iQpump1000 AC Drive

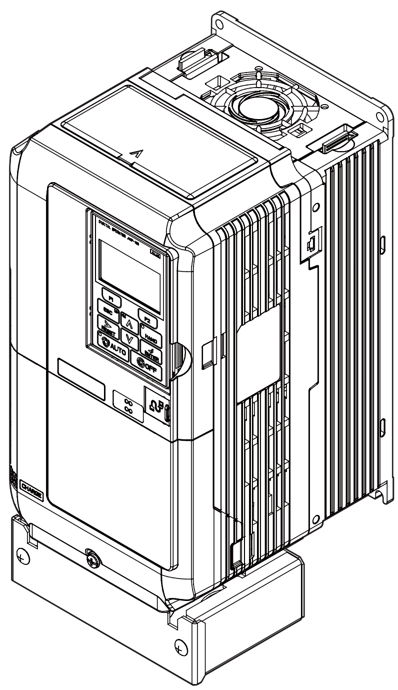
Intelligent Pump Controller

Quick Start Guide

Type: CIMR-PW□A□□□□

Models: 200 V Class: 3/4 to 175 HP ND
400 V Class: 3/4 to 500 HP ND
600 V Class: 2 to 250 HP ND

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



Intelligent Pump Controller

MANUAL NO. TOEP YAIP1W 01A

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◆ Simple Setup Procedure

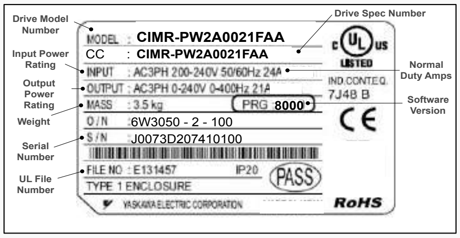
This procedure is a supplement to other documentation supplied with this equipment and guides the user in properly wiring the iQpump and motor. It also shows the configuration for a simplex pump application.

WARNING! *Read and adhere to all safety messages contained in this manual prior to performing this procedure. When installing the system be sure to follow good wiring practices and all applicable codes. Ensure that the mounting of the various components are secure and that the environment, such as extreme dampness, poor ventilation etc. will not cause system degradation. Please read this cheat sheet and other documentation provided with the iQpump thoroughly before attempting any installation.*

The setup procedure begins on the next page.

Step 1 — iQpump Model Identification and Mounting

To make sure you received the correct model, it is essential to verify the iQpump nameplate with your order and make sure the iQpump has the correct rating so it can be used with your motor. Please check the nameplate information as shown in the example below.



- Check that the available power will meet the **input power** requirements.
- Ensure that the **output power** from the iQpump is compatible with the motor requirements.
- In the case of systems with more than one iQpump, follow the above procedure for each iQpump and motor.

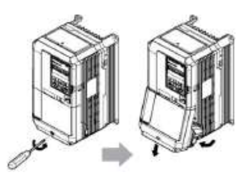
Mounting the iQpump

The mounting of the iQpump is extremely important regarding environment and accessibility. Depending on your system, there are various models available and the mounting dimensions (footprint) may be different. Because the mounting procedure is fairly extensive, it is beyond the scope of this document; Refer to the iQpump1000 Quick Start Guide (Document No. TOEPYAIP1W01) received with the iQpump, **Section 2.2 Mechanical Installation**. Match the model that you received and follow the procedure described in the manual to ensure a safe and functional installation. In cases where the system has more than one iQpump, refer to the proper clearances required for adequate ventilation. Please pay particular attention to:

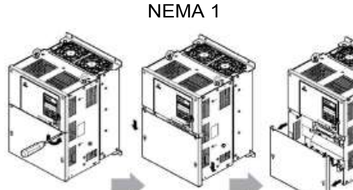
- The clearances to be maintained around the enclosure for adequate ventilation.
- The environmental specifications such as avoiding excessive dampness, extreme temperatures, chemical exposure, corrosive areas, etc. to avoid damage to the equipment and to maintain safety.

Removing and Attaching the Terminal Cover

Improper removal of the iQpump terminal cover as well as front cover can cause extensive damage to the iQpump. To avoid damage to these items, please pay particular attention to the **iQpump1000 Quick Start Guide TOEPYAIP1W01 Section 3.5 Removing and Attaching the Terminal Cover.**



NEMA 1



Open Chassis

Step 2 — Connect Motor and Line Power

Fig.1 & 2 below show the electrical connections for the input power and motor terminals for various iQpump models. Select the proper diagram for the model you are installing **(see Step 1). WITH POWER OFF** make the appropriate connections. **Make sure to follow good wiring practices and all applicable codes. Ensure that the equipment is grounded properly as shown in fig. 1**

DANGER; LETHAL VOLTAGES ARE PRESENT - Before applying power to the iQpump, ensure that the terminal cover is fastened and all wiring connections are secure. After the power has been turned OFF, wait <u>at least five minutes</u> until the charge indicator <u>extinguishes completely</u> before touching any wiring, circuit boards or components.

WARNING DO NOT CONNECT ANY OF THE FOLLOWING TERMINALS TO EARTH GROUND

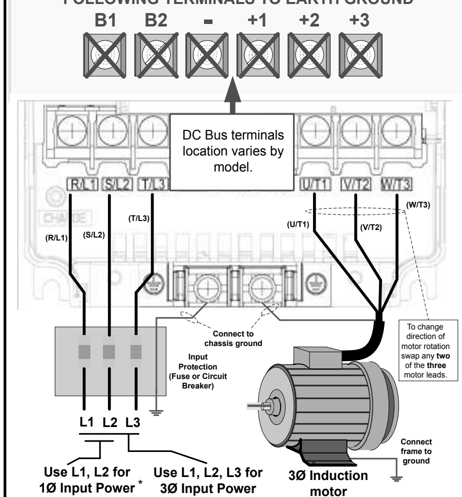


Fig. 1 Input Power and Output Motor Electrical Connections for Models: 2_0004 - 2_0056, 4_0002 - 4_0044 and 5_0003 - 50011

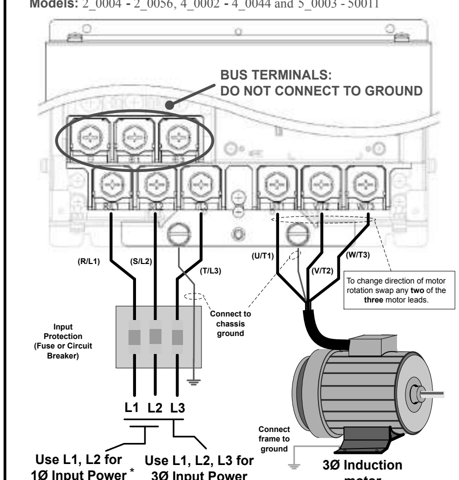


Fig. 2 Input Power and Output Motor Electrical Connections for Models: 2_0110 & Larger and 4_0058 & Larger

* Make sure the iQpump has been properly sized for single phase input power. For best performance, the drive input supply voltage must be equal to or greater than the motor rated voltage.

Step 3 — Real-time Clock Setup

This step shows how to setup the iQpump real-time clock for first use.

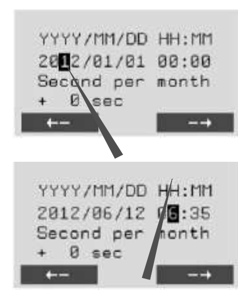
Note: If clock is not set the drive can still be programmed and operated, but ALM light will flash every 30s and showing **Clock Not Set** message.

Power up the drive and set the real-time Clock. The real-time Clock setup screen will appear at first power up.

Press to set the clock.

Note: After the real-time clock is set the real-time clock setup screen will not show again unless parameter o4-17 is set to "Set".

Real-time Clock Setup Screen



Use to move cursor to The left and to move cursor to the right use to adjust. When date and time are set press to save.

Example: Jun 12th 2012, 7:35am

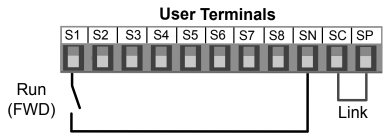
Note: Do NOT adjust sec per month.

Step 4 — Selecting Start/Stop and Speed Method

This step shows how to connect control wiring and feedback signal to the iQpump. Before making any control connections **MAKE SURE POWER TO THE iQpump IS TURNED OFF!** Next remove the terminal cover to gain access to the control terminals. (Step 1.)

SELECT START / STOP CONTROL METHOD — b1-02

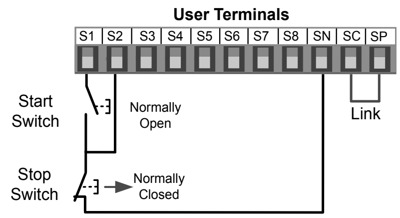
The iQpump is **DEFAULT SETUP TO START /STOP FROM THE KEYPAD** (digital operator). If this is the preferred start/stop method then continue to the feedback signal connection section. Please refer to the wiring diagram below to start/stop the iQpump using an external switch or contact.



Wiring Diagram: 2-Wire Control

Use for maintained contacts

Note: 3rd row of terminal board is shown here.



Wiring Diagram: 3-Wire Control

Use for momentary contacts

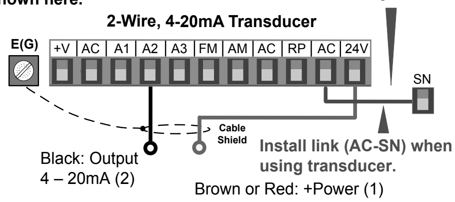
To use 3-Wire Control first Initialize the iQpump using parameter A1-03 = 3330 (Refer to the Quick Start Guide TOEP YAIP 1W 01)

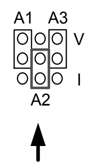
FEEDBACK SIGNAL WIRING (TRANSDUCER)

Note: 2nd row of terminal board is shown here.

Factory Installed **(Factory Default)**

2-Wire, 4-20mA Transducer





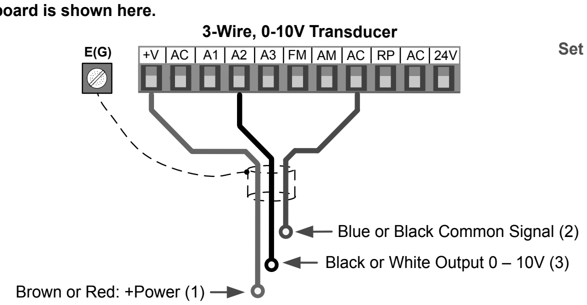
Jumper located inside the drive on the terminal board

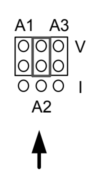
For use with 2-Wire, 4 – 20mA Transducer **(Factory Default)**

Note: 2nd row of terminal board is shown here.

3-Wire, 0-10V Transducer

Set Jumper to use 0 – 10V Transducer





Jumper located inside the drive on the terminal board

For use with 3-Wire, 0 – 10V Transducer

! Important Note: Signal colors and numbering may vary depending on feedback device used, please consult feedback device manual.

NOTE: It is beyond the scope of this document to program the iQpump drive for network communication control. Please refer to the refer to the iQpump1000 Quick Start Guide (Document No. TOEPYAIP1W01) for this selection.

Step 5

Changing Parameters and Monitoring the iQpump

This step shows how to access and modify an iQpump parameter as well as how to monitor iQpump signals such as output frequency and motor current.

Make sure all protective covers have been re-attached and power is turned on. DO NOT RUN THE MOTOR.

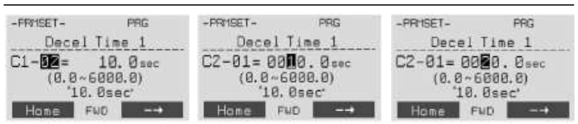
Access Parameter Menu and Change Parameter Value

Press two times until the digital operator shows the parameter menu.

2X → → Select Digit

2X

Inc./Dec. Selection | Go to Next Digit | Inc./Dec. Selection



Switch to Edit Mode → Modify Value → Save New Value

Hold button for 3 sec. to go back to the main menu.

Monitor Motor Frequency and Motor Current

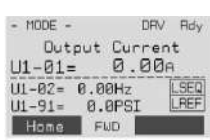
iQpump Digital Operator power-up state

Output Frequency and Transducer Feedback can be monitored simultaneously. Use and to select monitor signals.

Press simultaneously shows the monitor menu.

Press to access monitor menu.

Use to select monitor.



Please refer to the iQpump Quick Start Manual, (Document No. TOEP YAIP 1W 01) on how to access other drive monitors.

Step 6

Application Setup

This step shows how to configure the iQpump for a dedicated pump application.

Make sure all protective covers have been re-attached and power is turned on. DO NOT RUN THE MOTOR.

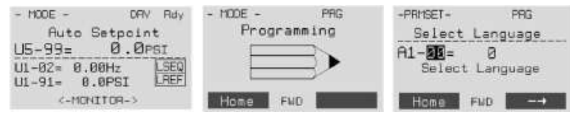
Available iQpump Application Macro's:

- 6008 Constant Pressure Mode (PSI) ← **Default**
- 6009 Pump Down Level Mode(Ft)
- 6010 Geothermal Mode
- 6011 VTC Pressure Control Mode
- 7770 General Purpose Mode

The factory default is setup for constant pressure PSI, only change if application different.

Select Application

Press two times until the digital operator shows the parameter menu.



2X → → 2X Select Digit

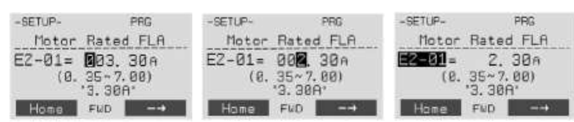
Inc./Dec. Selection | Switch to Edit Mode | Select Application

Press to select.

Enter Application Parameters

Hold button for 3 sec. to go back to the main menu.

3X → → Select Parameter.



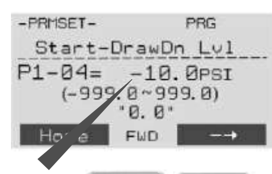
Switch to Edit Mode → Modify Value → Save New Value

Go Back to Main Menu

Hold button for 3 sec. to go back to the main menu.

Step 7

iQpump Quick Setup Parameter Overview (Simplex)

Parameter	Value	Description	Reference	Comments
A1-06	Dependent on Initialization Mode	Application Selected	Displays selected applications, see Step 6.	Read-only cannot be modified
E2-01	Drive Size Dependent	Motor Rated Current	Set to the motor nameplate full load amps.	For submersible motors use service factor amps (SFA).
E2-04	2	Number of Motor Poles	Number of motor poles is used to show the correct motor RPM on the display Enter '4' for an 1800 RPM motor and '2' for a 3600 RPM motor.	Confirm number of poles 2 Pole Motor = 3600 RPM 4 Pole Motor = 1800 RPM 6 Pole Motor = 1200 RPM 8 Pole Motor = 900 RPM
P1-03	145	Feedback Device Scaling	System Scaling: Enter feedback device maximum: Example: Enter 200 for pressure transducer with a maximum of 200 PSI at 20mA.	Confirm feedback device scaling. **(See Illustration 1)**
Q1-01	0	Setpoint 1	Set System Setpoint	**Set to system pressure**
P1-04	0.0 PSI	Start / Drawn Down Level	When the iQpump is turned **On** and the feedback signal level (transducer) falls below this level, the pump system will start after the time specified in P1-05 (default 1 sec). **Programming the Start Level as an Absolute Value.** Start / Draw Down Level has to programmed to a positive value in order for the Start / Draw Down Level to be an absolute value. Example: Start / Draw Down Level P1-04 set to **50 PSI** and delay time P1-05 set to **5 sec.** Pump system will start when the pressure drops below 50 PSI for 5 sec. **Programming the Start Level as a Delta Level from the System Setpoint** Start / Draw Down Level has to programmed to a negative value in order for the Start Level to be a delta value from the setpoint. Example: Start / Draw Down Level P1-04 set to **–10 PSI** with a system setpoint of **50 PSI** and a delay time P1-05 set to **5 sec**. Pump system will start when the pressure drops below 40 PSI (50 - 10) for 5 sec.	It is mandatory to program the Start / Draw Down Level in order to use the sleep function. **(See Illustration 2 and 3)**  Use  to change the sign.
P1-06	40.0 Hz	Minimum Pump Speed	Minimum speed (Hz) the pump motor has to operate at. **Example:** Base pump motor speed is 3600 RPM, minimum speed is 2400 RPM. Set minimum pump frequency to 40.0 Hz. (2400 ÷ 3600 x 60 Hz = 40 Hz)	Minimum pump frequency should be set to a value where the pump enters a no-flow condition.
P4-10	0 Disabled	Auto Mode Operator Run Power Down Storage	Stores the run status in the Auto mode when operating from digital operator (b1-02=0). 0: Disabled 1: Enabled	Recommended for use when Start/Stop command is from the keypad. **(See Step 9)**
P5-04	1 Enabled	Hand Key Enable / Disable	Enables or disables the Hand Key on the digital operator. 0: Disabled 1: Enabled	Hand Key on keypad. **(See Step 10)**

Step 7

iQpump Factory Defaults Overview (adjust certain settings specific to the application)

No.	Value	Description	Reference	Comments
b5-03	3.0 sec.	PI Integral Time	Decrease integral time to make iQpump more responsive.	**Caution:** can cause instability if value is too low.
b5-12	2 (Fault)	PI Feedback Reference Missing Detection Selection	Select what to do when the feedback device (transducer) fails or gets disconnected. 0: Disabled, continue running no message is displayed 1: Alarm, show warning on the keypad when the feedback device fails or is disconnected 2: Fault, stop pump system when the feedback fails or is disconnected	**NOTE:** Disable parameter b5-12 if no transducer is installed.
C1-01	20.0 sec. **See Note**	Acceleration Time 1	Time it takes to accelerate the pump motor from zero to maximum speed. **NOTE:** Factory default with Thrust Mode enabled is 12.0 sec, 20.0 sec when disabled.	Adjusted depending on system performance
C1-02	10.0 sec. **See Note**	Deceleration Time 1	Time it takes to decelerate the pump motor from maximum speed to zero. **NOTE:** Factory default with Thrust Mode enabled is 5.0 sec, 10.0 sec when disabled.	
L5-01	5	Number of Restart Attempts	Determines the number of times iQpump will perform an automatic restart on the faults listed in the comments column. iQpump System Protection Faults that can be setup to restart are Low Level Feedback, High Level Feedback, Transducer Loss, Not Maintaining Setpoint, Loss of Prime, Pump Over Cycle. Refer to parameters P4-07 and P4-08. The number of restart attempts is set by L5-01.	□ Overcurrent □ Ground Fault □ Output Phase Loss □ Input Phase Loss □ iQpump Overload □ Motor Overload □ Overtorque □ DC Bus Fuse Blown □ DC Bus Undervoltage □ DC Bus Overvoltage □ Overheat
L5-03	20 sec.	Maximum Restart Time After Fault	If the restart fails (or is not attempted due to a continuing fault condition) iQpump waits the Maximum Restart Time After Fault, before attempting another restart.	
P1-06	40.0 Hz	Minimum Pump Frequency	Minimum speed (Hz) the pump motor has to operate at. Example: Base pump motor speed is 3600 RPM, minimum speed is 2400 RPM. Set minimum pump frequency to 40.0 Hz. (2400 ÷ 3600 x 60 Hz = 40 Hz)	P1-06 should be set to the level where the pump can produce the minimum pressure even at zero flow.
P2-03	5 sec.	Sleep Delay Time	Time it takes before the pump system goes to sleep when the selected signal level (P2-01) falls below the specified sleep level (P2-02)	Adjust according to system requirements.
P4-12	30.0 Hz	Thrust Bearing Frequency	Sets the frequency reference used when the thrust bearing function is active. A value of 0 disables this function.	Primarily used for submersible pumps. Program P4-12 = 0.0 Hz to disable function when iQpump is used with a centrifugal pump.
P4-17	0.2 Min	Utility Start Delay	When utility power is restored and P4-10 is enabled (1), iQpump waits the time specified in P4-11 before auto operation becomes active.	Note: Only active when P4-10 is enabled (1) and operation (start/stop) is from the digital operator.

1 SYSTEM FEEDBACK UNIT / FEEDBACK DEVICE SCALING

P1-02 Feedback Unit

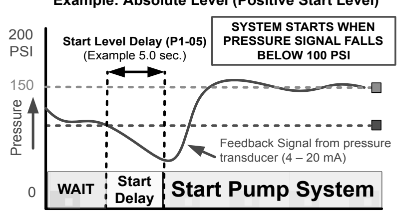
0: Inch of Water	8: Bar
1: PSI	9: Pascal
2: GPM	10: Degrees Celsius
3: Degrees Fahrenheit	11: Meter
4: CFM	12: Feet
5: CMH	13: Liters per Minute
6: Liters / Hr	14: cm per Minute
7: Liters/Sec	15: Inch Hg
	25: No Unit

P1-03 = 200.0 PSI Feedback Scaling

Feedback Maximum

2 START / DRAW DOWN LEVEL

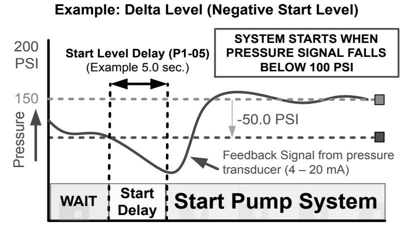
Example: Absolute Level (Positive Start Level)



System Setpoint (Example 150.0 PSI)
Feedback Scaling (P1-03) (Example 200.0 PSI)
System Units (P1-02) (Example PSI)
Start / Draw Down Level (P1-04) (Example 100.0 PSI)

START / DRAW DOWN LEVEL

Example: Delta Level (Negative Start Level)

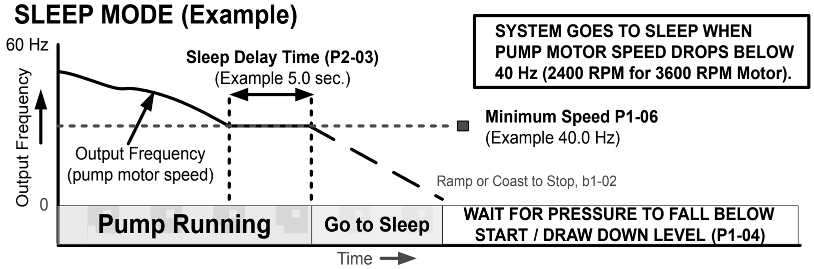


System Setpoint (Example 150.0 PSI)
Feedback Scaling (P1-03) (Example 200.0 PSI)
System Units (P1-02) (Example PSI)
Start / Draw Down Level (P1-04) (Example -50.0 PSI, (150.0 – 50.0)

Step 7

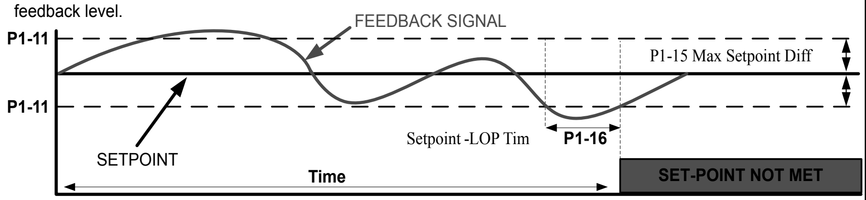
iQpump Factory Defaults Overview
(adjust certain settings specific to the application)

3 SLEEP MODE (Example)



4 PUMP SYSTEM FAULT SETUP

The iQpump can display a '**Setpoint Not Met**' fault when the iQpump is unable to maintain the programmed system setpoint due a problem with the pump system. Set P1-15 to the maximum allowed difference between setpoint and feedback level.

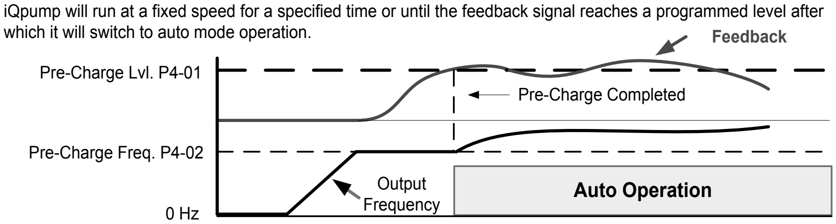


5 LOW/HIGH FEEDBACK LEVEL DETECTION

iQpump continuously monitors the system feedback signal. To display a '**Low Feedback**' fault set the low feedback level parameter P1-08 to the minimum feedback level allowed for your system and to display a '**High Feedback**' fault set the high feedback level parameter P1-11 to the maximum feedback level allowed.

6 PRE-CHARGE OPERATION

This function is used when the pump system requires to be pre-charged before normal operation. Upon start the iQpump will run at a fixed speed for a specified time or until the feedback signal reaches a programmed level after which it will switch to auto mode operation.

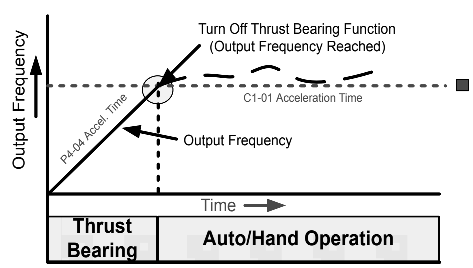


P4-01 Pre-Charge Level: Specified feedback level to stop pre-charge operation
P4-02 Pre-Charge Frequency: Set desired pre-charge speed
P4-03 Pre-Charge Time: Specified maximum pre-charge operation time

7 THRUST BEARING - SUBMERSIBLE MOTORS

When **using** a submersible motor in combination with the iQpump, it is recommended to use the **Thrust Bearing** function to prevent excess motor wear. To enable this function, enter the minimum motor frequency in parameter P4-11. Example: Minimum motor speed 1800 RPM, 1800 RPM ÷ 3600 RPM x 60.0 Hz = **30.0 Hz**

Thrust Acceleration Time P4-11
(Example 1.0 sec.)
Thrust Bearing Frequency P4-12
(Example 30.0 Hz)



8 AUTO OPERATION – POWER DOWN STORAGE

Allows iQpump to automatically start after power failure when operated from keypad / digital operator. This function is recommended for use when operating the iQpump in remote / unmanned areas. Use parameter P4-10 to enable.

⚠ When the iQpump is powered down while running, an internal run command will automatically be initiated upon power-up.

Step 8 Pump Rotation and Feedback Signal Check

In this step the motor is checked for proper direction and operation. This test is to be performed solely from the digital operator. Apply power to the iQpump after all the electrical connections have been made and protective covers have been re-attached. At this point, DO NOT RUN THE MOTOR, the Digital Operator should display as shown in **Fig. 3**.

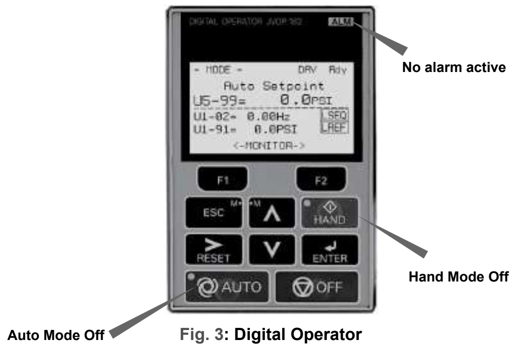


Fig. 3: **Digital Operator**

Motor Rotation Test

Next, push [HAND] on the Digital Operator; the display should read

and the **HAND** LED should be **ON**.

The motor should now be operating at in the correct direction of pump.

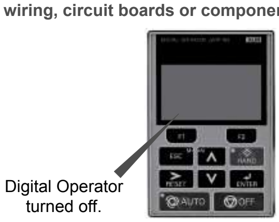
Push [OFF] on the Digital Operator; the display should read as in Fig. 3.

Press [ENTER] to access Hand Speed. Use [∧] [∨] [RESET] to change Hand Speed value. Press [ENTER] to save value.

If the direction is not correct, then power down the iQpump and follow Instructions below.

DANGER

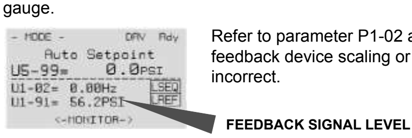
After the power has been turned OFF, wait at least five minutes until the charge indicator extinguishes completely before touching any wiring, circuit boards or components.



Use precaution, and refer to **Fig.1 or 2,** swap any **two** of the **three** output leads to the motor (U/T1, V/T2 and W/T3). After the wiring change, repeat **Step 8** and recheck motor direction.

FEEDBACK SIGNAL CHECK

Verify feedback on display (show keypad) matches mechanical pressure gauge.



Refer to parameter P1-02 and P1-03, if the feedback device scaling or system units are incorrect.

Step 9 Auto Mode Operation

AUTO MODE

The iQpump can be operated in AUTO mode when the following actions have been performed:

- All parameters are programmed
- Motor direction has been checked
- Auto Mode: Reference source selected in parameter b1-01 (See step 3)
- Auto Mode: Run source selected in parameter b1-02 (See Step 3)

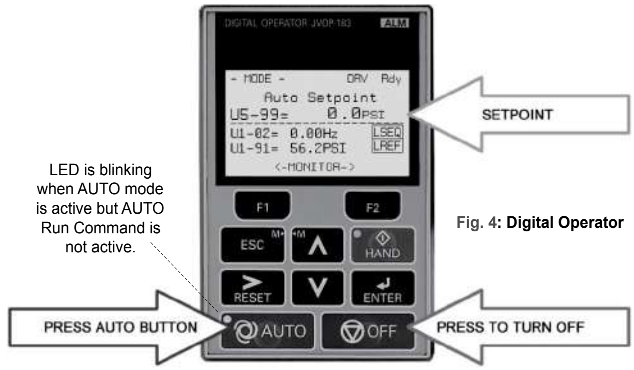


Fig. 4: **Digital Operator**

Press the **AUTO** button to put the iQpump into AUTO mode.

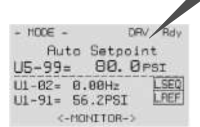
In AUTO mode the iQpump is capable of starting or stopping based on the Run Source Selection setting parameter b1-02. (See Step 3 Select Start/Stop Control Method) The setpoint used in AUTO mode is based on the Reference Source Selection setting parameter b1-01. (See Step 3 Select Speed Method)

SET SYSTEM SETPOINT

Next, press [ENTER] to access or modify the system setpoint that was entered using parameter Q1-01 System Setpoint in the iQpump Quick Setup Menu

Use [RESET] to select the digit and [∧] [∨] to change the system setpoint.

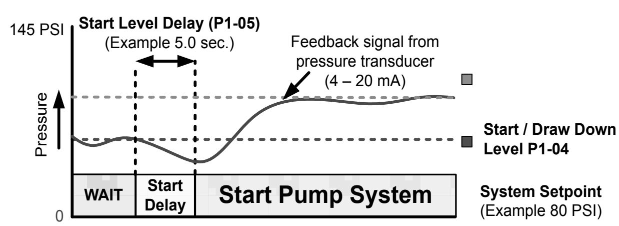
Next press [ENTER] to store setpoint and press [F1] to return to the main operation menu.



Next, press the **AUTO** button to start the iQpump.

Example: 80 PSI

iQpump automatically starts in Auto Mode when the feedback signal level falls below the programmed level in parameter P1-04 for the specified time in P1-05.



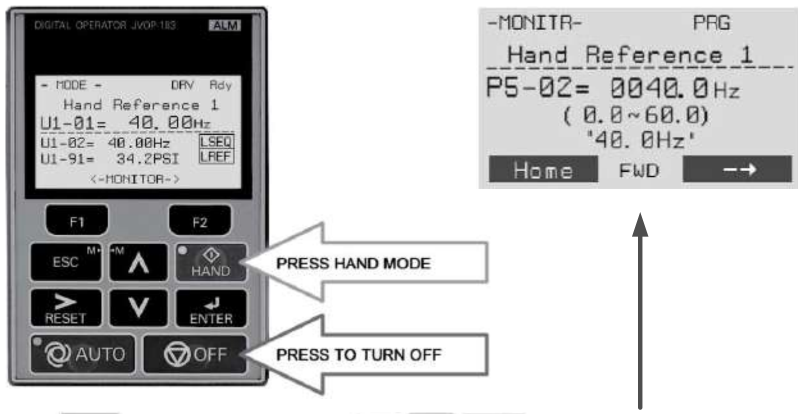
Refer to Illustration 2 on Page 3 of 4 for additional information on the Start Level Function.

Step 10 Hand Mode Operation

HAND MODE

The iQpump can be operated in HAND mode when the following actions have been performed:

- All parameters are programmed
- Motor direction has been checked

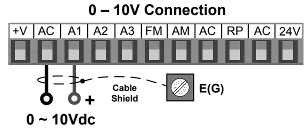


Press ENTER to access Hand Speed. Use ∧ ∨ RESET to change Hand Speed value. Press ENTER to save value.

Hand Speed from Analog Input (0 – 10V)

Set parameter P5-01 ‘Hand Mode Ref.’ to ‘0’ to adjust the hand mode reference from an external 0 – 10V signal connected to terminal A1 and AC.

0 – 10V Connection



Sleep and Anti-No-Flow (ANF) Detection (P2-23, P2-24, P2-25)

NOTE: Before adjusting Anti-No-Flow operation ensure your system is regulating satisfactory while operating under normal running conditions.

If stable continue to Step 1 to verify no-flow/sleep operation. If unstable turn off the Anti-No-Flow function (P2-23 = 0.00%) and adjust the PI control parameters b5-02 and b5-03 to stabilize pump system. Refer to iQpump Quick Start Guide (Document No.TOEP YAIP1W 01) for additional information. Once the system is stable, re-enable the Anti-No-Flow function by setting P2-23 to 0.40% and continue to Step 1 to verify no-flow/sleep operation.

Step 1: Verify system holds pressure by creating a no-flow situation (e.g. close off discharge valve).

Step 2: Press OFF button on the digital operator, wait 1 min. until system stabilizes and verify system pressure feedback U1-91. If the pressure drops more than 3 PSI (U1-91) adjust P2-25 to the actual delta pressure drop plus 1 PSI.

Example: Setpoint is 80 PSI, pressure feedback U1-91 shows 76 PSI, P2-25 should be 4 + 1 or 5 PSI.
Note: This value should always be more than your start level (P1-04). If not, the system pressure is not holding and this needs to be corrected, or the pump system will continue to cycle on and off.

Step 3: Run system in normal automatic operation with flow. Next check monitor U1-99 “ANF Timer” and verify that the value is incrementing and resetting back to zero continuously. If the value holds at 10 sec. (P2-24) increase P2-24 “Anti-No-Flow Detection Time” by increments of 5 sec. Repeat Step 3 each time P2-24 is adjusted.

Step 4: Create a no-flow situation (e.g. close discharge valve) and monitor that U1-99 “ANF Timer” increments and holds at P2-24 time (value set in Step 3). Once the Anti-No-Flow timer expires the speed will reduce gradually until it reaches minimum pump speed (P1-06) where it will hold for 5 sec. (P2-03) before going to sleep.

Step 5: Run system in normal automatic operation and verify sleep and wake-up operation until system performs satisfactory.

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Table of Contents

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.

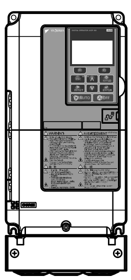
i.1 Preface

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.

This manual is designed to ensure correct and suitable application of drives. Read this manual before attempting to install, operate, maintain, or inspect a drive and keep it in a safe, convenient location for future reference. Be sure you understand all precautions and safety information before attempting application.

◆ Applicable Documentation

The following manuals are available for iQpump1000 drives:

	iQpump1000 AC Drive Quick Start Guide (TOEPYAIP1W01)
	Read this guide first. This guide is packaged together with the product and contains basic information required to install and wire the drive. It also gives an overview of fault diagnostics, maintenance, and parameter settings. The purpose of this guide 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.
	iQpump1000 AC Drive Technical Manual (SIEPYAIP1W01)
	This manual provides detailed information on parameter settings, drive functions, and MEMOBUS/Modbus specifications. Use this manual to expand drive functionality and to take advantage of higher performance features. This manual is available for download on our documentation website, www.yaskawa.com.
	iQpump1000 Simplified Setup Guide Sheet (TM.iQp1K.01)
	This sheet is packaged together with the drive and contains a step-by-step guide to enable the user to properly wire the drive and motor. It also describes simplex pump application configuration.

◆ 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 iQpump1000 Intelligent Pump Controller
- **BCD:** Binary Coded Decimal
- **H:** Hexadecimal Number Format
- **IGBT:** Insulated Gate Bipolar Transistor
- **kbps:** Kilobits per Second
- **MAC:** Media Access Control
- **Mbps:** Megabits per Second
- **r/min:** Revolutions per Minute
- **V/f:** V/f Control
- **OLV:** Open Loop Vector Control

◆ Trademarks

- CANopen is a trademark of CAN in Automation (CiA).
- CC-Link is a trademark of CC-Link Partner Association (CLPA).
- DeviceNet is a trademark of Open DeviceNet Vendor Association, Inc. (ODVA).
- PROFIBUS-DP is a trademark of PROFIBUS International (PI).

- MECHATROLINK-I/MECHATROLINK-II are trademarks of MECHATROLINK Members Association (MMA).
- 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 in models 4A0414 and larger, 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

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

Install adequate branch circuit protection according to applicable local codes and this Installation 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 maximum (200 V class) and 480 Vac maximum (400 V class), and 600 Vac maximum (600 V class) when protected by branch circuit protection devices specified in this supplement.

Crush Hazard

Do not use this drive in lifting applications without installing external safety circuitry to prevent accidental dropping of the load.

The drive does not possess built-in load drop protection for lifting applications.

Failure to comply could result in death or serious injury from falling loads.

Install electrical and/or mechanical safety circuit mechanisms independent of drive circuitry.

⚠ 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.

If a fuse is blown or a Ground Fault Circuit Interrupter (GFCI) is tripped, check the wiring and the selection of the peripheral devices.

Contact your supplier if the cause cannot be identified after checking the above.

Do not restart the drive immediately operate the peripheral devices if a fuse is blown or a GFCI is tripped.

Check the wiring and the selection of peripheral devices to identify the cause. Contact your supplier before restarting the drive or the peripheral devices if the cause cannot be identified.

Install adequate branch circuit short circuit protection per applicable codes.

Failure to comply could result in damage to the drive.

The drive is suitable for use on a circuit capable of delivering not more than 100,000 RMS symmetrical Amperes, 240 Vac maximum (200 V Class), 480 Vac maximum (400 V Class), and 600 Vac maximum (600 V Class) when protected by Bussmann Type FWH or FWP fuses as specified in *Factory Recommended Branch Circuit Protection* on page *336*.

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.

◆ General Application Precautions

■ Selection

Installing a Reactor

Use an AC reactor or DC link choke in the following situations:

- to suppress harmonic current.
- to smooth peak current that results from capacitor switching.
- when the power supply is above 600 kVA.
- when the drive is running from a power supply system with thyristor converters.

Note: A DC link choke is built in to drive models 2A0110 to 2A0415 ,4A0058 to 4A0675, and 5A0041 to 5A0242.

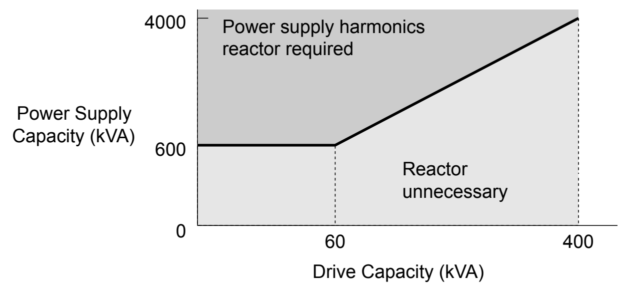


Figure i.1 Installing a Reactor

Single-Phase Input Selection

The drive is capable of single phase input. ***Refer to Main Circuit Connection Diagram on page 77*** for connection diagrams and ***Refer to Single-Phase Derating on page 247*** for application instructions and drive current ratings.

Drive Capacity

For specialized motors, make sure that the motor rated current is less than the rated output current for the drive.

When running more than one motor in parallel from a single drive, the capacity of the drive should be larger than [total motor rated current × 1.1].

■ Installation

Enclosure Panels

Keep the drive in a clean environment by installing the drive in an enclosure panel or selecting an installation area free of airborne dust, lint, and oil mist. Be sure to leave the required space between drives to provide for cooling, and take proper measures so the ambient temperature remains within allowable limits and keep flammable materials away from the drive. Yaskawa offers protective designs for drives that must be used in areas subjected to oil mist and excessive vibration. Contact Yaskawa or your Yaskawa agent for details.

Installation Direction

NOTICE: *Install the drive upright as specified in the manual.* ***Refer to Mechanical Installation on page 34*** *for more information on installation. Failure to comply may damage the drive due to improper cooling.*

■ Settings

Upper Limits

NOTICE: *The drive is capable of running the motor up to 400 Hz. Be sure to set the upper limit for the frequency of the drive to prevent the possible danger of accidentally operating equipment at higher than rated speed. The default setting for the maximum output frequency is 60 Hz.*

Lower Limits

NOTICE: *Many pumps have a minimum safe operating speed. Be sure to properly set the minimum pump speed in to protect the pump from damage.*

DC Injection Braking

NOTICE: *Excessive current during DC Injection Braking and excessive duration of DC Injection Braking can cause motor overheat.*

Acceleration/Deceleration Times

Acceleration and deceleration times are affected by the amount of torque generated by the motor, the load torque, and the inertia moment. Set a longer accel/decel time when Stall Prevention is enabled. The accel/decel times are lengthened for as long as the Stall Prevention function is in operation.

■ General Handling

Wiring Check

NOTICE: *Do not connect power supply lines to output terminals U/T1, V/T2, or W/T3. Failure to comply will destroy the drive. Be sure to perform a final check of all sequence wiring and other connections before turning on the power and also check for short circuits on the control terminals, which may damage the drive.*

Selecting a Circuit Breaker or Circuit Interrupter

Yaskawa recommends installing a Ground Fault Circuit Interrupter (GFCI) to the power supply side. The GFCI should be designed for use with AC drives (e.g., Type B according to IEC 60755).

Select a Molded Case Circuit Breaker (MCCB) or GFCI with a rated current 1.5 to 2 times higher than the drive rated input current to avoid nuisance trips caused by harmonics in the drive input current.

Magnetic Contactor Installation

NOTICE: *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.*

Inspection and Maintenance

WARNING! *Electrical Shock Hazard. Capacitors in the drive do not immediately discharge after shutting off the power. Wait for at least the amount of time specified on the drive before touching any components after shutting off the power. Failure to comply may cause injury to personnel from electrical shock.*

WARNING! *Burn Hazard. Because the heatsink can get very hot during operation, take proper precautions to prevent burns. When replacing the cooling fan, shut off the power and wait at least 15 minutes to be sure that the heatsink has cooled down. Failure to comply may cause burn injury to personnel.*

Wiring

Yaskawa recommends using ring terminals on all drive models. Drive models 2A0069 to 2A0415, 4A0058 to 4A0675, and 5A0041 to 5A0242 require the use of use ring terminals for UL/cUL compliance. Use only the tools recommended by the terminal manufacturer for crimping.

Transporting the Drive

NOTICE: *Never steam clean the drive. During transport, keep the drive from coming into contact with salts, fluorine, bromine, phthalate ester, and other such harmful chemicals.*

◆ Motor Application Precautions

■ Standard Induction Motors

Insulation Tolerance

NOTICE: *Consider motor voltage tolerance levels and motor insulation in applications with an input voltage of over 440 V or particularly long wiring distances.*

High-Speed Operation

NOTICE: *Problems may occur with the motor bearings and dynamic balance of the machine when operating a motor beyond its rated speed. Contact the motor or machine manufacturer.*

Torque Characteristics

Torque characteristics differ compared to operating the motor directly from line power. The user should have a full understanding of the load torque characteristics for the application.

Vibration and Shock

The drive allows selection of high carrier PWM control and low carrier PWM. Selecting high carrier PWM can help reduce motor oscillation (drive current derating may be required).

Take particular caution when adding a variable speed drive to an application running a motor from line power at a constant speed. If resonance occurs, use shock absorbing mounts to the motor base and enable the Jump frequency selection to prevent continuous operation in the resonant frequency range.

Audible Noise

The audible noise of the motor varies based on the carrier frequency setting. However, drive current derating may be required. When using a high carrier frequency, audible noise from the motor is comparable to the motor noise generated when running from line power.

■ Specialized Motors

Submersible Motor

The rated current of a submersible motor is greater than that of a standard motor, so select the drive capacity accordingly. Use a motor cable large enough to avoid decreasing the maximum torque level from voltage drop caused by a long motor cable.

Explosion-Proof Motor

The motor and the drive must be tested together to be certified as explosion-proof. The drive is not designed for explosion-proof areas.

Geared Motor

Make sure that the gear and the lubricant are rated for the desired speed range to avoid gear damage when operating at low speeds or very high speeds. Consult with the manufacturer for applications that require operation outside the rated speed range of the motor or gear box.

Single-Phase Motor

Variable speed drives are not designed to operate with single phase motors. Using capacitors to start the motor causes excessive current to flow and can damage drive components. A split-phase start or a repulsion start can burn out the starter coils because the internal centrifugal switch is not activated. The drive is for use with three-phase motors only.

■ Notes on Power Transmission Machinery

Installing an AC drive in machinery that was previously connected directly to the power supply will allow the machine to operate at variable speeds. Continuous operation outside of the rated speeds can wear on lubrication material in gear boxes and other power transmission parts. Make sure that lubrication is sufficient within the entire speed range to avoid machine damage. Note that operation above the rated speed can increase the noise generated by the machine.

◆ Drive Label Warning Example

Always heed the warning information listed in *Figure i.2* in the position shown in *Figure i.3*.

⚠ WARNING

Risk of electric shock.
- Read manual before installing.
- Wait 5 minutes for capacitor discharge after disconnecting power supply.
- To conform to CE requirements, make sure to ground the supply neutral for 400V class.
- After opening the manual switch between the drive and motor, please wait 5 minutes before inspecting, performing maintenance or wiring the drive.

Hot surfaces
- Top and Side surfaces may become hot. Do not touch.

Figure i.2 Warning Information Example

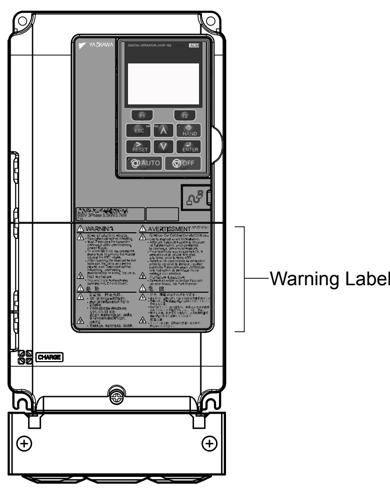


Figure i.3 Warning Information Position

◆ Warranty Information

■ Restrictions

The drive is not designed or manufactured for use in devices or systems that may directly affect or threaten human lives or health.

Customers who intend to use the product described in this manual for devices or systems relating to transportation, health care, space aviation, atomic power, electric power, or in underwater applications must first contact their Yaskawa representatives or the nearest Yaskawa sales office.

WARNING! *Injury to Personnel. This product has been manufactured under strict quality-control guidelines. However, if this product is to be installed in any location where failure of this product could involve or result in a life-and-death situation or loss of human life or in a facility where failure may cause a serious accident or physical injury, safety devices must be installed to minimize the likelihood of any accident.*

1

Receiving

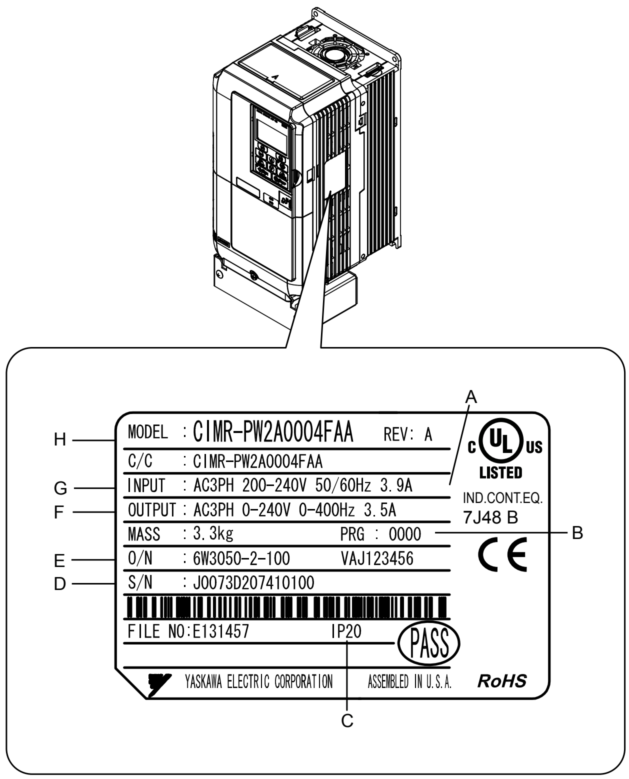
This chapter explains how to inspect the drive upon receipt, and gives an overview of the different enclosure types and components.

1.1 Model Number and Nameplate Check

Please perform the following tasks after receiving the drive:

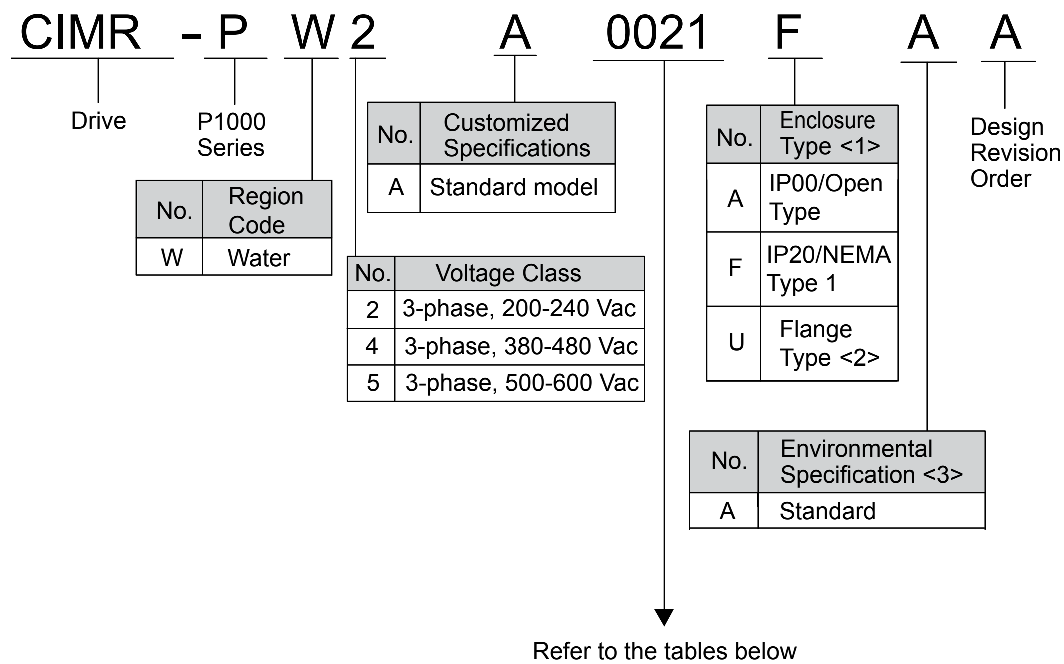
- Inspect the drive for damage.
  If the drive appears damaged upon receipt, contact the shipper immediately.
- Verify receipt of the correct model by checking the information on the nameplate.
- If you have received the wrong model or the drive does not function properly, contact your supplier.

◆ Nameplate



A – Normal Duty Amps
B – Software version
C – Enclosure type
D – Serial number
E – Lot number
F – Output specifications
G – Input specifications
H – AC drive model

Figure 1.1 Nameplate Information Example



<1> *Refer to Mechanical Installation on page 34* for differences regarding enclosure protection types and component descriptions.

<2> Provides method of mounting drive with backside (heatsink) external to enclosure, with NEMA 12 integrity.

<3> Please contact Yaskawa for details regarding Environmental Specifications.

■ Three-Phase 200 V Class

Table 1.1 Model Number and Specifications (200 V Class)

Drive Model	Max. Motor Capacity kW (HP)	Rated Output Current A
2A0004	0.75 (0.75)	3.5
2A0006	1.1 (1)	6.0
2A0008	1.5 (2)	8.0
2A0010	2.2 (3)	9.6
2A0012	3.0 (3)	12
2A0018	3.7 (5)	17.5
2A0021	5.5 (7.5)	21
2A0030	7.5 (10)	30
2A0040	11 (15)	40
2A0056	15 (20)	56
2A0069	18.5 (25)	69
2A0081	22 (30)	81
2A0110	30 (40)	110
2A0138	37 (50)	138
2A0169	45 (60)	169
2A0211	55 (75)	211
2A0250	75 (100)	250
2A0312	90 (125)	312
2A0360	110 (150)	360
2A0415	110 (175)	415

Three-Phase 400 V Class

Table 1.2 Model Number and Specifications (400 V Class)

Drive Model	Max. Motor Capacity kW (HP)	Rated Output Current A
4A0002	0.75 (0.75)	2.1
4A0004	1.5 (2)	4.1
4A0005	2.2 (3)	5.4
4A0007	3.0 (3)	6.9
4A0009	3.7 (5)	8.8
4A0011	5.5 (7.5)	11.1
4A0018	7.5 (10)	17.5
4A0023	11 (15)	23
4A0031	15 (20)	31
4A0038	18.5 (25)	38
4A0044	22 (30)	44
4A0058	30 (40)	58
4A0072	37 (50)	72
4A0088	45 (60)	88
4A0103	55 (75)	103
4A0139	75 (100)	139
4A0165	90 (125)	165
4A0208	110 (150)	208
4A0250	132 (200)	250
4A0296	160 (250)	296
4A0362	185 (300)	362
4A0414	220 (350)	414
4A0515	250 (400-450)	515
4A0675	355 (500-550)	675

Three-Phase 600 V Class

Table 1.3 Model Number and Specifications (600 V Class)

Drive Model	Max. Motor Capacity kW (HP)	Rated Output Current A
5A0003	1.5 (2)	2.7
5A0004	2.2 (3)	3.9
5A0006	3.7 (5)	6.1
5A0009	5.5 (7.5)	9
5A0011	7.5 (10)	11
5A0017	11 (15)	17
5A0022	15 (20)	22
5A0027	18.5 (25)	27
5A0032	22 (30)	32
5A0041	30 (40)	41
5A0052	37 (50)	52
5A0062	45 (60)	62
5A0077	55 (75)	77
5A0099	75 (100)	99
5A0125	90 (125)	125
5A0145	110 (150)	145
5A0192	160 (200)	192
5A0242	185 (250)	242

Note: *Refer to Single-Phase Derating on page 247* for Single-Phase ratings.

2

Mechanical Installation

This chapter explains how to properly mount and install the drive.

2.1 Mechanical Installation

This section outlines specifications, procedures, and the environment for proper mechanical installation of the drive.

◆ Installation Environment

Install the drive in an environment matching the specifications in ***Table 2.1*** to help prolong the optimum performance life of the drive.

Table 2.1 Installation Environment

Environment	Conditions
Installation Area	Indoors
Ambient Temperature	-10 °C to +40 °C (IP20/NEMA Type 1 enclosure) -10 °C to +50 °C (IP00/Open Type enclosure) Drive reliability improves in environments without wide temperature fluctuations. When using the drive in an enclosure panel, install a cooling fan or air conditioner in the area to ensure that the air temperature inside the enclosure does not exceed the specified levels. Do not allow ice to develop on the drive.
Humidity	95% RH or less and free of condensation
Storage Temperature	-20 to +60 °C
Surrounding Area	Install the drive in an area free from: • oil mist and dust • metal shavings, oil, water, or other foreign materials • radioactive materials • combustible materials (e.g., wood) • harmful gases and liquids • excessive vibration • chlorides • direct sunlight.
Altitude	1000 m or lower, up to 3000 m with derating
Vibration	10 to 20 Hz at 9.8 m/s^2 20 to 55 Hz at 5.9 m/s^2 (Models 2A0004 to 2A0211, 4A0002 to 4A0165, and 5A0003 to 5A0099) or 2.0 m/s^2 (Models 2A0250 to 2A0415, 4A0208 to 4A0675, and 5A0125 to 5A0242)
Orientation	Install the drive vertically to maintain maximum cooling effects.

NOTICE: *Avoid placing drive peripheral devices, transformers, or other electronics near the drive as the noise created can lead to erroneous operation. If such devices must be used in close proximity to the drive, take proper steps to shield the drive from noise.*

NOTICE: *Prevent foreign matter such as metal shavings and wire clippings from falling into the drive during installation. Failure to comply could result in damage to the drive. Place a temporary cover over the top of the drive during installation. Remove the temporary cover before drive start-up, as the cover will reduce ventilation and cause the drive to overheat.*

◆ Installation Orientation and Spacing

Install the drive upright as illustrated in ***Figure 2.1*** to maintain proper cooling.

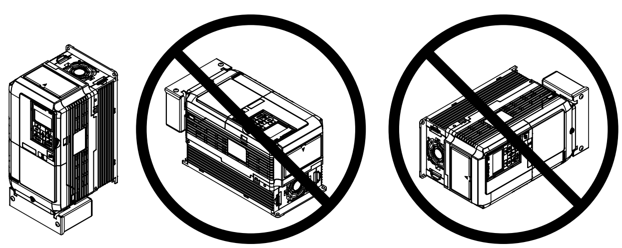
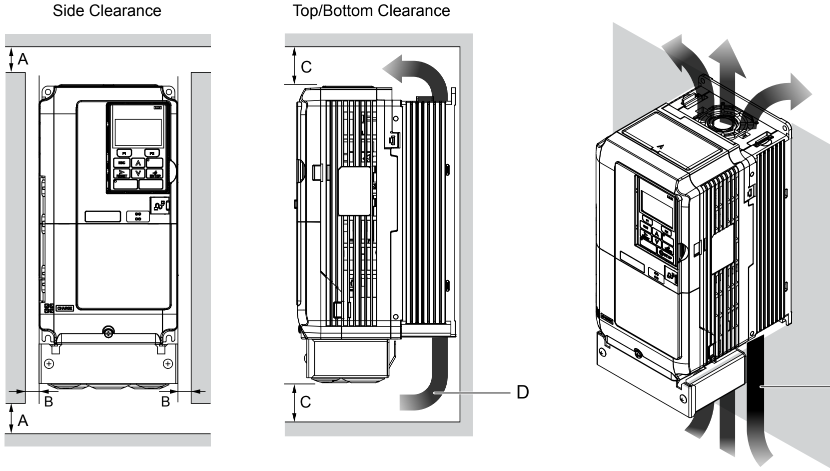


Figure 2.1 Correct Installation Orientation

■ Single Drive Installation

Figure 2.2 shows the installation distance required to maintain sufficient space for airflow and wiring. Install the heatsink against a closed surface to avoid diverting cooling air around the heatsink.



