closed: Activates High Slip Braking to stop the drive during a Run command.	81
69	Jog 2	Jog 2	Cause the drive to ramp to the jog frequency (d1-17).	81
6A	Drive enable	Drive Enable	Open: Drive disabled. If this input is opened during run, the drive will stop as specified by b1-03. Closed: Ready for operation.	81
6D	AUTO mode select	AUTO Mode Sel	Legacy Operation Mode (S5-04 = 0) • Open: HAND reference is selected (based on S5-01) • Closed: AUTO reference is selected (based on b1-01) Normal Operation Mode (S5-04 ≠ 0) **Note:** The drive will always be in AUTO mode at power up when S5-04 is set to 1. • Open: Drive is in OFF or HAND mode. • Closed: Drive is in AUTO mode (when HAND mode select input is open)	81
6E	HAND mode select	HAND Mode Se	Legacy Operation Mode (S5-04 = 0) • Open: AUTO reference is selected (based on b1-01) • Closed: HAND reference is selected (based on S5-01) Normal Operation Mode (S5-04 ≠ 0) **Note:** The drive will always be in AUTO mode at power up when S5-04 is set to 1. • Open: Drive is in OFF or AUTO mode. • Closed: Drive is in HAND mode. (when AUTO mode select input is open)	81

H1 Multi-Function Digital Input Selections				
H1-☐☐ Setting	**Function**	**LCD Display**	**Description**	**Page**
70	Drive Enable2	Drive Enable 2	Prevents the Drive from executing a Run command until the Drive Enable2 input is closed. When the Drive Enable2 input is open and a Run command is closed, the digital operator will display “dnE”. The drive will run when the Run and Drive Enable2 inputs are both closed. If the Drive Enable2 input is opened while the drive is running, the drive will stop using the method set by parameter b1-03.	81
7A	KEB Ride-Thru 2 (N.C.)	KEB Ridethru2NC	Open: KEB Ride-Thru 2 enabled. Drive disregards L2-29 and performs Single Drive KEB Ride-Thru 2.	81
7B	KEB Ride-Thru 2 (N.O.)	KEB Ridethru2NO	Closed: KEB Ride-Thru 2 enabled. Drive disregards L2-29 and performs Single Drive KEB Ride-Thru 2.	81
7C	Short circuit braking (N.O.)	SC Brake (NO)	Closed: Short Circuit Braking enabled	82
7D	Short circuit braking (N.C.)	SC Brake (NC)	OLV/PM Open: Short Circuit Braking enabled	82
A4	BP Customer Safeties	BP Emg Override	Closed: Indicates that customer safeties are in place.	82
A5	BP Drive/Bypass Select	BP Drv/Bypss Sel	Open: Bypass mode. Closed: Drive mode.	82
A6	BP BAS Interlock Input	BP BAS Interlock	Closed: Indicates that the dampers are open	82
A7	BP Customer Safeties	BP Cust Safeties	Closed: Indicates that customer safeties are in place.	82
A8	Secondary PI Disable (N.O.)	PI2 Disable N.O.	Closed: Disables the secondary PI controller. Output behavior depends on the setting of S3-12.	82
A9	Secondary PI Disable (N.C.)	PI2 Disable N.C.	Closed: Enables the secondary PI controller. Output behavior depends on the setting of S3-12 when open.	82
AA	Secondary PI Inverse Operation	PI2 Invert	Closed: Changes the sign of the secondary PI controller input (reverse acting PI control).	82
AB	Secondary PI Integral Reset	PI2 Intgrl Reset	Closed: Resets the secondary PI controller integral value.	82
AC	Secondary PI Integral Hold	PI2 Intgrl Hold	Closed: Locks the value of the secondary PI controller integral value.	82
AD	Select Secondary PI Parameters	Select PI2 Parms	Closed: Uses the secondary PI controller Proportional and Integral adjustments (S3-06 and S3-07) instead of the primary PI controller Proportional and Integral adjustments (b5-02 and b5-03). Only valid when S3-01 = 0 (secondary PI controller disabled). **Note:** This multi-function input has no effect on the secondary PI controller. It is only used for the primary PI controller (b5-☐☐).	82
AE	BP Bypass Run	BP Bypass Run	Closed: Commands a Run (via closing the BP Bypass Relay multi-function output) when in Bypass mode.	82
AF	Emergency Override Forward Run	EmergOverrideFWD	Closed: Emergency Override Forward Run	82
B0	Emergency Override Reverse Run	EmergOverrideREV	Closed: Emergency Override Reverse Run	82
B1	Customer Safeties	CustomerSafeties	The functionality is identical to Drive Enable 2 (H1-☐☐ = 70), except for the following characteristics: • The stopping method is forced to Coast to Stop when the input is open • The drive will display a “SAFE” alarm if the input is open when a Run command is present. It will not display “dnE”. Open: Customer Safeties are open. Drive will not run. Stopping method is Coast to Stop. Closed: Customer Safeties are in place.	83

H1 Multi-Function Digital Input Selections				
H1-□□ Setting	Function	LCD Display	Description	Page
B2	BAS Interlock	BAS Interlock	The functionality is identical to Drive Enable 2 (H1-□□ = 70), except for the following characteristics: • The stopping method is forced to Coast to Stop when the input is open • The drive will display an "inTLK" message if the input is open when a Run command is present. It will not display "dnE". • The state of the BAS Interlock multi-function input has no effect on the Emergency Override multi-function inputs (H1-□□ = AF, B0). The Emergency Override command will be accepted if the BAS Interlock digital input is open or closed. Open: Damper interlock is not closed. Drive will not run. Stopping method is Coast to Stop. Closed: Damper interlock is closed.	83

◆ H2: Multi-Function Digital Outputs

No. (Addr. Hex)	Name	LCD Display	Description	Values	Page
H2-01 (40B)	Terminal M1-M2 function selection (relay)	M1-M2 Func Sel	Refer to H2 Multi-Function Digital Output Settings on pages 231 to 233 for descriptions of setting values.	Default: E Range: 0 to 1B2	83
H2-02 (40C)	Terminal M3-M4 function selection (relay)	P1/PC Func Sel		Default: 0 Range: 0 to 1B2	83
H2-03 (40D)	Terminal M5-M6 function selection (relay)	P2/PC Func Sel		Default: A Range: 0 to 1B2	83

H2 Multi-Function Digital Output Settings				
H2-□□ Setting	Function	LCD Display	Description	Page
0	During run	During RUN 1	Closed: A Run command is active or voltage is output.	84
1	Zero speed	Zero Speed	Open: Output frequency is above the minimum output frequency set in E1-09. Closed: Output frequency is below the minimum output frequency set in E1-09.	84
2	Speed agree 1	Fref/Fout Agree1	Closed: Output frequency equals the speed reference (plus or minus the hysteresis set to L4-02).	84
3	User-set speed agree 1	Fref/Set Agree 1	Closed: Output frequency and speed reference equal L4-01 (plus or minus the hysteresis set to L4-02).	85
4	Frequency detection 1	Freq Detect 1	Closed: Output frequency is less than or equal to the value in L4-01 with hysteresis determined by L4-02.	85
5	Frequency detection 2	Freq Detect 2	Closed: Output frequency is greater than or equal to the value in L4-01 with hysteresis determined by L4-02.	85
6	Drive ready	Drive Ready	Closed: Power up is complete and the drive is ready to accept a Run command.	86
7	DC bus undervoltage	DC Bus Undervolt	Closed: DC bus voltage is below the Uv trip level set in L2-05.	86
8	During baseblock (N.O.)	BaseBlk 1	Closed: Drive has entered the baseblock state (no output voltage).	86
9	Frequency reference source	Ref Source	Open: External Reference 1 or 2 supplies the frequency reference (set in b1-01 or b1-15). Closed: HOA keypad supplies the frequency reference.	86
A	Run command source	Run Cmd Source	Open: External Reference 1 or 2 supplies the Run command (set in b1-02 or b1-16). Closed: HOA keypad supplies the Run command.	86
B	Torque detection 1 (N.O.)	Trq Det 1 N.O.	Closed: An overtorque or undertorque situation has been detected.	87
C	Frequency reference loss	Loss of Ref	Closed: Analog frequency reference has been lost.	87
E	Fault	Fault	Closed: Fault occurred.	87
F	Through mode	Not Used	Set this value when using the terminal in the pass-through mode.	87
10	Minor fault	Minor Fault	Closed: An alarm has been triggered, or the IGBTs have reached 90% of their expected life span.	87
11	Fault reset command active	Reset Cmd Active	Closed: A command has been entered to clear a fault via the input terminals or from the serial network.	87

Parameter List

A

H2 Multi-Function Digital Output Settings				
H2-□□ Setting	Function	LCD Display	Description	Page
12	Timer output	Timer Output	Closed: Timer output.	87
13	Speed agree 2	Fref/Fout Agree2	Closed: When drive output frequency equals the frequency reference ±L4-04.	87
14	User-set speed agree 2	Fref/Set Agree 2	Closed: When the drive output frequency is equal to the value in L4-03 ±L4-04.	88
15	Frequency detection 3	Freq Detect 3	Closed: When the drive output frequency is less than or equal to the value in L4-03 ±L4-04.	88
16	Frequency detection 4	Freq Detect 4	Closed: When the output frequency is greater than or equal to the value in L4-03 ±L4-04.	88
17	Torque detection 1 (N.C.)	Trq Det 1 N.C.	Open: Overtorque or undertorque has been detected.	87
1A	During Reverse	Reverse Dir	Closed: Drive is running in the reverse direction.	87
1B	During baseblock (N.C.)	BaseBlk 2	Open: Drive has entered the baseblock state (no output voltage).	89
1E	Restart enabled	Dur Flt Restart	Closed: An automatic restart is performed	89
1F	Motor overload alarm (oL1)	Overload (OL1)	Closed: oL1 is at 90% of its trip point or greater. An oH3 situation also triggers this alarm.	89
20	Drive overheat pre-alarm (oH)	OH Prealarm	Closed: Heatsink temperature exceeds the parameter L8-02 value.	89
2F	Maintenance period	Maintenance	Closed: Cooling fan, electrolytic capacitors, IGBTs, or the soft charge bypass relay may require maintenance.	89
37	During frequency output	During RUN 2	Open: Either the drive has stopped or baseblock, DC Injection Braking, or Initial Excitation is being performed. Closed: Drive is running the motor (not in a baseblock state and DC Injection is not being performed).	89
38	Drive enabled	Drive Enable	Closed: Multi-function input set for “Drive enable” is closed (H1-□□ = 6A)	90
39	Watt hour pulse output	Watt-hour Pulse	Output units are determined by H2-06. Outputs a pulse every 200 ms to indicate the kWh count.	90
3A	Drive overheat alarm	OH Alarm 2	Closed: An external device triggered an overheat warning in the drive.	90
3D	During speed search	During SpdSrch	Closed: Speed Search is being executed.	90
3E	PI feedback low	PID Feedback Low	Closed: PI feedback level is too low.	90
3F	PI feedback high	PID FeedbackHigh	Closed: The PI feedback level is too high.	90
4A	During KEB Ride-Thru	During KEB	Closed: KEB Ride-Thru is being performed.	90
4B	During short circuit braking	During SC Brake	OLV/PM Closed: Short Circuit Braking is active.	90
4C	During fast stop	During Fast Stop	Closed: A Fast Stop command has been entered from the operator or input terminals.	90
4D	oH Pre-alarm time limit	OH Pre-Alarm	Closed: oH pre-alarm time limit has passed.	90
50	Waiting for run	Waiting for Run	Closed: Delay executing any run command until the time set to b1-11 has expired.	90
51	Sequence timer 1 active	SeqTimer Disable	Closed: Sequence timer 1 is active.	90
52	Sequence timer 2 active	SeqTimer Cancel	Closed: Sequence timer 2 is active.	90
53	Sequence timer 3 active	Sequence timer 3	Closed: Sequence timer 3 is active.	90
54	Sequence timer 4 active	Sequence Timer 4	Closed: Sequence timer 4 is active.	90
58	Underload detection	UL6	Closed: Underload is detected.	90
60	Internal cooling fan alarm	Fan Alrm Det	Closed: Internal cooling fan alarm	91
71	Secondary PI Feedback Low	PI2 Feedback Low	Closed: PI2 feedback level is too low.	91
72	Secondary PI Feedback High	PI2 FeedbackHigh	Closed: The PI2 feedback level is too high.	91
A4	BP Drive Relay Contact	BP Emg Override	Closed: Line voltage is being supplied to the drive, and the motor is being run via the drive.	91
A5	BP Bypass Relay Contact	BP Drv/Bypss Sel	Closed: Line voltage is being supplied directly to the motor.	91
A6	BP BAS Interlock Relay Contact	BP BAS Interlock	Closed: Actuation signal for options dampers.	91
A9	Relay Operator Control	PI2 Disable N.C.	Closed: F1 (F2) key toggle relay output.	91

H2 Multi-Function Digital Output Settings				
H2-□□ Setting	Function	LCD Display	Description	Page
B2	BAS Interlock Relay Contact	BAS Interlock	Closed: Drive is running (not closed during Motor Preheat unless a Run command is present). Actuation signal for damper.	91
100 to 1B2	Function 0 to b2 with inverse output Note: A prefix of "!" is added to represent inverse functions on the LCD keypad display. Example: "!Zero speed"	–	Inverts the output switching of the multi-function output functions. Set the last two digits of 1□□ to reverse the output signal of that specific function.	91

◆ H3: Multi-Function Analog Inputs

No. (Addr. Hex)	Name	LCD Display	Description	Values	Page
H3-01 (410)	Terminal A1 Signal Level Selection	Term A1 Level 0: 0-10V, (LowLim=0) 1: 0-10V, (BipolRef) 2: 4-20 mA 3: 0-20 mA	0: 0 to 10 V with zero limit 1: 0 to 10 V without zero limit 2: 4-20 mA 3: 0-20 mA **Note:** Use jumper switch S1 to set input terminal A1 for current or voltage.	Default: 0 Range: 0 to 3	92
H3-02 (434)	Terminal A1 Function Selection	Term A1 FuncSel	Sets the function of terminal A1.	Default: 0 Range: 0 to 26	92
H3-03 (411) RUN	Terminal A1 Gain Setting	Terminal A1 Gain	Sets the level of the input value selected in H3-02 when 10 V is input at terminal A1.	Default: 100.0% Min.: -999.9 Max.: 999.9	92
H3-04 (412) RUN	Terminal A1 Bias Setting	Terminal A1 Bias	Sets the level of the input value selected in H3-02 when 0 V is input at terminal A1.	Default: 0.0% Min.: -999.9 Max.: 999.9	92
H3-09 (417)	Terminal A2 Signal Level Selection	Term A2 Level 0: 0-10V, (LowLim=0) 1: 0-10V, (BipolRef) 2: 4-20 mA 3: 0-20 mA	0: 0 to 10 V with zero limit 1: 0 to 10 V without zero limit 2: 4 to 20 mA 3: 0 to 20 mA **Note:** Use jumper switch S1 to set input terminal A2 for current or voltage input signal.	Default: 2 Range: 0 to 3	93
H3-10 (418)	Terminal A2 Function Selection	Term A2 FuncSel	Sets the function of terminal A2.	Default: 0 Range: 0 to 26	93
H3-11 (419) RUN	Terminal A2 Gain Setting	Terminal A2 Gain	Sets the level of the input value selected in H3-10 when 10 V (20 mA) is input at terminal A2.	Default: 100.0% Min.: -999.9 Max.: 999.9	94
H3-12 (41A) RUN	Terminal A2 Bias Setting	Terminal A2 Bias	Sets the level of the input value selected in H3-10 when 0 V (0 or 4 mA) is input at terminal A2.	Default: 0.0% Min.: -999.9 Max.: 999.9	94
H3-13 (41B)	Analog Input Filter Time Constant	A1/A2 Filter T	Sets a primary delay filter time constant for terminals A1 and A2. Used for noise filtering.	Default: 0.03 s Min.: 0.00 Max.: 2.00	94
H3-14 (41C)	Analog Input Terminal Enable Selection	A1/A2 Sel 1: A1 Available 2: A2 Available 3: A1/A2 Available	Determines which analog input terminals will be enabled when a digital input programmed for "Analog input enable" (H1-□□ = C) is activated. 1: Terminal A1 only 2: Terminal A2 only 3: Terminals A1 and A2	Default: 2 Range: 1 to 3	94
H3-16 (2F0)	Terminal A1 Offset	Term A1 Offset	Adds an offset when the analog signal to terminal A1 is at 0 V.	Default: 0 Min.: -500 Max.: 500	95
H3-17 (2F1)	Terminal A2 Offset	Term A2 Offset	Adds an offset when the analog signal to terminal A2 is at 0 V.	Default: 0 Min.: -500 Max.: 500	95

H3 Multi-Function Analog Input Settings				
H3-□□ Setting	Function	LCD Display	Description	Page
0	Frequency bias	Freq Ref Bias	10 V = E1-04 (maximum output frequency)	95
1	Frequency gain	Freq Ref Gain	0 to 10 V signal allows a setting of 0 to 100%. -10 to 0 V signal allows a setting of -100 to 0%.	95
2	Auxiliary frequency reference 1 (used as a Multi-Step Speed 2)	Aux Reference1	10 V = E1-04 (maximum output frequency)	95
3	Auxiliary frequency reference 2 (3rd step analog)	Aux Reference2	10 V = E1-04 (maximum output frequency)	95
4	Output voltage bias	Voltage Bias	10 V = E1-05 (motor rated voltage)	95
5	Accel/decel time gain	Acc/Dec Change	10 V = 100%	95
6	DC Injection Braking current	DC Brake Current	10 V = Drive rated current	95
7	Overtorque/undertorque detection level	Torque Det Level	10 V = Drive rated current (V/f) 10 V = Motor rated torque (OLV/PM)	96
8	Stall Prevention level during run	Stall Prev Level	10 V = Drive rated current	96
9	Output frequency lower limit level	Ref Lower Limit	10 V = E1-04 (maximum output frequency)	96
B	PI feedback	PID Feedback1	10 V = 100%	96
C	PI setpoint	PID Set Point	10 V = 100%	96
D	Frequency bias	Freq Ref Bias 2	10 V = E1-04 (maximum output frequency)	96
E	Motor temperature (PTC input)	E Motor PTC	10 V = 100%	96
F	Through mode	Not Used	Set this value when using the terminal in the pass-through mode.	96
16	Differential PI feedback	PID Feedback 2	10 V = 100%	96
25	Secondary PI Setpoint	PI2 Setpoint	10 V = S3-02 (maximum output frequency)	96
26	Secondary PI Feedback	PI2 Feedback	10 V = S3-02 (maximum output frequency)	96

◆ H4: Analog Outputs

No. (Addr. Hex)	Name	LCD Display	Description	Values	Page
H4-01 (41D)	Multi-Function Analog Output Terminal FM Monitor Selection	Term FM FuncSel	Selects the data to be output through multi-function analog output terminal FM. Set the desired monitor parameter to the digits available in U□-□□. For example, enter "103" for U1-03.	Default: 102 Range: 000 to 655	96
H4-02 (41E) RUN	Multi-Function Analog Output Terminal FM Gain	Terminal FM Gain	Sets the signal level at terminal FM that is equal to 100% of the selected monitor value.	Default: 100.0% Min.: -999.9 Max.: 999.9	97
H4-03 (41F) RUN	Multi-Function Analog Output Terminal FM Bias	Terminal FM Bias	Sets the signal level at terminal FM that is equal to 0% of the selected monitor value.	Default: 0.0% Min.: -999.9 Max.: 999.9	97
H4-04 (420)	Multi-Function Analog Output Terminal AM Monitor Selection	Terminal AM Sel	Selects the data to be output through multi-function analog output terminal AM. Set the desired monitor parameter to the digits available in U□-□□. For example, enter "103" for U1-03.	Default: 103 Range: 000 to 655	96
H4-05 (421) RUN	Multi-Function Analog Output Terminal AM Gain	Terminal AM Gain	Sets the signal level at terminal AM that is equal to 100% of the selected monitor value.	Default: 50.0% Min.: -999.9 Max.: 999.9	97
H4-06 (422) RUN	Multi-Function Analog Output Terminal AM Bias	Terminal AM Bias	Sets the signal level at terminal AM that is equal to 0% of the selected monitor value.	Default: 0.0% Min.: -999.9 Max.: 999.9	97

No. (Addr. Hex)	Name	LCD Display	Description	Values	Page
H4-07 (423)	Multi-Function Analog Output Terminal FM Signal Level Selection	Level Select1 0: 0-10 VDC 2: 4-20 mA	0: 0 to 10 V 2: 4 to 20 mA	Default: 0 Range: 0, 2	98
H4-08 (424)	Multi-Function Analog Output Terminal AM Signal Level Selection	AO Level Select2 0: 0-10 VDC 2: 4-20 mA	0: 0 to 10 V 2: 4 to 20 mA	Default: 0 Range: 0, 2	98

◆ H5: MEMOBUS/Modbus Serial Communication

No. (Addr. Hex)	Name	LCD Display	Description	Values	Page
H5-01 (425) <1>	Drive Slave Address	Serial Comm Adr	Selects drive station slave number (address) for MEMOBUS/ Modbus terminals R+, R-, S+, S-. Cycle power for the setting to take effect.	Default: 1F (Hex) Min.: 0 Max.: FF	280
H5-02 (426)	Communication Speed Selection	Serial Baud Rate 0: 1200 bps 1: 2400 bps 2: 4800 bps 3: 9600 bps 4: 19.2 kbps 5: 38.4 kbps 6: 57.6 kbps 7: 76.8 kbps 8: 115.2 kbps	0: 1200 bps 1: 2400 bps 2: 4800 bps 3: 9600 bps 4: 19200 bps 5: 38400 bps 6: 57600 bps 7: 76800 bps 8: 115200 bps Cycle power for the setting to take effect.	Default: 3 Range: 0 to 8	280
H5-03 (427)	Communication Parity Selection	Serial Com Sel 0: No parity 1: Even parity 2: Odd parity	0: No parity 1: Even parity 2: Odd parity Cycle power for the setting to take effect.	Default: 0 Range: 0 to 2	280
H5-04 (428)	Stopping Method after Communication Error (CE)	Serial Fault Sel 0: Ramp to Stop 1: Coast to Stop 2: Fast-Stop 3: Alarm Only 4: Alarm(d1-04)	0: Ramp to stop 1: Coast to stop 2: Fast Stop 3: Alarm only 4: Run at d1-04	Default: 3 Range: 0 to 4	280
H5-05 (429)	Communication Fault Detection Selection	Serial Flt Dtct 0: Disabled 1: Enabled	0: Disabled 1: Enabled If communication is lost for more than two seconds, a CE fault will occur.	Default: 1 Range: 0, 1	281
H5-06 (42A)	Drive Transmit Wait Time	Transmit WaitTIM	Set the wait time between receiving and sending data.	Default: 5 ms Min.: 5 Max.: 65	281
H5-07 (42B)	RTS Control Selection	RTS Control Sel 0: Disabled 1: Enabled	0: Disabled. RTS is always on. 1: Enabled. RTS turns on only when sending.	Default: 1 Range: 0, 1	281
H5-08 (62D)	Communication Protocol Selection	Protocol Select 0: MEMOBUS 1: N2 2: P1 3: BACnet	Selects the communication protocol. 0: MEMOBUS/Modbus 1: N2 (Metasys) 2: P1 (APOGEE FLN) 3: BACnet	Default: 0 Range: 0 to 3	281
H5-09 (435)	CE Detection Time	CE Detect Time	Sets the time required to detect a communications error. Adjustment may be needed when networking several drives.	Default: 2.0 s Min.: 0.0 Max.: 10.0	282
H5-10 (436)	Unit Selection for MEMOBUS/Modbus Register 0025H	CommReg 25h Unit 0: 0.1 V 1: 1 V	0: 0.1 V units 1: 1 V units	Default: 0 Range: 0, 1	283
H5-11 (43C)	Communications ENTER Function Selection	Enter CommandSel 0: Enter Required 1: No EnterRequired	0: Drive requires an Enter command before accepting any changes to parameter settings. 1: Parameter changes are activated immediately without the Enter command (same as V7).	Default: 0 Range: 0, 1	283
H5-12 (43D)	Run Command Method Selection	Run CommandSel 0: FWD Run &REV Run 1: Run & FWD/REV	0: FWD/Stop, REV/Stop 1: Run/Stop, FWD/REV	Default: 0 Range: 0, 1	283

No. (Addr. Hex)	Name	LCD Display	Description	Values	Page
H5-14 (310D)	BAC Dev Obj ID 0	BAC Dev Obj Id 0	BACnet device object ID	Default: 1 Range: 0 to FFFF	283
H5-15 (310E)	BAC Dev Obj ID 1	BAC Dev Obj Id 1	BACnet device object ID	Default: 0 Range: 0 to 3F	283

<1> If this parameter is set to 0, the drive will be unable to respond to MEMOBUS/Modbus commands.

A.10 L: Protection Function

L parameters provide protection to the drive and motor, including control during momentary power loss, Stall Prevention, frequency detection, fault restarts, overtorque detection, and other types of hardware protection.

◆ L1: Motor Protection

No. (Addr. Hex)	Name	LCD Display	Description	Values	Page
L1-01 (480)	Motor Overload Protection Selection	Mtr OL Charact 0: OL1 Disabled 1: VT Motor 4: PM Motor	0: Disabled 1: General purpose motor (standard fan cooled) 4: PM motor with variable torque The drive may not be able to provide protection when using multiple motors, even if overload is enabled in L1-01. Set L1-01 to 0 and install separate thermal relays to each motor.	Default: <1> Range: 0, 1, 4	99
L1-02 (481)	Motor Overload Protection Time	MOL Time Const	Sets the motor thermal overload protection (oL1) time.	Default: 1.0 min Min.: 1.0 Max.: 5.0	100
L1-03 (482)	Motor Overheat Alarm Operation Selection (PTC input)	Mtr OH Alarm Sel 0 : Ramp to Stop 1: Coast to Stop 2: Fast-Stop 3: Alarm only	Sets operation when the motor temperature analog input (H3-02 or H3-10 = E) exceeds the alarm level. 0: Ramp to stop 1: Coast to stop 2: Fast Stop (decelerate to stop using the deceleration time in C1-09) 3: Alarm only (“oH3” will flash)	Default: 3 Range: 0 to 3	101
L1-04 (483)	Motor Overheat Fault Operation Selection (PTC input)	Mtr OH Fault Sel 0 : Ramp to Stop 1: Coast to Stop 2: Fast-Stop	Sets stopping method when the motor temperature analog input (H3-02, or H3-10 = E) exceeds the oH4 fault level. 0: Ramp to stop 1: Coast to stop 2: Fast Stop (decelerate to stop using the deceleration time in C1-09)	Default: 1 Range: 0 to 2	101
L1-05 (484)	Motor Temperature Input Filter Time (PTC input)	Mtr Temp Filter	Adjusts the filter for the motor temperature analog input (H3-02, or H3-10 = E).	Default: 0.20 s Min.: 0.00 Max.: 10.00	102
L1-13 (46D)	Continuous Electrothermal Operation Selection	Mtr OL Mem Sel 0: Disabled 1: Enabled 2: Enabled(RTC)	0: Disabled 1: Enabled 2: Enable using Real Time Clock	Default: 1 Range: 0 to 2	102

<1> Default setting is determined by parameter A1-02, Control Method Selection.

◆ L2: Momentary Power Loss Ride-Thru

No. (Addr. Hex)	Name	LCD Display	Description	Values	Page
L2-01 (485)	Momentary Power Loss Operation Selection	PwrL Selection 0: Disabled 1: Enbl with Timer 2: Enbl whl CPU act	0: Disabled. Drive trips on Uv1 fault when power is lost. 1: Recover within the time set in L2-02. Uv1 will be detected if power loss is longer than L2-02. 2: Recover as long as CPU has power. Uv1 is not detected.	Default: 0 Range: 0 to 2	102
L2-02 (486)	Momentary Power Loss Ride-Thru Time	PwrL Ridethru t	Sets the Power Loss Ride-Thru time. Enabled only when L2-01 = 1 or 3.	Default: <1> Min.: 0.0 s Max.: 25.5 s	102
L2-03 (487)	Momentary Power Loss Minimum Baseblock Time	PwrL Baseblock t	Sets the minimum wait time for residual motor voltage decay before the drive output reenergizes after performing Power Loss Ride-Thru. Increasing the time set to L2-03 may help if overcurrent or overvoltage occur during Speed Search or during DC Injection Braking.	Default: <1> Min.: 0.1 s Max.: 5.0 s	103
L2-04 (488)	Momentary Power Loss Voltage Recovery Ramp Time	PwrL V/F Ramp t	Sets the time for the output voltage to return to the preset V/f pattern during Speed Search.	Default: <1> Min.: 0.0 s Max.: 5.0 s	103

No. (Addr. Hex)	Name	LCD Display	Description	Values	Page
L2-05 (489)	Undervoltage Detection Level (Uv1)	PUV Det Level	Sets the DC bus undervoltage trip level.	Default: 190 Vdc <2> <3> Min.: 150 Vdc Max.: 220 Vdc <3>	103
L2-06 (48A)	KEB Deceleration Time	KEB Decel Time	Sets the time required to decelerate from the speed when KEB was activated to zero speed.	Default: 0.00 s Min.: 0.00 Max.: 6000.0	103
L2-07 (48B)	KEB Acceleration Time	KEB Accel Time	Sets the time to accelerate to the frequency reference when momentary power loss is over. If set to 0.0, the active acceleration time is used.	Default: 0.00 s Min.: 0.00 Max.: 6000.0	103
L2-08 (48C)	Frequency Gain at KEB Start	KEB Freq Red	Sets the percentage of output frequency reduction at the beginning of deceleration when the KEB Ride-Thru function is started. Reduction = (slip frequency before KEB) × L2-08 × 2	Default: 100% Min.: 0 Max.: 300	103
L2-10 (48E)	KEB Detection Time (Minimum KEB Time)	KEB Detect Time	Sets the time to perform KEB Ride-Thru.	Default: 50 ms Min.: 0 Max.: 2000	104
L2-11 (461)	DC Bus Voltage Setpoint during KEB	KEB DC Bus Level	Sets the desired value of the DC bus voltage during KEB Ride-Thru.	Default: <2> [E1-01] × 1.22 Min.: 150 Vdc Max.: 400 Vdc <3>	104
L2-29 (475)	KEB Method Selection	KEB Mode Sel 0: Single Mode KEB1 1: Single Mode KEB2	0: Single Drive KEB Ride-Thru 1 1: Single Drive KEB Ride-Thru 2	Default: 0 Range: 0, 1	104

<1> Default setting is dependent on parameter o2-04, Drive Model Selection.

<2> Default setting is dependent on parameter E1-01, Input voltage Setting.

<3> Values shown are specific to 200 V class drives. Double the value for 400 V class drives.

◆ L3: Stall Prevention

No. (Addr. Hex)	Name	LCD Display	Description	Values	Page
L3-01 (48F)	Stall Prevention Selection during Acceleration	StallP Accel Sel 0: Disabled 1: General purpose 2: Intelligent	0: Disabled. 1: General purpose. Acceleration is paused as long as the current is above the L3-02 setting. 2: Intelligent. Accelerate in the shortest possible time without exceeding the L3-02 level. **Note:** Setting 2 is not available when using OLV/PM.	Default: 1 Range: 0 to 2	104
L3-02 (490)	Stall Prevention Level during Acceleration	StallP Accel Lvl	Used when L3-01 = 1 or 2. 100% is equal to the drive rated current.	Default: <1> Min.: 0% Max.: 150% <1>	105
L3-03 (491)	Stall Prevention Limit during Acceleration	StallPAcc LowLim	Sets Stall Prevention lower limit during acceleration when operating in the constant power range. Set as a percentage of drive rated current.	Default: 50% Min.: 0 Max.: 100	106
L3-04 (492)	Stall Prevention Selection during Deceleration	StallP Decel Sel 0: Disabled 1: General purpose 2: Intelligent 4: High Flux Brake 5: High Flux Brake2	0: Disabled. Deceleration at the active deceleration rate. An ov fault may occur. 1: General purpose. Deceleration is paused when the DC bus voltage exceeds the Stall Prevention level. 2: Intelligent. Decelerate as fast as possible while avoiding ov faults. 4: Overexcitation Deceleration. Decelerates while increasing the motor flux 5: Overexcitation Deceleration 2. Adjust the deceleration rate according to the DC bus voltage.	Default: 1 Range: 0 to 2; 4, 5 <2>	106

No. (Addr. Hex)	Name	LCD Display	Description	Values	Page
L3-05 (493)	Stall Prevention Selection during Run	StallP Run Sel 0: Disabled 1: Decel time 2: Decel time 2	0: Disabled. Drive runs at a set frequency. A heavy load may cause speed loss. 1: Decel time 1. Uses the deceleration time set to C1-02 while Stall Prevention is performed. 2: Decel time 2. Uses the deceleration time set to C1-04 while Stall Prevention is performed.	Default: 1 Range: 0 to 2	107
L3-06 (494)	Stall Prevention Level during Run	StallP Run Level	Enabled when L3-05 is set to 1 or 2. 100% is equal to the drive rated current.	Default: <1> Min.: 30% Max.: 150% <1>	107
L3-11 (4C7)	Overvoltage Suppression Function Selection	OV Inhibit Sel 0: Disabled 1: Enabled	Enables or disables the ov suppression function, which allows the drive to change the output frequency as the load changes to prevent an ov fault. 0: Disabled 1: Enabled	Default: 0 Range: 0, 1	108
L3-17 (462)	Target DC Bus Voltage for Overvoltage Suppression and Stall Prevention	DC Bus Reg Level	Sets the desired value for the DC bus voltage during overvoltage suppression and Stall Prevention during deceleration.	Default: 370 Vdc <3> <4> Min.: 150 Max.: 400 <4>	108
L3-20 (465)	DC Bus Voltage Adjustment Gain	DC Bus P Gain	Determines the proportional gain used by overvoltage suppression (L3-11 = 1), Single drive KEB 2 (L2-29 = 1), KEB Ride-Thru 2 (H1-□□ = 7A or 7B), and Intelligent Stall Prevention during Deceleration (L3-04 = 2) to control the DC bus voltage in OLV/PM.	Default: <5> Min.: 0.00 Max.: 5.00	109
L3-21 (466)	Accel/Decel Rate Calculation Gain	Acc/Dec P Gain	Sets the proportional gain used to calculate the deceleration rate during KEB Ride-Thru, ov suppression function, and Stall Prevention during deceleration (L3-04 = 2).	Default: <5> Min.: 0.00 Max.: 200.00	109
L3-22 (4F9)	Deceleration Time at Stall Prevention during Acceleration	PM Acc Stall P T	Sets the deceleration time used for Stall Prevention during acceleration in OLV/PM.	Default: 0.0 s Min.: 0.0 Max.: 6000	106
L3-23 (4FD)	Automatic Reduction Selection for Stall Prevention during Run	CHP Stall P Sel 0: Lv1 set in L3-06 1: Autom. Reduction	0: Sets the Stall Prevention level set in L3-04 that is used throughout the entire frequency range. 1: Automatic Stall Prevention level reduction in the constant output range. The lower limit value is 40% of L3-06.	Default: 0 Range: 0, 1	108
L3-24 (46E)	Motor Acceleration Time for Inertia Calculations	Mtr Accel Time	OLV/PM Sets the time needed to accelerate the uncoupled motor at rated torque from stop to the maximum frequency.	Default: <6> <7> Min: 0.001 s Max: 10.000 s	109
L3-25 (46F)	Load Inertia Ratio	Load Inertia Rat	OLV/PM Sets the ratio between the motor and machine inertia.	Default: 1.0 Min.: 1.0 Max.: 1000.0	110
L3-26 (455)	Additional DC Bus Capacitors	ExtDC busCapSize	When DC bus capacitors have been added externally, be sure to add those values to the internal capacitor table for proper DC bus calculations.	Default: 0 μF Min: 0 Max: 65000	110
L3-27 (456)	Stall Prevention Detection Time	Stl Prev DetTime	Sets the time the current must exceed the Stall Prevention level to activate Stall Prevention.	Default: 50 ms Min.: 0 Max.: 5000	110

<1> Upper limit is dependent on parameter L8-38, Frequency Reduction Selection.
<2> The setting range is 0 to 2 in OLV/PM control mode.
<3> Default setting is dependent on parameter E1-01, Input voltage Setting.
<4> Values shown are specific to 200 V class drives. Double the value for 400 V class drives.
<5> Default setting is determined by parameter A1-02, Control Mode Setting.
<6> Parameter value changes automatically if E2-11 is manually changed or changed by Auto-Tuning.
<7> Default setting is dependent on parameter o2-04, Drive Model Selection.

◆ L4: Speed Detection

No. (Addr. Hex)	Name	LCD Display	Description	Values	Page
L4-01 (499)	Speed Agreement Detection Level	Spd Agree Level	L4-01 sets the frequency detection level for digital output functions H2-☐☐ = 2, 3, 4, 5.	Default: 0.0 Hz Min.: 0.0 Max.: 240.0	110
L4-02 (49A)	Speed Agreement Detection Width	Spd Agree Width	L4-02 sets the hysteresis or allowable margin for speed detection.	Default:2.0 Hz Min.: 0.0 Max.: 20.0	110
L4-03 (49B)	Speed Agreement Detection Level (+/-)	Spd Agree Lvl+-	L4-03 sets the frequency detection level for digital output functions H2-☐☐ = 13, 14, 15, 16.	Default: 0.0 Hz Min.: -240.0 Max.: 240.0	110
L4-04 (49C)	Speed Agreement Detection Width (+/-)	Spd Agree Wdth+-	L4-04 sets the hysteresis or allowable margin for speed detection.	Default: 2.0 kHz Min.: 0.0 Max.: 20.0	110
L4-05 (49D)	Frequency Reference Loss Detection Selection	Ref Loss Sel 0: Stop 1: Run@L4-06PrevRef	0: Stop. Drive stops when the frequency reference is lost. 1: Run. Drive runs at a reduced speed when the frequency reference is lost.	Default: 1 Range: 0, 1	111
L4-06 (4C2)	Frequency Reference at Reference Loss	Fref at Floss	Sets the percentage of the frequency reference that the drive should run with when the frequency reference is lost.	Default: 80.0% Min.: 0.0 Max.: 100.0	111
L4-07 (470)	Speed Agreement Detection Selection	Freq Detect Sel 0: No Detection @BB 1: Always Detected	0: No detection during baseblock. 1: Detection always enabled.	Default: 0 Range: 0, 1	111

◆ L5: Fault Restart

No. (Addr. Hex)	Name	LCD Display	Description	Values	Page
L5-01 (49E)	Number of Auto Restart Attempts	Num of Restarts	Sets the number of times the drive may attempt to restart after the following faults occur: GF, LF, oC, ov, PF, oL1, oL2, oL3, STo, Uv1.	Default: 0 Min.: 0 Max.: 10	112
L5-02 (49F)	Auto Restart Fault Output Operation Selection	Restart Sel 0: Flt Outp Disabld 1: Flt Outp Enabled	0: Fault output not active. 1: Fault output active during restart attempt.	Default: 0 Range: 0, 1	112
L5-03 (4A0)	Time to Continue Making Fault Restarts	Max Restart Time	Enabled only when L5-05 is set to 0. Causes a fault if a fault restart cannot occur after the set time passes.	Default: 180.0 s Min.: 0.0 Max.: 600.0	112
L5-04 (46C)	Fault Reset Interval Time	Flt Reset Wait T	Sets the amount of time to wait between performing fault restarts.	Default: 10.0 s Min.: 0.5 Max.: 600.0	113
L5-05 (467)	Fault Reset Operation Selection	Torque Detection 0: Continuous 1: Use L5-04 Time	0: Continuously attempt to restart while incrementing restart counter only at a successful restart (same as F7 and G7). 1: Attempt to restart with the interval time set in L5-04 and increment the restart counter with each attempt (same as V7).	Default: 1 Range: 0, 1	113

◆ L6: Torque Detection

No. (Addr. Hex)	Name	LCD Display	Description	Values	Page
L6-01 (4A1)	Torque Detection Selection 1	Torq Det 1 Sel 0: Disabled 1: OL Alm at SpdAgr 2: OL Alm dur RUN 3: OL Flt at SpdAgr 4: OL Flt dur RUN 5: UL Alm at SpdAgr 6: UL Alm dur RUN 7: UL Flt at SpdAgr 8: UL Flt dur RUN 9: UL6Alm at SpdAgr 10: UL6Alm dur RUN 11: UL6Flt at SpdAgr 12: UL6Flt dur RUN	0: Disabled 1: oL3 detection only active during speed agree, operation continues after detection 2: oL3 detection always active during run, operation continues after detection 3: oL3 detection only active during speed agree, output shuts down on an oL3 fault 4: oL3 detection always active during run, output shuts down on an oL3 fault 5: UL3 detection only active during speed agree, operation continues after detection 6: UL3 detection always active during run, operation continues after detection 7: UL3 detection only active during speed agree, output shuts down on an oL3 fault 8: UL3 detection always active during run, output shuts down on an oL3 fault 9: UL6 at speed agree (alarm) 10: UL6 at run (alarm) 11: UL6 at speed agree (fault) 12: UL6 at run (fault)	Default: 0 Range: 0 to 12	115
L6-02 (4A2)	Torque Detection Level 1	Torq Det 1 Lvl	Sets the overtorque and undertorque detection level.	Default: 15% Min.: 0 Max.: 300	115
L6-03 (4A3)	Torque Detection Time 1	Torq Det 1 Time	Sets the time an overtorque or undertorque condition must exist to trigger torque detection 1.	Default: 10.0 s Min.: 0.0 Max.: 10.0	116
L6-13 (62E)	Motor Underload Protection Selection	Underload Select 0: Base Freq Enable 1: Max Freq Enable	Sets the motor underload protection (UL☐) based on motor load. 0: Overtorque/undertorque detection enabled 1: Base frequency motor load enabled	Default: 0 Range: 0, 1	115
L6-14 (62F)	Motor Underload Protection Level at Minimum Frequency	Underload Level	Sets the UL6 detection level at minimum frequency by percentage of drive rated current.	Default: 15% Min.: 0 Max.: 300	115

◆ L8: Drive Protection

No. (Addr. Hex)	Name	LCD Display	Description	Values	Page
L8-02 (4AE)	Overheat Alarm Level	OH Pre-Alarm Lvl	An overheat alarm occurs when heatsink temperature exceeds the L8-02 level.	Default: <1> Min.: 50 °C Max.: 150 °C	116
L8-03 (4AF)	Overheat Pre-Alarm Operation Selection	OH Pre-Alarm Sel 0: Ramp to stop 1: Coast to stop 2: Fast-Stop 3: Alarm only 4: Run@L8-19 Rate	0: Ramp to stop. A fault is triggered. 1: Coast to stop. A fault is triggered. 2: Fast Stop. Decelerate to stop using the deceleration time in C1-09. A fault is triggered. 3: Continue operation. An alarm is triggered. 4: Continue operation at reduced speed as set in L8-19.	Default: 4 Range: 0 to 4	117
L8-05 (4B1)	Input Phase Loss Protection Selection	Inp Ph Loss Det 0: Disabled 1: Enabled	Selects the detection of input current phase loss, power supply voltage imbalance, or main circuit electrolytic capacitor deterioration. 0: Disabled 1: Enabled	Default: 1 Range: 0, 1	118
L8-06 (4B2)	Input Phase Detection Level	Inp Ph Loss Lvl	When ripple is observed in the DC bus, expansion of the input bias is calculated. This value becomes the input phase if the difference between the maximum and minimum values of the ripple is greater than the value set to L8-06. Detection Level = 100% = Voltage class x √2	Default: <1> Min.: 0.0% Max.: 50.0%	118
L8-07 (4B3)	Output Phase Loss Protection Selection	Outp Ph Loss Det 0: Disabled 1: 1PH Loss Det 2: 2/3PH Loss Det	0: Disabled 1: Enabled (triggered by a single phase loss) 2: Enabled (triggered when two phases are lost)	Default: 1 Range: 0 to 2	118

No. (Addr. Hex)	Name	LCD Display	Description	Values	Page
L8-09 (4B5)	Output Ground Fault Detection Selection	Grnd Flt Det Sel 0: Disabled 1: Enabled	0: Disabled 1: Enabled	Default: <1> Range: 0, 1	118
L8-10 (4B6)	Heatsink Cooling Fan Operation Selection	Fan On/Off Sel 0: Dur Run (OffDly) 1: Always On	0: During run only. Fan operates only during run for L8-11 seconds after stop. 1: Fan always on. Cooling fan operates whenever the drive is powered up.	Default: 0 Range: 0, 1	118
L8-11 (4B7)	Heatsink Cooling Fan Off Delay Time	Fan Delay Time	Sets a delay time to shut off the cooling fan after the Run command is removed when L8-10 = 0.	Default: 300 s Min.: 0 Max.: 300	119
L8-12 (4B8)	Ambient Temperature Setting	Ambient Temp	Enter the ambient temperature. This value adjusts the oL2 detection level.	Default: 40 °C Min.: 40 Max.: 60	119
L8-15 (4BB)	oL2 Characteristics Selection at Low Speeds	OL2 Sel @ L-Spd 0: Disabled 1: Enabled	0: No oL2 level reduction below 6 Hz. 1: oL2 level is reduced linearly below 6 Hz. It is halved at 0 Hz.	Default: 1 Range: 0, 1	119
L8-18 (4BE)	Software Current Limit Selection	Soft CLA Sel 0: Disabled 1: Enabled	0: Disabled 1: Enabled	Default: 0 Range: 0, 1	119
L8-19 (4BF)	Frequency Reduction Rate during Overheat Pre-Alarm	Fc Red dur OHAlm	Specifies the frequency reference reduction gain at overheat pre-alarm when L8-03 = 4.	Default: 20.0% Min.: 0.0 Max.: 100.0	117
L8-27 (4DD)	Overcurrent Detection Gain	OC Level	Sets the gain for overcurrent detection as a percentage of the motor rated current. Overcurrent is detected using the lower value between the overcurrent level of the drive or the value set to L8-27.	Default: 300.0% Min.: 0.0 Max.: 300.0	119
L8-29 (4DF)	Current Unbalance Detection (LF2)	LF2 Flt Det Sel 0: Disabled 1: Enabled	0: Disabled 1: Enabled	Default: 1 Range: 0, 1	120
L8-32 (4E2)	Main Contactor and Cooling Fan Power Supply Failure Selection	MC/FAN PS FltSel 0: Ramp to stop 1: Coast to stop 2: Fast-Stop 3: Alarm only 4: Run@L8-19 Rate	Determines drive response when a fault occurs with the internal cooling fan. 0: Ramp to stop 1: Coast to stop 2: Fast stop (Decelerate to stop using the deceleration time set to C1-09) 3: Alarm only (“FAn” will flash) 4: Continue operation at reduced speed as set to L8-19.	Default: 1 Range: 0 to 4	120
L8-35 (4EC)	Installation Method Selection	Installation Sel 0: IP00/OpenChassis 2: IP20/Nema Type 1 3: ExternalHeatsink	0: IP00/Open-Chassis enclosure 2: IP20/NEMA Type 1 enclosure 3: External Heatsink Installation	Default: <1> <2> <3> Range: 0, 2, 3	120
L8-38 (4EF)	Carrier Frequency Reduction	Fc Reduct dur OL 0: Disabled 1: Active below 6Hz 2: Active @ any Spd	0: Disabled 1: Enabled below 6 Hz 2: Enabled for the entire speed range	Default: <4> Range: 0 to 2	121
L8-40 (4F1)	Carrier Frequency Reduction Off Delay Time	Fc Reduct Time	Sets the time that the drive continues running with reduced carrier frequency after the carrier reduction condition is gone. Setting 0.00 s disables the carrier frequency reduction time.	Default: 0.50 s Min.: 0.00 Max.: 2.00	121
L8-41 (4F2)	High Current Alarm Selection	High Cur Alm Sel 0: Disabled 1: Enabled	0: Disabled 1: Enabled. An alarm is triggered at output currents above 150% of drive rated current.	Default: 0 Range: 0, 1	121
L8-97 (3104)	Carrier Frequency Reduction Selection during oH Pre-Alarm	FC Sel dur OHAlm 0: Disabled 1: Enabled	Carrier frequency reduction protection selection. It is reduced to the carrier frequency at oH pre-alarm. 0: Disabled 1: Enabled	Default: 0 Range: 0, 1	–

<1> Default setting is dependent on parameter o2-04, Drive Model Selection.

<2> Parameter setting value is not reset to the default value when the drive is initialized.

<3> Default setting is determined by the drive model:
Setting 2: Models 2A0011 to 2A0211 and 4A0005 to 4A0096
Setting 0: Models 2A0273 to 2A0396 and 4A0124 to 4A0590

<4> Default setting is dependent on parameters A1-02, Control Method Selection, and o2-04, Drive Model Selection.

A.11 n: Special Adjustment

The n parameters adjust more advanced performance characteristics such as Hunting Prevention, speed feedback detection, High Slip Braking, and Online Tuning for motor line-to-line resistance.

◆ n1: Hunting Prevention

No. (Addr. Hex)	Name	LCD Display	Description	Values	Page
n1-01 (580)	Hunting Prevention Selection	Hunt Prev Select 0: Disabled 1: Enabled	0: Disabled 1: Enabled	Default: 1 Range: 0, 1	122
n1-02 (581)	Hunting Prevention Gain Setting	Hunt Prev Gain	If the motor vibrates while lightly loaded, increase the gain by 0.1 until vibration ceases. If the motor stalls, decrease the gain by 0.1 until the stalling ceases.	Default: 1.00 Min.: 0.00 Max.: 2.50	122
n1-03 (582)	Hunting Prevention Time Constant	Hunt Prev Time	Sets the time constant used for Hunting Prevention.	Default: <1> Min.: 0 ms Max.: 500 ms	122
n1-05 (530)	Hunting Prevention Gain while in Reverse	Hprev Gain @Rev	Sets the gain used for Hunting Prevention. If set to 0, the gain set to n1-02 is used for operation in reverse.	Default: 0.00 Min.: 0.00 Max.: 2.50	122

<1> Default setting is dependent on parameter o2-04, Drive Model Selection.

◆ n3: High Slip Braking (HSB) and Overexcitation Braking

No. (Addr. Hex)	Name	LCD Display	Description	Values	Page
n3-01 (588)	High-Slip Braking Deceleration Frequency Width	HSB DecStepWidth	Sets the output frequency reduction step width for when the drive stops the motor using HSB. Set as a percentage of the maximum output frequency. Increase this setting if overvoltage occurs during HSB.	Default: 5% Min.: 1 Max.: 20	123
n3-02 (589)	High-Slip Braking Current Limit	HSB Current Lim	Sets the current limit during HSB as a percentage of the motor rated current.	Default: <1> Min.: 0% Max.: 200%	123
n3-03 (58A)	High-Slip Braking Dwell Time at Stop	HSB DwelTim@Stp	Sets the time the drive will run with minimum frequency (E1-09) at the end of deceleration. If this time is set too low, the machine inertia can cause the motor to rotate slightly after HSB.	Default: 1.0 s Min.: 0.0 Max.: 10.0	123
n3-04 (58B)	High-Slip Braking Overload Time	HSB OL Time	Sets the time required for an HSB overload fault (oL7) to occur when the drive output frequency does not change during an HSB stop. This parameter does not typically require adjustment.	Default: 40 s Min.: 30 Max.: 1200	123
n3-13 (531)	Overexcitation Deceleration Gain	Hflux Brake Gain	Sets the gain applied to the V/f pattern during Overexcitation Deceleration (L3-04 = 4).	Default: 1.10 Min.: 1.00 Max.: 1.40	124
n3-21 (579)	High-Slip Suppression Current Level	Hflux I Supp Lvl	Sets output current level at which the drive will start reducing the overexcitation gain in order to prevent a too high motor slip during Overexcitation Deceleration. Set as a percentage of the drive rated current.	Default: 100% Min.: 0 Max.: 150	124
n3-23 (57B)	Overexcitation Operation Selection	Hflux Brake Sel 0: Enabled-Both Dir 1: Enabled-Fwd only 2: Enabled-Rev only	0: Enabled in both directions 1: Enabled only when rotating forward 2: Enabled only when in reverse	Default: 0 Range: 0 to 2	124

<1> Default setting is dependent on parameter L8-38, Frequency Reduction Selection.

◆ n8: PM Motor Control Tuning

No. (Addr. Hex)	Name	LCD Display	Description	Values	Page
n8-45 (538)	Speed Feedback Detection Control Gain	PM Spd Fdbk Gain	OLV/PM Increase this setting if hunting occurs. Decrease to lower the response.	Default: 0.80 Min.: 0.00 Max.: 10.00	124
n8-47 (53A)	Pull-In Current Compensation Time Constant	PM Pull-in I Tc	OLV/PM Sets the time constant to make the pull-in current reference and actual current value agree. Decrease the value if the motor begins to oscillate, and increase the value if it takes too long for the current reference to equal the output current.	Default: 5.0 s Min.: 0.0 Max.: 100.0	125
n8-48 (53B)	Pull-In Current	PM No-load Curr	OLV/PM Defines the d-Axis current reference during no-load operation at a constant speed. Set as a percentage of the motor rated current. Increase this setting if hunting occurs while running at constant speed.	Default: 30% Min.: 20 Max.: 200	125
n8-49 (53C)	d-Axis Current for High Efficiency Control	EnergySav ID Lvl	OLV/PM Sets the d-Axis current reference when running a high load at constant speed. Set as a percentage of the motor rated current.	Default: <1> Min.: -200.0% Max.: 0.0%	125
n8-51 (53E)	Acceleration/ Deceleration Pull-In Current	PM Pull-in I@Acc	OLV/PM Sets the d-Axis current reference during acceleration/ deceleration as a percentage of the motor rated current. Set to a high value when more starting torque is needed.	Default: 50% Min.: 0 Max.: 200	125
n8-54 (56D)	Voltage Error Compensation Time Constant	PM V Error CompT	OLV/PM Adjusts the value when hunting occurs at low speed. If hunting occurs with sudden load changes, increase n8-54 in increments of 0.1. Reduce this setting if oscillation occurs at start.	Default: 1.00 s Min.: 0.00 Max.: 10.00	125
n8-55 (56E)	Load Inertia	PMLoad wk2 Ratio 0: Less than 1:10 1: 1:10 to 1:30 2: 1:30 to 1:50 3: More than 1:50	OLV/PM Sets the ratio between motor and machine inertia. 0: Lower than 1:10 1: Between 1:10 to 1:30 2: Between 1:30 to 1:50 3: Higher than 1:50	Default: 0 Min.: 0 Max.: 3	126
n8-62 (57D)	Output Voltage Limit	PM Vout Limit	OLV/PM Prevents output voltage saturation. Should be set just below the voltage provided by the input power supply.	Default: 200.0 V <2> Min.: 0.0 Max.: 230.0 <2>	126
n8-65 (65C)	Speed Feedback Detection Control Gain during ov Suppression	SFdbk G @OV Supp	OLV/PM Sets the gain used for internal speed feedback detection during ov suppression.	Default: 1.50 Min.: 0.00 Max.: 10.00	126

<1> Default setting is dependent on parameter o2-04, Drive Model Selection.

<2> Values shown are specific to 200 V class drives. Double the value for 400 V class drives.

A.12 o: Operator-Related Settings

The o parameters set up the digital operator displays.

◆ o1: HOA Keypad Display Selection

No. (Addr. Hex)	Name	LCD Display	Description	Values	Page
o1-01 (500) RUN	Drive Mode Unit Monitor Selection	User Monitor Sel	Selects the content of the last monitor that is shown when scrolling through Drive Mode display. Enter the last three digits of the monitor parameter number to be displayed: U□-□□.	Default: 106 Range: 104 to 699	127
o1-02 (501) RUN	User Monitor Selection after Power Up	Power-On Monitor 1: Frequency Ref 2: FWD/REV 3: Output Freq 4: Output Current 5: User Monitor	1: Frequency reference (U1-01) 2: Direction 3: Output frequency (U1-02) 4: Output current (U1-03) 5: User Monitor	Default: 1 Range: 1 to 5	127
o1-03 (502)	HOA Keypad Operator Display Selection	Display Unit Sel 0: 0.01 Hz 1: 0.01% 2: r/min 3: User Units	Sets the units the drive should use to display the frequency reference and motor speed monitors. 0: 0.01 Hz 1: 0.01% (100% = E1-04) 2: r/min (calculated using the number of motor poles setting in E2-04, E4-04, or E5-04) 3: User-selected units (set by o1-10 and o1-11)	Default: 0 Range: 0 to 3	127
o1-06 (517)	User Monitor Selection Mode	Monitor Mode Sel 0: 3 Mon Sequential 1: 3 Mon Selectable	0: 3 Monitor Sequential (Displays the next two sequential monitors) 1: 3 Monitor Selectable (o1-07 and o1-08 selected monitor are shown)	Default: 0 Range: 0, 1	127
o1-07 (518)	Second Line Monitor Selection	2nd Monitor Sel	Selects the monitor that is shown in the second line. Enter the last three digits of the monitor parameter number to be displayed: U□-□□. For example, set "403" to display monitor parameter U4-03.	Default: 102 Range: 101 to 699	127
o1-08 (519)	Third Line Monitor Selection	3rd Monitor Sel	Selects the monitor that is shown in the third line. Enter the last three digits of the monitor parameter number to be displayed: U□-□□. For example, set "403" to display monitor parameter U4-03.	Default: 103 Range: 101 to 699	127
o1-09 (51C)	Frequency Reference Display Units	Fref Disp Unit 0: WC 1: PSI 2: GPM 3: °F 4: CFM 5: CMH 6: LPH 7: LPS 8: Bar 9: Pa 10: °C 11: Mtr 12: Ft 13: LPM 14: CMM 15: Custom unit 16: No Unit	Sets unit display for the frequency reference parameters and frequency related monitors when o1-03 > 40. 0: WC (Inch of water) 1: PSI (Pounds per square inch) 2: GPM (Gallons per minute) 3: F (Degrees Fahrenheit) 4: CFM (Cubic feet per minute) 5: CMH (Cubic meters per hour) 6: LPH (Liters per hour) 7: LPS (Liters per second) 8: Bar (Bar) 9: Pa (Pascal) 10: C (Degrees Celsius) 11: Mtr (Meters) 12: Ft (Feet) 13: LPM (Liters per minute) 14: CMM (Cubic meters per minute) 15: Custom units (Determined by o1-12) 16: None	Default: 16 Range: 0 to 16	127
o1-10 (520)	User-Set Display Units Maximum Value	UserDisp Scaling	These settings define the display values when o1-03 is set to 3. o1-10 sets the display value that is equal to the maximum output frequency. o1-11 sets the position of the decimal position.	Default: <1> Range: 1 to 60000	128
o1-11 (521)	User-Set Display Units Decimal Display	UserDisp Dec		Default: <1> Range: 0 to 3	129
o1-13 (3105)	Frequency Reference and Frequency Related Monitor Custom Units 1	Fref Cust Unit 1	Sets the customer-specified unit display for the frequency reference parameters and frequency related monitors when o1-03 = 3 and o1-09 = 15 as custom units.	Default: 41 Range: 30 to 7A	129
o1-14 (3106)	Frequency Reference and Frequency Related Monitor Custom Units 2	Fref Cust Unit 2	Sets the customer-specified unit display for the frequency reference parameters and frequency related monitors when o1-03 = 3 and o1-09 = 15 as custom units	Default: 41 Range: 30 to 7A	129

No. (Addr. Hex)	Name	LCD Display	Description	Values	Page
o1-15 (3107)	Frequency Reference and Frequency Related Monitor Custom Units 3	Fref Cust Unit 3	Sets the customer-specified unit display for the frequency reference parameters and frequency related monitors when o1-03 = 3 and o1-09 = 15 as custom units	Default: 41 Range: 30 to 7A	129
o1-16 (3108)	F1 Key Function Selection	F1 Key Func Sel 0: Standard 1: Mon 2: DRV/BYP 3: RUN BYP 4: RLY	Selects the function of the F1 key and the LCD display text above the F1 key. 0: Standard 1: Monitor 2: Drive/Bypass (DRV/BYP) 3: Bypass Run Command (RUN BYP) 4: Toggle Relay Output (RLY)	Default: 0 Range: 0 to 4	129
o1-17 (3109)	F2 Key Function Selection	F2 Key Func Sel 0: Standard 1: Mon 2: DRV/BYP 3: RUN BYP 4: RLY	Selects the function of the F1 key and the LCD display text above the F1 key. 0: Standard 1: Monitor 2: Drive/Bypass (DRV/BYP) 3: Bypass Run Command (RUN BYP) 4: Toggle Relay Output (RLY)	Default: 0 Range: 0 to 4	129
o1-18 (310A)	User Defined Parameter Upper	Userdefined par1	Allows the user to set values that can be used as reference information.	Default: 0 Range: 0 to 999	129
o1-19 (310B)	User Defined Parameter Lower	Userdefined par2	Allows the user to set values that can be used as reference information.	Default: 0 Range: 0 to 999	129

<1> Default setting is dependent on parameter o1-03, HOA Keypad Display Selection.

◆ o2: HOA Keypad Functions

No. (Addr. Hex)	Name	LCD Display	Description	Values	Page
o2-02 (506)	OFF Key Function Selection	Oper STOP Key 0: Disabled 1: Enabled	0: Disabled. OFF key is disabled in REMOTE operation. 1: Enabled. OFF key is always enabled.	Default: 1 Range: 0, 1	130
o2-03 (507)	User Parameter Default Value	User Default Sel 0: No Change 1: Save User Init 2: Clear User Init	0: No change. 1: Set defaults. Saves parameter settings as default values for a User Initialization. 2: Clear all. Clears the default settings that have been saved for a User Initialization.	Default: 0 Range: 0 to 2	130
o2-04 (508)	Drive Model Selection	Inverter Model #	Enter the drive model. Setting required only if installing a new control board.	Default: Determined by drive capacity	130
o2-05 (509)	Frequency Reference Setting Method Selection	Oper Ref Method 0: Disabled 1: Enabled	0: ENTER key must be pressed to enter a frequency reference. 1: ENTER key is not required. The frequency reference can be adjusted using the up and down arrow keys only.	Default: 0 Range: 0, 1	130
o2-06 (50A)	Operation Selection when HOA Keypad is Disconnected	Oper Discon Det 0: Disabled 1: Enabled	0: The drive continues operating if the HOA keypad is disconnected. 1: An oPr fault is triggered and the motor coasts to stop.	Default: 1 Range: 0, 1	131
o2-07 (527)	Motor Direction at Power Up when Using Operator	For/RevSel@PwrUp 0: Forward 1: Reverse	0: Forward 1: Reverse This parameter requires assigning drive operation to the HOA keypad.	Default: 0 Range: 0, 1	131
o2-19 (61F)	Selection of Parameter Write during Uv	ParameterSet Sel 0: Disabled 1: Enabled	Selects whether parameter settings can be changed during a DC bus undervoltage condition. Used with 24 V Power Supply (PS-A10L, PS-A10H). 0: Disabled 1: Enabled	Default: 0 Range: 0, 1	131

◆ o3: Copy Function

No. (Addr. Hex)	Name	LCD Display	Description	Values	Page
o3-01 (515)	Copy Function Selection	COPY SELECT 0: COPY SELECT 1: INV→OP READ 2: OP→INV WRITE 3: OP←→INV VERIFY	0: No action 1: Read parameters from the drive, saving them onto the HOA keypad. 2: Copy parameters from the digital operator, writing them to the drive. 3: Verify parameter settings on the drive to check if they match the data saved on the HOA keypad.	Default: 0 Range: 0 to 3	131
o3-02 (516)	Copy Allowed Selection	Read Allowable 0: Disabled 1: Enabled	0: Read operation prohibited 1: Read operation allowed	Default: 0 Range: 0, 1	132

◆ o4: Maintenance Monitor Settings

No. (Addr. Hex)	Name	LCD Display	Description	Values	Page
o4-01 (50B)	Cumulative Operation Time Setting	DrvElapsTimeCnt	Sets the value for the cumulative operation time of the drive in units of 10 h.	Default: 0 h Min.: 0 Max.: 9999	132
o4-02 (50C)	Cumulative Operation Time Selection	ElapsTimeCntSet 0: Power-On Time 1: Running Time	0: Logs power-on time 1: Logs operation time when the drive output is active (output operation time).	Default: 1 Range: 0, 1	132
o4-03 (50E)	Cooling Fan Operation Time Setting	FanElapsTimeCn	Sets the value of the fan operation time monitor U4-03 in units of 10 h.	Default: 0 h Min.: 0 Max.: 9999	132
o4-05 (51D)	Capacitor Maintenance Setting	BusCap Maint Set	Sets the value of the Maintenance Monitor for the capacitors. See U4-05 to check when the capacitors may need to be replaced.	Default: 0% Min.: 0 Max.: 150	132
o4-07 (523)	DC Bus Pre-Charge Relay Maintenance Setting	ChrgCircMaintSet	Sets the value of the Maintenance Monitor for the soft charge bypass relay. See U4-06 to check when the bypass relay may need to be replaced.	Default: 0% Min.: 0 Max.: 150	132
o4-11 (510)	U2, U3 Initialization	Fault Data Init 0: No Reset 1: Reset	0: U2-☐☐ and U3-☐☐ monitor data is not reset when the drive is initialized (A1-03). 1: U2-☐☐ and U3-☐☐ monitor data is reset when the drive is initialized (A1-03).	Default: 0 Range: 0, 1	133
o4-12 (512)	kWh Monitor Initialization	kWh Monitor Init 0: No Reset 1: Reset	0: U4-10 and U4-11 monitor data is not reset when the drive is initialized (A1-03). 1: U4-10 and U4-11 monitor data is reset when the drive is initialized (A1-03).	Default: 0 Range: 0, 1	133
o4-13 (528)	Number of Run Commands Counter Initialization	Run Counter Init 0: No Reset 1: Reset	0: Number of Run commands counter is not reset when the drive is initialized (A1-03). 1: Number of Run commands counter is reset when the drive is initialized (A1-03).	Default: 0 Range: 0, 1	133
o4-17 (3100) <1>	Set/Reset Real-time Clock	Set Time 0: Disabled 1: Enabled	Sets the current date and time for the Real-Time Clock. 0: Disabled 1: Enabled	Default: 0 Range: 0~ 1	133
o4-17 (3100) <2>	Set/Reset Real-time Clock	Set Time 0: — — 1: Set 2: Reset	Sets the current date and time for the Real-Time Clock. 0: — — No Setting 1: Real-Time Clock Set 2: Real-Time Clock Reset	Default: 0 Range: 0~2	133

<1> Available in drive software versions PRG: 1012 and earlier.

<2> Available in drive software versions PRG: 1013 and later.

A.13 S: Special Application

◆ S1: Dynamic Noise Control Function

No. (Addr. Hex)	Name	LCD Display	Description	Values	Page
S1-01 (3200)	Dynamic Audible Noise Control Function Selection	Dyn Noise Ctrl 0: Disabled 1: Enabled	Reduces audible noise by decreasing the output voltage in variable torque applications with light loads. 0: Disabled 1: Enabled	Default: 1 Range: 0, 1	134
S1-02 (3201)	Voltage Reduction Rate	Volt Reduce Amt	Sets the rate at which the output voltage will be reduced as a percentage of the V/f pattern when operating with no load.	Default: 50.0% Min.: 50.0 Max.: 100.0	134
S1-03 (3202)	Voltage Restoration Level	V Reduce On Lvl	Sets the level when the drive should start restoring the voltage as a percentage of the drive rated torque.	Default: 20.0% Min.: 0.0 Max.: 90.0	134
S1-04 (3203)	Voltage Restoration Complete Level	V Reduce Off Lvl	Sets the level at which voltage restoration for the V/f pattern is complete as a percentage of the drive rated torque. If the output torque rises above the value of S1-04, then the voltage will be controlled in a manner specified by the V/f pattern setting.	Default: 50.0% Min.: S1-03 + 10.0 Max.: 100.0	135
S1-05 (3204)	Voltage Restoration Sensitivity Time Constant	Sensitivity Time	Sets the level of sensitivity of the output torque and LPF time constant for the voltage reduction rate. The level of sensitivity can be adjusted in accordance with the load response.	Default: 1.000 s Min.: 0.000 Max.: 3.000	135
S1-06 (3205)	Voltage Restoration Time Constant at Impact	Impact Load Time	Sets the voltage restoration time constant if an impact load is added.	Default: 0.050 s Min.: 0.000 Max.: 1.000	135

◆ S2: Sequence Timers

No. (Addr. Hex)	Name	LCD Display	Description	Values	Page
S2-01 (3206)	Sequence Timer 1 Start Time	Tmr 1 Start Time	Sets the start time for timer 1. The value must be set less than or equal to S2-02.	Default: 00:00 Min.: 00:00 Max.: 24:00	137
S2-02 (3207)	Sequence Timer 1 Stop Time	Tmr 1 Stop Time	Sets the stop time for timer 1. The value must be set greater than or equal to S2-01.	Default: 00:00 Min.: 00:00 Max.: 24:00	137
S2-03 (3208)	Sequence Timer 1 Day Selection	Tmr 1 Day Sel 0: Timer disabled 1: Daily 2: Mon - Fri 3: Sat - Sun 4: Monday 5: Tuesday 6: Wednesday 7: Thursday 8: Friday 9: Saturday 10: Sunday	Sets the days for which sequence timer 1 is active. 0: Timer disabled 1: Daily 2: Mon - Fri 3: Sat - Sun 4: Monday 5: Tuesday 6: Wednesday 7: Thursday 8: Friday 9: Saturday 10: Sunday	Default: 0 Range: 0 to 10	138
S2-04 (3209)	Sequence Timer 1 Selection	Tmr 1 Seq Sel 0: Digital out only 1: Run 2: Run - PI Disable	Sets the action that occurs when sequence timers 1 is active. 0: Digital output only 1: Run 2: Run - PI disable	Default: 0 Range: 0 to 2	138
S2-05 (320A)	Sequence Timer 1 Reference Source	Tmr 1 Ref Source 0: Operator (d1-01) 1: Operator (d1-02) 2: Operator (d1-03) 3: Operator (d1-04) 4: Terminals 5: Serial com 6: Option PCB	Selects the frequency reference source used for running the drive when sequence timer 1 is active (only applicable when S2-04 is set to 1 or 2). 0: Operator (d1-01) 1: Operator (d1-02) 2: Operator (d1-03) 3: Operator (d1-04) 4: Terminals 5: Serial communication 6: Option card	Default: 0 Range: 0 to 6	138

No. (Addr. Hex)	Name	LCD Display	Description	Values	Page
S2-06 (320B)	Sequence Timer 2 Start Time	Tmr 2 Start Time	Sets the start time for timer 2. The value must be set less than or equal to S2-07.	Default: 00:00 Min.: 00:00 Max.: 24:00	137
S2-07 (320C)	Sequence Timer 2 Stop Time	Tmr 2 Stop Time	Sets the stop time for timer 2. The value must be set greater than or equal to S2-06.	Default: 00:00 Min.: 00:00 Max.: 24:00	137
S2-08 (320D)	Sequence Timer 2 Day Selection	Tmr 2 Day Sel 0: Timer disabled 1: Daily 2: Mon - Fri 3: Sat - Sun 4: Monday 5: Tuesday 6: Wednesday 7: Thursday 8: Friday 9: Saturday 10: Sunday	Sets the days for which sequence timer 2 is active. 0: Timer disabled 1: Daily 2: Mon - Fri 3: Sat - Sun 4: Monday 5: Tuesday 6: Wednesday 7: Thursday 8: Friday 9: Saturday 10: Sunday	Default: 0 Range: 0 to 10	138
S2-09 (320E)	Sequence Timer 2 Selection	Tmr 2 Seq Sel 0: Digital out only 1: Run 2: Run - PI Disable	Sets the action that occurs when sequence timers 2 is active. 0: Digital output only 1: Run 2: Run - PI disable	Default: 0 Range: 0 to 2	138
S2-10 (320F)	Sequence Timer 2 Reference Source	Tmr 2 Ref Source 0: Operator (d1-01) 1: Operator (d1-02) 2: Operator (d1-03) 3: Operator (d1-04) 4: Terminals 5: Serial com 6: Option PCB	Selects the frequency reference source used for running the drive when sequence timer 2 is active (only applicable when S2-09 is set to 1 or 2). 0: Operator (d1-01) 1: Operator (d1-02) 2: Operator (d1-03) 3: Operator (d1-04) 4: Terminals 5: Serial communication 6: Option card	Default: 0 Range: 0 to 6	138
S2-11 (3210)	Sequence Timer 3 Start Time	Tmr 3 Start Time	Sets the start time for timer 3. The value must be set less than or equal to S2-12.	Default: 00:00 Min.: 00:00 Max.: 24:00	137
S2-12 (3211)	Sequence Timer 3 Stop Time	Tmr 3 Stop Time	Sets the stop time for timer 3. The value must be set greater than or equal to S2-11.	Default: 00:00 Min.: 00:00 Max.: 24:00	137
S2-13 (3212)	Sequence Timer 3 Day Selection	Tmr 3 Day Sel 0: Timer disabled 1: Daily 2: Mon - Fri 3: Sat - Sun 4: Monday 5: Tuesday 6: Wednesday 7: Thursday 8: Friday 9: Saturday 10: Sunday	Sets the days for which sequence timer 3 is active. 0: Timer disabled 1: Daily 2: Mon - Fri 3: Sat - Sun 4: Monday 5: Tuesday 6: Wednesday 7: Thursday 8: Friday 9: Saturday 10: Sunday	Default: 0 Range: 0 to 10	138
S2-14 (3213)	Sequence Timer 3 Selection	Tmr 3 Seq Sel 0: Digital out only 1: Run 2: Run - PI Disable	Sets the action that occurs when sequence timer 3 is active. 0: Digital output only 1: Run 2: Run - PI disable	Default: 0 Range: 0 to 2	138
S2-15 (3214)	Sequence Timer 3 Reference Source	Tmr 3 Ref Source 0: Operator (d1-01) 1: Operator (d1-02) 2: Operator (d1-03) 3: Operator (d1-04) 4: Terminals 5: Serial com 6: Option PCB	Selects the frequency reference source used for running the drive when sequence timer 3 is active (only applicable when S2-14 is set to 1 or 2). 0: Operator (d1-01) 1: Operator (d1-02) 2: Operator (d1-03) 3: Operator (d1-04) 4: Terminals 5: Serial communication 6: Option card	Default: 0 Range: 0 to 6	138
S2-16 (3215)	Sequence Timer 4 Start Time	Tmr 4 Start Time	Sets the start time for timer 4. The value must be set less than or equal to S2-17.	Default: 00:00 Min.: 00:00 Max.: 24:00	137

No. (Addr. Hex)	Name	LCD Display	Description	Values	Page
S2-17 (3216)	Sequence Timer 4 Stop Time	Tmr 4 Stop Time	Sets the stop time for timer 4. The value must be set greater than or equal to S2-16.	Default: 00:00 Min.: 00:00 Max.: 24:00	137
S2-18 (3217)	Sequence Timer 4 Day Selection	Tmr 4 Day Sel 0: Timer disabled 1: Daily 2: Mon - Fri 3: Sat - Sun 4: Monday 5: Tuesday 6: Wednesday 7: Thursday 8: Friday 9: Saturday 10: Sunday	Sets the days for which sequence timer 4 is active. 0: Timer disabled 1: Daily 2: Mon - Fri 3: Sat - Sun 4: Monday 5: Tuesday 6: Wednesday 7: Thursday 8: Friday 9: Saturday 10: Sunday	Default: 0 Range: 0 to 10	138
S2-19 (3218)	Sequence Timer 4 Selection	Tmr 4 Seq Sel 0: Digital out only 1: Run 2: Run - PI Disable	Sets the action that occurs when sequence timer 4 is active. 0: Digital output only 1: Run 2: Run - PI disable	Default: 0 Range: 0 to 2	138
S2-20 (3219)	Sequence Timer 4 Reference Source	Tmr 4 Ref Source 0: Operator (d1-01) 1: Operator (d1-02) 2: Operator (d1-03) 3: Operator (d1-04) 4: Terminals 5: Serial com 6: Option PCB	Selects the frequency reference source used for running the drive when sequence timer 4 is active (only applicable when S2-19 is set to 1 or 2). 0: Operator (d1-01) 1: Operator (d1-02) 2: Operator (d1-03) 3: Operator (d1-04) 4: Terminals 5: Serial communication 6: Option card	Default: 0 Range: 0 to 6	138

◆ S3: Secondary PI (PI2) Control

No. (Addr. Hex)	Name	LCD Display	Description	Values	Page
S3-01 (321A) RUN	Secondary PI Enable Selection	PI2 Enable Sel 0: Disabled 1: Always 2: Drive running 3: Motor running	0: Secondary PI disabled 1: Always 2: Drive running 3: Motor running	Default: 0 Range: 0 to 3	139
S3-02 (321B) RUN	Secondary PI User Display	PI2 UsrDspMaxVal	Sets the scale value of 100% PI input.	Default: 10000 Min.: 0 Max.: 60000	139
S3-03 (321C) RUN	Secondary PI Display Digits	PI2 UsrDspDigits 0: No Dec (XXXXX) 1: 1 Dec (XXXX.X) 2. 2 Dec (XXX.XX) 3: 3 Dec (XX.XXX)	0: No decimal places 1: One decimal place 2: Two decimal places 3: Three decimal places	Default: 2 Range: 0 to 3	140
S3-04 (321D) RUN	Secondary PI Unit Selection	PI2 Unit Sel 0: WC 1: PSI 2: GPM 3: °F 4: CFM 5: CMH 6: LPH 7: LPS 8: Bar 9: Pa 10: °C 11: Mtr 12: LPM 13: CMM 14: No unit 15: %	0: Inch of water (WC) 1: Pounds per square inch (PSI) 2: Gallons per minute (GPM) 3: Degrees Fahrenheit (F) 4: Cubic feet per minute (CFM) 5: Cubic meters per hour (CMH) 6: Liters per hour (LPH) 7: Liters per second (LPS) 8: Bar (Bar) 9: Pascals (Pa) 10: Degrees Celsius (C) 11: Meters (Mtr) (Ft: Feet) 12: Liters per minute (LPM) 13: Cubic meters per minute (CMM) 14: No unit 15: Percentage (%)	Default: 15 Range: 0 to 15	140

No. (Addr. Hex)	Name	LCD Display	Description	Values	Page
S3-05 (321E) RUN	Secondary PI Setpoint Value	PI2 Setpoint	Sets the secondary PI controller target value	Default: 0.00 <1> Min.: 0.00 Max.: 600.00 <2>	140
S3-06 (321F) RUN	Secondary PI Proportional Gain Setting	PI2 Gain	Sets the proportional gain of the secondary PI controller. A setting of 0.00 disables P control.	Default: 1.00 Min.: 0.00 Max.: 25.00	140
S3-07 (3220) RUN	Secondary PI Integral Time Setting	PI2 I Time	Sets the integral time for the secondary PI controller. A setting of 0.0s disables integral control.	Default: 1.0 s Min.: 0.0 Max.: 360.0	140
S3-08 (3221) RUN	Secondary PI Integral Limit Setting	PI2 I Limit	Sets the maximum output possible from the integrator.	Default: 100.0% Min.: 0.0 Max.: 100.0	141
S3-09 (3222) RUN	Secondary PI Output Upper Limit	PI2 Upper Limit	Sets the maximum output possible from the secondary PI controller.	Default: 100.0% Min.: 0.0 Max.: 100.0	141
S3-10 (3223) RUN	Secondary PI Output Lower Limit	PI2 Lower Lim	Sets the minimum output possible from the secondary PI controller.	Default: 0.00% Min.: -100.00 Max.: 100.00	141
S3-11 (3224) RUN	Secondary PI Output Level Selection	PI2 Out Lvl Sel 0: Normal Character 1: Rev Character	0: Normal Output (direct acting) 1: Reverse Output (reverse acting)	Default: 0 Range: 0, 1	141
S3-12 (3225) RUN	Secondary PI Disable Mode	PI2 Disable Mode 0: No output 1: Lower Limit (S3-10) 2: Setpoint	0: No output (0%) 1: Lower Limit (S3-10) 2: Setpoint	Default: 0 Range: 0 to 2	141
S3-13 (3226) RUN	Secondary PI Low Feedback Detection Level	PI2 Low FB Lvl	Sets the secondary PI low feedback detection level.	Default: 0.00 <1> Min.: 0.00 Max.: 600.00 <2>	141
S3-14 (3227) RUN	Secondary PI Low Feedback Detection Time	PI2 Low FB Time	Sets the secondary PI low feedback detection delay time in seconds.	Default: 1.0 s Min.: 0.0 Max.: 25.5	142
S3-15 (3228) RUN	Secondary PI High Feedback Level	PI2 High FB Lvl	Sets the secondary PI high feedback detection level.	Default: 100.00 <1> Min.: 0.00 Max.: 600.00 <2>	142
S3-16 (3229) RUN	Secondary PI High Feedback Detection Time	PI2 High FB Tim	Sets the secondary PI high feedback detection delay time in seconds.	Default: 1.0 s Min.: 0.0 Max.: 25.5	142
S3-17 (322A) RUN	Secondary PI Feedback Detection Selection	PI2 FB Det Sel 0: PI2 Enabled 1: Always	0: Secondary PI enabled 1: Always	Default: 0 Range: 0, 1	142

<1> Unit is determined by S3-04.