A – 50 mm minimum
B – 30 mm minimum
C – 120 mm minimum
D – Airflow direction

Figure 2.2 Correct Installation Spacing

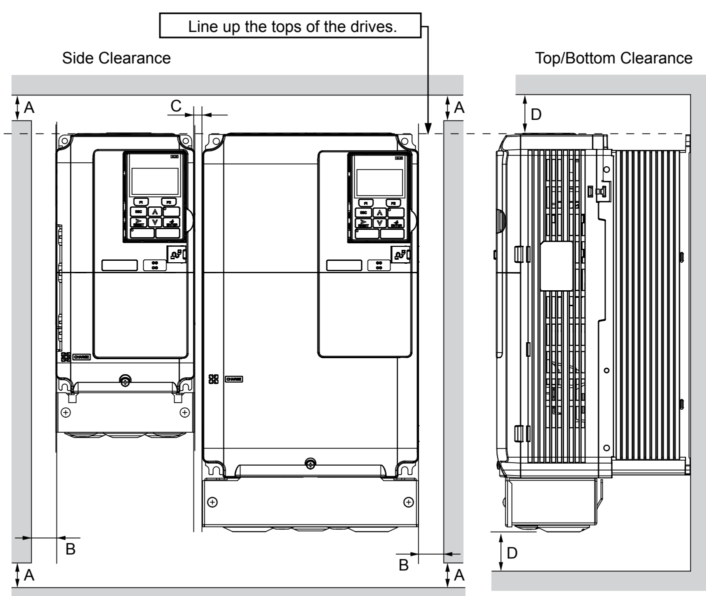
Note: IP20/NEMA Type 1 enclosure and IP00/Open Type enclosure models require the same amount of space above and below the drive for installation.

■ Multiple Drive Installation (Side-by-Side Installation)

Models 2A0004 to 2A0081, 4A0002 to 4A0044, and 5A0003 to 5A0032 can take advantage of Side-by-Side installation.

When installing multiple drives into the same enclosure panel, mount the drives according to *Figure 2.2* and set L8-35, Installation Method Selection, to 1 (Side-by-Side Mounting).

When mounting drives with the minimum clearance of 2 mm according to *Figure 2.3*, set parameter L8-35 to 1 while considering derating. *Refer to Parameter List on page 255* for details.



A – 50 mm minimum
B – 30 mm minimum
C – 2 mm minimum
D – 120 mm minimum

Figure 2.3 Space Between Drives (Side-by-Side Mounting)

Note: Align the tops of the drives when installing drives of different heights in the same enclosure panel. Leave space between the tops and bottoms of stacked drives for easier cooling fan replacement.

Mechanical Installation
2

Remove the top protective covers of all drives as shown in *Figure 2.4* when mounting IP20/NEMA Type 1 enclosure drives side-by-side. *Refer to Top Protective Cover on page 84* to remove and reattach the top protective cover.

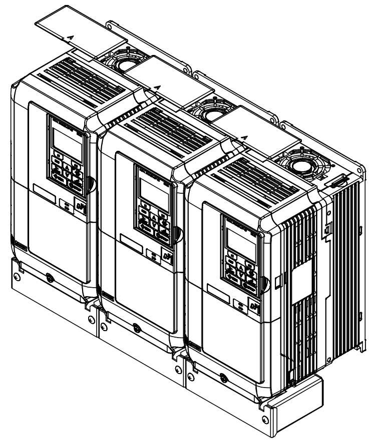


Figure 2.4 IP20/NEMA 1 Side-by-Side Mounting in Enclosure

◆ Transporting the Drive

CAUTION! *Do not lift the drive by the front cover. Failure to comply may result in minor or moderate injury if the main body of the drive falls.*

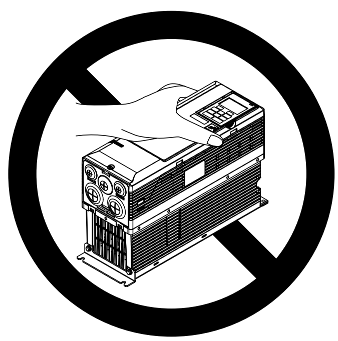


Figure 2.5 Incorrect Way to Transport the Drive

◆ HOA Keypad Remote Usage

■ Remote Operation

The HOA keypad mounted on the drive can be removed and connected to the drive using an extension cable up to 3 m (9.8 ft.) long to facilitate operation when the drive is installed in a location where it can not be easily accessed.

The HOA keypad can also be permanently mounted remote locations such as panel doors using an extension cable and an installation support set (depending on the installation type).

Note: *Refer to Peripheral Devices & Options on page 227* for information on extension cables and installation support sets.

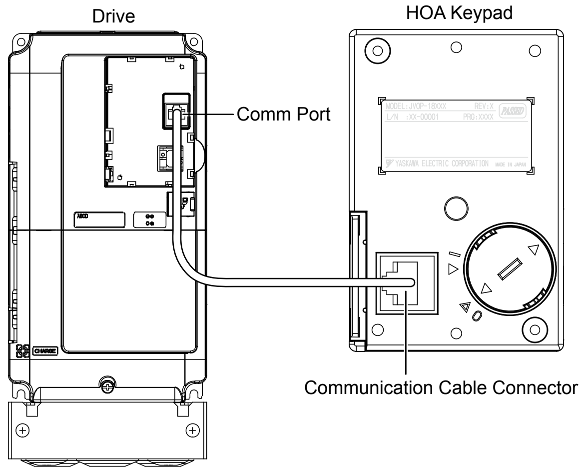


Figure 2.6 Communication Cable Connection

■ HOA Keypad Remote Installation

HOA Keypad Dimensions

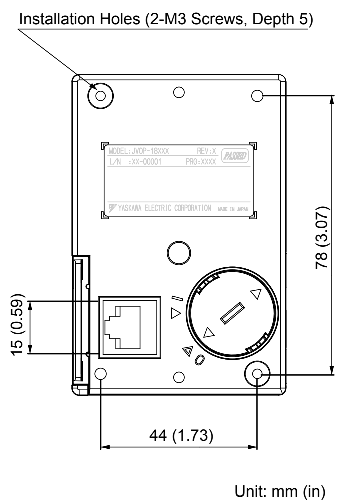


Figure 2.7 HOA Keypad Dimensions

Installation Types and Required Materials

The HOA keypad mounts to an enclosure two different ways:

- **External/face-mount** installs the HOA keypad outside the enclosure panel
- **Internal/flush-mount** installs the HOA keypad inside the enclosure panel

Table 2.2 HOA Keypad Installation Methods and Required Tools

Installation Method	Description	Installation Support Sets	Model	Required Tools
External/ Face-Mount	Simplified installation with the HOA keypad is mounted on the outside of the panel with two screws.	–	–	Phillips screwdriver (#1)
Internal/ Flush-Mount	Encloses the HOA keypad in the panel. The front of the HOA keypad is flush with the outside of the panel.	Installation Support Set A (for mounting with screws through holes in the panel)	EZZ020642A	Phillips screwdriver (#1, #2)
		Installation Support Set B (for use with threaded studs that are fixed to the panel)	EZZ020642B	Phillips screwdriver (#1) Wrench (7 mm)

NOTICE: *Prevent foreign matter such as metal shavings or wire clippings from falling into the drive during installation and project construction. Failure to comply could result in damage to the drive. Place a temporary cover over the top of the drive during installation. Remove the temporary cover before drive start-up, as the cover will reduce ventilation and cause the drive to overheat.*

Mechanical Installation

2

External/Face-Mount

1. Cut an opening in the enclosure panel for the HOA keypad as shown in *Figure 2.8*.
2. Position the HOA keypad so the display faces outwards, and mount it to the enclosure panel as shown in *Figure 2.9*.

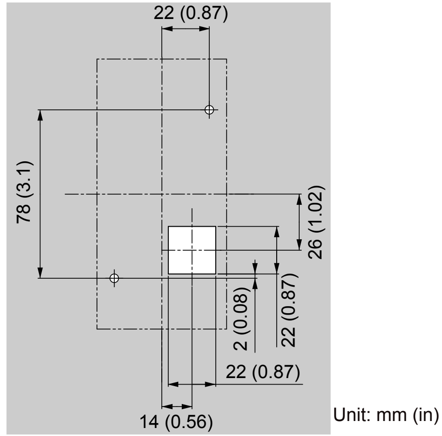


Figure 2.8 Panel Cut-Out Dimensions (External/Face-Mount Installation)

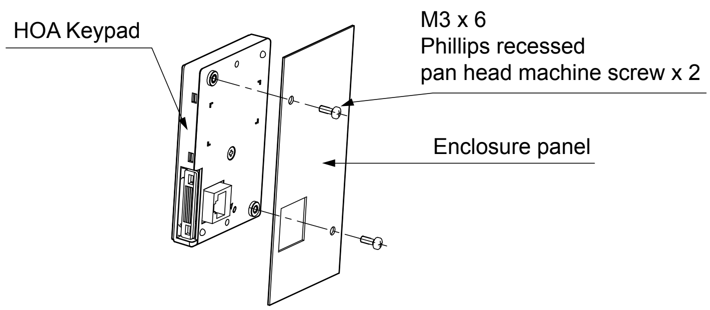


Figure 2.9 External/Face-Mount Installation

Internal/Flush-Mount

An internal/flush-mount requires an installation support set that must be purchased separately. Contact Yaskawa to order an installation support set and mounting hardware. *Figure 2.10* illustrates how to attach the Installation Support Set A.

1. Cut an opening in the enclosure panel for the HOA keypad as shown in *Figure 2.11*.
2. Mount the HOA keypad to the installation support.
3. Mount the installation support set and HOA keypad to the enclosure panel.

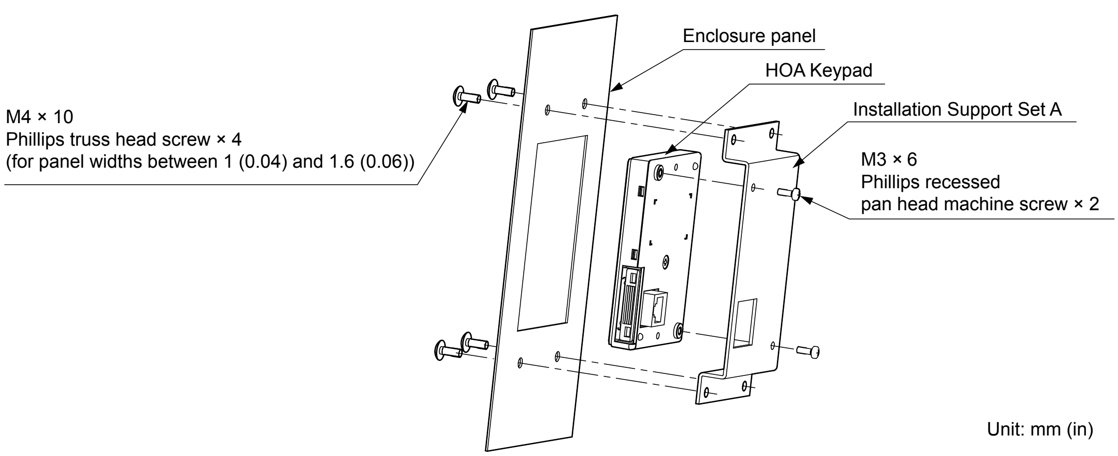
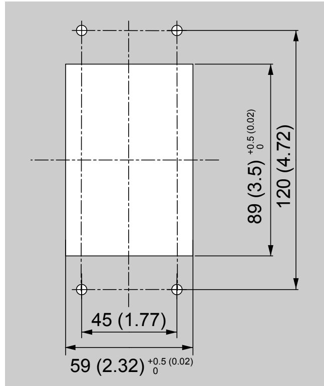


Figure 2.10 Internal/Flush Mount Installation

Note: Use a gasket between the enclosure panel and the HOA keypad in environments with a significant amount of dust or other airborne debris.



Unit : mm (in)

Figure 2.11 Panel Cut-Out Dimensions (Internal/Flush-Mount Installation)

◆ Exterior and Mounting Dimensions

Table 2.3 Drive Models and Types

Protective Design	Drive Model			Page
	Three-Phase 200 V Class	Three-Phase 400 V Class	Three-Phase 600 V Class	
IP20/NEMA Type 1 Enclosure	2A0004F 2A0006F 2A0008F 2A0010F 2A0012F 2A0018F 2A0021F 2A0030F 2A0040F 2A0056F 2A0069F 2A0081F 2A0110F 2A0138F 2A0169F 2A0211F	4A0002F 4A0004F 4A0005F 4A0007F 4A0009F 4A0011F 4A0018F 4A0023F 4A0031F 4A0038F 4A0044F 4A0058F 4A0072F 4A0088F 4A0103F 4A0139F 4A0165F	5A0003F 5A0004F 5A0006F 5A0009F 5A0011F 5A0017F 5A0022F 5A0027F 5A0032F 5A0041F 5A0052F 5A0062F 5A0077F 5A0099F	41
IP00/Open Type Enclosure	2A0250A <1> 2A0312A <1> 2A0360A <1> 2A0415A <2>	4A0208A <1> 4A0250A <1> 4A0296A <1> 4A0362A <1> 4A0414A <2> 4A0515A <2> 4A0675A <2> 4A0930A <2> 4A1200A <2>	5A0125A <1> 5A0145A <1> 5A0192A <1> 5A0242A <1>	45

Protective Design	Drive Model			Page
	Three-Phase 200 V Class	Three-Phase 400 V Class	Three-Phase 600 V Class	
Flange Type Enclosure (NEMA 12 Backside)	2A0004U 2A0006U 2A0008U 2A0010U 2A0012U 2A0018U 2A0021U 2A0030U 2A0040U 2A0056U 2A0069U 2A0081U 2A0110U 2A0138U 2A0169U 2A0211U 2A0250U 2A0312U 2A0360U 2A0415U	4A0002U 4A0004U 4A0005U 4A0007U 4A0009U 4A0011U 4A0018U 4A0023U 4A0031U 4A0038U 4A0044U 4A0058U 4A0072U 4A0088U 4A0103U 4A0139U 4A0165U 4A0208U 4A0250U 4A0296U 4A0362U 4A0414U 4A0515U 4A0675U	5A0003U 5A0004U 5A0006U 5A0009U 5A0011U 5A0017U 5A0022U 5A0027U 5A0032U 5A0041U 5A0052U 5A0062U 5A0077U 5A0099U 5A0125U 5A0145U 5A0192U 5A0242U	*48*

<1> Customers may convert these models to IP20/NEMA Type 1 enclosures using an IP20/NEMA Type 1 Kit. ***Refer to IP20/NEMA Type 1 Kit Selection on page 47*** to select the appropriate kit.

<2> Contact a Yaskawa representative for IP20/NEMA Type 1 Kit availability for these models.

■ IP20/NEMA Type 1 Enclosure Drives

Note: Removing the top protective cover or bottom conduit bracket from an IP20/NEMA Type 1 enclosure drive voids NEMA Type 1 protection while maintaining IP20 conformity.

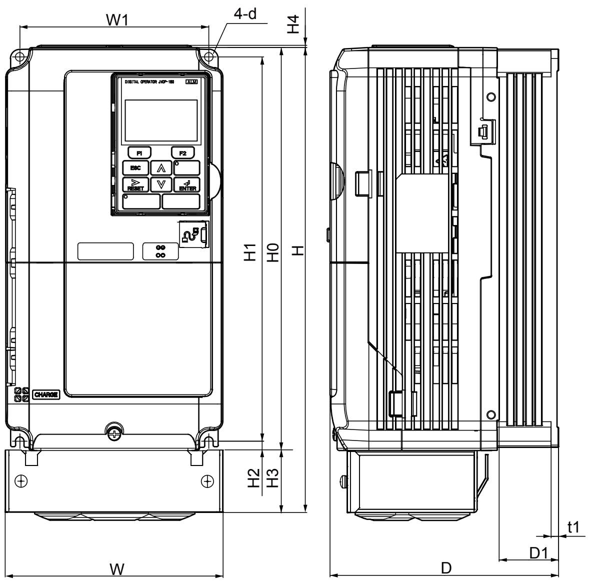


Figure 1

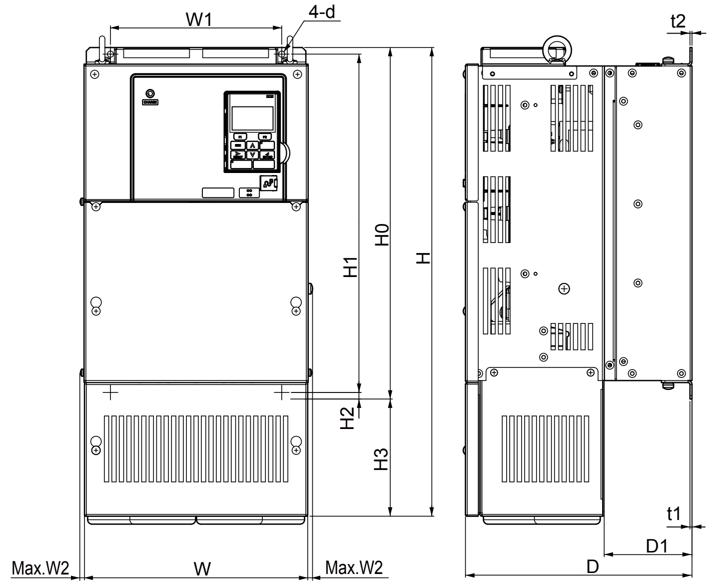


Figure 2

Table 2.4 Dimensions for IP20/NEMA Type 1 Enclosure: 200 V Class

Drive Model	Dimensions (in)															
	Figure	W	H	D	W1	W2	H0	H1	H2	H3	H4	D1	t1	t2	d	Wt. (lb)
2A0004F	1 <1>	5.51	11.81	5.79	4.80	–	10.24	9.76	0.24	1.57	0.06	1.50	0.20	–	M5	7.3
2A0006F		5.51	11.81	5.79	4.80	–	10.24	9.76	0.24	1.57	0.06	1.50	0.20	–	M5	7.3
2A0008F		5.51	11.81	5.79	4.80	–	10.24	9.76	0.24	1.57	0.06	1.50	0.20	–	M5	7.5
2A0010F		5.51	11.81	5.79	4.80	–	10.24	9.76	0.24	1.57	0.06	1.50	0.20	–	M5	7.5
2A0012F		5.51	11.81	5.79	4.80	–	10.24	9.76	0.24	1.57	0.06	1.50	0.20	–	M5	7.5
2A0018F		5.51	11.81	6.46	4.80	–	10.24	9.76	0.24	1.57	0.06	2.17	0.20	–	M5	8.2
2A0021F		5.51	11.81	6.46	4.80	–	10.24	9.76	0.24	1.57	0.06	2.17	0.20	–	M5	8.2
2A0030F		5.51	11.81	6.57	4.80	–	10.24	9.76	0.24	1.57	0.06	2.17	0.20	–	M5	9.3
2A0040F		5.51	11.81	6.57	4.80	–	10.24	9.76	0.24	1.57	0.06	2.17	0.20	–	M5	9.3
2A0056F		7.09	13.39	7.36	6.30	–	11.81	11.18	0.31	1.57	0.06	2.95	0.20	–	M5	13.0
2A0069F		8.66	15.75	7.76	7.56	–	13.78	13.19	0.31	1.97	0.06	3.07	0.20	–	M6	20.1
2A0081F		8.66	15.75	7.76	7.56	–	13.78	13.19	0.31	1.97	0.06	3.07	0.20	–	M6	22.0
2A0110F	2 <1>	10.00	21.02	10.16	7.68	0.31	15.75	15.16	0.30	5.28	–	3.94	0.09	0.09	M6	50.7
2A0138F		10.98	24.17	10.16	8.66	0.31	17.72	17.13	0.30	6.46	–	3.94	0.09	0.09	M6	61.7
2A0169F		12.95	28.74	11.14	10.24	0.31	21.65	21.06	0.30	7.09	–	4.33	0.09	0.09	M6	90.4
2A0211F		12.95	28.74	11.14	10.24	0.31	21.65	21.06	0.30	7.09	–	4.33	0.09	0.09	M6	92.6
Dimensions below are the dimensions of IP00/Open Type models after customer installation of the appropriate IP20/NEMA Type 1 Kit.																
2A0250A	2	17.95	37.80	12.99	12.80	0.31	27.76	26.77	0.49	10.04	–	5.12	0.13	0.13	M10	183.0
2A0312A		17.95	37.80	12.99	12.80	0.31	27.76	26.77	0.49	10.04	–	5.12	0.13	0.13	M10	194.0
2A0360A		19.84	45.98	13.78	14.57	0.31	31.50	30.43	0.51	14.49	–	5.12	0.18	0.18	M12	238.1

<1> Removing the top protective cover from a IP20/NEMA Type 1 enclosure drive voids NEMA Type 1 protection while retaining IP20 conformity.

Table 2.5 Dimensions for IP20/NEMA Type 1 Enclosure: 400 V Class

Drive Model	Dimensions (in)															
	Figure	W	H	D	W1	W2	H0	H1	H2	H3	H4	D1	t1	t2	d	Wt. (lb)
4A0002F	1 <1>	5.51	11.81	5.79	4.80	–	10.24	9.76	0.24	1.57	0.06	1.50	0.20	–	M5	7.5
4A0004F		5.51	11.81	5.79	4.80	–	10.24	9.76	0.24	1.57	0.06	1.50	0.20	–	M5	7.5
4A0005F		5.51	11.81	5.79	4.80	–	10.24	9.76	0.24	1.57	0.06	1.50	0.20	–	M5	7.5
4A0007F		5.51	11.81	6.46	4.80	–	10.24	9.76	0.24	1.57	0.06	2.17	0.20	–	M5	7.9
4A0009F		5.51	11.81	6.46	4.80	–	10.24	9.76	0.24	1.57	0.06	2.17	0.20	–	M5	8.2
4A0011F		5.51	11.81	6.46	4.80	–	10.24	9.76	0.24	1.57	0.06	2.17	0.20	–	M5	8.2
4A0018F		5.51	11.81	6.57	4.80	–	10.24	9.76	0.24	1.57	0.06	2.17	0.20	–	M5	9.0
4A0023F		5.51	11.81	6.57	4.80	–	10.24	9.76	0.24	1.57	0.06	2.17	0.20	–	M5	9.0
4A0031F		7.09	13.39	6.57	6.30	–	11.81	11.18	0.31	1.57	0.06	2.17	0.20	–	M5	12.6
4A0038F		7.09	13.39	7.36	6.30	–	11.81	11.18	0.31	1.57	0.06	2.95	0.20	–	M5	13.2
4A0044F		8.66	15.75	7.76	7.56	–	13.78	13.19	0.31	1.97	0.06	3.07	0.20	–	M6	19.2
4A0058F	2 <1>	10.00	18.31	10.16	7.68	0.31	15.75	15.16	0.30	2.56	–	3.94	0.09	0.09	M6	50.7
4A0072F		10.98	20.28	10.16	8.66	0.31	17.72	17.13	0.30	2.56	–	3.94	0.09	0.09	M6	59.5
4A0088F		12.95	24.80	10.16	10.24	0.31	20.08	19.49	0.30	4.72	–	4.13	0.09	0.13	M6	86.0
4A0103F		12.95	24.80	10.16	10.24	0.31	20.08	19.49	0.30	4.72	–	4.13	0.09	0.13	M6	86.0
4A0139F		12.95	28.74	11.14	10.24	0.31	21.65	21.06	0.30	7.09	–	4.33	0.09	0.09	M6	99.2
4A0165F		12.95	28.74	11.14	10.24	0.31	21.65	21.06	0.30	7.09	–	4.33	0.09	0.09	M6	101.4
Dimensions below are the dimensions of IP00/Open Type models after customer installation of the appropriate IP20/NEMA Type 1 Kit.																
4A0208A	2	17.95	37.80	12.99	12.80	0.31	27.76	26.77	0.49	10.04	–	5.12	0.13	0.13	M10	191.8
4A0250A		19.84	45.98	13.78	14.57	0.31	31.50	30.43	0.51	14.49	–	5.12	0.18	0.18	M12	233.7
4A0296A		19.84	45.98	13.78	14.57	0.31	31.50	30.43	0.51	14.49	–	5.12	0.18	0.18	M12	246.9
4A0362A		19.84	45.98	13.78	14.57	0.31	31.50	30.43	0.51	14.49	–	5.12	0.18	0.18	M12	257.9

<1> Removing the top protective cover from a IP20/NEMA Type 1 enclosure drive voids NEMA Type 1 protection while retaining IP20 conformity.

Table 2.6 Dimensions for IP20/NEMA Type 1 Enclosure: 600 V Class

Drive Model	Dimensions (in)															
	Figure	W	H	D	W1	W2	H0	H1	H2	H3	H4	D1	t1	t2	d	Wt. (lb)
5A0003F	1 <1>	5.51	11.81	5.79	4.80	–	10.24	9.76	0.24	1.57	0.06	1.50	0.20	–	M5	7.5
5A0004F		5.51	11.81	5.79	4.80	–	10.24	9.76	0.24	1.57	0.06	1.50	0.20	–	M5	7.5
5A0006F		5.51	11.81	6.46	4.80	–	10.24	9.76	0.24	1.57	0.06	2.17	0.20	–	M5	8.2
5A0009F		5.51	11.81	6.46	4.80	–	10.24	9.76	0.24	1.57	0.06	2.17	0.20	–	M5	8.2
5A0011F		5.51	11.81	6.57	4.80	–	10.24	9.76	0.24	1.57	0.06	2.17	0.20	–	M5	9.0
5A0017F		7.09	13.39	7.36	6.30	–	11.81	11.18	0.31	1.57	0.06	2.95	0.20	–	M5	13.2
5A0022F		7.09	13.39	7.36	6.30	–	11.81	11.18	0.31	1.57	0.06	2.95	0.20	–	M5	13.2
5A0027F		8.66	15.75	7.76	7.56	–	13.78	13.19	0.31	1.97	0.06	3.07	0.20	–	M6	19.2
5A0032F		8.66	15.75	7.76	7.56	–	13.78	13.19	0.31	1.97	0.06	3.07	0.20	–	M6	19.2
5A0041F	2	10.98	20.28	10.16	8.66	0.31	17.72	17.13	0.30	2.56	–	3.94	0.09	0.09	M6	59.5
5A0052F		10.98	20.28	10.16	8.66	0.31	17.72	17.13	0.30	2.56	–	3.94	0.09	0.09	M6	59.5
5A0062F		12.95	28.74	11.14	10.24	0.31	21.65	21.06	0.30	7.09	–	4.33	0.09	0.09	M6	99.2
5A0077F		12.95	28.74	11.14	10.24	0.31	21.65	21.06	0.30	7.09	–	4.33	0.09	0.09	M6	99.2
5A0099F		12.95	28.74	11.14	10.24	0.31	21.65	21.06	0.30	7.09	–	4.33	0.09	0.09	M6	99.2
Dimensions below are the dimensions of IP00/Open Type models after customer installation of the appropriate IP20/NEMA Type 1 Kit.																
5A0125A	2	17.95	37.80	12.99	12.80	0.31	27.76	26.77	0.49	10.04	–	5.12	0.13	0.13	M10	191.8
5A0145A		17.95	37.80	12.99	12.80	0.31	27.76	26.77	0.49	10.04	–	5.12	0.13	0.13	M10	191.8
5A0192A		19.84	45.98	13.78	14.57	0.31	31.50	30.43	0.51	14.49	–	5.12	0.18	0.18	M12	233.7
5A0242A		19.84	45.98	13.78	14.57	0.31	31.50	30.43	0.51	14.49	–	5.12	0.18	0.18	M12	257.9

<1> Removing the top protective cover or bottom conduit bracket from an IP20/NEMA Type 1 enclosure drive voids NEMA Type 1 protection while maintaining IP20 conformity.

IP20/NEMA Type 1 Enclosure Conduit Bracket Dimensions

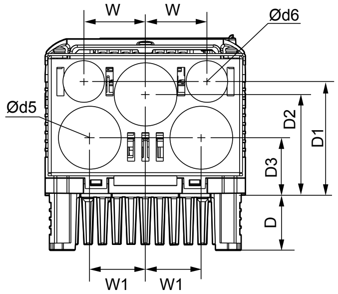


Figure 1

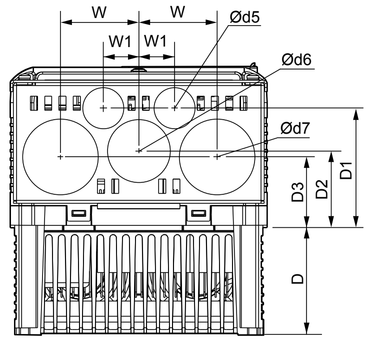


Figure 2

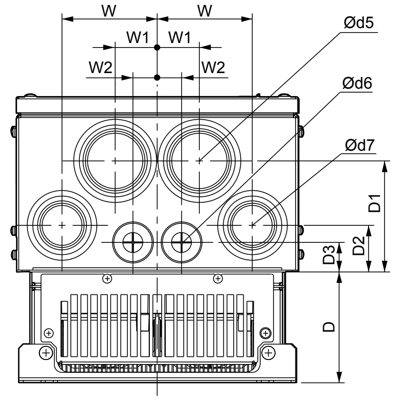


Figure 3

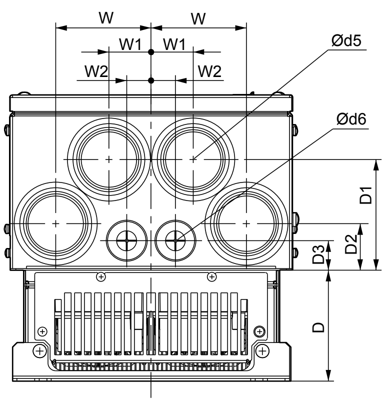


Figure 4

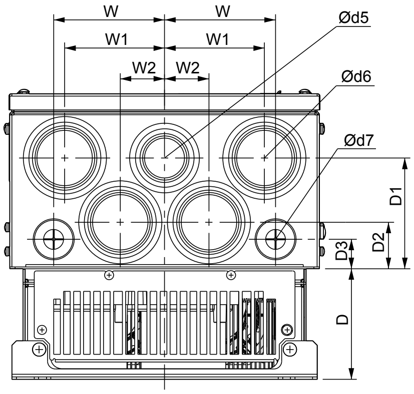


Figure 5

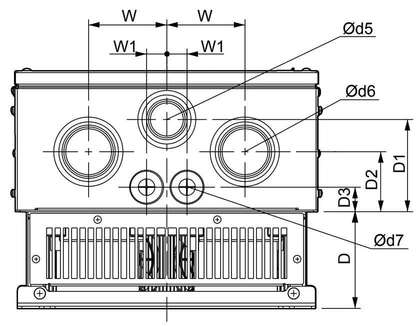


Figure 6

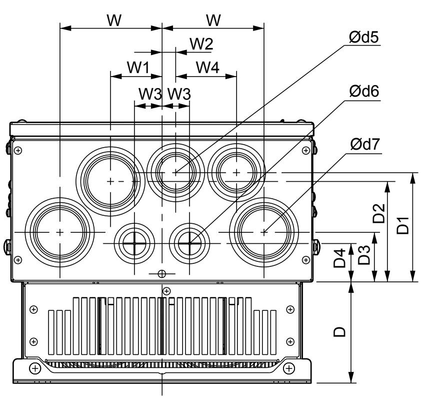


Figure 7

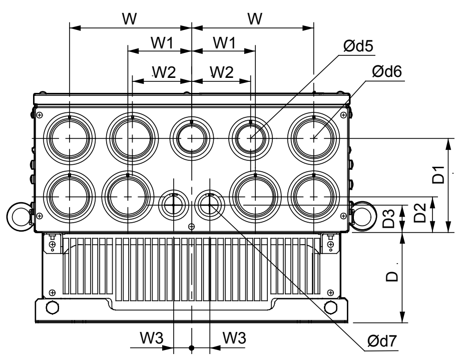


Figure 8

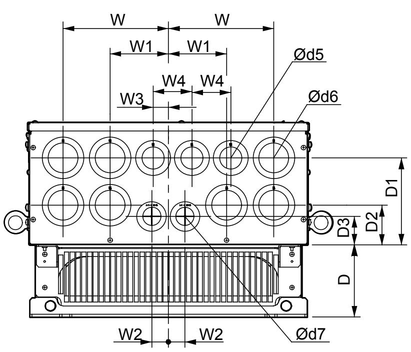


Figure 9

Table 2.7 Conduit Bracket Dimensions for IP20/NEMA Type 1

Drive Model	Dimensions (in)										Diameter (in)		
	Figure	W	D	W1	W2	W3	W4	D1	D2	D3	D4	d5	d6	d7
200 V Class														
2A0004F	1	1.7	1.5	1.5	–	–	–	1.6	2.8	3.1	–	0.9	1.4	–
2A0006F	1	1.7	1.5	1.5	–	–	–	1.6	2.8	3.1	–	0.9	1.4	–
2A0008F	1	1.7	1.5	1.5	–	–	–	1.6	2.8	3.1	–	–	–	–
2A0010F	1	1.7	1.5	1.5	–	–	–	1.6	2.8	3.1	–	0.9	1.4	–
2A0012F	1	1.7	2.2	1.5	–	–	–	1.6	2.8	3.1	–	0.9	1.4	–

Drive Model	Dimensions (in)										Diameter (in)		
	Figure	W	D	W1	W2	W3	W4	D1	D2	D3	D4	d5	d6	d7
2A0018F	2	1.7	2.2	1.5	–	–	–	1.6	2.8	3.1	–	1.4	0.9	1.7
2A0021F		1.7	2.2	1.5	–	–	–	1.6	2.8	3.1	–	1.4	0.9	1.7
2A0030F		1.7	2.2	1.5	–	–	–	1.6	2.8	3.1	–	1.4	0.9	1.7
2A0040F		1	3	2.2	–	–	–	1.9	3.3	2.1	–	1.4	0.9	1.7
2A0056F		1	3	2.2	–	–	–	1.9	3.3	2.1	–	1.4	0.9	1.7
2A0069F		1.1	3.1	2.5	–	–	–	2	3.4	2.2	–	1.4	0.9	1.7
2A0081F		1.1	3.1	2.5	–	–	–	2	3.4	2.2	–	1.4	0.9	1.7
2A0110F	4	3.4	3.9	1.5	0.9	–	–	3.9	1.7	1.0	–	2.4	1.1	–
2A0138F	5	3.9	3.9	3.5	1.6	–	–	3.9	1.7	1.0	–	2.0	2.4	1.1
2A0169F	7	4.4	4.3	2.2	0.6	1.2	2.6	4.7	4.3	2.1	1.6	2.0	1.4	2.4
2A0211F		4.4	4.3	2.2	0.6	1.2	2.6	4.7	4.3	2.1	1.6	2.0	1.4	2.4
2A0250A	8	6.9	5.1	3.6	3.3	1.0	–	5.4	2.0	1.6	–	2.0	2.4	1.4
2A0312A		6.9	5.1	3.6	3.3	1.0	–	5.4	2.0	1.6	–	2.0	2.4	1.4
2A0360A	9	7.5	5.1	4.1	1.2	1.1	2.8	6.2	2.8	2.0	–	2.0	2.4	1.7
400 V Class														
4A0002F	1	1.7	1.5	1.5	–	–	–	1.6	2.8	3.1	–	0.9	1.4	–
4A0004F		1.7	1.5	1.5	–	–	–	1.6	2.8	3.1	–	0.9	1.4	–
4A0005F		1.7	1.5	1.5	–	–	–	1.6	2.8	3.1	–	0.9	1.4	–
4A0007F		1.7	2.2	1.5	–	–	–	1.6	2.8	3.1	–	0.9	1.4	–
4A0009F		1.7	2.2	1.5	–	–	–	1.6	2.8	3.1	–	0.9	1.4	–
4A0011F		1.7	2.2	1.5	–	–	–	1.6	2.8	3.1	–	0.9	1.4	–
4A0018F		1.7	2.2	1.5	–	–	–	1.6	2.8	3.1	–	0.9	1.4	–
4A0023F	2	1	3	2.2	–	–	–	1.9	3.3	2.1	–	1.4	0.9	1.7
4A0031F		1	3	2.2	–	–	–	1.9	3.3	2.1	–	1.4	0.9	1.7
4A0038F		1.1	3.1	2.5	–	–	–	2	3.4	2.2	–	1.4	0.9	1.7
4A0044F		1.1	3.1	2.5	–	–	–	2	3.4	2.2	–	1.4	0.9	1.7
4A0058F	3	3.4	3.9	1.5	0.9	–	–	3.9	1.7	1.0	–	2.4	1.1	2.0
4A0072F		3.5	3.9	1.6	0.9	–	–	3.9	1.7	1.0	–	2.4	1.1	2.0
4A0088F	6	3.3	4.1	0.9	–	–	–	3.9	2.6	1.0	–	2.0	2.4	1.1
4A0103F		3.3	4.1	0.9	–	–	–	3.9	2.6	1.0	–	2.0	2.4	1.1
4A0139F	7	4.4	4.3	2.2	0.6	1.2	2.6	4.7	4.3	2.1	1.6	2.0	1.4	2.4
4A0165F		4.4	4.3	2.2	0.6	1.2	2.6	4.7	4.3	2.1	1.6	2.0	1.4	2.4
4A0208A	8	6.9	5.1	3.6	3.3	1.0	–	5.4	2.0	1.6	–	2.0	2.4	1.4
4A0250A	9	7.5	5.1	4.1	1.2	1.1	2.8	6.2	2.8	2.0	–	2.0	2.4	1.7
4A0296A		7.5	5.1	4.1	1.2	1.1	2.8	6.2	2.8	2.0	–	2.0	2.4	1.7
4A0362A		7.5	5.1	4.1	1.2	1.1	2.8	6.2	2.8	2.0	–	2.0	2.4	1.7
600 V Class														
5A0003F	1	1.7	1.5	1.5	–	–	–	1.6	2.8	3.1	–	0.9	1.4	–
5A0004F		1.7	1.5	1.5	–	–	–	1.6	2.8	3.1	–	0.9	1.4	–
5A0006F		1.7	2.2	1.5	–	–	–	1.6	2.8	3.1	–	0.9	1.4	–
5A0009F		1.7	2.2	1.5	–	–	–	1.6	2.8	3.1	–	0.9	1.4	–
5A0011F		1.7	2.2	1.5	–	–	–	1.6	2.8	3.1	–	0.9	1.4	–

Drive Model	Dimensions (in)											Diameter (in)		
	Figure	W	D	W1	W2	W3	W4	D1	D2	D3	D4	d5	d6	d7
5A0017F	2	1	3	2.2	–	–	–	1.9	3.3	2.1	–	1.4	0.9	1.7
5A0022F		1	3	2.2	–	–	–	1.9	3.3	2.1	–	1.4	0.9	1.7
5A0027F		1.1	3.1	2.5	–	–	–	2	3.4	2.2	–	1.4	0.9	1.7
5A0032F		1.1	3.1	2.5	–	–	–	2	3.4	2.2	–	1.4	0.9	1.7
5A0041F	3	3.5	3.9	1.6	0.9	–	–	3.9	1.7	1.0	–	2.4	1.1	2.0
5A0052F		3.5	3.9	1.6	0.9	–	–	3.9	1.7	1.0	–	2.4	1.1	2.0
5A0062F	7	4.4	4.3	2.2	0.6	1.2	2.6	4.7	4.3	2.1	1.6	2.0	1.4	2.4
5A0077F		4.4	4.3	2.2	0.6	1.2	2.6	4.7	4.3	2.1	1.6	2.0	1.4	2.4
5A0099F		4.4	4.3	2.2	0.6	1.2	2.6	4.7	4.3	2.1	1.6	2.0	1.4	2.4
5A0125A	8	6.9	5.1	3.6	3.3	1.0	–	5.4	2.0	1.6	–	2.0	2.4	1.4
5A0145A		6.9	5.1	3.6	3.3	1.0	–	5.4	2.0	1.6	–	2.0	2.4	1.4
5A0192A	9	7.5	5.1	4.1	1.2	1.1	2.8	6.2	2.8	2.0	–	2.0	2.4	1.7
5A0242A		7.5	5.1	4.1	1.2	1.1	2.8	6.2	2.8	2.0	–	2.0	2.4	1.7

Note: Removing the top protective cover or bottom conduit bracket from an IP20/NEMA Type 1 enclosure drive voids NEMA Type 1 protection while maintaining IP20 conformity.

■ IP00/Open Type Enclosure Drives

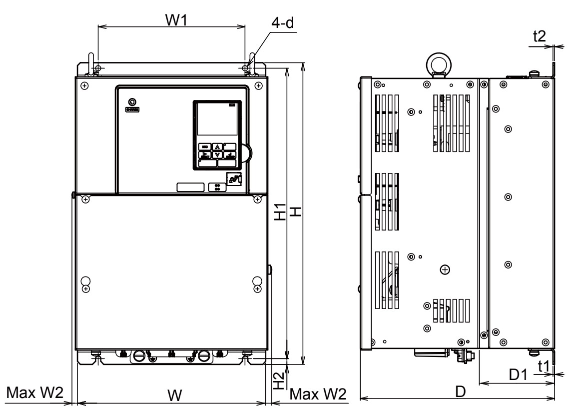


Figure 1

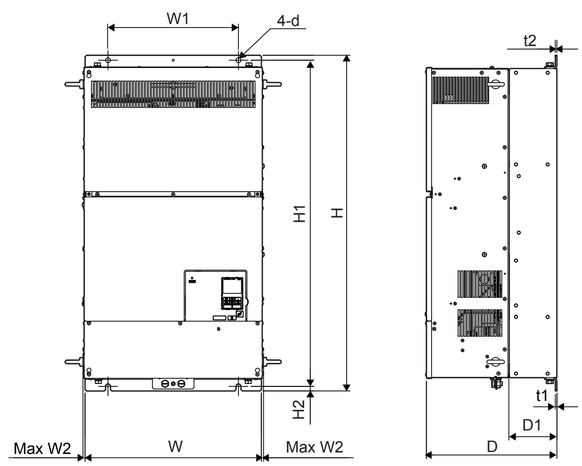


Figure 2

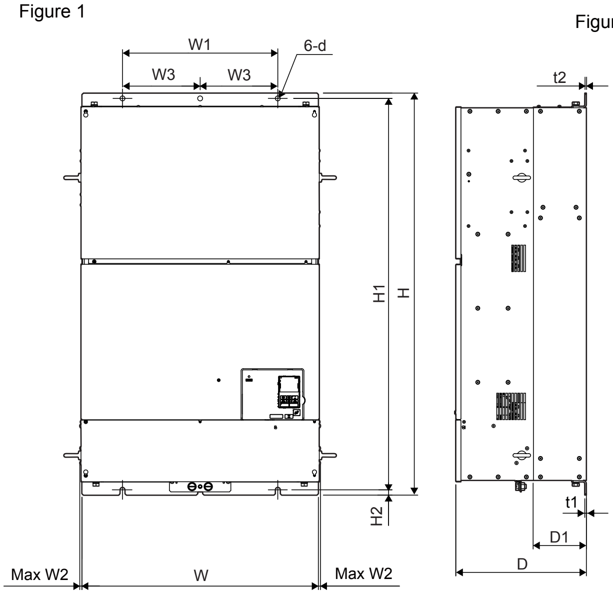


Figure 3

Table 2.8 Dimensions for IP00/Open Type Enclosure: 200 V Class

Drive Model	Dimensions (in)											
	Figure	W	H	D	W1	W2	H1	H2	D1	t1	t2	d	Wt. (lb)
2A0250A <1>	1	17.72	27.76	12.99	12.80	0.39	26.77	0.49	5.12	0.13	0.13	M10	167.6
2A0312A <1>	1	17.72	27.76	12.99	12.80	0.39	26.77	0.49	5.12	0.13	0.13	M10	176.4
2A0360A <1>	1	19.69	31.50	13.78	14.57	0.39	30.43	0.51	5.12	0.18	0.18	M12	216.1
2A0415A	1	19.69	31.50	13.78	14.57	0.39	30.43	0.51	5.12	0.18	0.18	M12	218.3

<1> Customers may convert these models to IP20/NEMA Type 1 enclosures using an IP20/NEMA Type 1 Kit. ***Refer to IP20/NEMA Type 1 Kit Selection on page 47*** to select the appropriate kit.

Table 2.9 Dimensions for IP00/Open Type Enclosure: 400 V Class

Drive Model	Dimensions (in)													
	Figure	W	H	D	W1	W2	W3	W4	H1	H2	D1	t1	t2	d	Wt. (lb)
4A0208A <1>	1	17.72	27.76	12.99	12.80	0.39	–	–	26.77	0.49	5.12	0.13	0.13	M10	174.2
4A0250A <1>	1	19.69	31.50	13.78	14.57	0.39	–	–	30.43	0.51	5.12	0.18	0.18	M12	211.6
4A0296A <1>	1	19.69	31.50	13.78	14.57	0.39	–	–	30.43	0.51	5.12	0.18	0.18	M12	224.9
4A0362A <1>	1	19.69	31.50	13.78	14.57	0.39	–	–	30.43	0.51	5.12	0.18	0.18	M12	235.9
4A0414A	2	19.69	37.40	14.57	14.57	0.31	–	–	36.34	0.51	5.31	0.18	0.18	M12	275.6
4A0515A	3	26.38	44.88	14.57	17.32	0.24	8.66	–	43.70	0.59	5.91	0.18	0.18	M12	476.2
4A0675A	3	26.38	44.88	14.57	17.32	0.24	8.66	–	43.70	0.59	5.91	0.18	0.18	M12	487.2

<1> Customers may convert these models to IP20/NEMA Type 1 enclosures using an IP20/NEMA Type 1 Kit. ***Refer to IP20/NEMA Type 1 Kit Selection on page 47*** to select the appropriate kit.

Table 2.10 Dimensions for IP00/Open Type Enclosure: 600 V Class

Drive Model	Dimensions (in)													
	Figure	W	H	D	W1	W2	W3	W4	H1	H2	D1	t1	t2	d	Wt. (lb)
5A0125A <1>	1	17.72	27.76	12.99	12.80	0.39	–	–	26.77	0.49	5.12	0.13	0.13	M10	174.2
5A0145A <1>	1	17.72	27.76	12.99	12.80	0.39	–	–	26.77	0.49	5.12	0.13	0.13	M10	174.2
5A0192A <1>	1	19.69	31.50	13.78	14.57	0.39	–	–	30.43	0.51	5.12	0.18	0.18	M12	235.9
5A0242A <1>	1	19.69	31.50	13.78	14.57	0.39	–	–	30.43	0.51	5.12	0.18	0.18	M12	235.9

<1> Customers may convert these models to IP20/NEMA Type 1 enclosures using an IP20/NEMA Type 1 Kit. ***Refer to IP20/NEMA Type 1 Kit Selection on page 47*** to select the appropriate kit.

IP20/NEMA Type 1 Kit Selection

Customers may convert IP00/Open Type models to IP20/NEMA Type 1 enclosures. Refer to *Table 2.11* to select the appropriate IP20/NEMA Type 1 Kit when performing the conversion.

Contact a Yaskawa representative for IP20/NEMA Type 1 Kit availability for IP00/Open Type models not listed.

Table 2.11 IP20/NEMA Type 1 Kit Selection

IP00/Open Type Drive Model	IP20/NEMA Type 1 Kit Code	Comments
2A0250A	100-054-503	*Refer to IP20/NEMA Type 1 Enclosure Drives on page 41* for drive dimensions with the IP20/NEMA Type 1 Kit installed.
2A0312A		
2A0360A		
4A0208A		
4A0250A	100-054-504	
4A0296A		
4A0362A		
5A0125A	100-054-503	
5A0145A		
5A0192A	100-054-504	
5A0242A		

■ Flange Type Enclosure (NEMA 12 Backside) Dimensions

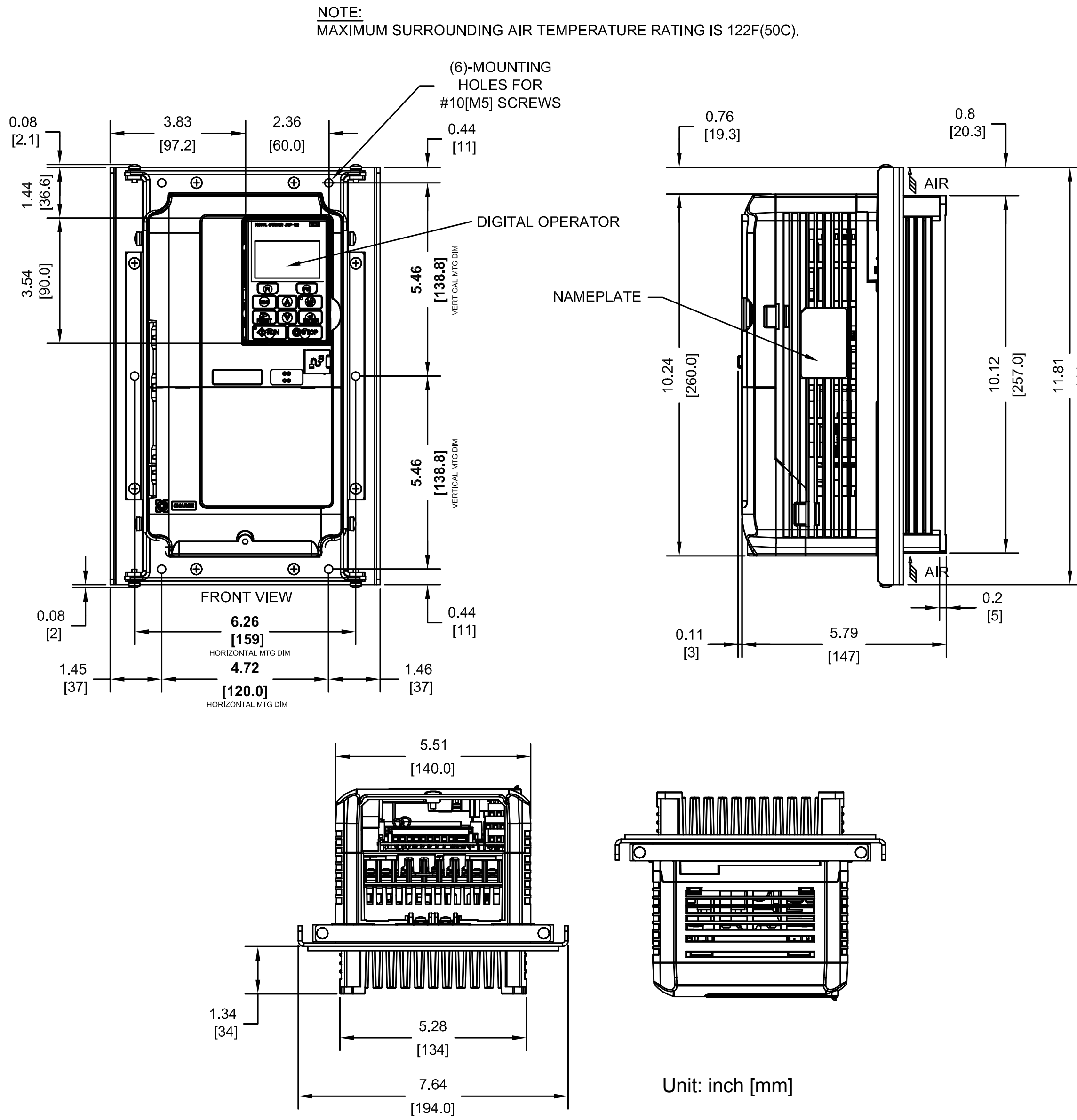


Figure 2.12 Models 2A0004U to 0012U, 4A0002U to 0005U, and 5A0003U and 0004U

Table 2.12 Weights for 2A0004U to 0012U, 4A0002U to 0005U, and 5A0003U and 0004U

Drive Model	2A0004U	2A0006U	2A0008U	2A0010U	2A0012U	4A0002U	4A0004U	4A0005U	5A0003U	5A0004U
Drive Weight lb (kg)	7.3 (3.3)	7.3 (3.3)	7.5 (3.4)	7.5 (3.4)	7.5 (3.4)	7.5 (3.4)	7.5 (3.4)	7.5 (3.4)	7.5 (3.4)	7.5 (3.4)

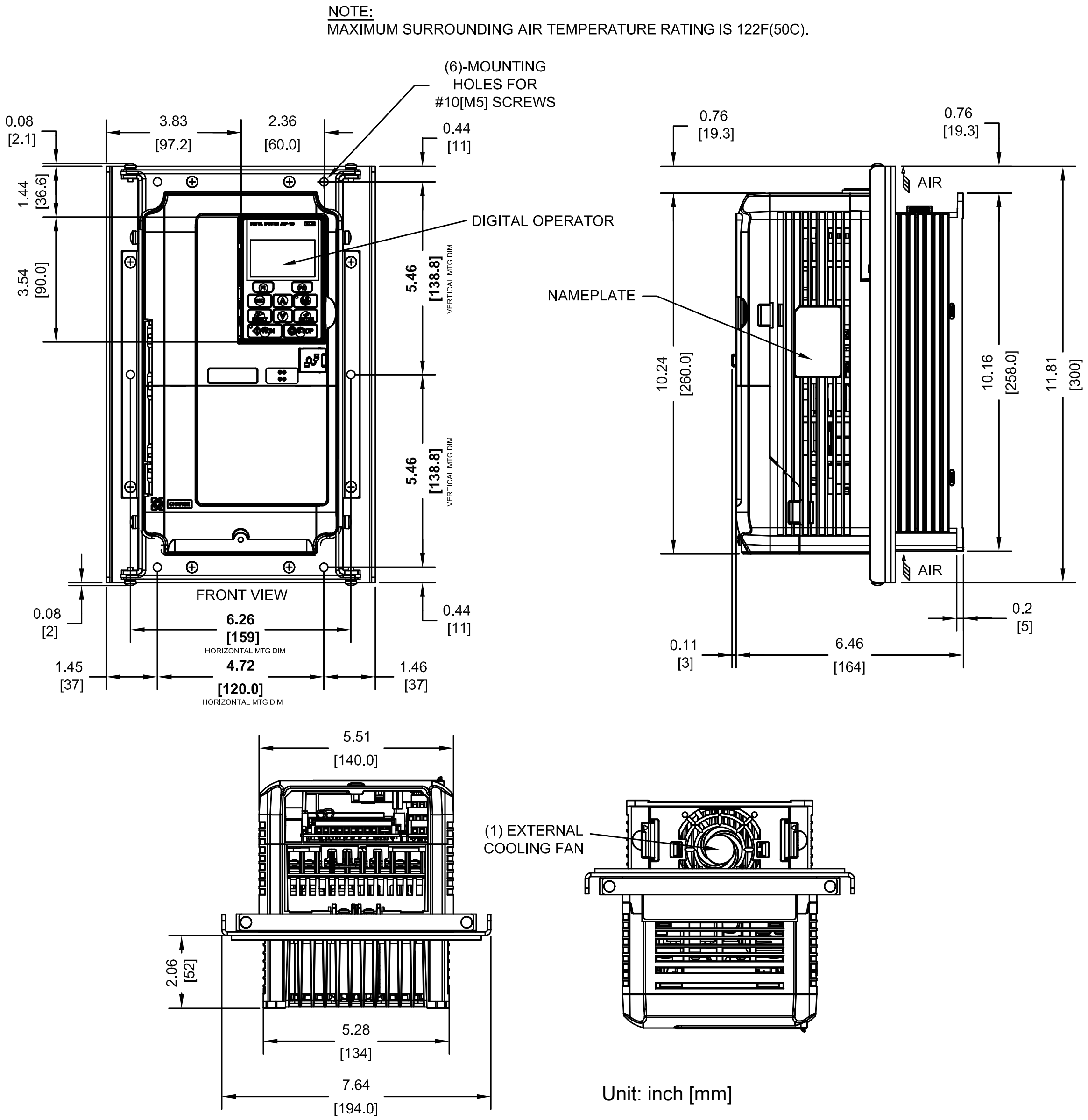


Figure 2.13 Models 2A0018U and 0021U, 4A0007U to 0011U, and 5A0006U and 0009U

Table 2.13 Weights for 2A0018U and 0021U, 4A0007U to 0011U, and 5A0006U and 0009U

Drive Model	2A0018U	2A0021U	4A0007U	4A0009U	4A0011U	5A0006U	5A0009U
Drive Weight lb (kg)	8.1 (3.7)	8.1 (3.7)	7.9 (3.6)	8.1 (3.7)	8.1 (3.7)	8.1 (3.7)	8.1 (3.7)

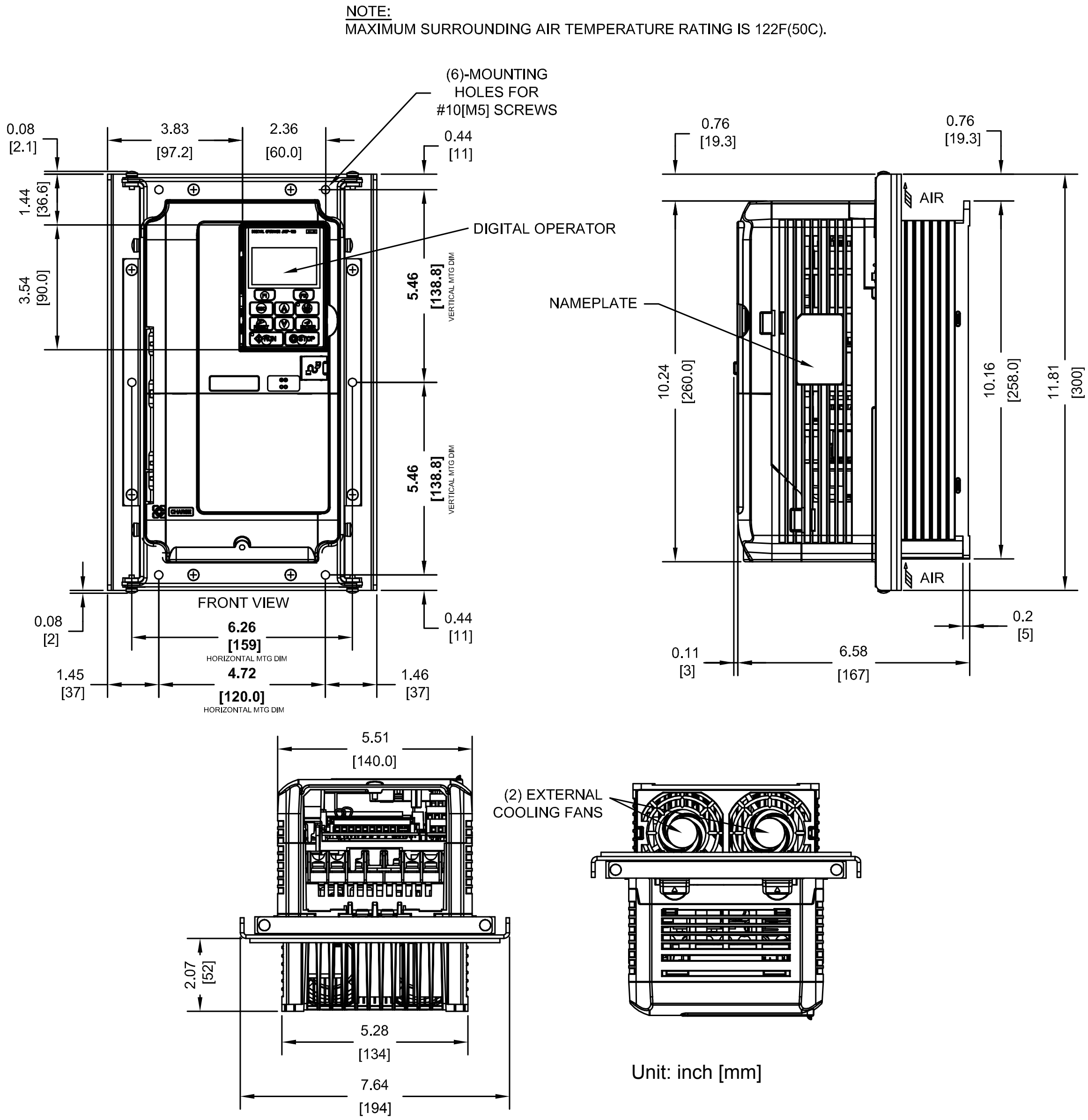


Figure 2.14 Models 2A0030U and 0040U, 4A0018U and 0023U, and 5A0011U

Table 2.14 Weights for 2A0030U and 0040U, 4A0018U and 0023U, and 5A0011U

Drive Model	2A0030U	2A0040U	4A0018U	4A0023U	5A0011U
Drive Weight lb (kg)	9.2 (4.2)	9.2 (4.2)	9.0 (4.1)	9.0 (4.1)	9.0 (4.1)