<2> Upper limit is S3-02, decimal placeholder is determined by S3-03.

◆ S4: Bypass Operation

No. (Addr. Hex)	Name	LCD Display	Description	Values	Page
S4-01 (322B) RUN	BP Auto Transfer on Fault Enable	BP Fault Trnsfer 0: Disabled 1: Enabled	0: No transfer after fault 1: Transfer to bypass after fault	Default: 1 Range: 0, 1	148
S4-02 (322C) RUN	Secondary PI User Display	BP Enrgy Sav Lvl	Delta used to determine when to switch into Energy Save Bypass. This allows for lower frequency output values to also trigger Energy Save Bypass functionality.	Default: 0 Hz Min.: 0 Max.: 20	148
S4-03 (322D) RUN	BP Energy Save Bypass Timer	BP Enrgy Sav TMR	Sets the time in seconds that the drive should run at the specified speed before entering Energy Save Bypass mode.	Default: 60 s Min.: 10 Max.: 60000	149
S4-04 (322E) RUN	BP Energy Save Bypass Speed Increase	BP Enrgy Sav Inc	Sets the value in Hz that the drive will increase the output frequency above E1-04 before performing an Energy Save transfer to bypass.	Default: 6 Hz Min.: 0 Max.: 10	149

◆ S5: HOA Keypad Parameters

No. (Addr. Hex)	Name	LCD Display	Description	Values	Page
S5-01 (322F)	HAND Frequency Reference Selection	HAND Fref Source 0: Operator 1: Terminals 2: d1-16 3: S5-05 4: Set by b1-01	0: HOA keypad 1: Terminals 2: d1-16 3: S5-05 4: Determined by b1-01	Default: 0 Range: 0 to 4	149
S5-02 (3230)	HAND/AUTO During Run Selection	HAND/AUTO @Run 0: Disabled 1: Enabled	0: Disabled 1: Enabled	Default: 1 Range: 0, 1	149
S5-03 (3231) RUN	HAND Mode PI Selection	HAND Mode PI Sel 0: Disabled 1: Enabled	0: Disabled 1: Enabled	Default: 1 Range: 0, 1	149
S5-04 (3232)	HAND Mode Behavior Selection	HAND BehaviorSel 0: Legacy 1: Normal 2: Normal w/ Memory	0: Legacy operation mode 1: Normal operation mode 2: Normal with memory **Note:** The drive will always be in AUTO mode at power up with S5-04 = 1.	Default: 1 Range: 0 to 2	149
S5-05 (3233) RUN	HAND Frequency Reference 1	HAND Freq Ref 2	Sets the frequency reference used in HAND mode when S5-01 is set to 2.	Default: 0.00 Hz Min.: 0.00 Max.: 240.00	151
S5-07 (3235)	HAND Key Function Selection (HOA Keypad)	Oper HAND Key 0: Disabled 1: Enabled	Determines whether the HAND key on the HOA keypad will be enabled for switching between HAND and AUTO. 0: Disabled 1: Enabled	Default: 1 Range: 0, 1	151

◆ S6: Z1000 Protection

No. (Addr. Hex)	Name	LCD Display	Description	Values	Page
S6-01 (3236)	Emergency Override Speed	E Override Speed	Sets the speed command used in Emergency Override mode when S6-02 = 0.	Default: 0.00 Hz Min.: 0.00 Max.: 240.00	152
S6-02 (3237)	Emergency Override Reference Selection	E OverrideRefSel 0: Use S6-01 Ref 1: Use AUTO Ref	Selects the frequency reference source for the Emergency Override function (H1-□□= AF or B0). 0: Use S6-01 Reference 1: Use AUTO Reference **Note:** In drive software versions PRG: 1013 and earlier, if the CALL alarm is displayed, the Emergency Override Forward (H1-0□ = AF) and Emergency Override Reverse (H1-0□ = B0) inputs are ignored. In drive software versions PRG: 1014 and later, the Emergency Override inputs will function even if the CALL alarm is displayed.	Default: 0 Range: 0, 1	152
S6-03 (3238)	ov2 Detect Time	ov2 Detect Time	Sets the detection time of ov2 in 0.1 s increments.	Default: 10.0 s Min.: 0.0 Max.: 1200.0	152
S6-04 (3239)	Main Contactor and Cooling Fan Power Supply Failure	FAN1 Fault Sel 0: Ramp to Stop 1: Coast to stop 2: Fast-Stop	Determines the action the drive should take when a fault occurs with the external cooling fan. 0: Ramp to stop 1: Coast to Stop 2: Fast Stop (decelerate to stop using the deceleration time in C1-09)	Default: 1 Range: 0 to 2	152
S6-07 (323C)	Output Phase Loss Detection Level for Dynamic Audible Noise Control	Outp Ph Loss Lv1	Sets the output phase loss detection level for Dynamic Audible Noise Control. Decrease the setting in steps of 10% when output phase loss is detected erroneously. This setting rarely needs to be changed.	Default: 100.0% Min.: 10.0 Max.: 100.0	152

A.14 T: Motor Tuning

Enter data into the following parameters to tune the motor and drive for optimal performance.

◆ T1: Induction Motor Auto-Tuning

No. (Addr. Hex)	Name	LCD Display	Description	Values	Page
T1-01 (701) <1>	Auto-Tuning Mode Selection	Tuning Mode Sel 2: Term Resistance 3: On-DelayCompTune	2: Stationary Auto-Tuning for Line-to-Line Resistance 3: Rotational Auto-Tuning for V/f Control Energy Saving	Default: 2 Range: 2, 3	153
T1-02 (702)	Motor Rated Power	Mtr Rated Power	Sets the motor rated power as specified on the motor nameplate. **Note:** Use the following formula to convert horsepower into kilowatts: 1HP = 0.746 kW.	Default: <2> Min.: 0.00 kW Max.: 650.00 kW	153
T1-03 (703)	Motor Rated Voltage	Rated Voltage	Sets the motor rated voltage as specified on the motor nameplate.	Default: 200.0 V <3> Min: 0.0 Max: 255.0 <3>	153
T1-04 (704)	Motor Rated Current	Rated Current	Sets the motor rated current as specified on the motor nameplate.	Default: <2> Min.: 10% of drive rated current Max.: 200% of drive rated current	153
T1-05 (705)	Motor Base Frequency	Rated Frequency	Sets the rated frequency of the motor as specified on the motor nameplate.	Default: 60.0 Hz Min.: 0.0 Max.: 240.0	153
T1-06 (706)	Number of Motor Poles	Number of Poles	Sets the number of motor poles as specified on the motor nameplate.	Default: 4 Min.: 2 Max.: 48	153
T1-07 (707)	Motor Base Speed	Rated Speed	Sets the rated speed of the motor as specified on the motor nameplate.	Default: 1750 r/min Min.: 0 Max.: 14400	153
T1-11 (70B)	Motor Iron Loss	Mtr Iron Loss(W)	Sets the iron loss for determining the Energy Saving coefficient. The value is set to E2-10 (motor iron loss) set when the power is cycled. If T1-02 is changed, a default value appropriate for the motor capacity that was entered will appear.	Default: 14 W <4> Min.: 0 Max.: 65535	154
T1-12 (FFF0)	T1 Tuning Start	Tuning Ready	The drive starts tuning.	No setting available	154

<1> The availability of certain Auto-Tuning methods depends on the control mode selected for the drive.

<2> Default setting is dependent on parameter o2-04, Drive Model Selection.

<3> Values shown are specific to 200 V class drives. Double the value for 400 V class drives.

<4> Default setting value differs depending on the motor code value and motor parameter settings.

◆ T2: PM Motor Auto-Tuning

No. (Addr. Hex)	Name	LCD Display	Description	Values	Page
T2-01 (750)	PM Motor Auto-Tuning Mode Selection	PM Tuning Mode 0: Standard Tuning	OLV/PM 0: PM Motor Parameter Settings	Default: 0 Range: 0	154
T2-03 (752)	PM Motor Type	PM Motor Type 0: IPM motor 1: SPM motor	OLV/PM 0: IPM motor 1: SPM motor	Default: 1 Range: 0, 1	154

No. (Addr. Hex)	Name	LCD Display	Description	Values	Page
T2-04 (730)	PM Motor Rated Power	Mtr Rated Power	OLV/PM Sets the motor rated power. **Note:** Use the following formula to convert horsepower into kilowatts: 1 HP = 0.746 kW.	Default: <1> Min.: 0.00 kW Max.: 650.00 kW	154
T2-05 (732)	PM Motor Rated Voltage	Rated Voltage	OLV/PM Enter the motor rated voltage as indicated on the motor nameplate.	Default: 200.0 V <2> Min.: 0.0 Max.: 255.0 <2>	154
T2-06 (733)	PM Motor Rated Current	Rated Current	OLV/PM Enter the motor rated current as indicated on the motor nameplate.	Default: <1> Min.: 10% of drive rated current Max.: 200% of drive rated current	155
T2-07 (753)	PM Motor Base Frequency	Base Frequency	OLV/PM Enter the motor base frequency as indicated on the motor nameplate.	Default: 87.5 Hz Min.: 0.0 Max.: 240.0	155
T2-08 (734)	Number of PM Motor Poles		OLV/PM Enter the number of motor poles for the PM motor as indicated on the motor nameplate.	Default: 6 Min.: 2 Max.: 48	155
T2-10 (754)	PM Motor Stator Resistance	Arm Resistance	OLV/PM Enter the rotor resistance for the PM motor as indicated on the motor nameplate.	Default: <3> Min.: 0.000 Ω Max.: 65.000 Ω	155
T2-11 (735)	PM Motor d-Axis Inductance	d-Axis Induct	OLV/PM Enter the d-axis inductance for the PM motor as indicated on the motor nameplate.	Default: <3> Min.: 0.00 mH Max.: 600.00 mH	155
T2-12 (736)	PM Motor q-Axis Inductance	q-Axis Induct	OLV/PM Enter the q-axis inductance for the PM motor as indicated on the motor nameplate.	Default: <3> Min.: 0.00 mH Max.: 600.00 mH	155
T2-13 (755)	Induced Voltage Constant Unit Selection	Iduct Volt Unit 0: mV/RPM 1: mV/(rad/sec)	OLV/PM 0: mV/(r/min). E5-09 will automatically be set to 0.0, and E5-24 will be used. 1: mV/(rad/sec). E5-24 will automatically be set to 0.0, and E5-09 will be used.	Default: 0 Range: 0, 1	155
T2-14 (737)	PM Motor Induced Voltage Constant	Induct Volt Coef	OLV/PM Enter the induced voltage coefficient for the PM motor as indicated on the motor nameplate. Setting units are determined by parameter T2-13, Induced Voltage Constant Unit Selection.	Default: <3> Min.: 0.1 Max.: 2000.0	155
T2-15 (756)	Pull-In Current Level for PM Motor Tuning	Pull-In I Lvl	OLV/PM Sets the amount of pull-in current to use for Auto-Tuning as a percentage of the motor rated current. Increase this setting for high inertia loads.	Default: 30% Min.: 0 Max.: 120	156
T2-18 (FFF1)	T2 Tuning Start	T2 Tuning Start	OLV/PM The drive starts tuning.	No setting available	156

<1> Default setting is dependent on parameter o2-04, Drive Model Selection.

<2> Values shown are specific to 200 V class drives. Double the value for 400 V class drives.

<3> Default setting is dependent on parameter T2-02, PM Motor Code Selection, and the drive capacity.

A.15 U: Monitors

Monitor parameters allow the user to view drive status, fault information, and other data concerning drive operation.

◆ U1: Operation Status Monitors

No. (Addr. Hex)	Name	LCD Display	Description	Analog Output Level	Unit
U1-01 (40)	Frequency Reference	Frequency Ref	Monitors the frequency reference. Display units are determined by o1-03.	10 V: Max frequency	0.01 Hz
U1-02 (41)	Output Frequency	Output Freq	Displays the output frequency. Display units are determined by o1-03.	10 V: Max frequency	0.01 Hz
U1-03 (42)	Output Current	Output Current	Displays the output current.	10 V: Drive rated current	<1> <2>
U1-04 (43)	Control Method	Control Method	0: V/f Control	No signal output available	–
U1-06 (45)	Output Voltage Reference	Output Voltage	Displays the output voltage.	10 V: 200 Vrms <3>	0.1 Vac
U1-07 (46)	DC Bus Voltage	DC Bus Voltage	Displays the DC bus voltage.	10 V: 400 V <3>	1 Vdc
U1-08 (47)	Output Power	Output kWatts	Displays the output power (this value is calculated internally).	10 V: Drive rated power (kW)	<4>
U1-10 (49)	Input Terminal Status	Input Term Sts	Displays the input terminal status. U1 - 10= 00000000 1 Digital input 1 (terminal S1 enabled) 1 Digital input 2 (terminal S2 enabled) 1 Digital input 3 (terminal S3 enabled) 1 Digital input 4 (terminal S4 enabled) 1 Digital input 5 (terminal S5 enabled) 1 Digital input 6 (terminal S6 enabled) 1 Digital input 7 (terminal S7 enabled)	No signal output available	–
U1-11 (4A)	Output Terminal Status	Output Term Sts	Displays the output terminal status. U1 - 11 = 00000000 1 Multi-Function Digital Output (terminal M1-M2) 1 Multi-Function Digital Output (terminal M3-M4) 1 Multi-Function Digital Output (terminal M5-M6) 0 Not Used 1 Fault Relay (terminal MA-MC closed MA-MC open)	No signal output available	–

No. (Addr. Hex)	Name	LCD Display	Description	Analog Output Level	Unit
U1-12 (4B)	Drive Status	Int Ctl Sts 1	Verifies the drive operation status. U1-12=00000000 1 During run 1 During zero-speed 1 During REV 1 During fault reset signal input 1 During speed agree 1 Drive ready 1 During alarm detection 1 During fault detection	No signal output available	–
U1-13 (4E)	Terminal A1 Input Level	Term A1 Level	Displays the signal level to analog input terminal A1.	10 V: 100%	0.1%
U1-14 (4F)	Terminal A2 Input Level	Term A2 Level	Displays the signal level to analog input terminal A2.	10 V: 100%	0.1%
U1-16 (53)	Output Frequency after Soft Starter	SFS Output	Displays output frequency with ramp time and S-curves. Units determined by o1-03.	10 V: Max frequency	0.01 Hz
U1-18 (61)	oPE Fault Parameter	OPE Error Code	Displays the parameter number that caused the oPE☐☐ or Err (EEPROM write error) error.	No signal output available	–
U1-19 (66)	MEMOBUS/Modbus Error Code	Transmit Err	Displays the contents of a MEMOBUS/Modbus error. U1-19=00000000 1 CRC Error 1 Data Length Error 0 Not Used 1 Parity Error 1 Overrun Error 1 Framing Error 1 Timed Out 0 Not Used	No signal output available	–
U1-25 (4D)	Software Number (Flash)	CPU 1 SW Number	FLASH ID	No signal output available	–
U1-26 (5B)	Software No. (ROM)	CPU 2 SW Number	ROM ID	No signal output available	–
U1-27 (7A8)	Message ID (OPR)	MessageID (OPR)	OPR ID	No signal output available	–
U1-28 (7A9)	Message ID (INV)	MessageID (INV)	INV ID	No signal output available	–

<1> The number of decimal places in the parameter value depends on the drive model. This value has two decimal places (0.01 A) if the drive is set for a maximum applicable motor capacity up to and including 11 kW, and one decimal place (0.1 A) if the maximum applicable motor capacity is higher than 11 kW.

<2> When reading the value of this monitor via MEMOBUS/Modbus, a value of 8192 is equal to 100% of the drive rated output current.

<3> Values shown are specific to 200 V class drives. Double the value for 400 V class drives.

<4> This value has two decimal places (0.01 kW) if the drive is set for a maximum applicable motor capacity up to and including 11 kW, and one decimal place (0.1 kW) if the maximum applicable motor capacity is higher than 11 kW.

◆ U2: Fault Trace

No. (Addr. Hex)	Name	LCD Display	Description	Analog Output Level	Unit
U2-01 (80)	Current Fault	Current Fault	Displays the current fault.	No signal output available	–
U2-02 (81)	Previous Fault	Last Fault	Displays the previous fault.	No signal output available	–

No. (Addr. Hex)	Name	LCD Display	Description	Analog Output Level	Unit
U2-03 (82)	Frequency Reference at Previous Fault	Frequency Ref	Displays the frequency reference at the previous fault.	No signal output available	0.01 Hz
U2-04 (83)	Output Frequency at Previous Fault	Output Freq	Displays the output frequency at the previous fault.	No signal output available	0.01 Hz
U2-05 (84)	Output Current at Previous Fault	Output Current	Displays the output current at the previous fault.	No signal output available	<1> <2>
U2-07 (86)	Output Voltage at Previous Fault	Output Voltage	Displays the output voltage at the previous fault.	No signal output available	0.1 Vac
U2-08 (87)	DC Bus Voltage at Previous Fault	DC Bus Voltage	Displays the DC bus voltage at the previous fault.	No signal output available	1 Vdc
U2-09 (88)	Output Power at Previous Fault	Output kWatts	Displays the output power at the previous fault.	No signal output available	0.1 kW
U2-11 (8A)	Input Terminal Status at Previous Fault	Input Term Sts	Displays the input terminal status at the previous fault. Displayed as in U1-10.	No signal output available	–
U2-12 (8B)	Output Terminal Status at Previous Fault	Output Term Sts	Displays the output status at the previous fault. Displays the same status displayed in U1-11.	No signal output available	–
U2-13 (8C)	Drive Operation Status at Previous Fault	Inverter Status	Displays the operation status of the drive at the previous fault. Displays the same status displayed in U1-12.	No signal output available	–
U2-14 (8D)	Cumulative Operation Time at Previous Fault	Elapsed time	Displays the cumulative operation time at the previous fault.	No signal output available	1 h
U2-15 (7E0)	Soft Starter Speed Reference at Previous Fault	SFS Output	Displays the speed reference for the soft starter at the previous fault.	No signal output available	0.01 Hz
U2-16 (7E1)	Motor q-Axis Current at Previous Fault	Motor Iq Current	Displays the q-axis current for the motor at the previous fault.	No signal output available	0.10%
U2-17 (7E2)	Motor d-Axis Current at Previous Fault	Motor Id Current	OLV/PM Displays the d-axis current for the motor at the previous fault.	No signal output available	0.10%
U2-20 (8E)	Heatsink Temperature at Previous Fault	Actual Fin Temp	Displays the temperature of the heatsink when the most recent fault occurred.	No signal output available	1 °C
U2-30 (3008)	Date Year at Previous Fault	Date Year YYYY	Displays the year when the most recent fault occurred.	No signal output available	–
U2-31 (3009)	Date Month and Day at Previous Fault	Date Mo Day MMDD	Displays the date and day when the most recent fault occurred.	No signal output available	–
U2-32 (300A)	Time Hours and Minutes at Previous Fault	Time Hr Min HHMM	Displays the time when the most recent fault occurred.	No signal output available	–

<1> This value has two decimal places (0.01 A) if the drive is set for a maximum applicable motor capacity up to and including 11 kW, and one decimal place (0.1 A) if the maximum applicable motor capacity is higher than 11 kW.

<2> When reading the value of this monitor via MEMOBUS/Modbus, a value of 8192 is equal to 100% of the drive rated output current.

◆ U3: Fault History

No. (Addr. Hex)	Name	LCD Display	Description	Analog Output Level	Unit
U3-01 to U3-04 (90 to 93 (800 to 803))	First to 4th Most Recent Fault	Fault Message ☐	Displays the first to the fourth most recent faults.	No signal output available	–
U3-05 to U3-10 (804 to 809)	5th to 10th Most Recent Fault	Fault Message ☐	Displays the fifth to the tenth most recent faults. After ten faults, data for the oldest fault is deleted. The most recent fault appears in U3-01, with the next most recent fault appearing in U3-02. The data is moved to the next monitor parameter each time a fault occurs.	No signal output available	–
U3-11 to U3-14 (94 to 97 (80A to 80D))	Cumulative Operation Time at 1st to 4th Most Recent Fault	Elapsed Time ☐	Displays the cumulative operation time when the first to the fourth most recent faults occurred.	No signal output available	1 h

No. (Addr. Hex)	Name	LCD Display	Description	Analog Output Level	Unit
U3-15 to U3-20 (80E to 813)	Cumulative Operation Time at 5th to 10th Most Recent Fault	Elapsed Time □	Displays the cumulative operation time when the fifth to the tenth most recent faults occurred.	No signal output available	1 h
U3-21 (300B)	Date Year at Most Recent Fault	Fault 1 YYYY	Displays the year when the most recent fault occurred.	No signal output available	–
U3-22 (300C)	Date Month and Day at Most Recent Fault	Fault 1 MMDD	Displays the date and day when the most recent faults occurred.	No signal output available	–
U3-23 (300D)	Time Hours and Minutes at Most Recent Fault	Fault 1 HHMM	Displays the time when the most recent fault occurred.	No signal output available	–
U3-24 (300E)	Date Year at 2nd Most Recent Fault	Fault 2 YYYY	Displays the year when the second most recent fault occurred.	No signal output available	–
U3-25 (300F)	Date Month and Day at 2nd Most Recent Fault	Fault 2 MMDD	Displays the date and day when the second most recent fault occurred.	No signal output available	–
U3-26 (3010)	Time Hours and Minutes at 2nd Most Recent Fault	Fault 2 HHMM	Displays the time when the second most recent fault occurred.	No signal output available	–
U3-27 (3011)	Date Year at 3rd Most Recent Fault	Fault 3 YYYY	Displays the year when the most third recent fault occurred.	No signal output available	–
U3-28 (3012)	Date Month and Day at 3rd Most Recent Fault	Fault 3 MMDD	Displays the date and day when the third most recent fault occurred.	No signal output available	–
U3-29 (3013)	Time Hours and Minutes at 3rd Most Recent Fault	Fault 3 HHMM	Displays the time when the third most recent fault occurred.	No signal output available	–
U3-30 (3014)	Date Year at 4th Most Recent Fault	Fault 4 YYYY	Displays the year when the fourth most recent fault occurred.	No signal output available	–
U3-31 (3015)	Date Month and Day at 4th Most Recent Fault	Fault 4 MMDD	Displays the date and day when the fourth most recent fault occurred.	No signal output available	–
U3-32 (3016	Time Hours and Minutes at 4th Most Recent Fault	Fault 4 HHMM	Displays the time when the fourth most recent fault occurred.	No signal output available	–
U3-33 (3017)	Date Year at 5th Most Recent Fault	Fault 5 YYYY	Displays the year when the fifth most recent fault occurred.	No signal output available	–
U3-34 (3018)	Date Month and Day at 5th Most Recent Fault	Fault 5 MMDD	Displays the date and day when the fifth most recent fault occurred.	No signal output available	–
U3-35 (3019)	Time Hours and Minutes at 5th Most Recent Fault	Fault 5 HHMM	Displays the time when the fifth most recent fault occurred.	No signal output available	–
U3-36 (301A)	Date Year at 6th Most Recent Fault	Fault 6 YYYY	Displays the year when the sixth most recent fault occurred.	No signal output available	–
U3-37 (301B)	Date Month and Day a 6th Most Recent Fault	Fault 6 MMDD	Displays the date and day when the sixth most recent fault occurred.	No signal output available	–
U3-38 (301C)	Time Hours and Minutes at 6th Most Recent Fault	Fault 6 HHMM	Displays the time when the most sixth recent fault occurred.	No signal output available	–
U3-39 (301D)	Date Year at 7th Most Recent Fault	Fault 7 YYYY	Displays the year when the most seventh recent fault occurred.	No signal output available	–
U3-40 (301E)	Date Month and Day at 7th Most Recent Fault	Fault 7 MMDD	Displays the date and day when the seventh most recent fault occurred.	No signal output available	–
U3-41 (301F)	Time Hours and Minutes at 7th Most Recent Fault	Fault 7 HHMM	Displays the time when the seventh most recent fault occurred.	No signal output available	–
U3-42 (3020)	Date Year at 8th Most Recent Fault	Fault 8 YYYY	Displays the year when the eighth most recent fault occurred.	No signal output available	–
U3-43 (3021)	Date Month and Day 8th at Most Recent Fault	Fault 8 MMDD	Displays the date and day when the eighth most recent fault occurred.	No signal output available	–
U3-44 (3022)	Time Hours and Minutes at 8th Most Recent Fault	Fault 8 HHMM	Displays the time when the eighth most recent fault occurred.	No signal output available	–
U3-45 (3023)	Date Year at 9th Most Recent Fault	Fault 9 YYYY	Displays the year when the ninth most recent fault occurred.	No signal output available	–
U3-46 (3024)	Date Month and Day at 9th Most Recent Fault	Fault 9 MMDD	Displays the date and day when the ninth most recent fault occurred.	No signal output available	–
U3-47 (3025)	Time Hours and Minutes at 9th Most Recent Fault	Fault 9 HHMM	Displays the time when the ninth most recent fault occurred.	No signal output available	–

No. (Addr. Hex)	Name	LCD Display	Description	Analog Output Level	Unit
U3-48 (3026)	Date Year at 10th Most Recent Fault	Fault 10 YYYY	Displays the year when the tenth most recent fault occurred.	No signal output available	–
U3-49 (3027)	Date Month and Day at 10th Most Recent Fault	Fault 10 MMDD	Displays the date and day when the tenth most recent fault occurred.	No signal output available	–
U3-50 (3028)	Time Hours and Minutes at 10th Most Recent	Fault 10 HHMM	Displays the time when the tenth most recent fault occurred.	No signal output available	–

◆ U4: Maintenance Monitors

No. (Addr. Hex)	Name	LCD Display	Description	Analog Output Level	Unit
U4-01 (4C)	Cumulative Operation Time	Drv Elapsed Time	Displays the cumulative operation time of the drive. The value for the cumulative operation time counter can be reset in parameter o4-01. Use parameter o4-02 to determine if the operation time should start as soon as the power is switched on or only while the Run command is present. The maximum number displayed is 99999, after which the value is reset to 0.	No signal output available	1 h
U4-02 (75)	Number of Run Commands	RUN Cmd Counter	Displays the number of times the Run command is entered. Reset the number of Run commands using parameter o4-13. This value will reset to 0 and start counting again after reaching 65535.	No signal output available	1 Time
U4-03 (67)	Cooling Fan Operation Time	Fan Elapsed TIme	Displays the cumulative operation time of the cooling fan. The default value for the fan operation time is reset in parameter o4-03. This value will reset to 0 and start counting again after reaching 99999.	No signal output available	1 h
U4-04 (7E)	Cooling Fan Maintenance	Fan Life Mon	Displays main cooling fan usage time as a percentage of its expected performance life. Parameter o4-03 can be used to reset this monitor.	No signal output available	1%
U4-05 (7C)	Capacitor Maintenance	Cap Life Mon	Displays main circuit capacitor usage time as a percentage of their expected performance life. Parameter o4-05 can be used to reset this monitor.	No signal output available	1%
U4-06 (7D6)	Soft Charge Bypass Relay Maintenance	ChgCirc Life Mon	Displays the soft charge bypass relay maintenance time as a percentage of its estimated performance life. Parameter o4-07 can be used to reset this monitor.	No signal output available	1%
U4-08 (68)	Heatsink Temperature	Heatsink Temp	Displays the heatsink temperature.	10 V: 100 °C	1 °C
U4-09 (5E)	LED Check	LED Oper Check	Lights all segments of the LED to verify that the display is working properly.	No signal output available	–
U4-10 (5C)	kWh, Lower 4 Digits	kWh Lower 4 dig	Monitors the drive output power. The value is shown as a 9-digit number displayed across two monitor parameters, U4-10 and U4-11. Example: 12345678.9 kWh is displayed as: U4-10: 678.9 kWh U4-11: 12345 MWh	No signal output available	1 kWh
U4-11 (5D)	kWh, Upper 5 Digits	kWh Upper 5 dig		No signal output available	1 MWh
U4-13 (7CF)	Peak Hold Current	Current PeakHold	Displays the highest current value that occurred during run.	No signal output available	0.01 A <1>
U4-14 (7D0)	Peak Hold Output Frequency	Freq@ I PeakHold	Displays the output frequency when the current value shown in U4-13 occurred.	No signal output available	0.01 Hz
U4-16 (7D8)	Motor Overload Estimate (oL1)	Motor OL1 Level	Shows the value of the motor overload detection accumulator. 100% is equal to the oL1 detection level.	10 V: 100%	0.1%

No. (Addr. Hex)	Name	LCD Display	Description	Analog Output Level	Unit
U4-18 (7DA)	Frequency Reference Source Selection	Reference Source	Displays the source for the frequency reference as XY-nn. **X: indicates which reference is used:** 0 = OFF 1 = AUTO 2 = HAND **Y-nn: indicates the reference source** 0-01 = HOA keypad 1-00 = Analog (not assigned) 1-01 = Analog (terminal A1) 1-02 = Analog (terminal A2) 2-02 to 17 = Multi-step speed (d1-02 to 17) 3-01 = MEMOBUS/Modbus communications 4-01 = Communication option card 9-01 = Up/Down	No signal output available	–
U4-19 (7DB)	Frequency Reference from MEMOBUS/ Modbus Comm.	MEMOBUS Freq Ref	Displays the frequency reference provided by MEMOBUS/ Modbus (decimal).	No signal output available	0.01%
U4-20 (7DC)	Option Frequency Reference	Option Freq Ref	Displays the frequency reference input by an option card (decimal).	No signal output available	–
U4-21 (7DD)	Run Command Source Selection	Run Cmd Source	Displays the source for the Run command as XY-nn. **X: Indicates which Run source is used:** 0 = OFF 1 = AUTO 2 = HAND **Y: Input power supply data** 0 = HOA keypad 1 = External terminals 3 = Serial communications (APOGEE FLN, BACnet, MEMOBUS/Modbus, or Metasys N2) 4 = Communication option card **nn: Run command limit status data** 00: No limit status. 01: Run command was left on when stopped in the PRG mode 02: Run command was left on when switching from LOCAL to REMOTE operation 03: Waiting for soft charge bypass contactor after power up (Uv or Uv1 flashes after 10 s) 04: Waiting for “Run command prohibited” time period to end 05: Fast Stop (digital input, HOA keypad) 06: b1-17 (Run command given at power-up) 07: During baseblock while coast to stop with timer 08: Frequency reference is below minimal reference during baseblock 09: Waiting for Enter command	No signal output available	–
U4-22 (7DE)	MEMOBUS/Modbus Communications Reference	MEMOBUS Ref Reg	Displays the drive control data set by MEMOBUS/Modbus communications register no. 0001H as a four-digit hexadecimal number.	No signal output available	–
U4-23 (7DF)	Communication Option Card Reference	Option Ref Reg	Displays drive control data set by an option card as a four-digit hexadecimal number.	No signal output available	–

<1> When reading the value of this monitor via MEMOBUS/Modbus, a value of 8192 is equal to 100% of the drive rated output current.

◆ U5: PI Monitors

No. (Addr. Hex)	Name	LCD Display	Description	Analog Output Level	Unit
U5-01 (57)	PI Feedback	PID Feedback 1	Displays the PI feedback value.	10 V: 100%	0.01%
U5-02 (63)	PI Input	PID Input	Displays the amount of PI input (deviation between PI setpoint and feedback).	10 V: 100%	0.01%
U5-03 (64)	PI Output	PID Output	Displays PI control output.	10 V: 100%	0.01%
U5-04 (65)	PI Setpoint	PID Setpoint	Displays the PI setpoint.	10 V: 100%	0.01%
U5-05 (7D2)	PI Differential Feedback	PID Feedback 2	Displays the second PI feedback value if differential feedback is used (H3-□□ = 16).	10 V: 100%	0.01%

No. (Addr. Hex)	Name	LCD Display	Description	Analog Output Level	Unit
U5-06 (7D3)	PI Adjusted Feedback	PID Diff Fdbk	Displays the difference of both feedback values if differential feedback is used (U5-01 - U5-05). If differential feedback is not used, then U5-01 and U5-06 will be the same.	10 V: 100%	0.01%
U5-07 (72)	AUTO Mode Frequency Reference Value	AUTO mode Fref	Displays the Frequency reference value at AUTO Mode.	No signal output available	0.01 Hz
U5-08 (73)	HAND Mode Frequency Reference Value	HAND mode Fref	Displays the Frequency reference value at HAND Mode.	No signal output available	0.01 Hz
U5-14 (86B)	PI Output Upper 4 Digits	PI Output U4	Displays Custom PI output. U5-14 shows the upper 4 digits.	10V: (b5-43 x 10000) + b5-44 <1>	1
U5-15 (86C)	PI Output Lower 4 Digits	PI Output L4	Displays Custom PI output. U5-15 shows the lower 4 digits.	No signal output available	0.01
U5-17 (302A)	PI2 Setpoint	PI2 Set-point	Displays the secondary PI setpoint.	10 V: Max frequency	0.01%
U5-18 (302B)	PI2 Feedback	PI2 Feedback	Displays the secondary PI feedback value.	10 V: Max frequency	0.01%
U5-19 (302C)	PI2 Input	PI2 Input	Displays the secondary PI input (deviation between PI target and feedback).	10 V: Max frequency	0.01%
U5-20 (302D)	PI2 Output	PI2 Output	Displays the secondary PI control output.	10 V: Max frequency	0.01%
U5-30 (3000)	Time Hr Min HHMM	Time Hr Min HHMM	Displays the current time (Hours and Minutes).	No signal output available	1
U5-31 (3001)	Date Year	Date Year	Displays the current year.	No signal output available	1
U5-32 (3002)	Date Mo Day MMDD	Date Mo Day MMDD	Displays the current date (Month and Day).	No signal output available	1
U5-33 (3003)	Day of the Week	Date Week 0: Sun 1: Mon 2: Tues 3: Wed 4: Thur 5: Fri 6: Sat	Displays the current day of the week. 0: Sunday 1: Monday 2: Tuesday 3: Wednesday 4: Thursday 5: Friday 6: Saturday	No signal output available	1

<1> Analog Output selection text is: “PI Output 2”.

◆ U6: Operation Status Monitors

No. (Addr. Hex)	Name	LCD Display	Description	Analog Output Level	Unit
U6-01 (51)	Motor Secondary Current (Iq)	Mot SEC Current	Displays the value of the motor secondary current (Iq). Motor rated secondary current is 100%.	10 V: Motor secondary rated current	0.1%
U6-02 (52)	Motor Excitation Current (Id)	Mot EXC Current	OLV/PM Displays the value calculated for the motor excitation current (Id). Motor rated secondary current is 100%.	10 V: Motor secondary rated current	0.1%
U6-05 (59)	Output Voltage Reference (Vq)	Voltage Ref (Vq)	OLV/PM Output voltage reference (Vq) for the q-Axis.	10 V: 200 Vrms <1>	0.1 Vac
U6-06 (5A)	Output Voltage Reference (Vd)	Voltage Ref (Vd)	OLV/PM Output voltage reference (Vd) for the d-Axis.	10 V: 200 Vrms <1>	0.1 Vac
U6-21 (7D5)	Offset Frequency	Offset Frequency	Displays the frequency added to the main frequency reference.	–	0.1%
U6-80 to U6-99 (7B0 to 7F9)	Option Monitors 1 to 20	–	Output monitor for option card. Refer to Option Instruction manual for details	No signal output available.	–

<1> Values shown are specific to 200 V class drives. Double the values for 400 V class drives.

A.16 Control Mode Dependent Parameter Default Values

The tables below list parameters that depend on the control mode selection. Changing the control mode initializes these parameters to the values shown here.

◆ A1-02 (Motor Control Mode) Dependent Parameters

Table A.3 A1-02 (Motor Control Mode) Dependent Parameters and Default Values

No.	Name	Setting Range	Resolution	Control Modes (A1-02)	
				V/f (0)	OLV/PM (5)
b3-08	Current Control Gain during Speed Search (Speed Estimation Type)	0.00 to 6.00	0.01	<1>	0.30
b3-09	Current Control Gain during Speed Search (Speed Estimation Type)	0.00 to 100.00	0.1	2.0	4.0
C2-01	S-Curve Characteristic at Accel Start	0.00 to 10.00	0.01 s	0.20	1.00
C4-01	Torque Compensation Gain	0.00 to 2.50	0.01	1.00	0.00
C4-02	Torque Compensation Primary Delay Time	0 to 60000	1 ms	200	100
C6-02	Carrier Frequency Selection	1 to 9; A to F	1	<1>	2
E1-04	Maximum Output Frequency	40.0 to 240.0	0.1 Hz	<2>	60.0
E1-05	Maximum Voltage	0.0 to 255.0 <3>	0.1 V	<2>	200.0
E1-06	Base Frequency	0.0 to 240.0	0.1 Hz	<2>	60.0
E1-09	Minimum Output Frequency	0.0 to 240.0	0.1 Hz	<2>	3.0
L1-01	Motor Overload Protection Selection	0, 1, 4	1	1	4
L3-20	DC Bus Voltage Adjustment Gain	0.00 to 5.00	0.01	1.00	0.65
L8-38	Carrier Frequency Reduction Selection	0 to 2	1	<1>	0
L8-40	Carrier Frequency Reduction Off-Delay Time	0.00 to 2.00	0.01 s	0.50	0.00

<1> Default setting is dependent on parameter o2-04, Drive Model Selection.

<2> Default setting is dependent on parameter E1-03, V/f Pattern Selection.

<3> Values shown are specific to 200 V class drives. Double the value for 400 V class drives.

Parameter List

A

A.17 V/f Pattern Default Values

The following tables show the V/f pattern setting default values depending on the control mode (A1-02) and the V/f pattern selection (E1-03 in V/f Control).

Table A.4 E1-03 V/f Pattern Settings for Drive Capacity: Models 2A0011 to 2A0017 and 4A0005 to 4A0008

No.	Unit	V/f Control																OLV/PM
E1-03	-	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F <1>	
E1-04	Hz	50.0	60.0	60.0	72.0	50.0	50.0	60.0	60.0	50.0	50.0	60.0	60.0	90.0	120.0	180.0	60.0	<2>
E1-05 <3>	V	200.0	200.0	200.0	200.0	200.0	200.0	200.0	200.0	200.0	200.0	200.0	200.0	200.0	200.0	200.0	230.0	<2>
E1-06	Hz	50.0	60.0	50.0	60.0	50.0	50.0	60.0	60.0	50.0	50.0	60.0	60.0	60.0	60.0	60.0	60.0	<2>
E1-07	Hz	2.5	3.0	3.0	3.0	25.0	25.0	30.0	30.0	2.5	2.5	3.0	3.0	3.0	3.0	3.0	3.0	–
E1-08 <3>	V	15.0	15.0	15.0	15.0	35.0	50.0	35.0	50.0	19.0	24.0	19.0	24.0	15.0	15.0	15.0	57.5	–
E1-09	Hz	1.3	1.5	1.5	1.5	1.3	1.3	1.5	1.5	1.3	1.3	1.5	1.5	1.5	1.5	1.5	1.5	<2>
E1-10 <3>	V	9.0	9.0	9.0	9.0	8.0	9.0	8.0	9.0	11.0	13.0	11.0	15.0	9.0	9.0	9.0	10.2	–

<1> This value determines the default values for E1-04 through E1-10.

<2> Default setting is dependent on parameter A1-02, Motor Control Mode. *Refer to A1-02 (Motor Control Mode) Dependent Parameters and Default Values on page 263* for details.

<3> Values shown here are specific to 200 V class drives. Double the value for 400 V class drives.