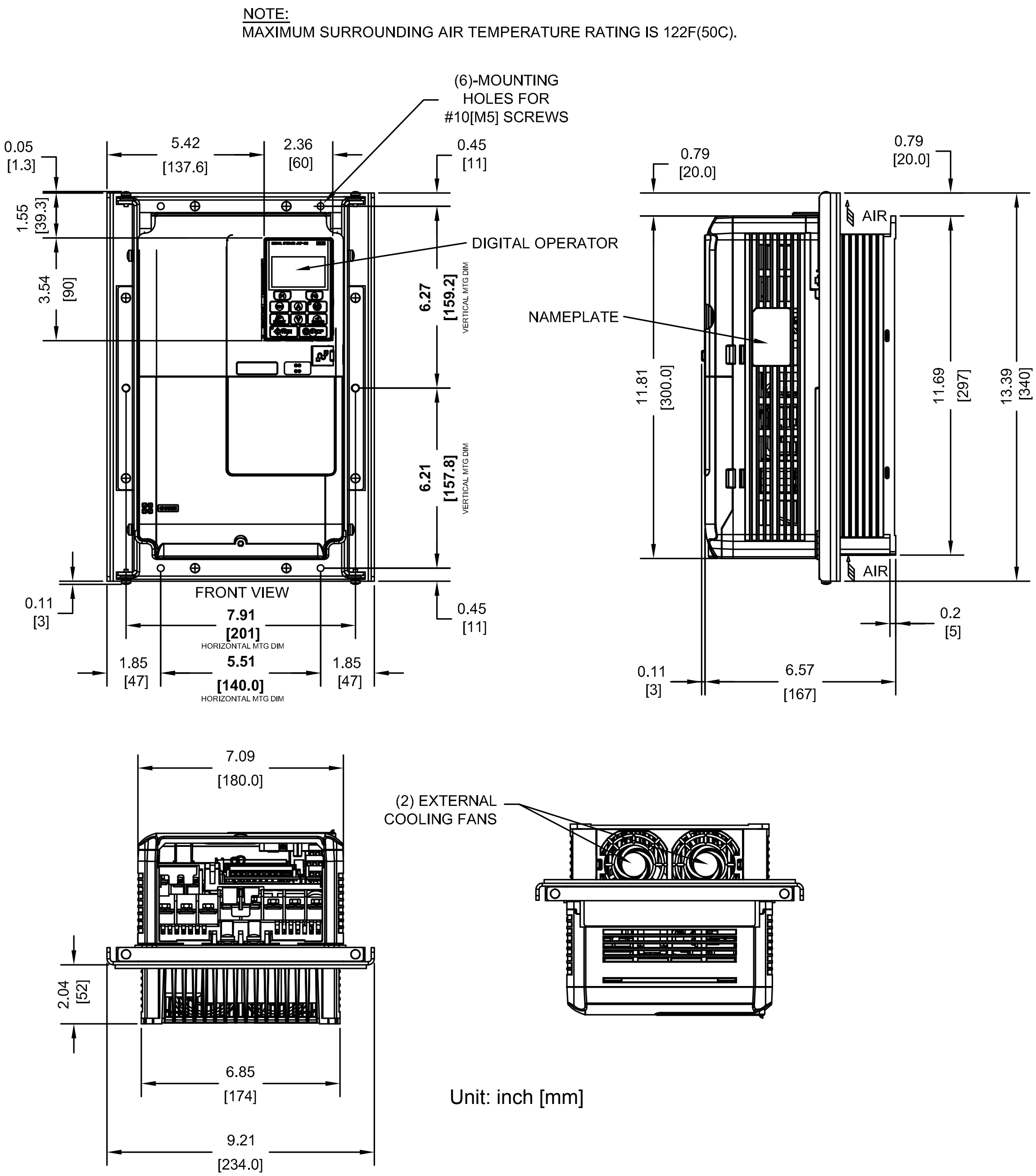


Figure 2.15 Model 4A0031U

Table 2.15 Weight for 4A0031U

Drive Model	4A0031U
Drive Weight lb (kg)	12.5 (5.7)

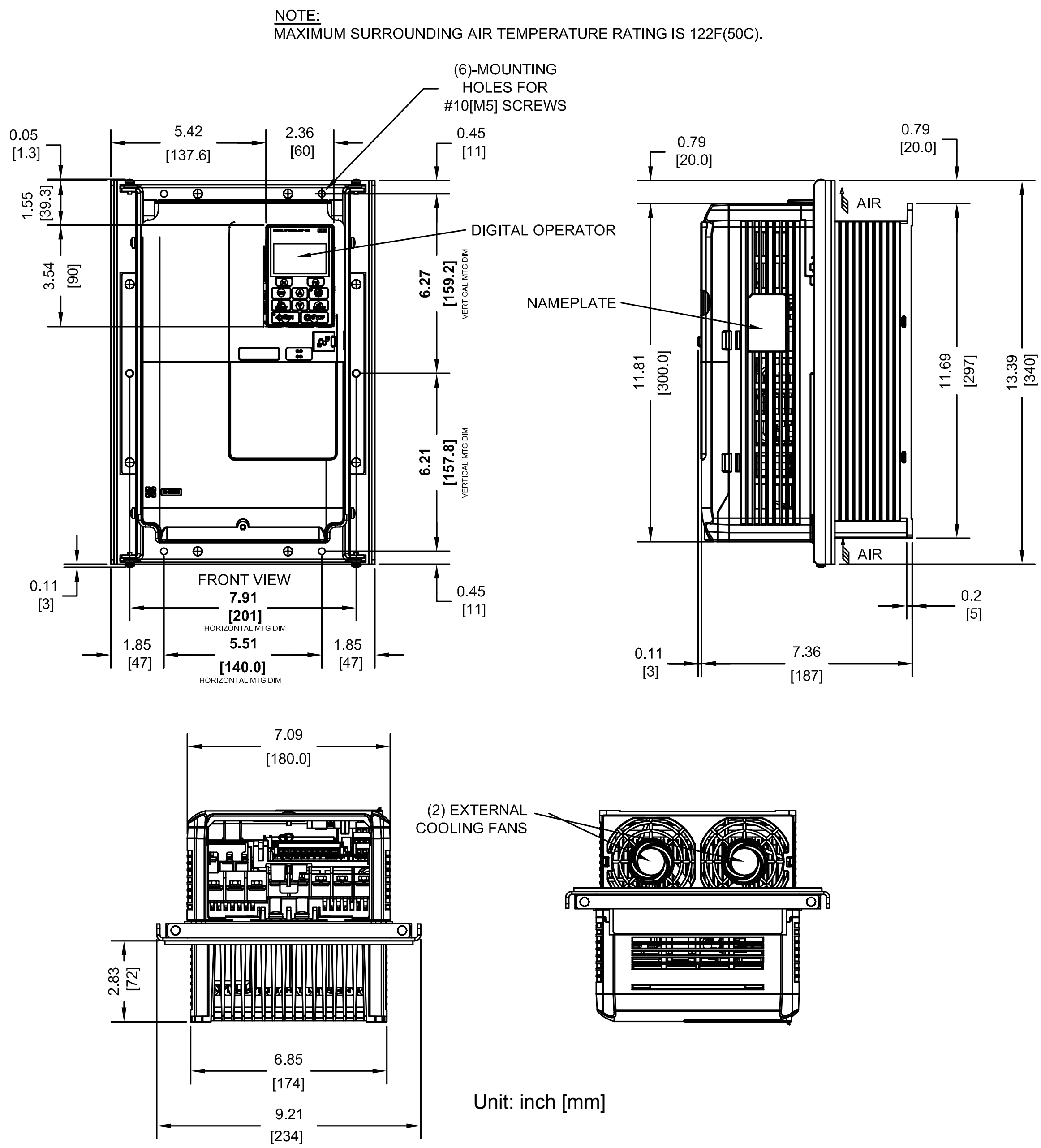


Figure 2.16 Models 2A0056U, 4A0038U, and 5A0017U and 5A0022U

Table 2.16 Weights for 2A0056U, 4A0038U, and 5A0017U and 5A0022U

Drive Model	2A0056U	4A0038U	5A0017U	5A0022U
Drive Weight lb (kg)	13.0 (5.9)	13.2 (6.0)	13.2 (6.0)	13.2 (6.0)

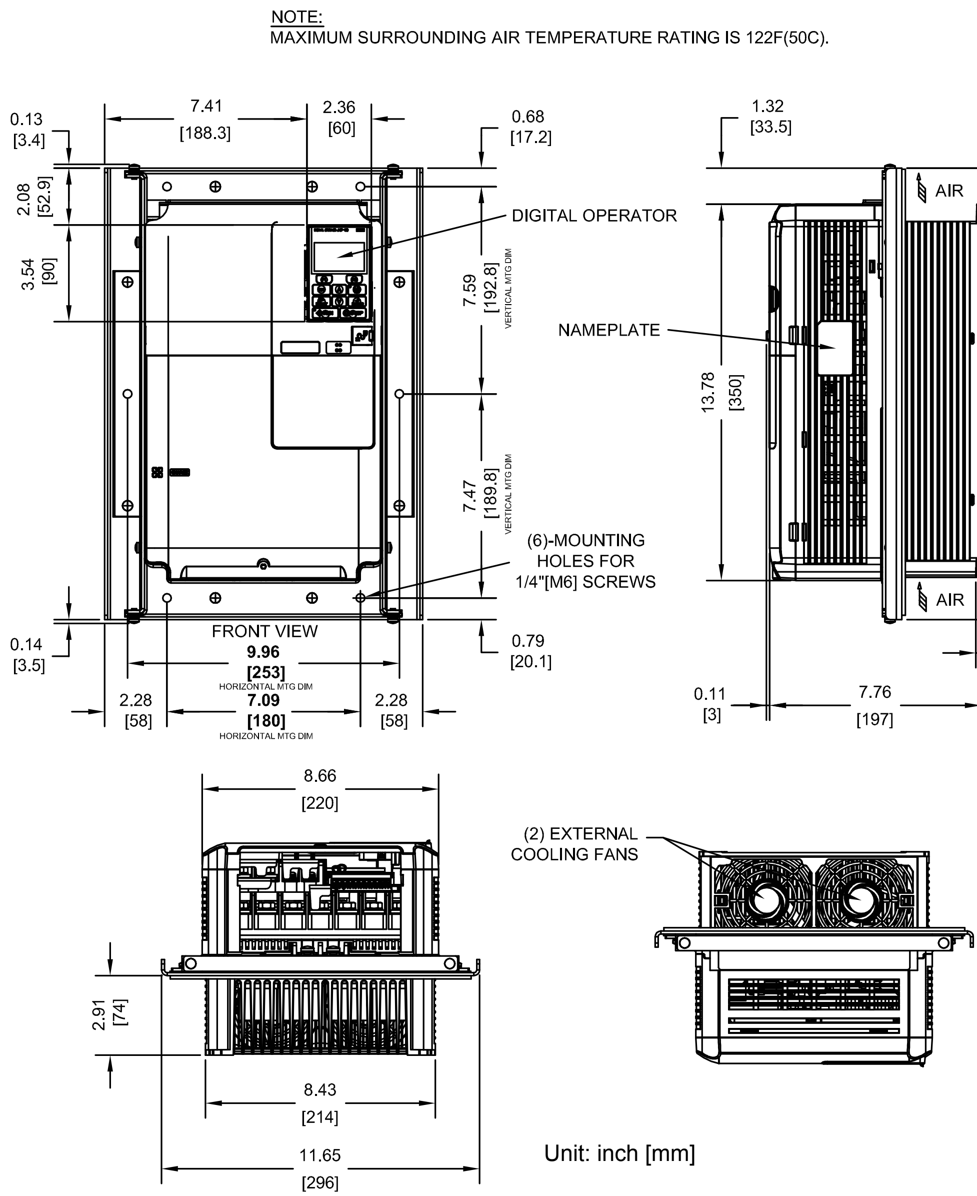


Figure 2.17 Models 2A0069U and 2A0081U, 4A0044U, and 5A0027U and 5A0032U

Table 2.17 Weights for 2A0069U and 2A0081U, 4A0044U, and 5A0027U and 5A0032U

Drive Model	2A0069U	2A0081U	4A0044U	5A0027U	5A0032U
Drive Weight lb (kg)	20.0 (9.1)	22.0 (10.0)	19.1 (8.7)	19.1 (8.7)	19.1 (8.7)

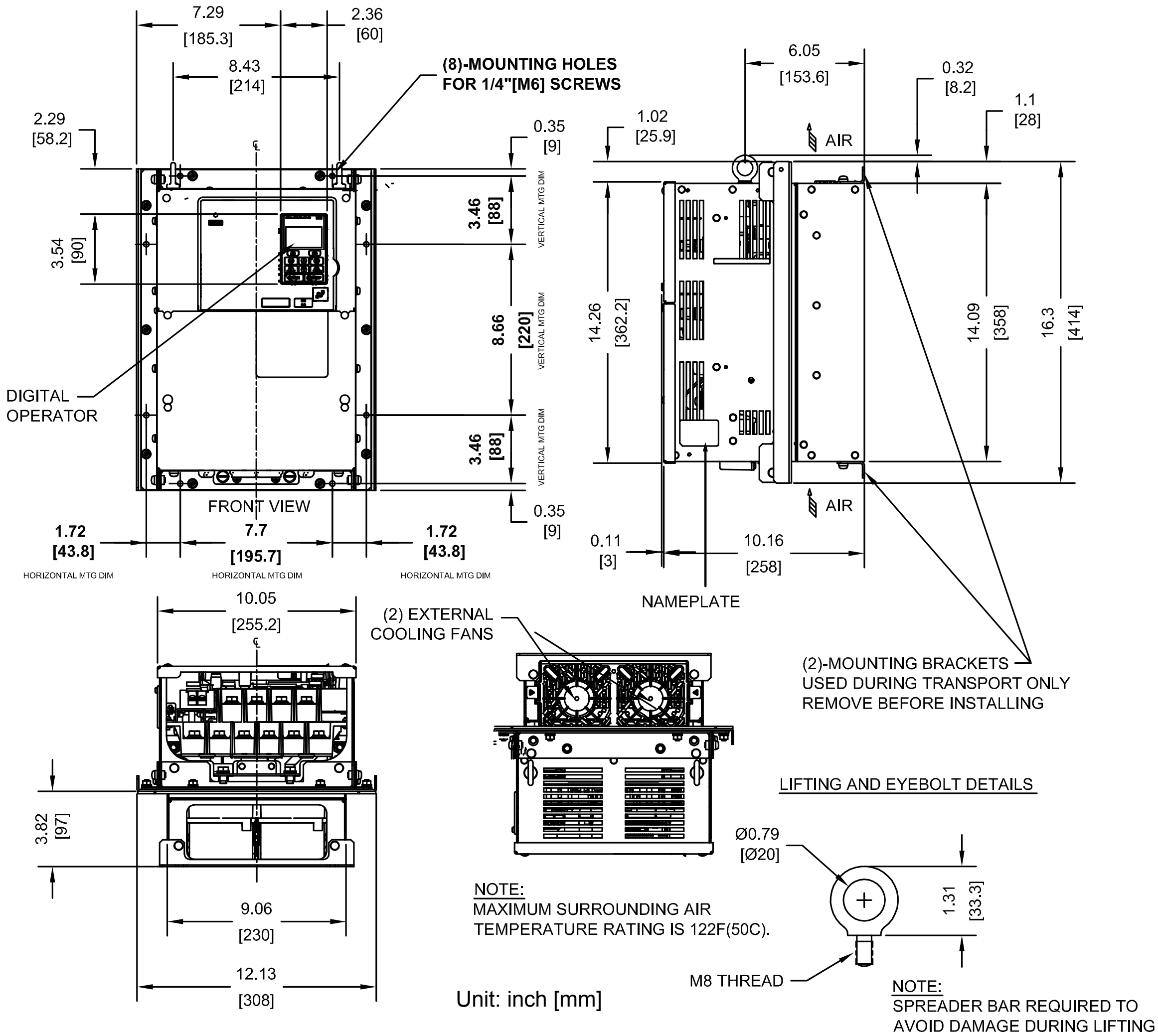


Figure 2.18 Models 2A0110U and 4A0058U

Table 2.18 Weights for 2A0110U and 4A0058U

Drive Model	2A0110U	4A0058U
Drive Weight lb (kg)	50.6 (23.0)	50.6 (23.0)

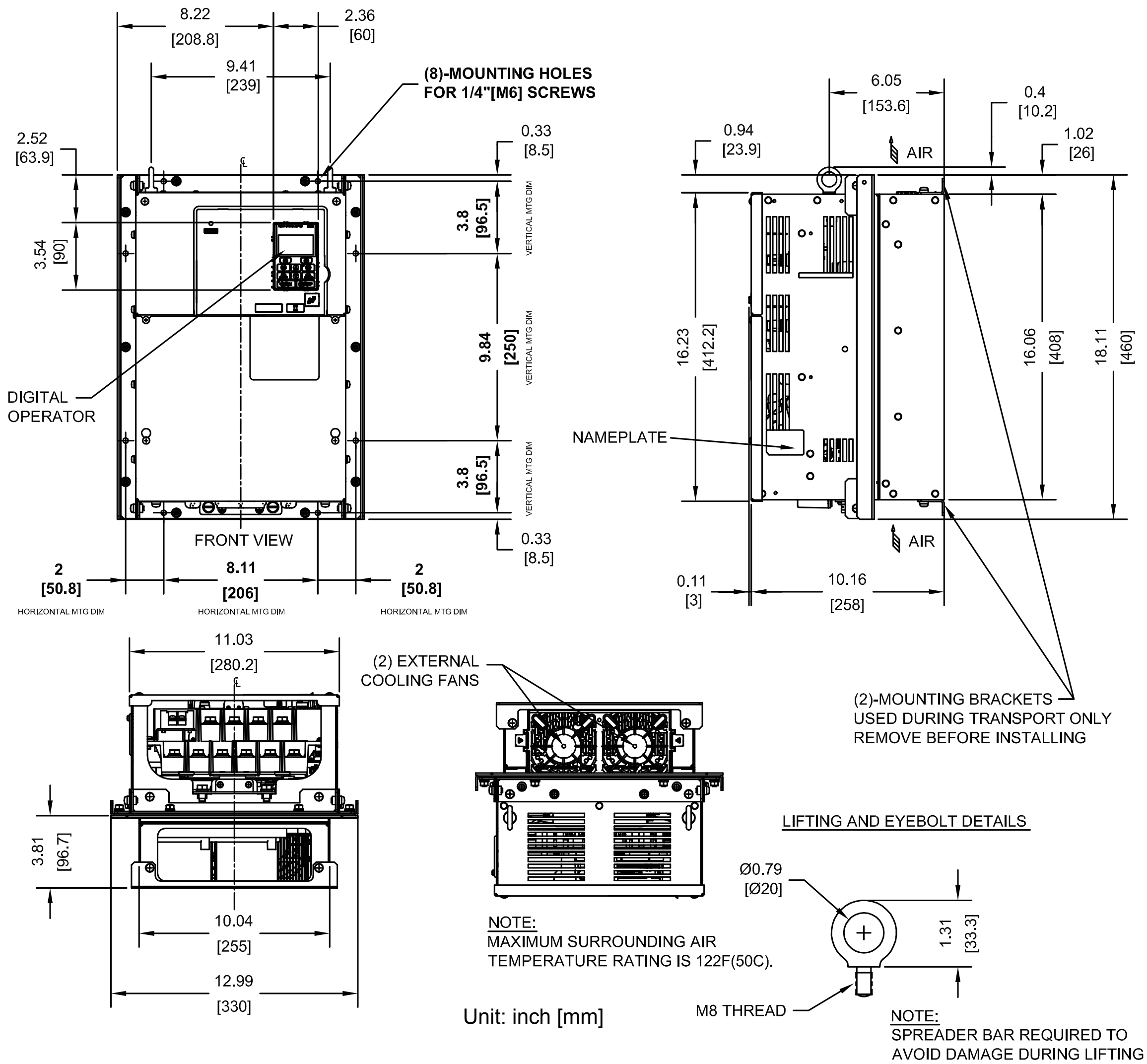


Figure 2.19 Models 2A0138U, 4A0072U, 5A0041U and 5A0052U

Table 2.19 Weights for 2A0138U, 4A0072U, 5A0041U and 5A0052U

Drive Model	2A0138U	4A0072U	5A0041U	5A0052U
Drive Weight lb (kg)	61.6 (28.0)	59.4 (27.0)	59.4 (27.0)	59.4 (27.0)

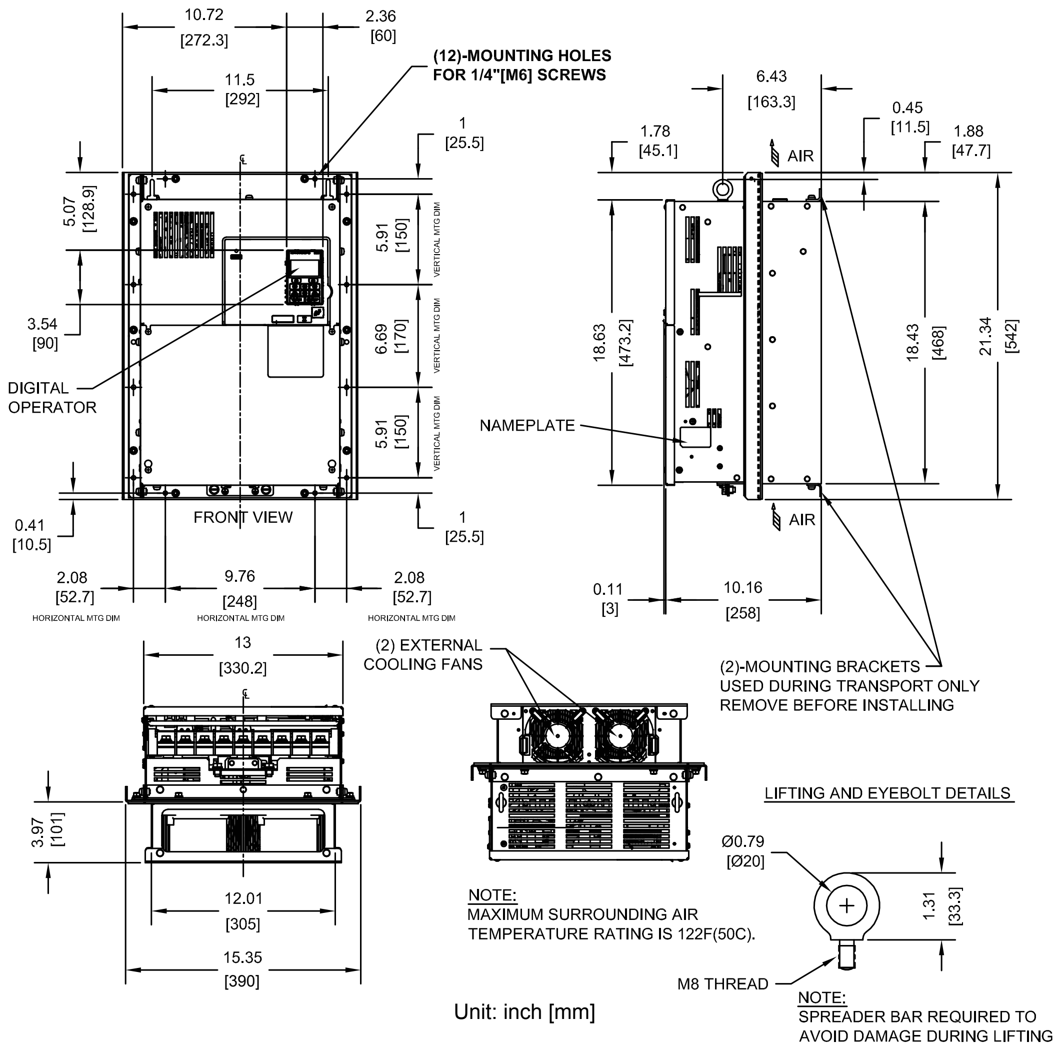


Figure 2.20 Models 4A0088U and 4A0103U

Table 2.20 Weights for 4A0088U and 4A0103U

Drive Model	4A0088U	4A0103U
Drive Weight lb (kg)	85.8 (39.0)	85.8 (39.0)

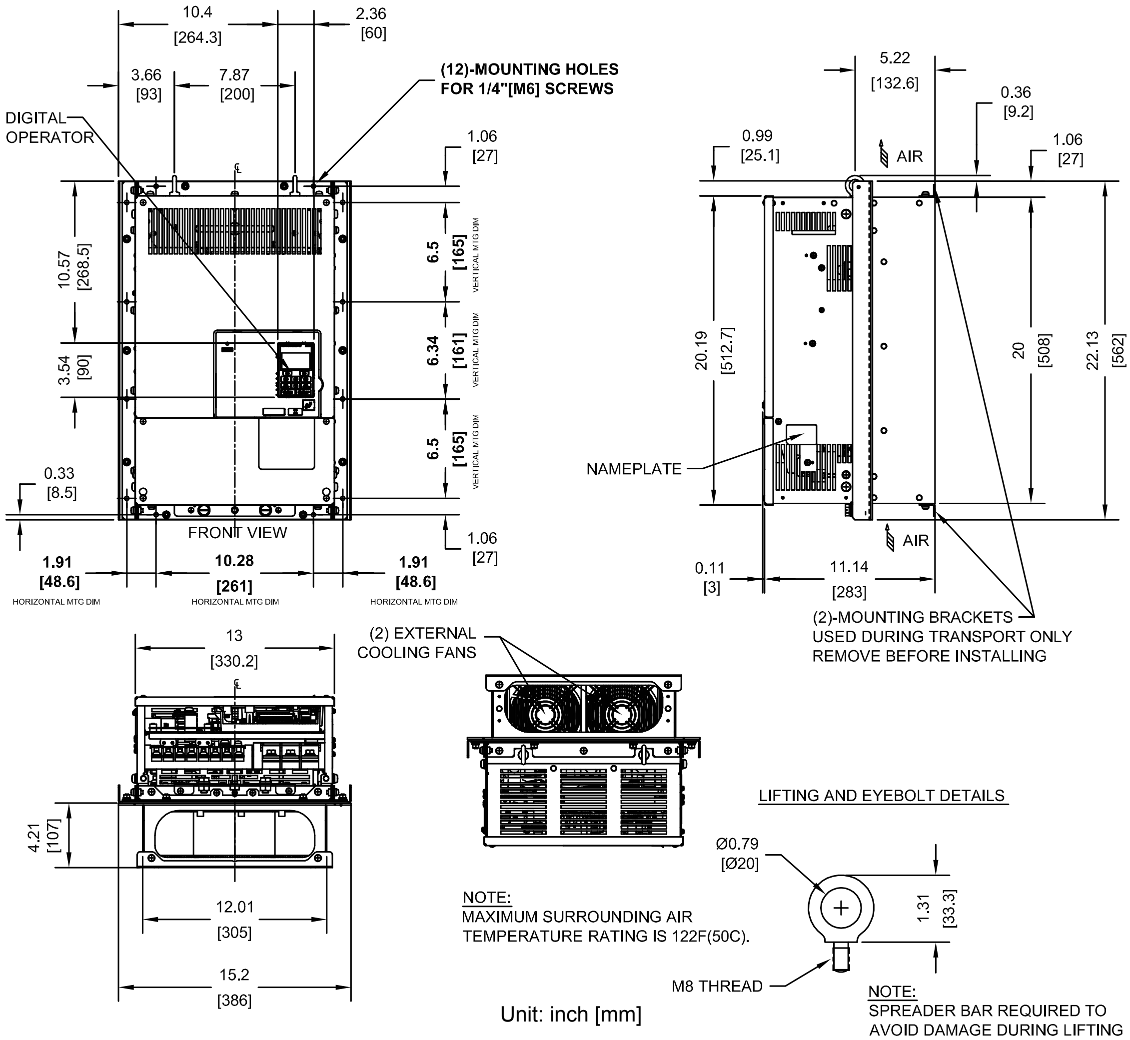


Figure 2.21 Models 2A0169U and 0211U, 4A0139U and 0165U, and 5A0062U to 0099U

Table 2.21 Weights for 2A0169U and 0211U, 4A0139U and 0165U, and 5A0062U to 0099U

Drive Model	2A0169U	2A0211U	4A0139U	4A0165U	5A0062U	5A0077U	5A0099U
Drive Weight lb (kg)	90.2 (41.0)	92.4 (42.0)	99.0 (45.0)	101.2 (46.0)	99.0 (45.0)	99.0 (45.0)	191 (87)

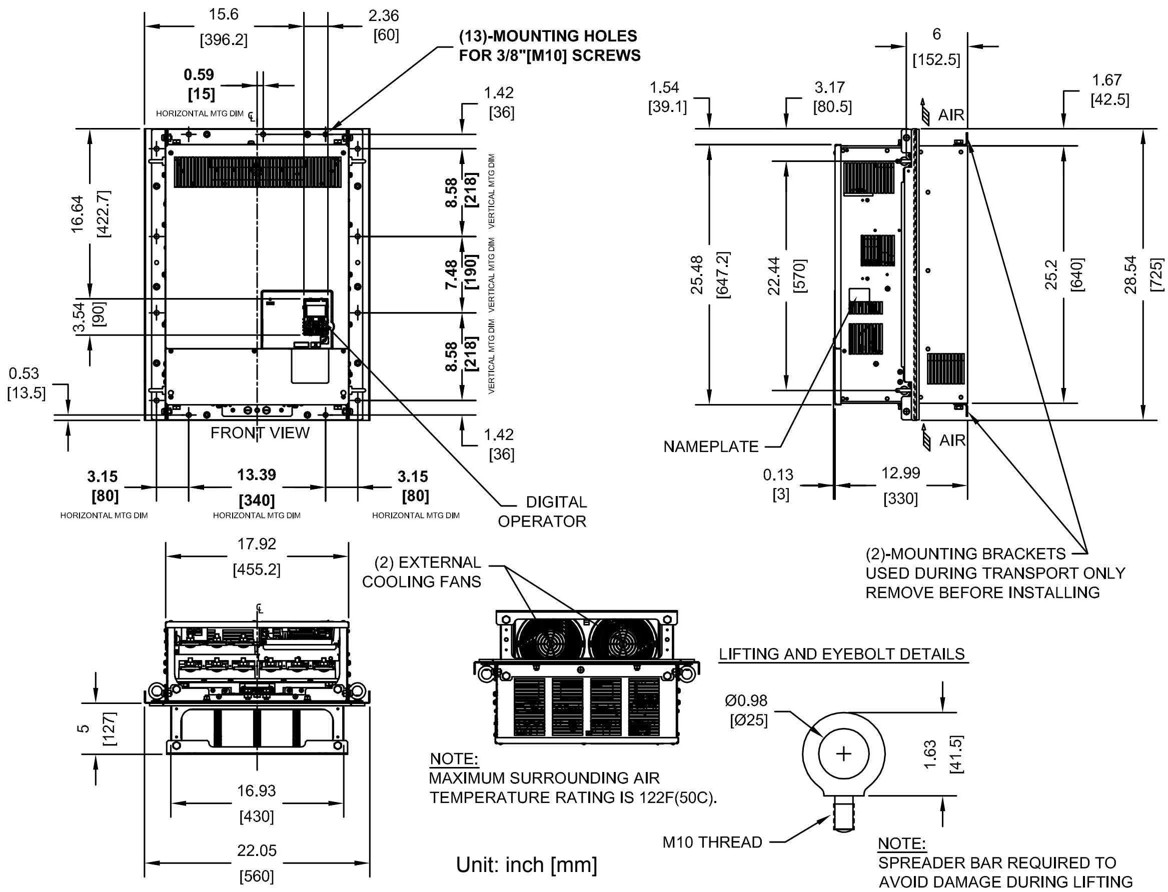


Figure 2.22 Models 2A0250U and 0312U, 4A0208U, and 5A0125U and 0145U

Table 2.22 Weights for 2A0250U and 0312U, 4A0208U, and 5A0125U and 0145U

Drive Model	2A0250U	2A0312U	4A0208U	5A0125U	5A0145U
Drive Weight lb (kg)	183 (83)	194 (88)	191 (87)	191 (87)	191 (87)

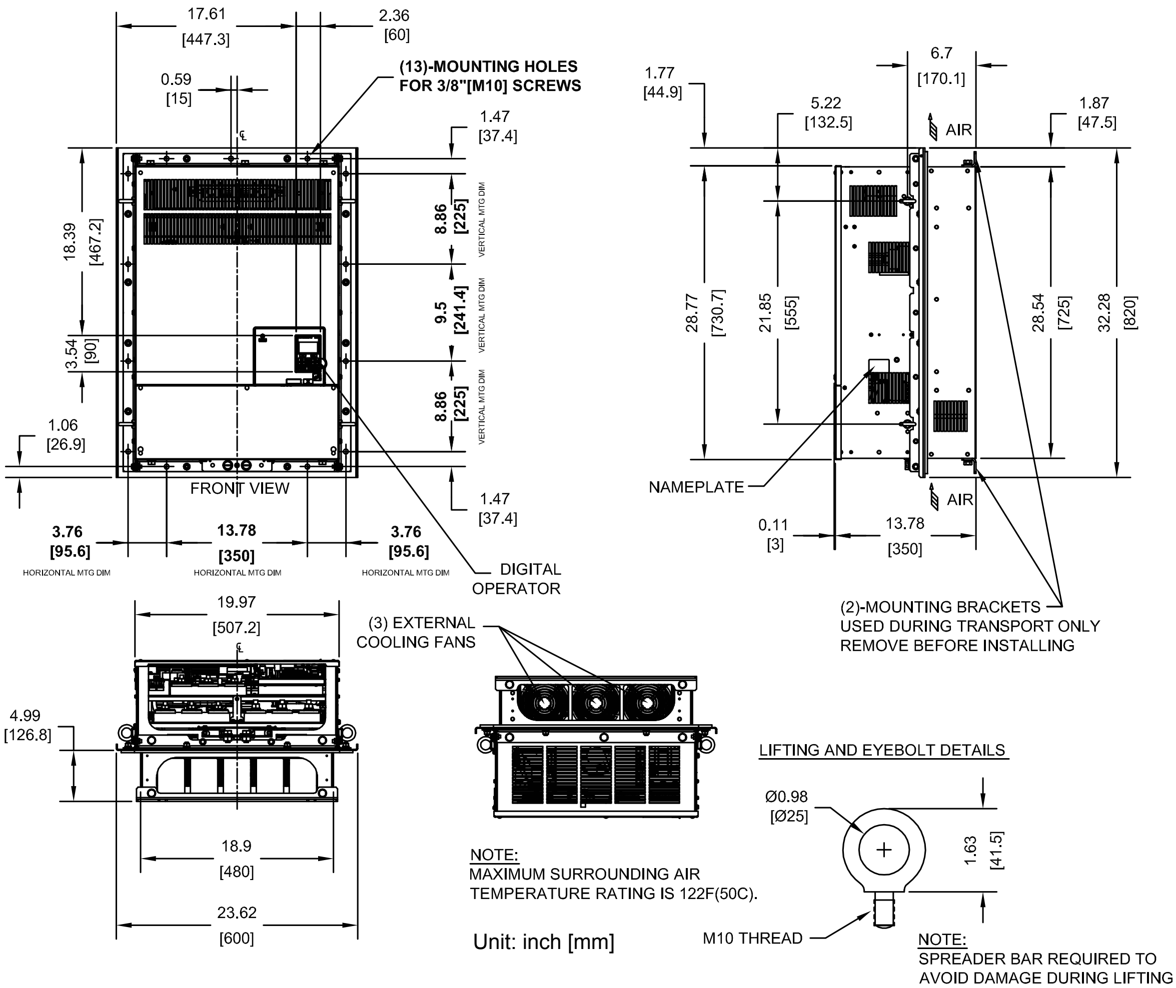


Figure 2.23 Models 2A0360U and 0415U, 4A0250U to 0362U, and 5A0192U and 0242U

Table 2.23 Weights for 2A0360U and 0415U, 4A0250U to 0362U, and 5A0192U and 0242U

Drive Model	2A0360U	2A0415U	4A0250U	4A0296U	4A0362U	5A0192U	5A0242U
Drive Weight lb (kg)	238 (108)	–	233 (106)	246 (112)	257 (117)	257 (117)	257 (117)

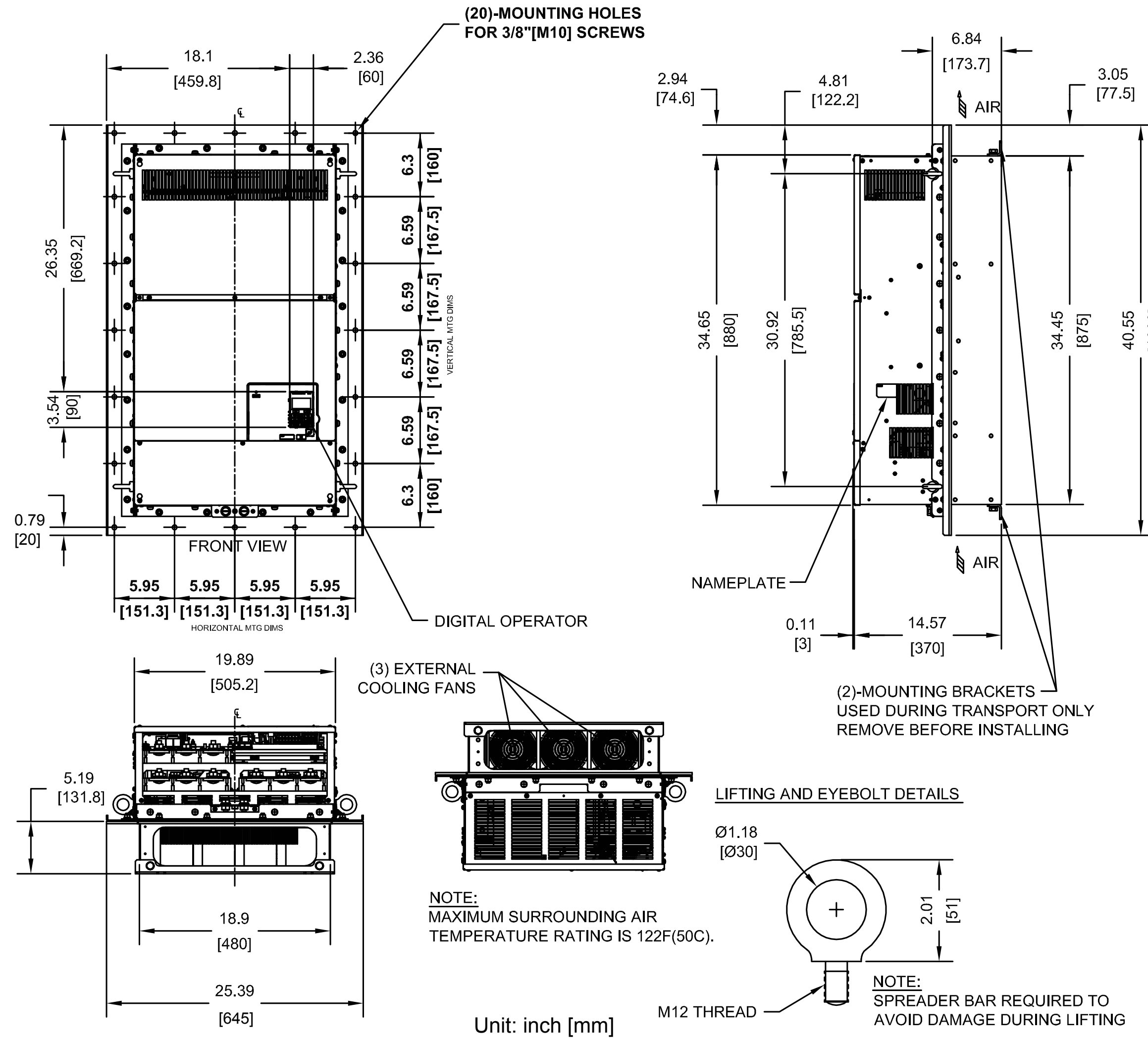


Figure 2.24 Model 4A0414U

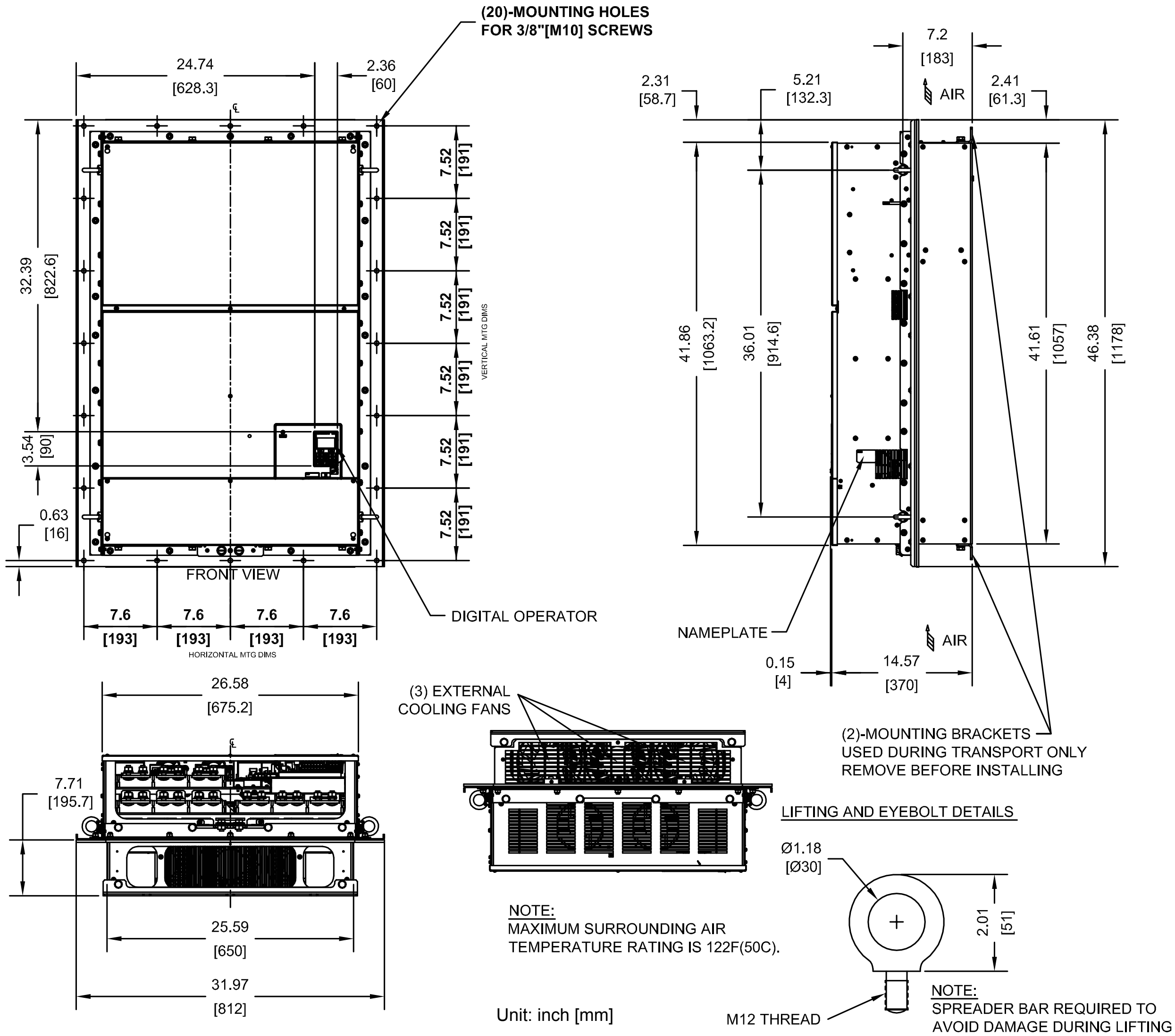


Figure 2.25 Models 4A0515U and 4A0675U

■ Flange Type Panel Cut-Out Dimensions

Flange type drives must be ordered from the factory using the U: Flange Type enclosure rating.

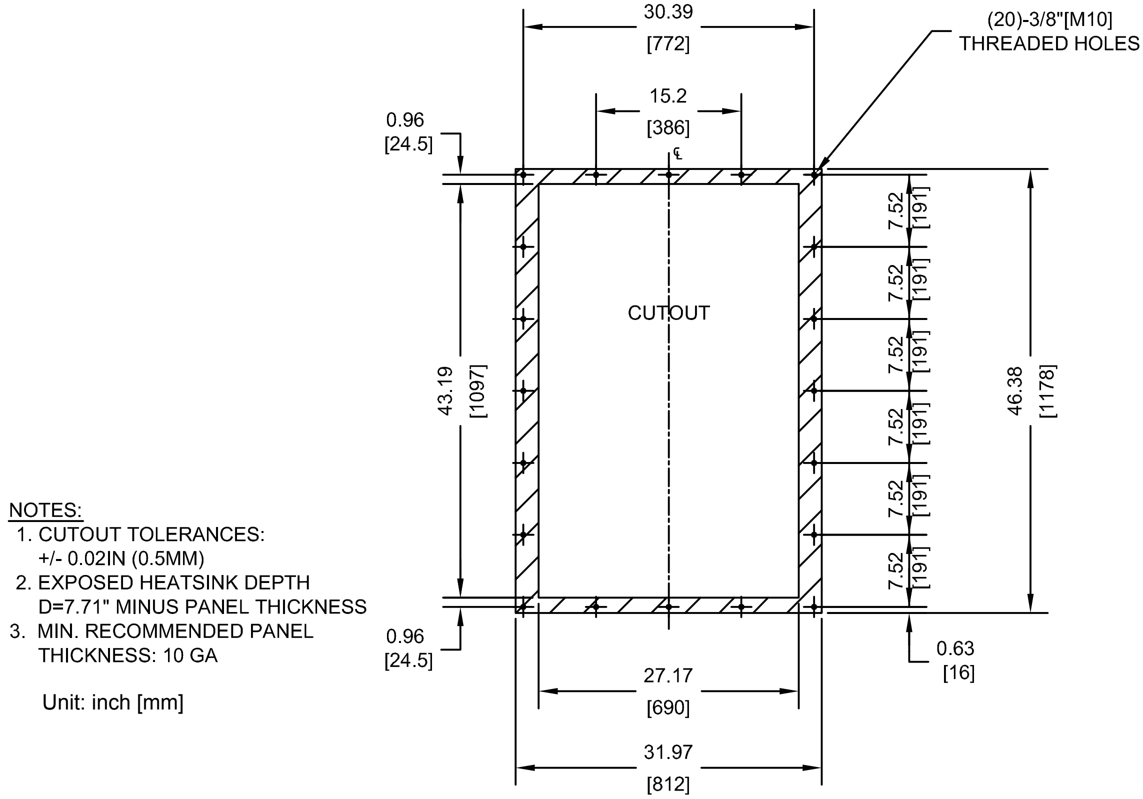


Figure 2.26 Models 2A0004U to 0012U, 4A0002U to 0005U, 5A0003U and 0004U

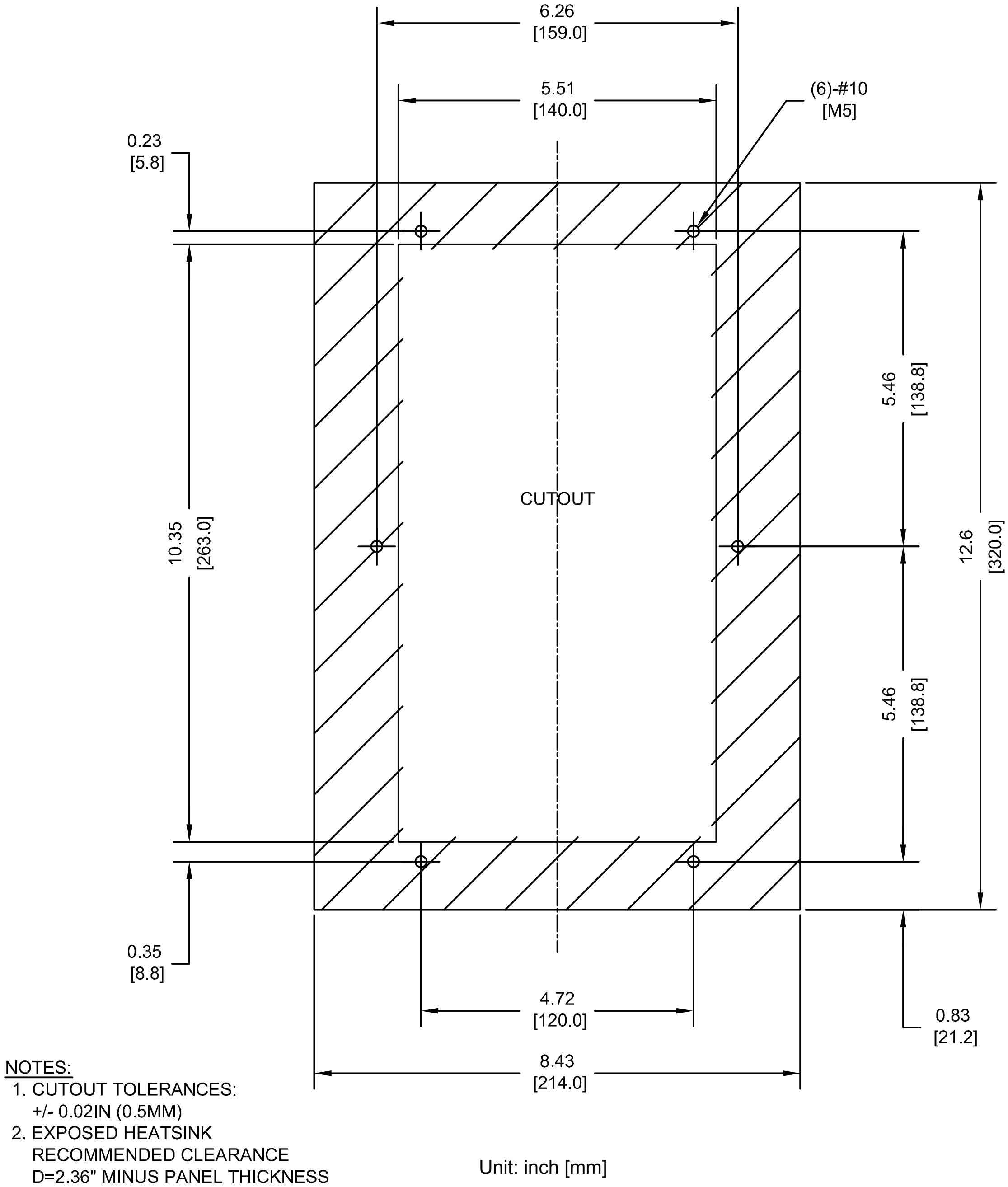


Figure 2.27 Models 2A0018U and 0021U, 4A0007U to 0011U, and 5A0006U and 0009U

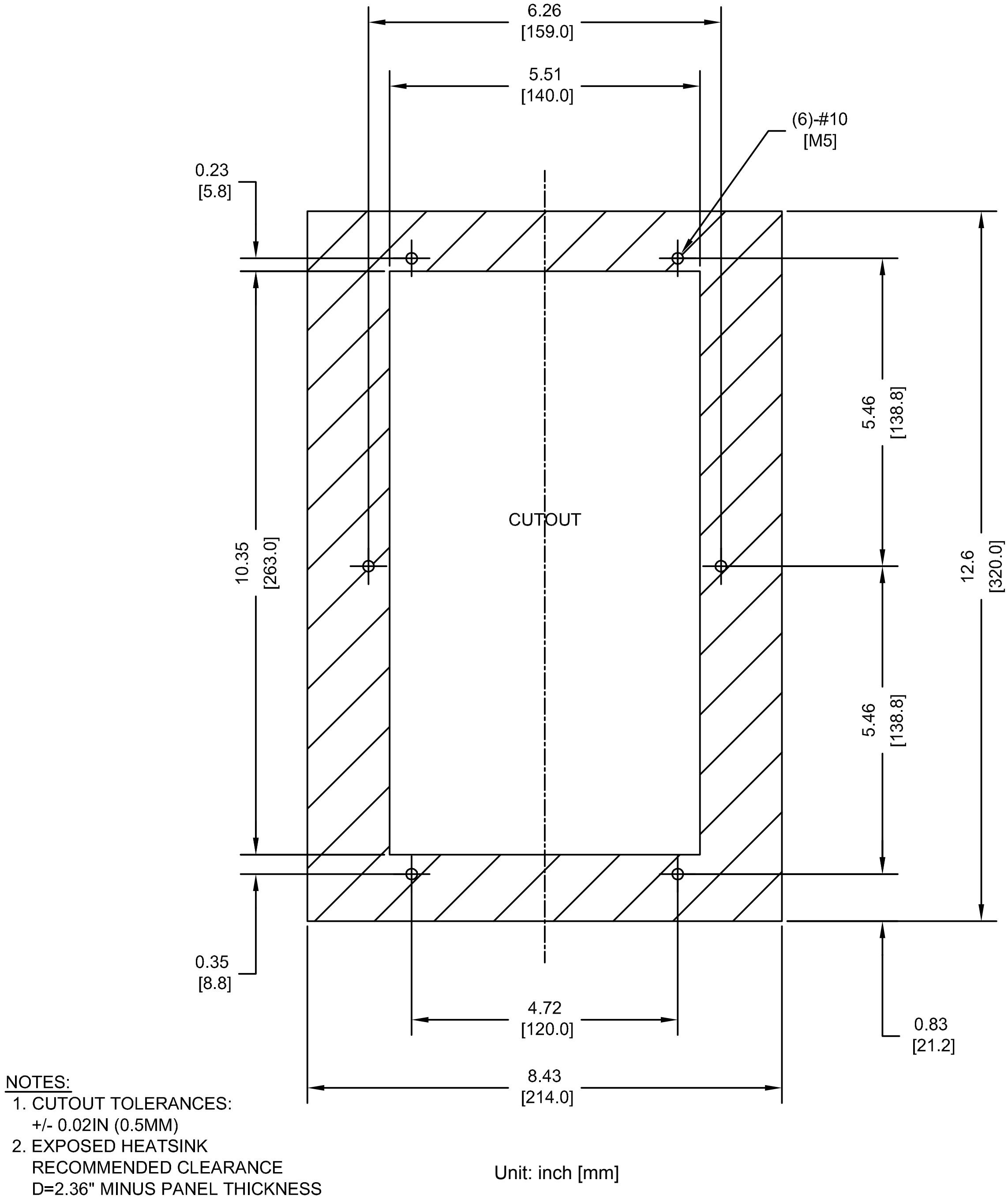
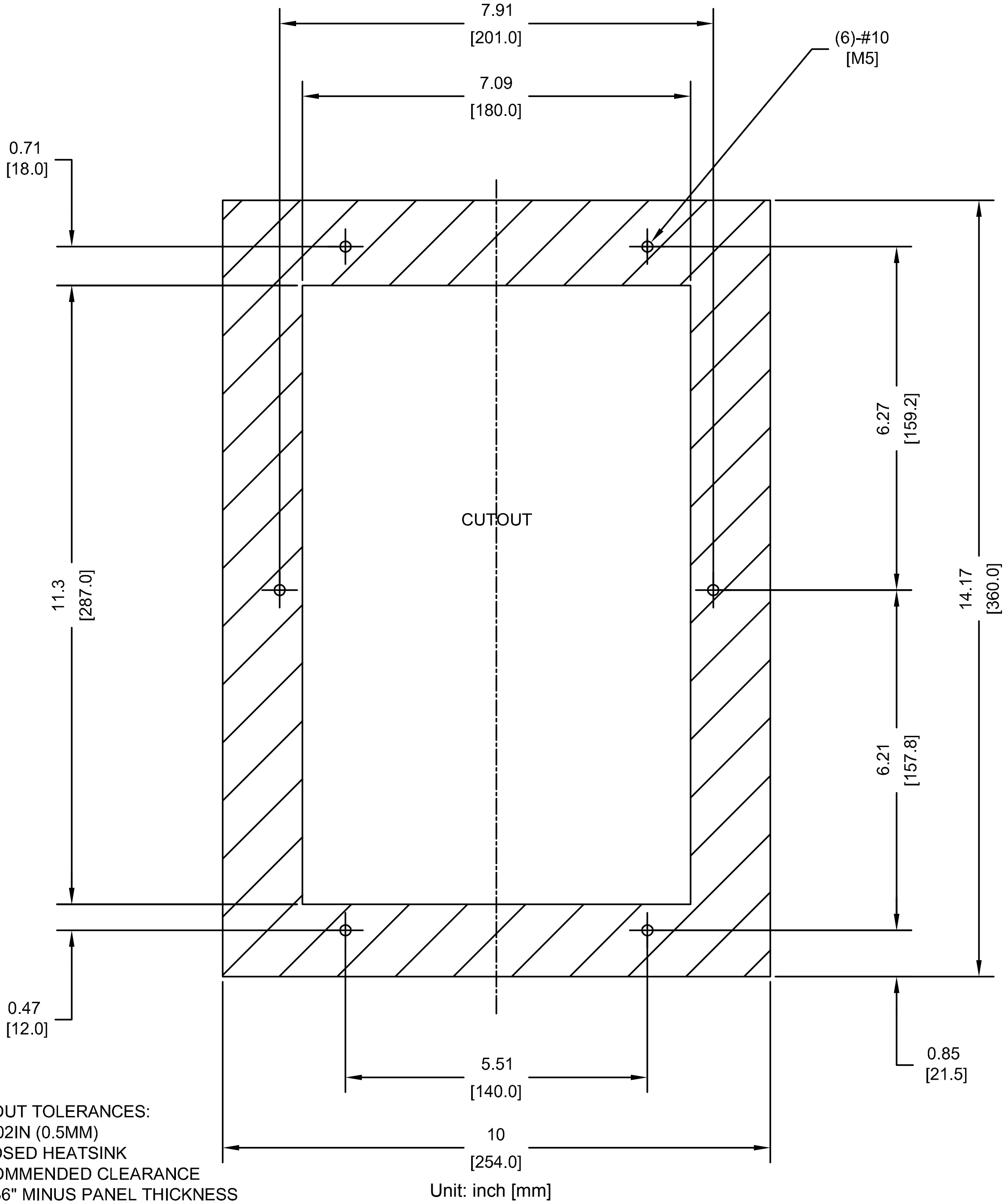