Table A.5 E1-03 V/f Pattern Settings for Drive Capacity: Models 2A0024 to 2A0169 and 4A0011 to 4A0077

No.	Unit	V/f Control																OLV/PM
E1-03	-	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F <1>	
E1-04	Hz	50.0	60.0	60.0	72.0	50.0	50.0	60.0	60.0	50.0	50.0	60.0	60.0	90.0	120.0	180.0	60.0	<2>
E1-05 <3>	V	200.0	200.0	200.0	200.0	200.0	200.0	200.0	200.0	200.0	200.0	200.0	200.0	200.0	200.0	200.0	230.0	<2>
E1-06	Hz	50.0	60.0	50.0	60.0	50.0	50.0	60.0	60.0	50.0	50.0	60.0	60.0	60.0	60.0	60.0	60.0	<2>
E1-07	Hz	2.5	3.0	3.0	3.0	25.0	25.0	30.0	30.0	2.5	2.5	3.0	3.0	3.0	3.0	3.0	3.0	–
E1-08 <3>	V	14.0	14.0	14.0	14.0	35.0	50.0	35.0	50.0	18.0	23.0	18.0	23.0	14.0	14.0	14.0	57.5	–
E1-09	Hz	1.3	1.5	1.5	1.5	1.3	1.3	1.5	1.5	1.3	1.3	1.5	1.5	1.5	1.5	1.5	1.5	<2>
E1-10 <3>	V	7.0	7.0	7.0	7.0	6.0	7.0	6.0	7.0	9.0	11.0	9.0	13.0	7.0	7.0	7.0	8.1	–

<1> This value determines the default values for E1-04 through E1-10.

<2> Default setting is dependent on parameter A1-02, Motor Control Mode. *Refer to A1-02 (Motor Control Mode) Dependent Parameters and Default Values on page 263* for details.

<3> Values shown here are specific to 200 V class drives. Double the value for 400 V class drives.

Table A.6 E1-03 V/f Pattern Settings for Drive Capacity: Models 2A0211 to 2A0396 and 4A0096 to 4A0590

No.	Unit	V/f Control																OLV/PM
E1-03	-	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F <1>	
E1-04	Hz	50.0	60.0	60.0	72.0	50.0	50.0	60.0	60.0	50.0	50.0	60.0	60.0	90.0	120.0	180.0	60.0	<2>
E1-05 <3>	V	200.0	200.0	200.0	200.0	200.0	200.0	200.0	200.0	200.0	200.0	200.0	200.0	200.0	200.0	200.0	230.0	<2>
E1-06	Hz	50.0	60.0	50.0	60.0	50.0	50.0	60.0	60.0	50.0	50.0	60.0	60.0	60.0	60.0	60.0	60.0	<2>
E1-07	Hz	2.5	3.0	3.0	3.0	25.0	25.0	30.0	30.0	2.5	2.5	3.0	3.0	3.0	3.0	3.0	3.0	–
E1-08 <3>	V	12.0	12.0	12.0	12.0	35.0	50.0	35.0	50.0	15.0	20.0	15.0	20.0	12.0	12.0	12.0	57.5	–
E1-09	Hz	1.3	1.5	1.5	1.5	1.3	1.3	1.5	1.5	1.3	1.3	1.5	1.5	1.5	1.5	1.5	1.5	<2>
E1-10 <3>	V	6.0	6.0	6.0	6.0	5.0	6.0	5.0	6.0	7.0	9.0	7.0	11.0	6.0	6.0	6.0	6.9	–

<1> This value determines the default values for E1-04 through E1-10.

<2> Default setting is dependent on parameter A1-02, Motor Control Mode. ***Refer to A1-02 (Motor Control Mode) Dependent Parameters and Default Values on page 263*** for details.

<3> Values shown here are specific to 200 V class drives. Double the value for 400 V class drives.

A.18 Defaults by Drive Model

The following tables show parameters and default settings that change with the drive model selection (o2-04).

Table A.7 200 V Class Drives Default Settings by Drive Model Selection

No.	Name	Unit	Default Settings							
–	Model	–	2A0011	2A0017	2A0025	2A0031	2A0046	2A0059	2A0075	2A0088
o2-04	Drive Model Selection	Hex.	66	68	6A	6B	6D	6E	6F	70
E2-11	Motor Rated Power	kW (HP)	2.2 (3)	3.7 (5)	5.5 (7.5)	7.5 (10)	11 (15)	15 (20)	18.5 (25)	22 (30)
b3-04	V/f Gain during Speed Search	%	100	100	100	100	100	100	100	100
b3-06	Output Current 1 during Speed Search	–	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
b3-08	Current Control Gain during Speed Search (Speed Estimation Type)	–	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50
b3-11	Speed Search Method Switching Level (Speed Estimation Type)	–	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
b8-04	Energy Saving Coefficient Value	–	156.8	122.9	94.75	72.69	70.44	63.13	57.87	51.79
C6-02	Carrier Frequency Selection	–	2	2	2	2	2	2	2	2
E2-01	Motor Rated Current	A	10.60	16.70	24.20	30.80	46.2	59.4	74.8	88
E2-02	Motor Rated Slip	Hz	2.90	2.73	1.50	1.30	1.70	1.60	1.67	1.70
E2-03	Motor No-Load Current	A	3.00	4.50	5.10	8.00	11.2	15.2	15.7	18.5
E2-05	Motor Line-to-Line Resistance	Ω	1.601	0.771	0.399	0.288	0.230	0.138	0.101	0.079
E2-10	Motor Iron Loss for Torque Compensation	W	77	112	172	262	245	272	505	538
L2-02	Momentary Power Loss Ride-Thru Time	s	0.3	0.3	0.7	0.8	1.0	1.3	1.5	1.8
L2-03	Momentary Power Loss Minimum Baseblock Time	s	0.5	0.6	0.7	0.8	0.9	1	1	1
L2-04	Momentary Power Loss Voltage Recovery Ramp Time	s	0.3	0.3	0.3	0.3	0.3	0.6	0.6	0.6
L2-05	Undervoltage Detection Level (Uv1)	–	190	190	190	190	190	190	190	190
L3-24	Motor Acceleration Time for Inertia Calculations	s	0.145	0.154	0.168	0.175	0.265	0.244	0.317	0.355
L8-02	Overheat Alarm Level	°C	80	80	105	105	110	110	115	115
L8-06	Input Phase Detection Level	–	16.0	21.0	15.0	18.0	22.0	23.0	24.0	24.0
L8-09	Output Ground Fault Detection Selection	–	0	0	0	0	0	0	1	1
L8-35	Installation Method Selection	–	2	2	2	2	2	2	2	2
L8-38	Carrier Frequency Reduction	–	2	2	2	2	2	2	2	2
n1-03	Hunting Prevention Time Constant	ms	10	10	10	10	10	10	10	10

No.	Name	Unit	Default Settings						
–	Model	–	2A0114	2A0143	2A0169	2A0211	2A0273	2A0343	2A0396
o2-04	Drive Model Selection	Hex.	72	73	74	75	76	77	78
E2-11	Motor Rated Power	kW (HP)	30 (40)	37 (50)	45 (60)	55 (75)	75 (100)	90 125)	110 (150)
b3-04	V/f Gain during Speed Search	%	80	80	80	80	80	80	80
b3-06	Output Current 1 during Speed Search	–	0.5	0.5	0.5	0.5	0.7	0.7	0.7
b3-08	Current Control Gain during Speed Search (Speed Estimation Type)	–	0.50	0.50	0.50	0.50	0.50	0.50	0.50
b3-11	Speed Search Method Switching Level (Speed Estimation Type)	–	5.0	5.0	5.0	5.0	5.0	5.0	5.0
b8-04	Energy Saving Coefficient Value	–	46.27	38.16	35.78	31.35	23.10	20.65	18.12
C6-02	Carrier Frequency Selection	–	2	2	2	2	2	1	1
E2-01	Motor Rated Current	A	114	143	169	211	273	343	396
E2-02	Motor Rated Slip	Hz	1.80	1.33	1.60	1.43	1.39	1.39	1.39
E2-03	Motor No-Load Current	A	21.9	38.2	44.0	45.6	72.0	72.0	72.0
E2-05	Motor Line-to-Line Resistance	Ω	0.064	0.039	0.030	0.022	0.023	0.023	0.023
E2-10	Motor Iron Loss for Torque Compensation	W	699	823	852	960	1200	1200	1200
L2-02	Momentary Power Loss Ride-Thru Time	s	2.0	2.0	2.0	2.0	2.0	2.0	2.0
L2-03	Momentary Power Loss Minimum Baseblock Time	s	1.1	1.1	1.2	1.3	1.5	1.5	1.7
L2-04	Momentary Power Loss Voltage Recovery Ramp Time	s	0.6	0.6	1	1	1	1	1
L2-05	Undervoltage Detection Level (Uv1)	–	190	190	190	190	190	190	190
L3-24	Motor Acceleration Time for Inertia Calculations	s	0.323	0.320	0.387	0.317	0.533	0.592	0.646
L8-02	Overheat Alarm Level	°C	115	109	109	109	109	120	120
L8-06	Input Phase Detection Level	–	25.0	28.0	26.0	28.0	28.0	13.0	16.0
L8-09	Output Ground Fault Detection Selection	–	1	1	1	1	1	1	1
L8-35	Installation Method Selection	–	2	2	2	2	2	0	0
L8-38	Carrier Frequency Reduction	–	2	2	2	2	2	2	2
n1-03	Hunting Prevention Time Constant	ms	10	10	10	10	10	100	100

Table A.8 400 V Class Drives Default Settings by Drive Capacity

No.	Name	Unit	Default Settings							
–	Model	–	4A0005		4A0008		4A0011		4A0014	
E1-01	Input Voltage Setting	V	Setting < 460 V	Setting ≥ 460 V	Setting < 460 V	Setting ≥ 460 V	Setting < 460 V	Setting ≥ 460 V	Setting < 460 V	Setting ≥ 460 V
o2-04	Drive Model Selection	Hex.	94		96		98		99	
E2-11	Motor Rated Power	kW (HP)	1.5 (2)	2.2 (3)	3.0 (4)	3.7 (5)	4 (5)	5.5 (7.5)	5.5 (7.5)	7.5 (10)
b3-04	V/f Gain during Speed Search	%	100	100	100	100	100	100	100	100
b3-06	Output Current 1 during Speed Search	–	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
b3-08	Current Control Gain during Speed Search (Speed Estimation Type)	–	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50
b3-11	Speed Search Method Switching Level (Speed Estimation Type)	–	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
b8-04	Energy Saving Coefficient Value	–	338.8	313.6	265.7	245.8	245.8	189.5	189.5	145.38
C6-02	Carrier Frequency Selection	–	2	2	2	2	2	2	2	2
E2-01	Motor Rated Current	A	3.10	4.80	5.70	7.60	7.00	11.00	9.80	14.00
E2-02	Motor Rated Slip	Hz	2.50	3.00	2.70	2.70	2.70	1.50	1.50	1.30
E2-03	Motor No-Load Current	A	1.4	1.5	1.9	2.3	2.3	2.6	2.6	4
E2-05	Motor Line-to-Line Resistance	Ω	10.1	6.495	4.360	3.333	3.333	1.595	1.595	1.152
E2-10	Motor Iron Loss for Torque Compensation	W	53	77	105	130	130	193	193	263
L2-02	Momentary Power Loss Ride-Thru Time	s	0.3	0.4	0.4	0.6	0.5	0.8	0.5	0.8
L2-03	Momentary Power Loss Minimum Baseblock Time	s	0.4	0.5	0.5	0.6	0.6	0.7	0.7	0.8
L2-04	Momentary Power Loss Voltage Recovery Ramp Time	s	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3
L2-05	Undervoltage Detection Level (Uv1)	–	380	380	380	380	380	380	380	380
L3-24	Motor Acceleration Time for Inertia Calculations	s	0.166	0.145	0.145	0.154	0.154	0.168	0.168	0.175
L8-02	Overheat Alarm Level	°C	75	75	75	75	75	75	95	95
L8-06	Input Phase Detection Level	–	14.0	14.0	15.0	15.0	16.0	17.0	22.0	24.0
L8-09	Output Ground Fault Detection Selection	–	0	0	0	0	0	0	0	0
L8-35	Installation Method Selection	–	2	2	2	2	2	2	2	2
L8-38	Carrier Frequency Reduction	–	2	2	2	2	2	2	2	2
n1-03	Hunting Prevention Time Constant	ms	10	10	10	10	10	10	10	10

No.	Name	Unit	Default Settings							
–	Model	–	4A0021		4A0027		4A0034		4A0040	
E1-01	Input voltage Setting	–	Setting < 460 V	Setting ≥ 460 V	Setting < 460 V	Setting ≥ 460 V	Setting < 460 V	Setting ≥ 460 V	Setting < 460 V	Setting ≥ 460 V
o2-04	Drive Model Selection	Hex.	9A		9C		9D		9E	
E2-11	Motor Rated Power	kW (HP)	7.5 (10)	11 (15)	11 (15)	15 (20)	15 (20)	18.5 (25)	18.5 (25)	22 (30)
b3-04	V/f Gain during Speed Search	%	100	100	100	100	100	100	100	100
b3-06	Output Current 1 during Speed Search	–	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
b3-08	Current Control Gain during Speed Search (Speed Estimation Type)	–	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50
b3-11	Speed Search Method Switching Level (Speed Estimation Type)	–	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
b8-04	Energy Saving Coefficient Value	–	145.38	140.88	140.88	126.26	126.26	115.74	115.74	103.58
C6-02	Carrier Frequency Selection	–	2	2	2	2	2	2	2	2
E2-01	Motor Rated Current	A	13.30	21.0	19.9	27.0	26.5	34.0	32.9	40.0
E2-02	Motor Rated Slip	Hz	1.30	1.70	1.70	1.60	1.60	1.67	1.67	1.70
E2-03	Motor No-Load Current	A	4	5.6	5.6	7.6	7.6	7.8	7.8	9.2
E2-05	Motor Line-to-Line Resistance	Ω	1.152	0.922	0.922	0.55	0.55	0.403	0.403	0.316
E2-10	Motor Iron Loss for Torque Compensation	W	263	385	385	440	440	508	508	586
L2-02	Momentary Power Loss Ride-Thru Time	s	0.7	1.1	1.0	1.5	1.1	1.6	1.5	2.0
L2-03	Momentary Power Loss Minimum Baseblock Time	s	0.8	0.9	0.9	1.0	1.0	1.0	1.0	1.0
L2-04	Momentary Power Loss Voltage Recovery Ramp Time	s	0.3	0.3	0.3	0.6	0.6	0.6	0.6	0.6
L2-05	Undervoltage Detection Level (Uv1)	–	380	380	380	380	380	380	380	380
L3-24	Motor Acceleration Time for Inertia Calculations	s	0.175	0.265	0.265	0.244	0.244	0.317	0.317	0.355
L8-02	Overheat Alarm Level	°C	95	95	95	95	100	100	100	100
L8-06	Input Phase Detection Level	–	23.0	27.0	23.0	25.0	31.0	30.0	25.0	24.0
L8-09	Output Ground Fault Detection Selection	–	0	0	0	0	0	0	0	0
L8-35	Installation Method Selection	–	2	2	2	2	2	2	2	2
L8-38	Carrier Frequency Reduction	–	2	2	2	2	2	2	2	2
n1-03	Hunting Prevention Time Constant	ms	10	10	10	10	10	10	10	10

A.18 Defaults by Drive Model

No.	Name	Unit	Default Settings							
–	Model	–	4A0052		4A0065		4A0077		4A0096	
E1-01	Input voltage Setting	–	Setting < 460 V	Setting ≥ 460 V	Setting < 460 V	Setting ≥ 460 V	Setting < 460 V	Setting ≥ 460 V	Setting < 460 V	Setting ≥ 460 V
o2-04	Drive Model Selection	Hex.	9F		A1		A2		A3	
E2-11	Motor Rated Power	kW (HP)	22 (30)	30 (40)	30 (40)	37 (50)	37 (50)	45 (60)	45 (60)	55 (75)
b3-04	V/f Gain during Speed Search	%	100	100	100	100	100	100	100	80
b3-06	Output Current 1 during Speed Search	–	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
b3-08	Current Control Gain during Speed Search (Speed Estimation Type)	–	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50
b3-11	Speed Search Method Switching Level (Speed Estimation Type)	–	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
b8-04	Energy Saving Coefficient Value	–	103.58	92.54	92.54	76.32	76.32	71.56	71.56	67.2
C6-02	Carrier Frequency Selection	–	2	2	2	2	2	2	2	2
E2-01	Motor Rated Current	A	38.6	52.0	52.3	65.0	65.6	77.0	79.7	96.0
E2-02	Motor Rated Slip	Hz	1.70	1.80	1.80	1.33	1.33	1.60	1.60	1.46
E2-03	Motor No-Load Current	A	9.2	10.9	10.9	19.1	19.1	22	22	24
E2-05	Motor Line-to-Line Resistance	Ω	0.316	0.269	0.269	0.155	0.155	0.122	0.122	0.088
E2-10	Motor Iron Loss for Torque Compensation	W	586	750	750	925	925	1125	1125	1260
L2-02	Momentary Power Loss Ride-Thru Time	s	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
L2-03	Momentary Power Loss Minimum Baseblock Time	s	1.0	1.1	1.1	1.1	1.1	1.2	1.2	1.2
L2-04	Momentary Power Loss Voltage Recovery Ramp Time	s	0.6	0.6	0.6	0.6	0.6	0.6	0.6	1.0
L2-05	Undervoltage Detection Level (Uv1)	–	380	380	380	380	380	380	380	380
L3-24	Motor Acceleration Time for Inertia Calculations	s	0.355	0.323	0.323	0.320	0.320	0.387	0.387	0.317
L8-02	Overheat Alarm Level	°C	102	102	102	102	102	102	102	102
L8-06	Input Phase Detection Level	–	22.0	24.0	24.0	24.0	24.0	24.0	25.0	25.0
L8-09	Output Ground Fault Detection Selection	–	1	1	1	1	1	1	1	1
L8-35	Installation Method Selection	–	2	2	2	2	2	2	2	2
L8-38	Carrier Frequency Reduction	–	2	2	2	2	2	2	2	2
n1-03	Hunting Prevention Time Constant	ms	10	10	10	10	10	10	10	10

No.	Name	Unit	Default Settings							
–	Model	–	4A0124		4A0156		4A0180		4A0240	
E1-01	Input voltage Setting	–	Setting < 460 V	Setting ≥ 460 V	Setting < 460 V	Setting ≥ 460 V	Setting < 460 V	Setting ≥ 460 V	Setting < 460 V	Setting ≥ 460 V
o2-04	Drive Model Selection	Hex.	A4		A5		A6		A7	
E2-11	Motor Rated Power	kW (HP)	55 (75)	75 (100)	75 (100)	90 (125)	90 (125)	110 (150)	110 (150)	150 (200)
b3-04	V/f Gain during Speed Search	%	80	60	60	60	60	60	60	60
b3-06	Output Current 1 during Speed Search	–	0.5	0.7	0.7	0.7	0.7	0.7	0.7	0.7
b3-08	Current Control Gain during Speed Search (Speed Estimation Type)	–	0.50	0.80	0.80	0.80	0.80	0.80	0.80	0.80
b3-11	Speed Search Method Switching Level (Speed Estimation Type)	–	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
b8-04	Energy Saving Coefficient Value	–	67.2	46.2	46.2	38.91	38.91	36.23	36.23	32.79
C6-02	Carrier Frequency Selection	–	2	2	2	2	2	2	2	2
E2-01	Motor Rated Current	A	95.0	124.0	130.0	156.0	156.0	180.0	190.0	240.0
E2-02	Motor Rated Slip	Hz	1.46	1.39	1.39	1.40	1.40	1.40	1.40	1.38
E2-03	Motor No-Load Current	A	24	36	36	40	40	49	49	58
E2-05	Motor Line-to-Line Resistance	Ω	0.088	0.092	0.092	0.056	0.056	0.046	0.046	0.035
E2-10	Motor Iron Loss for Torque Compensation	W	1260	1600	1600	1760	1760	2150	2150	2350
L2-02	Momentary Power Loss Ride-Thru Time	s	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
L2-03	Momentary Power Loss Minimum Baseblock Time	s	1.2	1.3	1.3	1.5	1.5	1.7	1.7	1.7
L2-04	Momentary Power Loss Voltage Recovery Ramp Time	s	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
L2-05	Undervoltage Detection Level (Uv1)	–	380	380	380	380	380	380	380	380
L3-24	Motor Acceleration Time for Inertia Calculations	s	0.317	0.533	0.533	0.592	0.592	0.646	0.646	0.673
L8-02	Overheat Alarm Level	°C	102	102	112	112	112	112	112	112
L8-06	Input Phase Detection Level	–	24.0	27.0	24.0	23.0	23.0	23.0	24.0	26.0
L8-09	Output Ground Fault Detection Selection	–	1	1	1	1	1	1	1	1
L8-35	Installation Method Selection	–	2	2	2	2	2	2	2	2
L8-38	Carrier Frequency Reduction	–	2	2	2	2	2	2	2	2
n1-03	Hunting Prevention Time Constant	ms	30	30	30	30	30	30	30	30

No.	Name	Unit	Default Settings							
–	**Model**	**–**	**4A0302**		**4A0361**		**4A0414**		**4A0480**	
E1-01	**Input voltage Setting**	**–**	**Setting < 460 V**	**Setting ≥ 460 V**	**Setting < 460 V**	**Setting ≥ 460 V**	**Setting < 460 V**	**Setting ≥ 460 V**	**Setting < 460 V**	**Setting ≥ 460 V**
o2-04	**Drive Model Selection**	**Hex.**	**A9**		**AA**		**AB**		**AC**	
E2-11	**Motor Rated Power**	**kW (HP)**	**160 (220)**	**185 (250)**	**185 (300)**	**220 (350)**	**220 (300)**	**260 (350)**	**250 (340)**	**300 (400)**
b3-04	V/f Gain during Speed Search	%	60	60	60	60	60	60	60	60
b3-06	Output Current 1 during Speed Search	–	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7
b3-08	Current Control Gain during Speed Search (Speed Estimation Type)	–	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80
b3-11	Speed Search Method Switching Level (Speed Estimation Type)	–	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
b8-04	Energy Saving Coefficient Value	–	30.13	30.57	30.57	27.13	27.13	21.76	21.76	21.76
C6-02	Carrier Frequency Selection	–	2	2	1	1	1	1	1	1
E2-01	Motor Rated Current	A	270.0	302.0	310.0	361.0	370.0	414.0	500.0	480.0
E2-02	Motor Rated Slip	Hz	1.35	1.30	1.30	1.30	1.30	1.25	1.25	1.25
E2-03	Motor No-Load Current	A	70	81	81	96	96	130	130	130
E2-05	Motor Line-to-Line Resistance	Ω	0.029	0.025	0.025	0.02	0.02	0.014	0.014	0.014
E2-10	Motor Iron Loss for Torque Compensation	W	2850	3200	3200	3700	3700	4700	4700	4700
L2-02	Momentary Power Loss Ride-Thru Time	s	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
L2-03	Momentary Power Loss Minimum Baseblock Time	s	1.8	1.9	1.9	2.0	2.0	2.1	2.1	2.1
L2-04	Momentary Power Loss Voltage Recovery Ramp Time	s	1.0	1.8	1.8	1.8	1.8	2.0	2.0	2.0
L2-05	Undervoltage Detection Level (Uv1)	–	380	380	380	380	380	380	380	380
L3-24	Motor Acceleration Time for Inertia Calculations	s	0.777	0.864	0.864	0.910	0.910	1.392	1.395	1.392
L8-02	Overheat Alarm Level	°C	111	111	140	140	140	140	140	140
L8-06	Input Phase Detection Level	–	27.0	25.0	14.0	14.0	23.0	21.0	26.0	25.0
L8-09	Output Ground Fault Detection Selection	–	1	1	1	1	1	1	1	1
L8-35	Installation Method Selection	–	2	2	0	0	0	0	0	0
L8-38	Carrier Frequency Reduction	–	2	2	2	2	2	2	2	2
n1-03	Hunting Prevention Time Constant	ms	30	30	100	100	100	100	100	100

No.	Name	Unit		
–	Model	–	4A0590	
E1-01	Input voltage Setting	–	Setting < 460 V	Setting ≥ 460 V
o2-04	Drive Model Selection	Hex.	AE	
E2-11	Motor Rated Power	kW (HP)	300 (400)	370 (500)
b3-04	V/f Gain during Speed Search	%	60	60
b3-06	Output Current 1 during Speed Search	–	0.7	0.7
b8-04	Energy Saving Coefficient Value	–	21.76	23.84
C6-02	Carrier Frequency Selection	–	1	1
E2-01	Motor Rated Current	A	500.0	590.0
E2-02	Motor Rated Slip	Hz	1.25	1.00
E2-03	Motor No-Load Current	A	130	130
E2-05	Motor Line-to-Line Resistance	Ω	0.014	0.012
E2-10	Motor Iron Loss for Torque Compensation	W	4700	5560
L2-02	Momentary Power Loss Ride-Thru Time	s	2.0	2.0
L2-03	Momentary Power Loss Minimum Baseblock Time	s	2.1	2.3
L2-04	Momentary Power Loss Voltage Recovery Ramp Time	s	2.0	2.2
L2-05	Undervoltage Detection Level (Uv1)	–	380	380
L3-24	Motor Acceleration Time for Inertia Calculations	s	1.392	1.667
L8-02	Overheat Alarm Level	°C	120	120
L8-06	Input Phase Detection Level	–	19.0	23.0
L8-09	Output Ground Fault Detection Selection	–	1	1
L8-35	Installation Method Selection	–	2	2
L8-38	Carrier Frequency Reduction	–	0	0
n1-03	Hunting Prevention Time Constant	ms	100	100

This Page Intentionally Blank

Appendix: B

BACnet Communications

B.1 BACnet Configuration

Drives can be monitored and controlled by a controller on a Building Automation and Control network (BACnet) using RS-485 technology and MS-TP (Master-Slave/Token-Passing) protocol. The drives conform to the BACnet application specific controller (B-ASC) device profile.

Up to 127 drives can communicate on a single BACnet MS-TP network. If more drives or BACnet devices are required, then a BACnet router is required to allow another MS-TP network to be available with up to another 127 drives.

The BACnet node address is configurable by a parameter in the drive. This defines the physical address of the drive on the MS-TP network. In addition, both the Device Object instance ID and the Device Object Name are configurable. These allow the drive to have a virtual address, thus simplifying controller configuration.

Once the addressing is set, a controller can initiate communication to the drive. The drive will perform the specified function and then send a response back to the controller. The drive will usually respond immediately, but may delay its response until it gets the token for commands that may take extra local processing time.

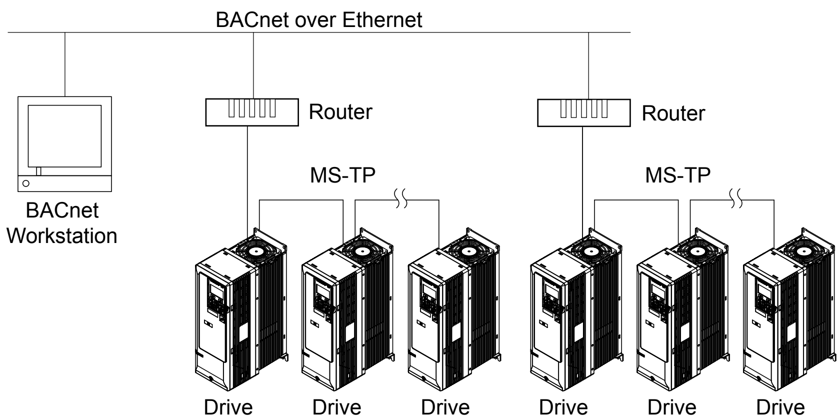


Figure B.1 Connecting Multiple Drives to a BACnet Workstation

B.2 Communication Specifications

BACnet specifications appear in the following table:

Item	Specifications
Interface	MS-TP (Master-Slave/Token-Passing) RS-485
Communication Parameters	Communication Speeds: 1200, 2400, 4800, 9600, 19200, 38400, 57600, 76800 bps Data Length: 8-bit (fixed) Parity: Select Even, Odd, or None Stop Bit: 1-bit (fixed)
Protocol	BACnet MS-TP
Max Number of Drives	127 per MS-TP Network Segment

B.3 Connecting to a Network

This section explains how to connect the drive to a BACnet network and the network termination required for a connection.

◆ Network Cable Connection

Follow the instructions below to connect the drive to a BACnet network.

1. With the power shut off, connect the communications cable to the drive and the master. Use terminal TB4 for BACnet.

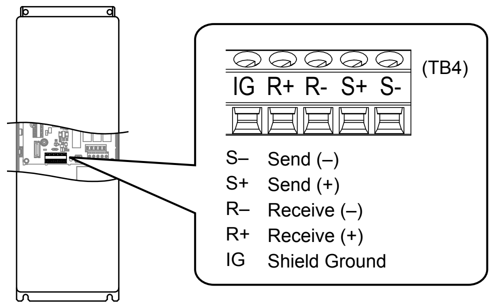


Figure B.2 Serial Communications Cable Connection Terminal (TB4)

Note: Separate the communications cables from the main circuit cables and other wiring and power cables. Use shielded cables for the communications cables, and properly shielded clamps to prevent problems with noise. When using RS-485 communications, connect S+ to R+, and S- to R- as shown in the diagram below.

2. Check or set the termination resistor selection at all slaves. Use the description in ***Network Termination*** on page ***279*** for slaves that are Z1000 drives.
3. Switch the power on.
4. Set the parameters needed for serial communications (H5-01 through H5-12) using the digital operator.
5. Shut the power off and wait until the display on the digital operator goes out completely.
6. Turn the power back on.
7. The drive is now ready to begin communicating with the master.

◆ Wiring Diagram for Multiple Connections

Figure B.3 explains the wiring diagrams for multiple connections using BACnet communication.

■ RS-485 Interface

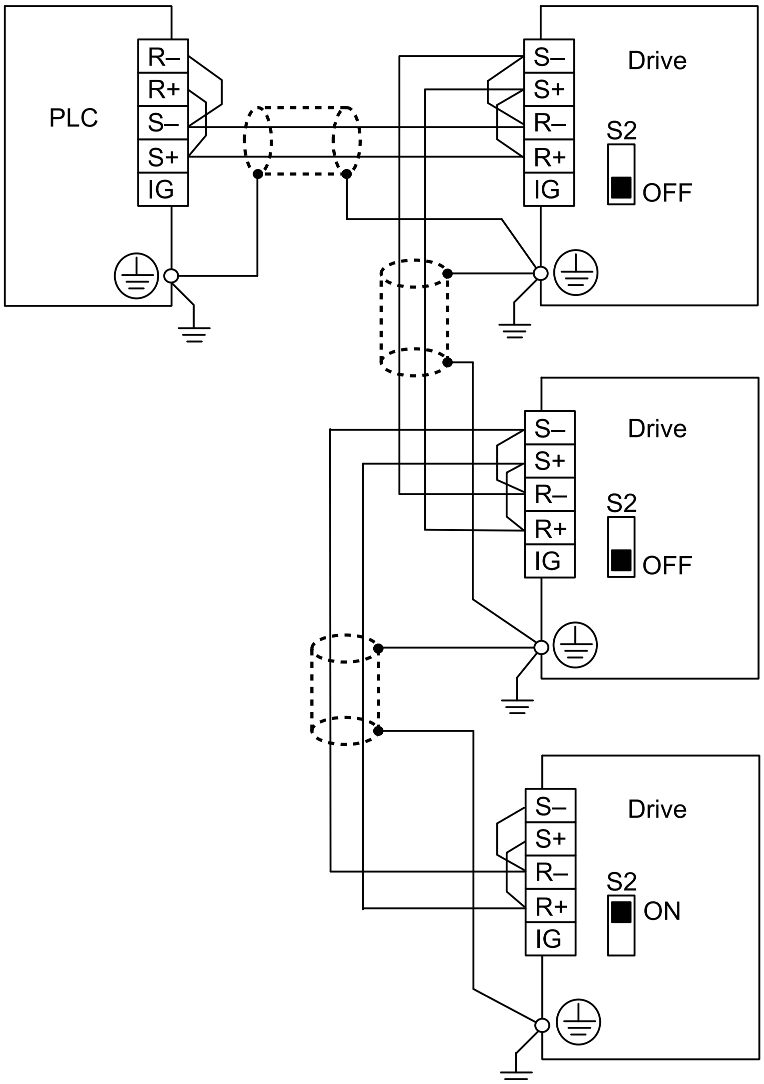


Figure B.3 RS-485 Interface

Note:
1. Set DIP switch S2 to the ON position on the drive located at the end of the network. Set DIP switch S2 to the OFF positions on all other slave devices.
2. Set H5-07 to 1 when using the RS-485 interface.

◆ Network Termination

The two ends of the BACnet network line have to be terminated. The drive has a built in termination resistor that can be enabled or disabled using DIP switch S2. If a drive is located at the end of a network line, enable the termination resistor by setting DIP switch S2 to the ON position. Disable the termination resistor on all slaves that are not located at the network line end.

B.4 BACnet Setup Parameters

◆ BACnet Serial Communication

This section describes parameters necessary to set up BACnet communications.

■ H5-01: Drive Slave Address

Sets the drive slave address used for communications.

Note: Cycle the power after changing this parameter to enable the new setting.

No.	Name	Setting Range	Default
H5-01	Drive Slave Address	0 to FFH	1FH

Each slave drive must be assigned a unique slave address for serial communications to work. Slave addresses do not need to be assigned in sequential order, but no two drives may share the same address.

■ H5-02: Communication Speed Selection

Sets the communications speed for APOGEE FLN, BACnet, MEMOBUS/Modbus, and Metasys N2.

Note:
1. Cycle the power after changing this parameter to enable the new setting.
2. When Metasys N2 communications are selected (H5-08 = 1), selecting a baud rate other than 9600 bps will trigger an oPE29 error.
3. When APOGEE FLN (P1) communications are selected (H5-08 = 2), selecting a baud rate other than 4800 bps will trigger an oPE29 error.
4. When BACnet communications are selected (H5-08 = 3), selecting 115200 bps (Setting 8) will trigger an oPE29 error.

No.	Name	Setting Range	Default
H5-02	Communication Speed Selection	0 to 8	<1>

<1> Default depends on H5-08 setting:
H5-08 = 0, MEMOBUS/Modbus; default: 3
H5-08 = 1, N2 (Metasys); default: 3
H5-08 = 2, P1 (APOGEE FLN); default: 2
H5-08 = 3, BACnet; default: 3

H5-02	Communication Speed	H5-02	Communication Speed
0 <1>	1200 bps	5 <1>	38400 bps
1 <1>	2400 bps	6 <1>	57600 bps
2	4800 bps	7 <1>	76800 bps
3 <1>	9600 bps	8 <1> <2>	115200 bps
4 <1>	19200 bps		

<1> Not available when H5-08 is set to 2 P1 (APOGEE FLN).
<2> Not available when H5-08 is set to 0 (MEMOBUS/Modbus) or 1 (Metasys N2).

■ H5-03: Communication Parity Selection

Sets the parity used for communications.

Note: Cycle the power after changing this parameter to enable the new setting.

No.	Name	Setting Range	Default
H5-03	Communication Parity Selection	0 to 2	0

Setting 0: No parity

Setting 1: Even parity

Setting 2: Odd parity

■ H5-04: Stopping Method after Communication Error

Selects the stopping method after a communications error (CE) has occurred.

No.	Name	Setting Range	Default
H5-04	Stopping Method after CE	0 to 4	3

Setting 0: Ramp to Stop

Uses the deceleration time currently enabled.

Setting 1: Coast to Stop

Setting 2: Fast Stop

Setting 3: Alarm Only - Operation Continues

Setting 4: Run at d1-04

■ H5-05: Communication Fault Detection Selection

Enables or disables the CE detection for communications.

No.	Name	Setting Range	Default
H5-05	Communication Fault Detection Selection	0 or 1	1

Setting 0: Disabled

No communication error detection. The drive continues operation.

Setting 1: Enabled

If the drive does not receive data from the master for longer than the time set to H5-09, then a CE fault will be triggered and the drive will operate as determined by parameter H5-04.

■ H5-06: Drive Transmit Wait Time

Sets the time the drive waits after receiving data from a master until responding data.

No.	Name	Setting Range	Default
H5-06	Drive Transmit Wait Time	5 to 65 ms	5 ms

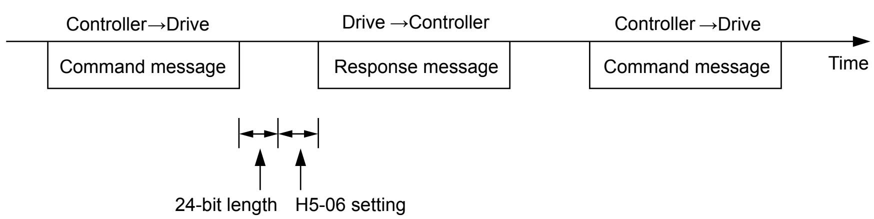


Figure B.4 Drive Transmit Wait Time Setting

■ H5-07: RTS Control Selection

Enables or disables RTS control.

No.	Name	Setting Range	Default
H5-07	RTS Control Selection	0 or 1	1

Setting 0: Disabled. RTS is always on.

Use this setting with point-to-point RS-422 communications.

Setting 1: Enabled. RTS switches while sending.

Use this setting with RS-485 communications or when using multi-drop RS-422 communications.

■ H5-08: Communications Protocol Selection

Selects the communications protocol.

No.	Name	Setting Range	Default
H5-08	Communications Protocol Selection	0 to 3	0

Setting 0: MEMOBUS/Modbus

Setting 1: N2 (Metasys)

Setting 2: P1 (APOGEE FLN)

Setting 3: BACnet

■ H5-09: Communications Fault Detection Time

Sets the time the communications must be lost before the drive triggers a CE fault.

No.	Name	Setting Range	Default
H5-09	Communications Fault Detection Time	0.0 to 10.0 s	2.0 s

■ H5-10: Unit Selection for MEMOBUS/Modbus Register 0025H

Sets the unit for the output voltage monitor value in MEMOBUS/Modbus register 0025H.

No.	Name	Setting Range	Default
H5-10	Unit Selection for MEMOBUS/Modbus Register 0025H	0 or 1	0

Setting 0: 0.1 V units

Setting 1: 1 V units

■ H5-11: Communications Enter Function Selection

Selects whether an Enter command is necessary to change parameter values via MEMOBUS/Modbus communications. ***Refer to Enter Command on page 291***.

No.	Name	Setting Range	Default
H5-11	Communications Enter Function Selection	0 or 1	0

Setting 0: Enter command necessary

Parameter changes become effective after an Enter command. An Enter command must only be sent after the last parameter change, not for each single parameter.

Setting 1: Enter command not necessary

Parameter value changes become effective immediately without the need to send an Enter command.

■ H5-12: Run Command Method Selection

Selects the type of sequence used when the Run command source is set to MEMOBUS/Modbus communications (b1-02, b1-16 = 2).

No.	Name	Setting Range	Default
H5-12	Run Command Method Selection	0 or 1	0

Setting 0: FWD/Stop, REV/Stop

Setting bit 0 of MEMOBUS/Modbus register 0001H will start and stop the drive in the forward direction. Setting bit 1 will start and stop the drive in reverse.

Setting 1: Run/Stop, FWD/REV

Setting bit 0 of MEMOBUS/Modbus register 0001H will start and stop the drive. Setting bit 1 changes the direction.

■ H5-14, H5-15: BACnet Device Object Identifiers 0 and 1

These parameters set the Instance Identifier of the BACnet Device Object, where the H5-14 value is the least significant word and the H5-15 value is the most significant word.

No.	Name	Setting Range	Default
H5-14	BACnet Device Object Identifier 0	0 to FFFFH	1
H5-15	BACnet Device Object Identifier 1	0 to 3FH	0

Example 1: Set Device Object Instance Identifier of “1234”

1234 decimal is equal to 4D2H (hexadecimal)

Set H5-14 to 4D2H and set H5-15 to 0.

Example 2: Set Device Object Instance Identifier of “1234567”

12334567 decimal is equal to 12D687H

Set H5-14 to D687H and set H5-15 to 12H.

B.5 Drive Operations by BACnet

The drive operations that can be performed by BACnet communication depend on drive parameter settings. This section explains the functions that can be used and related parameter settings.

◆ Observing the Drive Operation

A controller can perform the following actions with BACnet communications at any time regardless of parameter settings (except for H5-☐☐parameters):

- Observe drive status and drive control terminal status from a controller
- Read and write parameters
- Set and reset faults
- Set multi-function inputs.

Note: Input settings from the input terminals S☐ and from BACnet communications are both linked by a logical OR operation.

◆ Controlling the Drive

Select an external reference and adjust the parameters in *Table B.1* accordingly to start and stop the drive or set the frequency reference using BACnet communications.

Table B.1 Setting Parameters for Drive Control from BACnet

Reference Source	Parameter	Name	Required Setting
External Reference 1	b1-01	Frequency Reference Selection 1	2
	b1-02	Run Command Selection 1	2
External Reference 2	b1-15	Frequency Reference Selection 2	2
	b1-16	Run Command Selection 2	2

Refer to b1-01: Frequency Reference Selection for AUTO Mode on page 24 and *Refer to b1-02: Run Command Selection for AUTO Mode on page 25* for details on external reference parameter selections.