Figure 2.28 Models 2A0030U and 0040U, 4A0018U and 0023U, and 5A0011U



NOTES:
1. CUTOUT TOLERANCES:
+/- 0.02IN (0.5MM)
2. EXPOSED HEATSINK
RECOMMENDED CLEARANCE
D=2.36" MINUS PANEL THICKNESS

Figure 2.29 Model 4A0031U

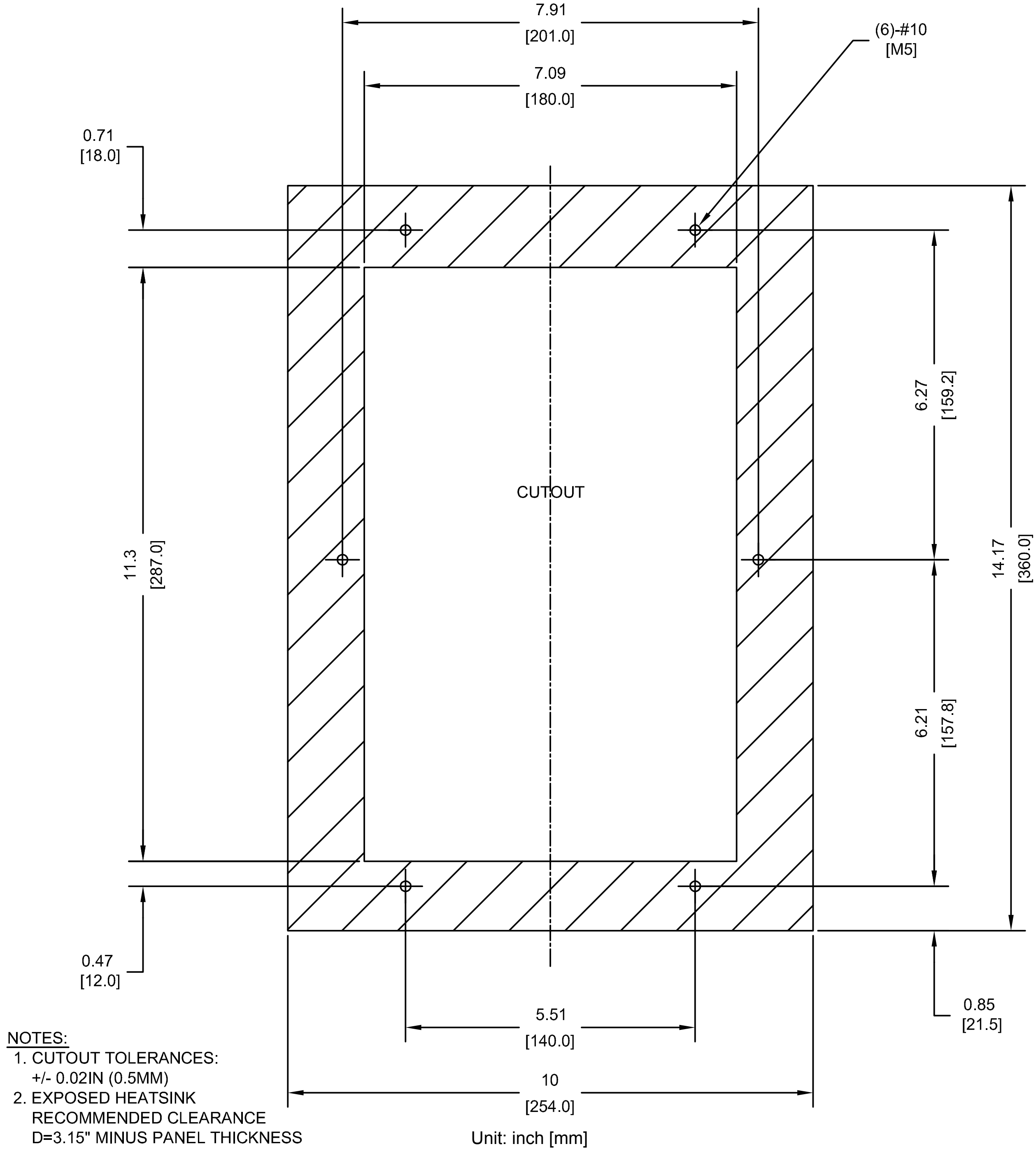


Figure 2.30 Models 2A0056U, 4A0038U, and 5A0017U and 5A0022U

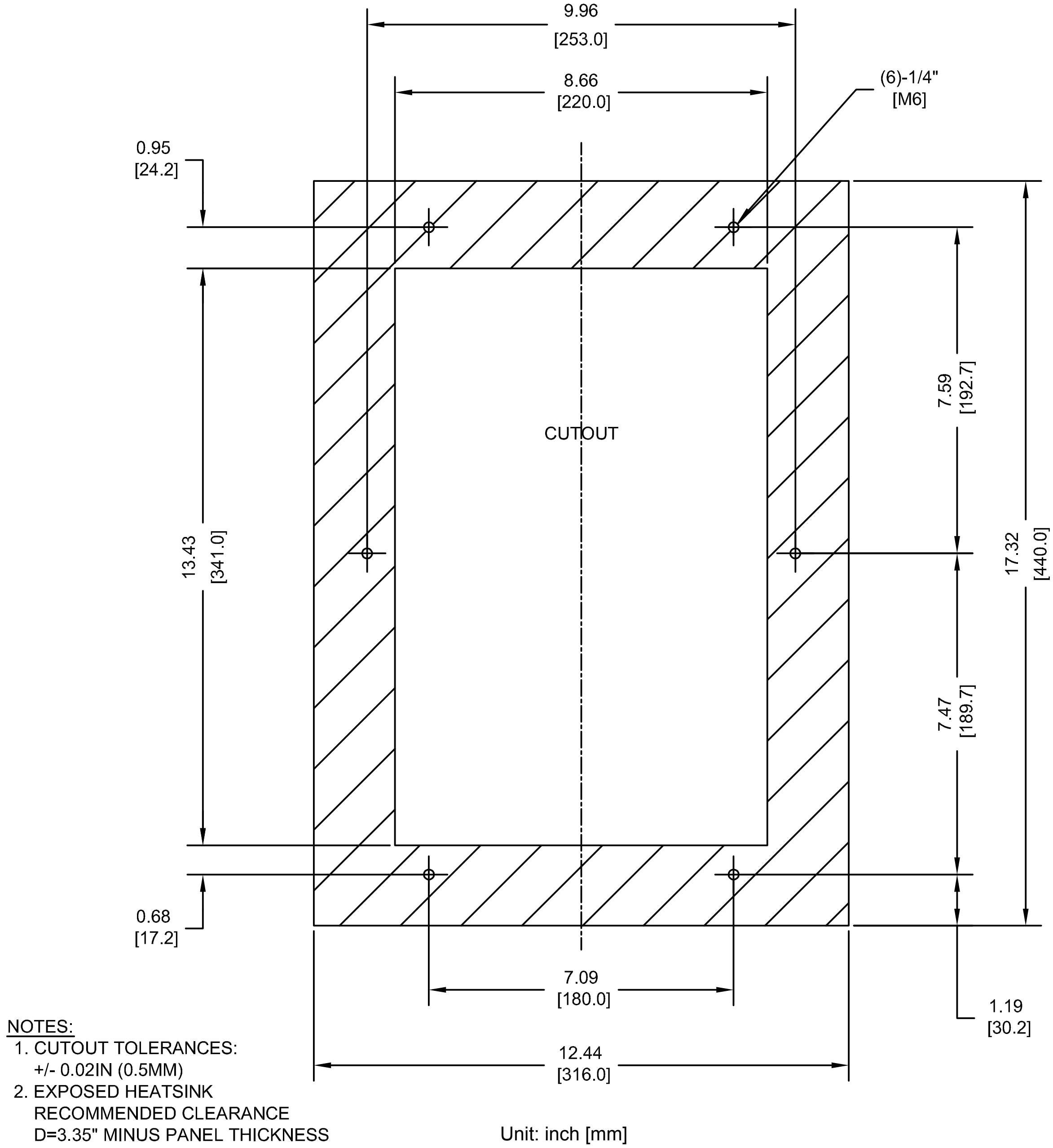


Figure 2.31 Models 2A0069U and 2A0081U, 4A0044U, and 5A0027U and 5A0032U

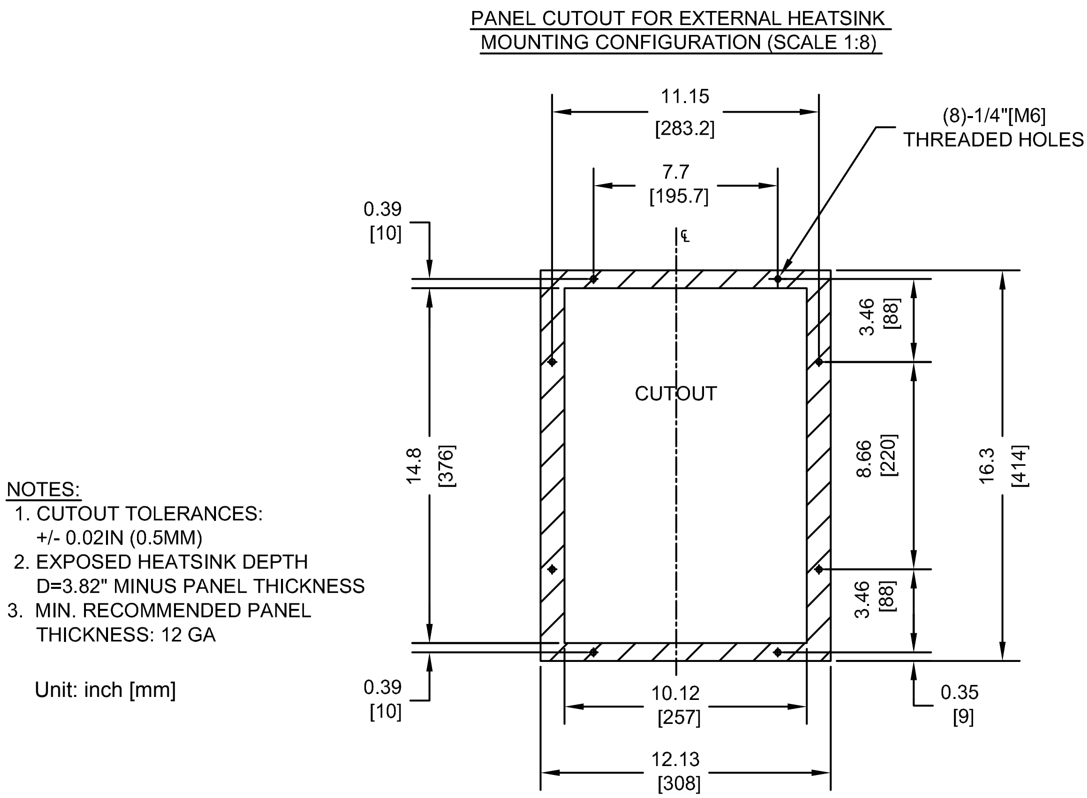


Figure 2.32 Models 2A0110U and 4A0058U

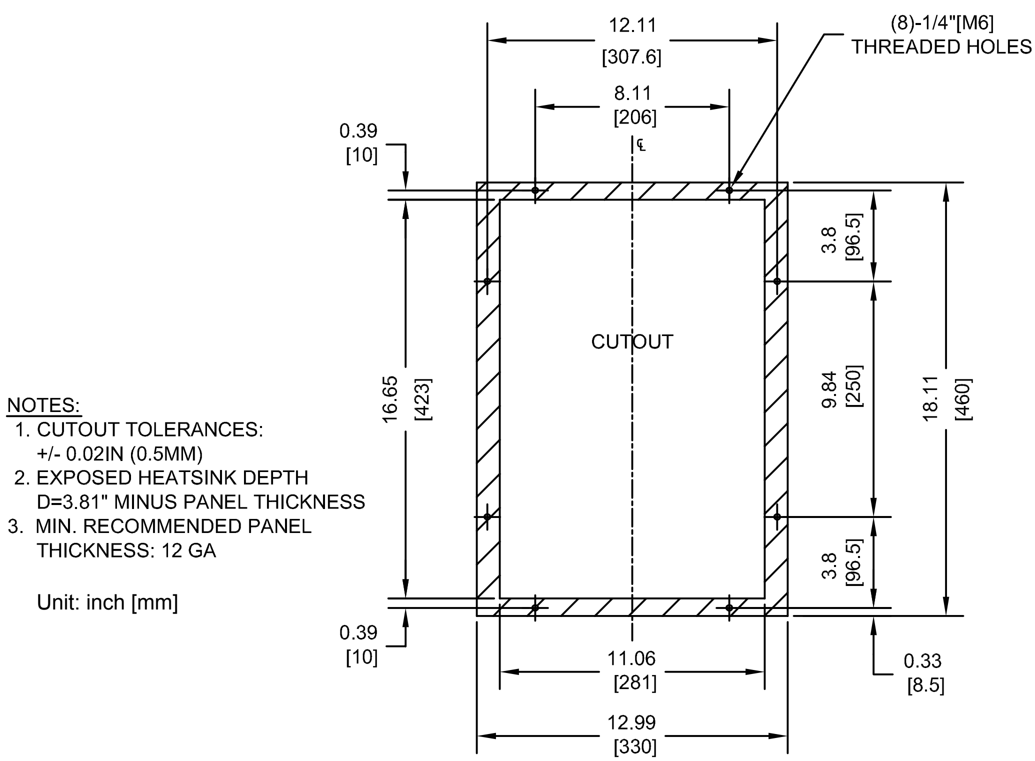


Figure 2.33 Models 2A0138U, 4A0072U, and 5A0041U and 5A0052U

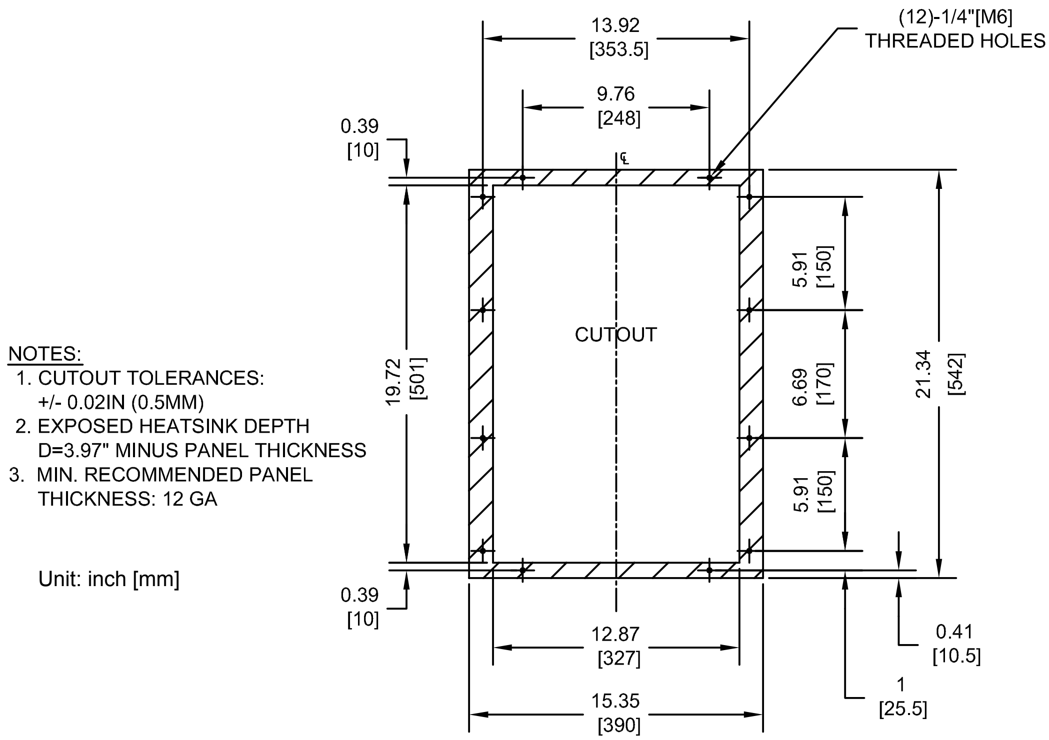


Figure 2.34 Models 4A0088U and 4A0103U

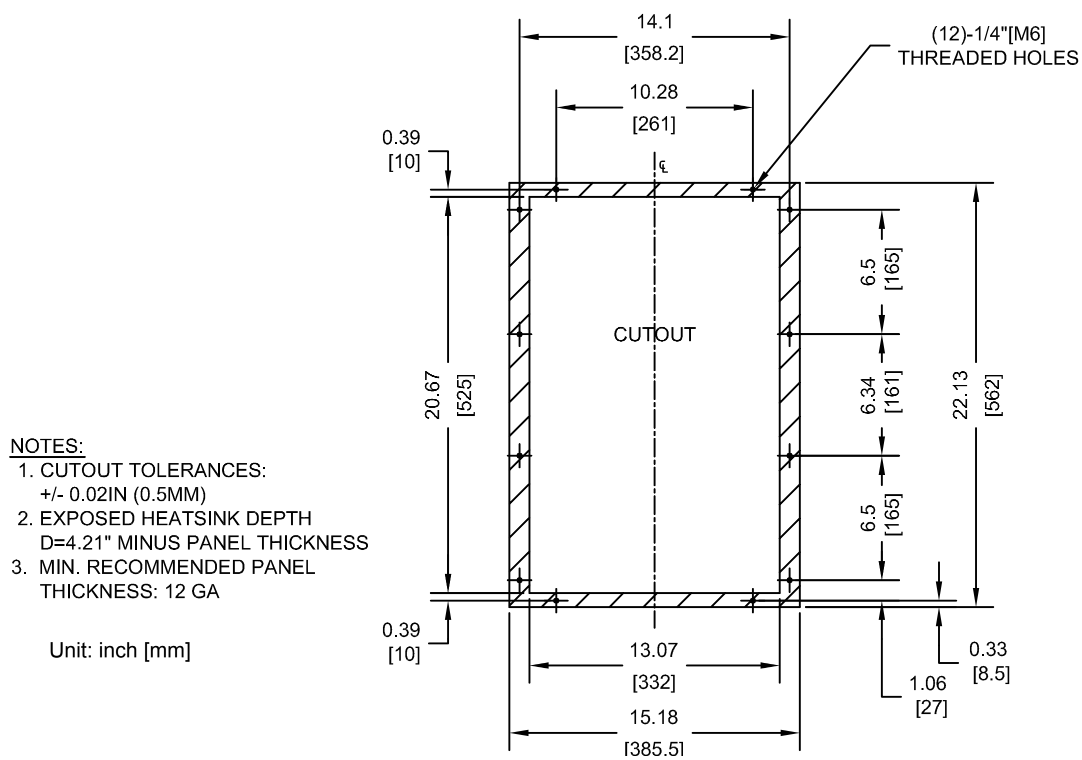


Figure 2.35 Models 2A0169U and 0211U, 4A0139U and 0165U, and 5A0062U to 0099U

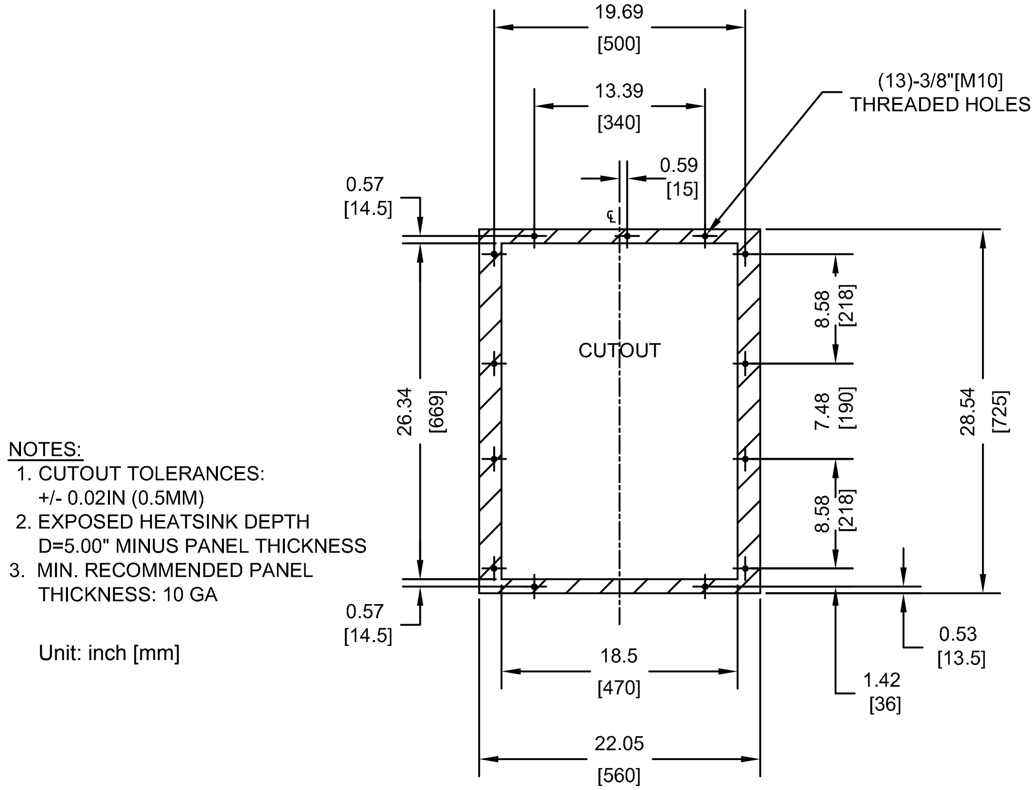


Figure 2.36 Models 2A0250U and 0312U, 4A0208U, and 5A0125U and 0145U

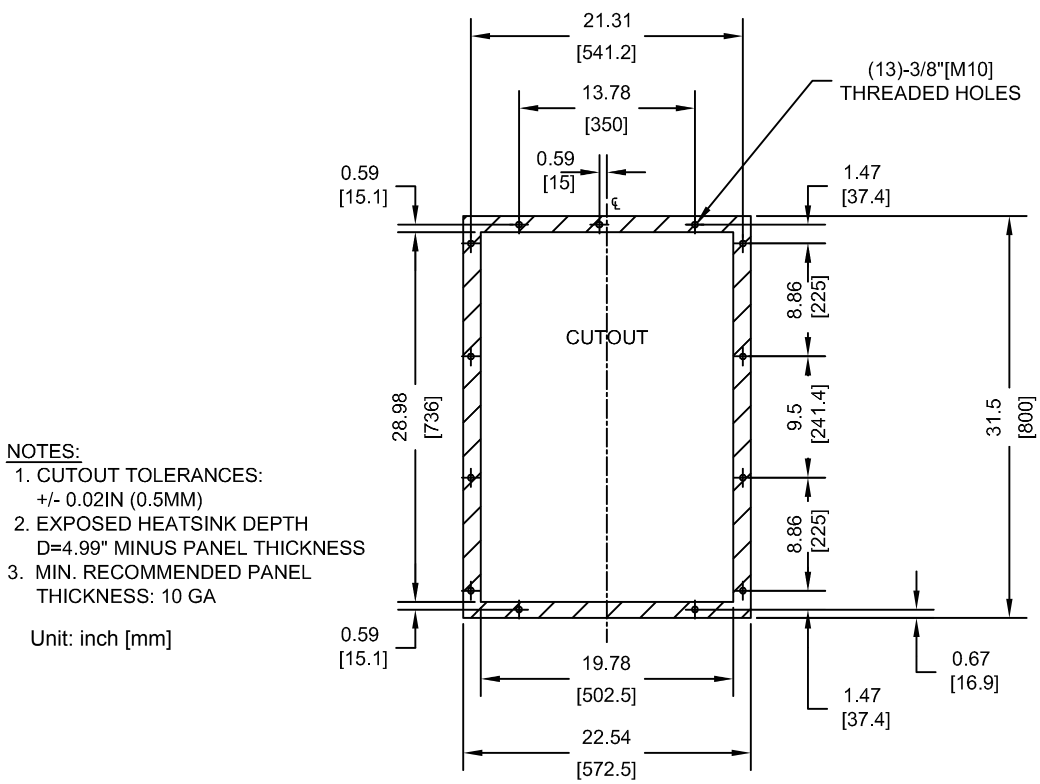


Figure 2.37 Models 2A0360U and 0415U, 4A0250U and 0362U, and 5A0192U and 0242U

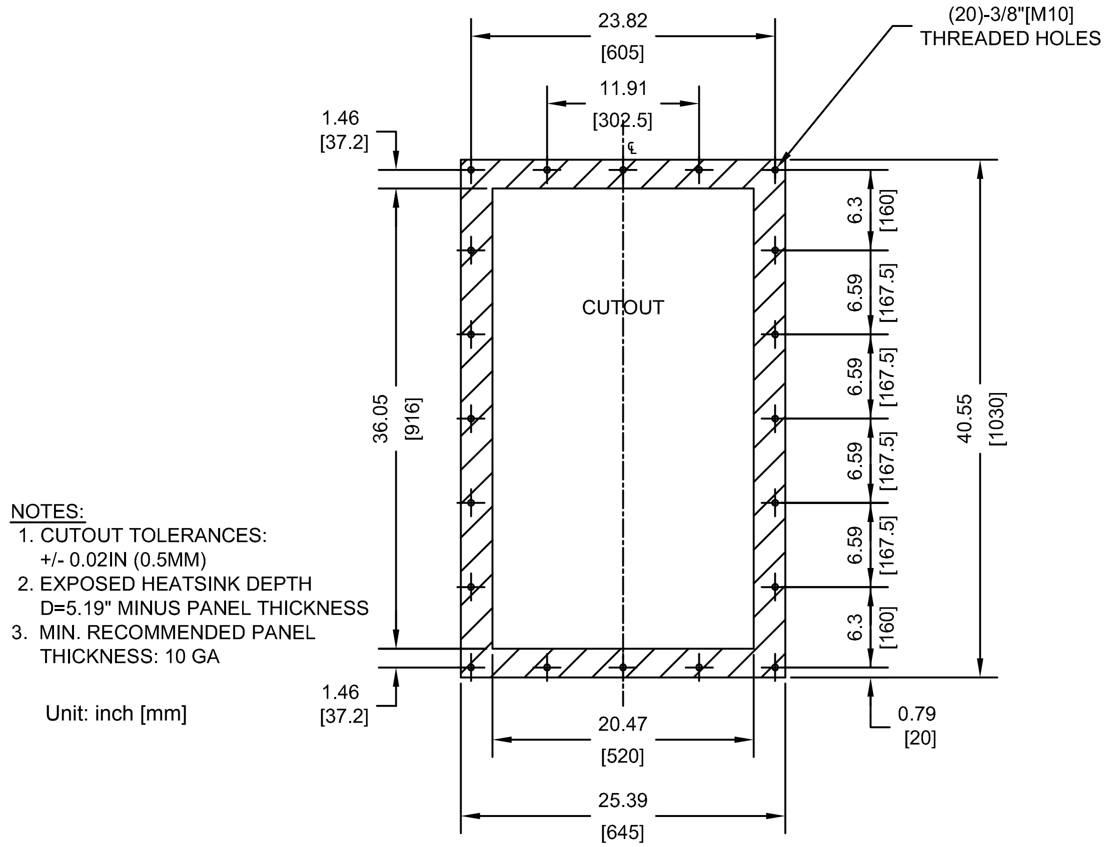


Figure 2.38 Model 4A0414U

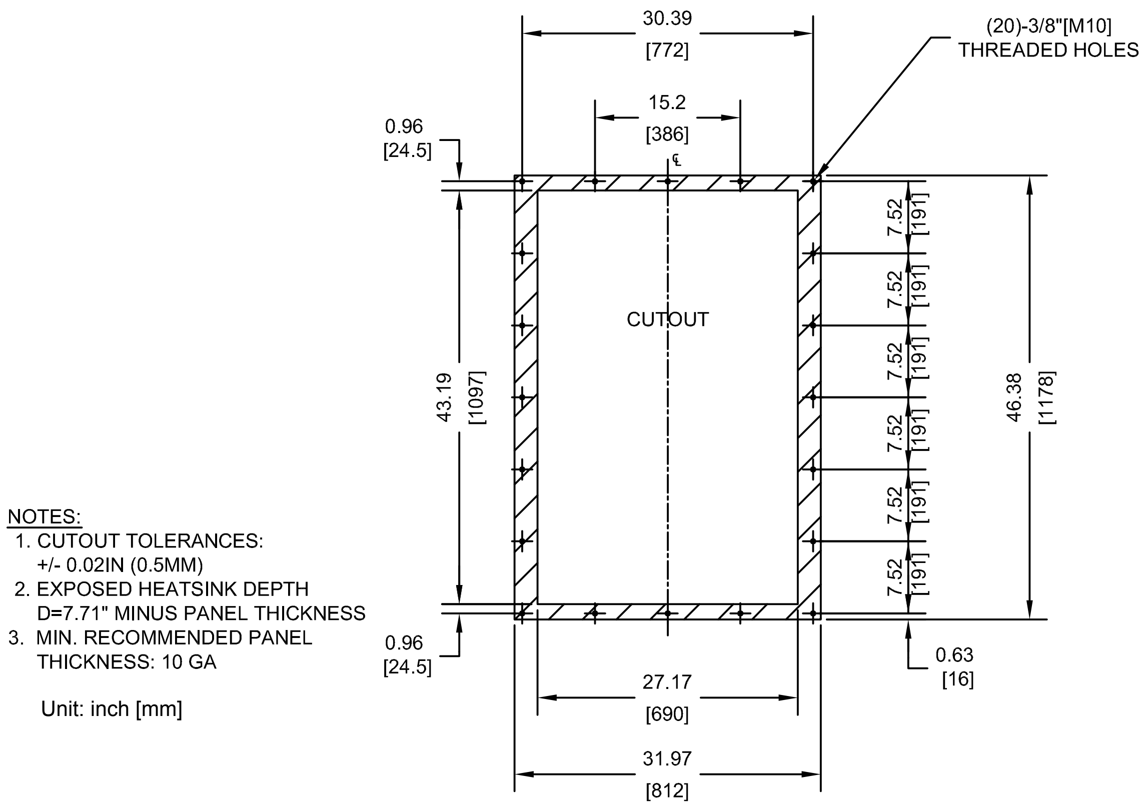


Figure 2.39 Models 4A0515U and 4A0675U

Mechanical Installation

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3

Electrical Installation

This chapter explains proper procedures for wiring the control circuit terminals, motor, and power supply.

3.1 Standard Connection Diagram

Connect the drive and peripheral devices as shown in ***Figure 3.1***. It is possible to set and run the drive via the digital operator without connecting digital I/O wiring. This section does not discuss drive operation; ***Refer to Start-Up Programming & Operation on page 105*** for instructions on operating the drive.

NOTICE: *Inadequate wiring could result in damage to the drive. Install adequate branch circuit short circuit protection per applicable codes. The drive is suitable for circuits capable of delivering not more than 100,000 RMS symmetrical amperes, 240 Vac maximum (200 V class), 480 Vac maximum (400 V class), 600 Vac maximum (600 V class).*

NOTICE: *When the input voltage is 440 V or higher or the wiring distance is greater than 100 meters, pay special attention to the motor insulation voltage or use a drive duty motor. Failure to comply could lead to motor insulation breakdown.*

NOTICE: *Do not connect AC control circuit ground to drive enclosure. Improper drive grounding can cause control circuit malfunction.*

Note: The minimum load for the relay outputs M1-M2, M3-M4, MA-MB-MC, and MD-ME-MF is 10 mA.

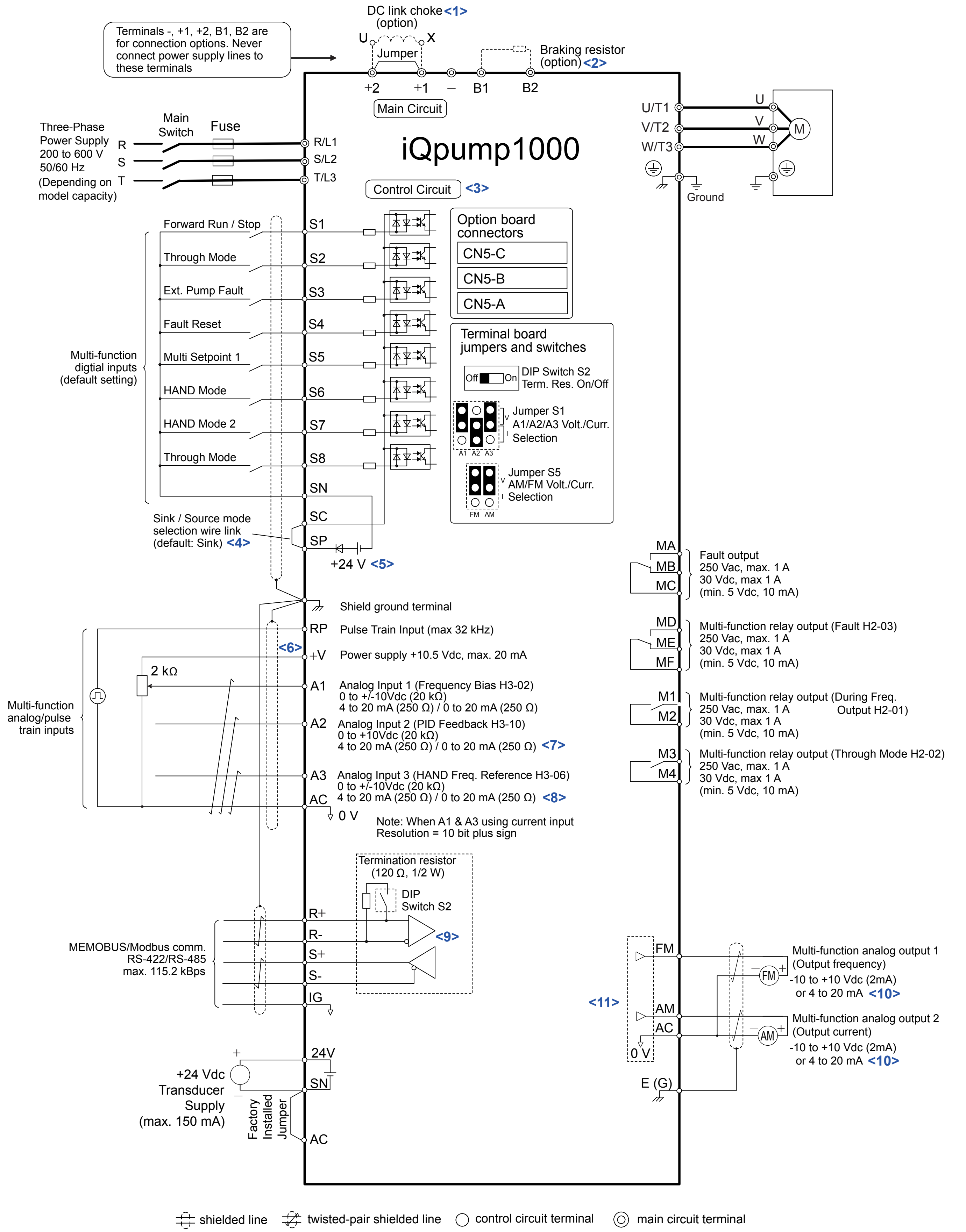

Figure 3.1 Drive Standard Connection Diagram (example: model 2A0040)

<1> Remove the jumper when installing a DC link choke. Models 2A0110 to 2A0415 and 4A0058 to 4A0675 come with a built-in

Electrical Installation

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DC link choke.

<2> Set L8-55 to 0 to disable the protection function of the built-in braking transistor of the drive when using an optional regenerative converter or dynamic braking option. Leaving L8-55 enabled may cause a braking resistor fault (rF). Additionally, disable Stall Prevention (L3-04 = 0) when using an optional regenerative converter, regenerative or braking units, or dynamic braking option. Leaving If L3-04 enabled may prevent the drive from stopping within the specified deceleration time.

<3> Supplying power to the control circuit separately from the main circuit requires 24 V power supply (option).

<4> This figure illustrates an example of a sequence input to S1 through S8 using a non-powered relay or an NPN transistor. Install the wire link between terminals SC-SP for Sink mode, between SC-SN for Source mode, or leave the link out for external power supply. Never short terminals SP and SN, as it will damage the drive.

<5> This voltage source supplies a maximum current of 150 mA.

<6> The maximum output current capacity for the +V terminal on the control circuit is 20 mA. Never short terminals +V and AC, as it can cause erroneous operation or damage the drive.

<7> Set jumper S1 to select between a voltage or current input signal to terminal A2. The default setting is for current input.

<8> Set jumper S1 to select between a voltage or current input signal to terminal A1 and A3. The default setting is for voltage input.

<9> Set DIP switch S2 to the ON position to enable the termination resistor in the last drive in a MEMOBUS/Modbus network.

<10> Monitor outputs work with devices such as analog frequency meters, ammeters, voltmeters, and wattmeters. They are not intended for use as a feedback-type signal.

<11> Use jumper S5 to select between voltage or current output signals at terminals AM and FM. Set parameters H4-07 and H4-08 accordingly.

WARNING! *Sudden Movement Hazard. Do not close the wiring for the control circuit unless the multifunction input terminal parameters are properly set. Improper sequencing of run/stop circuitry could result in death or serious injury from moving equipment.*

WARNING! *Sudden Movement Hazard. Ensure start/stop and safety circuits are wired properly and in the correct state before energizing the drive. Failure to comply could result in death or serious injury from moving equipment. When programmed for 3-Wire control, a momentary closure on terminal S1 may cause the drive to start.*

WARNING! *Sudden Movement Hazard. Confirm the drive I/O signals and external sequence before executing the application preset function. Executing the application preset function or setting A1-03 ≠ 0 will change the drive I/O terminal functions and may cause unexpected equipment operation. Failure to comply may cause death or serious injury.*

NOTICE: *When using the automatic fault restart function with wiring designed to shut off the power supply upon drive fault, make sure the drive does not trigger a fault output during fault restart (L5-02 = 0, default). Failure to comply will prevent the automatic fault restart function from working properly.*

3.2 Main Circuit Connection Diagram

Refer to diagrams in this section when wiring the main circuit of the drive. Connections may vary based on drive capacity. The DC power supply for the main circuit also provides power to the control circuit.

NOTICE: *Do not use the negative DC bus terminal "–" as a ground terminal. This terminal is at high DC voltage potential. Improper wiring connections could damage the drive.*

◆ Three-Phase 200 V Class Models 2A0004 to 2A0081
Three-Phase 400 V Class Models 4A0002 to 4A0044
Three-Phase 600 V Class Models 5A0003 to 5A0032

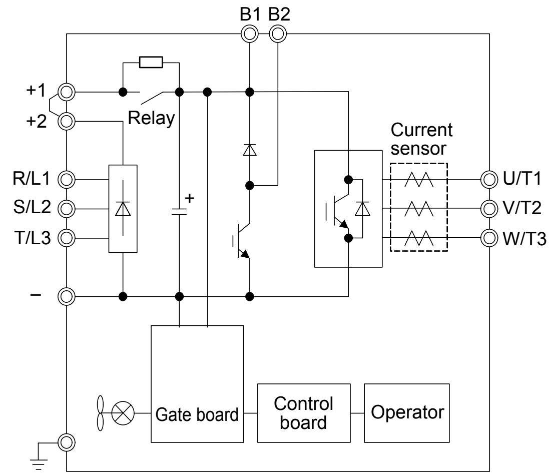

Figure 3.2 Connecting Main Circuit Terminals

◆ Three-Phase 200 V Class Models 2A0110, 2A0138
Three-Phase 400 V Class Models 4A0058, 4A0072
Three-Phase 600 V Class Models 5A0041, 5A0052

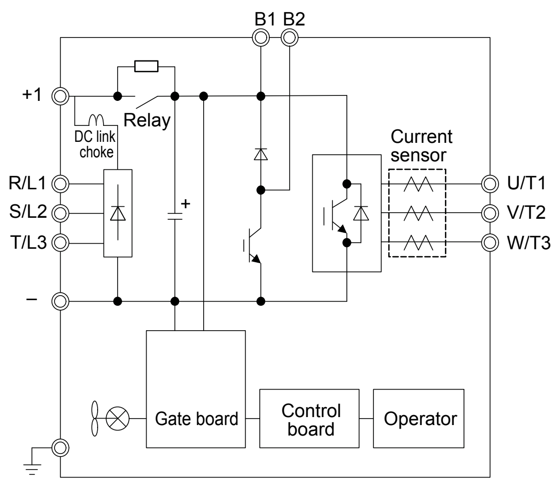

Figure 3.3 Connecting Main Circuit Terminals

Electrical Installation

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◆ Three-Phase 200 V Class Models 2A0169 to 2A0211 Three-Phase 400 V Class Models 4A0088 to 4A0139 Three-Phase 600 V Class Models 5A0062 to 5A0099

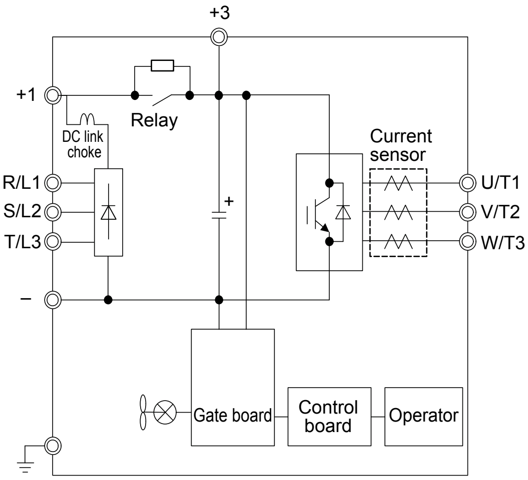


Figure 3.4 Connecting Main Circuit Terminals

◆ Three-Phase 200 V Class Models 2A0250 to 2A0415 Three-Phase 400 V Class Models 4A0165 to 4A0675 Three-Phase 600 V Class Models 5A0125 to 5A0242

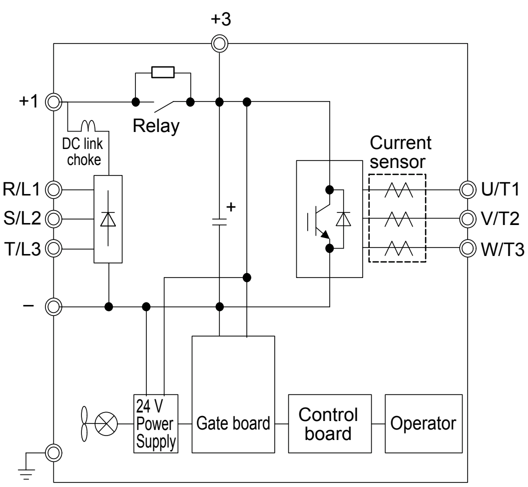


Figure 3.5 Connecting Main Circuit Terminals

◆ Single-Phase Connections

Use terminals R/L1 and S/L2 to connect single-phase power.

3.3 Terminal Cover

Follow the procedure below to remove the terminal cover for wiring and to reattach the terminal cover after wiring is complete.

◆ Models 2A0004 to 2A0081, 4A0002 to 4A0044, 5A0003 to 5A0032 (IP20/NEMA Type 1 Enclosure)

■ Removing the Terminal Cover

1. Loosen the terminal cover screw using a #2 Phillips screwdriver. Screw sizes vary by drive model.

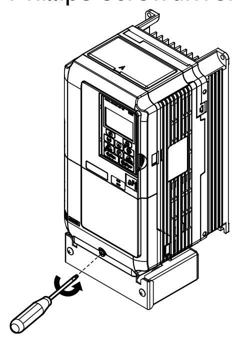


Figure 3.6 Removing the Terminal Cover on an IP20/NEMA Type 1 Enclosure Drive

2. Push in on the tab located on the bottom of the terminal cover and gently pull forward to remove the terminal cover.

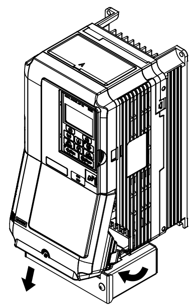


Figure 3.7 Removing the Terminal Cover on an IP20/NEMA Type 1 Enclosure Drive

■ Reattaching the Terminal Cover

Power lines and signal wiring should pass through the opening provided. ***Refer to Wiring the Main Circuit Terminal on page 94*** and ***Wiring the Control Circuit Terminal*** on page ***99*** for details on wiring.

Reattach the terminal cover after completing the wiring to the drive and other devices.

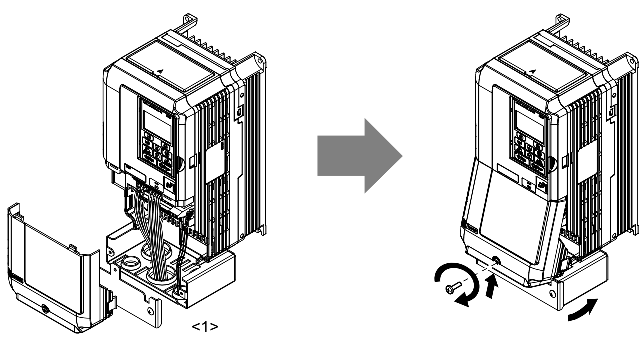


Figure 3.8 Reattaching the Terminal Cover on an IP20/NEMA Type 1 Enclosure Drive

<1> Connect the ground wiring first, then the main circuit wiring, and finally the control circuit wiring.

◆ Models 2A0110 to 2A0250, 4A0208 to 4A0675, and 5A0125 to 5A0242 (IP00/Open Type Enclosure)

■ Removing the Terminal Cover

1. Loosen the screws on the terminal cover, then pull down on the cover.

Note: The terminal cover and the number of terminal cover screws differ depending on the drive model.

CAUTION! *Do not completely remove the cover screws, just loosen them. If the cover screws are removed completely, the terminal cover may fall off causing an injury.*

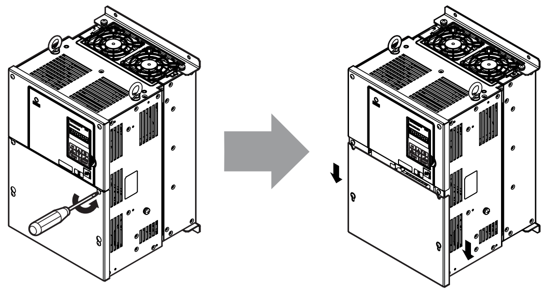


Figure 3.9 Removing the Terminal Cover on an IP00/Open Type Enclosure Drive

2. Pull forward on the terminal cover to free it from the drive.

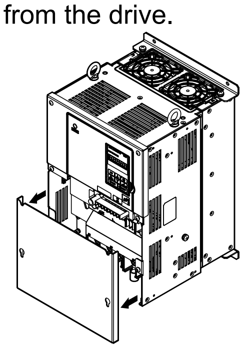


Figure 3.10 Removing the Terminal Cover on an IP00/Open Type Enclosure Drive

■ Reattaching the Terminal Cover

After wiring the terminal board and other devices, double-check connections and reattach the terminal cover. ***Refer to Wiring the Main Circuit Terminal on page 94*** and ***Wiring the Control Circuit Terminal*** on page ***99*** for details on wiring.

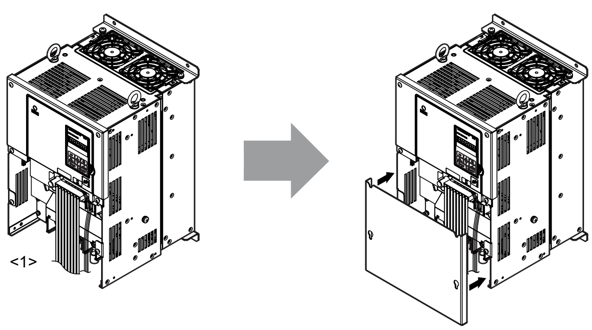


Figure 3.11 Reattaching the Terminal Cover on an IP00/Open Type Enclosure Drive

<1> Connect the ground wiring first, then the main circuit wiring, and finally the control circuit wiring.

3.4 HOA Keypad and Front Cover

Detach the HOA keypad from the drive for remote operation or when opening the front cover to install an option card.

NOTICE: *Be sure to remove the HOA keypad prior to opening or reattaching the front cover. Leaving the HOA keypad plugged into the drive when removing the front cover can result in erroneous operation caused by a poor connection. Firmly fasten the front cover back into place before reattaching the HOA keypad.*

◆ Removing/Reattaching the HOA Keypad

■ Removing the HOA Keypad

While pressing on the tab located on the right side of the digital operator, pull the HOA keypad forward to remove it from the drive.

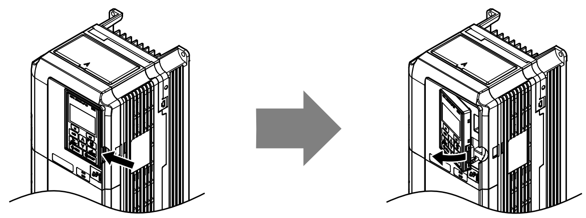


Figure 3.12 Removing the HOA Keypad

■ Reattaching the HOA Keypad

Insert the HOA keypad into the opening in the top cover while aligning it with the notches on the left side of the opening. Next, press gently on the right side of the keypad until it clicks into place.

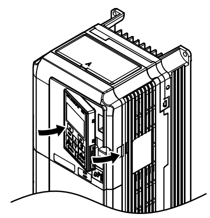


Figure 3.13 Reattaching the HOA Keypad

◆ Removing/Reattaching the Front Cover

■ Removing the Front Cover

Models 2A0004 to 2A0081, 4A0002 to 4A0044, and 5A0003 to 5A0032

After removing the terminal cover and the HOA keypad, loosen the screw that affixes the front cover (models 2A0056, 4A0038, 5A0022, and 5A0027 do not use a screw to affix the front cover) . Pinch in on the tabs found on each side of the front cover, then pull forward to remove it from the drive.

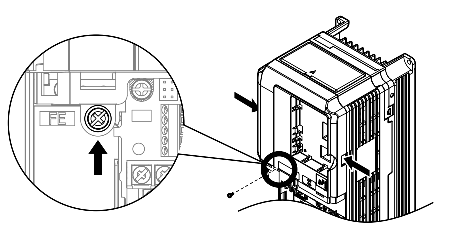


Figure 3.14 Remove the Front Cover (2A0004 to 2A0081, 4A0002 to 4A0044, and 5A0003 to 5A0032)

Models 2A0110 to 2A0415 and 4A0058 to 4A0675

1. Remove the terminal cover and the HOA keypad.
2. Loosen the installation screw on the front cover.
3. Use a straight-edge screwdriver to loosen the hooks on each side of the cover that hold it in place.

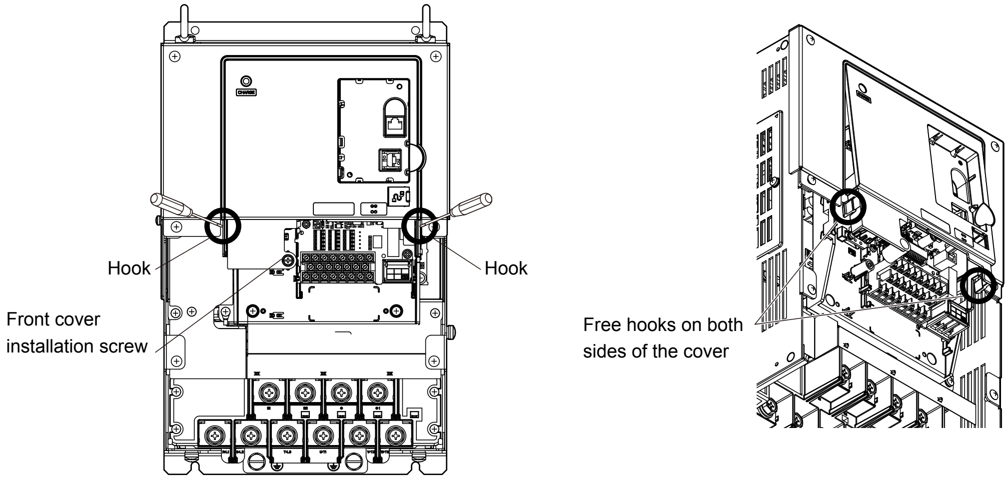


Figure 3.15 Remove the Front Cover (2A0010 to 2A0415 and 4A0058 to 4A0675)

4. Unhook the left side of the front cover then swing the left side towards you as shown in ***Figure 3.16*** until the cover comes off.

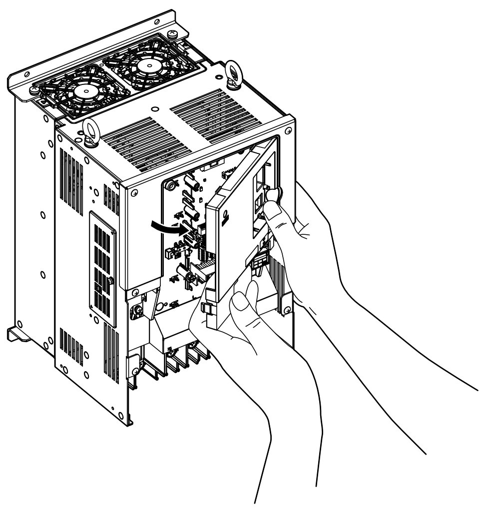


Figure 3.16 Remove the Front Cover (2A0010 to 2A0415 and 4A0058 to 4A0675)

■ Reattaching the Front Cover

Models 2A0004 to 2A0081, 4A0002 to 4A0044, and 5A0003 to 5A0032

Reverse the instructions given in *Remove the Front Cover (2A0004 to 2A0081, 4A0002 to 4A0044, and 5A0003 to 5A0032)* on page *81* to reattach the front cover. Pinch inwards on the hooks found on each side of the front cover while guiding it back into the drive. Make sure it clicks firmly into place.

Models 2A0110 to 2A0415 and 4A0058 to 4A0675

1. Slide the front cover so the hooks on the top connect to the drive.

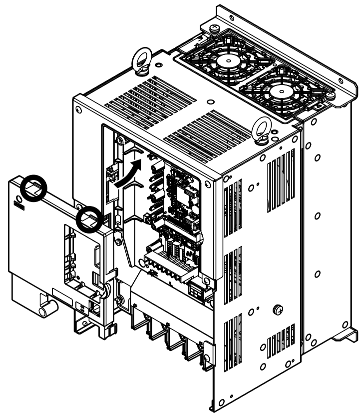


Figure 3.17 Reattach the Front Cover (2A0110 to 2A0415 and 4A0058 to 4A0675)

2. After connecting the hooks to the drive, press firmly on the cover to lock it into place.

3.5 Top Protective Cover

Drive models 2A0004 to 2A0081, 4A0002 to 4A0044, and 5A0003 to 5A0032 are designed to IP20/NEMA Type 1 specifications with a protective cover on the top. Removing this top protective cover or the bottom conduit bracket from an IP20/NEMA Type 1 enclosure drive voids the NEMA Type 1 protection while maintaining IP20 conformity.

◆ Removing the Top Protective Cover

Insert the tip of a straight-edge screwdriver into the small opening located on the front edge of the top protective cover. Gently apply pressure as shown in the figure below to free the cover from the drive.

Note: Removing the top protective cover or the bottom conduit bracket from an IP20/NEMA Type 1 enclosure drive voids the NEMA Type 1 protection while maintaining IP20 conformity.

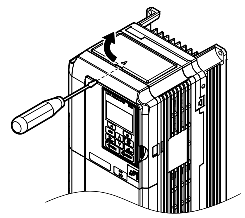


Figure 3.18 Removing the Top Protective Cover

◆ Reattaching the Top Protective Cover

Insert the two small protruding hooks on the rear side of the top protective cover into the provided mounting holes near the back of the drive, then press down on the front side of the top protective cover to fasten the cover into place.

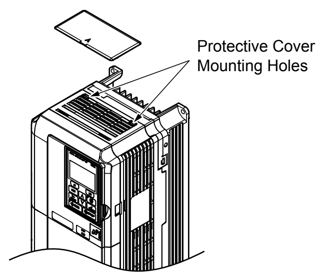


Figure 3.19 Reattaching the Protective Cover

3.6 Main Circuit Wiring

This section describes the functions, specifications, and procedures required to safely and properly wire the main circuit in the drive.

NOTICE: *Do not solder the ends of wire connections to the drive. Soldered wiring connections can loosen over time. Improper wiring practices could result in drive malfunction due to loose terminal connections.*

NOTICE: *Do not switch the drive input to start or stop the motor. Frequently switching the drive on and off shortens the life of the DC bus charge circuit and the DC bus capacitors, and can cause premature drive failures. For the full performance life, refrain from switching the drive on and off more than once every 30 minutes.*

Note: *Refer to Single-Phase Derating on page 247* for applying and protecting the drive when using single-phase input power.

Refer to Input Fuse Installation on page 347 for details on fuse selection.

◆ Factory Recommended Branch Circuit Protection

WARNING! *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.*
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.

Yaskawa recommends installing branch circuit protection according to maintain compliance with UL508C. Semiconductor protective type fuses are preferred. Alternate branch circuit protection devices are also listed in this manual. *Refer to Factory Recommended Branch Circuit Protection on page 336* for details.

◆ Main Circuit Terminal Functions

Table 3.1 Main Circuit Terminal Functions

<table>
<tr><th colspan="2">Terminal</th><th colspan="3">Type</th><th rowspan="4">Function</th><th rowspan="4">Page</th></tr>
<tr><th>200 V Class</th><th rowspan="3">Drive Model</th><th>2A0004 to 2A0081</th><th>2A0110 to 2A0138</th><th>2A0169 to 2A0415</th></tr>
<tr><th>400 V Class</th><th>4A0002 to 4A0044</th><th>4A0058, 4A0072</th><th>4A0088 to 4A0675</th></tr>
<tr><th>600 V Class</th><th>5A0003 to 5A0032</th><th>5A0041 to 5A0052</th><th>5A0062 to 5A0242</th></tr>
<tr><td colspan="2">R/L1</td><td colspan="3" rowspan="3">Main circuit power supply input</td><td rowspan="3">Connects line power to the drive</td><td rowspan="3">75</td></tr>
<tr><td colspan="2">S/L2</td></tr>
<tr><td colspan="2">T/L3</td></tr>
<tr><td colspan="2">U/T1</td><td colspan="3" rowspan="3">Drive output</td><td rowspan="3">Connects to the motor</td><td rowspan="3">75</td></tr>
<tr><td colspan="2">V/T2</td></tr>
<tr><td colspan="2">W/T3</td></tr>
<tr><td colspan="2">B1</td><td colspan="2" rowspan="2">Braking resistor</td><td rowspan="2">Not available</td><td rowspan="2">Available for connecting a braking resistor or a braking resistor unit option</td><td rowspan="2">–</td></tr>
<tr><td colspan="2">B2</td></tr>
<tr><td colspan="2">+2</td><td rowspan="3">• DC link choke connection (+1, +2) (remove the shorting bar between +1 and +2)
• DC power supply input (+1, −)</td><td colspan="2">Not available</td><td rowspan="4">For connecting:
• the drive to a DC power supply (terminals +1 and – are not EU/CE or UL approved)
• dynamic braking options
• a DC link choke</td><td rowspan="4">–</td></tr>
<tr><td colspan="2">+1</td><td rowspan="2">DC power supply input (+1, −)</td><td rowspan="3">• DC power supply input (+1, −)
• Braking unit connection (+3, −)</td></tr>
<tr><td colspan="2">–</td></tr>
<tr><td colspan="2">+3</td><td colspan="2">Not available</td></tr>
<tr><td colspan="2">⏚</td><td colspan="3">For 200 V class: 100 Ω or less
For 400 V class: 10 Ω or less
For 600 V class: 10 Ω or less</td><td>Grounding terminal</td><td>94</td></tr>
</table>

Note: Use terminals B1 and – when installing a CDBR-type braking unit on drives with built-in braking transistors (Models 2A0004 to 2A0138, 4A0002 to 4A0072, and 5A0003 to 5A0052).