B.6 Communications Timing

To prevent a communications overrun in the slave drive, the master should wait a certain time between sending messages to the same drive. In the same way, the slave drive must wait before sending response messages to prevent an overrun in the master. This section explains the message timing.

◆ Command Messages from Master to Drive

The master must wait for a specified time between receiving a response and resending the same type of command to the same slave drive to prevent overrun and data loss. The minimum wait time depends on the command as shown in ***Table B.2***.

Table B.2 Minimum Wait Time for Sending Messages

Command Type	Example	Minimum Wait Time
1	• Control command (Run, Stop) • Set inputs/outputs • Read monitors and parameter values	5 ms <1>
2	Write parameters	H5-11 = 0: 50 ms H5-11 = 1: 200 ms <1>
3	Save changes using an Enter command	200 ms to 2 s, depending on the number of parameters that were changed <1>
4	Enter with storage to drive EEPROM after initialization	5 s

<1> If the drive receives command type 1 data during the minimum wait time, it will perform the command and then respond. However, if it receives a command type 2 or 3 during that time, either a communication error will result or the command will be ignored.

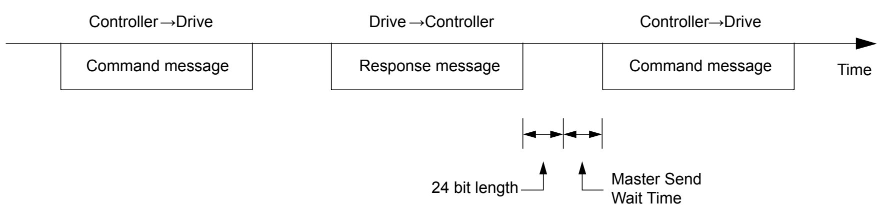


Figure B.5 Minimum Wait Time for Sending Messages

Set a timer in the master to check how long it takes for the slave drive(s) to respond to the master. If no response is received within a certain amount of time, the master should try resending the message.

◆ Response Messages from Drive to Master

If the drive receives a command from the master, it will process the data received and wait for the time set in H5-06 until it responds. Increase H5-06 if the drive response causes overrun in the master.

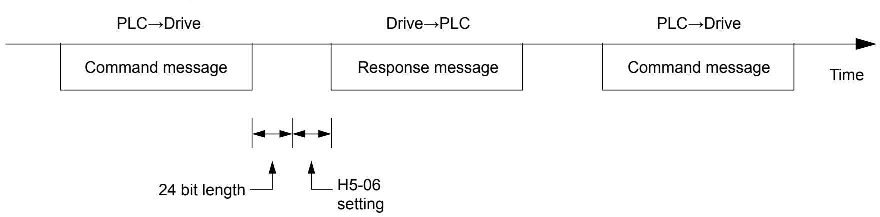


Figure B.6 Minimum Response Wait Time

B.7 BACnet Objects Supported

◆ Present Value Access

The Present Value (PV) of BACnet objects can always be read. In addition, some PVs can be written or commanded. A commandable PV is similar to writing the value, but the value is actually written into a priority array. The value occupying the highest priority in the array will be used by the drive. The convention for showing how the PV is accessed is shown in *Table B.3* and will be noted for the PV of each object.

Table B.3 Present Value Access Values

PV Access	Name	Description
C	Commandable	Value written to a priority array. The highest priority value in the array is then written to the drive.
R	Readable	Value is read-only
W	Writable	Value written to the drive

◆ Supported Properties of Objects

Table B.4 Object Properties

Property	Object Type						
	Device	Analog Input	Analog Output	Analog Value	Binary Output	Binary Output	Binary Value
Object_Identifier	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Object_Name	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Object_Type	Yes	Yes	Yes	Yes	Yes	Yes	Yes
System_Status	Yes	–	–	–	–	–	–
Vendor_Name	Yes	–	–	–	–	–	–
Vendor_Identifier	Yes	–	–	–	–	–	–
Model_Name	Yes	–	–	–	–	–	–
Firmware_Revision	Yes	–	–	–	–	–	–
Protocol_Version	Yes	–	–	–	–	–	–
Protocol_Revision	Yes	–	–	–	–	–	–
Protocol_Services_Supported	Yes	–	–	–	–	–	–
Protocol_Object_Types_Supported	Yes	–	–	–	–	–	–
Object_List	Yes	–	–	–	–	–	–
Max_ADPU_Length_Accepted	Yes	–	–	–	–	–	–
Segmentation_Supported	Yes	–	–	–	–	–	–
Local_Time	Yes	–	–	–	–	–	–
Local_Date	Yes	–	–	–	–	–	–
ADPU_Timeout	Yes	–	–	–	–	–	–
Number_Of_ADPU_Retries	Yes	–	–	–	–	–	–
Max_Masters	Yes	–	–	–	–	–	–
Max_Info_Frames	Yes	–	–	–	–	–	–
Device_Address_Binding	Yes	–	–	–	–	–	–
Database_Revision	Yes	–	–	–	–	–	–
Present_Value	–	Yes	Yes	Yes	Yes	Yes	Yes
Status_Flags	–	Yes	Yes	Yes	Yes	Yes	Yes
Event_State	–	Yes	Yes	Yes	Yes	Yes	Yes
Reliability	–	Yes	Yes	Yes	Yes	Yes	Yes
Out_Of_Service	–	Yes	Yes	Yes	Yes	Yes	Yes
Units	–	Yes	Yes	Yes	–	–	–
Priority_Array	–	–	Yes <1>	Yes <1>	–	Yes	Yes
Relinquish_Default	–	–	Yes <1>	Yes <1>	–	Yes	Yes
Polarity	–	–	–	–	Yes	Yes	–

Property	Object Type						
	Device	Analog Input	Analog Output	Analog Value	Binary Output	Binary Output	Binary Value
Inactive_Text	–	–	–	–	Yes	Yes	Yes
Active_Text	–	–	–	–	Yes	Yes	Yes

<1> For Commandable Object Instances only.

◆ Analog Input Objects

Table B.5 Analog Input Objects

Object ID	Object Name	Modbus Address	Precision	Range	Units	PV Access
AI1	Analog Input 1 Level	004EH	XXXX.X	–	%	R
AI2	Analog Input 2 Level	004FH	XXXX.X	–	%	R
AI3	Not used	–	–	–	–	–
AI4	Not used	–	–	–	–	–
AI5	Not used	–	–	–	–	–
AI6	Display Format o1-03	0502H	XXXXX	–	–	R
AI7	Scale Format b5-20	01E2H	XXXXX	–	–	R
AI8	Inverter Model o2-04	0508F	XXXXX	–	–	R
AI9	Rated Current n9-01	05D0H	XXXX.X	–	Amps	R

◆ Analog Output Objects

Table B.6 Analog Output Objects

Object ID	Object Name	Modbus Address	Precision	Range	Units	PV Access
AO1	Analog Output 1 Level	0007H	XXXX.X	0 to 100.0	%	C
AO2	Analog Output 2 Level	0008H	XXXX.X	0 to 100.0	%	C

◆ Analog Value Objects

Table B.7 Analog Value Objects

Object ID	Object Name	Modbus Address	Precision	Range	Units	PV Access
AV1	Not used	–	–	–	–	–
AV2	Frequency Command	0002H	XXX.XX Depends on o1-03	0.00 to 600.00	Hz Depends on o1-03	C
AV3	PI Setpoint	0006H	XXX.XX	0.00 to 100.00	%	C
AV4	Not used	–	–	–	–	–
AV5	Not used	–	–	–	–	–
AV6	Not used	–	–	–	–	–
AV7	Not used	–	–	–	–	–
AV8	Not used	–	–	–	–	–
AV9	Frequency Reference	0040H	XXX.XX Depends on o1-03	–	Hz Depends on o1-03	R
AV10	Output Frequency	0041H	XXX.XX Depends on o1-03	–	Hz Depends on o1-03	R
AV11	Output Voltage	0045H	XXXX.X	–	Volts	R

Object ID	Object Name	Modbus Address	Precision	Range	Units	PV Access
AV12	Output Current	0042H	XXXX.X (for drives rated above 11 kVA) XXX.XX (for drives rated 11 kVA or lower)	–	Amps	R
AV13	Output Power	0047H	XXXX.X (for drives rated above 11 kVA) XXX.XX (for drives rated 11 kVA or lower)	–	Watts	R
AV14	Torque Reference	0048H	XXXX.X	–	%	R
AV15	Not used	–	–	–	–	–
AV16	Not used	–	–	–	–	–
AV17	Not used	–	–	–	–	–
AV18	DC Bus Voltage	0031H	XXXX.X	–	Volts	R
AV19	PI Feedback Level	0038H	XXXX.X	–	%	R
AV20	PI Input Level	0039H	XXXX.X	–	%	R
AV21	PI Output Level	003AH	XXXX.X	–	%	R
AV22	CPU Software	005BH	XXXXX	–	–	R
AV23	Flash Number	004DH	XXXXX	–	–	R
AV24	Not used	–	–	–	–	–
AV25	kVA Setting	003EH	XXXXX	–	–	R
AV26	Control Method	003FH	XXXXX	–	–	R
AV27	Accel Time	0200H	XXXX.X (when C1-10 = 1) XXX.XX (when C1-10 = 0)	0.0 to 6000.0 (when C1-10 = 1) 0.00 to 600.00 (when C1-10 = 0)	Sec	W
AV28	Decel Time	0201H	XXXX.X (when C1-10 = 1) XXX.XX (when C1-10 = 0)	0.0 to 6000.0 (when C1-10 = 1) 0.00 to 600.00 (when C1-10 = 0)	Sec	W
AV29 <1>	Param Number	–	XXXXX	0 to FFFFH	–	W
AV30 <1>	Param Data	–	XXXXX	0 to FFFFH	–	W

<1> *Refer to Accessing Drive Parameters and the Enter Command on page 291* for an explanation of how to read and write drive parameters not listed in the analog or binary objects.

◆ Binary Input Objects

Table B.8 Binary Input Objects

Object ID	Object Name	Modbus Address	Active Text	Inactive Text	PV Access
BI1	Input Terminal 1	002BH:bit 0	ON	OFF	R
BI2	Input Terminal 2	002BH:bit 1	ON	OFF	R
BI3	Input Terminal 3	002BH:bit 2	ON	OFF	R
BI4	Input Terminal 4	002BH:bit 3	ON	OFF	R
BI5	Input Terminal 5	002BH:bit 4	ON	OFF	R
BI6	Input Terminal 6	002BH:bit 5	ON	OFF	R
BI7	Input Terminal 7	002BH:bit 6	ON	OFF	R
BI8	Multi-Function Out 1	0020H:bit 5	ON	OFF	R
BI9	Multi-Function Out 2	0020H:bit 6	ON	OFF	R

◆ Binary Output Objects

Table B.9 Binary Output Objects

Object ID	Object Name	Modbus Address	Active Text	Inactive Text	PV Access
BO1	MF Output M1-M2	0009H:bit 0	ON	OFF	C
BO2	MF Output M3-M4	0009H:bit 1	ON	OFF	C
BO3	MF Output MA-MC	0009H:bit 2	ON	OFF	C
BO4	Ref Sel: PI Setpoint	000FH:bit 1	ON	OFF	C
BO5	Ref Sel: Term S5 IN	000FH:bit 12	ON	OFF	C
BO6	Ref Sel: Term S6 IN	000FH:bit 13	ON	OFF	C
BO7	Refl Sel: Term S7 IN	000FH:bit 14	ON	OFF	C

◆ Binary Value Objects

Table B.10 Binary Value Objects

Object ID	Object Name	Modbus Address	Active Text	Inactive Text	PV Access
BV1	RUN FWD	0001H:bit 0	RUN	OFF	C
BV2	RUN REV	0001H:bit 1	REV	OFF	C
BV3	EXT FAULT	0001H:bit 2	FAULT	OFF	C
BV4	FAULT RESET	0001H:bit 3	RESET	OFF	C
BV5	COM NET	0001H:bit 4	COM	LOCAL	C
BV6	COM CNTRL	0001H:bit 5	COM	LOCAL	C
BV7	MF Input 3 Cmd	0001H:bit 6	ON	OFF	C
BV8	MF Input 4 Cmd	0001H:bit 7	ON	OFF	C
BV9	MF Input 5 Cmd	0001H:bit 8	ON	OFF	C
BV10	MF Input 6 Cmd	0001H:bit 9	ON	OFF	C
BV11	MF Input 7 Cmd	0001H:bit 10	ON	OFF	C
BV12	Set Fault Contact Cmd	0009H:bit 6	ENABLE	OFF	C
BV13	RUN-STOP	0020H:bit 0	RUN	OFF	R
BV14	REV-FWD	0020H:bit 1	REV	FWD	R
BV15	READY	0020H:bit 2	READY	OFF	R
BV16	FAULT	0020H:bit 3	FAULTED	OFF	R
BV17	Data Set Error	0020H:bit 4	ERROR	OFF	R
BV18	Overcurrent – Ground Fault	0021H:bit 0	OC-GF	OFF	R
BV19	Main Circuit Overvoltage	0021H:bit 1	OV	OFF	R
BV20	Drive Overload	0021H:bit 2	OL2	OFF	R
BV21	Drive Overheat	0021H:bit 3	OH1-OH2	OFF	R
BV22	Fuse Blown	0021H:bit 5	PUF	OFF	R
BV23	PI Feedback Loss	0021H:bit 6	FBL	OFF	R
BV24	External Fault	0021H:bit 7	EF0-EF	OFF	R
BV25	Hardware Error	0021H:bit 8	CPF	OFF	R
BV26	Mtr Ovrld-OvrTorque	0021H:bit 9	OL1-OL3	OFF	R
BV27	Overspeed	0021H:bit 10	OS-DEV	OFF	R
BV28	Main CKT Undervoltage	0021H:bit 11	UV	OFF	R
BV29	MCU, Cntl Pwr Sy Err	0021H:bit 12	UV1-2-3	OFF	R
BV30	Output Phase Loss	0021H:bit 13	LF	OFF	R
BV31	Communication Error	0021H:bit 14	CE	OFF	R
BV32	Operator Disconnect	0021H:bit 15	OPR	OFF	R
BV33	Operating	002CH:bit 0	OPERATING	OFF	R
BV34	Aero Speed	002CH:bit 1	ON	OFF	R

Object ID	Object Name	Modbus Address	Active Text	Inactive Text	PV Access
BV35	Frequency Agree	002CH:bit 2	ON	OFF	R
BV36	Desired Frequency Agree	002CH:bit 3	ON	OFF	R
BV37	Frequency Detect 1	002CH:bit 4	ON	OFF	R
BV38	Frequency Detect 2	002CH:bit 5	ON	OFF	R
BV39	Drive Startup Complete	002CH:bit 6	ON	OFF	R
BV40	Low Voltage Detect	002CH:bit 7	ON	OFF	R
BV41	Base Block	002CH:bit 8	ON	OFF	R
BV42	Frequency Reference Mode	002CH:bit 9	COM	LOCAL	R
BV43	Run Command Mode	002CH:bit 10	COM	LOCAL	R
BV44	Overtorque Detect	002CH:bit 11	ON	OFF	R
BV45	Frequency Refer Lost	002CH:bit 12	ON	OFF	R
BV46	Retry Error	002CH:bit 13	ON	OFF	R
BV47	Modbus Comms Error	002CH:bit 14	ON	OFF	R
BV48	Modbus Timeout Error	002CH:bit 15	ON	OFF	R
BV49	CRC Error	003DH:bit 0	ON	OFF	R
BV50	Invalid Data Length	003DH:bit 1	ON	OFF	R
BV51	Parity Error	003DH:bit 3	ON	OFF	R
BV52	Overrun Error	003DH:bit 4	ON	OFF	R
BV53	Framing Error	003DH:bit 5	ON	OFF	R
BV54	Timeout Error	003DH:bit 6	ON	OFF	R
BV55 <1>	Parameter Accept	0910H:bit 0	ON	OFF	W
BV56 <1>	Parameter Enter	0900H:bit 0	ON	OFF	W
BV57	Drive Comm Error	-	ON	OFF	R

<1> *Refer to Accessing Drive Parameters and the Enter Command on page 291* for an explanation of how to read and write drive parameters not listed in the analog or binary objects.

◆ Device Object

The Device Object fully describes the BACnet device to the network. Notable is that the Device Object Instance ID and the Device Object Name are configurable.

The Device Object Instance ID is a unique internetwork-wide numerical value. It is a 22-bit value that can range from 0 to 4,194,303. It is configurable by parameters H5-14 and H5-15. Any changes to these parameters will not take effect until the power is cycled to the drive.

The Device Object Name is a unique internetwork-wide character string. It is a 20-character string. It is writable from the BACnet network. Any new string written will not take effect until the power is cycled to the drive.

B.8 Accessing Drive Parameters and the Enter Command

◆ Reading Drive Parameters

Reading drive parameters not listed in the analog or digital objects is accomplished using AV29 and AV30 as shown below:

1. In decimal, write the desired Modbus register to AV29.
2. In decimal, read the value at the given register from AV30.

For example, to read the Frequency Reference Upper Limit, read from parameter d2-01.

Parameter d2-01 is located at Modbus register 0289H, which is decimal 649.

Set AV29 to "649"

Read AV30 to get the value.

◆ Writing Drive Parameters

Writing drive parameters not listed in the analog or digital objects is accomplished using AV29, AV30, and BV55 or BV56 as shown below:

1. In decimal, write the desired Modbus register to AV29.
2. In decimal, write the value to be written into AV30.
3. At this point the value is written to the drive, but the location is pending. If necessary, write in more values this way, then the drive will accept these settings by one of two methods:

   Set BV55 to "ON" to move data to active memory.

   Set BV56 to "ON" to move data into active memory and save to non-volatile memory.

For example, to reset the KWH Monitor, write a value of "1" to parameter o1-12.

Parameter o1-12 is located at Modbus register 0512H, which is decimal 1298.

Set AV29 to "1298"

Set AV30 to "1"

Set BV55 to "ON".

◆ Enter Command

Enter Commands are only required when using AV29 and AV30 to access drive parameters. An Enter command is not required when reading or writing to the other BACnet objects.

When writing parameters to the drive from a controller using BACnet communications, parameter H5-11 determines if an Enter command must be issued to enable these parameters. This section describes the types and functions of the Enter commands.

■ Enter Command Types

The drive supports two types of Enter commands as shown in ***Table B.11***.

Table B.11 Enter Command Types

BACnet Object	Modbus Address	Description
BV55 (Write "ON")	0910H (Write 0)	Writes data in the RAM only. Parameter changes are lost when the drive is shut off.
BV56 (Write "ON")	0900H (Write 0)	Simultaneously writes data into the EEPROM (non-volatile memory) of the drive and enables the data in RAM. Parameter changes remain after cycling power.

Note: The EEPROM can only be written to 100,000 times, so it is recommended to limit the number of times writing to the EEPROM. The Enter command registers 0900H and 0910H are write-only and if these registers are read, the register address will be invalid. However, BACnet objects BV55 and BV56 can be read without error.

B.9 Communication Errors

Errors that may occur when accessing drive parameters using the BACnet objects are shown in *Table B.12*.

Table B.12 MEMOBUS to BACnet Error Conversion

Error Code	Description
03d	BN_ERR_DEVICE_IS_BUSY Writing to a parameter was attempted while the drive was saving parameters to non-volatile memory.
27d	BN_ERR_READ_ACCESS_DENIED Invalid parameter register number used when reading.
37d	BN_ERR_VALUE_OUT_OF_RANGE Value written to the parameter is out of the valid range.
40d	BN_ERR_WRITE_ACCESS_DENIED An invalid parameter register number was used when writing. Writing to a parameter was attempted while the drive was in a mode that disables writing (i.e., writing while the drive was Auto-Tuning). Writing to a parameter was attempted while the DC Bus had an Undervoltage (Uv) fault

B.10 Self-Diagnostics

The drive has a built-in self-diagnosing function of the serial communication interface circuits. To perform the self-diagnosis function, use the following procedure.

DANGER! *Electrical Shock Hazard. Do not connect or disconnect wiring while the power is on. Failure to comply will result in death or serious injury. Before servicing, disconnect all power to the equipment. The internal capacitor remains charged even after the power supply is turned off. The charge indicator LED will extinguish when the DC bus voltage is below 50 Vdc. To prevent electric shock, wait at least one minute after all indicators are OFF and measure the DC bus voltage level to confirm safe level.*

1. Turn on the power to the drive.
2. Note the present terminal S6 function selection setting (H1-06) and set it for the communications test mode (H1-06 = 67).
3. Turn off the power to the drive.
4. With the power off, wire the drive as shown in the following diagram, connecting terminals R+ and S+, R- and S-, and S6 and SP.

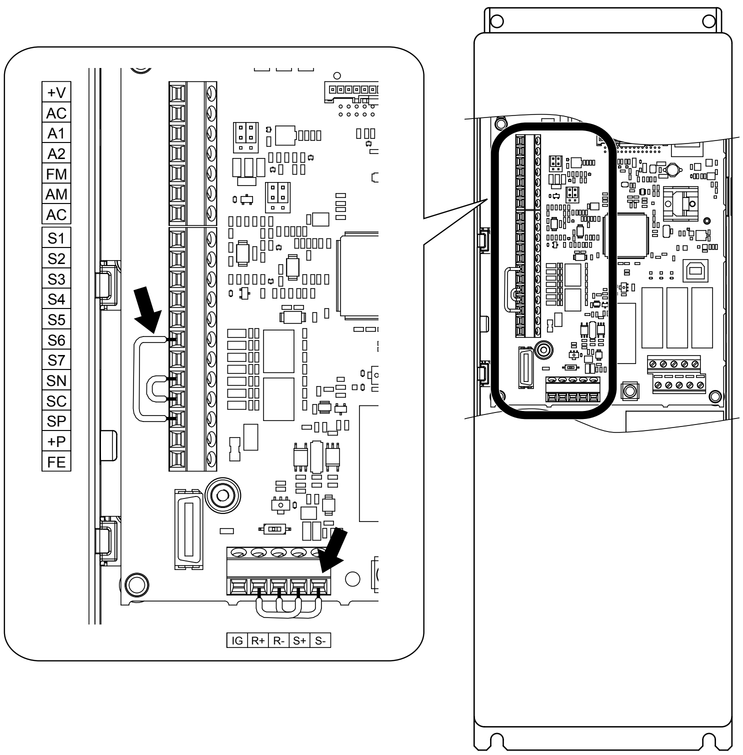


Figure B.7 Terminal Connections for Communication Self-Diagnostics

5. Connect a wire jumper between terminals SN and SC to change to source mode.
6. Turn the power to the drive back on.
7. During normal operation, the drive will display “Pass” to indicate that the communications test mode is operating normally.

   When a fault occurs, the drive will display “CE” on the keypad display.
8. Turn off the power supply.
9. Remove the wire jumpers from terminal R+, R-, S+, S-, and S6-SP. Reset the wire jumper to its original position and set terminal S6 to its original function.
10. Return to normal operation.

BACnet Communications

B

B.11 BACnet Protocol Implementation Conformance Statement

Date: 1/4/2011 Vendor Name: Yaskawa America, Inc.

Product Name: AC Motor Controller Product

Model Number: CIMR-ZU□A-□□□□

Application Software Version: 1.3 / Firmware Revision: VSE90101X / BACnet Protocol Revision: 4

Product Description:

The Yaskawa Z1000 Drive and Bypass products are high performance products specifically designed for commercial building automation applications. The Yaskawa BACnet feature connects the Z1000 Drive and Bypass products to a standard BACnet MS/TP network. These products may be fully controlled and monitored over BACnet. All drive parameters are available for reading and writing

BACnet Standardized Device Profile (Annex L):

□ BACnet Operator Workstation (B-OWS)

□ BACnet Building Controller (B-BC)

■ BACnet Advanced Application Controller (B-AAC)

□ BACnet Application Specific Controller (B-ASC)

□ BACnet Smart Sensor (B-SS)

□ BACnet Smart Actuator (B-SA)

List all BACnet Interoperability Building Blocks Supported (Annex K):

- Data Sharing-ReadProperty-B (DS-RP-B)
- Data Sharing-WriteProperty-B (DS-WP-B)
- Data Sharing - ReadProperty Multiple - B (DS-RPM-B)
- Data Sharing - WriteProperty Multiple - B (DS-WPM-B)
- Device Management-Dynamic Device Binding-B (DM-DDB-B)
- Device Management-Dynamic Object Binding-B (DM-DOB-B)
- Device Management-DeviceCommunicationControl-B (DM-DCC-B)
- Device Management-ReinitializeDevice-B (DM-RD-B)
- Device Management-TimeSyncronization-B (DM-TS-B)

Segmentation Capability:

□ Segmented requests supported / Window Size

□ Segmented responses supported / Window Size

Standard Object Types Supported:

- Device Object
- Analog Input Object
- Analog Output Object
- Analog Value Object
- Binary Input Object
- Binary Output Object
- Binary Value Object

Data Link Layer Options:

□BACnet IP, (Annex J)

□BACnet IP, (Annex J), Foreign Device

□ISO 8802-3, Ethernet (Clause 7)

□ ANSI/ATA 878.1, 2.5 Mb. ARCNET (Clause 8)

□ANSI/ATA 878.1, RS-485 ARCNET (Clause 8), baud rate(s)

■MS/TP master (Clause 9), baud rate(s): 1200, 2400, 4800, 9600, 19200, 38400, 57600, 76800, 115200

□MS/TP slave (Clause 9), baud rate(s):

□Point-To-Point, EIA 232 (Clause 10), baud rate(s):

□Point-To-Point, modem, (Clause 10), baud rate(s):

□LonTalk, (Clause 11), medium:

□Other:

Device Address Binding:

Is static device binding supported? (This is currently necessary for two-way communication with MS/TP slaves and certain other devices.) □Yes ■ No

Networking Options:

□Router, Clause 6 - List all routing configurations, e.g., ARCNET-Ethernet, Ethernet-MS/TP, etc.

□Annex H, BACnet Tunneling Router over IP

□BACnet/IP Broadcast Management Device (BBMD)

Does the BBMD support registrations by Foreign Devices? □Yes ■ No

Character Sets Supported:

Indicating support for multiple character sets does not imply that they can all be supported simultaneously.

■ ANSI X3.4

□ IBM/Microsoft

□ DBCS

□ ISO 8859-1

□ ISO 10646 (UCS-2)

□ ISO 10646 (UCS-4)

□ JIS C 6226

If this product is a communication gateway, describe the types of non-BACnet equipment/networks(s) that the gateway supports: Not supported

This Page Intentionally Blank

Appendix: C

APOGEE FLN (P1) Communications

C.1 APOGEE FLN Set-Up

The APOGEE FLN (P1) communication protocol is applicable in Z1000 software versions PRG: 1015 and later.

A Yaskawa America, Inc. representative is responsible for proper configuration of the drive for its primary application, while a Siemens Building Technologies, Inc. representative is responsible for field panel programming to make use of the drive functionality in the building automation system. As such, there must be coordination between the Yaskawa America and Siemens Building Technologies representatives to ensure that the programming of the drive is consistent with the particular application requirements. After verifying that the drive installation and wiring are correct, apply power to the drive. ***Table C.1*** lists the parameters and values required for proper APOGEE FLN communication and control.

Z1000 parameter settings For APOGEE FLN communications

Table C.1 Drive APOGEE FLN Communication Parameter Settings

Parameter Number	HOA Keypad Display	APOGEE FLN Setting
b1-01	Reference Source	2: Serial Com
b1-02	Run Source	2: Serial Com
H1-03	Digital Input Terminal S3 Function Selection	70: Drive Enable2
H5-01	Serial Comm Adr	Select the drive address (default = 1Fh (31 dec))
H5-02	Serial Baud Rate	2: 4800 Baud
H5-08	Protocol Select	2: P1

NOTICE: *Damage to Equipment. A Yaskawa representative should set the drive parameters to their appropriate values. Changes made to the settings of the parameters in* ***Table C.1*** *can result in damage to the drive or building equipment.*

C.2 Communication Specifications

APOGEE FLN specifications appear in the following table:

Item	Specifications
Interface	FLN RS-485
Communication Parameters	Communication Speed: 4800 bps Data Length: 8-bit (fixed) Parity: Select Even, Odd, or None Stop Bit: 1-bit (fixed)
Protocol	APOGEE FLN P1
Max Number of Drives	127 per FLN Network Segment

C.3 Connecting to a Network

This section explains how to connect the drive to an APOGEE FLN network and the network termination required for a connection.

◆ Network Cable Connection

Follow the instructions below to connect the drive to an APOGEE FLN network.

1. With the power shut off, connect the communications cable to the drive and the master. Use terminal TB4 for APOGEE FLN.

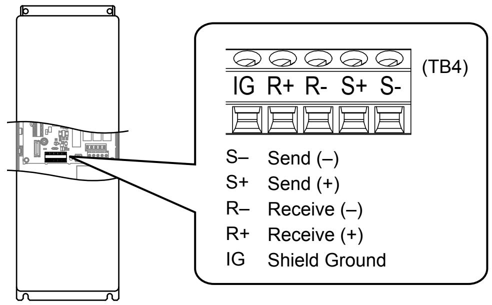


Figure C.1 Serial Communications Cable Connection Terminal (TB4)

Note: Separate the communications cables from the main circuit cables and other wiring and power cables. Use shielded cables for the communications cables, and properly shielded clamps to prevent problems with noise. When using RS-485 communications, connect S+ to R+, and S- to R- as shown in the diagram below.

2. Check or set the termination resistor selection at all slaves. Use the description in ***Network Termination*** on page ***279*** for slaves that are Z1000 drives.
3. Switch the power on.
4. Set the parameters needed for serial communications (H5-01 through H5-12) using the digital operator.
5. Shut the power off and wait until the display on the digital operator goes out completely.
6. Turn the power back on.
7. The drive is now ready to begin communicating with the master.

◆ Wiring Diagram for Multiple Connections

Figure B.3 and *Figure E.4* explain the wiring diagrams for multiple connections using APOGEE FLN communication.

■ RS-485 Interface

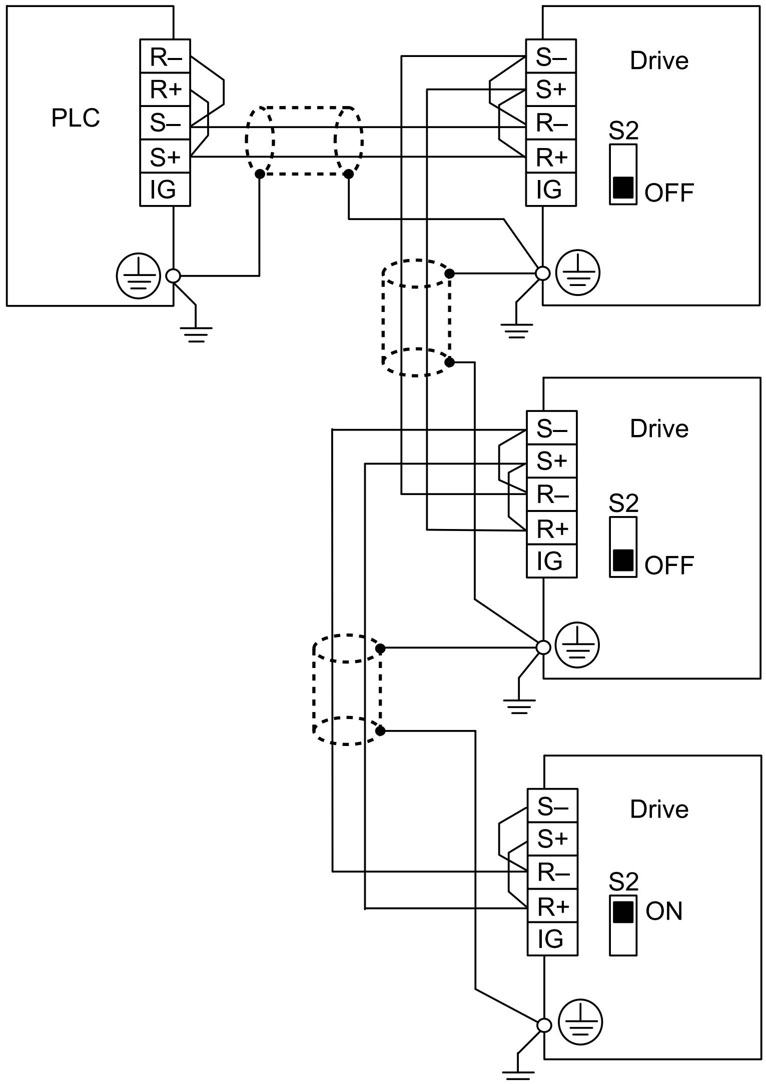


Figure C.2 RS-485 Interface

Note:
1. Set DIP switch S2 to the ON position on the drive located at the end of the network. Set DIP switch S2 to the OFF positions on all other slave devices.
2. Set H5-07 to 1 when using the RS-485 interface.

◆ Network Termination

Terminate each APOGEE FLN network segment on both ends to eliminate signal reflections. Yaskawa recommends using the Siemens Building Automation BLN Trunk Terminator (PN: 538-664) and setting the network termination switch on the drive, S1-1, to OFF.

◆ Recommended Cable

Table C.2 APOGEE FLN Cable Specifications

Secification	Description
Cable configuration	Twisted shielded pair
Gauge	Stranded wire: 0.2 to 1.0 mm^2 (24 to 16 AWG) Sold wire: 0.2 to 1.5 mm^2 (24 to 16 AWG)
Wire lay	Minimum 6 twists per foot
Shields	100% foil with drain wire
NEC type	UL type CMP
Temperature	-10 °C to +40 °C IP20/NEMA Type 1 Enclosure, External Heatsink (2A0011 to 2A0273 and 4A0005 to 4A0302) -10 °C to +50 °C IP00/Open Type Enclosure (2A0343 and 2A0396, and 4A0361 to 4A0590)

Note: Cable lengths cannot exceed 152 m (500 feet) at 4800 baud.

C.4 Slope and Intercept Conversion

Several drive parameters are available for monitoring purposes. The available parameters include FREQ OUTPUT (Point 3), SPEED (Point 5), CURRENT (Point 6), TORQUE (Point 7), POWER (Point 8), DRIVE TEMP (Point 9), KWH (Point 10), and RUN TIME (Point 12). These points can be unbundled for monitoring or used in various global control strategies.

◆ Drive Controlled Feedback

The most typical application is Supervisory Control. The sensor for the control variable (e.g., water temperature) is hard-wired to the drive and the control device (fan) is modulated using the PI control loop built into the drive. The setpoint for the control variable (water temperature set point) is unbundled and commanded by the field panel, based on the building control strategy implemented in PPCL.

When this strategy is used, the point to unbundle and command for the set point is INPUT REF 1 (Point 60). The control variable (e.g., water temperature) can be monitored by unbundling PI FEEDBACK (Point 62). These points are provided in units of percent, where 0% and 100% correspond to the range of the sensor being used to measure the control variable. These points have default units in Hz. If other units are required, unbundle these points with appropriate slopes and intercepts. The new intercept will be equal to the lowest value of the desired range.

The following formulas allow the user to define a new slope and intercept to convert the unit.

$$\text{New Slope} = \frac{\text{(Desired Range) x (Slope of Existing Point)}}{\text{(Range of Existing Point)}}$$

$$\text{New Slope} = \frac{(60 - 0)\ \text{Hz x}\ (0.01)}{(100 - 0)\%} = 0.006$$

■ Conversion Example

The drive is controlling a fan, which in turn is controlling the water temperature from a cooling tower. The temperature sensor has a range of -1 °C to +121 °C (30 °F to 250 °F). To unbundle the set point (INPUT REF 1), for commanding in degrees Fahrenheit, where 0 to 60 Hz is equal to -1 °C to +121 °C: New Intercept = 30 (the temperature that corresponds to 0%)

$$\text{New Slope} = \frac{\text{(Desired Range) x (Slope of Existing Point)}}{\text{(Range of Existing Point)}}$$

$$\text{New Slope} = \frac{(250 - 30)\ ^\circ\text{F x}\ (0.1)}{(100 - 0)\%} = 0.22$$

Note:
1. Desired Range = Range Maximum – Range Minimum
2. Range of Existing Point = Existing Range Maximum – Existing Range Minimum

◆ Field Panel Controlled Feedback

In this strategy, the sensor is connected to the APOGEE FLN network at a remote location, and the control loop is executed in PPCL. The drive speed command is passed from the field panel to the drive by commanding INPUT REF 1 (Point 60).

NOTICE: *Damage to Equipment. This strategy is not recommended because it means that the loop is being closed over the network. Delays due to processor scan time and network traffic can cause control to be degraded or lost and damage to HVAC equipment may result.*

■ Unbundle the Feedback

To unbundle the feedback (PI FEEDBACK) for monitoring in degrees Fahrenheit:

New Intercept = 30

$$\text{New Slope} = \frac{\text{(Desired Range) x (Slope of Existing Point)}}{\text{(Range of Existing Point)}}$$

$$\text{New Slope} = \frac{(250 - 30)\ ^\circ\text{F x } (0.01)}{(100 - 0)\%} = 0.022$$

Note:
1. Desired Range = Range Maximum – Range Minimum
2. Range of Existing Point = Existing Range Maximum – Existing Range Minimum

◆ Other Functionalities

Enable the following functions during start-up of the drive:

Enable the Drive to Run

RUN ENABLE (Point 35) can be commanded to require the drive to have a physical input (Terminal S3) set before the drive can run. This works in conjunction with CMD RUN.STOP (Point 24) or the CMD REV.STOP (Point 22). If RUN ENABLE (Point 35) is commanded ON then terminal S3 needs to be on and CMD RUN.STOP (Point 24) or CMD REV.STOP (point 22) needs to be commanded ON for the drive to run. If, on the other hand, RUN ENABLE (Point 35) is commanded OFF, then to run the drive CMD RUN.STOP (Point 24) or CMD REV.STOP (Point 22), is the only point that needs to be commanded ON.

Start and Stop the Drive

CMD RUN.STOP (Point 24) can be commanded to run the drive in the forward direction. STOP.RUN (Point 23) shows the current status of the drive.

Change Directions

CMD REV.STOP (Point 22) can be commanded to run the drive in the reverse direction. FWD.REV (Point 21) shows the current direction of the drive rotation.

NOTICE: *Damage to Equipment. Improper drive direction may damage HVAC equipment if parameter b1-04, Reverse Enable, is improperly set (b1-04 = 0).*

Lock the Drive Panel

Locking the panel prevents the user from using the HAND and OFF keys locally at the drive panel. LOCK PANEL (Point 33) can be commanded to lock and unlock the panel.

Digital Outputs

MULTI OUT 1 (Point 40), MULTI OUT 2 (Point 41), and MULTI OUT 3 (Point 42) are physical digital outputs on the drive. Their purpose depends on how the drive has been set-up. The drive can be programmed so that these points can display various limits, warnings, and status conditions. Some examples include frequency limit, over current, and motor over temperature fault.

Loop Gain

PID P GAIN (Point 63) and PID I TIME (Point 64) are the gain and integral time parameters similar to the P and I gains in the APOGEE FLN Terminal Equipment Controllers. The PI loop of the drive is structured differently than the Siemens loop, so there is not a one-to-one correspondence between the gains.

Reading and Resetting Faults

OK.FAULT (Point 93) shows the current status of the drive. FAULT CODE (Point 17) contains the code for the most current fault. LST FLT CODE (Point 66) contains the code for the previous fault. See table below for descriptions of the fault codes. The drive can be reset back to OK mode by commanding RESET FAULT (Point 94) to RESET.

C.5 APOGEE FLN Point Database

This section shows the APOGEE FLN point database for Application 2721.

◆ APOGEE FLN Point List Summary

This database is for APOGEE FLN Application 2721 and features 97 logical points: 29 Logical Analog Inputs (LAI), 35 Logical Analog Outputs (LAO), 19 Logical Digital Inputs (LDI) and 14 Logical Digital Outputs (LDO). These points configure, control or monitor the operation of the drive.

Information to consider when referencing this table:

1. Points not listed are not used in this application.
2. A single value in a column means that the value is the same in English units and in SI units.
3. Point numbers that appear in bold italic type (e.g. ***03***) can be unbundled at the field panel.