◆ Protecting Main Circuit Terminals

■ Insulation Caps or Sleeves

Use insulation caps or sleeves when wiring the drive with crimp terminals. Take particular care to ensure that the wiring does not touch nearby terminals or the surrounding case.

■ Insulation Barrier

Insulation barriers are packaged with drive models 4A0414 through 4A0675 to provide added protection between terminals. Yaskawa recommends using the provided insulation barriers to ensure proper wiring. Refer to ***Figure 3.20*** for instructions on placement of the insulation barriers.

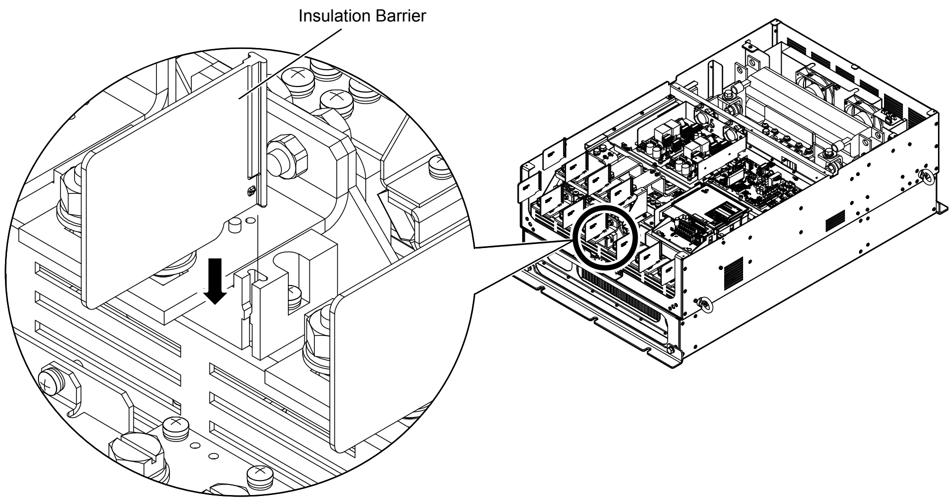


Figure 3.20 Installing Insulation Barriers

◆ Wire Gauges and Tightening Torque

Use the tables in this section to select the appropriate wires and crimp terminals.

Gauges listed in the tables are for use in the United States.

Note:
1. Wire gauge recommendations based on drive continuous current ratings (ND) using 75 °C 600 Vac vinyl-sheathed wire assuming ambient temperature within 40 °C and wiring distance less than 100 m.
2. Terminals +1, +2, +3, –, B1 and B2 are for connecting optional devices such as a DC link choke or braking resistor. Do not connect other nonspecific devices to these terminals.

- Consider the amount of voltage drop when selecting wire gauges. Increase the wire gauge when the voltage drop is greater than 2% of motor rated voltage. Ensure the wire gauge is suitable for the terminal block. Use the following formula to calculate the amount of voltage drop:

  Line drop voltage (V) = $\sqrt{3}$ × wire resistance (Ω/km) × wire length (m) × current (A) × 10^{-3}
- Refer to instruction manual TOBP C720600 00 for braking transistor option or braking resistor option wire gauges.
- Use terminals +1 and – when connecting a regenerative converter or a regen unit.

  NOTICE: *Do not connect a braking resistor to terminals +1 or –. Failure to comply may cause damage to the drive circuitry.*
- Use terminals B1 and – when installing a CDBR-type braking unit on drives with built-in braking transistors (models 2A0004 to 2A0138, 4A0002 to 4A0072, and 5A0003 to 5A0052).

  NOTICE: *Do not connect a braking resistor to terminals +1 or –. Failure to comply may cause damage to the drive circuitry.*
- ***Refer to UL Standards Compliance on page 343*** for information on UL compliance.

Yaskawa recommends using closed-loop crimp terminals on all drive models. UL/cUL approval requires the use of closed-loop crimp terminals when wiring the drive main circuit terminals on models 2A0110 to 2A0415 and 4A0058 to 4A0675. Use only the tools recommended by the terminal manufacturer for crimping. ***Refer to Closed-Loop Crimp Terminal Size on page 343*** for closed-loop crimp terminal recommendations.

The wire gauges listed in the following tables are Yaskawa recommendations. Refer to local codes for proper wire gauge selections.

■ Three-Phase 200 V Class

Table 3.2 Wire Gauge and Torque Specifications (Three-Phase 200 V Class)

Drive Model	Terminal	Recomm. Gauge AWG, kcmil	Wire Range AWG, kcmil	Screw Size	Tightening Torque N·m (lb.in.)
2A0004 2A0006 2A0008 2A0010	R/L1, S/L2, T/L3	14	14 to 10	M4	1.2 to 1.5 (10.6 to 13.3)
	U/T1, V/T2, W/T3	14	14 to 10		
	–, +1, +2	–	14 to 10		
	B1, B2	–	14 to 10		
	⏚	10 <1>	14 to 10		
2A0012	R/L1, S/L2, T/L3	12	14 to 10	M4	1.2 to 1.5 (10.6 to 13.3)
	U/T1, V/T2, W/T3	14	14 to 10		
	–, +1, +2	–	14 to 10		
	B1, B2	–	14 to 10		
	⏚	10 <1>	14 to 10		
2A0018	R/L1, S/L2, T/L3	10	12 to 10	M4	1.2 to 1.5 (10.6 to 13.3)
	U/T1, V/T2, W/T3	10	14 to 10		
	–, +1, +2	–	14 to 10		
	B1, B2	–	14 to 10		
	⏚	10 <1>	14 to 10		
2A0021	R/L1, S/L2, T/L3	10	12 to 10	M4	1.2 to 1.5 (10.6 to 13.3)
	U/T1, V/T2, W/T3	10	12 to 10		
	–, +1, +2	–	12 to 10		
	B1, B2	–	14 to 10		
	⏚	10 <1>	12 to 10		

Drive Model	Terminal	Recomm. Gauge AWG, kcmil	Wire Range AWG, kcmil	Screw Size	Tightening Torque N·m (lb.in.)
2A0030	R/L1, S/L2, T/L3	8	10 to 6	M4	2.1 to 2.3 (18.4 to 20.4)
	U/T1, V/T2, W/T3	8	10 to 6		
	–, +1, +2	–	10 to 6		
	B1, B2	–	14 to 10		
	⏚	8 <1>	10 to 8	M5	2 to 2.5 (17.7 to 22.1)
2A0040	R/L1, S/L2, T/L3	6	8 to 6	M4	2.1 to 2.3 (18.4 to 20.4)
	U/T1, V/T2, W/T3	8	8 to 6		
	–, +1, +2	–	6		
	B1, B2	–	12 to 10		
	⏚	8 <1>	10 to 8	M5	2 to 2.5 (17.7 to 22.1)
2A0056	R/L1, S/L2, T/L3	4	6 to 4	M6	5.4 to 6.0 (47.8 to 53.1)
	U/T1, V/T2, W/T3	4	6 to 4		
	–, +1, +2	–	6 to 4		
	B1, B2	–	10 to 6	M5	2.7 to 3.0 (23.9 to 26.6)
	⏚	6	8 to 6	M6	4 to 6 (35.4 to 53.1)
2A0069	R/L1, S/L2, T/L3	3	4 to 3	M8	9.9 to 11.0 (87.6 to 97.4)
	U/T1, V/T2, W/T3	3	4 to 3		
	–, +1, +2	–	4 to 3		
	B1, B2	–	8 to 6	M5	2.7 to 3.0 (23.9 to 26.6)
	⏚	6	6 to 4	M6	4 to 6 (35.4 to 53.1)
2A0081	R/L1, S/L2, T/L3	2	3 to 2	M8	9.9 to 11.0 (87.6 to 97.4)
	U/T1, V/T2, W/T3	2	3 to 2		
	–, +1, +2	–	3 to 2		
	B1, B2	–	6	M5	2.7 to 3.0 (23.9 to 26.6)
	⏚	6	6 to 4	M6	4 to 6 (35.4 to 53.1)
2A0110 <2>	R/L1, S/L2, T/L3	1/0	3 to 1/0	M8	9 to 11 (79.7 to 97.4)
	U/T1, V/T2, W/T3	1/0	3 to 1/0		
	–, +1	–	2 to 1/0		
	B1, B2	–	6 to 1/0		
	⏚	6	6 to 4		
2A0138 <2>	R/L1, S/L2, T/L3	2/0	1 to 2/0	M10	18 to 23 (159 to 204)
	U/T1, V/T2, W/T3	2/0	1 to 2/0		
	–, +1	–	1/0 to 3/0		
	B1, B2	–	4 to 2/0		
	⏚	4	4	M8	9 to 11 (79.7 to 97.4)
2A0169 <2>	R/L1, S/L2, T/L3	4/0	2/0 to 4/0	M10	18 to 23 (159 to 204)
	U/T1, V/T2, W/T3	4/0	3/0 to 4/0		
	–, +1	–	1 to 4/0		
	+3	–	1/0 to 4/0		
	⏚	4	4 to 2		
2A0211 <2>	R/L1, S/L2, T/L3	1/0 × 2P	1/0 to 2/0	M10	18 to 23 (159 to 204)
	U/T1, V/T2, W/T3	1/0 × 2P	1/0 to 2/0		
	–, +1	–	1 to 4/0		
	+3	–	1/0 to 4/0		
	⏚	4	4 to 1/0		

Drive Model	Terminal	Recomm. Gauge AWG, kcmil	Wire Range AWG, kcmil	Screw Size	Tightening Torque N·m (lb.in.)
2A0250 <2>	R/L1, S/L2, T/L3	3/0 × 2P	3/0 to 300	M12	32 to 40 (283 to 354)
	U/T1, V/T2, W/T3	3/0 × 2P	3/0 to 300		
	–, +1	–	3/0 to 300		
	+3	–	2 to 300	M10	18 to 23 (159 to 204)
	⏚	3	3 to 300	M12	32 to 40 (283 to 354)
2A0312 <2>	R/L1, S/L2, T/L3	4/0 × 2P	3/0 to 300	M12	32 to 40 (283 to 354)
	U/T1, V/T2, W/T3	3/0 × 2P	3/0 to 300		
	–, +1	–	3/0 to 300		
	+3	–	3/0 to 300	M10	18 to 23 (159 to 204)
	⏚	2	2 to 300	M12	32 to 40 (283 to 354)
2A0360 <2>	R/L1, S/L2, T/L3	250 × 2P	4/0 to 600	M12	32 to 40 (283 to 354)
	U/T1, V/T2, W/T3	4/0 × 2P	4/0 to 600		
	–, +1	–	250 to 600		
	+3	–	3/0 to 600	M10	18 to 23 (159 to 204)
	⏚	1	1 to 350	M12	32 to 40 (283 to 354)
2A0415 <2>	R/L1, S/L2, T/L3	350 × 2P	250 to 600	M12	32 to 40 (283 to 354)
	U/T1, V/T2, W/T3	300 × 2P	300 to 600		
	–, +1	–	300 to 600		
	+3	–	3/0 to 600	M10	18 to 23 (159 to 204)
	⏚	1	1 to 350	M12	32 to 40 (283 to 354)

<1> When installing an EMC filter, additional measures must be taken to comply with IEC61800-5-1. ***Refer to EMC Filter Installation on page 338*** for details.

<2> Drive models 2A0110 to 2A0415 require the use of UL-Listed closed-loop crimp terminals for UL/cUL compliance. Use only the tools recommended by the terminal manufacturer for crimping.

■ Three-Phase 400 V Class

Table 3.3 Wire Gauge and Torque Specifications (Three-Phase 400 V Class)

Drive Model	Terminal	Recomm. Gauge AWG, kcmil	Wire Range AWG, kcmil	Screw Size	Tightening Torque N·m (lb.in.)
4A0002 4A0004	R/L1, S/L2, T/L3	14	14 to 10	M4	1.2 to 1.5 (10.6 to 13.3)
	U/T1, V/T2, W/T3	14	14 to 10		
	–, +1, +2	–	14 to 10		
	B1, B2	–	14 to 10		
	⏚	12	14 to 12		
4A0005 4A0007 4A0009	R/L1, S/L2, T/L3	14	14 to 10	M4	1.2 to 1.5 (10.6 to 13.3)
	U/T1, V/T2, W/T3	14	14 to 10		
	–, +1, +2	–	14 to 10		
	B1, B2	–	14 to 10		
	⏚	10	14 to 10		
4A0011	R/L1, S/L2, T/L3	12	14 to 10	M4	1.2 to 1.5 (10.6 to 13.3)
	U/T1, V/T2, W/T3	14	14 to 10		
	–, +1, +2	–	14 to 10		
	B1, B2	–	14 to 10		
	⏚	10	14 to 10		

Drive Model	Terminal	Recomm. Gauge AWG, kcmil	Wire Range AWG, kcmil	Screw Size	Tightening Torque N·m (lb.in.)
4A0018	R/L1, S/L2, T/L3	10	12 to 6	M4	2.1 to 2.3 (18.4 to 20.4)
	U/T1, V/T2, W/T3	10	12 to 6		
	–, +1, +2	–	12 to 6		
	B1, B2	–	12 to 10		
	⏚	10	14 to 10	M5	2 to 2.5 (17.7 to 22.1)
4A0023	R/L1, S/L2, T/L3	10	10 to 6	M4	2.1 to 2.3 (18.4 to 20.4)
	U/T1, V/T2, W/T3	10	10 to 6		
	–, +1, +2	–	12 to 6		
	B1, B2	–	12 to 10		
	⏚	10	12 to 10	M5	2 to 2.5 (17.7 to 22.1)
4A0031	R/L1, S/L2, T/L3	8	8 to 6	M5	2.7 to 3.0 (23.9 to 26.6)
	U/T1, V/T2, W/T3	8	10 to 6		
	–, +1, +2	–	10 to 6		
	B1, B2	–	10 to 8	M5	
	⏚	8	10 to 8	M6	4 to 6 (35.4 to 53.1)
4A0038	R/L1, S/L2, T/L3	6	8 to 6	M5	2.7 to 3.0 (23.9 to 26.6)
	U/T1, V/T2, W/T3	8	8 to 6		
	–, +1, +2	–	6		
	B1, B2	–	10 to 8	M5	
	⏚	6	10 to 6	M6	4 to 6 (35.4 to 53.1)
4A0044	R/L1, S/L2, T/L3	6	6 to 4	M6	5.4 to 6.0 (47.8 to 53.1)
	U/T1, V/T2, W/T3	6	6 to 4		
	–, +1, +2	–	6 to 4		
	B1, B2	–	10 to 8	M5	2.7 to 3.0 (23.9 to 26.6)
	⏚	6	8 to 6	M6	4 to 6 (35.4 to 53.1)
4A0058 <1>	R/L1, S/L2, T/L3	4	6 to 4	M8	9 to 11 (79.7 to 97.4)
	U/T1, V/T2, W/T3	4	6 to 4		
	–, +1	–	6 to 1		
	B1, B2	–	8 to 4		
	⏚	6	8 to 6		
4A0072 <1>	R/L1, S/L2, T/L3	3	4 to 3	M8	9 to 11 (79.7 to 97.4)
	U/T1, V/T2, W/T3	3	4 to 3		
	–, +1	–	4 to 1		
	B1, B2	–	6 to 3		
	⏚	6	6		
4A0088 <1>	R/L1, S/L2, T/L3	2	3 to 1/0	M8	9 to 11 (79.7 to 97.4)
	U/T1, V/T2, W/T3	2	3 to 1/0		
	–, +1	–	3 to 1/0		
	+3	–	6 to 1/0		
	⏚	4	6 to 4		
4A0103 <1>	R/L1, S/L2, T/L3	1/0	2 to 1/0	M8	9 to 11 (79.7 to 97.4)
	U/T1, V/T2, W/T3	1	2 to 1/0		
	–, +1	–	3 to 1/0		
	+3	–	4 to 1/0		
	⏚	4	6 to 4		

Drive Model	Terminal	Recomm. Gauge AWG, kcmil	Wire Range AWG, kcmil	Screw Size	Tightening Torque N·m (lb.in.)
4A0139 <1>	R/L1, S/L2, T/L3	3/0	1/0 to 4/0	M10	18 to 23 (159 to 204)
	U/T1, V/T2, W/T3	2/0	1/0 to 4/0		
	–, +1	–	1/0 to 4/0		
	+3	–	3 to 4/0		
	⏚	4	4		
4A0165 <1>	R/L1, S/L2, T/L3	4/0	3/0 to 4/0	M10	18 to 23 (159 to 204)
	U/T1, V/T2, W/T3	4/0	3/0 to 4/0		
	–,+1	–	1 to 4/0		
	+3	–	1/0 to 4/0		
	⏚	4	4 to 2		
4A0208 <1>	R/L1, S/L2, T/L3	300	2 to 300	M10	18 to 23 (159 to 204)
	U/T1, V/T2, W/T3	300	2 to 300		
	–,+1	–	1 to 250		
	+3	–	3 to 3/0		
	⏚	4	4 to 300		
4A0250 <1>	R/L1, S/L2, T/L3	400	1 to 600	M10	18 to 23 (159 to 204)
	U/T1, V/T2, W/T3	400	1/0 to 600		
	–,+1	–	3/0 to 600		
	+3	–	1 to 325		
	⏚	2	2 to 350		
4A0296 <1>	R/L1, S/L2, T/L3	500	2/0 to 600	M12	32 to 40 (283 to 354)
	U/T1, V/T2, W/T3	500	2/0 to 600		
	–,+1	–	3/0 to 600		
	+3	–	1 to 325	M10	18 to 23 (159 to 204)
	⏚	2	2 to 350	M12	32 to 40 (283 to 354)
4A0362 <1>	R/L1, S/L2, T/L3	4/0 × 2P	3/0 to 600	M12	32 to 40 (283 to 354)
	U/T1, V/T2, W/T3	4/0 × 2P	3/0 to 600		
	–,+1	–	4/0 to 600		
	+3	–	3/0 to 600	M10	18 to 23 (159 to 204)
	⏚	1	1 to 350	M12	32 to 40 (283 to 354)
4A0414 <1> <2>	R/L1, S/L2, T/L3	300 × 2P	4/0 to 300	M12	32 to 40 (283 to 354)
	U/T1, V/T2, W/T3	300 × 2P	4/0 to 300		
	–,+1	–	3/0 to 300		
	+3	–	3/0 to 300		
	⏚	1	1 to 3/0		
4A0515 <1> <2>	R/L1, S/L2, T/L3	3/0 × 4P	3/0 to 300	M12	32 to 40 (283 to 354)
	U/T1, V/T2, W/T3	4/0 × 4P	3/0 to 300		
	–,+1	–	1/0 to 300		
	+3	–	1/0 to 300		
	⏚	1/0	1/0 to 300		
4A0675 <1> <2>	R/L1, S/L2, T/L3	300 × 4P	4/0 to 300	M12	32 to 40 (283 to 354)
	U/T1, V/T2, W/T3	300 × 4P	4/0 to 300		
	–,+1	–	1/0 to 300		
	+3	–	1/0 to 300		
	⏚	2/0	2/0 to 300		

<1> Drive models 4A0058 to 4A0675 require the use of UL-Listed closed-loop crimp terminals for UL/cUL compliance. Use only the tools recommended by the terminal manufacturer for crimping.

<2> When installing an EMC filter, additional measures must be taken to comply with IEC61800-5-1. ***Refer to EMC Filter Installation on page 338*** for details.

■ Three-Phase 600 V Class

Table 3.4 Wire Gauge and Torque Specifications (Three-Phase 600 V Class)

Drive Model	Terminal	Recomm. Gauge AWG, kcmil	Wire Range AWG, kcmil	Screw Size	Tightening Torque N·m (lb.in.)
5A0003 5A0004 5A0006	R/L1, S/L2, T/L3	14	14 to 10	M4	1.2 to 1.5 (10.6 to 13.3)
	U/T1, V/T2, W/T3	14	14 to 10		
	–, +1, +2	–	14 to 10		
	B1, B2	–	14 to 10		
	⏚	10	14 to 10		
5A0009	R/L1, S/L2, T/L3	14	14 to 10	M4	1.2 to 1.5 (10.6 to 13.3)
	U/T1, V/T2, W/T3	14	14 to 10		
	–, +1, +2	–	14 to 10		
	B1, B2	–	14 to 10		
	⏚	10	12 to 10		
5A0011	R/L1, S/L2, T/L3	10	14 to 6	M4	1.2 to 1.5 (10.6 to 13.3)
	U/T1, V/T2, W/T3	14	14 to 6		
	–, +1, +2	–	14 to 6		
	B1, B2	–	14 to 10		
	⏚	8	12 to 8	M5	2 to 2.5 (17.7 to 22.1)
5A0017	R/L1, S/L2, T/L3	10	10 to 6	M5	2 to 2.5 (17.7 to 22.1)
	U/T1, V/T2, W/T3	10	10 to 6		
	–, +1, +2	–	10 to 6		
	B1, B2	–	10 to 8		
	⏚	8	12 to 8	M6	4 to 6 (35.4 to 53.1)
5A0022	R/L1, S/L2, T/L3	8	10 to 6	M5	2 to 2.5 (17.7 to 22.1)
	U/T1, V/T2, W/T3	10	10 to 6		
	–, +1, +2	–	10 to 6		
	B1, B2	–	10 to 8		
	⏚	8	10 to 6	M6	4 to 6 (35.4 to 53.1)
5A0027 5A0032	R/L1, S/L2, T/L3	6	6 to 4	M6	4 to 6 (35.4 to 53.1)
	U/T1, V/T2, W/T3	6	6 to 4		
	–, +1, +2	–	6 to 4		
	B1, B2	–	10 to 8	M5	2 to 2.5 (17.7 to 22.1)
	⏚	6	10 to 6	M6	4 to 6 (35.4 to 53.1)
5A0041	R/L1, S/L2, T/L3	6	10 to 3	M8	9 to 11 (79.7 to 97.4)
	U/T1, V/T2, W/T3	6	10 to 3		
	–, +1	–	6 to 1		
	B1, B2	–	12 to 3		
	⏚	6	6		
5A0052	R/L1, S/L2, T/L3	4	10 to 3	M8	9 to 11 (79.7 to 97.4)
	U/T1, V/T2, W/T3	6	10 to 3		
	–, +1	–	6 to 1		
	B1, B2	–	8 to 3		
	⏚	6	6		
5A0062	R/L1, S/L2, T/L3	4	10 to 4/0	M10	18 to 23 (159 to 204)
	U/T1, V/T2, W/T3	4	10 to 4/0		
	–, +1	–	4 to 4/0		
	+3	–	6 to 4/0		
	⏚	4	4		

Drive Model	Terminal	Recomm. Gauge AWG, kcmil	Wire Range AWG, kcmil	Screw Size	Tightening Torque N·m (lb.in.)
5A0077	R/L1, S/L2, T/L3	3	10 to 4/0	M10	18 to 23 (159 to 204)
	U/T1, V/T2, W/T3	3	10 to 4/0		
	–, +1	–	3 to 4/0		
	+3	–	6 to 4/0		
	⏚	4	4		
5A0099	R/L1, S/L2, T/L3	1/0	10 to 4/0	M10	18 to 23 (159 to 204)
	U/T1, V/T2, W/T3	1	10 to 4/0		
	–, +1	–	2 to 4/0		
	+3	–	4 to 4/0		
	⏚	4	4		
5A0125	R/L1, S/L2, T/L3	2/0	1 to 300	M10	18 to 23 (159 to 204)
	U/T1, V/T2, W/T3	2/0	1 to 300		
	–, +1	–	2/0 to 3/0		
	+3	–	1 to 1/0		
	⏚	3	4 to 300		
5A0145	R/L1, S/L2, T/L3	3/0	2/0 to 300	M10	18 to 23 (159 to 204)
	U/T1, V/T2, W/T3	3/0	2/0 to 300		
	–, +1	–	3/0 to 4/0		
	+3	–	1/0 to 2/0		
	⏚	3	4 to 300		
5A0192	R/L1, S/L2, T/L3	300	2/0 to 600	M12	32 to 40 (283 to 354)
	U/T1, V/T2, W/T3	250	2/0 to 600		
	–, +1	–	2/0 to 400		
	+3	–	2/0 to 250	M10	18 to 23 (159 to 204)
	⏚	1	1 to 350	M12	32 to 40 (283 to 354)
5A0242	R/L1, S/L2, T/L3	400	2/0 to 600	M12	32 to 40 (283 to 354)
	U/T1, V/T2, W/T3	350	2/0 to 600		
	–, +1	–	2/0 to 500		
	+3	–	250 to 300	M10	18 to 23 (159 to 204)
	⏚	1	1 to 350	M12	32 to 40 (283 to 354)

◆ Main Circuit Terminal and Motor Wiring

This section outlines the various steps, precautions, and checkpoints for wiring the main circuit terminals and motor terminals.

WARNING! *Electrical Shock Hazard. Do not connect the AC power line to the output terminals of the drive. Failure to comply could result in death or serious injury by fire as a result of drive damage from line voltage application to output terminals.*

NOTICE: *When connecting the motor to the drive output terminals U/T1, V/T2, and W/T3, the phase order for the drive and motor should match. Failure to comply with proper wiring practices may cause the motor to run in reverse if the phase order is backward.*

NOTICE: *Do not connect phase-advancing capacitors or LC/RC noise filters to the output circuits. Failure to comply could result in damage to the drive, phase-advancing capacitors, LC/RC noise filters or ground fault circuit interrupters.*

■ Cable Length Between Drive and Motor

Voltage drop along the motor cable may cause reduced motor torque when the wiring between the drive and the motor is too long, especially at low frequency output. This can also be a problem when motors are connected in parallel with a fairly long motor cable. Drive output current will increase as the leakage current from the cable increases. An increase in leakage current may trigger an overcurrent situation and weaken the accuracy of the current detection.

Adjust the drive carrier frequency according to *Table 3.5*. If the motor wiring distance exceeds 100 m because of the system configuration, reduce the ground currents.

Table 3.5 Cable Length Between Drive and Motor

Cable Length	50 m or less	100 m or less	Greater than 100 m
Carrier Frequency	15 kHz or less	5 kHz or less	2 kHz or less

Note: When setting carrier frequency for drives running multiple motors, calculate cable length as the total wiring distance to all connected motors.

■ Ground Wiring

Follow the precautions below when wiring the ground for one drive or a series of drives.

WARNING! *Electrical Shock Hazard. Make sure the protective earthing conductor complies with technical standards and local safety regulations. Because the leakage current exceeds 3.5 mA in models 4A0414 and larger, 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.*

WARNING! *Electrical Shock Hazard. Always use a ground wire that complies with technical standards on electrical equipment and minimize the length of the ground wire. Improper equipment grounding may cause dangerous electrical potentials on equipment chassis, which could result in death or serious injury.*

WARNING! *Electrical Shock Hazard. Be sure to ground the drive ground terminal (200 V class: ground to 100 Ω or less; 400 V class: ground to 10 Ω or less; 600 V class: ground to 10 Ω or less). Improper equipment grounding could result in death or serious injury by contacting ungrounded electrical equipment.*

NOTICE: *Do not share the ground wire with other devices such as welding machines or large-current electrical equipment. Improper equipment grounding could result in drive or equipment malfunction due to electrical interference.*

NOTICE: *When using more than one drive, ground multiple drives according to instructions. Improper equipment grounding could result in abnormal operation of drive or equipment.*

Refer to ***Figure 3.21*** when using multiple drives. Do not loop the ground wire.

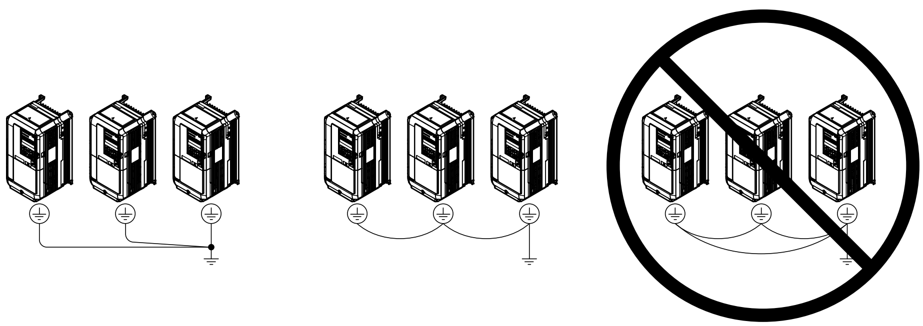


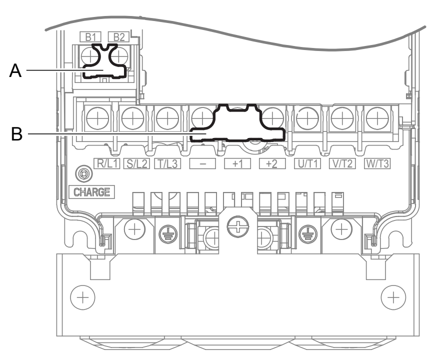
Figure 3.21 Multiple Drive Wiring

■ Wiring the Main Circuit Terminal

WARNING! *Electrical Shock Hazard. Shut off the power supply to the drive before wiring the main circuit terminals. Failure to comply may result in death or serious injury.*

Wire the main circuit terminals after the terminal board has been properly grounded.

Models 2A0004 to 2A0081, 4A0002 to 4A0044, and 5A0003 to 5A0032 have a cover placed over the DC bus and braking circuit terminals prior to shipment to help prevent miswiring. Use wire cutters to cut away covers as needed for terminals.



A – Braking circuit protective cover **B – DC bus protective cover**

Figure 3.22 Protecting Cover to Prevent Miswiring (Model 5A0011)

◼ Main Circuit Connection Diagram

Refer to Main Circuit Connection Diagram on page 77 when wiring terminals on the main power circuit of the drive.

WARNING! *Fire Hazard. The braking resistor connection terminals are B1 and B2. Do not connect braking resistors to any other terminals. Improper wiring connections could cause the braking resistor to overheat and cause death or serious injury by fire. Failure to comply may result in damage to the braking circuit or drive.*

3.7 Control Circuit Wiring

◆ Control Circuit Terminal Block Functions

Drive parameters determine which functions apply to the multi-function digital inputs (S1 to S8), multi-function digital outputs (M1 to M4), multi-function analog inputs (A1 to A3), and multi-function analog monitor output (FM, AM). The default setting is listed next to each terminal in *Figure 3.1* on page *75*.

WARNING! *Sudden Movement Hazard. Always check the operation and wiring of control circuits after being wired. Operating a drive with untested control circuits could result in death or serious injury.*

WARNING! *Sudden Movement Hazard. Confirm the drive I/O signals and external sequence before starting test run. Setting parameter A1-03 may change the I/O terminal function automatically from the factory setting.* ***Refer to Application Selection on page*** *. Failure to comply may result in death or serious injury.*

■ Input Terminals

Table 3.6 lists the input terminals on the drive. Text in parenthesis indicates the default setting for each multi-function input.

Table 3.6 Control Circuit Input Terminals

Type	No.	Terminal Name (Function)	Function (Signal Level) Default Setting	Page
Multi-Function Digital Inputs	S1	Multi-function input 1 (Closed: Forward run, Open: Stop)	• Photocoupler • 24 Vdc, 8 mA • *Refer to Sinking/Sourcing Mode Switch for Digital Inputs on page 101*.	*276*
	S2	Multi-function input 2 (Through mode)		
	S3	Multi-function input 3 (External pump fault, N.O.)		
	S4	Multi-function input 4 (Fault reset)		
	S5	Multi-function input 5 (Multi setpoint 1)		
	S6	Multi-function input 6 (HAND mode)		
	S7	Multi-function input 7 (HAND mode 2)		
	S8	Multi-function input 8 (Through mode)		
	SC	Multi-function input common	Multi-function input common	
	SP	Digital input power supply +24 Vdc	24 Vdc power supply for digital inputs, 150 mA max	*101*
	SN	Digital input power supply 0 V 24 V transducer power supply 0 V	**NOTICE:** *Do not jumper or short terminals SP and SN. Failure to comply will damage the drive.*	*101*
Analog Inputs / Pulse Train Input	RP	Multi-function pulse train input (Frequency reference)	• Input frequency range: 0 to 32 kHz • Signal Duty Cycle: 30 to 70% • High level: 3.5 to 13.2 Vdc, low level: 0.0 to 0.8 Vdc • Input impedance: 3 kΩ	*153* *288*
	+V	Power supply for analog inputs	10.5 Vdc (max allowable current 20 mA)	*151*
	24 V	+24 Vdc transducer power supply for customer use	150 mA maximum capacity	–
	A1	Multi-function analog input 1 (Frequency reference bias)	• -10 to 10 Vdc, 0 to 10 Vdc (input impedance: 20 kΩ) • 4 to 20 mA, 0 to 20 mA (input impedance: 250 Ω) • Voltage or current input must be selected by jumper S1 and H3-01.	*151* *160*
	A2	Multi-function analog input 2 (PID feedback)	• -10 to 10 Vdc, 0 to 10 Vdc (input impedance: 20 kΩ) • 4 to 20 mA, 0 to 20 mA (input impedance: 250 Ω) • Voltage or current input must be selected by jumper S1 and H3-09.	*151* *151* *162*
	A3	Multi-function analog input 3 (HAND frequency reference)	• -10 to 10 Vdc, 0 to 10 Vdc (input impedance: 20 kΩ) • 4 to 20 mA, 0 to 20 mA (input impedance: 250 Ω) • Voltage or current input must be selected by jumper S1 and H3-05.	*151*
	AC	Frequency reference common	0 V	*151*
	E (G)	Ground for shielded lines and option cards	–	–

■ Output Terminals

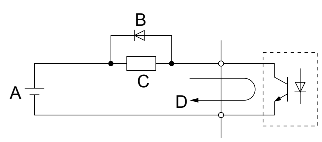
Table 3.7 lists the output terminals on the drive. Text in parenthesis indicates the default setting for each multi-function output.

Table 3.7 Control Circuit Output Terminals

Type	No.	Terminal Name (Function)	Function (Signal Level) Default Setting	Page
Fault Relay Output	MA	N.O.	30 Vdc, 10 mA to 1 A; 250 Vac, 10 mA to 1 A Minimum load: 5 Vdc, 10 mA	*159*
	MB	N.C. output		
	MC	Fault output common		
Multi-Function Digital Output <1>	MD	N.O.	30 Vdc, 10 mA to 1 A; 250 Vac, 10 mA to 1 A Minimum load: 5 Vdc, 10 mA	*159*
	ME	N.C. Output		
	MF	Common (Speed agree)		
	M1	Multi-function digital output (During frequency output)	30 Vdc, 10 mA to 1 A; 250 Vac, 10 mA to 1 A Minimum load: 5 Vdc, 10 mA	
	M2			
	M3	Multi-function digital output (Through mode)		
	M4			
Monitor Output	FM	Analog monitor output 1 (Output frequency)	-10 to +10 Vdc, or 0 to +10 Vdc	*286*
	AM	Analog monitor output 2 (Output current)		
	AC	Monitor common	0 V	–

<1> Refrain from assigning functions to digital relay outputs that involve frequent switching, as doing so may shorten relay performance life. Switching life is estimated at 200,000 times (assumes 1 A, resistive load).

Connect a suppression diode as shown in ***Figure 3.23*** when driving a reactive load such as a relay coil. Ensure the diode rating is greater than the circuit voltage.



A – External power, 48 V max.
B – Suppression diode
C – Coil
D – 50 mA or less

Figure 3.23 Connecting a Suppression Diode

■ Serial Communication Terminals

Table 3.8 Control Circuit Terminals: Serial Communications

Type	No.	Signal Name	Function (Signal Level)	
MEMOBUS/Modbus Communication <1>	R+	Communications input (+)	MEMOBUS/Modbus communication: Use an RS-422 or RS-485 cable to connect the drive.	RS-422/RS-485 MEMOBUS/Modbus communication protocol 115.2 kbps (max.)
	R-	Communications input (-)		
	S+	Communications output (+)		
	S-	Communications output (-)		
	IG	Shield ground	0 V	

<1> Enable the termination resistor in the last drive in a MEMOBUS/Modbus network by setting DIP switch S2 to the ON position. ***Refer to Control I/O Connections on page 101*** for more information on the termination resistor.

◆ Terminal Configuration

The control circuit terminals are arranged as shown in ***Figure 3.24***.

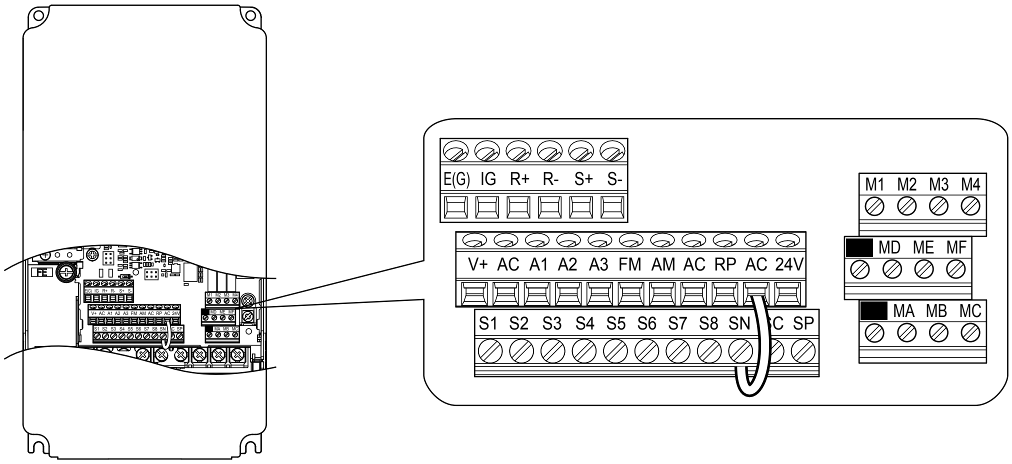


Figure 3.24 Control Circuit Terminal Arrangement

■ Wire Size and Torque Specifications

Select appropriate wire type and gauges from ***Table 3.9***. For simpler and more reliable wiring, use crimp ferrules on the wire ends. Refer to ***Table 3.10*** for ferrule terminal types and sizes.

Table 3.9 Wire Gauges

Terminal	Screw Size	Tightening Torque N•m (lb. in)	Bare Wire Terminal		Ferrule-Type Terminal		Wire Type
			Applicable wire size mm² (AWG)	Recomm. wire size mm² (AWG)	Applicable wire size mm² (AWG)	Recomm. wire size mm² (AWG)	
S1-S8, SC, SN, SP	M3	0.5 to 0.6 (4.4 to 5.3)	Stranded wire: 0.2 to 1.0 (24 to 16) Solid wire: 0.2 to 1.5 (24 to 16)	0.75 (18)	0.25 to 0.5 (24 to 20)	0.5 (20)	Shielded wire, etc.
RP, V+, A1, A2, A3, AC, 24 V							
MA, MB, MC, MD, ME, MF							
M1-M4							
FM, AM, AC							
R+, R-, S+, S-, IG							

■ Ferrule-Type Wire Terminals

Yaskawa recommends using CRIMPFOX 6, a crimping tool manufactured by PHOENIX CONTACT, to prepare wire ends with insulated sleeves before connecting to the drive. See ***Table 3.10*** for dimensions.

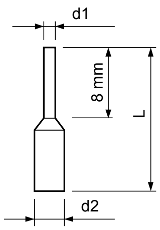


Figure 3.25 Ferrule Dimensions

Table 3.10 Ferrule Terminal Types and Sizes

Size mm^2 (AWG)	Type	L (mm)	d1 (mm)	d2 (mm)	Manufacturer
0.25 (24)	AI 0.25-8YE	12.5	0.8	1.8	PHOENIX CONTACT
0.34 (22)	AI 0.34-8TQ	10.5	0.8	1.8	
0.5 (20)	AI 0.5-8WH or AI 0.5-8OG	14	1.1	2.5	

◆ Wiring the Control Circuit Terminal

This section describes the proper procedures and preparations for wiring the control terminals.

WARNING! *Electrical Shock Hazard. Do not remove covers or touch the circuit boards while the power is on. Failure to comply could result in death or serious injury.*

NOTICE: *Separate control circuit wiring from main circuit wiring (terminals R/L1, S/L2, T/L3, B1, B2, U/T1, V/T2, W/T3, -, +1, +2) and other high-power lines. Improper wiring practices could result in drive malfunction due to electrical interference.*

NOTICE: *Separate wiring for digital output terminals MA, MB, MC, MD, ME, MF and M1 to M4 from wiring to other control circuit lines. Improper wiring practices could result in drive or equipment malfunction or nuisance trips.*

NOTICE: *Use a class 2 power supply when connecting to the control terminals. Improper application of peripheral devices could result in drive performance degradation due to improper power supply. Refer to NEC Article 725 Class 1, Class 2, and Class 3 Remote-Control, Signaling, and Power Limited Circuits for requirements concerning class 2 power supplies.*

NOTICE: *Insulate shields with tape or shrink tubing to prevent contact with other signal lines and equipment. Improper wiring practices could result in drive or equipment malfunction due to short circuit.*

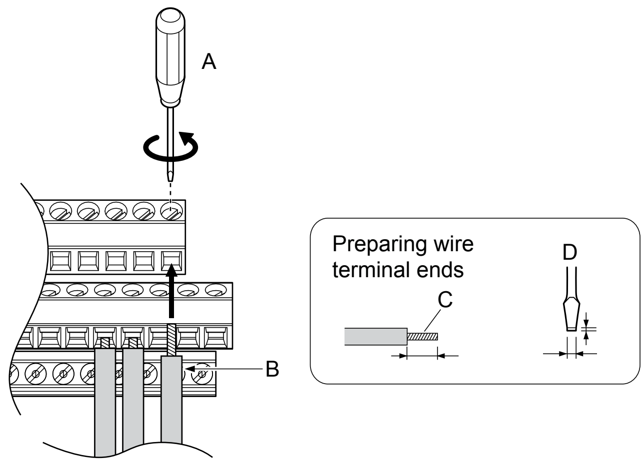
NOTICE: *Connect the shield of shielded cable to the appropriate ground terminal. Improper equipment grounding could result in drive or equipment malfunction or nuisance trips.*

NOTICE: *Do not tighten screws beyond the specified tightening torque. Failure to comply may result in erroneous operation, damage to the terminal block, or cause a fire.*

NOTICE: *Use shielded twisted-pair cables as indicated to prevent operating faults. Improper wiring practices could result in drive or equipment malfunction due to electrical interference.*

Wire the control circuit only after terminals have been properly grounded and main circuit wiring is complete. ***Refer to Terminal Board Wiring Guide on page 100*** for details. Prepare the ends of the control circuit wiring as shown in ***Figure 3.28***. ***Refer to Wire Gauges on page 98***.

Connect control wires as shown in ***Figure 3.26*** and ***Figure 3.27***.



A – Loosen screw to insert wire.
B – Single wire or stranded wire
C – Avoid fraying wire strands when stripping insulation from wire. Strip length 5.5 mm.
D – Blade depth of 0.4 mm or less Blade width of 2.5 mm or less

Figure 3.26 Terminal Board Wiring Guide

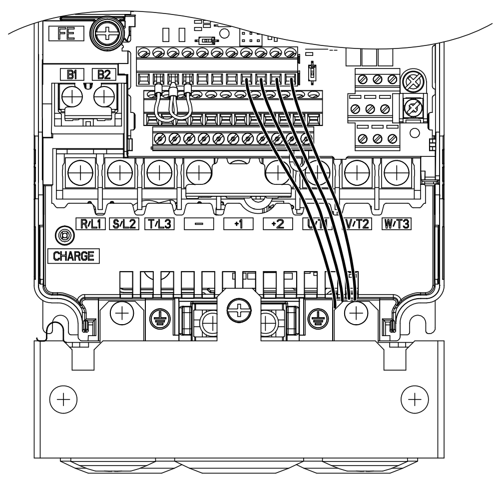
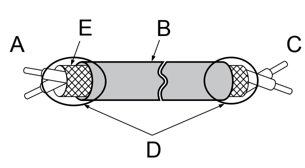


Figure 3.27 Terminal Board Location Inside the Drive

When setting the frequency by analog reference from an external potentiometer, use shielded twisted-pair wires (preparing wire ends as shown in ***Figure 3.28***) and connect the shield to the ground terminal of the drive.



A – Drive side
B – Insulation
C – Control device side
D – Shield sheath (insulate with tape)
E – Shield

Figure 3.28 Preparing the Ends of Shielded Cables

NOTICE: *The analog signal wiring between the drive and the operator station or peripheral equipment should not exceed 50 meters when using an analog signal from a remote source to supply the frequency reference. Failure to comply could result in poor system performance.*

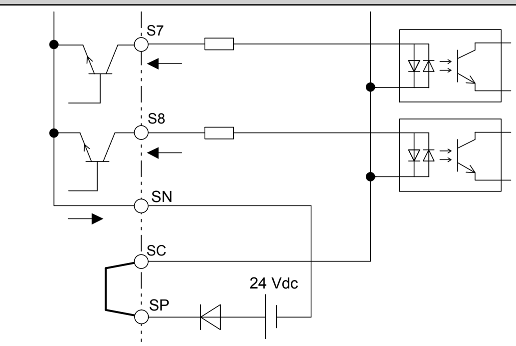
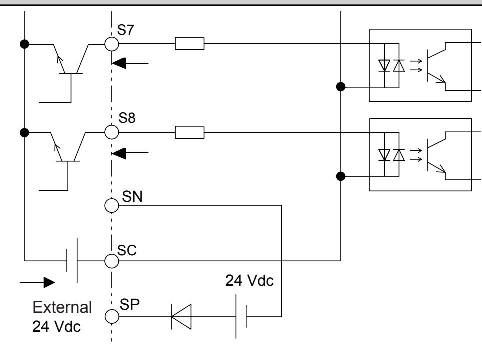
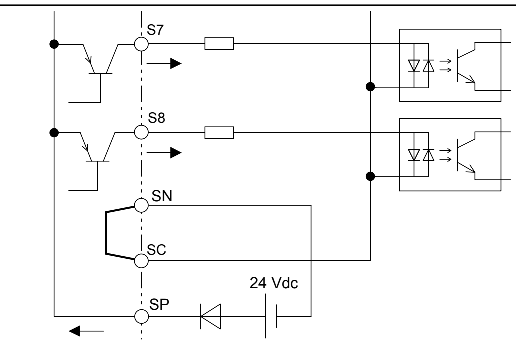
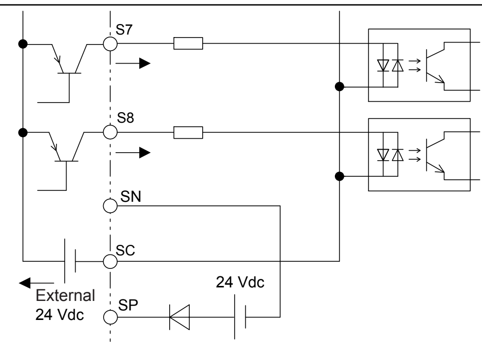
3.8 Control I/O Connections

◆ Sinking/Sourcing Mode Switch for Digital Inputs

Use the wire jumper between terminals SC and SP or SC and SN to select between Sink mode, Source mode or external power supply for the digital inputs S1 to S8 as shown in *Table 3.11* (Default: Sink mode, internal power supply).

NOTICE: *Do not short terminals SP and SN. Failure to comply will damage the drive.*

Table 3.11 Digital Input Sink/Source/External Power Supply Selection

Mode	Drive Internal Power Supply (Terminals SN and SP)	External 24 Vdc Power Supply
Sinking Mode (NPN)		
Sourcing Mode (PNP)		

◆ Terminals A1, A2, and A3 Input Signal Selection

Terminals A1, A2, and A3 can be used to input either a voltage or a current signal. Select the signal type using jumper S1 as explained in *Table 3.12*. Set parameters H3-01, H3-05, and H3-09 accordingly as shown in *Table 3.13*.

Note: If terminals A1 and A2 are both set for frequency bias (H3-02 = 0 and H3-10 = 0), both input values will be combined to create the frequency reference.

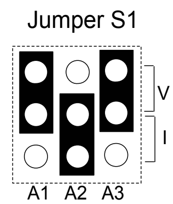


Figure 3.29 Terminal A2 Set to Current Input; A1 and A3 Set to Voltage Input

Table 3.12 Jumper S1 Settings

Setting	Description
V (top position)	Voltage input (-10 to +10 V or 0 to 10 V)
I (bottom position)	Current input (4 to 20 mA or 0 to 20 mA)

Table 3.13 Voltage/Current Selection Parameter Details

No.	Parameter Name	Description	Setting Range	Default Setting
H3-01	Terminal A1 signal level selection	Selects the signal level for terminal A1. 0: 0 to 10 Vdc 1: 0 to 10 Vdc Bipolar 2: 4 to 20 mA 3: 0 to 20 mA	0 to 3	0
H3-05	Terminal A3 signal level selection	Selects the signal level for terminal A3. 0: 0 to 10 Vdc 1: 0 to 10 Vdc Bipolar 2: 4 to 20 mA 3: 0 to 20 mA	0 to 3	0
H3-09	Terminal A2 signal level selection	Selects the signal level for terminal A2. 0: 0 to 10 Vdc 1: 0 to 10 Vdc Bipolar 2: 4 to 20 mA 3: 0 to 20 mA	0 to 3	2

◆ Terminal AM/FM Signal Selection

The signal type for terminals AM and FM can be set to either voltage or current output using jumper S5 on the terminal board as explained in ***Table 3.14***. When changing the setting of jumper S5, parameters H4-07 and H4-08 must be set accordingly. The default selection is voltage output for both terminals.

Table 3.14 Jumper S5 Settings

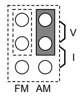
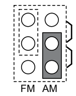
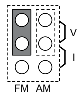
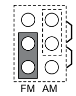
Terminal	Voltage Output	Current Output
Terminal AM		
Terminal FM		

Table 3.15 Parameter H4-07 and H4-08 Details

No.	Parameter Name	Description	Setting Range	Default Setting
H4-07	Terminal AM signal level selection	0: 0 to 10 Vdc 1: -10 to 10 Vdc 2: 4 to 20 mA	0 to 2	0
H4-08	Terminal FM signal level selection			

3.9 Connect to a PC

This drive is equipped with a USB port (type-B).

The drive can connect to a USB port on a PC using a USB 2.0, AB-type cable (sold separately). After connecting the drive to a PC, Yaskawa SCADA software for iQpump can be used to monitor drive performance and manage parameter settings. A complementary version of the SCADA software is available for download on our website at iqpump.yaskawa.com.

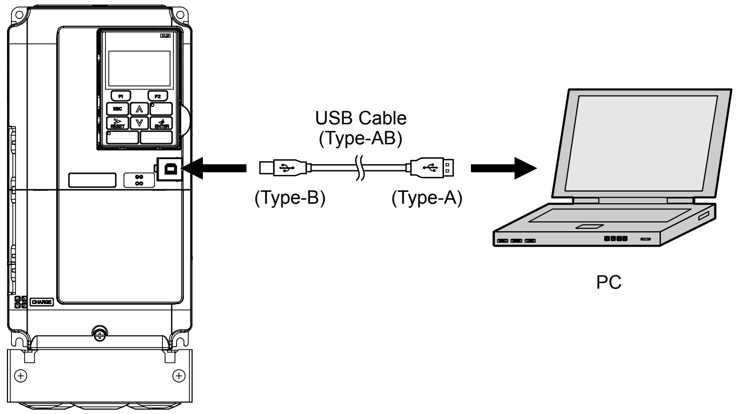


Figure 3.30 Connecting to a PC (USB)

4

Start-Up Programming & Operation

This chapter explains startup procedures, HOA keypad functions, gives instructions on programming the drive for initial operation, and other important functions.

4.1 Drive Start-Up Preparation

To provide the most reliable iQpump1000 drive available and to avoid any extra costs related to loss or reduction of warranty coverage, an authorized Yaskawa service representative should complete this start-up procedure. Please complete the following checklist and maintain it in a secure location, as technical service personnel may request information from this checklist.

Note: *Refer to Powering Up the Drive on page 108* prior to powering up the drive for the first time.

Date:____

Start-Up Person:

Company Name:________________________________ Start-Up Location: ________________________________

Sales Order #: __________________________________ Serial #: ____

Printed Name: __________________________________ Drive Location: __________________________________

Phone #: ______________________________________ Signature: ______________________________________

Owner's Representative:

Printed Name: __________________________________ Phone #: ____

Company: ______________________________________ Signature: ______________________________________

◆ Start-Up Checklist

☑	No.	Item
☐	1	The drive is thoroughly tested at the factory. The start up person should verify that the drive is free of shipping and installation damage. Shipping damage is not covered by the Yaskawa warranty. Claims must be filed with the shipping company as soon as possible for any potential recovery via insurance.
☐	2	Review the iQpump simplified setup procedure shipped with the drive. *Refer to Simple Setup Procedure on page 3* for another version of this document.
☐	3	Verify that the model number and voltage ratings in the purchase order match the nameplate data for each unit.
☐	4	The location of the drive is important to achieve proper performance and normal operating life. *Refer to Installation Environment on page 34* for details.
☐	5	Ensure the drive is on a vertical surface with adequate space for air circulation. *Refer to Correct Installation Spacing on page 35* for proper spacing.
☐	6	Verify that the proper branch circuit protection is installed in front of the drive. *Refer to Factory Recommended Branch Circuit Protection on page 336* for proper input fuse or circuit breaker sizing.
☐	7	**NOTICE:** *Separate control circuit wiring from main circuit wiring (terminals R/L1, S/L2, T/L3, B1, B2, U/T1, V/T2, W/T3, -, +1, +2) and other high-power lines. Improper wiring practices could result in drive malfunction due to electrical interference.*
☐	8	**NOTICE:** *Insulate shields with tape or shrink tubing to prevent contact with other signal lines and equipment. Improper wiring practices could result in drive or equipment malfunction due to short circuit.*
☐	9	**WARNING!** *Electrical Shock Hazard. Do not connect the AC power line to the output terminals of the drive. Failure to comply could result in death or serious injury by fire as a result of drive damage from line voltage application to output terminals.*
☐	10	**NOTICE:** *Do not connect phase-advancing capacitors or LC/RC noise filters to the output circuits. Failure to comply could result in damage to the drive, phase-advancing capacitors, LC/RC noise filters or ground fault circuit interrupters.*
☐	11	Use crimp insulated terminals or insulated shrink tubing for wiring connections. Wires should have a continuous maximum allowable temperature of 75 °C 600 Vac UL-approved vinyl-sheathed insulation. Consider the amount of voltage drop when selecting wire gauges. Increase the wire gauge when the voltage drop is greater than 2% of motor rated voltage. Ensure the wire gauge is suitable for the terminal block. Use the following formula to calculate the amount of voltage drop: Line drop voltage (V) = $3 \times$ wire resistance (Ω/km) $\times$ wire length (m) $\times$ current (A) $\times 10^{-3}$
☐	12	If the cable between the drive and motor exceeds 50 m (164 ft.), adjust the carrier frequency set C6-02 accordingly.
☐	13	Determine proper wire size for power and motor leads.

☑	No.	Item
☐	14	**WARNING!** *Always ground the ground terminal. (200 V Class: Ground to 100 Ω or less, 400 V Class: Ground to 10 Ω or less). Improper equipment grounding could result in death or serious injury by contacting ungrounded electrical equipment.* When using multiple drives, ground each drive directly or daisy-chain to the ground pole(s). DO NOT FORM A LOOP WITH THE GROUND LEADS. ***Refer to Multiple Drive Wiring on page 94***.
☐	15	Review terminal functions of signal and control circuits.
☐	16	Verify if any customer safety devices are required (e.g. External Pump Fault).
☐	17	Record the following motor nameplate information: Voltage: ____________________Motor Rated Amps: ____________________
☐	18	Verify that the commercial power supply is within the rated drive input voltage: Power Supply: ____________________Vac Drive Input Voltage: ____________________Vac
☐	19	Determine whether three-phase input power or single-phase input power is to be used. ***Refer to Single-Phase Derating on page 247*** for additional application information if using single-phase.
☐	19	Verify that the leads in the three-phase electric motor conduit box are configured for the proper voltage.
☐	20	Ensure Motor Rated Current is less than or equal to drive output amps. If multiple motors are being used, make sure that the Motor Rated Current sum is less than or equal to drive output amp rating. Please note that if multiple motors are being operated from one drive, each motor must have its own overload and short circuit protection.
☐	21	Wire all necessary power leads to the drive. **DO NOT CONNECT MOTOR TO DRIVE AT THIS TIME.**
☐	22	Wire all necessary ground wires to the drive.
☐	23	Wire all necessary control wires to the drive.
☐	24	Ensure that the power leads are connected to the R/L1, S/L2 and T/L3 terminals in the drive. Confirm single-phase input or three-phase input wiring.
☐	25	Tighten all of the three-phase power and ground connections. Please check that all control and signal terminations are tight.
☐	26	Inspect the control circuit connections (including the shield) and determine if a motor safety circuit is connected. If normally closed, these contacts may be wired in series with the RUN command contacts, which are between terminals S1 and SN of the drive. No special programming is required. Alternately, these contacts could be wired between terminals S3 and SN as External Fault Inputs, and may be either normally closed or normally open contacts.
☐	27	Record any other connections to the drive to determine if special programming is required for the following: Multi-function Inputs Multi-function Outputs Multi-function Digital Inputs Multi-function Analog Outputs Network Communications ***Refer to Parameter List on page 255*** for details.

4.2 Powering Up the Drive

Review the following table before applying power.

Item to Check	Description
Power supply voltage	200 V class: Three-phase/Single-phase 200 to 240 Vac 50/60 Hz 400 V class: Three-phase/Single-phase 380 to 480 Vac 50/60 Hz 600 V class: Three-phase/Single-phase 500 to 600 Vac 50/60 Hz
	Properly wire the power supply input terminals (R/L1, S/L2, T/L3) for three-phase and (R/L1, S/L2) for single-phase.
	Check for proper grounding of drive and motor.
Drive output terminals and motor terminals	Properly wire drive output terminals U/T1, V/T2, and W/T3 with motor terminals U, V, and W.
Control circuit terminals	Check control circuit terminal connections.
Drive control terminal status	Open all control circuit terminals (off).
Status of the load and connected machinery	Decouple the motor from the load.

◆ Setting the Real Time Clock

When the drive is powered up for the first time, the time and date must be set. The HOA keypad will display the time and date setup screen for 30 seconds. If a button is not pressed during this time, the display will clear and a “Clock Not Set” alarm will flash. Pressing the F2 (Data) key will display the setting screen again.