Table C.3 APOGEE FLN Application 2721 Point Number Summary

Point Number	Point Type	Point Name	Factory Default (SI Units)	Eng. Units (SI Units)	Slope (SI Units)	Intercept (SI Units)	On Text	Off Text	Parameter
1	LAO	CTLR ADDRESS	31	–	1	0	–	–	H5-01
2	LAO	APPLICATION	–	–	1	0	–	–	–
03	LAI	FREQ OUTPUT	0	Hz	0.01	0	–	–	U1-02
04	LAI	PCT OUTPUT	0	%	0.01	0	–	–	–
05	LAI	SPEED	0	RPM	1	0	–	–	–
06	LAI	CURRENT	0	A	0.01	0	–	–	U1-03
07	LAI	TORQUE	0	%	0.1	0	–	–	–
08	LAI	POWER	0	kW	0.1	0	–	–	U1-08
09	LAI	DRIVE TEMP	0	° C/F	1	0	–	–	U4-08
10	LAI	DRIVE KWH	0	kWh	0.1	0	–	–	U4-10
11	LAI	MWH	0	MWh	1	0	–	–	U4-11
12	LAI	RUN TIME	0	h	1	0	–	–	U4-01
13	LAI	DC BUS VOLT	0	V	1	0	–	–	U1-07
14	LAI	AC OUT VOLT	0	V	0.1	0	–	–	U1-06
15	LAI	PAR N9.01	0	A	0.01	0	–	–	n9-01
16	LAI	RUN TIMEX10K	0	10Kh	1	0	–	–	U4-01
17	LAI	FAULT CODE	0	–	1	0	–	–	U2-01
18	LDI	MINOR FLT	NO FLT	–	1	0	FAULT	NO FLT	U1-12 (Bit 6)
19	LDI	MAJOR FLT	NO FLT	–	1	0	FAULT	NO FLT	U1-12 (Bit 7)
20	LAO	OVRD TIME	1	h	1	0	–	–	–
21	LDI	FWD.REV	FWD	–	1	0	REV	FWD	U1-12 (Bit 2)
22	LDO	CMD REV.STOP	STOP	–	1	0	REV	STOP	–
23	LDI	RUN.STOP	STOP	–	1	0	RUN	STOP	U1-12 (Bit 0)
24	LDO	CMD RUN.STOP	STOP	–	1	0	FWD	STOP	–
25	LDI	ZERO SPEED	OFF	–	1	0	ON	OFF	U1-12 (Bit 1)
26	LDI	SPEED AGREE	NO AGR	–	1	0	AGREE	NO AGR	U1-12 (Bit 4)
27	LDI	DRIVE READY	NOTRDY	–	1	0	READY	NOTRDY	U1-12 (Bit 5)
28	LDI	LOC.REM MON	REMOTE	–	1	0	LOCAL	REMOTE	–
29	LDO	DAY.NGT	DAY	–	1	0	NGT	DAY	–
30	LAO	CURRENT LMT	0	A	0.01	0	–	–	E2-01
31	LAO	ACCEL TIME	0	s	0.1	0	–	–	C1-01
32	LAO	DECEL TIME	0	s	0.1	0	–	–	C1-02
33	LDO	LOCK PANEL	UNLOCK	–	1	0	LOCK	UNLOCK	–

Point Number	Point Type	Point Name	Factory Default (SI Units)	Eng. Units (SI Units)	Slope (SI Units)	Intercept (SI Units)	On Text	Off Text	Parameter
35 <1>	LDO	RUN ENABLE	STOP	–	1	0	ENABLE	STOP	–
36	LAO	STALL PRE RN	90	%	1	30	–	–	L3-06
37	LAO	STALL PRE AC	120	%	1	0	–	–	L3-02
38	LAO	FREQ UP LIM	100	%	0.1	0	–	–	d2-01
39	LAO	FREQ LOW LIM	0	%	0.1	0	–	–	d2-02
40	LDI	MULTI OUT 1	OFF	–	1	0	ON	OFF	U1-11 (Bit 0)
41	LDI	MULTI OUT 2	OFF	–	1	0	ON	OFF	U1-11 (Bit 1)
42	LDI	MULTI OUT 3	OFF	–	1	0	ON	OFF	U1-11 (Bit 2)
43	LDI	SAFETY ILOCK	OFF	–	1	0	ON	OFF	U1-10 (Bit 2)
44	LDO	MF INP 1	OFF	–	1	0	ON	OFF	–
45	LDO	MF INP 2	OFF	–	1	0	ON	OFF	–
46	LDO	MF INP 3	OFF	–	1	0	ON	OFF	–
47	LDO	MF INP 4	OFF	–	1	0	ON	OFF	–
48	LDO	MF INP 5	OFF	–	1	0	ON	OFF	–
49	LAO	JUMP FREQ 1	0	Hz	0.1	0	–	–	d3-01
50	LAO	JUMP FREQ 2	0	Hz	0.1	0	–	–	d3-02
51	LAO	JUMP FREQ 3	0	Hz	0.1	0	–	–	d3-03
52	LAO	JUMP FREQ BW	0	Hz	0.1	0	–	–	d3-04
53	LAO	NUM AUTOSTRT	0	–	1	0	–	–	L5-01
54	LAO	POWER LOSS RT	0.1	s	0.1	0	–	–	L2-02
55	LAO	RUN OP MODE	1	–	1	0	–	–	b1-02
56	LAO	REF OP MODE	1	–	1	0	–	–	b1-01
57	LAO	OPER DISP MD	0	–	1	0	–	–	o1-03
58	LDI	MF IN 1 MON	OFF	–	1	0	ON	OFF	U1-10 (Bit 2)
59	LDI	MF IN 2 MON	OFF	–	1	0	ON	OFF	U1-10 (Bit 3)
60	LAO	INPUT REF 1	0	Hz	0.01	0	–	–	–
61	LAO	INPUT REF 2	0	Hz	0.01	0	–	–	d1-02
62	LAI	PID FEEDBACK	0	%	0.01	0	–	–	U5-01
63	LAO	PID P GAIN	2	–	0.01	0	–	–	b5-02
64	LAO	PID I TIM	0.5	s	0.1	0	–	–	b5-03
65	LDO	PID MODE SEL	DISABLE	–	1	0	ENABLE	DISABLE	b5-01
66	LAI	LST FLT CODE	0	–	1	0	–	–	U2-02
67	LAI	FREF.FLT	0	Hz	0.01	0	–	–	U2-03
68	LAI	OUT FREQ FLT	0	Hz	0.01	0	–	–	U2-04
69	LAI	OUT CUR.FLT	0	A	0.01	0	–	–	U2-05
70	LAO	RD PARAM NUM	1	–	1	0	–	–	–
71	LAI	RD PARAM DAT	0	–	1	0	–	–	–
72	LAO	WR PARAM NUM	1	–	1	0	–	–	–
73	LAO	WR PARAM DAT	0	–	1	0	–	–	–
74	LDI	MF IN 3 MON	OFF	–	1	0	ON	OFF	U1-10 (Bit 4)
75	LAI	OUT VOLT.FLT	0	V	0.1	0	–	–	U2-07
76	LAI	DC BUS.FLT	0	V	1	0	–	–	U2-08
77	LAI	OUT PWR.FLT	0	kW	0.1	0	–	–	U2-09

Point Number	Point Type	Point Name	Factory Default (SI Units)	Eng. Units (SI Units)	Slope (SI Units)	Intercept (SI Units)	On Text	Off Text	Parameter
78	LDI	MF IN 4 MON	OFF	–	1	0	ON	OFF	U1-10 (Bit 5)
79	LAI	PID DEVIATE	0	%	0.01	0	–	–	U5-02
80	LAO	PID I LIMIT	100	%	0.1	0	–	–	b5-04
81	LAO	PID UP LIMIT	100	%	0.1	0	–	–	b5-06
82	LAO	PID OFFS ADJ	100	%	0.1	-100	–	–	b5-07
83	LAO	PID PRI DYTM	0	s	0.1	0	–	–	b5-08
84	LAO	PID FB RMDS	0	–	1	0	–	–	b5-12
85	LAO	PID FB RMDL	0	%	1	0	–	–	b5-13
86	LAO	PID FB RMDT	1	s	0.1	0	–	–	b5-14
87	LAI	PID OUT CAP	0	%	0.01	0	–	–	U5-14
88	LAI	PID REF	0	%	0.01	0	–	–	U5-04
89	LAI	COMM ERR CD	0	–	1	0	–	–	U1-19
90	LDO	COMM FLT ENA	ENABLE	–	1	0	ENABLE	DISABLE	H5-05
91	LAO	CBL LOSS FRQ	0	Hz	0.01	0	–	–	d1-04
92	LAO	CBL LOSS TMR	2	s	0.1	0	–	–	H5-09
93	LDI	OK.FAULT	OK	–	1	0	FAULT	OK	U1-12 (Bit 7)
94	LDO	RESET FAULT	NO	–	1	0	RESET	NO	–
95	LDI	DRV COMM ERR	NO FLT	–	1	0	FAULT	NO FLT	–
96	LDO	EXTERNAL FLT	OK	–	1	0	FAULT	OK	–
97	LDI	MF IN 5 MON	OFF	–	1	0	ON	OFF	U1-10 (Bit 6)
99	LAI	ERROR STATUS	0	–	1	0	–	–	U1-19

<1> Set H1-03 to 70 , Drive Enable2, for pt 35 to work properly.

C.6 Cable Loss Configuration and Behavior

This section describes the configurable cable loss feature of the drive. This feature offers a user maximum flexibility in determining the drive response to a loss of communication.

◆ Drive Behavior At Loss of Communication

After some interval without receipt of a message, the drive can be configured to respond in one of the following manners:

- Continue at last speed
- Continue at last speed with Alarm
- Continue at preset speed
- Ramp to Stop with EF0 fault
- Coast to Stop with EF0 fault
- Emergency Stop with EF0 fault

◆ APOGEE FLN Points

Three APOGEE FLN points are used to select the desired behavior:

- POINT 92 – CBL LOSS TMR
- POINT 91 – CBL LOSS FRQ
- POINT 90 – COMM FLT ENA

Table C.4 Cable Loss Behavior Summary

Behavior	H5-04 Setting	CBL LOSS TMR (Point 92)	CBL LOSS FRQ (Point 91)	COMM FLT ENA (Point 90)
Decelerate to stop (stop time in C1-02) **EF0 Fault**	0	Timeout interval	X	On
Coast to stop **EF0 Fault**	1	Timeout interval	X	On
Fast stop (stop time in C1-09) **EF0 Fault**	2	Timeout interval	X	On
Continue at last speed	3	0	X	X
Continue at last speed with alarm	3	Timeout interval	X	On
Continue at preset speed with alarm	4	Timeout interval	Preset speed	On

Note:

1. Communication must first be established and then lost for these features to function as described. If a drive is powered-up without a cable connected or with the master controller offline, a communications timeout does not occur.
2. For modes which describe the drive running after a communications timeout, a Run command must have been issued (RUN ENABLE (Point 35) = ‘On’ and either CMD RUN.FWD (Point 22) = ‘On’ or CMD RUN.REV (Point 24) = ‘On’) prior to loss of communications. For safety purposes, the drive will not automatically restart from a stopped condition. If a user requires the drive to restart automatically, additional external wiring is required to accomplish this (consult factory).

Upon expiration of the communications timeout interval, a CE (Communication Error) fault will be declared and will remain until communication is restored.

■ Continue at Last Speed

In this mode, CBL LOSS TMR (POINT 92) is set to 0, disabling the cable loss feature. The other two settings, CBL LOSS FRQ (POINT 91) and COMM FLT ENA (POINT 90), are ignored. If communication is lost, the drive maintains its last commanded state. The drive will not display an alarm or fault to indicate it has lost communication. This behavior can also be achieved by setting parameter H5-04 to 3. The drive will display an alarm and continue running. For this specific condition, the COMM FLT ENA(POINT 90) must be enabled and CBL LOSS TMR (POINT 91) should be set to a value other than 0. A CE drive alarm will be set.

■ Continue at Preset Speed

In this mode, CBL LOSS TMR (POINT 92) is set to the desired interval, CBL LOSS FRQ (POINT 91) is set to the desired preset speed and H5-04 is set to 4. If the time between messages exceeds the timeout interval, the drive speed command, INPUT REF 1, (Point 60) is set to the CBL LOSS FRQ (POINT 91) and the drive continues running at this new speed. COMM FLT ENA (POINT 90) must be set to ON.

■ Stop

COMM FLT ENA (POINT 90) must be set to ON. In this mode, CBL LOSS TMR (POINT 92) is set to the desired interval and parameter H5-04 is set to a value of 0, 1, or 2. If the time between messages exceeds the timeout interval, the drive’s speed command, INPUT REF 1, (Point 60) is set to 0. The stopping method is determined by the setting of H5-04. A CE drive fault will be set. H5-04 = 0 selects Ramp to Stop. The deceleration time or the slope of the ramp is determined by the setting of drive parameter C1-02. H5-04 = 1 selects Coast to Stop. The drive does not attempt to control the rate of deceleration. H5-04 = 2 selects Fast Stop. The deceleration time is determined by the setting of drive parameter C1-09.

Note: \The behavior of the drive at cable loss is controlled by parameter H5-04. This drive parameter works with the points as described in the table above to determine how the drive will respond to a cable loss. If the cable loss fault is disabled, the drive will continue in its last state, if running the drive will continue to run at the last commanded frequency.

■ Stop with Fault (CE)

In this mode, CBL LOSS TMR (POINT 92) is set to the desired interval, COMM FLT ENA (POINT 90) or is set to “ON” and either CMD RUN.FWD (Point 22) or CMD RUN.REV (Point 24) is also set to “ON”. If the time between messages exceeds the timeout interval, a “CE” fault is declared and the drive stops. The stopping method is controlled by the setting of H5-04 and is described above. CBL LOSS FRQ (POINT 91) is ignored.

■ Drive Fault Numbers

Refer to Alarm Register Contents on page 357 for fault trace/history register contents information.

C.7 Mailbox Functions

This section defines the APOGEE FLN points that read and write drive parameters.

◆ Reading a Drive Parameter

Two points are defined for reading any drive parameter:

- #70 Specifies the parameter to be read from
- #71 Reports the value of the parameter specified in Point #70

When this point is read, it retrieves data from the parameter and sends it to the controller

Example: Writing a value of 387 (183H) to Point #70 specifies drive parameter b1-04. Reading Point #71 returns the current setting of parameter b1-04 to the controller.

◆ Writing to a Drive Parameter

Two points are defined for writing to any drive parameter:

- #72 Specifies the parameter to be written to
- #73 Entry location of the value to be written to the parameter specified in Point #72

When this point is written to, it will write the value to the drive. An enter or accept command does not need to be sent for the data to be taken by the drive. The behavior of the write is the same as with the digital operator. If the drive is running, there are a limited number of drive parameters that can be written to.

Example: Writing a value of 387 (183H) to Point #72 specifies drive parameter b1-04. Writing a value of 1 to Point #73 enables the drive for reverse run.

C.8 Troubleshooting

This section describes the steps necessary to troubleshoot drive communications on an APOGEE FLN network.

◆ Troubleshooting Checklist

☑	No.	Item
☐	1.	Connect power to the drive and verify that the drive operates correctly in HAND mode from the digital operator without being connected to the network. Record the drive model number at this time: Model Number: CIMR-ZU ___ ___ ___ ___ (e.g. CIMR-ZU2A0021FAA)
☐	2.	Record the control board part number: ETC - ___ ___ ___ ___ ___ ___ - ___ ___ ___ ___ ___
☐	3.	All network devices have unique addresses and drives are addressed between 0-99 (0-63 hex). Drive address: ____________
☐	4.	The Run/Stop command source parameter, b1-02 is set correctly. b1-02: ____________
☐	5.	The Speed Command source parameter, b1-01, is set correctly. b1-01: ____________
☐	6.	The correct cable type is used: Mfg: ____________________ P/N: ____________________
☐	7.	All cable connections are correct per device schematic and are secure.
☐	8.	All cables have been checked for continuity. There are no breaks or shorts.
☐	9.	The network is correctly terminated.
☐	10.	The shield is continuous throughout the network and is properly grounded on each end.
☐	11.	The network cable is routed away from any high voltage cable(s) or source(s).
☐	12.	All network devices have been tested for conformance with the APOGEE FLN specification.

This Page Intentionally Blank

Appendix: D

Metasys N2 Communications

D.1 Metasys N2 Specifications

Drives can be monitored and controlled by a controller on a Metasys N2 network (N2) using RS-485 technology. The drives act as slaves on the N2 network.

Up to 255 drives can communicate on a single N2 network. If more drives or N2 devices are required, another N2 network is required.

The N2 node address is configurable by a parameter in the drive. This defines the physical address of the drive on the MS-TP network.

Once the addressing is set, a controller can initiate communication to the drive. The drive will perform the specified function and then send a response back to the controller.

The Metasys N2 communication protocol is applicable in Z1000 software versions PRG: 1015 and later.

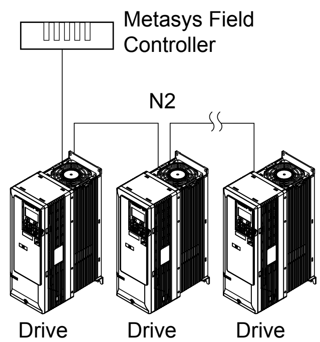


Figure D.1 Connecting Multiple Drives to a Metasys N2 Network

D.2 Communication Specifications

Metasys N2 specifications appear in the following table:

Item	Specifications
Interface	RS-485
Communication Parameters	Communication Speed: 9600 bps Data Length: 8-bit (fixed) Parity: None Stop Bit: 1-bit (fixed)
Protocol	Metasys N2
Max Number of Drives	255 per N2 Network Segment
Applicable Drive Software	PRG: 1015 and later

D.3 Connecting to a Network

This section explains how to connect the drive to an N2 network and the network termination required for a connection.

◆ Network Cable Connection

Follow the instructions below to connect the drive to an N2 network.

1. With the power shut off, connect the communications cable to the drive and the master. Use terminal TB4 for N2.

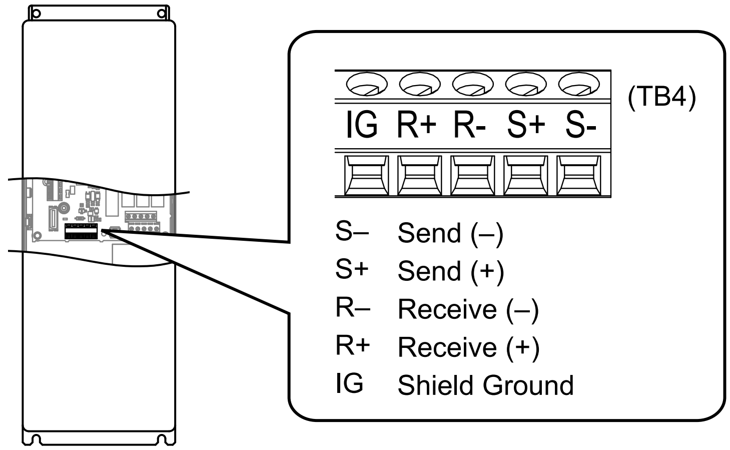


Figure D.2 Serial Communications Cable Connection Terminal (TB4)

Note: Separate the communications cables from the main circuit cables and other wiring and power cables. Use shielded cables for the communications cables, and properly shielded clamps to prevent problems with noise. When using RS-485 communications, connect S+ to R+, and S- to R- as shown in the diagram below.

2. Check or set the termination resistor selection at all slaves. Use the description in ***Network Termination*** on page ***279*** for slaves that are Z1000 drives.
3. Switch the power on.
4. Set the parameters needed for serial communications (H5-01 through H5-12) using the digital operator.
5. Shut the power off and wait until the display on the digital operator goes out completely.
6. Turn the power back on.
7. The drive is now ready to begin communicating with the master.

◆ Wiring Diagram for Multiple Connections

Figure B.3 explains the wiring diagrams for multiple connections using N2 communication.

■ RS-485 Interface

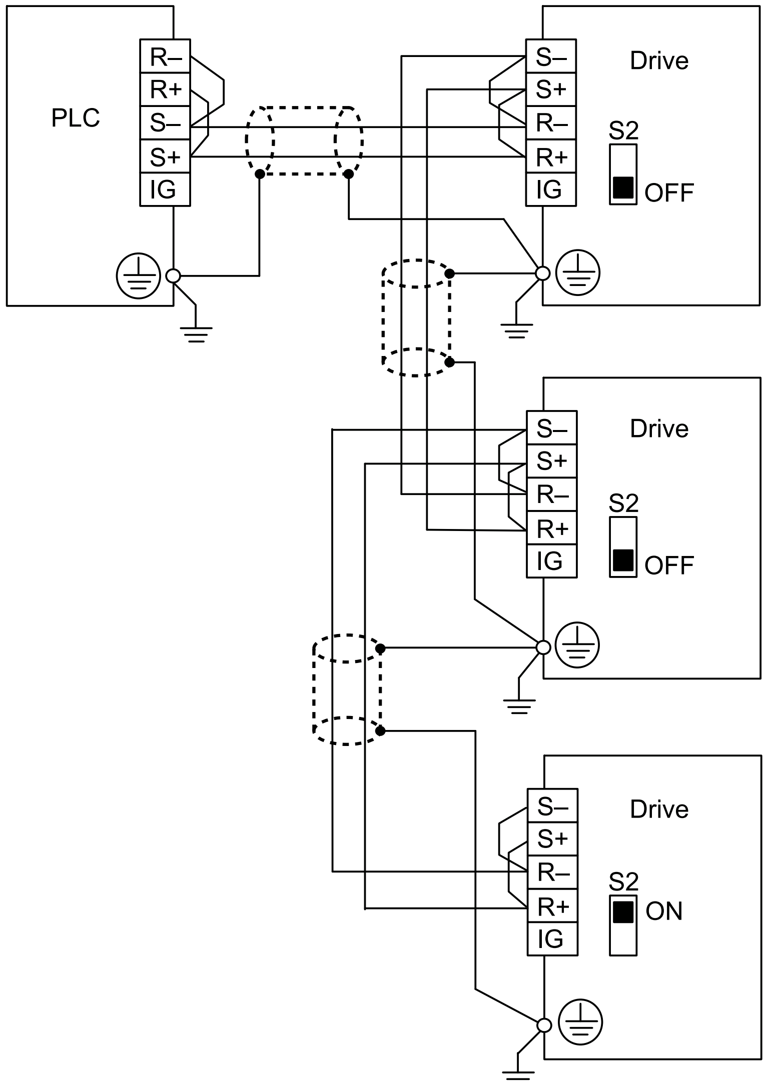


Figure D.3 RS-485 Interface

Note:
1. Set DIP switch S2 to the ON position on the drive located at the end of the network. Set DIP switch S2 to the OFF positions on all other slave devices.
2. Set H5-07 to 1 when using the RS-485 interface.

◆ Network Termination

The two ends of the N2 network line have to be terminated. The drive has a built in termination resistor that can be enabled or disabled using DIP switch S2. If a drive is located at the end of a network line, enable the termination resistor by setting DIP switch S2 to the ON position. Disable the termination resistor on all slaves that are not located at the network line end.

D.4 N2 Setup Parameters

◆ N2 Serial Communication

This section describes parameters necessary to set up N2 communications.

■ H5-01: Drive Slave Address

Sets the drive slave address used for communications.

Note: Cycle the power after changing this parameter to enable the new setting.

No.	Name	Setting Range	Default
H5-01	Drive Slave Address	0 to FFH	1FH

Each slave drive must be assigned a unique slave address for serial communications to work. Slave addresses do not need to be assigned in sequential order, but no two drives may share the same address.

■ H5-02: Communication Speed Selection

Sets the communications speed for APOGEE FLN, BACnet, MEMOBUS/Modbus, and Metasys N2.

Note:
1. Cycle the power after changing this parameter to enable the new setting.
2. When Metasys N2 communications are selected (H5-08 = 1), selecting a baud rate other than 9600 bps will trigger an oPE29 error.
3. When APOGEE FLN (P1) communications are selected (H5-08 = 2), selecting a baud rate other than 4800 bps will trigger an oPE29 error.
4. When BACnet communications are selected (H5-08 = 3), selecting 115200 bps (Setting 8) will trigger an oPE29 error.

No.	Name	Setting Range	Default
H5-02	Communication Speed Selection	0 to 8	<1>

<1> Default depends on H5-08 setting:
H5-08 = 0, MEMOBUS/Modbus; default: 3
H5-08 = 1, N2 (Metasys); default: 3
H5-08 = 2, P1 (APOGEE FLN); default: 2
H5-08 = 3, BACnet; default: 3

H5-02	Communication Speed	H5-02	Communication Speed
0 <1>	1200 bps	5 <1>	38400 bps
1 <1>	2400 bps	6 <1>	57600 bps
2	4800 bps	7 <1>	76800 bps
3 <1>	9600 bps	8 <1> <2>	115200 bps
4 <1>	19200 bps		

<1> Not available when H5-08 is set to 2 P1 (APOGEE FLN).

<2> Not available when H5-08 is set to 0 (MEMOBUS/Modbus) or 1 (Metasys N2).

■ H5-03: Communication Parity Selection

Sets the parity used for communications.

Note: Cycle the power after changing this parameter to enable the new setting.

No.	Name	Setting Range	Default
H5-03	Communication Parity Selection	0 to 2	0

Setting 0: No parity

Setting 1: Even parity

Setting 2: Odd parity

H5-04: Stopping Method after Communication Error

Selects the stopping method after a communications error (CE) has occurred.

No.	Name	Setting Range	Default
H5-04	Stopping Method after CE	0 to 4	3

Setting 0: Ramp to Stop

Uses the deceleration time currently enabled.

Setting 1: Coast to Stop

Setting 2: Fast Stop

Setting 3: Alarm Only - Operation Continues

Setting 4: Run at d1-04

H5-05: Communication Fault Detection Selection

Enables or disables the CE detection for communications.

No.	Name	Setting Range	Default
H5-05	Communication Fault Detection Selection	0 or 1	1

Setting 0: Disabled

No communication error detection. The drive continues operation.

Setting 1: Enabled

If the drive does not receive data from the master for longer than the time set to H5-09, then a CE fault will be triggered and the drive will operate as determined by parameter H5-04.

H5-06: Drive Transmit Wait Time

Sets the time the drive waits after receiving data from a master until responding data.

No.	Name	Setting Range	Default
H5-06	Drive Transmit Wait Time	5 to 65 ms	5 ms

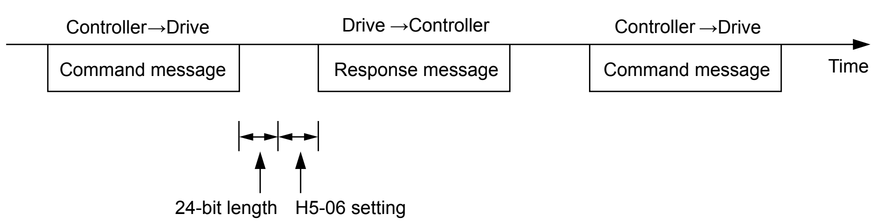


Figure D.4 Drive Transmit Wait Time Setting

H5-07: RTS Control Selection

Enables or disables RTS control.

No.	Name	Setting Range	Default
H5-07	RTS Control Selection	0 or 1	1

Setting 0: Disabled. RTS is always on.

Use this setting with point-to-point RS-422 communications.

Setting 1: Enabled. RTS switches while sending.

Use this setting with RS-485 communications or when using multi-drop RS-422 communications.

H5-08: Communications Protocol Selection

Selects the communications protocol.

No.	Name	Setting Range	Default
H5-08	Communications Protocol Selection	0 to 3	0

Setting 0: MEMOBUS/Modbus

Setting 1: N2

Setting 2: P1

Setting 3: BACnet

■ H5-09: Communications Fault Detection Time

Sets the time the communications must be lost before the drive triggers a CE fault.

No.	Name	Setting Range	Default
H5-09	Communications Fault Detection Time	0.0 to 10.0 s	2.0 s

■ H5-10: Unit Selection for MEMOBUS/Modbus Register 0025H

Note: Leave parameter setting at default (Setting 0: 0.1 V units) for N2.

Sets the unit for the output voltage monitor value in MEMOBUS/Modbus register 0025H.

No.	Name	Setting Range	Default
H5-10	Unit Selection for MEMOBUS/Modbus Register 0025H	0 or 1	0

Setting 0: 0.1 V units

Setting 1: 1 V units

■ H5-11: Communications Enter Function Selection

Selects whether an Enter command is necessary to change parameter values via serial communications.

No.	Name	Setting Range	Default
H5-11	Communications Enter Function Selection	0 or 1	0

Setting 0: Enter command necessary

Parameter changes become effective after an Enter command. An Enter command must only be sent after the last parameter change, not for each single parameter.

Setting 1: Enter command not necessary

Parameter value changes become effective immediately without the need to send an Enter command.

■ H5-12: Run Command Method Selection

Selects the type of sequence used when the Run command source is set to serial communications (b1-02, b1-16 = 2).

No.	Name	Setting Range	Default
H5-12	Run Command Method Selection	0 or 1	0

Setting 0: FWD/Stop, REV/Stop

Setting B0 1 (bit 0 of MEMOBUS/Modbus register 0001H) will start and stop the drive in the forward direction. Setting B0 2 (bit 1 of MEMOBUS/Modbus register 0001H) will start and stop the drive in reverse.

Setting 1: Run/Stop, FWD/REV

Setting B0 1 (bit 0 of MEMOBUS/Modbus register 0001H) will start and stop the drive. Setting B0 2 (bit 1 of MEMOBUS/Modbus register 0001H) changes the direction.

■ H5-14, H5-15: BACnet Device Object Identifiers 0 and 1

Note: These parameters are ignored when N2 protocol is selected (H5-08 = 1).

These parameters set the Instance Identifier of the BACnet Device Object, where the H5-14 value is the least significant word and the H5-15 value is the most significant word.

No.	Name	Setting Range	Default
H5-14	BACnet Device Object Identifier 0	0 to FFFFH	1
H5-15	BACnet Device Object Identifier 1	0 to 3FH	0

Example 1: Set Device Object Instance Identifier of “1234”

1234 decimal is equal to 4D2H (hexadecimal)

Set H5-14 to 4D2H and set H5-15 to 0.

Example 2: Set Device Object Instance Identifier of “1234567”

12334567 decimal is equal to 12D687H

Set H5-14 to D687H and set H5-15 to 12H.

D.5 Drive Operations by N2

The drive operations that can be performed by N2 communication depend on drive parameter settings. This section explains the functions that can be used and related parameter settings.

◆ Observing the Drive Operation

A controller can perform the following actions with N2 communications at any time regardless of parameter settings (except for H5-☐☐ parameters):

- Observe drive status and drive control terminal status from a controller
- Read and write parameters
- Set and reset faults
- Set multi-function inputs.

Note: Input settings from the input terminals S☐ and from N2 communications are both linked by a logical OR operation.

◆ Controlling the Drive

Select an external reference and adjust the parameters in ***Table B.1*** accordingly to start and stop the drive or set the frequency reference using N2 communications.

Table D.1 Setting Parameters for Drive Control from N2

Reference Source	Parameter	Name	Required Setting
External Reference 1	b1-01	Frequency Reference Selection 1	2
	b1-02	Run Command Selection 1	2
External Reference 2	b1-15	Frequency Reference Selection 2	2
	b1-16	Run Command Selection 2	2

Refer to the User Manual for details on external reference parameter selections.

■ Drive Functions

Each of the following functions must be enabled during start-up of the drive:

Start and Stop the Drive

Set the Run Forward Command (BO 1) to run the drive in the forward direction. Set the Run Reverse Command (BO 2) to run the drive in the reverse direction. Run/Stop Monitor (BI 1) shows the current run status of the drive. Forward/Reverse Monitor (BI 2) shows the current direction.

NOTICE: *Damage to Equipment. Improper drive direction may damage HVAC equipment if parameter b1-04, Reverse Enable, is set to 0 (Enable).*

Lock the Drive Panel

Locking the panel prevents the user from using the HAND and OFF keys locally at the drive panel. Panel Lock (BO 10) can be commanded to lock and unlock the panel.

Digital Inputs

Multi-Function Input S3 (BO 5) through Multi-Function Input S7 (BO 9) are physical digital inputs on the drive. They can be set either by external devices, such as limit or pressure switches, or by the network. Their function depends on how the drive has been programmed. Refer to the User Manual section on Multi-Function Inputs (H1-03 through H1-07) for detailed information on the use and programming of the multi-function inputs. The multi-function input status can be monitored through Multi-Function Input 1 Monitor (BI 14) through Multi-Function Input 5 Monitor (BI 19). The Multi-Function Input # Monitor state is the logical OR of the serial command value (BO 5 through BO 9) and the state of the external connection.

Note: The multi-function inputs can be set by both external devices or over the network. Use caution when connecting the multi-function inputs to external devices to ensure correct system operation.

Digital Outputs

Multi-Function Output 1 (BI 10) through Multi-Function Output 3 (BI 12) are physical digital outputs on the drive. Their function depends on how the drive has been programmed. Refer to the User Manual section on Multi-Function Outputs (H2-01 through H2-03) for detailed information on the use and programming of the multi-function outputs.

Loop Gain

PI Proportional Gain (AO 4) and PI Integral Time (AO 5) are the gain and integral time parameters used by the drive. The PI loop is structured differently than the Metasys loop. Refer to the User Manual section on PID for information on how the PI loop functions.

Reading and Resetting Faults

The Fault Monitor (BI 4) and Drive Ready Monitor (BI 3) show the current status of the drive. The Fault Code (AI 10) contains the code for the most current fault. The LST Fault Code (AI 19) contains the code for the previous fault. ***Refer to Alarm Register Contents on page 357*** for descriptions of the fault codes. The drive faults can be reset through the Fault Reset Command (BO 4). The Fault Reset Command is only available when the Run Forward Command and the Run Reverse Command are both OFF.

■ Cable Loss Configuration and Behavior

This section describes the configurable cable loss feature of the drive. This feature offers a user maximum flexibility in determining drive response to a loss of communication.

Drive Behavior at Loss of Communication

The drive can be configured to respond to an interval without receipt of a message in one of the following methods:

- Continue at last speed
- Continue at last speed with alarm
- Continue at preset speed
- Ramp to Stop with EF0 fault
- Coast to Stop with EF0 fault
- Emergency Stop with EF0 fault

Metasys N2 I/O

Three Metasys N2 outputs are used to select the desired behavior:

- AO 21 – Cable Loss Timeout
- AO 22 – Cable Loss Speed
- BO 11 – Communication Fault

Table D.2 Cable Loss Behavior Summary

Behavior	H5-04	Cable Loss Timeout (AO 21)	Cable Loss Speed (AO 22)	Communication Fault Enable (BO 11)
Decelerate to stop (stop time in C1-02) EF0 fault	0	Timeout Interval	X	On
Coast to stop EF0 fault	1	Timeout Interval	X	On
Emergency stop (stop time in C1-09) EF0 fault	2	Timeout Interval	X	On
Continue at last speed	3	0	X	X
Continue at last speed with alarm	3	Timeout Interval	X	On
Continue at preset speed with alarm	4	Timeout Interval	Preset speed	On

Note:
1. Communication must first be established and then lost for these features to function as described. If a drive is powered-up without a cable connected or with the master controller offline, a communications timeout does not occur.
2. For modes that describe the drive running after a communications timeout, a run command must have been issued (BO 1 = 'On' or BO 2 = 'On') prior to loss of communications. For safety purposes, the drive will not automatically restart from a stopped condition. If a user requires the drive to restart automatically, additional external wiring is required to accomplish this (consult factory).

Upon expiration of the communications timeout interval, the FAULT LED lights and remains lit until communication is restored.

Continue at Last Speed

In this mode, Cable Loss Timeout (AO 21) is set to 0, disabling the cable loss feature. The other two settings Cable Loss Speed (AO 22) and Communication Fault Enable (BO 11) are ignored. If communication is lost, the drive simply maintains its last commanded state. The drive will not display an alarm or fault to indicate it has lost communication. This behavior can also be achieved by setting parameter H5-04 to "3". The drive will display an alarm and continue running. For this specific condition, the Communication Fault Enable (BO 11) must be enabled and Cable Loss Timeout (AO 21) should be set to a value other than 0.

Continue at Preset Speed

In this mode, Cable Loss Timeout (AO 21) is set to the desired interval, Cable Loss Speed (AO 22) is set to the desired preset speed and H5-04 is set to “4”. If the time between messages exceeds the timeout interval, the drive speed command (AO 1) is set to the Cable Loss Speed (AO 22) and the drive continues running at this new speed. Communication Fault Enable (BO 11) must be set to ‘On’.

Stop with Fault (EF0)

Communication Fault Enable (BO 11) must be set to ‘On’. In this mode, Cable Loss Timeout (AO 21) is set to the desired interval and parameter H5-04 is set to a value of 0,1 or 2. If the time between messages exceeds the timeout interval, the drive will declare an EF0 fault and the drive speed command (AO 1) will be set to 0. The stopping method is determined by the setting of H5-04.

- H5-04 = 0 selects Ramp to Stop. The deceleration time or the slope of the ramp is determined by the setting of drive parameter C1-02
- H5-04 = 1 selects Coast to Stop. The drive does not attempt to control the rate of deceleration.
- H5-04 = 2 selects Emergency or Fast Stop. The deceleration time is determined by the setting of drive parameter C1-09.

Note: The behavior of the drive at cable loss is controlled by parameter H5-04. This drive parameter works with the points as described in the table above to determine how the drive will respond to a cable loss. If the cable loss fault is disabled, the drive will continue in its last state, if running the drive will continue to run at the last commanded frequency.

D.6 Communications Timing

To prevent a communications overrun in the slave drive, the master should wait a certain time between sending messages to the same drive. In the same way, the slave drive must wait before sending response messages to prevent an overrun in the master. This section explains the message timing.

◆ Command Messages from Master to Drive

The master must wait for a specified time between receiving a response and resending the same type of command to the same slave drive to prevent overrun and data loss. The minimum wait time depends on the command as shown in *Table B.2*.

Table D.3 Minimum Wait Time for Sending Messages

Command Type	Example	Minimum Wait Time
1	• Control command (Run, Stop) • Set inputs/outputs • Read monitors and parameter values	5 ms <1>
2	Write parameters	H5-11 = 0: 50 ms H5-11 = 1: 200 ms <1>
3	Save changes using an Enter command	200 ms to 2 s, depending on the number of parameters that were changed <1>
4	Enter with storage to drive EEPROM after initialization	5 s

<1> If the drive receives command type 1 data during the minimum wait time, it will perform the command and then respond. However, if it receives a command type 2 or 3 during that time, either a communication error will result or the command will be ignored.

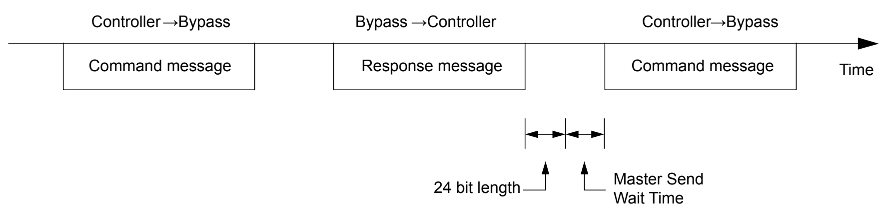


Figure D.5 Minimum Wait Time for Sending Messages

Set a timer in the master to check how long it takes for the slave drive(s) to respond to the master. If no response is received within a certain amount of time, the master should try resending the message.

◆ Response Messages from Drive to Master

If the drive receives a command from the master, it will process the data received and wait for the time set in H5-06 until it responds. Increase H5-06 if the drive response causes overrun in the master.

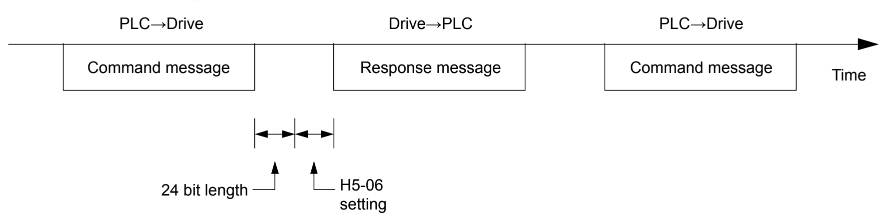


Figure D.6 Minimum Response Wait Time

Metasys N2 Communications
D

D.7 Metasys N2 Point Database

This section describes the Metasys N2 point database. This database features 100 logical points: 38 Analog Inputs (AI), 32 Analog Outputs (AO), 19 Binary Inputs (BI) and 11 Binary Outputs (BO). These points configure, control, and monitor the operation of the drive.

◆ Metasys N2 Analog Input (AI) Summary

Table D.4 Metasys N2 Analog Input Summary (Z1000 to Metasys N2)

Object ID	Object Name	Units	Z1000 Parameter
AI 1	Speed Reference	0.01 Hz	U1-01
AI 2	Output Speed	0.01 Hz	U1-02
AI 3	Output Current	0.1 A	U1-03
AI 4	kWatt Hour Meter	kWh	U4-10
AI 5	Output Power	0.1 kWh	U1-08
AI 6	Drive Temperature	1 °C	U4-08
AI 7	PI Feedback	0.01%	U5-01
AI 8	AC Output Voltage	0.1 Vac	U1-06
AI 9	DC Bus Voltage	1 Vdc	U1-07
AI 10	Fault Code	–	U2-01
AI 11	Elapsed Time - Hours	1 hour	U4-01
AI 12	Elapsed Time - 10K Hours	10K hours	U4-01
AI 13	MWatt Hour meter	MWh	U4-11
AI 14	Drive Rated Current	A	n9-01
AI 15	Communication Error Code	–	U1-19
AI 16	PI Deviation	0.01%	U5-02
AI 17	PI Output Capacity	0.01%	U5-03
AI 18	PI Reference	0.01%	U5-04
AI 19	Last Fault Code	–	U2-02
AI 20	Freq Ref @ Fault	0.01 Hz	U2-03
AI 21	Output Freq @ Fault	0.01 Hz	U2-04
AI 22	Output Current @ Fault	0.1 A	U2-05
AI 23	Out Volt Ref @ Fault	0.1 Vac	U2-07
AI 24	DC Bus Volts @ Fault	1 Vdc	U2-08
AI 25	Output Power @ Fault	0.1 kW	U2-09
AI 26	Input Term Status @ Fault	–	U2-11
AI 27	Output Term Status @ Fault	–	U2-12
AI 28	Operation Status @ Fault	–	U2-13
AI 29	Elapsed Operation Time @ Fault	1 hour	U2-14
AI 30	Most Recent Fault	–	U3-01
AI 31	2nd Most Recent Fault	–	U3-02
AI 32	3rd Most Recent Fault	–	U3-03
AI 33	4th Most Recent Fault	–	U3-04
AI 34	Elapsed Time @ Current Fault	1 hour	U3-11
AI 35	Elapsed Time @ 2nd Fault	1 hour	U3-12
AI 36	Elapsed Time @ 3rd Fault	1 hour	U3-13
AI 37	Elapsed Time @ 4th Fault	1 hour	U3-14
AI 38	Read Parameter Data	–	–

◆ Metasys N2 Analog Output (AO) Summary

Table D.5 Metasys N2 Analog Output Summary (Z1000 to Metasys N2)

Object ID	Object Name	Units	Default Value	Z1000 Parameter
AO 1	Speed Command	0.01 Hz	–	–
AO 2	Acceleration Time	seconds	30.0	C1-01
AO 3	Deceleration Time	seconds	30.0	C1-02
AO 4	PI Proportional Gain	–	2.00	b5-02
AO 5	PI Integral Time	seconds	5.0	b5-03
AO 6	Stall Prevention Level – Run	%	120	L3-06
AO 7	Stall Prevention Level – Accel	%	120	L3-02
AO 8	Reference Operation Mode Select	–	1	b1-01
AO 9	Run Operation Mode Select	–	1	b1-02
AO 10	PI Mode Select	–	0	b5-01
AO 11	Frequency Command Upper Limit	% of Max	100.0	d2-01
AO 12	Frequency Command Lower Limit	% of Max	0.0	d2-02
AO 13	Motor Rated Current	A	Motor model dependent	E2-01
AO 14	Jump Frequency 1	0.1 Hz	0.0	d3-01
AO 15	Jump Frequency 2	0.1 Hz	0.0	d3-02
AO 16	Jump Frequency 3	0.1 Hz	0.0	d3-03
AO 17	Jump Frequency Bandwidth	0.1 Hz	1.0	d3-04
AO 18	Number of Auto Restarts	–	0	L5-01
AO 19	Operator Display Mode	–	0	o1-03
AO 20	Power Loss Ride-Thru	seconds	Drive model dependent	L2-02
AO 21	Cable Loss Timeout	seconds	2.0	H5-09
AO 22	Cable Loss Speed	0.01 Hz	0.00	d1-04
AO 23	PI Integral Limit	0.1%	100.0	b5-04
AO 24	PI Upper Limit Value	0.1	100.0	b5-06
AO 25	PI Offset Adjustment	0.1	0.0	b5-07
AO 26	PI Primary Delay Time	0.01	0.00	b5-08
AO 27	PI Feedback Reference Missing Detection Select	1	0	b5-12
AO 28	PI Feedback Reference Missing Detection Level	1%	0	b5-13
AO 29	PI Feedback Reference Missing Detection Time	0.1 s	1.0	b5-14
AO 30	Read Parameter Number	–	–	–
AO 31	Write Parameter Number	–	–	–
AO 32	Write Parameter Data	–	–	–

◆ Metasys N2 Binary Input (BI) Summary

Table D.6 Metasys N2 Binary Input Summary (Z1000 to Metasys N2)

Object ID	Object Name	Default	Off (0) State	On (1) State
BI 1	Run/Stop Monitor	0	Stopped	Running
BI 2	Forward/Reverse Monitor	0	Forward	Reverse
BI 3	Drive Ready Monitor	0	Not Ready	Ready
BI 4	Fault Monitor	0	Not Faulted	Faulted
BI 5	Zero Speed	0	Not Zero Speed	Zero Speed
BI 6	Speed Agree	0	Not Speed Agree	Speed Agree
BI 7	Minor Fault	0	No Minor Fault	Minor Fault
BI 8	Major Fault	0	No Major Fault	Major Fault
BI 9	Drive Communication Error Monitor	0	No Error	Error

Object ID	Object Name	Default	Off (0) State	On (1) State
BI 10	Multi-Function Output 1 (H2-01)	0	Off	On
BI 11	Multi-Function Output 2 (H2-02)	0	Off	On
BI 12	Multi-Function Output 3 (H2-03)	0	Off	On
BI 13	Safety Interlock Monitor	0	Safety Clear Terminal 3 Closed	Safety Set Terminal 3 Open
BI 14	HAND/AUTO Reference Monitor	0	REMOTE	LOCAL
BI 15	Multi-Function Input S3 Monitor	0	Off	On
BI 16	Multi-Function Input S4 Monitor	0	Off	On
BI 17	Multi-Function Input S5 Monitor	0	Off	On
BI 18	Multi-Function Input S6 Monitor	0	Off	On
BI 19	Multi-Function Input S7 Monitor	0	Off	On

◆ Metasys N2 Binary Output (BO) Summary

Table D.7 Metasys N2 Binary Output Summary (Z1000 to Metasys N2)

Object ID	Object Name	Default	Off (0) State	On (1) State
BO 1	Run Forward Command	0	Stop	Forward
BO 2	Run Reverse Command	0	Stop	Reverse
BO 3	Serial Fault (EF0) Command	0	No Fault	Fault
BO 4	Fault Reset Command	0	No Reset	Reset
BO 5	Multi-Function Input S3 (H1-03)	0	Off	On
BO 6	Multi-Function Input S4 (H1-04)	0	Off	On
BO 7	Multi-Function Input S5 (H1-05)	0	Off	On
BO 8	Multi-Function Input S6 (H1-06)	0	Off	On
BO 9	Multi-Function Input S7 (H1-07)	0	Off	On
BO10	Panel Lock	0	LOCAL/REMOTE and Stop/Reset Keys Enabled	LOCAL/REMOTE and Stop/Reset Keys Disabled
BO 11	Communication Fault Enable	0	EF0 Not Activated if Cable Loss Occurs	EF0 Activated if Cable Loss Occurs

D.8 Mailbox Function

◆ Reading Drive Parameters

Two points are defined for reading drive parameters:

- AO 30 – Specifies the parameter to be read from the drive
- AI 38 – Reports the value of the parameter specified in AO 30.

When this point is read, it retrieves data from the parameter and sends it to the controller

Example: Writing a value of 387 (183 hex) to AO 30 specifies drive parameter b1-04. Reading AI 38 returns the current setting of parameter b1-04 to the controller.

◆ Writing Drive Parameters

Two points are defined for writing to drive parameters:

- AO 31 – Specifies the parameter to be written to
- AO 32 – Entry location of the value to be written to the parameter specified in AO 31. When this point is written to, it will write the value to the drive. An ENTER or ACCEPT command does not need to be sent for the data to be taken by the drive. The behavior of the write is the same as with the digital operator. If the drive is running, there are a limited number of drive parameters that can be written to.

Example: Writing a value of 387 (183 hex) to AO 31 specifies drive parameter b1-04. Writing a value of 1 to AO 32 sets b1-04 to 1 and enables the drive for reverse run.

D.9 Self-Diagnostics

The drive has a built-in self-diagnosing function of the serial communication interface circuits. To perform the self-diagnosis function, use the following procedure.

DANGER! *Electrical Shock Hazard. Do not connect or disconnect wiring while the power is on. Failure to comply will result in death or serious injury. Before servicing, disconnect all power to the equipment. The internal capacitor remains charged even after the power supply is turned off. The charge indicator LED will extinguish when the DC bus voltage is below 50 Vdc. To prevent electric shock, wait at least one minute after all indicators are OFF and measure the DC bus voltage level to confirm safe level.*

1. Turn on the power to the drive.
2. Note the present terminal S6 function selection setting (H1-06) and set it for the communications test mode (H1-06 = 67).
3. Turn off the power to the drive.
4. With the power off, wire the drive as shown in the following diagram, connecting terminals R+ and S+, R- and S-, and S6 and SP.

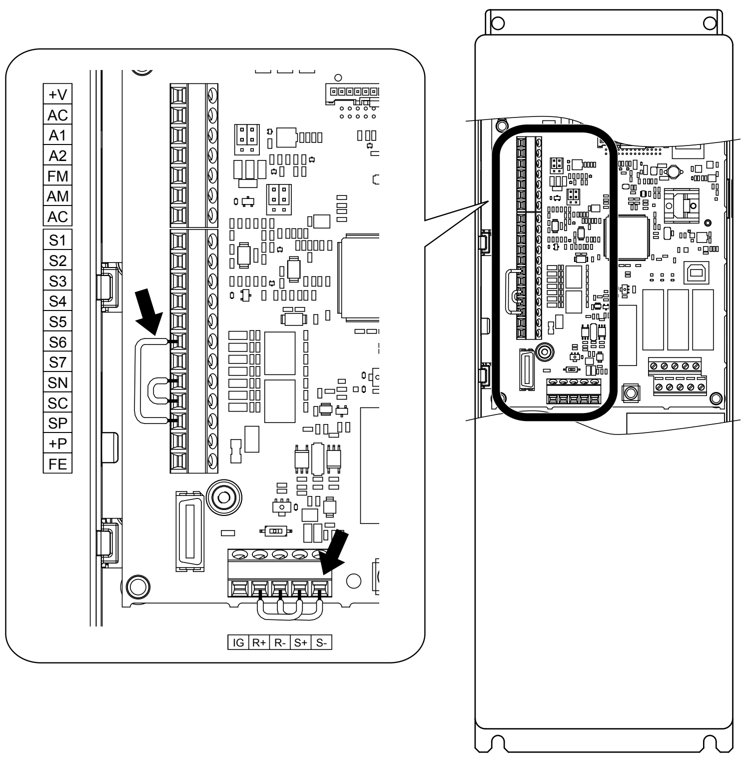


Figure D.7 Terminal Connections for Communication Self-Diagnostics

5. Connect a wire jumper between terminals SN and SC to change to source mode.
6. Turn the power to the drive back on.
7. During normal operation, the drive will display "Pass" to indicate that the communications test mode is operating normally.

   When a fault occurs, the drive will display "CE" on the keypad display.
8. Turn off the power supply.
9. Remove the wire jumpers from terminal R+, R-, S+, S-, and S6-SP. Reset the wire jumper to its original position and set terminal S6 to its original function.
10. Return to normal operation.

Appendix: E

MEMOBUS/Modbus Communications

E.1 MEMOBUS/Modbus Configuration

Drives can be controlled from a PLC or other master device via serial communications using the MEMOBUS/Modbus protocol.

MEMOBUS/Modbus communications can be configured using one master (PLC) and up to 31 slaves. The drive has slave functionality only, and serial communication is normally initiated from the master and responded to by the slaves.

The master performs serial communications with only one slave at a time. The address or node for each slave must be set beforehand so that the master can communicate with the slave at that address. A slave that receives a command from the master will perform the specified function and then send a response back to the master.

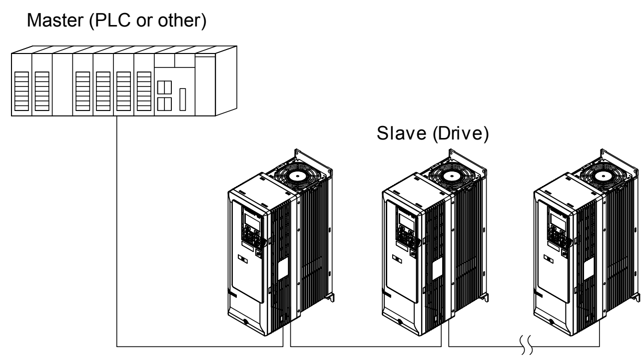


Figure E.1 Connecting Multiple Drives to a PLC

E.2 Communication Specifications

MEMOBUS/Modbus specifications appear in the following table:

Item	Specifications	
Interface	RS-422, RS-485	
Communications Cycle	Asynchronous (Start-stop synchronization)	
Communication Parameters	Communication Speeds Available	1.2; 2.4; 4.8; 9.6; 19.2; 38.4; 57.6; 76.8; 115.2 kbps
	Data length	8-bit (fixed)
	Parity	Select even, odd, or none
	Stop bit	1-bit (fixed)
Protocol	MEMOBUS/Modbus (using RTU mode only)	
Max Number of Slaves	31 drives (using RS-485 only)	

E.3 Connecting to a Network

This section explains how to connect the drive to a MEMOBUS/Modbus network and the network termination required for a connection.

◆ Network Cable Connection

Follow the instructions below to connect the drive to a MEMOBUS/Modbus network.

1. With the power shut off, connect the communications cable to the drive and the master. Use terminal TB4 for MEMOBUS/Modbus.

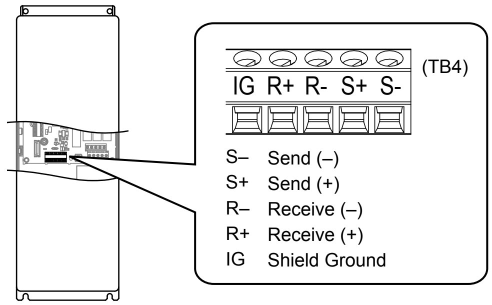


Figure E.2 Serial Communications Cable Connection Terminal (TB4)

Note: Separate the communications cables from the main circuit cables and other wiring and power cables. Use shielded cables for the communications cables, and properly shielded clamps to prevent problems with noise. When using RS-485 communications, connect S+ to R+, and S- to R- as shown in the diagram below.

2. Check or set the termination resistor selection at all slaves. Use the description in ***Network Termination*** on page ***279*** for slaves that are Z1000 drives.
3. Switch the power on.
4. Set the parameters needed for serial communications (H5-01 through H5-12) using the digital operator.
5. Shut the power off and wait until the display on the digital operator goes out completely.
6. Turn the power back on.
7. The drive is now ready to begin communicating with the master.

◆ Wiring Diagram for Multiple Connections

Figure B.3 and *Figure E.4* explain the wiring diagrams for multiple connections using MEMOBUS/Modbus communication.

■ RS-485 Interface

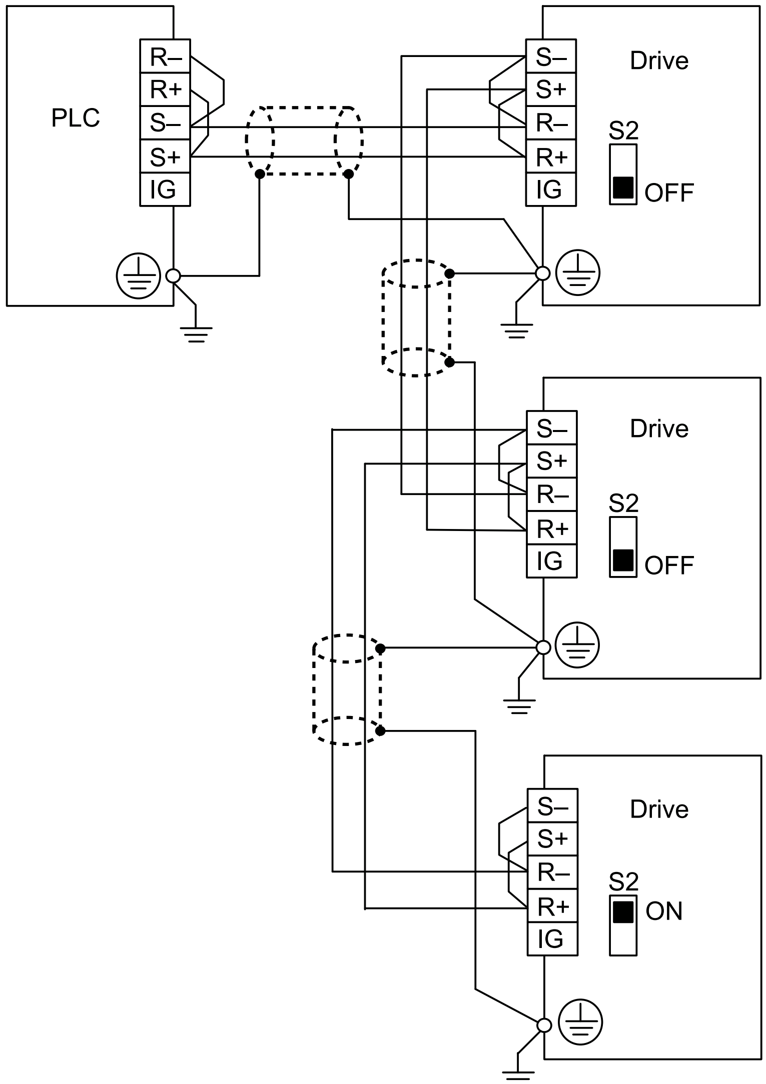


Figure E.3 RS-485 Interface

Note:
1. Set DIP switch S2 to the ON position on the drive located at the end of the network. Set DIP switch S2 to the OFF positions on all other slave devices.
2. Set H5-07 to 1 when using the RS-485 interface.

■ RS-422 Interface

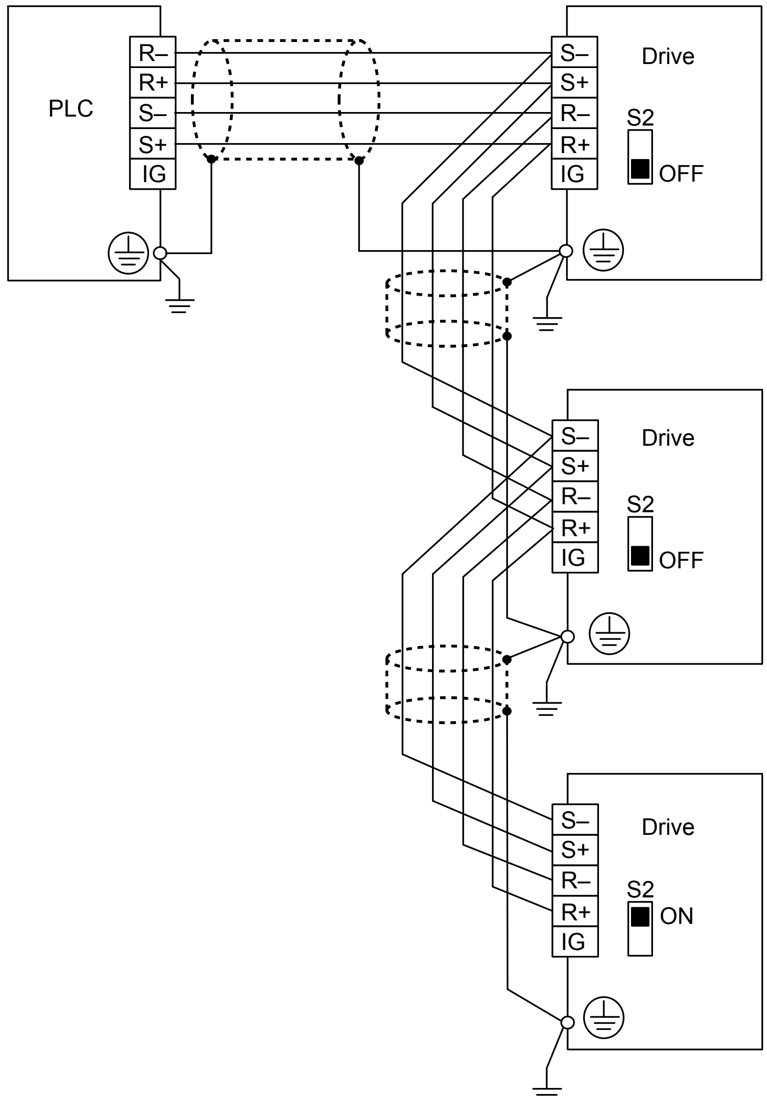


Figure E.4 RS-422 Interface

Note:
1. Set DIP switch S2 to the ON position on the drive located at the end of the network. Set DIP switch S2 to the OFF positions on all other slave devices.
2. Set H5-07 to 1 when using the RS-422 interface in a multi-drop circuit. Set H5-07 to 0 when using the RS-422 in a point-to-point circuit.

◆ Network Termination

The two ends of the MEMOBUS/Modbus network line have to be terminated. The drive has a built in termination resistor that can be enabled or disabled using DIP switch S2. If a drive is located at the end of a network line, enable the termination resistor by setting DIP switch S2 to the ON position. Disable the termination resistor on all slaves that are not located at the network line end.

E.4 MEMOBUS/Modbus Setup Parameters

◆ MEMOBUS/Modbus Serial Communication

This section describes parameters necessary to set up MEMOBUS/Modbus communications.

■ H5-01: Drive Slave Address

Sets the drive slave address used for communications.

Note: Cycle the power after changing this parameter to enable the new setting.

No.	Name	Setting Range	Default
H5-01	Drive Slave Address	0 to FFH	1FH

Each slave drive must be assigned a unique slave address for serial communications to work. Slave addresses do not need to be assigned in sequential order, but no two drives may share the same address.

■ H5-02: Communication Speed Selection

Sets the communications speed for APOGEE FLN, BACnet, MEMOBUS/Modbus, and Metasys N2.

Note:
1. Cycle the power after changing this parameter to enable the new setting.
2. When Metasys N2 communications are selected (H5-08 = 1), selecting a baud rate other than 9600 bps will trigger an oPE29 error.
3. When APOGEE FLN (P1) communications are selected (H5-08 = 2), selecting a baud rate other than 4800 bps will trigger an oPE29 error.
4. When BACnet communications are selected (H5-08 = 3), selecting 115200 bps (Setting 8) will trigger an oPE29 error.

No.	Name	Setting Range	Default
H5-02	Communication Speed Selection	0 to 8	<1>

<1> Default depends on H5-08 setting:
H5-08 = 0, MEMOBUS/Modbus; default: 3
H5-08 = 1, N2 (Metasys); default: 3
H5-08 = 2, P1 (APOGEE FLN); default: 2
H5-08 = 3, BACnet; default: 3

H5-02	Communication Speed	H5-02	Communication Speed
0 <1>	1200 bps	5 <1>	38400 bps
1 <1>	2400 bps	6 <1>	57600 bps
2	4800 bps	7 <1>	76800 bps
3 <1>	9600 bps	8 <1> <2>	115200 bps
4 <1>	19200 bps		

<1> Not available when H5-08 is set to 2 P1 (APOGEE FLN).

<2> Not available when H5-08 is set to 0 (MEMOBUS/Modbus) or 1 (Metasys N2).

■ H5-03: Communication Parity Selection

Sets the parity used for communications.

Note: Cycle the power after changing this parameter to enable the new setting.

No.	Name	Setting Range	Default
H5-03	Communication Parity Selection	0 to 2	0

Setting 0: No parity

Setting 1: Even parity

Setting 2: Odd parity

■ H5-04: Stopping Method after Communication Error

Selects the stopping method after a communications error (CE) has occurred.

No.	Name	Setting Range	Default
H5-04	Stopping Method after CE	0 to 4	3

Setting 0: Ramp to Stop

Uses the deceleration time currently enabled.

Setting 1: Coast to Stop

Setting 2: Fast Stop

Setting 3: Alarm Only - Operation Continues

Setting 4: Run at d1-04

■ H5-05: Communication Fault Detection Selection

Enables or disables the CE detection for communications.

No.	Name	Setting Range	Default
H5-05	Communication Fault Detection Selection	0 or 1	1

Setting 0: Disabled

No communication error detection. The drive continues operation.

Setting 1: Enabled

If the drive does not receive data from the master for longer than the time set to H5-09, then a CE fault will be triggered and the drive will operate as determined by parameter H5-04.

■ H5-06: Drive Transmit Wait Time

Sets the time the drive waits after receiving data from a master until responding data.

No.	Name	Setting Range	Default
H5-06	Drive Transmit Wait Time	5 to 65 ms	5 ms

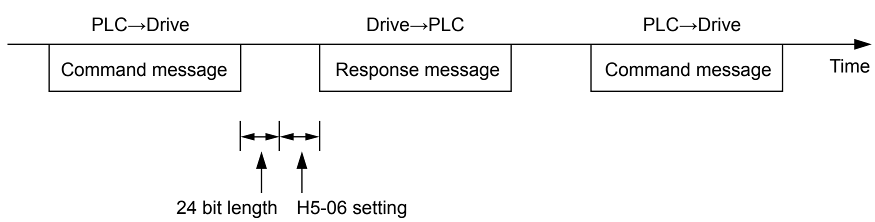


Figure E.5 Drive Transmit Wait Time Setting

■ H5-07: RTS Control Selection

Enables or disables RTS control.

No.	Name	Setting Range	Default
H5-07	RTS Control Selection	0 or 1	1

Setting 0: Disabled. RTS is always on.

Use this setting with point-to-point RS-422 communications.

Setting 1: Enabled. RTS switches while sending.

Use this setting with RS-485 communications or when using multi-drop RS-422 communications.

■ H5-08: Communications Protocol Selection

Selects the communications protocol.

No.	Name	Setting Range	Default
H5-08	Communications Protocol Selection	0 to 3	0

Setting 0: MEMOBUS/Modbus

Setting 1: N2 (Metasys)

Setting 2: P1 (APOGEE FLN)

Setting 3: BACnet

■ H5-09: Communications Fault Detection Time

Sets the time the communications must be lost before the drive triggers a CE fault.

No.	Name	Setting Range	Default
H5-09	Communications Fault Detection Time	0.0 to 10.0 s	2.0 s

■ H5-10: Unit Selection for MEMOBUS/Modbus Register 0025H

Sets the unit for the output voltage monitor value in MEMOBUS/Modbus register 0025H.

No.	Name	Setting Range	Default
H5-10	Unit Selection for MEMOBUS/Modbus Register 0025H	0 or 1	0

Setting 0: 0.1 V units

Setting 1: 1 V units

■ H5-11: Communications Enter Function Selection

Selects whether an Enter command is necessary to change parameter values via MEMOBUS/Modbus communications. ***Refer to Enter Command on page 291***.

No.	Name	Setting Range	Default
H5-11	Communications Enter Function Selection	0 or 1	0

Setting 0: Enter command necessary

Parameter changes become effective after an Enter command. An Enter command must only be sent after the last parameter change, not for each single parameter.

Setting 1: Enter command not necessary

Parameter value changes become effective immediately without the need to send an Enter command.

■ H5-12: Run Command Method Selection

Selects the type of sequence used when the Run command source is set to network communications (b1-02 = 2).

No.	Name	Setting Range	Default
H5-12	Run Command Method Selection	0 or 1	0

Setting 0: FWD/Stop, REV/Stop

Setting bit 0 will start and stop the drive in the forward direction. Setting bit 1 will start and stop the drive in reverse.

Setting 1: Run/Stop, FWD/REV

Setting bit 0 will start and stop the drive. Setting bit 1 changes the direction.

E.5 Drive Operations by MEMOBUS/Modbus

The drive operations that can be performed by MEMOBUS/Modbus communication depend on drive parameter settings. This section explains the functions that can be used and related parameter settings.

◆ Observing the Drive Operation

A PLC can perform the following actions with MEMOBUS/Modbus communications at any time regardless of parameter settings (except for H5-☐☐parameters):

- observe drive status and drive control terminal status from a PLC.
- read and write parameters.
- set and reset faults.
- set multi-function inputs.

Note: Input settings from the input terminals (S1 to S8) and from MEMOBUS/Modbus communications are both linked by a logical OR operation.

E.6 Communications Timing

To prevent a communications overrun in the slave drive, the master should wait a certain time between sending messages to the same drive. In the same way, the slave drive must wait before sending response messages to prevent an overrun in the master. This section explains the message timing.

◆ Command Messages from Master to Drive

The master must wait for a specified time between receiving a response and resending the same type of command to the same slave drive to prevent overrun and data loss. The minimum wait time depends on the command as shown in ***Table B.2***.

Table E.1 Minimum Wait Time for Sending Messages

Command Type	Example	Minimum Wait Time
1	• Control command (Run, Stop) • Set inputs/outputs • Read monitors and parameter values	5 ms <1>
2	Write parameters	H5-11 = 0: 50 ms H5-11 = 1: 200 ms <1>
3	Save changes using an Enter command	200 ms to 2 s, depending on the number of parameters that were changed <1>
4	Enter with storage to drive EEPROM after initialization	5 s

<1> If the drive receives command type 1 data during the minimum wait time, it will perform the command and then respond. However, if it receives a command type 2 or 3 during that time, either a communication error will result or the command will be ignored.

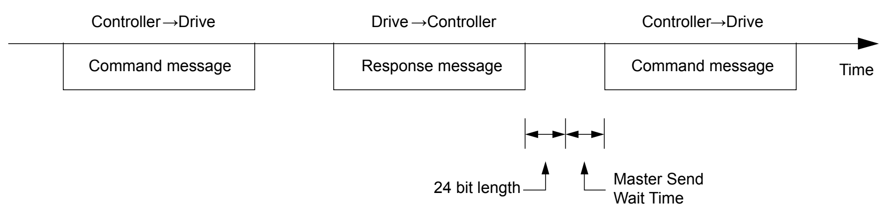


Figure E.6 Minimum Wait Time for Sending Messages

Set a timer in the master to check how long it takes for the slave drive(s) to respond to the master. If no response is received within a certain amount of time, the master should try resending the message.

◆ Response Messages from Drive to Master

If the drive receives a command from the master, it will process the data received and wait for the time set in H5-06 until it responds. Increase H5-06 if the drive response causes overrun in the master.

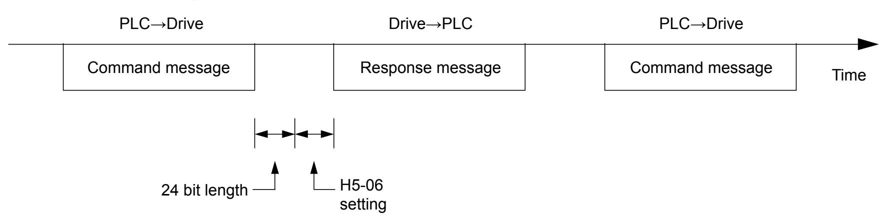


Figure E.7 Minimum Response Wait Time

E.7 Message Format

◆ Message Content

In MEMOBUS/Modbus communications, the master sends commands to the slave, and the slave responds. The message format is configured for both sending and receiving as shown below, and the length of data packets depends on the command (function) content.

SLAVE ADDRESS
FUNCTION CODE
DATA
ERROR CHECK

◆ Slave Address

The slave address in the message defines the note the message is sent to. Use addresses between 0 and FF (hex). If a message with slave address 0 is sent (broadcast), the command from the master will be received by all slaves. The slaves do not provide a response to a broadcast type message.

◆ Function Code

The three types of function codes are shown in the table below.

Function Code	Function Name	Data Length (bytes)			
		Command Message		Response Message	
		Minimum	Maximum	Minimum	Maximum
03H	Read MEMOBUS/Modbus registers	8	8	7	37
08H	Loopback test	8	8	8	8
10H	Write to multiple MEMOBUS/Modbus registers	11	41	8	8

◆ Data

Configure consecutive data by combining the MEMOBUS/Modbus register address (test code in case of a loopback test) and the data the register contains. The data length changes depending on the command details.

A drive MEMOBUS/Modbus register always has a data length of two bytes. Data written into drive registers must also always have a length of two bytes. Register data read out from the drive will always consist of two bytes.

◆ Error Check

The drive uses a CRC-16 (cyclic redundancy check, checksum method) for checking data validity. Use the procedure described below when calculating the CRC-16 checksum for command data or when verifying response data.

■ Command Data

When the drive receives data, it calculates the CRC-16 checksum from the data and compares it to the CRC-16 value received within the message. Both must match before a command is processed.

An initial value of FFFFH (i.e., all 16 bits equal 1) must be used for CRC-16 calculations in the MEMOBUS/Modbus protocol.

Calculate the CRC-16 checksum using the following steps:

1. The starting value is FFFFH.
2. Perform an XOR operation of this value and the slave address.
3. Right shift the result.
4. When the overflow bit of the shift operation becomes 1, perform an XOR operation of the result from step 3 above and the fix value A001H.
5. Repeat steps 3 and 4 until eight shift operations have been performed.
6. After eight shift operations, perform an XOR operation with the result and the next data in the message (function code, register address, data). Continue with steps 3 to 5 until the last data has been processed.
7. The result of the last shift or XOR operation is the checksum.

The example in ***Table E.2*** shows the CRC-16 calculation of the slave address 02H and the function code 03H, yielding the result D140H.

Note: This example does not show the calculation for a complete MEMOBUS/Modbus command. Normally data would follow in the calculation.

Table E.2 CRC-16 Checksum Calculation Example

Description	Calculation	Overflow	Description	Calculation	Overflow
Initial Value (FFFFH)	1111 1111 1111 1111		Function Code 03H	0000 0000 0000 0011	
Address 02H	0000 0000 0000 0010		XOR w result	1000 0001 0011 1101	
XOR w initial value	1111 1111 1111 1101		Shift 1	0100 0000 1001 1110	1
Shift 1	0111 1111 1111 1110	1	XOR w A001H	1010 0000 0000 0001	
XOR w A001H	1010 0000 0000 0001		XOR result	1110 0000 1001 1111	
XOR result	1101 1111 1111 1111		Shift 2	0111 0000 0100 1111	1
Shift 2	0110 1111 1111 1111	1	XOR w A001H	1010 0000 0000 0001	
XOR w A001H	1010 0000 0000 0001		XOR result	1101 0000 0100 1110	
XOR result	1100 1111 1111 1110		Shift 3	0110 1000 0010 0111	0
Shift 3	0110 0111 1111 1111	0	Shift 4	0011 0100 0001 0011	1
Shift 4	0011 0011 1111 1111	1	XOR w A001H	1010 0000 0000 0001	
XOR w A001H	1010 0000 0000 0001		XOR result	1001 0100 0001 0010	
XOR result	1001 0011 1111 1110		Shift 5	0100 1010 0000 1001	0
Shift 5	0100 1001 1111 1111	0	Shift 6	0010 0101 0000 0100	1
Shift 6	0010 0100 1111 1111	1	XOR w A001H	1010 0000 0000 0001	
XOR w A001H	1010 0000 0000 0001		XOR result	1000 0101 0000 0101	
XOR result	1000 0100 1111 1110		Shift 7	0100 0010 1000 0010	1
Shift 7	0100 0010 0111 1111	0	XOR w A001H	1010 0000 0000 0001	
Shift 8	0010 0001 0011 1111	1	XOR result	1110 0010 1000 0011	
XOR w A001H	1010 0000 0000 0001		Shift 8	0111 0001 0100 0001	1
XOR result	1000 0001 0011 1110		XOR w A001H	1010 0000 0000 0001	
Perform operations with next data (function code)			XOR result	1101 0001 0100 0000	
			CRC-16	1101 0001 0100 0000	
				D 1 4 0 (upper) (lower)	
			Continue from here with next data.		

■ Response Data

Perform a CRC-16 calculation on the response message data as described above as a validation check. The result should match the CRC-16 checksum received within the response message.

E.8 Message Examples

Below are some examples of command and response messages.

◆ Reading Drive MEMOBUS/Modbus Register Contents

Using the function code 03H (Read), a maximum of 16 MEMOBUS/Modbus registers can be read out at a time.

The following table shows message examples when reading status signals, error details, data link status, and frequency references from the slave 2 drive.

Command Message			Response Message (normal)			Response Message (fault)		
Slave Address		02H	Slave Address		02H	Slave Address		02H
Function Code		03H	Function Code		03H	Function Code		83H
Starting No.	Upper	00H	Data Quantity		08H	Error Code		03H
	Lower	20H	1st storage register	Upper	00H	CRC-16	Upper	F1H
Data Quantity	Upper	00H		Lower	65H		Lower	31H
	Lower	04H	Next storage register	Upper	00H			
CRC-16	Upper	45H		Lower	00H			
	Lower	F0H	Next storage register	Upper	00H			
				Lower	00H			
			Next storage register	Upper	01H			
				Lower	F4H			
			CRC-16	Upper	AFH			
				Lower	82H			

◆ Loopback Test

Function code 08H performs a loopback test that returns a response message with exactly the same content as the command message. The response message can be used to check communications between the master and slave. User-defined test code and data values can also be set.

The following table shows a message example when performing a loopback test with the slave 1 drive.

Command Message			Response Message (normal)			Response Message (fault)		
Slave Address		01H	Slave Address		01H	Slave Address		01H
Function Code		08H	Function Code		08H	Function Code		88H
Test Code	Upper	00H	Test Code	Upper	00H	Error Code		01H
	Lower	00H		Lower	00H	CRC-16	Upper	86H
Data	Upper	A5H	Data	Upper	A5H		Lower	50H
	Lower	37H		Lower	37H			
CRC-16	Upper	DAH	CRC-16	Upper	DAH			
	Lower	8DH		Lower	8DH			

◆ Writing to Multiple Registers

Function code 10H allows the user to write multiple drive MEMOBUS/Modbus registers with one message. This process works similar to reading registers, in that the address of the first register to be written and the data quantity are set in the command message. The data to be written must be consecutive so that the register addresses are in order, starting from the specified address in the command message. The data order must be high byte then lower byte.

The following table shows an example of a message where a forward operation has been set with a frequency reference of 60.0 Hz for the slave 1 drive.

If parameter values are changed using the Write command, an Enter command may be necessary to activate or save the data depending on the setting of H5-11. ***Refer to H5-11: Communications Enter Function Selection on page 283*** and ***Refer to Enter Command on page 291*** for detailed descriptions.

<table>
<tr><th colspan="3">Command Message</th><th colspan="3">Response Message (normal)</th><th colspan="3">Response Message (fault)</th></tr>
<tr><td colspan="2">Slave Address</td><td>01H</td><td colspan="2">Slave Address</td><td>01H</td><td colspan="2">Slave Address</td><td>01H</td></tr>
<tr><td colspan="2">Function Code</td><td>10H</td><td colspan="2">Function Code</td><td>10H</td><td colspan="2">Function Code</td><td>90H</td></tr>
<tr><td rowspan="2">Starting No.</td><td>Upper</td><td>00H</td><td rowspan="2">Starting No.</td><td>Upper</td><td>00H</td><td colspan="2">Error Code</td><td>02H</td></tr>
<tr><td>Lower</td><td>01H</td><td>Lower</td><td>01H</td><td rowspan="2">CRC-16</td><td>Upper</td><td>CDH</td></tr>
<tr><td rowspan="2">Data Quantity</td><td>Upper</td><td>00H</td><td rowspan="2">Data Quantity</td><td>Upper</td><td>00H</td><td>Lower</td><td>C1H</td></tr>
<tr><td>Lower</td><td>02H</td><td>Lower</td><td>02H</td><td colspan="3" rowspan="8"></td></tr>
<tr><td colspan="2">Number of Bytes</td><td>04H</td><td rowspan="2">CRC-16</td><td>Upper</td><td>10H</td></tr>
<tr><td rowspan="2">Starting Data</td><td>Upper</td><td>00H</td><td>Lower</td><td>08H</td></tr>
<tr><td>Lower</td><td>01H</td><td colspan="3" rowspan="5"></td></tr>
<tr><td rowspan="2">Next Data</td><td>Upper</td><td>02H</td></tr>
<tr><td>Lower</td><td>58H</td></tr>
<tr><td rowspan="2">CRC-16</td><td>Upper</td><td>63H</td></tr>
<tr><td>Lower</td><td>39H</td></tr>
</table>

Note: Double the number of the data quantity for the number of bytes in the command message.