■ Feedback Loss Wire Break Alarm

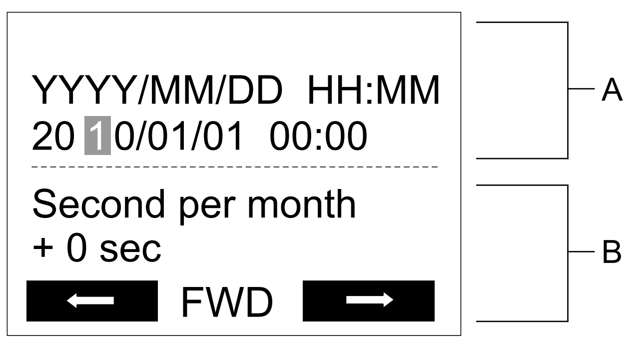
If there is no sensor wired to the drive, a “Feedback Loss – Wire Break” alarm will flash on the display after the 30-second time and date screen has elapsed (not the “Clock Not Set” alarm). Providing the proper feedback device signal will clear the Feedback Loss alarm. The “Clock Not Set” alarm will then flash.

The drive requires a feedback device (e.g., pressure transducer, flow meter, etc.) to perform automatic system regulation. Any analog 0~10 V or 4-20 mA feedback device can be used in combination with the drive.

Note: The factory default setting for the drive is 4~20 mA feedback device connected to analog input A2.

■ Real Time Clock Setting Display

Note: Setting the Real-Time Clock will clear a “TIM” alarm.



A – Real Time Clock Setting Display Set in 24-Hour Clock Time **B – Gain/Loss Adjustment Display**

Figure 4.1 Real Time Clock Adjustment Display

Display	Description
YYYY	Set the year with the last two digits.
MM	Set the month with two digits.
DD	Set the day with two digits.
HH:MM	Set the hours and minutes, with two digits for each. **Note:** Set in 24-hour clock time. After initial setup, the time will display in 12-hour clock time.
Second per month	Set the gain or loss in seconds per month. **Note:** This does not need to be set for the RTC to function properly.

Moving the Cursor

Pressing the F2 key or the RESET key will move the cursor to the digit on the right. Pressing the F1 key will move the cursor to the left.

Changing Settings

- **Changing YYYY/MM/DD HH:MM:** Pressing the up arrow key will increase the number selected by the cursor from 0 to 9. Pressing the down arrow key will decrease the number selected by the cursor from 0 to 9.
- **Setting the Seconds per Month:***This setting does not need to be adjusted.* Pressing the up arrow key will increase the number selected by the cursor from -504 to +488 in increments of 8. Pressing the down arrow key will decrease the number selected by the cursor from -504 to +488 in increments of 8.

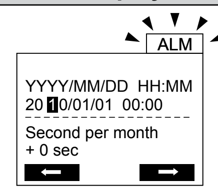
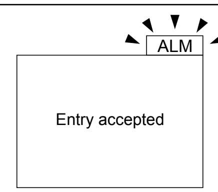
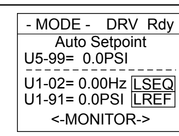
  The feature is used to keep the RTC in sync with an external device clock, like a PLC or BAS system, and will adjust the clock by a set amount of seconds every month.

■ Real-Time Clock Setting at Initial Power-up of a New Drive

Setting the Real-time clock is required at power-up of a new drive or after digital operator battery replacement.

Table 4.1 illustrates how to set the Real-Time Clock at initial power-up of a new drive.

Table 4.1 Clock Adjustment Procedure at Power-up of a New Drive

Procedure			Display
1	Turn the power on. The Real Time Clock Adjustment Display will appear. Use the right arrow key to select the desired digit, then set the correct date and 24-hour clock time using the up and down arrow keys.	→	
2	After entering the Real-Time Clock data, press the ENTER key to save the changes. The display will indicate "Entry Accepted" and return to the initial display in step 3 and the alarm LED will be OFF.	→	
3	Initial display.	→	

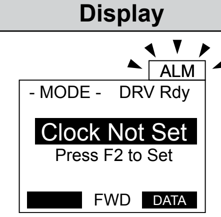
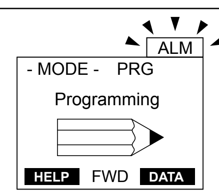
■ Manual Clock Adjustment by Setting o4-17 to 1

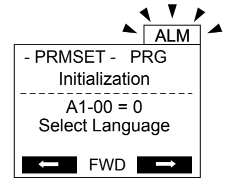
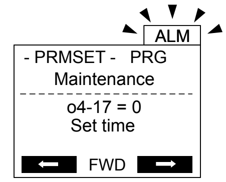
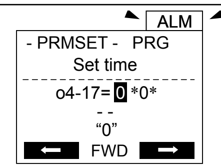
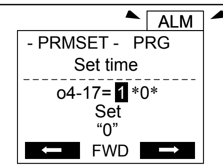
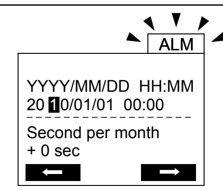
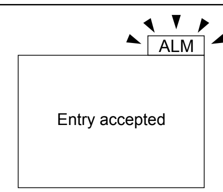
The following actions are possible in the Clock Adjustment Mode:

- Set the current time
- Check the time set to the drive Real-Time Clock

Table 4.2 illustrates how to set the Real-Time Clock manually.

Table 4.2 Manual Clock Adjustment Procedure by Setting o4-17 to 1

Procedure			Display
1	The "Clock Not Set" display will appear if the Real-Time Clock data is not entered within 30 seconds of power-up on a new drive.	→	
2	Use the up and down arrow keys to scroll through display menu until the screen shows "Programming".	→	

Procedure			Display
3	Press the ENTER key to enter select the parameter setting mode.	➡	
4	Use the up and down arrow keys to scroll through display menu until parameter o4-17 appears.	➡	
5	Press the ENTER key until “0” flashes.	➡	
6	Press the up arrow key so that the display changes to “1”.	➡	
7	Press the ENTER key and the time setting screen will appear. Use the right arrow key to select the desired digit, then set the correct date and time using the up and down arrow keys.	➡	
8	After entering the correct time, press the ENTER key to save the changes. The display will return to the display shown in step 5 and the alarm LED will be OFF.	➡	

■ o4-17: Real-Time Clock Setting (Resetting RTC Back to Factory Default)

No. (Addr. Hex)	Name	Description	Values
o4-17 (3100)	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

Setting 0: — —

No Setting (Default)

Setting 1: Set

When o4-17 is set to 1, the digital operator will show the Clock Adjustment display. In Clock Adjustment Mode the user can adjust the Real-Time Clock.

Setting 2: Reset

When o4-17 is set to 2, the Real-Time Clock data is cleared. A Clock Not Set alarm will occur until o4-17 is set to 1 and the Real-Time Clock is set.

4.3 Using the HOA Keypad

Use the HOA keypad to enter OFF commands, switch AUTO or HAND Mode, change parameters, and display data including fault and alarm information.

◆ Keys and Displays

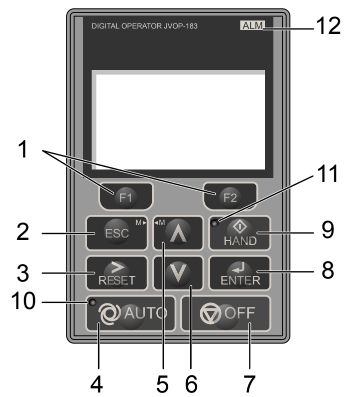


Figure 4.2 Keys and Displays on the HOA Keypad

No.	Display	Name	Function
1	F1 F2	Function Key (F1, F2)	The functions assigned to F1 and F2 vary depending on the currently displayed menu. The name of each function appears in the lower half of the display window.
2	ESC	ESC Key	• Returns to the previous display. • Moves the cursor one space to the left. • Pressing and holding this button will return to the Frequency Reference display.
3	RESET	RESET Key	• Moves the cursor to the right. • Resets the drive to clear a fault situation.
4	AUTO	AUTO Key	Selects the source of Run command and frequency reference. • Set the drive to AUTO mode. • Run command input source depends on b1-02. • Frequency reference input source depends on b1-01.
5	∧	Up Arrow Key	Scrolls up to display the next item, selects parameter numbers, and increments setting values.
6	∨	Down Arrow Key	Scrolls down to display the previous item, selects parameter numbers, and decrements setting values.
7	OFF	OFF Key	Follows the stopping method set in b1-03 to stop drive operation.
8	ENTER	ENTER Key	• Enters parameter values and settings. • Selects a menu item to move between displays.
9	HAND	HAND Key	The drive runs at a selectable frequency reference source by b1-12. • Set the drive to HAND mode. • When b1-13 is set to 1, HAND and AUTO mode can be switched while the drive is running.
10	AUTO	AUTO Light	Lit while the drive is in AUTO mode. Refer to page *113* for details.
11	HAND	HAND Light	Lit while the drive is in HAND mode. Refer to page *113* for details.
12	ALM	ALM LED Light	*Refer to ALARM (ALM) LED Displays on page 113.*

◆ LCD Display

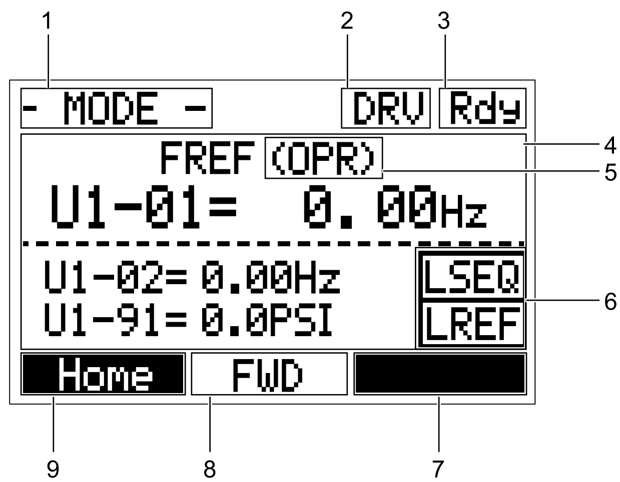


Figure 4.3 LCD Display

Table 4.3 Display and Contents

No.	Name	Display	Content
1	Operation Mode Menus	MODE	Displayed when in Mode Selection.
		QMONI: Use F1/F2	Instructions to access the Quick Monitors.
		MENU: Use UP/DWN	Instructions to access the next menu item.
		MONITR	Displayed when in Monitor Mode.
		VERIFY	Indicates the Verify Menu.
		PRMSET	Displayed when in Parameter Setting Mode.
		A.TUNE	Displayed during Auto-Tuning.
		SETUP	Displayed when in Setup Mode.
2	Mode Display Area	DRV	Displayed when in Drive Mode.
		PRG	Displayed when in Programming Mode.
3	Ready	Rdy	Indicates the drive is ready to run.
4	Data Display	—	Displays specific data and operation data.
5	Frequency Reference Assignment <1>	OPR	Displayed when the frequency reference is assigned to the HOA keypad.
		COM	Displayed when the frequency reference is assigned to the MEMOBUS/Modbus Communication Inputs of the drive.
		OP	Displayed when the frequency reference is assigned to option card connected to the drive.
		AI	Displayed when the function reference is assigned to an analog input.
		OFF	Displayed when HAND mode is OFF.
6	LOCAL/REMOTE Display <2>	RSEQ	Displayed when the Run command is supplied from a remote source. **Note:** This display will blink when b1-02 is set to 1 (Digital Inputs).
		LSEQ	Displayed when the Run command is supplied from the HOA keypad.
		RREF	Displayed when the Run command is supplied from a remote source. **Note:** This display will blink when b1-01 is set to 1 (Analog Inputs).
		LREF	Displayed when the Run command is supplied from the HOA keypad.

No.	Name	Display	Content
7	Function Key 2 (F2)	<-MONITOR->	Pressing F2 displays the next Quick Monitor.
		DATA	Pressing F2 scrolls to the next display.
		→	Pressing F2 scrolls the cursor to the right.
		RESET	Pressing F2 resets the existing drive fault error.
		Monitor	Pressing F2 switches Monitor mode.
8	FWD/REV	FWD	Indicates forward motor operation.
		REV	Indicates reverse motor operation.
9	Function Key 1 (F1)	<-MONITOR->	Pressing F1 displays the next Quick Monitor.
		←	Pressing F1 scrolls the cursor to the left.
		Home	Pressing F1 returns to the top menu (Frequency Reference).
		ESC	Pressing F1 returns to the previous display.
		Monitor	Pressing F1 switches Monitor mode.

<1> Displayed when in Frequency Reference Mode.

<2> Displayed when in Frequency Reference Mode and Monitor Mode.

◆ ALARM (ALM) LED Displays

Table 4.4 ALARM (ALM) LED Status and Contents

State	Content	Display
Illuminated	When the drive detects an alarm or error.	ALM
Flashing	• When an alarm occurs. • When an oPE is detected. • When a fault or error occurs during Auto-Tuning.	ALM
Off	Normal operation (no fault or alarm).	ALM

◆ AUTO LED and HAND LED Indications

Table 4.5 AUTO LED and HAND LED Indications

AUTO LED	HAND LED	State
AUTO Off	HAND Off	OFF mode
AUTO Off	HAND On solid	HAND mode
AUTO Off	HAND Long blink (50% duty)	HAND mode when the Frequency Reference is 0 and/or decelerating in HAND mode.
AUTO On solid	HAND Off	Running in AUTO mode
AUTO Long blink (50% duty)	HAND Off	Running in AUTO mode when the Frequency Reference is 0 and/or decelerating in AUTO mode.

AUTO LED	HAND LED	State
Short blink (15% duty)	Off	AUTO mode, Ready, No run command input.
Double blink	Off	AUTO mode, stopped by a Fast- Stop from a Multi-Function Digital Input.

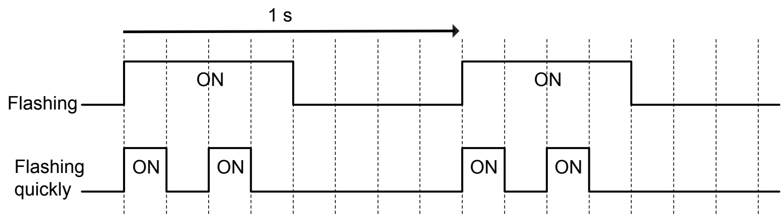


Figure 4.4 AUTO LED and OFF LED Status and Meaning

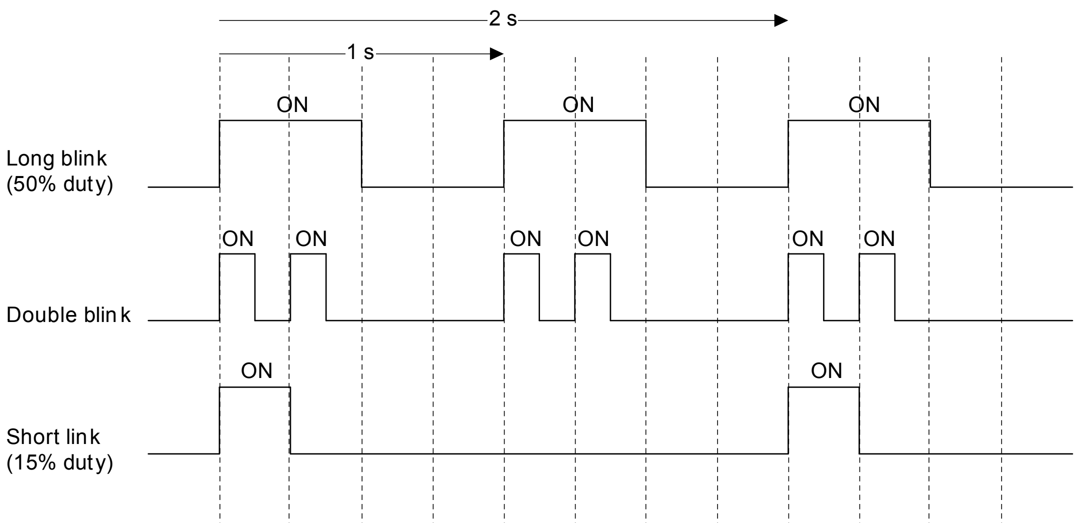


Figure 4.5 LEDs and Drive Operation in AUTO Mode

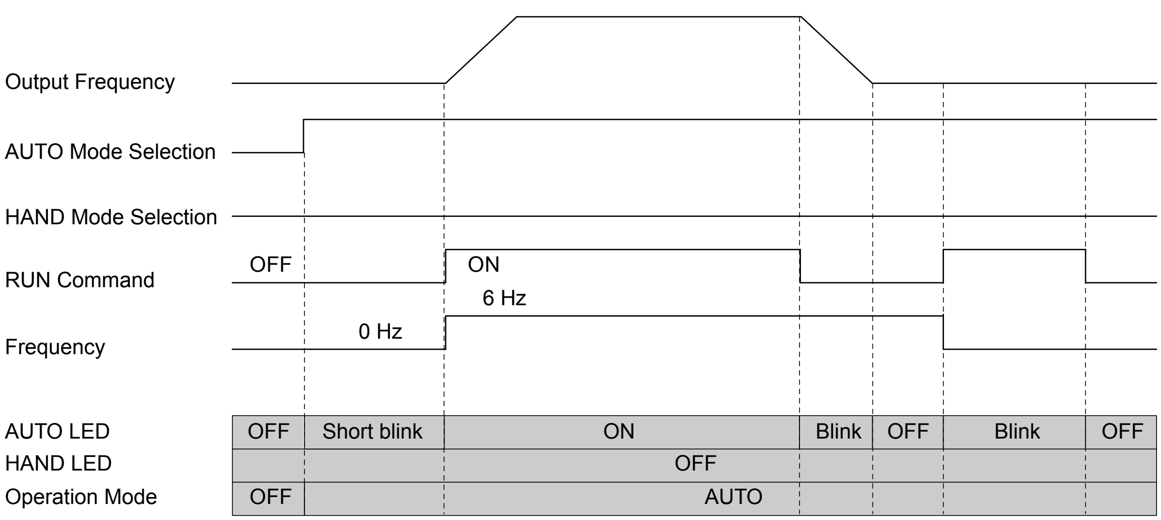


Figure 4.6 LEDs and Drive Operation in HAND Mode

◆ Menu Structure for HOA Keypad

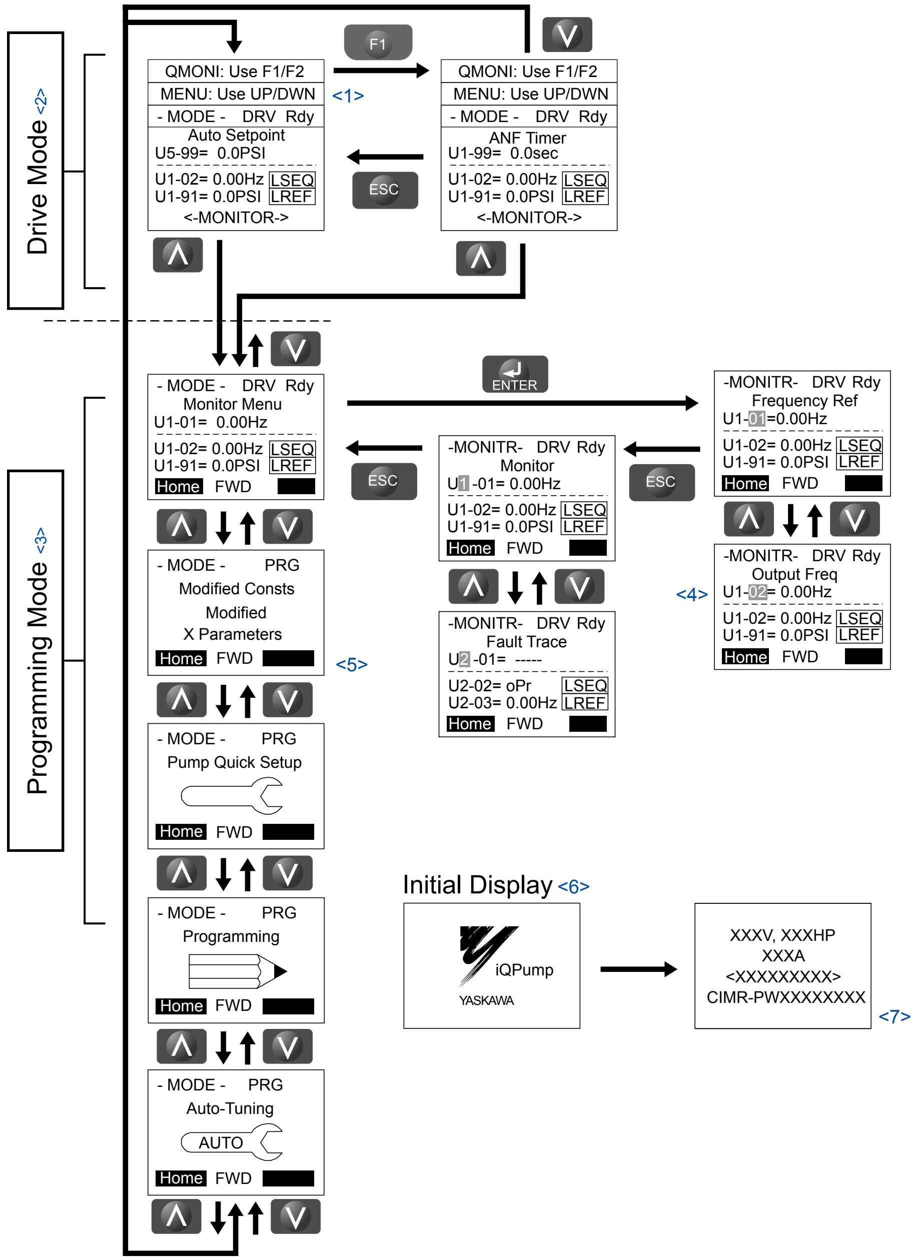


Figure 4.7 HOA Keypad Menu and Screen Structure

<1> The display cycles between these three displays on the initial startup screen and the Quick Monitor screens.

<2> Pressing AUTO or HAND will start the motor.

<3> Drive cannot operate motor.

<4> Flashing characters are shown with white letters on gray background. (Example: 0)

<5> “X” characters are used as examples in this manual. The HOA keypad will display the actual setting values.

<6> The Frequency Reference appears after the initial display that shows the product name.

<7> The information that appears on the display will vary depending on the drive model.

◆ Changing Parameter Settings or Values

This example explains changing C1-02 (Deceleration Time 1) from 10.0 seconds (default) to 20.0 seconds.

Note: During serial communication writing, if a parameter change is also attempted via the HOA keypad, a “BUSY - WRITE PROTECTED” message will display. Parameter change will not be possible from the HOA keypad until an Enter command is received via the serial communication to finish the serial writing process.

	Step		Display/Result
1.	Turn on the power to the drive. The initial display appears.	➜	- MODE - DRV Rdy Auto Setpoint U5-99= 0.0PSI U1-02= 0.00Hz LSEQ U1-91= 0.0PSI LREF <-MONITOR->
2.	Press Λ or V until the Parameter Setting Mode screen appears.	➜	- MODE - PRG Programming Home FWD
3.	Press ENTER to enter the parameter menu tree.	➜	-PRMSET- PRG Initialization A1-00= 0 Select Language Home FWD ⟶
4.	Press Λ or V to select the C parameter group.	➜	-PRMSET- PRG Basic Setup C1-01= 20.0 sec Accel Time 1 Home FWD ⟶
5.	Press ENTER two times.		➜ -PRMSET- PRG Accel/Decel C1-01= 20.0 sec Accel Time 1 Home FWD ⟶ ➜ -PRMSET- PRG Accel Time 1 C1-01= 20.0Sec (0.0~6000.0) “20.0 sec” Home FWD ⟶
6.	Press Λ or V to select parameter C1-02.	➜	-PRMSET- PRG Decel Time 1 C1-02= 10.0Sec (0.0~6000.0) “10.0 sec” Home FWD ⟶
7.	Press ENTER to view the current setting value (10.0 s). The leftmost digit flashes.	➜	-PRMSET- PRG Decel Time 1 C1-02= 0010.0Sec (0.0~6000.0) “10.0 sec” Home FWD ⟶
8.	Press F2 or RESET until the desired number is selected. “1” flashes.	➜	-PRMSET- PRG Decel Time 1 C1-02=0010.0Sec (0.0~6000.0) “10.0 sec” Home FWD ⟶
9.	Press Λ and enter 0020.0.	➜	-PRMSET- PRG Decel Time 1 C1-02=0020.0sec (0.0~6000.0) “10.0 sec” Home FWD ⟶
10.	Press ENTER to confirm the change.	➜	Entry Accepted
11.	The display automatically returns to the screen shown in Step 6.	➜	-PRMSET- PRG Decel Time 1 C1-02= 20.0sec (0.0~6000.0) “10.0 sec” Home FWD ⟶

Step			Display/Result
12.	Press ESC as many times as necessary to return to the initial display.	➡	- MODE - DRV Rdy Auto Setpoint U5-99= 0.0PSI U1-02= 0.00Hz LSEQ U1-91= 0.0PSI LREF <-MONITOR->

4.4 Pump Application Presets

The following sections list the parameters affected by the different Application Presets.

Note: Setting A1-03 to 6011 (VTC Pressure Control) changes the Quick Start and Pre-set parameters (tables below) and also changes HAND Mode so that it is no longer lower-limited by the minimum pump frequency or the thrust frequency. Also, the default for P1-06 when in RPM mode is 1800 RPM instead of 2400 RPM.

◆ Parameters Set Depending on A1-03 Setting

The following table shows the parameters that are set depending on the A1-03 initialization:

A1-03 = 6008 (A1-06 = 8) Pressure Control		A1-03 = 6009 (A1-06 = 9) Pump Down Level		A1-03 = 6010 (A1-06 = 10) Geothermal Mode		A1-03 = 6011 (A1-06 = 11) VTC Pressure Ctl		A1-03 = 7770 (A1-06 = 1) General Purpose	
Parameter	Value	Parameter	Value	Parameter	Value	Parameter	Value	Parameter	Value
		b5-09	1	b1-01	5	b5-03	5.0	b1-01	1
		b5-39	2	b5-01	0	C1-01	15.0 sec	b1-02	1
		P1-02	6	H3-10	21	C1-02	15.0 sec	b5-01	0
		P2-01	2	o1-08	180	E2-04	4	C1-01	25.0 sec
		P2-23	0.00%			L5-01	0	C1-02	25.0 sec
						P1-03	100.0 PSI	H1-06	4
						P1-06	35.0 Hz	H1-07	F
						P2-03	15sec	H2-01	0
						P2-23	0.00%	H2-02	A
						P3-50	35.0 Hz	H3-10	2
						P3-60	35.0 Hz	L5-01	0
						P3-70	35.0 Hz	L5-04	180.0 sec
						P4-12	0.0 Hz	o1-06	0
						P5-02	6.0 Hz	P1-05	0 sec
						Q5-03	40.0 PSI	P1-06	0.0 Hz
						Q5-06	50.0 PSI	P4-12	0.0 Hz
						Q5-09	20.0 PSI	P4-17	0.0 min
						Q5-10	5.0 min	P5-02	0.0 Hz
						Q5-11	2		
						Q5-16	1.00		
						Q5-17	3.0 sec		
						H2-01	80H		
						H2-02	81H		
						H2-03	82H		

◆ Parameters Displayed Depending on A1-06 Setting

The following table shows which parameters are shown on the Pump Quick Setting menu depending on the A1-06 selection:

A1-03 = 6008 (A1-06 = 8) Pressure Control	A1-03 = 6009 (A1-06 = 9) Pump Down Level	A1-03 = 6010 (A1-06 = 10) Geothermal Mode	A1-03 = 6011 (A1-06 = 11) VTC Pressure Ctl	A1-03 = 7770 (A1-06 = 1) General Purpose
E2-01	E2-01	b1-02	E2-01	b1-01
E2-04	E2-04	E2-01	E2-04	b1-02
P1-03	P1-02	E2-04	b1-02	C1-01
Q1-01	P1-03	P1-06	C1-01	C1-02
P1-04	Q1-01	Q2-01	C1-02	E2-01
P1-06	P1-04	Q2-02	P1-03	E2-04
P4-10	P1-06	Q2-03	Q1-01	L5-01
P5-04	P2-02	Q2-04	P1-04	L5-04
	P4-10	Q2-05	P1-06	P1-06
	P5-04	Q2-06	P1-08	
		Q2-07	P1-09	
		Q2-08	P1-11	
		Q2-09	P1-12	
		Q2-10	P2-02	
		Q2-11	P2-03	
		Q2-12	P4-01	
		P4-10	P4-02	
		P5-04	P4-03	

4.5 iQpump Presets and Functions

◆ iQpump Presets

■ Pump Down Level Control Application Preset

This preset allows the drive to regulate the depth of water in a tank or other vessel that is being filled by an external source. A feedback device that measures water depth is wired to the drive. A PI-control process loop will then modulate the pump speed to pump water out the tank to keep the water depth the setpoint level (pump out at the recharge rate). The drive controller has an application preset to simplify the start up and control of this application.

- System units are in feet (P1-02 = 6).
- Feedback device scaling (P1-03). The feedback device scaling must be entered into the drive for proper control.
- Minimum pump speed (P1-06). Most pumps cannot be run below a certain speed or cavitation can occur.
- Number of Motor Poles (E2-02). The default is for a 2-pole motor.
- Sleep Function. The drive controller will sleep when the system demand is low and awaken when demand returns.

Required Control Wiring

Most depth level transducers have current-based feedback (4-20 mA). The A2 terminal of the drive is preset for 4-20 mA and pre-programmed for PI feedback (H3-10 = B). If the sensor is voltage based (0-10 V) and terminal A3 is unused, then wire the transducer to terminal A3 and program H3-10 to F (A2 not used) and H3-06 to B (A3 PI Feedback).

Start Up Procedure

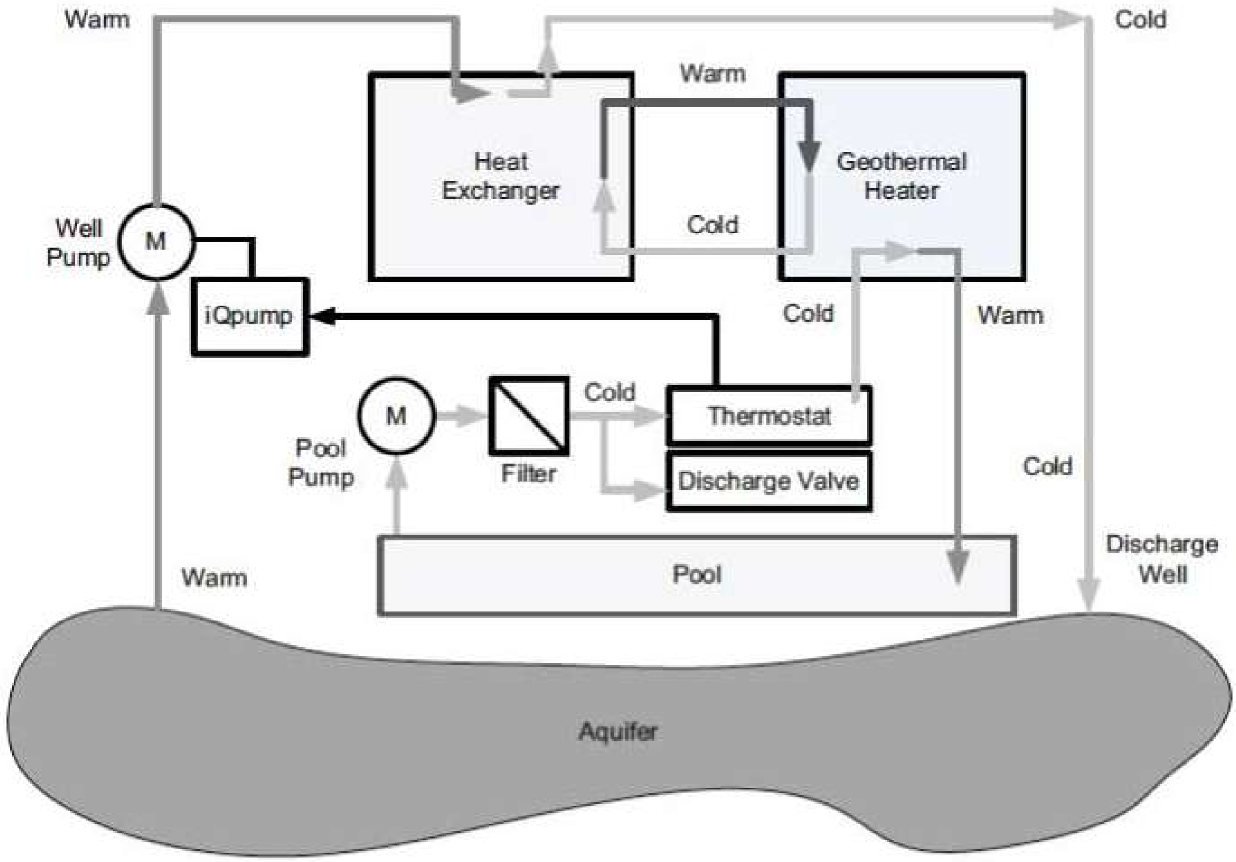
1. Set parameter A1-03 to 6009 (Pump Down Level) to pre-set parameter values for this application.
2. Set the motor-rated current in parameter E2-01. This information can be found on the motor nameplate or specification sheet.
3. Set the number of motor poles in parameter E2-04 (2-pole motors have a rated RPM of slightly less than 3600 RPM; 4-pole motors have a rated RPM of slightly less than 1800 RPM). This information can be found on the motor nameplate or specification sheet.
4. Set the feedback device scaling in parameter P1-03. Check the sensor nameplate or specification sheet. For example, if the device outputs 20 mA at 14.50 ft of water depth, the set P1-03 to 14.50. The drive controller will automatically scale all associated parameters and monitors. Monitor U1-91 (Pump Feedback) will display the measured water depth in feet. The drive has a High Feedback Fault set in parameter P1-11. Make sure that P1-11 is appropriately set for sensor scaling in P1-03.
5. Set the desired water depth level in parameter Q1-01 (PI setpoint). This is desired water depth that the drive will regulate the pump speed around. To quickly access this parameter, press the HOME key and then the ENTER key. The U1-99 monitor on the home screen displays the Q1-01 PI setpoint.
6. Set the minimum speed that the pump can be run in parameter P1-06. The default is 40 Hz. This information can be found on the pump specification sheet.
7. The default settings will allow the drive to automatically restart after power loss if the drive was running at the time of power loss. To disable, set P4-10 to 1.
8. Press the AUTO key to start the drive with PI control (water depth control). Press the OFF key to stop the drive.
9. The pump can be run in a Hand (local) mode for maintenance purposes by pressing the HAND key while the drive is stopped. The HAND key acts as a start button. Press the OFF button to stop the drive. Press AUTO to return the drive to PI control. The HAND speed reference can be set in P5-02 (Hand Reference 1). Disable the HAND key by setting P5-04 to 0 (disabled).
10. Configure the sleep function. The pump can be programmed to shut off or “sleep” if the water falls below the depth set in parameter P2-02 (Sleep Level). The controller will monitor the water depth feedback signal and wake up when the water depth rises above the setting in parameter P1-04 (Start – Draw Down Level). Logically, set the Sleep Level (P2-02) lower than the PI setpoint and set the Draw Down Level (P1-04) slightly above the PI setpoint. This way the drive won’t wake up until the water has already exceeded the desired depth setting. By sleeping, the drive will save energy and mechanical wear. A setting of zero in P1-04 will disable the sleep function (default setting).

Related Parameters

No.	Parameter Name	Setting Values
A1-01	Access Level Selection	Default: 2 Range: 0 to 3
A1-03	Initialize Parameters	Default: 0 Range: 0 to 5550; 6008 to 6011; 7770
E2-01	Motor Rated Current	Default: Min.: 10% of drive rated current Max.: 200% of drive rated current
E2-04	Number of Motor Poles	Default: 2 Min.: 2 Max.: 48
P1-03	Feedback Device Scaling	Default: 145.0 PSI Min.: 0.1 Max.: 6000.0
P1-11	High Feedback Level	Default: 0.0 PSI Min.: 0.0 Max.: 6000.0
P1-06	Minimum Pump Speed	Default: 40.0 Hz Min.: 0.0 Max.: [E1-04]
P1-04	Start / Draw Down Level	Default: 0.0 Min.: -999.9 Max.: 999.9
P2-02	Sleep Level	Default: 0.0 Hz Min.: 0.0 Max.: 6000.0
P4-10	AUTO Mode Operator Run Power Down Storage	Default: 0 Range: 0, 1
P5-02	HAND Speed Reference 1	Default: 40.0 Hz Min.: 0 Max.: [E1-04]
P5-04	HAND Key Function Selection	Default: 1 Range: 0, 1
Q1-01	PID Controller Setpoint 1	Default: 0.0 Min.: 0.0 Max.: 6000.0
U1-99	Anti-No-Flow Timer	No signal output available

■ Geothermal Mode Application Preset

A geothermal well facilitates heat transfer between the earth and a known system, such as space heating, dehydration, electric power generation and food processing. The geothermal function has the ability to regulate the speed of the drive controller based on an external temperature signal following a preset temperature-speed curve. The drive controller has an application preset to simplify the start up and control of this application



Required Control Wiring

Most temperature transducers have current-based feedback, (4 - 20 mA). The A2 terminal of the drive is pre-set for 4 to 20 mA and Temperature Feedback (H3-10 = 21). If the sensor is voltage-based (0 to 10 V) and terminal A3 is unused, then wire the transducer to terminal A3 and program H3-10 to F (A2 not used) and H3-06 to 21 (A3 Temperature Feedback).

Start Up Procedure

1. Set parameter A1-03 to 6010 (Geothermal Mode) to pre-set parameter values for this application. The second line of the HOA Keypad will read “Geothermal Mode”.
2. Set the method of giving the drive a run command in parameter b1-02. The default setting is to use the AUTO key on the HOA keypad.
3. Set the motor-rated current in parameter E2-01. This information can be found on the motor nameplate or specification sheet.
4. Set the number of motor poles in parameter E2-04 (2-pole motors have a rated RPM of slightly less than 3600 RPM; 4-pole motors have a rated RPM of slightly less than 1800 RPM). This information can be found on the motor nameplate or specification sheet.
5. Set the minimum speed at which the pump can run in parameter P1-06. The default is 40 Hz. This information can be found on the pump specification sheet.
6. Set the feedback device scaling in parameters Q2-01 and Q2-02. Q2-01 sets the temperature at 0 V (4 mA). Q2-02 sets the temperature at 10 V (20 mA). The monitor for this feedback is U1-80 (Geothermal Temperature).
7. Set the pump speed-temperature characteristics in Q2-03 to Q2-08. This allows the drive to modulate the pump speed based on the analog input temperature feedback of the water. This will attempt to regulate the water temperature between the Q2-06 and Q2-07 settings. *Figure 4.8* shows normal operation.

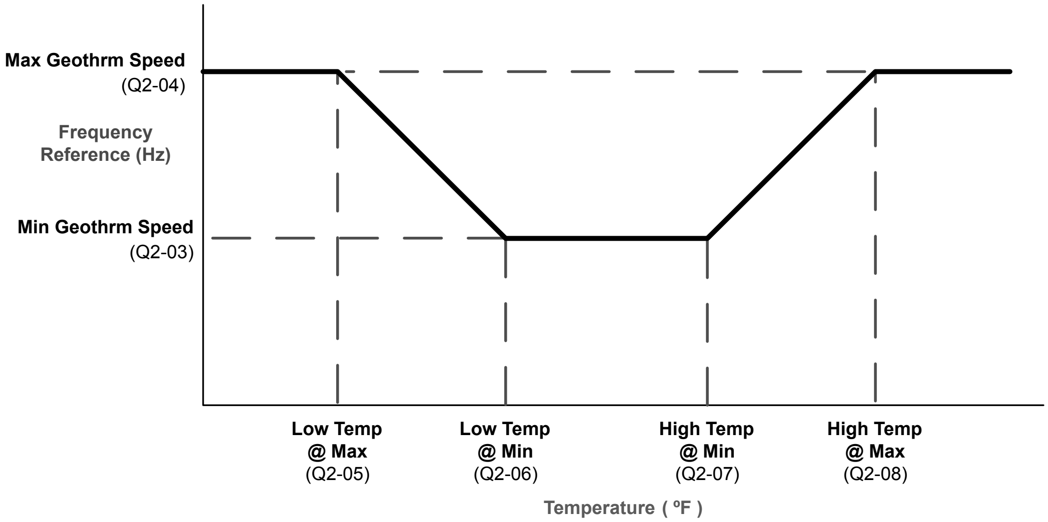


Figure 4.8 Normal Temperature Regulation

The drive can also be programmed for inverse operation by changing the parameter settings in Q2-03 to Q2-08 as shown in ***Figure 4.9***.

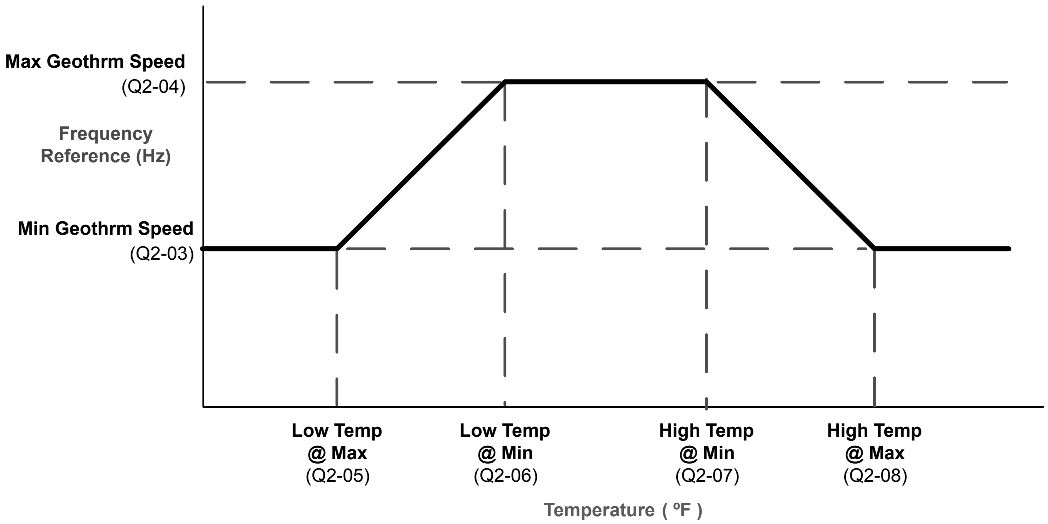


Figure 4.9 Inverse Temperature Regulation

8. Set the response to temperature feedback signal loss. The drive will monitor the feedback signal for signal loss. This function can be disabled by setting Q2-09 to 0. When a wire break is detected (or if no analog input is programmed for Geothermal Temp), a “TLGI - Geothermal Input” fault or “Temp Lost – Geothermal Input” alarm will be triggered depending on the setting of Q2-09. If Q2-09 is set to 2 (fault), the drive will only fault when running in AUTO Mode. It will only display the alarm if not running or if it is running in HAND Mode.

9. Set the Geothermal Sleep characteristics. The drive will sleep if the drive runs at the minimum speed (Q2-03) for the time set in Q2-10. Setting Q2-11 to 0 disables the sleep function (default setting).

10. Set the wake up characteristics. The drive will wake from Geothermal Sleep when Geothermal Temperature (U1-80) is greater than the “High Temp @ Min” plus the Geothermal Wake Level (Q2-07 + Q2-11) or is less than “Low Temp @ Min” minus the Geothermal Wake Level (Q2-06 – Q2-11) for more than the Geothermal Wake Delay Time (Q2-12).

11. The default settings will allow the drive to automatically restart after power loss if the drive was running at the time of power loss. Set P4-10 to 1 to disable this function.

12. Press the AUTO key to start the drive with PI control (water depth control). Press the OFF key to stop the drive.

13. The pump can be run in HAND (LOCAL) Mode for maintenance purposes by pressing the HAND key while the drive is stopped. The HAND key acts as a start button. Press the OFF button to stop the drive. Press AUTO to return the drive to geothermal control. The HAND speed reference can be set in P5-02 (Hand Reference 1). Disable the HAND key by setting P5-04 to 0 (disabled).

Related Parameters, Faults, and Alarms

No.	Parameter Name	Setting Values
A1-01	Access Level Selection	Default: 2 Range: 0 to 3
A1-03	Initialize Parameters	Default: 0 Range: 0 to 5550; 6008 to 6011; 7770
b1-02	Run Command Selection 1	Default: 0 Range: 0 to 3
E2-01	Motor Rated Current	Default: Min.: 10% of drive rated current Max.: 200% of drive rated current
E2-04	Number of Motor Poles	Default: 2 Min.: 2 Max.: 48
P1-03	Feedback Device Scaling	Default: 145.0 PSI Min.: 0.1 Max.: 6000.0
P1-04	Start / Draw Down Level	Default: 0.0 Min.: -999.9 Max.: 999.9
P1-06	Minimum Pump Speed	Default: 40.0 Hz Min.: 0.0 Max.: [E1-04]
P1-11	High Feedback Level	Default: 0.0 PSI Min.: 0.0 Max.: 6000.0
P2-02	Sleep Level	Default: 0.0 Hz Min.: 0.0 Max.: 6000.0
P4-10	AUTO Mode Operator Run Power Down Storage	Default: 0 Range: 0, 1
P5-02	HAND Speed Reference 1	Default: 40.0 Hz Min.: 0 Max.: [E1-04]
P5-04	HAND Key Function Selection	Default: 1 Range: 0, 1
Q1-01	PID Controller Setpoint 1	Default: 0.0 Min.: 0.0 Max.: 6000.0
Q2-01	Minimum Geothermal Temperature Input	Default: 0.0 °F Min.: -110.0 Max.: 275.0
Q2-02	Maximum Geothermal Temperature Input	Default: 120.0 °F Min.: -100.0 Max.: 275.0
Q2-03	Minimum Geothermal Speed	Default: 40.0 Hz Min.: 0.0 Max.: 400.0
Q2-04	Maximum Geothermal Speed	Default: 60.0 Hz Min.: 0.0 Max.: 400.0
Q2-05	Low Temperature to Run at Maximum Geothermal Speed	Default: 55.0 °F Min.: -110.0 Max.: 275.0
Q2-06	Low Temperature to Run at Minimum Geothermal Speed	Default: 65.0 °F Min.: -110.0 Max.: 275.0

No.	Parameter Name	Setting Values
Q2-07	High Temperature to Run at Minimum Geothermal Speed	Default: 75.0 °F Min.: -110.0 Max.: 275.0
Q2-08	High Temperature to Run at Maximum Geothermal Speed	Default: 85.0 °F Min.: -110.0 Max.: 275.0
Q2-09	Geothermal Temperature Loss Detection	Default: 1 Range: 0 to 2
Q2-10	Geothermal Sleep Delay Time	Default: 30 s Min.: 0 Max.: 3600
Q2-11	Geothermal Temperature Delta Wake Level	Default: 0.0 °F Min.: 0.0 Max.: 50.00
U1-99	Anti-No-Flow Timer	No signal output available

H3 Multi-Function Analog Input Settings

H3-☐☐ Setting	Function	Description
21	Geothermal Temperature	Full scale: Q2-02 = 10 V (or 20 mA), Q2-01 = 0 V (or 4 mA) This input is internally limited to -999.9 °F to +999.9 °F
F	Not Used	Disables the functionality of the programmed terminal.

HOA Keypad Display	Error Name
oPE29	Geothermal Set Error
Cause	**Possible Solutions**
P1-01 parameter selection is not compatible with Geothermal Mode (b1-01 = 5).	Confirm b1-01 and P1-01 parameter settings.

HOA Keypad Display	Fault Name
TLGI Geothermal Input	Temperature Lost Geothermal Input The geothermal input is not present.
Cause	**Possible Solutions**
The input signal level has dropped below 3 mA or risen above 21 mA when the drive was running and b1-01 = 5, H3-0☐ = 21 (Geothermal Input), H3-0☐ = 2 (4 to 20 mA), and Q2-09 = 2 (Fault).	Confirm that the device connected to the analog input terminal is installed and working properly.
The drive was running while b1-01 = 5, H3-0☐≠ 21 (Geothermal Temp), and Q2-09 = 2 (Fault).	Assign one of the analog inputs to “Geothermal Temperature”, H3-0☐ = 21.

HOA Keypad Display	Minor Fault Name
Geo Params Chk Q2-05 to Q2-08	Geothermal Mode Parameters The drive is running at the level set in Q2-03 due to an incorrect setting.
Cause	**Possible Solution**
The temperature parameter values are set incorrectly.	Set the temperature parameters in the following order: Q2-08 > Q2-07 > Q2-06 > Q2-05

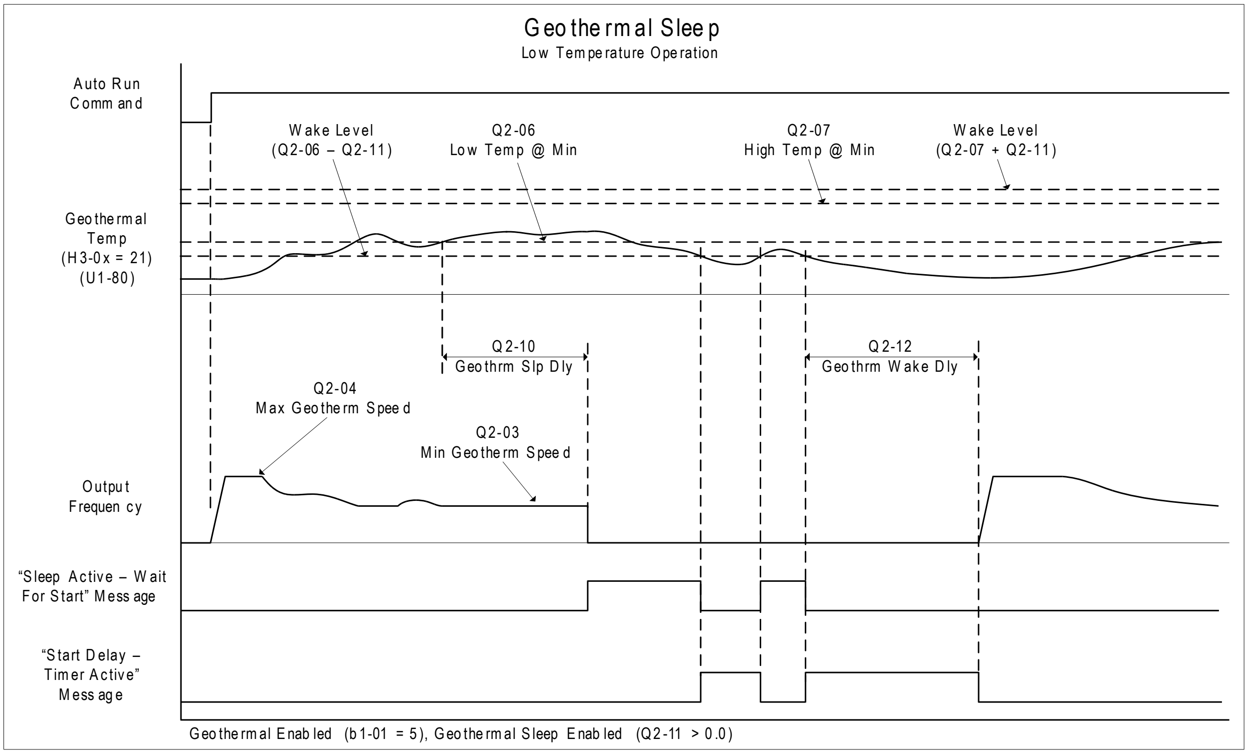


Figure 4.10 Geothermal Sleep – Low Temperature Operation

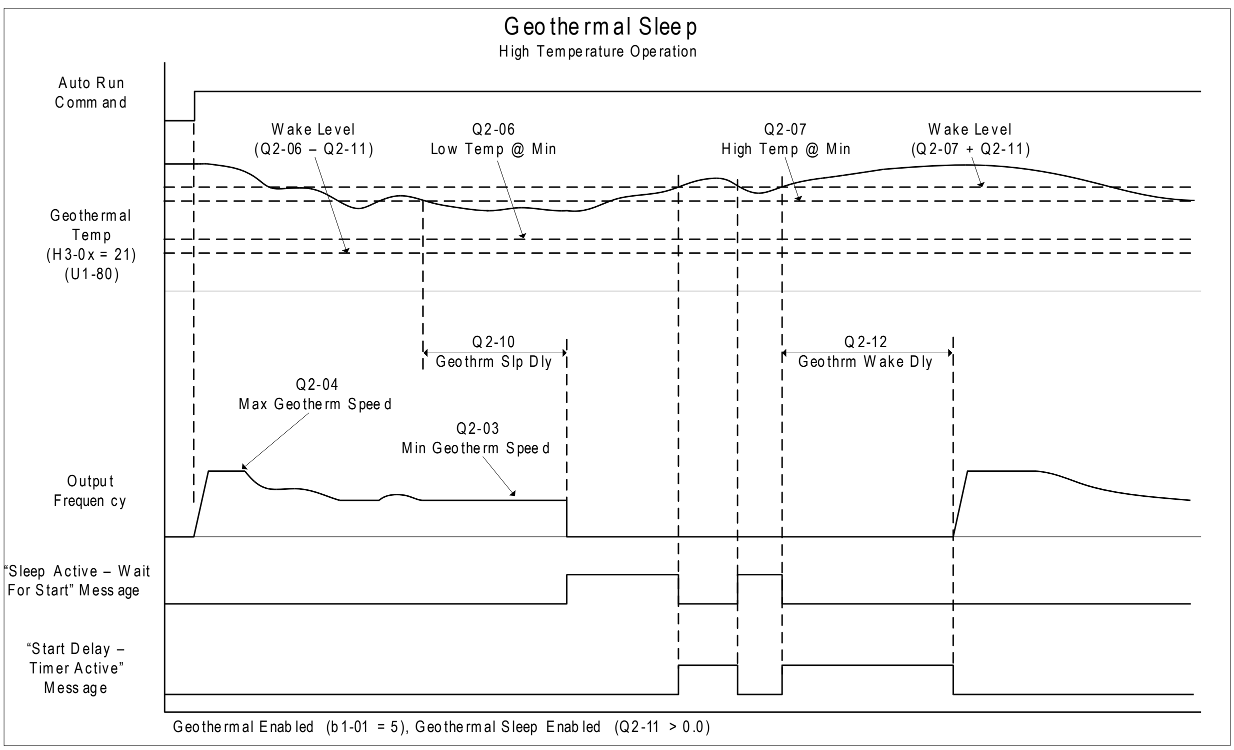


Figure 4.11 Geothermal Sleep – High Temperature Operation

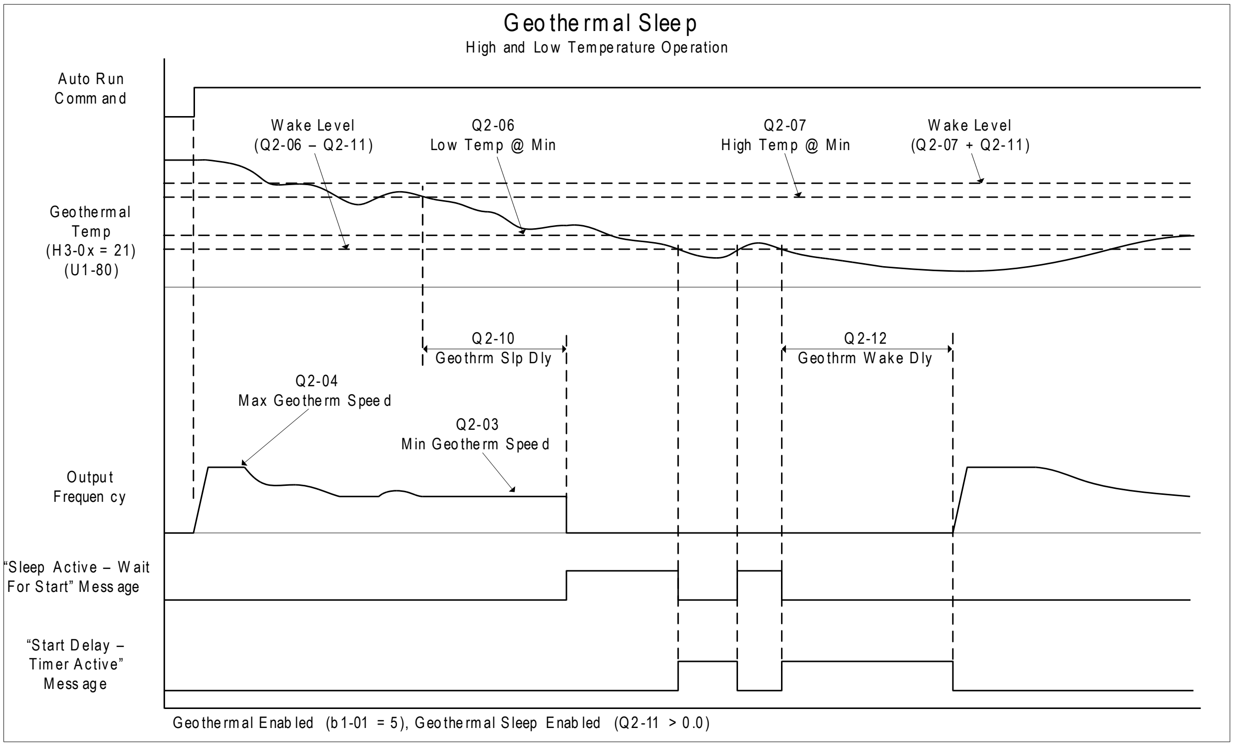


Figure 4.12 Geothermal Sleep – High and Low Temperature Operation

■ General Purpose Mode Application Preset

The purpose of this mode is to allow the drive controller to run a motor at a set speed without the PI process loop. This preset is designed to simplify using the drive for applications other than pumping control. The default settings call for the frequency reference to be an analog input and the run command to come from the terminal strip via a maintain contact closure. The PI loop is disabled and no process feedback is required.

Required Control Wiring

No additional control wiring is required when the drive controller is at its default settings.

Start Up Procedure

1. Set parameter A1-03 to 7770 (General Purpose Mode) to pre-set parameter values for this application.
2. Set the source of the frequency reference for the drive controller in parameter b1-01. The default setting is from the terminal strip via a 0 to 10 V analog signal wired into terminal A1.
3. Set the source of the Run Command for the drive controller in parameter b1-02. The default setting is from the terminal strip via a maintained contact closure.
4. Set the Acceleration Time of the motor in parameter C1-01. This is the time to accelerate the motor from zero speed to 60 Hz (E1-04 Maximum Output Frequency).
5. Determine the stopping method of the motor. The default setting is coast to stop. To ramp the motor to a stop, set b1-03 to 0 and then set the motor deceleration time in parameter C1-02. This is the time to stop the motor from to 60 Hz (E1-04 Maximum Output Frequency) to zero speed.
6. Set the motor-rated current in parameter E2-01. This information can be found on the motor nameplate or specification sheet.
7. Set the number of motor poles in parameter E2-04 (2-pole motors have a rated RPM of slightly less than 3600 RPM; 4-pole motors have a rated RPM of slightly less than 1800 RPM). This information can be found on the motor nameplate or specification sheet.
8. Determine whether the drive controller should attempt to reset itself after a fault. The default setting is disabled. The function is turned on by setting 1 to 10 reset attempts in parameter L5-01 and the time between each reset in parameter L5-04.
9. Set the minimum speed at which the motor can run in parameter P1-06. The default is 0 Hz. If the system has a minimum safe operation speed, set it in P1-06. This will act as a lower limit of the frequency reference.

10. The motor can be run in HAND (LOCAL) Mode for maintenance purposes by pressing the HAND key while the drive is stopped. The HAND key acts as a start button. Press the OFF button to stop the drive. Set P5-04 to 0 to disable the HAND key. The default frequency reference is 0.0 Hz in HAND Mode. This can be changed in parameter P5-02. The AUTO key has no effect with the default settings in the General Purpose Application Preset.

Related Parameters

No.	Parameter Name	Setting Values
A1-03	Initialize Parameters	Default: 0 Range: 0 to 5550; 6008 to 6011; 7770
b1-01	Frequency Reference Selection 1	Default: 0 Range: 0 to 5
b1-02	Run Command Selection 1	Default: 0 Range: 0 to 3
b1-03	Stopping Method Selection	Default: 1 Range: 0 to 3
C1-01	Acceleration Time 1	Default: 20.0 s Min.: 0.0 Max.: 6000.0
C1-02	Deceleration Time 1	Default: 20.0 s Min.: 0.0 Max.: 6000.0
E1-04	Maximum Output Frequency	Default: 60.0 Hz Min.: 40.0 Max.: 400.0
E2-01	Motor Rated Current	Default: Min.: 10% of drive rated current Max.: 200% of drive rated current
E2-04	Number of Motor Poles	Default: 2 Min.: 2 Max.: 48
L5-01	Number of Auto Restart Attempts	Default: 5 Min.: 0 Max.: 10
L5-04	Fault Reset Interval Time	Default: 20.0 s Min.: 10.0 Max.: 3600.0
P1-06	Minimum Pump Speed	Default: 40.0 Hz Min.: 0.0 Max.: [E1-04]
P5-02	HAND Reference	Default: 40.0 Hz Min.: 0 Max.: [E1-04]
P5-04	HAND Key Function Selection	Default: 1 Range: 0, 1

■ Well Draw Down Control Application Preset

The Well draw down function allows the drive to deliver water at a constant pressure as long as ground water level remains above a specified level. If the ground water level drops to this specified level the drive will switch from a constant pressure regulator to a level regulator, which will continue to supply water at the recharge rate of the well. Water will continue to flow at a reduced rate. Should the water level down hole continue to drop the drive will go to sleep and wait till the water level rises again to the specified wake up level to start pumping again. Once the water level rises above that level it will switch back to constant pressure mode.

Start Up Procedure

The following is a sample setup for the Well Draw Down function with 4 to 20 mA transducer feedback on both level (connected to input A1) and constant pressure (connected to A2)

1. Select a Proper Depth Sensing Transducer. The proper transducer for depth sensing has been specifically designed for depth sensing. This means the transducer element, electrical connections, and connecting cable are sealed for submersion. Additionally the sensor will have a vent tube running the length of the electrical conductors to compensate for changes in barometric air pressure, which ensures accurate feedback with changing weather patterns. Another

important design characteristic is that the electrical conductors are installed by the manufacturer at the length specified by the installer. This ensures that the manufacturer can calibrate the transducer to compensate for the voltage drop across the conductor length. The maximum length for pressure transducer leads is 50 meters (164 feet) and beyond that length the voltage drop will cause inaccurate feedback. It is common for wells to exceed this depth. Do not use standard pressure transducer for level control. Select a range of depth that closely matches your application range. One size does not fit all as depth calculations work with small changes in feedback. If the range is too large accuracy will be compromised.

Proper Depth Transducer Characteristics:

Sealed element and electrical connections

Barometric compensation

Specified cable length calibrated by the manufacturer

Proper range, one that is close to applications actual operation

2. Install Depth Sensing Pressure Transducer Down Hole. Since the feedback from the transducer is low voltage and the output of the drive to the motor is a PWM waveform an effort should be made to keep the transducer leads as far from the motor leads as possible. Given that space in the bore hole is at a premium this is a difficult task and connection of the transducer shield drain wire is important. Many installers will set the transducer in its own plastic tubing with a cap at the bottom end that the transducer can rest on. It is necessary to drill holes in the tubing at or close to the bottom to allow water to flood the tube. This type of installation will help protect the transducer and connecting cable from damage and allow it to be retrieved if necessary.
3. Connect Level Transducer to the drive via Terminal A1. Most depth level transducers are current based feedback, typically 4 to 20 mA. The A1 terminal of the drive is selectable for either voltage or current based pressure transducer feedback. Most transducers in common use are current based (4 to 20 mA).
4. Set the drive to accept current based (4 to 20 mA) Feedback Set the A1 terminal of Jumper S1 to current type input (I) as shown in ***Figure 4.13***. Set parameter H3-01 to 2 (4 to 20 mA) for signal type on A1. Set parameter H3-02 to 23, function of the A1 input, Well Level feedback

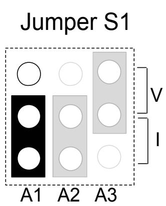


Figure 4.13 Terminal A1 Set to Current Input

Table 4.6 Jumper S1 Settings

Setting	Description
V (top position)	Voltage input (0 to 10 V Bipolar)
I (bottom position)	Current input (4 to 20 mA or 0 to 20 mA)

5. Connect Standard Pressure Transducer to Terminal A2. Terminal A2 is designed to accept both current and voltage based feedback devices and by default the drive is set to 4 to 20 mA input. Make sure to set all necessary parameters for proper constant pressure regulation.
6. Set parameter Q4-01 to 1 to enable the Well Draw Down Feature.
7. Set Constant Pressure Setpoint in U1-01 or Q1-01. U1-01 is the only monitor which will change parameter values without going to the program menu. Using this monitor, the setpoint can be changed while the drive is running. A setpoint must be entered for the Well Draw Down feature to work properly.
8. Enter the maximum value of the range of the transducer in PSI in parameter Q4-02 and the drive will automatically scale associated parameters. The level transducer should display a specification for range (e.g., 0 to 50 PSI [115.4 feet]) 1 PSI = 2.308 ft.
9. Set Well Level to be maintained in parameter Q4-03 This is the level (in feet) at which the drive will stop regulating pressure and start maintaining level. If the water level rises above this level, the drive will automatically switch back to pressure regulation.
10. Set Well Level to Sleep in parameter Q4-04 When the well level reaches this level (in feet) and the sleep time set in parameter Q4-05 expires, the drive will go to sleep and stop running the pump. The pump will remain in this state until the well level reaches the wake level set in Q4-06..

11. Set Wake Level in parameter Q4-06. When the well level has reached this level (in feet) and the on-delay timer set in Q4-07 expires, the drive will automatically start running again. Set this level should to a value greater than Q4-03 (Maintain Level) so the drive will automatically go to pressure regulation mode.
12. Set the Minimum Pump Speed while in Level Control in parameter Q4-08 Set this speed at a level which ensures that the pump is moving water out of the well. If it is set to a speed where no water is moving, the PI regulator may not drive the well level to the sleep level and cause damage to the pump or motor. This speed is only used in Level Control Mode but the actual minimum speed in Level Mode will be the greater value between P1-06 (minimum pump frequency) and P4-05 (thrust frequency). If Q4-08 is set higher than P1-06 and P4-05, it will only be used while the drive is in Level Control Mode.
13. Set Low Level Detection Value in Parameter Q4-09 and program the drive response in Q4-11 This is the level (in feet) at which you do not want the pump to run at because below this level there is a danger dry running. Generally this level is a fail safe level and if reached you would likely want the drive to fault out and stop running immediately. This can also activate the drive fault contacts, which can be used for auxiliary notification such as a horn or external warning light. In Q4-11 the drive can be programmed for one of four responses 0. No Response, 1. Alarm Only, 2. Fault 3. Time Delay. Default is Alarm Only. Note: option 3 is controlled by parameters Q4-12 (timer) and L5-01 > 0 (fault auto-restart).
14. Verify Settings and Well Level in Monitor U1-97 By using monitor U1-97 (displayed in feet) without the pump running you should see the well level displayed and can note it down. Then press the Auto button to start the drive in pressure regulation mode. This assumes all other parameters for pressure regulation have been set up prior to this step. Once the setpoint pressure has been reached check U1-97 and note the level. Depending on the recharge rate of the well this value will be lower than the level without the pump running by some amount. This can give you an idea of the well’s recharge rate at the current demand. It will give you an idea if the other levels you have set are appropriate. The level should be checked periodically over the season of operation to check level variations related to times of the year.

Related Parameters

No.	Parameter Name	Setting Values
H3-01	Terminal A1 Signal Level Selection	Default: 0 Range: 0 to 3
H3-02	Terminal A1 Function Selection	Default: 0 Range: 0 to 32
L5-01	Number of Auto Restart Attempts	Default: 5 Min.: 0 Max.: 10
P1-06	Minimum Pump Speed	Default: 40.0 Hz Min.: 0.0 Max.: [E1-04]
P4-05	Pre-Charge Loss of Prime Level	Default: 0.0 A Min.: 0.0 Max.: 1000.0
Q1-01	PID Controller Setpoint 1	Default: 0.0 Min.: 0.0 Max.: 6000.0
Q4-01	Water Level Selection	Default: 0 Range: 0, 1
Q4-02	Water Level Scaling	Default: 100 PSI Min.: 5 Max.: 500
Q4-03	Water Level Setpoint	Default: 20.0 ft Min.: 0.0 Max.: 1200.0
Q4-04	Minimum Water Level	Default: 10.0 ft Min.: 0.0 Max.: 1200.0
Q4-05	Water Level Sleep Delay Time	Default: 5 s Min.: 0 Max.: 3600

No.	Parameter Name	Setting Values
Q4-06	Wake-Up Water Level	Default: 30.0 ft Min.: 0.0 Max.: 1200.0
Q4-07	Water Level Control Sleep Wake-Up Time	Default: 1 s Min.: 0 Max.: 3600
Q4-08	Level Control Minimum Speed	Default: 0.00 Hz Min.: 0.00 Max.: 400.00
Q4-09	Low Level Detection Level	Default: 0.0 ft Min.: 0.0 Max.: 1200.0
Q4-10	Low Level Detection Time Delay	Default: 0.0 Min.: 0.0 Max.: 300.0
Q4-11	Low Level Behavior	Default: 1 Range: 0 to 3
Q4-12	Water Level Control Auto-Restart Time	Default: 5.0 min Min.: 0.1 Max.: 6000.0
Q4-15	Low Water Level Detection Time Unit	Default: 0 Range: 0, 1
U1-01	Frequency Reference	10 V: Max frequency
U1-97	Water Level	Full scale: 10 V = Q4-02

◆ iQpump Functions

■ Low City or Low Suction Inlet Pressure

This function is used with low suction inlet pressure switches on pressure booster systems for buildings that get their main water supply from a municipality. This pressure switch enables and disables the pump system when the inlet supply is at a low demand and when running the pump system in this condition will cause damage.

An inlet pressure switch is wired directly into the drive using one of the digital input terminals. If the pressure switch is active and sufficient pressure is available, the drive system will operate normally. If the pressure switch indicates that incoming pressure is too low, the drive will take the following actions:

- The drive will be forced into a sleep-like state (coast to stop).
- Any drives staged in multiplex mode will immediately coast to stop.
- The selected alarm “Low City Pressure”, “Low Suction Pressure”, or “Low Water In Tank” will be displayed (determined by P4-24).

All drives will restart when sufficient pressure returns.

Required Control Wiring

Any one of the multi-function digital inputs (S1 to S8) must be wired and programmed with a low suction inlet pressure switch. The appropriate terminal parameter (H1-☐☐) must be to set 73 (Low City Pressure). The action of the switch (normally open / normally closed) is set in parameter P4-21.

Start Up Procedure

1. Set all other parameters required for the application such as PI control loop, sleep, motor, and I/O parameters.
2. Set one digital input for the low suction inlet pressure switch (H1-☐☐ = 73). Wire the switch to this terminal.
3. Configure the terminal for a normally open / closed switch type using parameter P4-21.
4. Configure the delay times for activating and removing the alarm in parameters P4-23 and P4-24. This can be used to stop the drive from cycling too frequently if the pressure varies a lot.
5. Select the alarm message that will be displayed when a Low City condition is detected using parameter P4-24. Options include “Low Cty Pressure”, “Low Suction Pres”, and “Low Watr In Tank”.

Related Parameters, Faults, and Alarms

No.	Parameter Name	Setting Values
P4-21	Low City Input Select	Default: 1 Range: 0, 1
P4-22	Low City On-Delay Time	Default: 10 s Min.: 1 Max.: 1000
P4-23	Low City Off-Delay Time	Default: 5 s Min.: 0 Max.: 1000
P4-24	Low City Alarm Text	Default: 0 Range: 0 to 2

H1 Multi-Function Digital Input Settings		
H1-☐☐ Setting	Function	Description
73	Low City Press	Indicates that sufficient or insufficient pressure is present on the inlet to the pump. Used mainly for pressure booster situations.

HOA Keypad Display	Minor Fault Name
Low City Pressure	Low City Pressure
Cause	**Possible Solution**
Insufficient pressure is present on the inlet to the pump.	• Check pressure switch contact for correct operation. • Check control wiring to drive terminal strip from pressure switch contact. • Check to make sure that suction pressure is present by means of a separate measuring device.

HOA Keypad Display	Minor Fault Name
Low Suction Pressure	Low Suction Pressure
Cause	**Possible Solution**
Insufficient suction pressure is present.	• Check pressure switch contact for correct operation. • Check control wiring to drive terminal strip from pressure switch contact. • Check to make sure that suction pressure is present by means of a separate measuring device.

HOA Keypad Display	Minor Fault Name
Low Water in Tank	Low Water in Tank
Cause	**Possible Solution**
The water level in the tank is too low.	• Check pressure switch contact for correct operation. • Check control wiring to drive terminal strip from pressure switch contact. • Check to make sure that suction pressure is present by means of a separate measuring device.

■ Hard Current Limit

This function provides a current limit of the pump (motor). The function is designed to prevent long-term overload conditions of the pump, especially if the motor and drive are oversized compared to the pump. The drive will attempt to limit the output current by reducing the frequency reference. The frequency is reduced using an internal current PI regulator. This function will only operate correctly when the drive is connected to a variable torque motor load such as a centrifugal pump. More specifically, it will only operate if the load is such that output current increases as output frequency increases (and vice-versa). The current limit function reduces the pump speed to just above the lower value between the minimum pump speed (P1-06) or the minimum output frequency. If PI mode is enabled (b5-01 > 0), a special limit will be applied to the PID integrator when output current limit is active to prevent integrator wind-up.

Start Up Procedure

1. Set all other parameters required for the application such as PI control loop, sleep, motor, and I/O parameters
2. Turn on the current limit function by setting Q3-01 to 1 (enabled). The default setting is 0 (disabled).
3. Set the desired current limit in Q3-02. This value should not exceed the motor, pump or drive's ratings. This does not in any way change the motor (oL1) and inverter (oL2) overload functions.
4. If desired, program a multi-function digital output (H2-☐☐) to 89 (Output Current Limit) to annunciate the alarm.

Related Parameters

No.	Parameter Name	Setting Values
Q3-01	Output Current Limit Select	Default: 0 Range: 0, 1
Q3-02	Current Limit	Default: 0.0 A Min.: 0.0 Max.: 1000.0

H2 Multi-Function Digital Output Settings		
H2-□□ Setting	Function	Description
89	Output 1 Limit	Closed: Drive output speed is being limited due to the output current limit or the single phase foldback regulator.

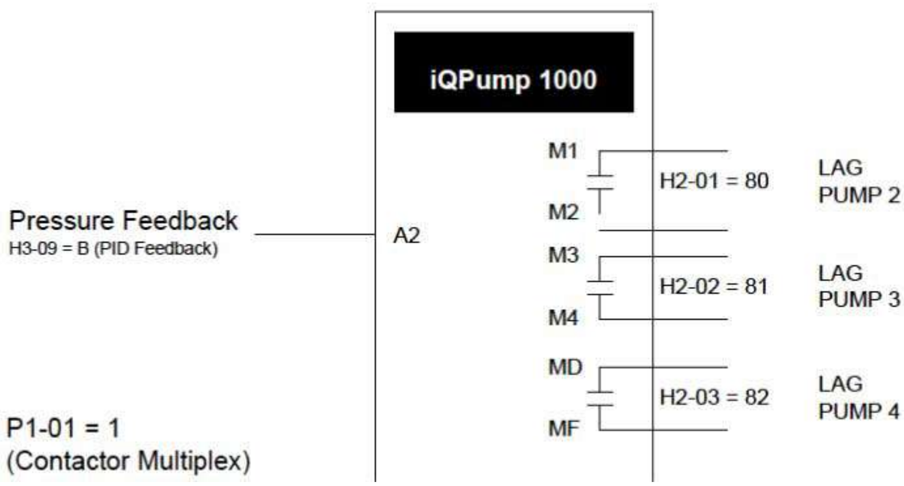
■ Vertical Turbine Controller (VTC)

Vertical turbine pumps are typically used when water needs to be pumped from deep-water wells or open bodies of water such as rivers, lakes, irrigation canals, lifting stations, and water storage facilities. The VTC Application Preset allows the operator to easily setup control for a wide range of pumping applications. The drive will automatically adjust pump-operating conditions from Simplex (one pump on the drive) to multiple lag pumps as the process variables change. Control can be extended from simple pressure regulation to adding suction and vacuum control as well.

Required Control Wiring

Most pressure transducers have current-based feedback (4 - 20 mA). The drive A2 terminal is pre-set for 4-20 mA and pre-programmed for PI feedback (H3-10 = B). If the sensor is voltage based (0-10 V) and terminal A3 is unused, then wire the transducer to terminal A3 and program H3-10 to F (A2 not used) and H3-06 to B (A3 PI Feedback).

When using lag pumps, the lag pump on/off control must be wired to the drive digital output terminals. The figure below shows the drive with the pressure transducer wired into terminal A2 and 3 lag pumps wired into output relays.



Start Up Procedure for iQpump1000 with Three Lag Pumps

1. Set parameter A1-03 to 6011 (VTC Pressure Control). This will preset parameter values for this application.
2. Set the motor-rated current in parameter E2-01. This information can be found on the motor nameplate or specification sheet.
3. Set the number of motor poles in parameter E2-04 (2-pole motors have a rated RPM of slightly less than 3600 RPM; 4-pole motors have a rated RPM of slightly less than 1800 RPM). This information can be found on the motor nameplate or specification sheet.
4. Set the feedback device scaling in parameter P1-03. Check the sensor nameplate or specification sheet. For example, if the device outputs 20 mA at 100.0 PSI of pressure, then set P1-03 to 100.0 PSI. The drive controller will automatically scale all associated parameters and monitors. Monitor U1-91 (Pump Feedback) will display the measured pressure in PSI. The drive has a High Feedback Fault set in parameter P1-11. Make sure that P1-11 is appropriately set for sensor scaling in P1-03.
5. Set the desired pressure setpoint in parameter Q1-01 (PI setpoint). This is desired pressure that the drive will regulate the pump to control around. To quickly access this parameter, press the HOME key and then the ENTER key. The U1-99 monitor on the home screen displays the Q1-01 PI setpoint.

6. Set the minimum speed that the pump can be run in parameter P1-06. The default is 35 Hz. This information can be found on the pump specification sheet.
7. The default setting is for the drive to control the pump motor wired to the drive. Additional Lag pumps can be added to the system by wiring the on/off switch of the lag-pump motor to the drive as shown in the figure above. Set parameter P1-01 to 1 (Contactor Lag). This will enable the multiplexing control for multiple pumps
8. Set the number of additional lag pumps in parameter P3-00. For example, for a system with the drive pump and 3 additional lag pumps, set P3-00 to 3.
9. Set each lag pump's shutdown (stage off) level in Parameters P3-50, P3-60 and P3-70. The value is set in Hz. The setting tells the drive controller to de-stage the lag pump if the output frequency drops below this level. This setting needs to be coordinated with minimum pump speed (P1-06) and the sleep level. It is important that all lag pumps be de-staged above the sleep level or the drive will not enter sleep mode
10. The drive will stage lag pumps on based on the output frequency of the drive. At start, only the drive pump will be running. If the drive output frequency reaches 60 Hz for the time set in P3-05 and the pressure setpoint cannot be met, the drive will stage on (turn on) one of the lag pumps. The drive will stage on additional lag pumps until the pressure setpoint can be achieved.
11. The drive will stage lag pumps off based on the output frequency of the drive. Assume the system has been running with multiple lag pumps on. Now the demand starts to drop. The drive's output frequency will drop. If the output frequency falls below a lag pump frequency shutdown level for the time set in P3-09, the pump is de-staged. The drive will continue to de-stage pumps until the pressure setpoint can be met
12. Configure the sleep function. The drive can be programmed to shut off or sleep if the pressure stays at or above the Q1-01 setpoint with all lag pumps de-staged and the drive running at the minimum pump speed. In order to turn on the sleep function, set parameter P1-04 (Start – Draw Down Level) to a level slightly less than the pressure Q1-01 setpoint. When the drive is sleeping and the system pressure drops below the P1-04 setting, the drive will wake up and begin regulating pressure again. By sleeping, the drive will save energy and mechanical wear. A setting of zero in P1-04 will disable the sleep function (default setting).
13. Press the AUTO key to start the drive with PI control (pressure control). Press the OFF key to stop the drive
14. The pump can be run in a Hand (local) mode for maintenance purposes by pressing the HAND key while the drive is stopped. The HAND key acts as a start button. Press the OFF button to stop the drive. Press AUTO to return the drive to PI control. The HAND frequency reference is preset to 6 Hz in parameter P5-02. Disable the HAND key by setting P5-04 = 0 (disabled).

Related Parameters

No.	Parameter Name	Setting Values
A1-03	Initialize Parameters	Default: 0 Range: 0 to 5550; 6008 to 6011; 7770
E2-01	Motor Rated Current	Default: Min.: 10% of drive rated current Max.: 200% of drive rated current
E2-04	Number of Motor Poles	Default: 2 Min.: 2 Max.: 48
H3-06	Terminal A3 Function Selection	Default: 20 Range: 0 to 32
H3-10	Terminal A2 Function Selection	Default: B Range: 0 to 32
P1-01	Pump Mode	Default: 0 Range: 0, 1, 3
P1-03	Feedback Device Scaling	Default: 145.0 PSI Min.: 0.1 Max.: 6000.0
P1-04	Start / Draw Down Level	Default: 0.0 Min.: -999.9 Max.: 999.9
P1-06	Minimum Pump Speed	Default: 40.0 Hz Min.: 0.0 Max.: [E1-04]

No.	Parameter Name	Setting Values
P1-11	High Feedback Level	Default: 0.0 PSI Min.: 0.0 Max.: 6000.0
P3-00	Number of Lag Pumps	Default: 1 Min.: 1 Max.: 5
P3-05	Add Pump Delay Time	Default: 2 s Min.: 0 Max.: 3600
P3-09	Shutdown Pump Delay Time	Default: 5 s Min.: 0 Max.: 3600
P3-50	Pump 2 Frequency Shutdown Level	Default: 40.0 Hz Min.: 0.0 Max.: 400.0
P3-60	Pump 3 Frequency Shutdown Level	Default: 40.0 Hz Min.: 0.0 Max.: 400.0
P3-70	Pump 4 Frequency Shutdown Level	Default: 40.0 Hz Min.: 0.0 Max.: 400.0
P5-02	HAND Reference	Default: 40.0 Hz Min.: 0 Max.: [E1-04]
P5-04	HAND Key Function Selection	Default: 1 Range: 0, 1
Q1-01	PID Controller Setpoint 1	Default: 0.0 Min.: 0.0 Max.: 6000.0
U1-91)	Pump Feedback	No signal output available
U1-99	Anti-No-Flow Timer	No signal output available

■ Pre-Charge Function with One Lag Pump

The pre-change function is designed to start a pumping system in a controlled manner. Rather than turning on the PI loop immediately at start up, the pre-charge function operates at a fixed speed to pre-fill the piping or storage tank before switching to PID control. This prevents the PI loop integrator from building up unnecessarily and also allows for a soft pressurization and fill of the system.

When an “auto” run command is issued or when waking up from the sleep state, the drive will check to see if it should perform a pre-charge operation. If so, it will ramp up and run at the pre-charge frequency. Some of the pump protective functions are disabled during pre-charge operation.

The drive will exit the pre-charge function when any of the below conditions are met:
- The process feedback level reaches the pre-charge level (P4-01)
- A multi-function digital input programmed for a Low Water Level switch deactivates (H1-☐☐ = 8F)
- The pre-charge timer expires (P4-03).

Required Control Wiring

No control wiring is required. An optional Low Water Level switch can be used to turn off the pre-charge function. Wire the switch into one the drive digital inputs and program the corresponding H1-☐☐ parameter to 8F (the switch is normally open and closes during low water level).

Start Up Procedure

1. Set all other parameters required for the application such as PI control loop, sleep, motor, and I/O parameters. However, this function can be used in conjunction across a wide range of applications using a PI control process loop.
2. Set the pre-charge level in parameter (P4-01). This is the process feedback level (PSI, depth, etc.) that must be achieved before the pre-charge function will turn off.
3. Set the pre-charge frequency reference in parameter P2-02. This is the frequency that the drive will run at during pre-charge. Set this value to reasonable speed that is above the minimum pump speed (P1-06) and close to the average running frequency of the drive controller.

4. Set the pre-charge timer in P4-03. When the drive goes into pre-charge mode, no low-water switch is wired to the drive, and if the pre-charge level (P4-01) cannot be obtained, the drive will exit the pre-charge function after the P4-03) time and begin normal PI control
5. A multi-function digital input can be wired to and programmed for Pre-charge Disable if required (H1-☐☐ = 8C). Parameter P1-30 configures the switch type (0: Normally Open, 1: Normally Closed).
6. A multi-function digital output can be wired to and programmed to close whenever the pre-charge function is active (H2-☐☐ = A4).

Conditions for Entering Pre-charge Mode

- Drive Ready or Sleeping (run command, not faulted, not in program mode).
- NOT in HAND Mode
- “Disable Pre-charge” digital input NOT closed.
- Pre-charge time set greater than zero (P4-03 > 0)
- If the Pre-charge level is greater than zero (P4-01 > 0) and the PID feedback is below the P4-01 level (Forward acting PID, b5-09 = 0).
- If the Pre-charge level is greater than zero (P4-01 > 0) and the PID feedback is above the P4-01 level (Reverse acting PID, b5-09 = 1).

Operation During Pre-Charge Mode

- Drive will run at the Pre-Charge frequency (P4-02).
- The PID controller is disabled.
- The HOA keypad will display the message “Pre Chg Mode – Pre-chg Active”.
- The pre-charge digital output (H2-0☐ = A4) will close
- If the Pre-Charge frequency (P4-02) is set less than minimum pump speed (P1-06), an alarm “Freq. Ref < Pump Min P1-06” will be displayed and the drive will run at the minimum pump speed.

Conditions for Exiting the Pre-Charge Mode

- When Pre-charge timer expires (P4-03). The drive will always exit after the pre-charge timer expires.
- When the “Disable Pre-Charge” digital input (H1-☐☐ = 8C) is closed, even momentarily
- When the PID feedback satisfies Pre-charge level (P4-01):

  Feedback is greater than Pre-Charge Level (P4-01) (forward-acting PID, b5-09 = 0)

  Feedback is less than Pre-Charge Level (P4-01) (reverse-acting PID, b5-09 = 1)
- When the “Low Water” digital input (H1-☐☐ = 8C) deactivates. A digital input must be programmed to “Low Water” (H1-0☐ = 8F). The input is configured in P1-30 (0: normally open, 1: normally closed).

Related Parameters

No.	Parameter Name	Setting Values
P4-01	Pre-Charge Level	Default: 0.0 PSI Min.: 0.0 Max.: 6000.0
P4-02	Pre-Charge Frequency	Default: 0.0 Hz Min.: 0.0 Max.: [E1-04]
P4-03	Pre-Charge Time	Default: 0.0 min Min.: 0.0 Max.: 3600.0
P4-05	Pre-Charge Loss of Prime Level	Default: 0.0 A Min.: 0.0 Max.: 1000.0
P4-06	Pre-Charge Frequency 2	Default: 0.0 Hz Min.: 0.0 Max.: [E1-04]
P4-07	Pre-Charge Time 2	Default: 0.0 min Min.: 0.0 Max.: 3600.0

No.	Parameter Name	Setting Values
P4-08	Pre-Charge Loss of Prime Level 2	Default: 0.0 A Min.: 0.0 Max.: 1000.0

H1 Multi-Function Digital Input Settings		
H1-□□ Setting	Function	Description
8C	Disable Pre-Charge	Closed: Pre-Charge disabled.

H2 Multi-Function Digital Output Settings		
H2-□□ Setting	Function	Description
A4	Pre-Charge	Closed: Drive is in Pre-Charge mode.

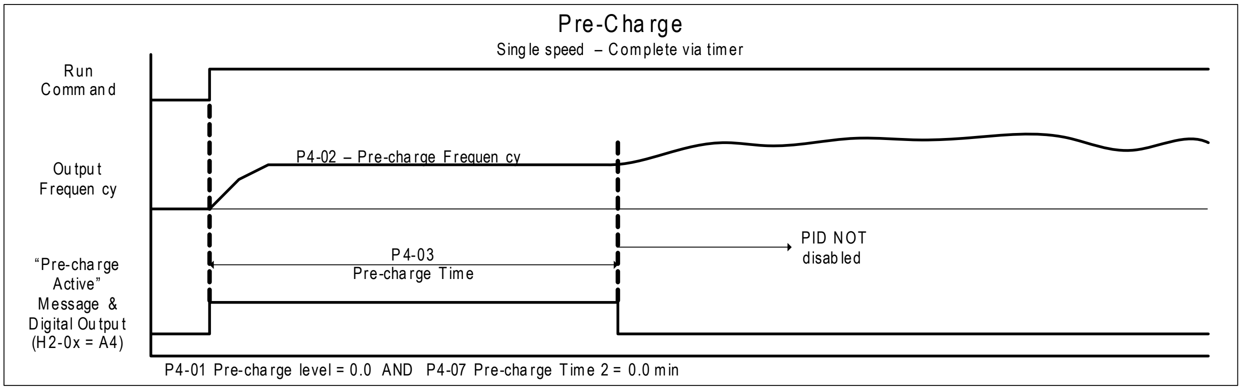


Figure 4.14 Pre-Charge Single Speed Complete via Timer

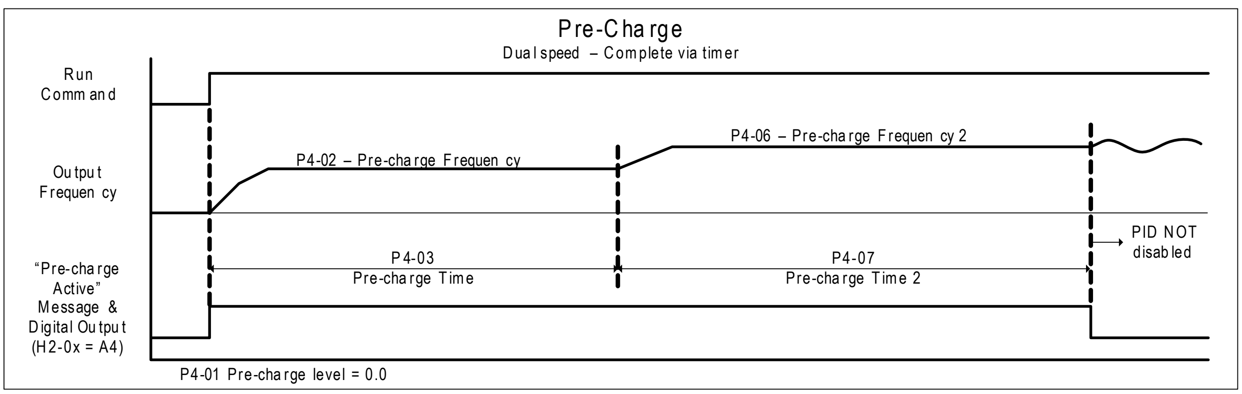


Figure 4.15 Pre-Charge Dual Speed Complete via Timer

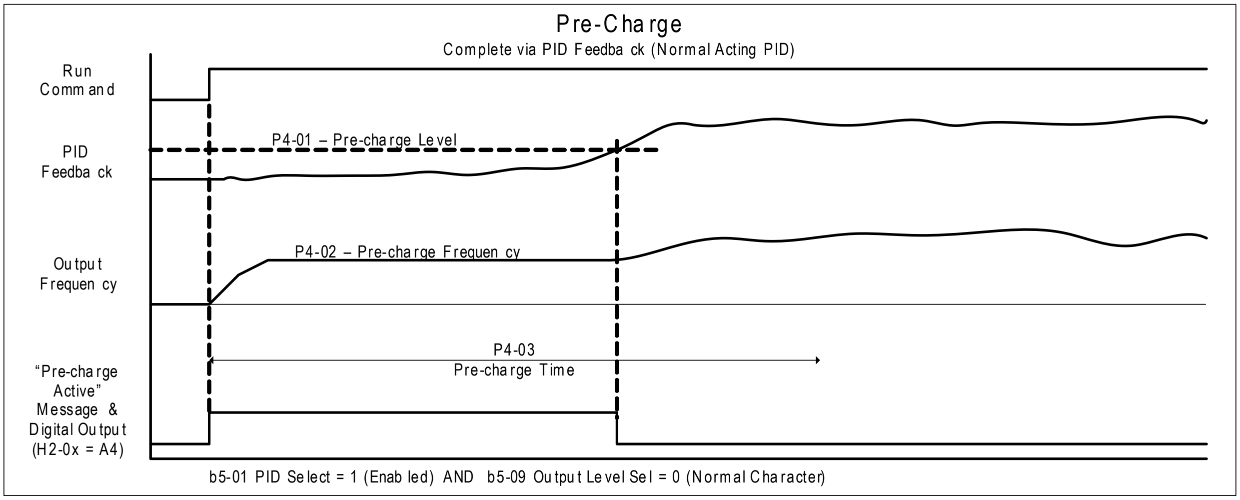


Figure 4.16 Pre-Charge Complete via Normal PID Feedback

■ Setpoint Boost after Lag Pump De-Staging

When a lag pump is de-staged (turned off), there can be a sudden drop in pressure in the system due to the pump de-staging. The Setpoint Boost function will dampen the shock load (pressure dip) to the system by temporarily raising the PI setpoint of the drive controller during de-staging.

The function will raise the setpoint to the measured feedback value at the time of de-staging for the time set in P3-11. When the P3-11 time expires, the setpoint will return to the Q1-01 value and the drive operates normally. The intention of the feature is to get the drive to begin accelerating as soon as a pump is de-staged, thus limiting the shock to the system since the PI controller would tell the drive to accelerate anyway in response the de-staged pump. It is not intended to regulate at the boosted setpoint for a long period of time.

- The maximum PI setpoint is limited to the Q1-01 setpoint plus the P3-10 (Max Boost at De-Stage) setting.
- This feature cannot decrease the setpoint, therefore the function is disabled if b5-09 = 1 (inverse acting).
- If the iQpump controller calls for a lag pump to be staged during the P3-11 time, the staging will occur with the Setpoint Boost function being immediately disabled.
- Setting either P3-10 or P3-11 to zero disables the Setpoint Boost function.
- The PI control loop is active during Setpoint Boost.
- The default setting for P3-10 is 0.0 PSI and P3-11 is 5.0 sec.

Start Up Procedure

1. Set all other parameters required for the application such as PI control loop, sleep, motor, and I/O parameters. *Refer to Vertical Turbine Controller (VTC) on page 133* for an example. However, this function can be used in conjunction across a wide range of applications using a PI control process loop with multiple lag pumps that are staged and de-staged
2. Set the maximum Setpoint Boost in parameter (P3-10). This is set in the selected system units (PSI, etc.). When a de-staging occurs and Setpoint Boost is to occur, the PI feedback level temporarily becomes the PI setpoint. Parameter P3-10 limits how much the PI setpoint can be raised.
3. Set the Setpoint Boost time in parameter P3-11. This sets how long the Setpoint Boost function will boost the PI setpoint. After the P3-11 time expires, the PI setpoint will return to the Q1-01 setting.

Related Parameters

No.	Parameter Name	Setting Values
b5-09	PID Output Level Selection	Default: 0 Range: 0, 1
P3-10	Setpoint Boost Maximum at De-Stage	Default: 0.0 PSI Min.: -20.0 Max.: 20.0
P3-11	Setpoint Boost after De-Stage Time	Default: 5.0 s Min.: 0.0 Max.: 60.0

No.	Parameter Name	Setting Values
Q1-01	PID Controller Setpoint 1	Default: 0.0 Min.: 0.0 Max.: 6000.0

■ Frequency Reduction after Lag Pump Staging

When a lag pump is staged (turned on), there can be a sudden increase in pressure in the system due to the pump staging on. The Frequency Reduction function will dampen the shock load (pressure spike) to the system by temporarily limiting (lowering) the drive controller output frequency during pump staging.

The function will limit the output frequency at time of de-staging for the time set in P3-07. When the P3-07 time expires, the frequency limit is removed and the drive operates normally. The intention of the feature is to get the drive to begin decelerating as soon as a pump is staged to limit the shock to the system, as the PI controller would tell the drive to decelerate in response the staged on pump. It is not intended to regulate at the limited output frequency for an extended period of time.

Note:
1. When a lag pump is staged on, the drive will upper-limit the output frequency for the P3-07 (Frequency Reduction Time) setting. The output frequency limit is determined by subtracting parameter P3-06 (Frequency Reduction at Staging) from parameter P3-03 (Max-Multi Level). The default setting for P3-03 is 59.0 Hz, P3-06 is 0.0 PSI, and P3-07 is 5.0 sec.
2. The drive integrator will be limited to prevent wind-up and ensure a smooth transition back out of frequency limit.
3. Once the P3-07 time expires, the upper-limit will be removed and the drive will operate normally.
4. If the drive calls for de-staging a pump during the P3-07 time, the de-stage will be allowed to happen, and normal PI operation will immediately resume.
5. If either P3-06 or P3-07 is set to zero, this feature will not operate.

Start Up Procedure

1. Set all other parameters required for the application such as PI control loop, sleep, motor, and I/O parameters. ***Refer to Vertical Turbine Controller (VTC) on page 133*** for an example. However, this function can be used in conjunction across a wide range of applications using a PI control process loop with multiple lag pumps that are staged and de-staged.
2. Set the amount of frequency reduction at staging in parameter P3-06. When a staging occurs, the output frequency is limited to P3-03 – P3-06.

   Example: If P3-03 = 59 Hz (default) and P3-06 is set to 3 Hz, the output frequency will be limited to 56 Hz.
3. Set the Frequency Reduction time at staging in parameter P3-07. This sets how long the output frequency will be limited during pump staging. After the P3-07 time expires, the PI controller will return to normal.

Related Parameters

No.	Parameter Name	Setting Values
b5-09	PID Output Level Selection	Default: 0 Range: 0, 1
P3-10	Setpoint Boost Maximum at De-Stage	Default: 0.0 PSI Min.: -20.0 Max.: 20.0
P3-11	Setpoint Boost after De-Stage Time	Default: 5.0 s Min.: 0.0 Max.: 60.0
Q1-01	PID Controller Setpoint 1	Default: 0.0 Min.: 0.0 Max.: 6000.0

■ Using the DO-A3 Option for Additional Lag Pumps

The drive comes standard with three output relays capable of controlling three lag pumps. With the addition of a DO-A3 card installed in the drive, two additional lag pumps can be controlled bring the total to five lag pumps.

Required Control Wiring

Install the DO-A3 option card on the CN5-A, CN5-B, or CN5-C option connector on the drive. Refer to the DO-A3 Installation Manual packaged with the option for installation and wiring instructions. The option card has two relay outputs on terminal block 1 (TB1) and 6 photocoupler outputs on terminal block 2 (TB2). the drive uses only the relay outputs on terminal block 1.

Start Up Procedure for Controlling a Lead Pump plus Five Lag Pumps

1. Install and wire the DO-A3 as indicated in the option installation manual.
2. Set all other parameters required for the application such as PI control loop, sleep, motor, and I/O parameters.
3. Program drive parameters with the values shown in *Table 4.7* to correctly control each lag pump.

Table 4.7 Lag Pump Settings

Lag Pump Number	Terminal Location	Terminal Numbers	Parameter	Setting
1	Control Board	M1-M2	H2-01	80
2		M3-M4	H2-02	81
3		MD-MF	H2-03	82
4	DO-A3 Option	M1-M2	F5-07	83
5		M3-M4	F5-08	84

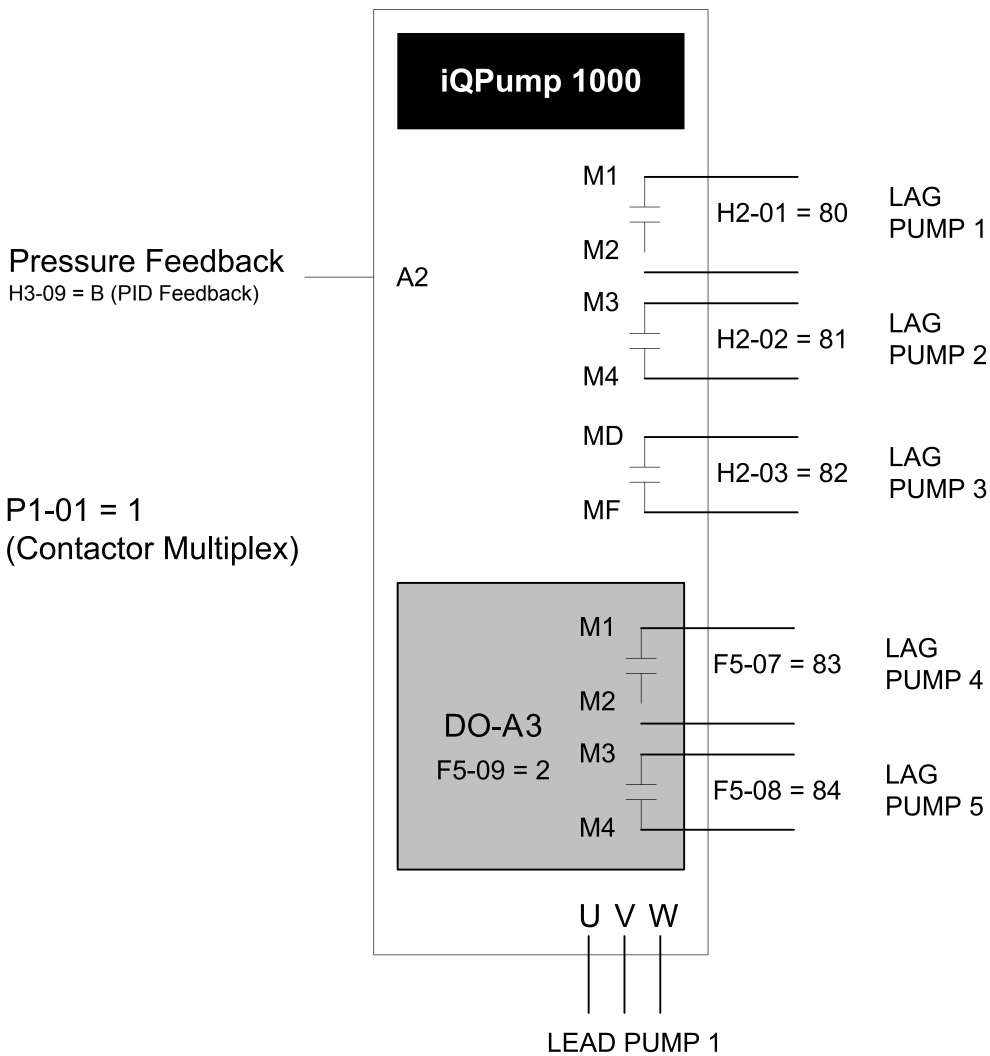


Figure 4.17 Controlling Five Lag Pumps with DO-A3 Option

■ Software Multiplexing Setup

Wiring the Drive RS-485 Network Connections

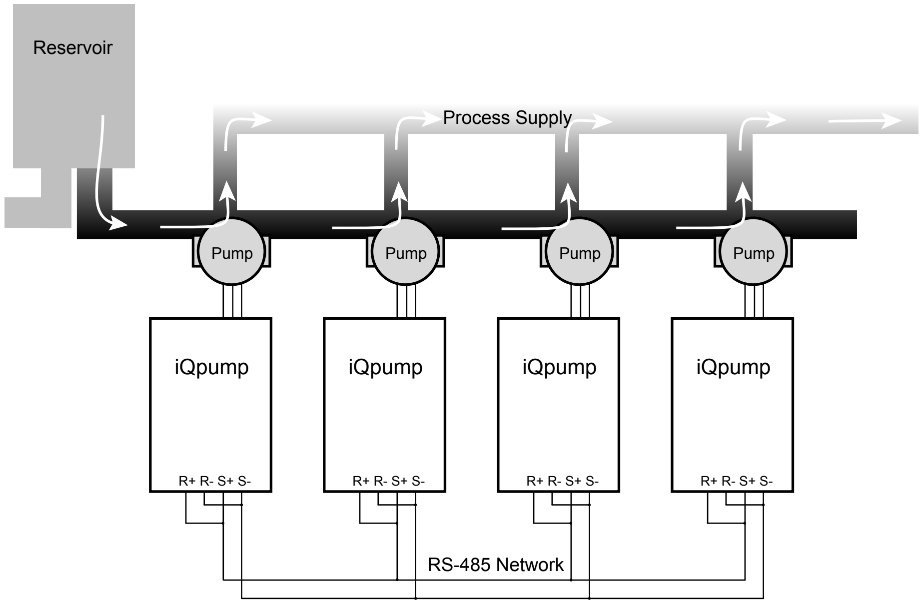


Figure 4.18 System Overview

Perform the following steps to make the RS-485 network connections between all drives that will be multiplexed:

1. Jumper terminals (R+ to S+) and jumper terminals (R- to S-) terminals on each individual drive according to ***Figure 4.19***.

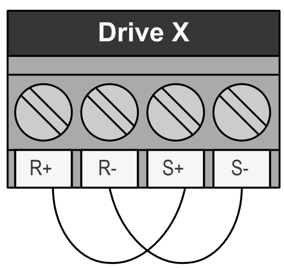


Figure 4.19 Drive Terminal Jumpers

2. Use shielded communication cable for steps 3 and 4 to connect the drives in a daisy chain manner according to ***Figure 4.20***.
3. Daisy chain the (R+ to S+) terminals between each drive.
4. Daisy chain the (R- to S-) terminals between each drive.

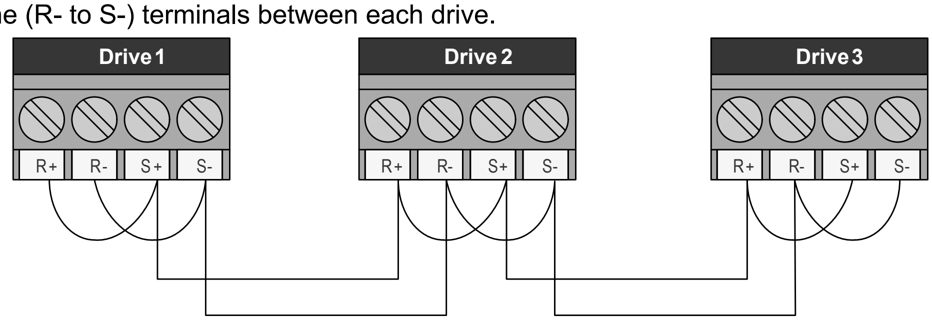


Figure 4.20 Daisy Chain Three Drives

Start-Up Programming & Operation

4

Setting the Drive Networking Parameters

1. 1. Set parameter H5-01, Serial Node Address, on each drive.

Note: For optimal performance, use consecutive numbers starting from 1. Parameter setting H5-01 must be unique for each drive.

2. Set parameter P9-25, Highest Node Address, on each drive.

Note: For optimal performance, set to highest H5-01 value. This setting must be the same for all the drives on the network.

3. Set P1-01 to 3 (MEMOBUS/Modbus Network) on all the drives.
4. Cycle main power to all networked drives.

Note: The H5-01 setting will not take effect until power is cycled to the drive and may cause communication errors and unexpected behavior.

Verifying the iQpump1000 Drive Network Communications

Access monitor U9-02, Network Activity, and verify:

- No drives have a value of 0 <->
- All drives are receiving valid data indicated by a regular change in the monitor value.
- At least one drive has the unit <M>, while the others have the unit <+>.

Table 4.8 Network Connectivity Information

Network State	Top Line on Home Screen (o1-12 = 1)	U9-02 Network Activity
Drive is the Master and is communicating with another drive.	<M> CONNECTED Pump Off Network U5-99= 100.0PSI U1-02= 0.00Hz LSEQ U1-91= 62.8PSI LREF <- MONITOR ->	- MONITR - DRV RDY Network Activity U9-02= 9453<M> U1-02= 0.00Hz LSEQ U1-91= 62.8PSI LREF Home FWD
Drive is a node on the network and is communicating with a Master.	<+> CONNECTED Pump Off Network U5-99= 100.0PSI U1-02= 0.00Hz LSEQ U1-91= 62.8PSI LREF <- MONITOR ->	- MONITR - DRV RDY Network Activity U9-02= 324<+> U1-02= 0.00Hz LSEQ U1-91= 62.8PSI LREF Home FWD
Drive is not able to communicate to any other drives.	<-> DISCONNECTED Pump Off Network U5-99= 100.0PSI U1-02= 0.00Hz LSEQ U1-91= 62.8PSI LREF <- MONITOR ->	- MONITR - DRV RDY Network Activity U9-02= 0<-> U1-02= 0.00Hz LSEQ U1-91= 62.8PSI LREF Home FWD

If a drive displays U9-02 = 0 <->:

- Check physical connections.
- Verify the H5-□□ serial communication settings.
- Confirm the P9-25 and P9-27 settings on all the drives. P9-25 should be set to the highest H5-01 address and at least one drive should have P9-27 set to 0.
- Cycle main power.

Multiplexing Principle

Always observed by system:

- New drives start as Lead and run in PI mode.
- Only the Lead drive can request staging and de-staging.
- Staging will start a new Lead drive and make the old Lead drive into a Lag drive.

- De-staging will stop the current Lead drive and restore the previous drive as the Lead drive.

Drive Run Order

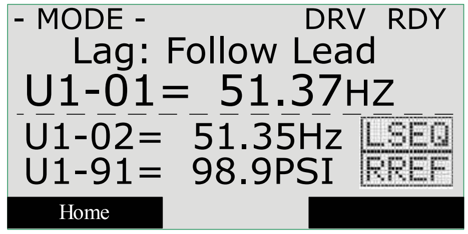
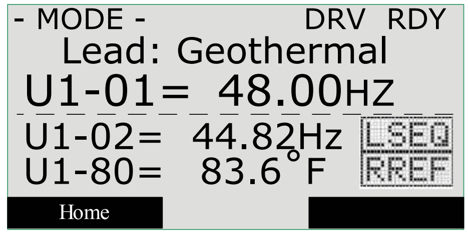
U9-04, Running Queue No:

- Shows the position in the iQpump MEMOBUS running queue.
- Set U9-04 to 0 for pumps that are not running.
- Set U9-04 to 1 on the first pump that came on and is still running.
- Set U9-04 to 2 on the second pump that came on and is still running.
- Set U9-04 to the number of pumps running for the current Lead drive.

Multiplex Status Display

Table 4.9 Multiplex Status Display

Network State	Display
Drive is not able to accept commands from the iQpump MEMOBUS network because the drive is not in AUTO Mode run.	- MODE - DRV RDY Pump Off Network U5-99= 100.0PSI U1-02= 0.00Hz LSEQ U1-91= 62.8PSI RREF Home
Drive is in AUTO Mode and waiting for a run command from the iQpump MEMOBUS network.	- MODE - DRV RDY Wait for Net Cmd U5-99= 100.0PSI U1-02= 0.00Hz LSEQ U1-91= 62.8PSI RREF Home
Drive is in AUTO Mode, Lead operation and is currently regulating the system using PI control.	- MODE - DRV RDY Lead: Setpoint U5-99= 100.0PSI U1-02= 52.38Hz LSEQ U1-91= 62.8PSI RREF Home
Drive is in Auto Mode, Lag operation and is holding the speed at the time it made the switch from being a lead drive to a lag. Speed is held until P9-07 time expires. The Home screen will display U1-01 instead of U5-99.	- MODE - DRV RDY Lag: Fixed Hold U1-01= 59.41HZ U1-02= 59.41Hz LSEQ U1-91= 99.8PSI RREF Home
Drive is in Auto Mode, Lag operation and is running at the speed set in P9-06. The Home Screen will display U1-01 instead of U5-99.	- MODE - DRV RDY Lag: Fixed P9-06 U1-01= 55.00HZ U1-02= 55.00Hz LSEQ U1-91= 99.9PSI RREF Home

Network State	Display
Drive is in AUTO Mode, Lag operation and is following the speed of the current Lead drive. The Home screen will display U1-01 instead of U5-99.	
Drive is in AUTO Mode, Lead operation with Geothermal Enabled. The Home screen will display U1-01 instead of U5-99	

PI Feedback via Network

The Network PI Feedback comes from a drive on the network with a valid analog PI feedback source and can be used as the primary or secondary feedback source for a networked drive.

Set P9-02 to 0 if a drive has an analog PI feedback device installed and switching to network as a backup is not desired.

if a drive has an analog PI feedback device installed and the network PI feedback is considered as a backup, set P9-02 to 1 for no alarm message when switched and set P9-02 to 2 for an alarm.

Set P9-02 to 3 if a drive has no analog PI feedback device installed and relies solely on the analog PI feedback of another networked drive.

Note: Connect an analog PI feedback device to each drive for best performance.

Related Parameters

No.	Parameter Name	Setting Values
H5-01	Drive Node Address	Default: 1F (Hex) Min.: 0 Max.: FF
P1-01	Pump Mode	Default: 0 Range: 0, 1, 3
P9-02	Feedback Source	Default: 0 Range: 0 to 3
P9-25	Highest Node Address	Default: 08h Min.: 02h Max.: 08h
P9-27	Network Recovery	Default: 1 Range: 0 to 3
U9-02	Network Activity	No signal output available
U9-04	Running Queue Number	No signal output available

■ Simple Duplex System Application Example

A customer requires a duplex system with the following capabilities:

- Control the system pressure using two drives (no PLCs).
- Alternate drives everyday to even out the pump wear.
- Toggle switch for Run command.
- Each drive will have its own feedback transducer. Due to the shut-off valves, the network feedback should not be used as a backup.
- Pump is at optimal running speed when running at fixed speed is 54.0 Hz.
- Setpoint is 100 PSI, feedback scale is 145 PSI, start level is 80 PSI.

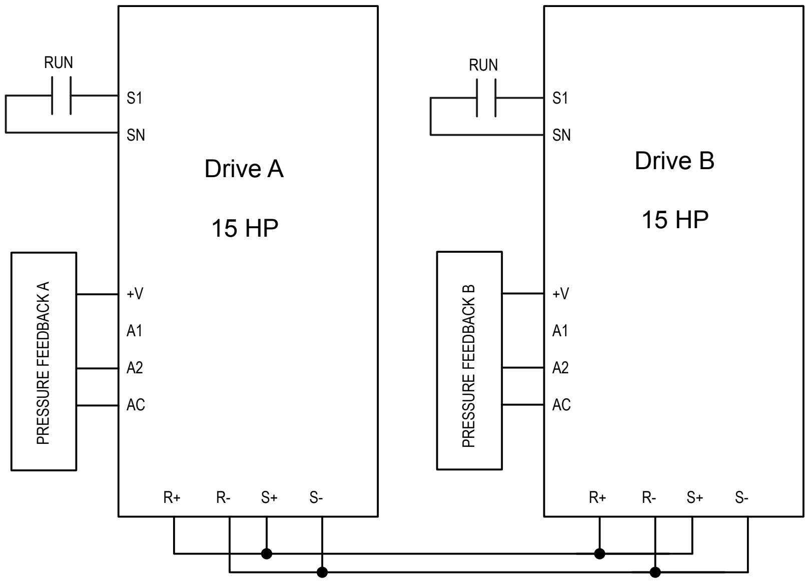


Figure 4.21 Simplified Wiring Diagram

Table 4.10 Related Parameters for Simple Duplex System Example

Description	Drive A <1>	Drive B <1>
Run Source: 1 (Terminals)	b1-02 = 1	b1-02 = 1
Node Address	H5-01 = 1	H5-01 = 2
Highest Node Address	P9-25 = 2	P9-25 = 2
Pump Mode: 3 (Network)	P1-01 = 3	P1-01 = 3
Feedback Source: 0 (Analog)	P9-02 = 0	P9-02 = 0
Lag Fixed Speed	P9-06 = 54.0 Hz	P9-06 = 54.0 Hz
Setpoint	U5-99 = 100 PSI	U5-99 = 100 PSI
Start Level	P1-04 = 80 PSI	P1-04 = 80 PSI

<1> All other multiplexing and alternation parameters are set to default settings.

Duplex System with Fine Tuning Application Example

The customer would like to run the second drive for 10 to 20 seconds at minimum speed then shut it off, letting the first drive run at maximum. This will then run the second drive again and the cycle will repeat. The customer must also account for system losses when running both pumps by boosting the setpoint by 5 PSI. In the event that the pressure exceeds 125 PSI, the second drive should de-stage if both drives are running. If the pressure exceeds 140 PSI, a high feedback fault should occur and stop the drive.

There are multiple methods to handle the pump cycling problem:

- Lower the lag fixed speed (P9-06)
- Decrease the lag fixed speed delay (P9-07)
- Increase the staging frequency level (P9-09)
- Increase the staging delay time (P9-11)
- Increase the de-staging delay time (P9-15)
- Increase the stabilization time (P9-16)

- Increase both the Add Freq Level and Add Dly Time

Table 4.11 Related Parameters for Duplex System with Fine Tuning Application Example

Description	Drive A <1>	Drive B <1>
Run Source: 1 (Terminals)	b1-02 = 1	b1-02 = 1
Node Address	H5-01 = 1	H5-01 = 2
Highest Node Address	P9-25 = 2	P9-25 = 2
Pump Mode: 3 (Network)	P1-01 = 3	P1-01 = 3
Feedback Source: 0 (Analog)	P9-02 = 0	P9-02 = 0
Lag Fixed Speed	P9-06 = 54.0 Hz	P9-06 = 54.0 Hz
Setpoint	U5-99 = 100 PSI	U5-99 = 100 PSI
Start Level	P1-04 = 140 PSI	P1-04 = 140 PSI
High Feedback Quick De-Stage	P9-18 = 89.3%	P9-18 = 89.3%
Setpoint Modifier	P9-17 = 5.0 PSI	P9-17 = 5.0 PSI
Add Drive Frequency Level	P9-09 = 59.0 Hz	P9-09 = 59.0 Hz
Add Drive Delay	P9-11 = 12.0 s	P9-11 = 12.0 s

<1> All other multiplexing and alternation parameters are set to default settings.

Duplex System with Jockey Pump Example

A customer requires a pump system with the following requirements:

- One small pump (the Jockey pump) will run the system during off-peak times.
- Two larger pumps will run the system when the demand is higher.
- The Jockey pump should not run when the two larger pumps are running.
- Pump wear is still an issue, but it is expected that the small pump will run longer hours and will always run first after a loss of power.
- The feedback scale is 145 PSI.
- There is only one feedback transducer in the system.