MEMOBUS/Modbus Communications

E

E.9 MEMOBUS/Modbus Data Table

The table below lists all MEMOBUS/Modbus data. There are three types of data: command data, monitor data, and broadcast data.

◆ Command Data

It is possible to both read and write command data.

Note: Bits that are not used should be set to 0. Refrain from writing to reserved registers.

Register No.	Contents	
0000H	Reserved	
0001H	Operation Commands and Multi-function Inputs	
	bit 0	H5-12 = 0: Forward Run Command (0 = Stop, 1 = Forward Run) H5-12 = 1: Run Command (0 = Stop, 1 = Run)
	bit 1	H5-12 = 0: Reverse Run Command (0 = Stop, 1 = Reverse Run) H5-12 = 1: Forward/Reverse (0 = Forward, 1 = Reverse)
	bit 2	External Fault (EF0)
	bit 3	Fault Reset
	bit 4	Multi-Function Input 1 Function is ComRef when H1-01 = 40 (Forward/Stop). ***Refer to d: Reference Settings on page 58*** for ComRef explanations.
	bit 5	Multi-Function Input 2 Function is ComCtrl when H1-02 = 41 (Reverse/Stop). ***Refer to d: Reference Settings on page 58*** for ComCtrl explanations.
	bit 6	Multi-Function Input 3
	bit 7	Multi-Function Input 4
	bit 8	Multi-Function Input 5
	bit 9	Multi-Function Input 6
	bit A	Multi-Function Input 7
	bit B to F	Reserved
0002H	Frequency Reference	Units are determined by parameter o1-03.
0003H	V/f Gain	
0004H, 0005H	Reserved	
0006H	PI Target, 0.01% units, signed	
0007H	Analog Output Terminal FM Setting (10 V / 4000 H)	
0008H	Analog Output Terminal AM Setting (10 V / 4000 H)	
0009H	Settings for Multi-Function Digital Outputs	
	bit 0	Multi-Function Contact Output 1 (terminal M1-M2)
	bit 1	Multi-Function Contact Output 2 (terminal M3-M4)
	bit 2	Multi-Function Contact Output 3 (terminal M5-M6)
	bit 3 to 5	Reserved
	bit 6	Enables the function in bit 7
	bit 7	Fault Contact Output (terminal MA/MB-MC)
	bit 8 to F	Reserved
000AH to 000CH	Reserved	
000DH	PI2 Setpoint	
000EH	Reserved	

Register No.	Contents	
000FH	Control Selection Setting	
	bit 0	Reserved
	bit 1	PI Setpoint Input
	bit 2, bit 3	Reserved
	bit 4	PI2 Target Input (enables the setting from MEMOBUS/Modbus)
	bit 5 to B	Reserved
	bit C	Enable Terminal S5 Input for Broadcast Data
	bit D	Enable Terminal S6 Input for Broadcast Data
	bit E	Enable Terminal S7 Input for Broadcast Data
	bit F	Reserved
0010H to 001FH	Reserved	

◆ Monitor Data

Monitor data can be read only.

Register No.	Contents	
0020H	Drive Status 1	
	bit 0	During Run
	bit 1	During Reverse
	bit 2	Drive Ready
	bit 3	Fault
	bit 4	Data Setting Error
	bit 5	Multi-Function Contact Output 1 (terminal M1-M2)
	bit 6	Multi-Function Contact Output 2 (terminal M3-M4)
	bit 7	Multi-Function Contact Output 3 (terminal M5-M6)
	bit 8 to D	Reserved
	bit E	ComRef status
	bit F	ComCtrl status
0021H	Fault Contents 1	
	bit 0	Overcurrent (oC), Ground fault (GF)
	bit 1	Overvoltage (ov)
	bit 2	Drive Overload (oL2)
	bit 3	Overheat 1 (oH1), Drive Overheat Warning (oH2)
	bit 4, bit 5	Reserved
	bit 6	PI Feedback Loss (FbL / FbH)
	bit 7	EF to EF7: External Fault
	bit 8	CPF☐☐: Hardware Fault (includes oFx)
	bit 9	Motor Overload (oL1), Overtorque Detection 1 (oL3), Undertorque Detection 1 (UL3)
	bit A	Reserved
	bit B	Main Circuit Undervoltage (Uv)
	bit C	Undervoltage (Uv1), Control Power Supply Undervoltage (Uv2), Soft Charge Circuit Fault (Uv3)
	bit D	Output Phase Loss (LF), Input Phase Loss (PF)
	bit E	MEMOBUS/Modbus Communication Error (CE), Option Communication Error (bUS)
	bit F	Operator Connection Fault (oPr)

Register No.	Contents	
0022H	Data Link Status	
	bit 0	Writing data or switching motors
	bit 1	Reserved
	bit 2	
	bit 3	Upper or lower limit error
	bit 4	Data conformity error
	bit 5	Writing to EEPROM
	bit 6 to F	Reserved
0023H	Frequency Reference <1>	
0024H	Output Frequency <1>	
0025H	Output Voltage Reference, 0.1 V units (units are determined by parameter H5-10)	
0026H	Output Current, 0.1 A units	
0027H	Output Power	
0028H	Reserved	
0029H	Fault Contents 2	
	bit 0	Reserved
	bit 1	Ground Fault (GF)
	bit 2	Input Phase Loss (PF)
	bit 3	Output Phase Loss (LF)
	bit 4, bit 5	Reserved
	bit 6	Motor Overheat 2 (PTC input) (oH4)
	bit 7 to F	Reserved
002AH	Alarm Contents 1	
	bit 0, 1	Reserved
	bit 2	Run Command Input Error (EF)
	bit 3	Drive Baseblock (bb)
	bit 4	Overtorque Detection 1 (oL3)
	bit 5	Heatsink Overheat (oH)
	bit 6	Overvoltage (ov)
	bit 7	Undervoltage (Uv)
	bit 8	Cooling Fan Error (FAn)
	bit 9	MEMOBUS/Modbus Communication Error (CE)
	bit A	Option Communication Error (bUS)
	bit B	Undertorque Detection 1 (UL3)
	bit C	Motor Overheat (oH3)
	bit D	PI Feedback Loss (FbL, FbH)
	bit E	Reserved
	bit F	Serial Communication Transmission Error (CALL)
002BH	Input Terminal Status	
	bit 0	Terminal S1 Closed
	bit 1	Terminal S2 Closed
	bit 2	Terminal S3 Closed
	bit 3	Terminal S4 Closed
	bit 4	Terminal S5 Closed
	bit 5	Terminal S6 Closed
	bit 6	Terminal S7 Closed
	bit 7 to F	Reserved

Register No.	Contents	
002CH	Drive Status 2	
	bit 0	During Run
	bit 1	Zero Speed
	bit 2	Speed Agree
	bit 3	User Speed Agree
	bit 4	Frequency Detection 1
	bit 5	Frequency Detection 2
	bit 6	Drive Ready
	bit 7	During Undervoltage
	bit 8	During Baseblock
	bit 9	Frequency Reference from Operator Keypad
	bit A	Run Command from Operator Keypad
	bit B	Over/Undertorque 1
	bit C	Frequency Reference Loss
	bit D	During Fault Restart
	bit E	Fault
	bit F	Communication Timeout
002DH	Output Terminal Status	
	bit 0	Multi-Function Contact Output 1 (terminal M1-M2)
	bit 1	Multi-Function Contact Output 2 (terminal M3-M4)
	bit 2	Multi-Function Contact Output 3 (terminal M5-M6)
	bit 3 to 6	Reserved
	bit 7	Fault Contact Output (terminal MA/MB-MC)
	bit 8 to F	Reserved
002EH	Reserved	
002FH	Frequency Reference Bias (from Up/Down 2 Function), 0.1% units	
0030H	Reserved	
0031H	DC Bus Voltage, 1 Vdc units	
0032H, 0033H	Reserved	
0034H	Product Code 1 [ASCII], Product Type (Z0 for Z1000)	
0035H	Product Code 2 [ASCII], Region Code	
0036H, 0037H	Reserved	
0038H	PI Feedback, 0.1% units, unsigned, 100% / max. output frequency	
0039H	PI Input, 0.1% units, signed, 100% / max. output frequency	
003AH	PI Output, 0.1% units, signed, 100% / max. output frequency	
003BH, 003CH	Reserved	
003DH	Communications Error Contents <2>	
	bit 0	CRC Error
	bit 1	Data Length Error
	bit 2	Reserved
	bit 3	Parity Error
	bit 4	Overrun Error
	bit 5	Framing Error
	bit 6	Timeout
	bit 7 to F	Reserved
003EH	Output Frequency	r/min <4>
003FH		0.01% units
0040H to 004AH	Used for various monitors U1-□□. *Refer to U: Monitors on page 256* for parameter details.	

Register No.	Contents	
004BH	Drive status (U1-12)	
	bit 0	During Run
	bit 1	During Zero Speed
	bit 2	During Reverse Run
	bit 3	During Fault Reset Signal Input
	bit 4	During Speed Agree
	bit 5	Drive Ready
	bit 6	Alarm
	bit 7	Fault
	bit 8	During Operation Error (oPE□□)
	bit 9	During Momentary Power Loss
	bit A, bit B	Reserved
	bit E	ComRef status, NetRef status
	bit F	ComCtrl status, NetCtrl status
004CH to 007EH	Used for various monitors U1-□□, U4-□□, U5-□□ and U6-□□. ***Refer to U: Monitors on page 256*** for parameter details.	
007FH	Alarm Code, ***Refer to Alarm Register Contents on page 357*** for alarm codes.	
0080H to 0097H	Used for monitors U2-□□, U3-□□. ***Refer to U: Monitors on page 256*** for parameter details and ***Refer to Fault Trace Contents on page 355*** for register value descriptions.	
0098H	High Word of Accumulated Operation Time Monitor, 10 h units (U4-01)	
0099H	Low Word of Accumulated Operation Time Monitor, 1 h units (U4-01)	
009AH	High Word of Cooling Fan Operation Time Monitor (U4-03)	
009BH	Low Word of Cooling Fan Operation Time Monitor (U4-03)	
009CH to 00AAH	Reserved	
00ABH	Drive Rated Current <3>	
00ACH	Motor Speed (U1-05)	r/min units <4>
00ADH		0.01% units
00AEH to 00B4H	Reserved	
00B5H	Frequency Reference After Soft-starter (U1-16)	r/min units <4>
00B6H		0.01% units
00B7H	Frequency Reference	r/min <4>
00B8H		0.01% units
00B9H to 00BEH	Reserved	
00BFH	Lists the last two digits of operation error code oPE□□.	
00C0H	Fault Contents 3	
	bit 1	Undervoltage (Uv1)
	bit 2	Control Power Supply Undervoltage (Uv2)
	bit 3	Soft Charge Circuit Fault (Uv3)
	bit 4	Reserved
	bit 5	Ground Fault (GF)
	bit 6	Overcurrent (oC)
	bit 7	Overvoltage (ov)
	bit 8	Heatsink Overheat (oH)
	bit 9	Heatsink Overheat (oH1)
	bit A	Motor Overload (oL1)
	bit B	Drive Overload (oL2)
	bit C	Overtorque Detection 1 (oL3)
	bit D to F	Reserved

Register No.	Contents	
00C1H	Fault Contents 4	
	bit 0	External Fault at input terminal S3 (EF3)
	bit 1	External Fault at input terminal S4 (EF4)
	bit 2	External Fault at input terminal S5 (EF5)
	bit 3	External Fault at input terminal S6 (EF6)
	bit 4	External Fault at input terminal S7 (EF7)
	bit 5	Reserved
	bit 6	Cooling Fan Error (FAn)
	bit 7 to 9	Reserved
	bit A	Input Phase Loss (PF)
	bit B	Output Phase Loss (LF)
	bit C	Motor Overheat (PTC input) (oH3)
	bit D	Digital Operator Connection Fault (oPr)
	bit E	EEPROM Write Error (Err)
	bit F	Motor Overheat Fault (PTC input) (oH4)
00C2H	Fault Contents 5	
	bit 0	MEMOBUS/Modbus Communication Error (CE)
	bit 1	Option Communication Error (bUS)
	bit 2 to 5	Reserved
	bit 6	Option External Fault (EF0)
	bit 7	PI Feedback Loss (FbL)
	bit 8	Undertorque Detection 1 (UL3)
	bit 9	Reserved
	bit A	High Slip Braking Overload (oL7)
	bit B to E	Reserved
	bit F	Hardware Fault (includes oFx)
00C3H	Fault Contents 6	
	bit 0 to 4	Reserved
	bit 5	Current Imbalance (LF2)
	bit 6	Pullout Detection (STo)
	bit 7 to 9	Reserved
	bit A	Too Many Speed Search Restarts (SEr)
	bit B to F	Reserved
00C4H	Fault Contents 7	
	bit 0	PI Feedback Loss (FbH)
	bit 1	External Fault 1, input terminal S1 (EF1)
	bit 2	External Fault 2, input terminal S2 (EF2)
	bit 3, bit 4	Reserved
	bit 5	Current Offset Fault (CoF)
	bit 6 to B	Reserved
	bit C	Output Voltage Detection Fault (voF)
	bit D to F	Reserved
00C5H	Fault Contents 8	
	bit 0	Reserved
	bit 1	Node Setup Fault (nSE)
	bit 2 to 5	Reserved
	bit 9	Motor Underload Protection (UL6)
	bit A to F	Reserved
00C6H, 00C7H	Reserved	

Register No.	Contents	
00C8H	Alarm Contents 2	
	bit 0	Undervoltage (Uv)
	bit 1	Overvoltage (ov)
	bit 2	Heatsink Overheat (oH)
	bit 3	Drive Overheat (oH2)
	bit 4	Overtorque 1 (oL3)
	bit 5	Reserved
	bit 6	Run Commands Input Error (EF)
	bit 7	Drive Baseblock (bb)
	bit 8	External Fault 3, input terminal S3 (EF3)
	bit 9	External Fault 4, input terminal S4 (EF4)
	bit A	External Fault 5, input terminal S5 (EF5)
	bit B	External Fault 6, input terminal S6 (EF6)
	bit C	External Fault 7, input terminal S7 (EF7)
	bit D	Reserved
	bit E	Cooling Fan Error (FAn)
	bit F	Reserved
00C9H	Alarm Contents 3	
	bit 0, bit 1	Reserved
	bit 2	Digital Operator Connection Fault (oPr)
	bit 3	MEMOBUS/Modbus Communication Error (CE)
	bit 4	Option Communication Error (bUS)
	bit 5	Reserved
	bit 6	Motor Overload (oL1)
	bit 7	Drive Overload (oL2)
	bit 8	Reserved
	bit 9	Option Card External fault (EF0)
	bit A, bit B	Reserved
	bit C	Serial Communication Transmission Error (CALL)
	bit D	Undertorque Detection 1 (UL3)
	bit E	Reserved
	bit F	MEMOBUS/Modbus Test Mode Fault (SE)
00CAH	Alarm Contents 4	
	bit 0	Reserved
	bit 1	Motor Overheat 1 (PTC Input) (oH3)
	bit 2 to 5	Reserved
	bit 6	PI Feedback Loss (FbL)
	bit 7	PI Feedback Loss (FbH)
	bit 9	Drive Disabled (dnE)
	bit A to F	Reserved
00CBH	Alarm Contents 5	
	bit 0 to 2	Reserved
	bit 3	High Current Alarm (HCA)
	bit 4	Cooling Fan Maintenance Time (LT-1)
	bit 5	Soft Charge Bypass Relay Maintenance Time (LT-2)
	bit 6, 7	Reserved
	bit 8	External Fault 1 (input terminal S1) (EF1)
	bit 9	External Fault 2 (input terminal S2) (EF2)
	bit A to F	Reserved

Register No.	Contents	
00CCH	Alarm Contents 6	
	bit 0	Output Voltage Detection Fault (VoF)
	bit 1	Reserved
	bit 2	Capacitor Maintenance Time (LT-3)
	bit 3 to C	Reserved
	bit D	Motor Underload Protection (UL6)
	bit E	Waiting for Run (WrUn)
	bit F	Reserved
00CDH	Reserved	
00CEH	Alarm Contents 7	
	bit 2	Time Not Set (TIM)
	bit 3	Operator Battery Low (bAT)
	bit 4	Time Data Error (TdE)
	bit 5	External Fan Fault (Fn1)
	bit 6	Emergency Override Forward Run (EoF)
	bit 7	Emergency Override Reverse Run (Eor)
00CFH	Reserved	
00D0H	CPF Contents 1	
	bit 0, 1	Reserved
	bit 2	A/D Conversion Error (CPF02)
	bit 3	PWM Data Fault (CPF03)
	bit 4, 5	Reserved
	bit 6	EEPROM Memory Data Error (CPF06)
	bit 7	Terminal Board Connection Error (CPF07)
	bit 8	EEPROM Serial Communications Fault (CPF08)
	bit 9 to F	Reserved
00D1H	CPF Contents 2	
	bit 0 to 3	Reserved
	bit 4	Hardware fault at power up (CPF20)
	bit 5	Hardware fault at communication start up (CPF21)
	bit 6	A/D Conversion Fault (CPF22)
	bit 7	PWM Feedback Fault (CPF23)
	bit 8	Drive Unit Signal Fault (CPF24)
	bit 9 to F	Reserved
00D2H	Reserved	
00D3H to 00D7H	oFA0x Contents (CN5)	
00D8H	oFA0x Contents (CN5)	
	bit 0	Option Compatibility Error (oFA00)
	bit 1	Option not properly connected (oFA01)
	bit 2 to 4	Reserved
	bit 5	A/D Conversion Error (oFA05)
	bit 6	Option Response Error (oFA06)
	bit 7 to F	Reserved

Register No.	Contents	
00D9H	oFA1x Contents (CN5)	
	bit 0	Option RAM Fault (oFA10)
	bit 1	Option Operation Mode Fault (SLMoD) (oFA11)
	bit 2	Drive Receive CRC Error (oFA12)
	bit 3	Drive Receive Frame Error (oFA13)
	bit 4	Drive Receive Abort Error (oFA14)
	bit 5	Option Receive CRC Error (oFA15)
	bit 6	Option Receive Frame Error (oFA16)
	bit 7	Option Receive Abort Error (oFA17)
	bit 8 to F	Reserved
00DAH	Reserved	
00DBH	oFA3x Contents (CN5)	
	bit 0	Comm. ID Error (oFA30)
	bit 1	Model Code Error (oFA31)
	bit 2	Sumcheck Error (oFA32)
	bit 3	Comm. option timeout waiting for response (oFA33)
	bit 4	MEMOBUS Timeout (oFA34)
	bit 5	Drive timeout waiting for response (oFA35)
	bit 6	CI Check Error (oFA36)
	bit 7	Drive timeout waiting for response (oFA37)
	bit 8	Control Command Selection Error (oFA38)
	bit 9	Drive timeout waiting for response (oFA39)
	bit A	Control Response Selection 1 Error (oFA40)
	bit B	Drive timeout waiting for response (oFA41)
	bit C	Control Response Selection 2 Error (oFA42)
	bit D	Control Response Selection Error (oFA43)
	bit E, bit F	Reserved
00DCH to 00E9H	Reserved	
00EAH	Fault Contents 9	
	bit 0	Time Not Set (TIM)
	bit 1	Oper Battery Low (bAT)
	bit 2	Time Data Err (TdE)
	bit 3	Time Interval Error (TIE)
	bit 4	Overvoltage 2 (ov2)
	bit 5	Reserved
	bit 6	External Fan Fault (Fn1)
	bit 7 to F	Reserved
00EBH to 00FFH	Reserved	
0100H to 2FFFH	Reserved	
3000H to 3003H	Used for Various Monitors U5-□□. *Refer to U: Monitors on page 256* for details.	
3004H	Set Time HHMM	
3005H	Set Date Year	
3006H	Set Date Month Day MMDD	
3007H	Set RTC	
3008H to 3028H	Used for Various Monitors U2-□□, U3-□□, U5-□□. *Refer to U: Monitors on page 256* for details.	
3029H to 302EH	Reserved	
302FH	RTC Enter	
3030H	RTC Enter Enable	

<1> Parameter o1-03, Digital Operator Display Selection, determines the units.

<2> Communication error contents are saved until the fault is reset.

<3> The number of decimal places in the parameter value depends on the drive model. This value has two decimal places (0.01 A) in drive models 2A0011 to 2A0046 and 4A0005 to 4A0021; this value has one decimal place (0.1 A) in drive models 2A0059 to 2A0396 and 4A0027 to 4A0590.

<4> Set the number of motor poles to parameter E2-04, E4-04, or E5-05 depending on the motor being used.

◆ Broadcast Messages

Data can be written from the master to all slave devices at the same time.

The slave address in a broadcast command message must be set to 00H. All slaves will receive the message, but will not respond.

Register No.	Contents	
0001H	Digital Input Command	
	bit 0	Forward Run (0: Stop 1: Run)
	bit 1	Direction Command (0: Forward, 1: Reverse)
	bit 2, bit 3	Reserved
	bit 4	External Fault
	bit 5	Fault Reset
	bit 6 to B	Reserved
	bit C	Multi-Function Digital Input S5
	bit D	Multi-Function Digital Input S6
	bit E	Multi-Function Digital Input S7
	bit F	Reserved
0002H	Frequency Reference	30000/100%

◆ Fault Trace Contents

The table below shows the drive fault codes that can be read out by MEMOBUS/Modbus commands from the U2-□□ monitor parameters.

Table E.3 Fault Trace / History Register Contents

Fault Code	Fault Name	Fault Code	Fault Name
0002H	Undervoltage (Uv1)	0021H	MEMOBUS/Modbus Communication Error (CE)
0003H	Control Power Supply Undervoltage (Uv2)	0022H	Option Communication Error (bUS)
0004H	Soft Charge Circuit Fault (Uv3)	0027H	Option External Fault (EF0)
0006H	Ground Fault (GF)	0028H	PI Feedback Loss (FbL)
0007H	Overcurrent (oC)	0029H	Undertorque Detection 1 (UL3)
0008H	Overvoltage (ov)	002BH	High Slip Braking Overload (oL7)
0009H	Heatsink Overheat (oH)	0030H	Hardware Fault (including oFx)
000AH	Heatsink Overheat (oH1)	0036H	Output Current Imbalance (LF2)
000BH	Motor Overload (oL1)	0037H	Pullout Detection (Sto)
000CH	Drive Overload (oL2)	003BH	Too Many Speed Search Restarts (SEr)
000DH	Overtorque Detection 1 (oL3)	0041H	PI Feedback Loss (FbH)
0010H	Braking Resistor Overheat (rH)	0042H	External Fault 1, Input Terminal S1 (EF1)
0011H	External Fault at Input Terminal S3 (EF3)	0043H	External Fault 2, Input Terminal S2 (EF2)
0012H	External Fault at Input Terminal S4 (EF4)	0046H	Current Offset Fault (CoF)
0013H	External Fault at Input Terminal S5 (EF5)	0047H	PLC Detection Error 1 (PE1)
0014H	External Fault at Input Terminal S6 (EF6)	0048H	PLC Detection Error 2 (PE2)
0015H	External Fault at Input Terminal S7 (EF7)	004DH	Output Voltage Detection Fault (voF)
001BH	Input Phase Loss (PF)	0052H	Node Setup Fault (nSE)
001CH	Output Phase Loss (LF)	005AH	Motor Underload Protection (UL6)
001DH	Motor Overheat (PTC input) (oH3)	0083H	A/D Conversion Error (CPF02)
001EH	Digital Operator Connection (oPr)	0084H	PWM Data Fault (CPF03)
001FH	EEPROM Write Error (Err)	0087H	EEPROM Memory Data Error (CPF06)
0020H	Motor Overheat (PTC input) (oH4)	0088H	Terminal Board Connection Error (CPF07)

Fault Code	Fault Name
0089H	EEPROM Serial Communication Fault (CPF08)
008CH	RAM Fault (CPF11)
008DH	Flash Memory Circuit Exception (CPF12)
008EH	Watchdog Circuit Exception (CPF13)
008FH	Control Circuit Fault (CPF14)
0091H	Clock Fault (CPF16)
0092H	Timing Fault (CPF17)
0093H	Control Circuit Fault (CPF18)
0094H	Control Circuit Fault (CPF19)
0095H	Hardware Fault at Power Up (CPF20)
0096H	Hardware Fault at Communication Start Up (CPF21)
0097H	A/D Conversion Fault (CPF22)
0098H	PWM Feedback Fault (CPF23)
0099H	Drive Unit Signal Fault (CPF24)
009AH	Terminal Board is Not Properly Connected. (CPF25)
009BH	ASIC BB Circuit Error (CPF26)
009CH	ASIC PWM Setting Register Error (CPF27)
009DH	ASIC PWM Pattern Error (CPF28)
009EH	ASIC On-delay Error (CPF29)
009FH	ASIC BBON Error (CPF30)
00A0H	ASIC Code Error (CPF31)
00A1H	ASIC Start-up Error (CPF32)
00A2H	Watch-dog Error (CPF33)
00A3H	ASIC Power/Clock Error (CPF34)
00A4H	External A/D Converter Error (CPF35)
00A9H	Control Circuit Error (CPF40)
00AAH	Control Circuit Error (CPF41)
00ABH	Control Circuit Error (CPF42)
00ACH	Control Circuit Error (CPF43)
00ADH	Control Circuit Error (CPF44)
00AEH	Control Circuit Error (CPF45)
0101H	Option Compatibility Error (oFA00)

Fault Code	Fault Name
0102H	Option Not Properly Connected (oFA01)
0106H	A/D Conversion Error (oFA05)
0107H	Option Response Error (oFA06)
0111H	Option RAM Fault (oFA10)
0112H	Option Operation Mode Fault (SLMOD) (oFA11)
0113H	Drive Receive CRC Error (oFA12)
0114H	Drive Receive Frame Error (oFA13)
0115H	Drive Receive Abort Error (oFA14)
0116H	Option Receive CRC Error (oFA15)
0117H	Option Receive Frame Error (oFA16)
0118H	Option Receive Abort Error (oFA17)
0131H	Comm. ID Error (oFA30)
0132H	Model Code Error (oFA31)
0133H	Sumcheck Error (oFA32)
0134H	Comm. Option Timeout Waiting for Response (oFA33)
0135H	MEMOBUS Timeout (oFA34)
0136H	Drive Timeout Waiting for Response (oFA35)
0137H	CI Check Error (oFA36)
0138H	Drive Timeout Waiting for Response (oFA37)
0139H	Control Command Selection Error (oFA38)
013AH	Drive Timeout Waiting for Response (oFA39)
013BH	Control Response Selection 1 Error (oFA40)
013CH	Drive Timeout Waiting for Response (oFA41)
013DH	Control Response Selection 2 Error (oFA42)
013EH	Control Response Selection Error (oFA43)
0401H	Time Not Set (TIM)
0402H	Operator Battery Low (bAT)
0403H	Time Data Error (TdE)
0404H	Time Interval Error (TiE)
0405H	Overvoltage 2 (ov2)
0407H	External Fan Fault (Fn1)

◆ Alarm Register Contents

The table below shows the alarm codes that can be read out from MEMOBUS/Modbus register 007FH.

Table E.4 Alarm Register 007FH Contents

Fault Code	Fault Name	Fault Code	Fault Name
0001H	Undervoltage (Uv)	0028H	PI Feedback Loss (FbH)
0002H	Overvoltage (ov)	002AH	Drive Disabled (dnE)
0003H	Heatsink Overheat (oH)	0031H, 0033H	Reserved
0004H	Overheat Signal from MFDI (oH2)	0034H	High Current Alarm (HCA)
0005H	Overtorque 1 (oL3)	0035H	Cooling Fan Maintenance Time (LT-1)
0007H	Run commands input error (EF)	0036H	Capacitor Maintenance Time (LT-2)
0008H	Drive Baseblock (bb)	0038H	Reserved
0009H	External Fault 3, input terminal S3 (EF3)	0039H	External Fault (input terminal S1) (EF1)
000AH	External Fault 4, input terminal S4 (EF4)	003AH	External Fault (input terminal S2) (EF2)
000BH	External Fault 5, input terminal S5 (EF5)	003FH	PLC Alarm (PA1)
000CH	External Fault 6, input terminal S6 (EF6)	0040H	PLC Alarm (PA2)
000DH	External Fault 7, input terminal S7 (EF7)	0041H	Output Voltage Detection Fault (voF)
000FH	Internal Fan Fault (FAn)	004EH	Motor Underload Protection (UL6)
0014H	MEMOBUS/Modbus Communication Error (CE)	004FH	Waiting for Run (WrUn)
0015H	Option Communication Error (bUS)	0063H	Time Not Set (TIM)
0017H	Motor Overload (oL1)	0064H	Operator Battery Low (bAT)
0018H	Drive Overload (oL2)	0065H	Time Data Error (TdE)
001AH	Option Card External Fault (EF0)	0066H	External Fan Fault (Fn1)
001DH	Serial Communication Transmission Error (CALL)	0067H	Emergency Override Forward Run (EoF)
001EH	Undertorque Detection 1 (UL3)	0068H	Emergency Override Reverse Run (Eor)
0020H	MEMOBUS/Modbus Test Mode Fault (SE)	006AH	Customer Safety (SAFE)
0022H	Motor Overheat (oH3)	006BH	Interlock Open (inTLK)
0027H	PI Feedback Loss (FbL)		

E.10 Enter Command

When writing parameters to the drive from the PLC using MEMOBUS/Modbus communication, parameter H5-11 determines whether an Enter command must be issued to enable these parameters. This section describes the types and functions of the Enter commands.

◆ Enter Command Types

The drive supports two types of Enter commands as shown in *Table B.11*. An Enter command is enabled by writing 0 to register numbers 0900H or 0910H. It is only possible to write to these registers; attempting to read from these registers will cause an error.

Table E.5 Enter Command Types

Register No.	Description
0900H	Simultaneously writes data into the EEPROM (non-volatile memory) of the drive and enables the data in RAM. Parameter changes remain after cycling power.
0910H	Writes data in the RAM only. Parameter changes are lost when the drive is shut off.

Note: The EEPROM can only be written to 100,000 times, so it is recommended to limit the number of times writing to the EEPROM. The Enter command registers are write-only and if these registers are read, the register address will be invalid (Error code: 02H). An Enter command is not required when reference or broadcast data are sent to the drive.

■ H5-11 and the Enter Command

An enter command is not required when writing registers 0000H to 001FH. Changes to those registers take effect immediately, independent of the setting in parameter H5-11.

H5-11 Settings	H5-11 = 0	H5-11 = 1
How parameter settings are enabled	When the Enter command is received from the master.	As soon as the value is changed.
Upper/lower limit check	Upper/lower limit check is performed, taking the settings of related parameters into account.	Checks only the upper/lower limits of the parameters that were changed.
Default value of related parameters	Not affected. The settings of related parameters remain unchanged. They must be changed manually if needed.	Default settings of related parameters are changed automatically.
Error handling when setting multiple parameters	Data is accepted even if one setting is invalid. The invalid setting will be discarded. No error message occurs.	Error occurs if only one setting is invalid. All data that was sent are discarded.

E.11 Communication Errors

◆ MEMOBUS/Modbus Error Codes

A list of MEMOBUS/Modbus errors appears below.

When an error occurs, remove whatever caused the error and restart communications.

Error Code	Error Name / Cause
01H	Function Code Error
	• Attempted to set a function code from a PLC other than 03H, 08H, and 10H.
02H	Register Number Error
	• A register number specified in the command message does not exist. • Attempted to send a broadcast message using other register numbers than 0001H or 0002H.
03H	Bit Count Error
	• Read data or write data is greater than 16 bits. Invalid command message quantity. • In a write message, the “Number of Data Items” contained within the message does not equal twice the amount of data words (i.e., the total of Data 1+ Data 2, etc.).
21H	Data Setting Error
	• Control data or parameter write data is outside the allowable setting range. • Attempted to write a contradictory parameter setting.
22H	Write Mode Error
	• During run, the user attempted to write a parameter that cannot be written to during run. • During an EEPROM memory data error (CPF06), the master attempted to write to a parameter other than A1-00 to A1-05, E1-03, or o2-04. • Attempted to write to read-only data.
23H	DC Bus Undervoltage Write Error
	• During an undervoltage situation, the master attempted to write to parameters that cannot be written to during undervoltage.
24H	Write Error During Parameter Process
	• Master attempted writing to the drive while the drive was processing parameter data.

◆ Slave Not Responding

In the following situations, the slave drive will ignore the command message sent from the master, and not send a response message:

- When a communications error (overrun, framing, parity, or CRC-16) is detected in the command message.
- When the slave address in the command message and the slave address in the drive do not match (remember to set the slave address for the drive using H5-01).
- When the gap between two blocks (8-bit) of a message exceeds 24 bits.
- When the command message data length is invalid.

Note: If the slave address specified in the command message is 00H, all slaves execute the write function, but do not return response messages to the master.

E.12 Self-Diagnostics

The drive has a built-in self-diagnosing function of the serial communication interface circuits. To perform the self-diagnosis function, use the following procedure.

DANGER! *Electrical Shock Hazard. Do not connect or disconnect wiring while the power is on. Failure to comply will result in death or serious injury. Before servicing, disconnect all power to the equipment. The internal capacitor remains charged even after the power supply is turned off. The charge indicator LED will extinguish when the DC bus voltage is below 50 Vdc. To prevent electric shock, wait at least one minute after all indicators are OFF and measure the DC bus voltage level to confirm safe level.*

1. Turn on the power to the drive.
2. Note the present terminal S6 function selection setting (H1-06) and set it for the communications test mode (H1-06 = 67).
3. Turn off the power to the drive.
4. With the power off, wire the drive as shown in the following diagram, connecting terminals R+ and S+, R- and S-, and S6 and SP.

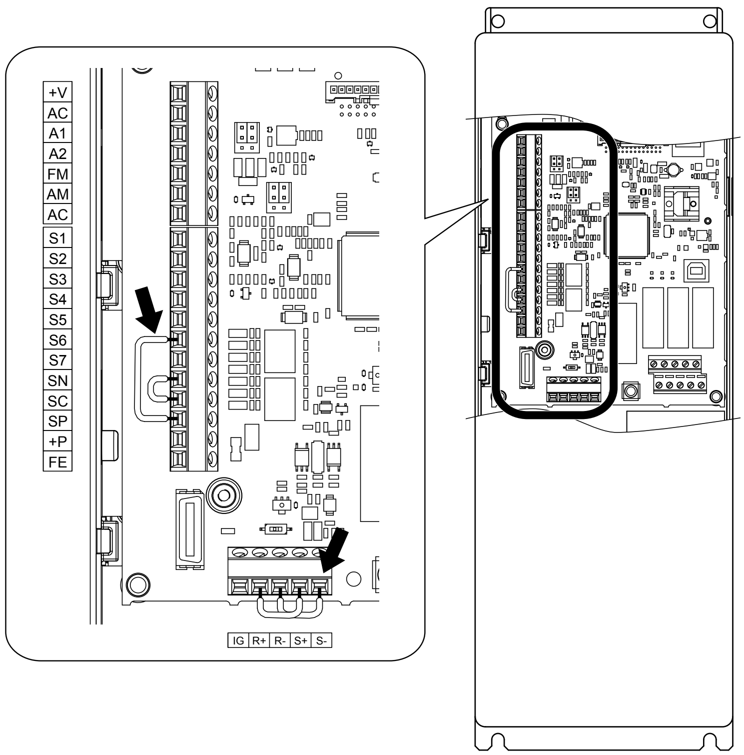


Figure E.8 Terminal Connections for Communication Self-Diagnostics

5. Connect a wire jumper between terminals SN and SC to change to source mode.
6. Turn the power to the drive back on.
7. During normal operation, the drive will display “Pass” to indicate that the communications test mode is operating normally.

   When a fault occurs, the drive will display “CE” on the keypad display.
8. Turn off the power supply.
9. Remove the wire jumpers from terminal R+, R-, S+, S-, and S6-SP. Reset the wire jumper to its original position and set terminal S6 to its original function.
10. Return to normal operation.

Index

Numerics

A

B

C

D

E

F

N

O

P

R

S

Revision History

The revision dates and the numbers of the revised manuals appear on the bottom of the back cover.

MANUAL NO. SIEP C710616 45B

Published in U.S.A. September 2012 11-5 ◇1

Date of original publication

Date of publication

Date of Publication	Revision Number	Section	Revised Content
November 2012	2	–	Updated documentation for software version PRG: 1015
		All	Revision: Reviewed and corrected entire documentation.
		Appendix B	Addition: BACnet Communication
		Appendix C	Addition: APOGEE FLN (P1) Communication
		Appendix D	Addition: Metasys N2 Communication
September 2012	1	–	Removed references to model 4A0515 throughout book Updated documentation for software versions PRG: 1013 and PRG: 1014 Updated technical specifications for 4A0361 and 4A0414 models throughout book
		Chapter 1	Addition: Technical data for Real Time Clock function
May 2011	–	–	First Edition. This manual supports drive software versions PRG: 1011 and PRG: 1012.

YASKAWA AC Drive Z1000
AC Drive for HVAC Fan and Pump
Programming Manual

YASKAWA AMERICA, INC.
2121 Norman Drive South, Waukegan, IL 60085, U.S.A.
Phone: (800) YASKAWA (927-5292) or 1-847-887-7000 Fax: 1-847-887-7310
http://www.yaskawa.com

DRIVE CENTER (INVERTER PLANT)
2-13-1, Nishimiyaichi, Yukuhashi, Fukuoka, 824-8511, Japan
Phone: 81-930-25-3844 Fax: 81-930-25-4369
http://www.yaskawa.co.jp

YASKAWA ELECTRIC CORPORATION
New Pier Takeshiba South Tower, 1-16-1, Kaigan, Minatoku, Tokyo, 105-6891, Japan
Phone: 81-3-5402-4502 Fax: 81-3-5402-4580
http://www.yaskawa.co.jp

YASKAWA ELÉTRICO DO BRASIL LTDA.
Avenda Fagundes Filho, 620 Bairro Saude, São Paulo, SP04304-000, Brazil
Phone: 55-11-3585-1100 Fax: 55-11-5581-8795
http://www.yaskawa.com.br

YASKAWA EUROPE GmbH
Hauptstrasse 185, 65760 Eschborn, Germany
Phone: 49-6196-569-300 Fax: 49-6196-569-398
http://www.yaskawa.eu.com

YASKAWA ELECTRIC UK LTD.
1 Hunt Hill Orchardton Woods, Cumbernauld, G68 9LF, United Kingdom
Phone: 44-1236-735000 Fax: 44-1236-458182
http://www.yaskawa.co.uk

YASKAWA ELECTRIC KOREA CORPORATION
9F, Kyobo Securities Bldg., 26-4, Yeouido-dong, Yeongdeungpo-gu, Seoul, 150-737, Korea
Phone: 82-2-784-7844 Fax: 82-2-784-8495
http://www.yaskawa.co.kr

YASKAWA ELECTRIC (SINGAPORE) PTE. LTD.
151 Lorong Chuan, #04-01, New Tech Park, 556741, Singapore
Phone: 65-6282-3003 Fax: 65-6289-3003
http://www.yaskawa.com.sg

YASKAWA ELECTRIC (CHINA) CO., LTD.
12F, Carlton Bld., No.21 HuangHe Road, HuangPu District, Shanghai 200003, China
Phone: 86-21-5385-2200 Fax: 86-21-5385-3299
http://www.yaskawa.com.cn

YASKAWA ELECTRIC (CHINA) CO., LTD. BEIJING OFFICE
Room 1011, Tower W3 Oriental Plaza, No. 1 East Chang An Ave.,
Dong Cheng District, Beijing, 100738, China
Phone: 86-10-8518-4086 Fax: 86-10-8518-4082

YASKAWA ELECTRIC TAIWAN CORPORATION
9F, 16, Nanking E. Rd., Sec. 3, Taipei, 104, Taiwan
Phone: 886-2-2502-5003 Fax: 886-2-2505-1280

YASKAWA ELECTRIC INDIA PRIVATE LIMITED
#17/A Electronics City, Hosur Road Bangalore 560 100 (Karnataka), India
Phone: 91-80-4244-1900 Fax: 91-80-4244-1901
http://www.yaskawaindia.in

YASKAWA ELECTRIC CORPORATION

MANUAL NO. SIEP C710616 45C

Published in Japan November 2012 11-5 ②
12-7-10_YAI