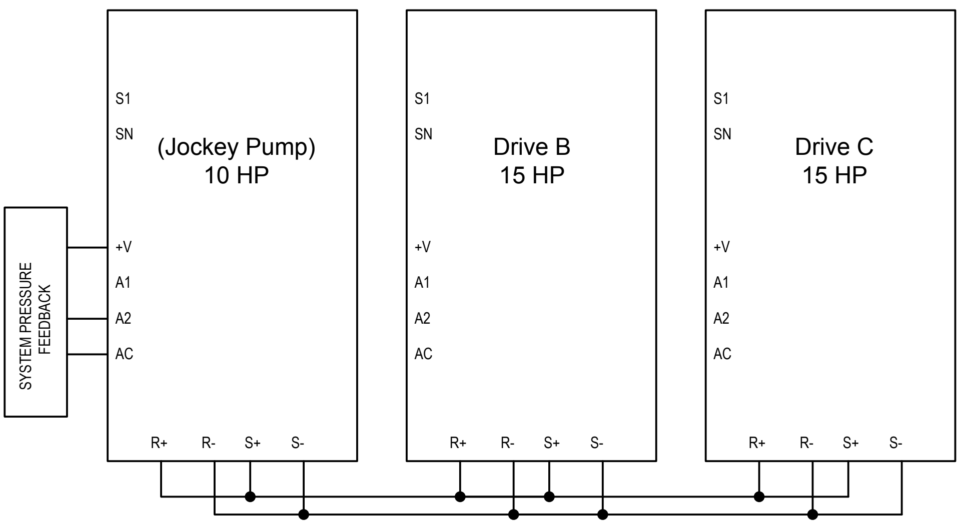


Figure 4.22 Simplified Wiring Diagram

Table 4.12 Related Parameters for Duplex System with Jockey Pump Example

Description	Jockey Pump <1>	Drive B <1>	Drive C <1>
Node Address	H5-01 = 1	H5-01 = 2	H5-01 = 3
Highest Node Address	P9-25 = 3	P9-25 = 3	P9-25 = 3
Pump Mode: 3 (Network)	P1-01 = 3	P1-01 = 3	P1-01 = 3
Feedback Source: 0 (Analog), 3 (Network)	P9-02 = 0	P9-02 = 3	P9-02 = 3
Lag Drive Speed: 0 (Always), 2 (Turn Off)	P9-05 = 2	P9-05 = 0	P9-05 = 0
Allow Net Run: 0 (Always), 2 (First Only)	P9-20 = 2	P9-20 = 0	P9-20 = 0

Description	Jockey Pump <1>	Drive B <1>	Drive C <1>
Run Priority	P9-21 = 7	P9-21 = 8	P9-21 = 8
Lead Swap @ Sleep	P9-24 = 0	P9-24 = 1200 s	P9-24 = 1200 s
Setpoint	U5-99 = 100 PSI	U5-99 = 100 PSI	U5-99 = 100 PSI
Start Level	P1-04 = 80 PSI	P1-04 = 80 PSI	P1-04 = 80 PSI

<1> All other multiplexing and alternation parameters are set to default settings.

Triplex System Example

A customer who currently runs a duplex system would like to retrofit an existing triplex system with the following requirements:

- Three similarly sized pumps would run the system.
- A maximum of two drives should be running at any point; the third drive is a backup.
- Alternation should only happen when pumps are not running (sleeping).
- If one of the analog pressure feedback transducers should fail, read from a working one and notify the customer of the failure by the alarm display.
- Setpoint is 90 PSI, feedback scale is 145 PSI, start level is 75 PSI.

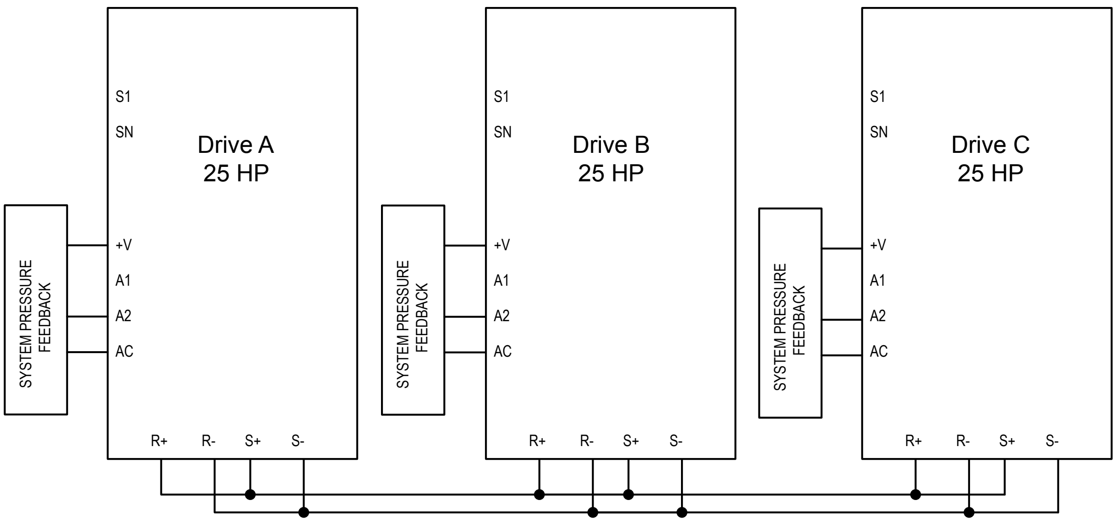


Figure 4.23 Simplified Wiring Diagram

Table 4.13 Related Parameters for Triplex System Example

Description	Drive A <1>	Drive B <1>	Drive C <1>
Node Address	H5-01 = 1	H5-01 = 2	H5-01 = 3
Highest Node Address	P9-25 = 3	P9-25 = 3	P9-25 = 3
Pump Mode: 3 (Network)	P1-01 = 3	P1-01 = 3	P1-01 = 3
Feedback Source: 2 (Analog ->Net, with Alarm)	P9-02 = 2	P9-02 = 2	P9-02 = 2
Alternation Mode: 3 (FIFO @ Sleep)	P9-04 = 3	P9-04 = 3	P9-04 = 3
Maximum Running Pumps	P9-23 = 2	P9-23 = 2	P9-23 = 2
Setpoint	U5-99 = 90 PSI	U5-99 = 90 PSI	U5-99 = 90 PSI
Start Level	P1-04 = 75 PSI	P1-04 = 75 PSI	P1-04 = 75 PSI

<1> All other multiplexing and alternation parameters are set to default settings.

■ Multiplexing Stop History

Many irrigation-pumping skids consist of a PM pump (Pressure Maintenance) and typically two larger booster pumps to maintain high flow peak demands. In many cases depending on the number of irrigation zones in combination with the type of sprinkler heads used, the flow demand fluctuates and may not require the use of both larger booster pumps at the same time until higher flow rates are required. The drive Controller "Run Stop" history ensures that both booster pumps alternate each run cycle.

Table 4.14 P9-01, Lead Drive Selection, Detection Settings

Setting	Description
0	Next Available Select next available drive on the network as the new lead drive
1	Lowest Runtime (default) Select the iQpump Controller with the lowest runtime as the new lead drive
2	Stop History Select the iQpump that had been stopped for the longest time.

Note: The new lead drive selection also applies to Alternation (P9-03 > 0) and will use the Stop History list when finding the alternate.

Triplex Irrigation Booster System Example

When pressure is dropping, the PM Pump (if installed) will attempt to return the system pressure to the desired setpoint level. If the PM Pump is not able to return the system to the setpoint pressure, typically due to a greater flow demand, the booster pump #1 will be staged on.

The drive controller will speed up or slow down the pump as needed to maintain the system pressure. When flow decreases and the pump system is no longer required to run, the system will go to sleep waiting for the pressure to drop. On the next run cycle the PM pump will start up again, and instead of running booster pump #1, booster pump #2 is stages on, since booster #1 ran during the last cycle.

This method ensures that during normal operation both booster pumps will operate evenly as lead or lag pumps each run cycle.

A triplex irrigation booster system has one PM Pump (pressure maintenance) and two larger booster pumps of the same horsepower. The customer would like to ensure that the PM Pump is also the lead pump to recharge the system during low flow usage, but during high demands the booster pumps alternate on each run cycle or if required will both run to support very high flow demands.

- Jockey/PM Pump will also be lead to start.
- Jockey/PM Pump will stage booster pump 1 or 2 and stay running for 20 seconds and then shut off.
- Booster pump 1 will run system and if required, call for booster pump 2 or vice versa.
- On sleep mode, the lead drive for starting will swap back to Jockey/PM Pump.
- System setpoint 100 PSI.
- Pressure drop of 10 PSI will start the Jockey pump.
- All drives have individual transducers rated 200 PSI maximum, but if there is a transducer failure, switch to network.

Triplex Irrigation Booster System Related Parameters

Table 4.15 Related Parameters

Parameter No.	Parameter Name	PM Pump	Booster Pump 1	Booster Pump 2
H5-01	Drive Node Address	1	2	3
P1-01	Pump Mode	3	3	3
P1-03	Feedback Device Scaling	200 PSI	200 PSI	200 PSI
P1-04	Start / Draw Down Level	-10.0 PSI	-10.0 PSI	-10.0 PSI
P9-01	Lead Drive Selection	2	2	2
P9-02	Feedback Source	2	2	2
P9-07	Lag Fixed Speed Delay	20 s	5 s	5 s
P9-20	Allow Network Run	2	0	0
P9-21	Run Priority	7	8	8
P9-24	Lead Swap at Sleep	0 s	1 s	1 s
P9-25	Highest Node Address	3	3	3
U5-99	PID Setpoint Command	100 PSI	100 PSI	100 PSI

4.6 Basic iQpump Setup and Application Preset Parameters

This section explains the basic settings required for initial drive operation. Checking these basic parameter settings will help to ensure a successful drive start-up. *Refer to Parameter List on page 255* for a complete listing of drive parameters if more information is required for parameters not listed in this section.

■ 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 3	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 digital operator.

Setting 2: Advanced Access Level (A) and Setup Access Level (S)

All parameters can be viewed and edited.

Setting 3: Lock Parameters

Notes on Parameter Access

- If the drive parameters are password protected by A1-04 and A1-05, parameters A1-00 through A1-03, A1-06, 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 digital operator until an Enter command is issued to the drive from the serial communication.

■ A1-03: Initialize Parameters

Resets parameters to default values or performs an Application Preset for fan or pump applications. 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, 5550, 6008, 6009, 6010, 6011, 7770	0

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.

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* for more information on digital input functions.

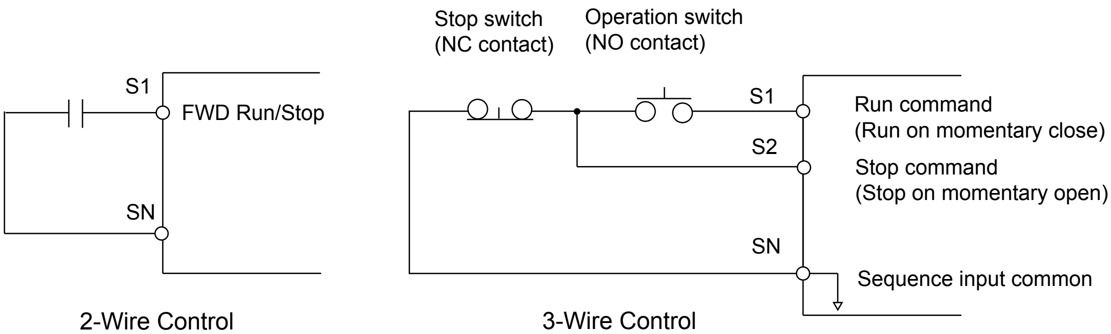


Figure 4.24 2 & 3-Wire Control Wiring Examples

Notes on Parameter Initialization

The parameters shown in *Table 4.16* will not be reset when the drive is initialized by setting A1-03 = 2220 or 3330.

Table 4.16 Parameters Not Changed by Drive Initialization

No.	Parameter Name
A1-00	Language Selection
E1-03	V/f Pattern Selection
F6-08	Communication Parameter Reset
L8-35	Installation Selection
o2-04	Drive/kVA Selection

Setting 5550: Terminal/Control Initialize

An oPE04 error appears on the digital operator when a terminal block with settings saved to its built-in memory is installed in a drive that has edited parameters. Set A1-03 to 5550 to use the parameter settings saved to the terminal block memory.

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.

Refer to Pump Application Presets on page 118 for detailed information on Application Presets.

Setting 6008: Pressure Control

Application Preset for Pressure Control applications. *Refer to Pump Application Presets on page 118* for a list of parameters and default values for this Application Preset.

Setting 6009: Pump Down Level

Application Preset for Pump Down Level applications. *Refer to Pump Application Presets on page 118* for a list of parameters and default values for this Application Preset.

Setting 6010: Geothermal Mode

Application Preset for Geothermal Mode. *Refer to Pump Application Presets on page 118* for a list of parameters and default values for this Application Preset.

Setting 6011: VTC Pressure Mode

Application Preset for VTC Pressure Mode. *Refer to Pump Application Presets on page 118* for a list of parameters and default values for this Application Preset.

Setting 7770: General Purpose

General Purpose Application Preset. *Refer to Pump Application Presets on page 118* for a list of parameters and default values for this Application Preset.

■ b1-01: Frequency Reference Selection 1

Selects the frequency reference source 1 for the REMOTE mode.

Note: If a Run command is input to the drive but the frequency reference entered is 0 or below the minimum frequency, the RUN indicator LED on the digital operator will light and the STOP indicator will flash.

No.	Parameter Name	Setting Range	Default
b1-01	Frequency Reference Selection 1	0 to 5	0

In order to run the drive and motor, the drive must receive a Run command and an Auto Setpoint command. Parameter b1-01 specifies the origin of the Auto setpoint when in AUTO Mode. Switch to AUTO mode by pressing the AUTO button on the HOA keypad while the drive is stopped.

Note: If a Run command is input to the drive without a corresponding Auto setpoint, the Run indicator on the HOA keypad will turn on and the STOP indicator on the keypad will blink.

If the drive should follow the "HAND Reference" set by the HOA keypad, use HAND Mode by pressing the HAND key and set P5-01 to "1: Hand Reference (P5-02)." The HAND reference can then be entered into the U1-01 monitor parameter in the "-DRIVE- " Menu.

The drive offers the ability to provide four types of "Auto Setpoint" reference sources. These Auto Setpoint reference sources are determined by the setting of b1-01 and the drive set to AUTO Mode by pressing the AUTO key on the keypad.

Prior to programming, it is recommended to select the system units (P1-02) and the feedback device, Scaling (P1- 03) first. P1-03 will automatically scale the drive setpoint.

Example: P1-02 = 1: PSI

P1-03 = 200, feedback range = 200 PSI.

If the drive should follow an "Auto Set-Point" set by the HOA keypad: Set b1-01 to "0: Operator" (factory default). The Auto setpoint can then be entered into the U1-01 monitor parameter in the "-DRIVE-" menu.

Setting 0: Operator (HOA keypad)

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

- switching between the multi-speed references in the d1-☐☐ parameters.
- entering the frequency reference on the operator keypad.

This selection will also switch PID setpoint to Q1-01.

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, A2, or A3.

To set the drive to follow an "Auto Setpoint" set by the analog input, set b1-01 to 1 (Terminals) and connect a potentiometer or external signal to the drive.

Note: When b1-01 is set to 1 (Terminals) and P5-01 is set to 0 (HAND Mode Reference), the setpoint and the HAND reference are determined by the external analog signal.

Voltage Input

Voltage input can be used at any of the three analog input terminals. Make the settings as described in *Table 4.17* for the input used.

Table 4.17 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 Vdc	H3-01 = 0	H3-02 = 0 (Frequency Reference Bias)	H3-03	H3-04	–
	0 to 10 Vdc Bipolar	H3-01 = 1				
A2	0 to 10 Vdc	H3-09 = 0	H3-10 = 0 (Frequency Reference Bias)	H3-11	H3-12	Set jumper S1 on the terminal board to "V" for voltage input.
	0 to 10 Vdc Bipolar	H3-09 = 1				
A3	0 to 10 Vdc	H3-05 = 0	H3-06 = 0 (Frequency Reference Bias)	H3-07	H3-08	Set DIP switch S4 on the terminal board to "AI".
	0 to 10 Vdc Bipolar	H3-05 = 1				

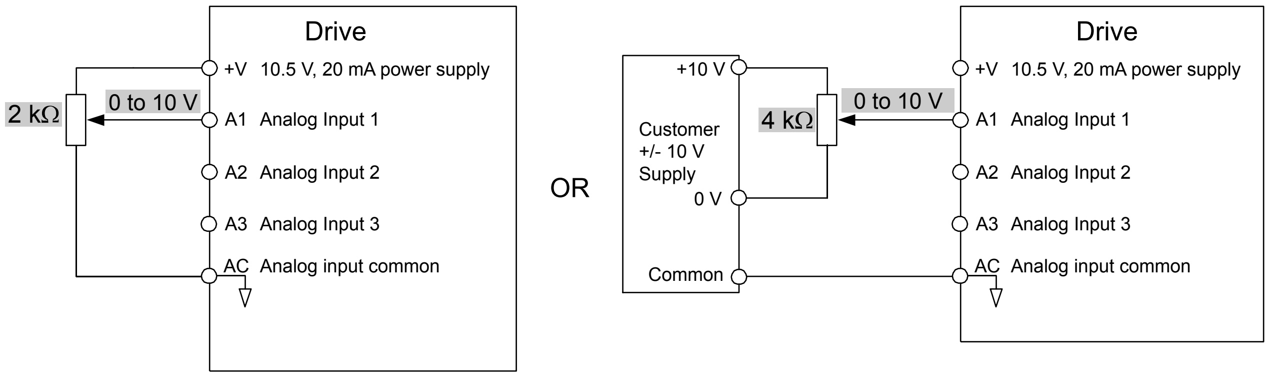


Figure 4.25 Setting the Frequency Reference as a Voltage Signal at Terminal A1

Current Input

Input terminals, A1, A2, and A3 can accept a current input signal. Refer to ***Table 4.18*** for an example to set terminal A2 for current input.

Table 4.18 Analog Input Settings for Frequency Reference Using a Current Signal

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

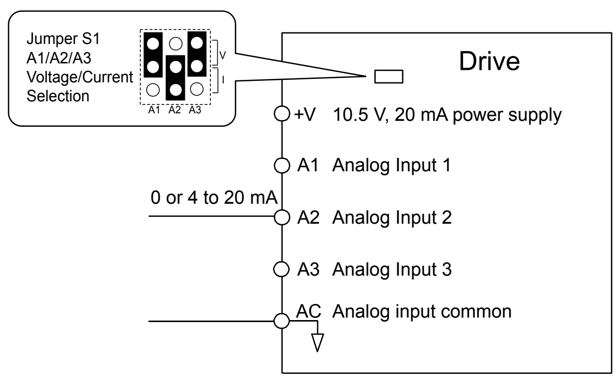


Figure 4.26 Setting the Frequency Reference as a Current Signal to Terminal A2

Switching between Main/Auxiliary Frequency References

The frequency reference input can be switched between the analog terminals A1, A2, and A3 using multi-speed inputs. To use several speed references for a multi-step speed sequence, set the H1-oo parameters to 3, 4, 5, and 32. To assign the Jog reference to a digital input, set H1-□□ to 6.

Setting 2: Serial Communications

This setting requires entering the frequency reference via the RS-485/422 serial communications port (control terminals R+, R-, S+, S-).

To setup the drive to receive the “Auto Setpoint” from serial communication, set b1-01 to “2: Serial Com,” and connect the RS-422/RS-485 serial communications cable to terminals R+, R-, S+, and S- on the control I/O terminal block. Refer to ***153*** to see the connection diagram using a PC to provide the auto setpoint reference to the drive.

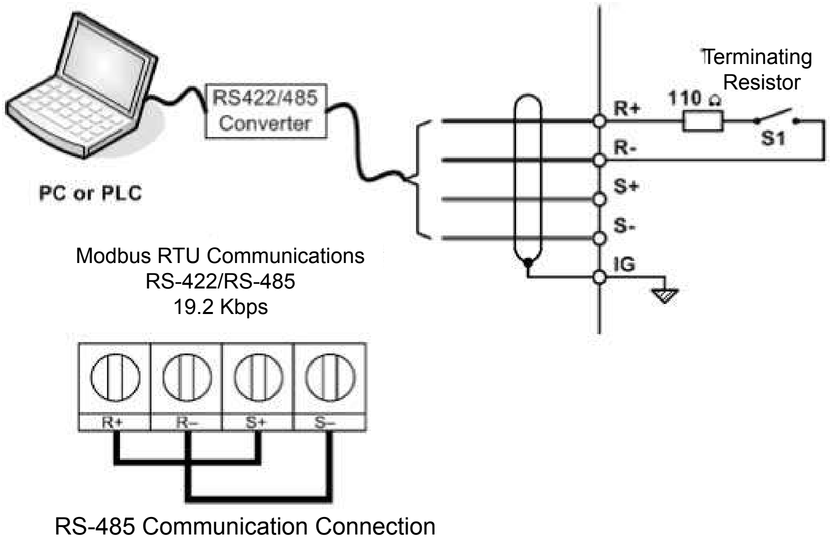


Figure 4.27 PC or PLC Connection Diagram

Setting 3: Option card

This setting requires entering the frequency reference via an option board plugged into connector CN5-A on the drive control board. Consult the option board 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 Operator Programming Error will be displayed on the digital operator and the drive will not run.

To setup the drive to receive the "Auto Setpoint" for a network communication option card, set b1-01 to "3: Option PCB", and plug a supported communication option card into the drive control PCB. Consult the manual supplied with the option for instructions on integrating the drive into the network system.

Refer to Option Installation on page 228 for a list of available drive network communication options.

Setting 4: Pulse Train Input

This setting requires a pulse train signal to terminal RP to provide the frequency reference. Follow the directions below to verify that the pulse signal is working properly.

Verifying the Pulse Train is Working Properly

- Set b1-04 to 4 and set H6-01 to 0.
- Set the H6-02 to the pulse train frequency value that equals 100% of the frequency reference.
- Enter a pulse train signal to terminal RP and check for the correct frequency reference on the display.

Setting 5: Geothermal Mode

Refer to Geothermal Mode Application Preset on page 122 for details on how to use this function.

■ b1-02: Run Command Selection 1

Determines the Run command source 1 in AUTO Mode.

The drive comes factory programmed for Start and Stop from the keypad, but the user can program the drive to receive a Run command from four different inputs: digital operator, terminals, serial communications, or an option PCB.

To set the drive to receive the Run command from the HOA keypad, set b1-02 to "0: Operator," and the HAND key will be used to provide the Run command to the drive.

To set the drive to receive the Run command from the external terminals, set b1-02 to "1: Terminals" and initiate an external Run command by a contact closure between terminals S1 and SN.

Note: Using the external terminals requires setting the drive to AUTO Mode by pressing the AUTO key.

No.	Parameter Name	Setting Range	Default
b1-02	Run Command Selection 1	0 to 3	0

Setting 0: Operator (HOA keypad)

This setting requires entering the Run command via the HOA keypad AUTO key and also illuminates the HAND indicator on the digital operator.

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.
- 2-Wire sequence 2:

  Two inputs (Start/Stop-FWD/REV).
- 3-Wire sequence:

  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*** .

Setting 2: MEMOBUS/Modbus Communications

This setting requires entering the Run command via serial communications by connecting the RS-485/422 serial communication cable to control terminals R+, R-, S+, and S- on the removable terminal block.

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-A port on the control PCB. Refer to the option board manual for instructions on integrating the drive into the communication system.

Note: If b1-02 is set to 3, but an option board is not installed in CN5-A, an oPE05 operator programming error will be displayed on the digital operator 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	0

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, Zero Speed Control, or Short Circuit Braking.

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.

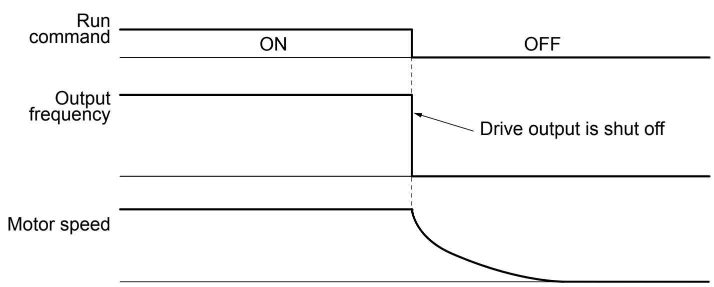


Figure 4.28 Coast to Stop

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: DC Injection Braking and Short Circuit Braking on page 258***) or Speed Search (***Refer to b3: Speed Search on page 259***) 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 Injection Braking is 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.

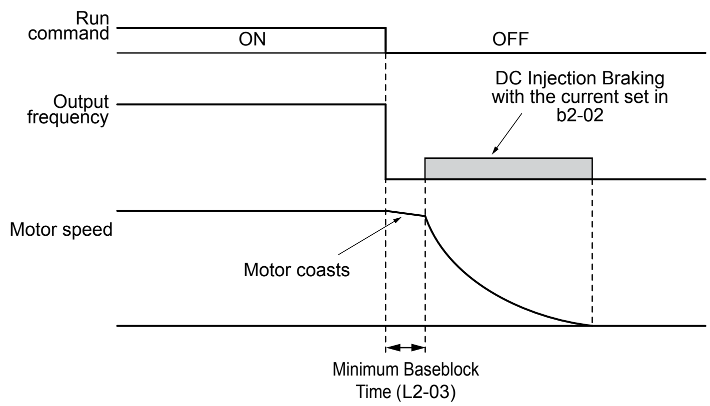


Figure 4.29 DC Injection Braking to Stop

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:

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

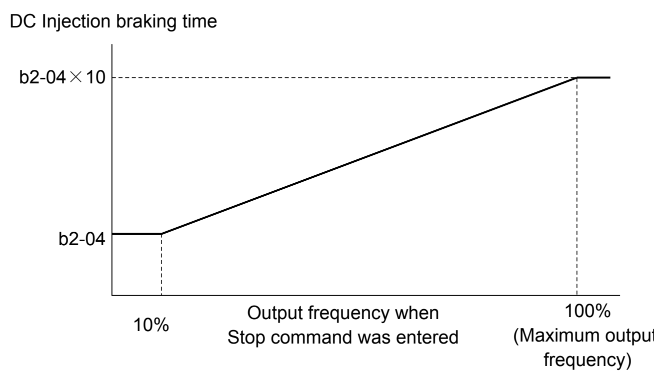


Figure 4.30 DC Injection Braking Time Depending on Output Frequency

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 to Stop with Timer (Used for Back Spin Control on Vertical Turbine Pumps)

When the Run command is removed, the drive coasts to a stop. If parameter b1-11 is set to zero, the coast-timer becomes a value determined by a combination of output frequency and the C1-02 parameter. However, if b1-11 is set greater than zero, the coast timer is set to b1-11. If the Run command is re-issued during the coast-timer time, the drive WILL restart when the coast-timer expires without the need to re-cycle the run command. The coast-timer will operate for both AUTO Mode and HAND Mode. The coast-timer will still operate when the drive goes to sleep then wakes up.

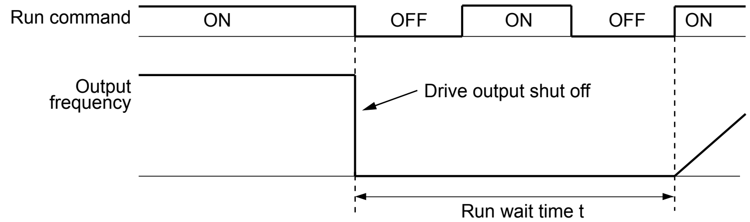


Figure 4.31 Coast to Stop with Timer

Start-Up Programming & Operation
4

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

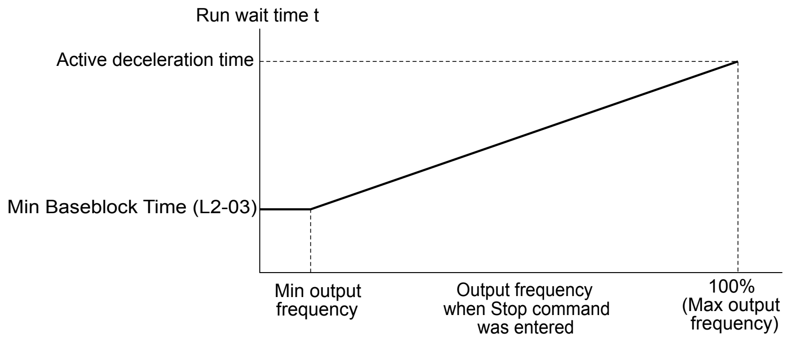


Figure 4.32 Run Wait Time Depending on Output Frequency

■ 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	0

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.

■ b5-01: PID Function Setting

Enables and disables the PID operation and selects the PID operation mode.

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

Setting 0: PID disabled

Setting 1: Output frequency = PID output 1

The PID controller is enabled and the PID output builds the frequency reference. The PID input is D controlled.

■ b5-03: Integral Time Setting (I)

Sets the time constant used to calculate the integral of the PID 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	1.0 s

■ b5-09: PID Output Level Selection

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

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

Setting 0: Normal Output

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

Setting 1: Reverse Output

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

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

When parameter b5-20 is set to 3, parameters b5-38 and b5-39 set a user-defined display for the PID setpoint (b5-19) and PID 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	PID Setpoint User Display	1 to 60000	Determined by b5-20
b5-39	PID Setpoint Display Digits	0 to 3	Determined by b5-20

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

Two 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	0.0 to 6000.0 s <1>	20.0 s
C1-02	Deceleration Time 1		10.0 s
C1-03	Acceleration Time 2		
C1-04	Deceleration Time 2		

<1> The setting range for the acceleration and deceleration times is determined by the accel/decel time setting units in C1-10. For example, if the time is set in units of 0.01 s (C1-10 = 0), the setting range becomes 0.00 to 600.00 s.

Switching Acceleration Times by Digital Input

Accel/decel time 1 is active by default if no input is set. Activate accel/decel times 2, 3, and 4 by digital inputs (H1-□□ = 7 and 1A) as explained in *Table 4.19*.

Table 4.19 Accel/Decel Time Selection by Digital Input

Accel/Decel Time Sel. 1 H1-□□ = 7	Accel/Decel Time Sel. 2 H1-□□ = 1A	Active Times	
		Acceleration	Deceleration
0	0	C1-01	C1-02
1	0	C1-03	C1-04

Figure 4.33 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).

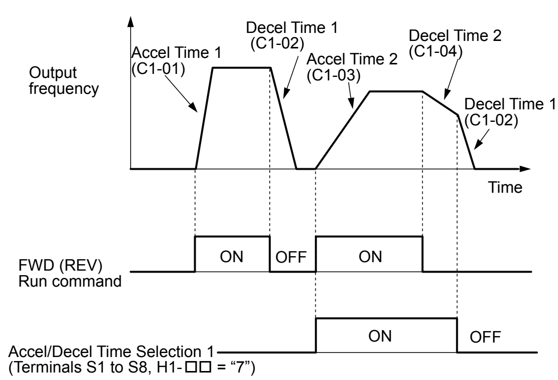


Figure 4.33 Timing Diagram of Accel/Decel Time Change

■ 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. If Auto-Tuning completes successfully, the value entered to T1-04 will automatically be saved to E2-01.

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, and one decimal place (0.1 A) if the maximum applicable motor capacity is higher than 11 kW. ***Refer to Power Ratings on page 234*** for details.

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.

■ E2-04: 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	2

■ H1-01 to H1-08: Functions for Terminals S1 to S8

These parameters assign functions to the multi-function digital inputs. The various functions and settings are listed in ***Table 4.20***.

No.	Parameter Name	Setting Range	Default
H1-01	Multi-Function Digital Input Terminal S1 Function Selection	1 to 9F	40 (F) <1> : Forward Run Command (2-Wire sequence)
H1-02	Multi-Function Digital Input Terminal S2 Function Selection	1 to 9F	F: Through Mode
H1-03	Multi-Function Digital Input Terminal S3 Function Selection	0 to 9F	26: External Pump Fault
H1-04	Multi-Function Digital Input Terminal S4 Function Selection	0 to 9F	14: Fault Reset
H1-05	Multi-Function Digital Input Terminal S5 Function Selection	0 to 9F	8D (0) <1> : Multi Setpoint 1
H1-06	Multi-Function Digital Input Terminal S6 Function Selection	0 to 9F	80 (3) <1> : HAND Mode
H1-07	Multi-Function Digital Input Terminal S7 Function Selection	0 to 9F	81 (4) <1> : HAND Mode 2
H1-08	Multi-Function Digital Input Terminal S8 Function Selection	0 to 9F	F (6) <1> : Through Mode

<1> Number appearing in parenthesis is the default value after performing a 3-Wire initialization (A1-03 = 3330).

Table 4.20 Multi-Function Digital Input Terminal Settings

Setting	Function	Page
0	3-Wire sequence	–
3	Multi-Step Speed Reference 1	–
4	Multi-Step Speed Reference 2	–
5	Multi-Step Speed Reference 3	–
6	Jog reference selection	–
7	Accel/decel time selection 1	–
8	Baseblock command (N.O.)	–
9	Baseblock command (N.C.)	–
A	Accel/decel ramp hold	–
B	Drive overheat alarm (oH2)	–
C	Analog terminal input selection	–
F	Through mode	–
10	Up command	–
11	Down command	–
12	Forward Jog	–
13	Reverse Jog	–
14	Fault reset	–
15	Fast Stop (N.O.)	–
17	Fast Stop (N.C.)	–
18	Timer function input	–
19	PID disable	–
1A	Accel/decel time selection 2	–
1B	Program lockout	–
1E	Reference sample hold	–
20 to 2F	Ext. pump fault	–
30	PID integral reset	–
31	PID integral hold	–
32	Multi-Step Speed Reference 4	–
34	PID soft starter cancel	–
35	PID input level selection	–
40	Forward run command (2-Wire sequence)	–
41	Reverse run command (2-Wire sequence)	–
42	Run command (2-Wire sequence 2)	–
43	FWD/REV command (2-Wire sequence 2)	–
47	Node setup	–
51	Sequence Timer Disable	–
52	Sequence Timer Cancel	–
60	DC Injection Braking command	–

Setting	Function	Page
61	External Speed Search command 1	–
62	External Speed Search command 2	–
63	Field weakening	–
65	KEB Ride-Thru 1 (N.C.)	–
66	KEB Ride-Thru 1 (N.O.)	–
67	Communications test mode	–
68	High Slip Braking (HSB)	–
6A	Drive enable	–
73	Low City Press	–
75	Up 2 command	–
76	Down 2 command	–
7A	KEB Ride-Thru 2 (N.C.)	–
7B	KEB Ride-Thru 2 (N.O.)	–
80	HAND Mode	–
81	HAND Mode 2	–
88	Volute-Thermostat Normally Open	
89	Volute-Thermostat Normally Closed	
8C	Disable Pre-Charge	–
8D	Multi Setpoint 1	–
8E	Multi Setpoint 2	–
8F	Low Water Level	–
90	High Water Level	–
92	Reset Accum	–
95	Remove Drive Disable	–
A8	Secondary PI Disable (N.O.)	–
A9	Secondary PI Disable (N.C.)	–
AA	Secondary PI Inverse Operation	–
AB	Secondary PI Integral Reset	–
AC	Secondary PI Integral Hold	–
AD	Select Secondary PI Parameters	–
AF	Emergency Override Forward Run	–
B0	Emergency Override Reverse Run	–

■ H2-01 to H2-03: Terminal M1-M2, M3-M4, and MD-ME-MF Function Selection

The drive has three multi-function output terminals. *Table 4.21* 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 192	37: During Frequency Output
H2-02	Terminal M3-M4 Function Selection (relay)	0 to 192	F: Through Mode
H2-03	Terminal MD-ME-MF Function Selection (relay)	0 to 192	E: Fault

Table 4.21 Multi-Function Digital Output Terminal Settings

Setting	Function	Page
0	During run	–
1	Zero speed	–
2	Speed agree 1	–
3	User-set speed agree 1	–
4	Frequency detection 1	–
5	Frequency detection 2	–
6	Drive ready	–
7	DC bus undervoltage	–
8	During baseblock (N.O.)	–
9	Frequency reference source	–
A	Run command source	–
B	Torque detection 1 (N.O.)	–
C	Frequency reference loss	–
D	Braking resistor fault	–
E	Fault	–
F	Through mode	–
10	Minor fault	–
11	Fault reset command active	–
12	Timer output	–
13	Speed agree 2	–
14	User-set speed agree 2	–
15	Frequency detection 3	–
16	Frequency detection 4	–
17	Torque detection 1 (N.C.)	–
18	Torque detection 2 (N.O.)	
19	Torque detection 2 (N.C.)	–
1A	During reverse	–
1B	During baseblock (N.C.)	–
1E	Restart enabled	–
1F	Motor overload alarm (oL1)	–
20	Drive overheat pre-alarm (oH)	–
22	Mechanical weakening detection	–
2F	Maintenance period	–
30	During torque limit	–
37	During frequency output	–
38	Drive enabled	–
39	Watt hour pulse output	–
3C	LOCAL/REMOTE status	–
3D	During speed search	–
3E	PID feedback low	–
3F	PID feedback high	–
4A	During KEB Ride-Thru	–
4C	During fast stop	–
4D	oH Pre-alarm time limit	–
4E	Braking transistor fault (rr)	–
4F	Braking resistor overheat (oH)	–

Setting	Function	Page
50	Waiting to Run	–
51	Sequence timer 1 SeqTimer Disable	–
52	Sequence timer 2 SeqTimer Cancel	–
53	Sequence timer 3 Sequence timer 3	–
54	Sequence timer 4 Sequence Timer 4	–
58	Underload detection UL6	–
60	Internal cooling fan alarm	–
71	Secondary PI Feedback Low PI2 Feedback Low	–
72	Secondary PI Feedback High PI2 FeedbackHigh	–
73	Low City Press	–
80	Pump 2 Control	–
81	Pump 3 Control	–
82	Pump 4 Control	–
83	Pump 5 Control	–
84	Pump 6 Control	–
89	Output 1 Limit	–
8B	Lube Pump	–

Setting	Function	Page
91	Pump Fault	–
92	Transducer Loss	–
93	Setptoint Not Met	–
94	Loss of Prime	–
95	Volute Thermostat Fault	
96	High Feedback	–
97	Low Feedback	–
98	Low Flow	–
99	Accum Level	–
9A	High Flow	–
9B	Low Water Level	–
9C	Low Suction	–
9D	High Suction	–
A2	Sleep Active	–
A3	Start Delay	–
A4	Pre-Charge	–
A5	Anti-Jam Active	–
A9	Thrust Mode	–
AA	Utility Start Delay	–
100 to 1AA	Function 0 to AA with inverse output	–

Setting 30: During Torque Limit

The output closes when the motor is operating at the torque limit specified by the L7-☐☐ parameters or an analog input. This setting can only be used in OLV control mode.

■ H3-01: Terminal A1 Signal Level Selection

Selects the input signal level for analog input A1.

No.	Name	Setting Range	Default
H3-01	Terminal A1 Signal Level Selection	0 to 3	0

Setting 0: 0 to 10 Vdc

The input level is 0 to 10 Vdc. 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 Vdc Bipolar

The input level is -10 to 10 Vdc. 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

Setting 3: 0 to 20 mA

■ H3-02: Terminal A1 Function Selection

Selects the input signal level for analog input A3.

No.	Name	Setting Range	Default
H3-02	Terminal A1 Function Selection	0 to 32	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 input at terminal A1 (gain).

Parameter H3-04 sets the level of the selected input value that is equal to 0 V 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.

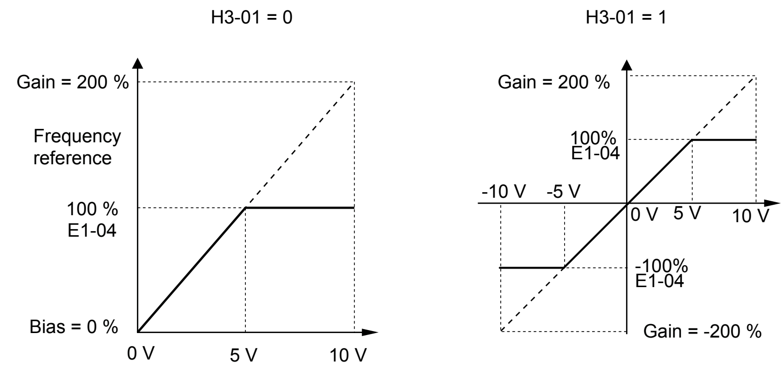


Figure 4.34 Frequency Reference Setting by Analog Input with Increased Gain

- 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.

  When parameter H3-01 = 1, the motor will rotate in reverse between -10 and 2 Vdc input.

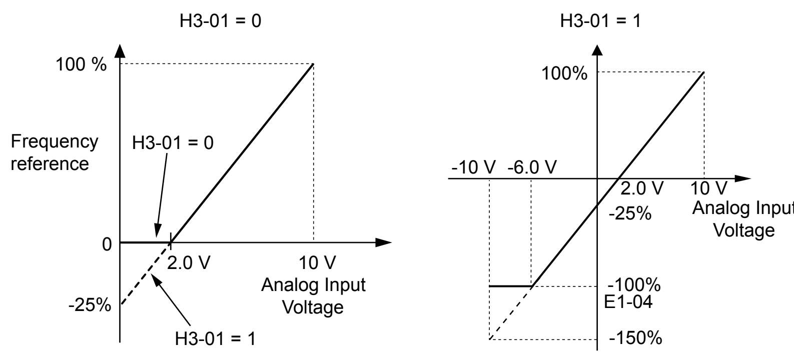


Figure 4.35 Frequency Reference Setting by Analog Input with Negative Bias

■ H3-05: Terminal A3 Signal Level Selection

Determines the function assigned to analog input terminal A3.

No.	Name	Setting Range	Default
H3-05	Terminal A3 Signal Level Selection	0 to 3	0

Setting 0: 0 to 10 Vdc

The input level is 0 to 10 Vdc. See the explanation provided for H3-01. *Refer to Setting 0: 0 to 10 Vdc on page 160*.

Setting 1: 0 to 10 Vdc Bipolar

The input level is -10 to 10 Vdc. See the explanation provided for H3-01. *Refer to Setting 1: 0 to 10 Vdc Bipolar on page 160*.

Setting 2: 4 to 20 mA

Setting 3: 0 to 20 mA

■ H3-06: Terminal A3 Function Selection

Determines the function assigned to analog input terminal A3.

No.	Name	Setting Range	Default
H3-06	Terminal A3 Function Selection	0 to 31	20

■ H3-07, H3-08: Terminal A3 Gain and Bias Setting

Parameter H3-07 sets the level of the selected input value that is equal to 10 Vdc input at terminal A3 (gain).

Parameter H3-08 sets the level of the selected input value that is equal to 0 V input at terminal A3 (bias).

No.	Name	Setting Range	Default
H3-07	Terminal A3 Gain Setting	-999.9 to 999.9%	100.0%
H3-08	Terminal A3 Bias Setting	-999.9 to 999.9%	0.0%

■ 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 Vdc

The input level is 0 to 10 Vdc. ***Refer to Setting 0: 0 to 10 Vdc on page 160***.

Setting 1: 0 to 10 Vdc Bipolar

The input level is -10 to 10 Vdc. ***Refer to Setting 1: 0 to 10 Vdc Bipolar on page 160***.

Setting 2: 4 to 20 mA

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

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.

No.	Name	Setting Range	Default
H3-10	Terminal A2 Function Selection	0 to 32	B

■ 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%

■ 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 U1: Operation Status Monitors on page 326*** 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 999	102
H4-04	Multi-Function Analog Output Terminal AM Monitor Selection	000 to 999	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 4.36* 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

The output signal is adjustable while the drive is stopped.

Terminal FM

1. View the value set to H4-02 (Terminal FM Monitor Gain) on the digital operator. A voltage equal to 100% of the parameter being set in H4-01 will be output from terminal FM.
2. Adjust H4-02 viewing the monitor connected to the terminal FM.
3. View the value set to H4-03 on the digital operator; terminal FM will output a voltage equal to 0% of the parameter being set in H4-01.
4. Adjust H4-03 viewing the output signal on the terminal FM.

Terminal AM

1. View the value set to H4-05 (Terminal AM Monitor Gain) on the digital operator. A voltage equal to 100% of the parameter being set in H4-04 will be output from terminal AM.
2. Adjust H4-05 viewing the monitor connected to the terminal AM.
3. View the value set to H4-06 on the digital operator; terminal AM will output a voltage equal to 0% of the parameter being set in H4-04.
4. Adjust H4-06 viewing the output signal on the terminal AM.

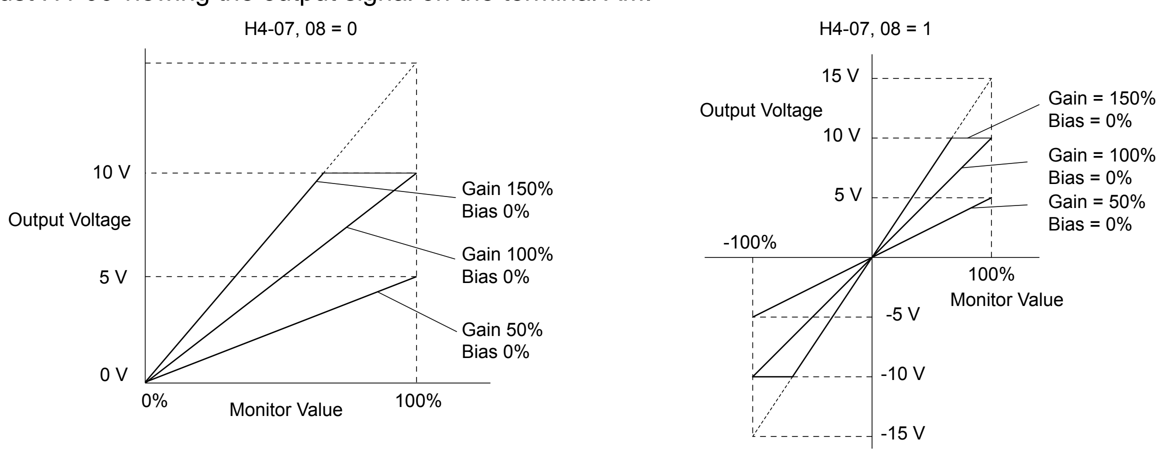


Figure 4.36 Analog Output Gain and Bias Setting Example 1 and 2

Set H4-03 to 30% for an output signal of 3 V at terminal FM when the monitored value is at 0%.

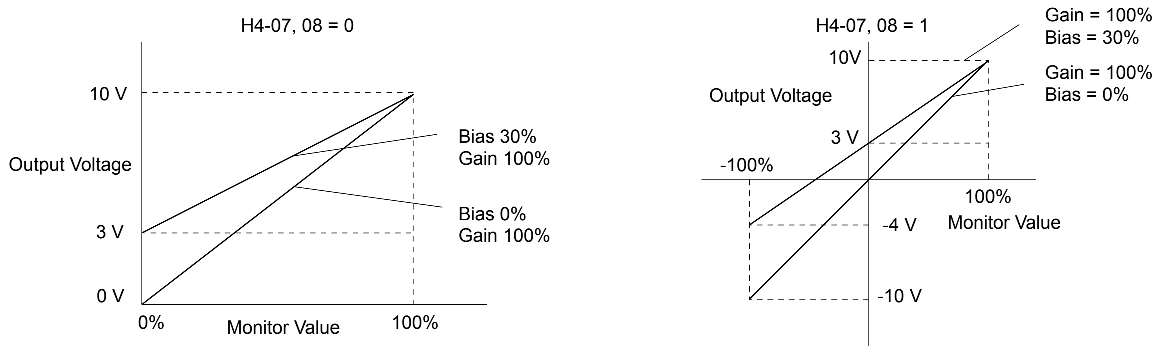


Figure 4.37 Analog Output Gain and Bias Setting Example 3

■ 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.

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

■ L5-01: Number of Auto Restart Attempts

Sets the number of times that the drive may attempt to restart itself.

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	5 Times

■ 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

■ o1-08: Third Line User Monitor Selection

Selects the monitor that is shown in the third line. Effective only when o1-06 is set to 1.

Enter the last three digits of the monitor parameter number to be displayed: U□-□□. For example, set “403” to display monitor parameter U4-03.

No.	Name	Setting Range	Default
o1-07	Second Line User Monitor Selection	101 to 799	103

■ P1-01: Pump Mode

Selects the base operation mode of the drive controller.

No.	Parameter Name	Setting Range	Default
P1-01	Pump Mode	0, 1, 3	0

Setting 0: Drive only

Designed for single pump stand-alone applications

Setting 1: Contactor lag

Contactor Lag systems multiplex a main pump with up to 5 lag pumps. The drive will stage and de-stage the lag pumps based on system demand by using its digital output contacts to control the lag pump motor starters

Setting 3: MEMOBUS network

Up to eight drives can be networked together as a coordinated system to provide for system redundancy and precise control.

■ P1-02: System Units

Selects the base unit in which most drive PID setpoints, scaling, monitors, limits, and faults/alarm levels will be set.

Note: Set this parameter prior to changing other parameters, as internal scaling is based on P1-02.

No.	Parameter Name	Setting Range	Default
P1-02	System Units	0 to 10; 25	1

Setting 0: No unit

Setting 1: PSI: Pounds per square inch

Setting 2: Pa: Pascals

Setting 3: Bar: Bar

Setting 4: "WC: Inch of water

Setting 5: "Hg: Inch of Mercury

Setting 6: ft: feet

Setting 7: m: meters

Setting 8: °F: Degrees Fahrenheit

Setting 9: °C: Degrees Celsius

Setting 10: Percent

Setting 25: Flow (Use P6-04)

■ P1-03: Feedback Device Scaling

Sets the feedback device scaling used for the PID controller. This information can be found on the nameplate or specification sheet and is usually expressed as the maximum output of the device.

For example, a pressure sensor scaling might be 145.0 PSI at 20 mA output and would require setting P1-03 to 145.0 PSI.

Note: Set this parameter prior to changing other parameters related to the PID feedback, as internal scaling is based on P1-03.

No.	Parameter Name	Setting Range	Default
P1-03	Feedback Device Scaling	0.1 to 6000.0	145.0 PSI

■ P1-04: Start / Draw Down Level

Sets the wake up level from the Sleep function. This setting is dependent on whether PID is normal or inverse acting (b5-09). When the drive is asleep and the PID feedback signal rises above (normal acting) or falls below (inverse acting) this setting for the time set in P1-05, Start Level Delay Time, the drive will wake up.

No.	Parameter Name	Setting Range	Default
P1-04	Start / Draw Down Level	-999.9 to 999.9	0.0

■ P1-05: Start Level Delay Time

Sets the delay time for waking the drive to prevent accidental wake up caused by erratic feedback.

No.	Parameter Name	Setting Range	Default
P1-05	Start Level Delay Time	0 to 3600	1 s

■ P1-06: Minimum Pump Speed

Sets the minimum speed at which the drive will run the pump. Most pumps cannot run at low speeds due to cavitation, so be sure to consult the pump specification sheet for the minimum safe run speed.

No.	Parameter Name	Setting Range	Default
P1-06	Minimum Pump Speed	0.0 to E1-04	40.0 Hz

■ P1-08: Low Feedback Level

Sets the level at which a Low Feedback alarm or fault will occur. When the PID feedback falls below the P1-08 setting for the time set in P1-09, the drive will respond based on the setting in P1-10.

No.	Parameter Name	Setting Range	Default
P1-08	Low Feedback Level	0.0 to 6000.0	0.0 PSI

■ P1-09: Low Feedback Level Fault Delay Time

Sets the delay time after which a Low Feedback alarm or fault will occur. When the PID feedback falls below the P1-08 setting for the time set in P1-09, the drive will respond based on the setting in P1-10.

No.	Parameter Name	Setting Range	Default
P1-09	Low Feedback Level Fault Delay Time	0 to 3600	10 s

■ P1-10: Low Feedback Selection

Selects the drive response to a Low Feedback condition. When the PID feedback falls below the P1-08 setting for the time set in P1-09, the drive will respond based on the setting in P1-10.

No.	Parameter Name	Setting Range	Default
P1-10	Low Feedback Selection	0 to 2	0

Setting 0: Fault

Setting 1: Alarm

Setting 2: Digital out only

■ P1-11: High Feedback Level

Sets the level at which a High Feedback alarm or fault will occur. When the PID feedback rises above the P1-11 setting for the time set in P1-12, the drive will respond based on the setting in P1-13.

No.	Parameter Name	Setting Range	Default
P1-11	High Feedback Level	0.0 to 6000.0	155.0 PSI

■ P1-12: High Feedback Level Fault Delay Time

Sets the delay time after which a Low Feedback alarm or fault will occur. When the PID feedback rises above the P1-11 setting for the time set in P1-12, the drive will respond based on the setting in P1-13.

No.	Parameter Name	Setting Range	Default
P1-12	High Feedback Level Fault Delay Time	0 to 3600	5 s

■ P1-13: High Feedback Selection

Selects the drive response to a High Feedback condition. When the PID feedback rises above the P1-11 setting for the time set in P1-12, the drive will respond based on the setting in P1-13.

No.	Parameter Name	Setting Range	Default
P1-13	High Feedback Selection	0 to 2	0

Setting 0: Fault

Setting 1: Alarm

Setting 2: Digital out only

■ P2-01: Sleep Level Type

Selects which data source the drive will use to determine if it should activate the sleep function. This parameter is application-dependent and should be set in conjunction with the type of system data is available. Choose the data type that best represents a low-activity condition for the system.

Note: Set this parameter prior to changing other parameters related to the Sleep Function, as internal scaling is based on P2-01.

No.	Parameter Name	Setting Range	Default
P2-01	Sleep Level Type	0 to 4	0

Setting 0: Output frequency

Setting 1: Output current

Setting 2: Feedback

Setting 3: Output speed (RPM)

Setting 4: Flow meter (requires flow meter)

■ P2-02: Sleep Level

Sets the level at which the drive will enter sleep mode. The drive will enter sleep mode when the monitored data falls below the P2-02 setting for the time set in P2-03.

No.	Parameter Name	Setting Range	Default
P2-02	Sleep Level	0.0 to 6000.0	0.0 Hz

■ P2-03: Sleep Delay Time

Sets the delay time after which the drive will enter sleep mode. The drive will enter sleep mode when the monitored data falls below the P2-02 setting for the time set in P2-03.

No.	Parameter Name	Setting Range	Default
P2-03	Sleep Delay Time	0 to 3600	0 s

■ P3-00: Number of Lag Pumps

Sets the number of lag pumps in the system. When using Contactor Multiplexing for the control lag pumps, first set P1-01 to 1. Then select the number of lag pumps to be controlled in P3-00. Set the corresponding multi-function digital outputs for lag pumps (H2-□□ = 80-82 and F5-□□ = 83-84). The methods used to determine lag pump staging and de-staging order are selected in P1-30 and P1-31.

No.	Parameter Name	Setting Range	Default
P3-00	Number of Lag Pumps	1 to 5	1

■ P3-50: Pump 2 Frequency Shutdown Level

Sets the level at which the first lag pump (2nd pump in the system) will shut down or de-stage. This parameter is effective when the P3-01 is set to 0 or 2 (pump staging is based on output frequency). When the output frequency falls below the P3-50 leel for the time set in P3-09, the pump will be de-staged.

No.	Parameter Name	Setting Range	Default
P3-50	Pump 2 Frequency Shutdown Level	0.0 to 400.0	40.0 Hz

■ P3-60: Pump 3 Frequency Shutdown Level

Sets the level at which the second lag pump (3rd pump in the system) will shut down or de-stage. This parameter is effective when the P3-01 is set to 0 or 2 (pump staging is based on output frequency). When the output frequency falls below the P3-50 leel for the time set in P3-09, the pump will be de-staged.

No.	Parameter Name	Setting Range	Default
P3-60	Pump 3 Frequency Shutdown Level	0.0 to 400.0	40.0 Hz

■ P3-70: Pump 4 Frequency Shutdown Level

Sets the level at which the third lag pump (4th pump in the system) will shut down or de-stage. This parameter is effective when the P3-01 is set to 0 or 2 (pump staging is based on output frequency). When the output frequency falls below the P3-50 leel for the time set in P3-09, the pump will be de-staged.

No.	Parameter Name	Setting Range	Default
P3-40	Pump 4 Frequency Shutdown Level	0.0 to 400.0	40.0 Hz

■ P4-01: Pre-Charge Level

Sets the level at which the drive will activate the pre-charge function. At start, if the PID is below the P4-01 setting, the drive will run at the P4-02 frequency setting for the time set in P4-03. PID control is delayed until the Pre-charge function stops. The drive will exit the pre-charge function early if the feedback rises above the P4-01 setting or if a Low Water digital input switch (H1-☐☐ = 8F) deactivates. Pre-charge is useful to slowly fill or pressurize a system.

No.	Parameter Name	Setting Range	Default
P4-01	Pre-Charge Level	0.0 to 6000.0	0.0 PSI

■ P4-02: Pre-Charge Frequency

Sets the frequency at which the pre-charge function will run.

No.	Parameter Name	Setting Range	Default
P4-02	Pre-Charge Frequency	0.0 to E1-04	0.0 Hz

■ P4-03: Pre-Charge Time

Sets the duration of time that the Pre-Charge function will run.

No.	Parameter Name	Setting Range	Default
P4-03	Pre-Charge Time	0.0 to 3600.0	0.0 min

■ P4-10: AUTO Mode Operator Run Power Down Storage

Selects drive response to power loss with regards to the Run command. When running in AUTO Mode and using a Run command from the keypad (b1-02 = 0), P4-10 determines whether the drive will automatically start running when power is reapplied. The factory setting of this parameter requires pressing the AUTO key to start the drive after power loss.

WARNING! *Sudden Movement Hazard. If the drive is running at power loss, it will automatically initiate an internal Run command upon power-up if P4-10 = 1 (Enabled) and could result in death or serious injury from moving equipment.*

No.	Parameter Name	Setting Range	Default
P4-10	AUTO Mode Operator Run Power Down Storage	0, 1	0

Setting 0: Disabled

Setting 1: Enabled

■ P4-12: Thrust Bearing Frequency

Sets the frequency used by the drive when determining which acceleration and deceleration time to use. The Thrust Bearing function is used for applications using submersible motors. The function provides an alternate acceleration time (P4-11) and deceleration time (P4-13) for protecting the pump bearings.

At start, the drive will use the P4-11 acceleration time until the P4-12 frequency is reached, at which time it will use the active C1-☐☐ acceleration and deceleration times. At stop, if the output frequency is above the P4-12 setting, the active C1-☐☐ deceleration time will be used until the P4-12 setting is reached at which time it will use the P4-13 time setting for the rest of deceleration.

If P4-12 is set greater than P1-06 (minimum Pump Speed), P4-12 will become the frequency lower limit. The drive PID control must be disabled (b5-01 = 0) for this function to work.

No.	Parameter Name	Setting Range	Default
P4-12	Thrust Bearing Frequency	0.0 to E1-04	30.0 Hz

■ P4-17: Utility Start Delay

Set the delay time after power up until the drive will recognize a Run command present within one second of power up.

This is useful in preventing a peak power surge when multiple drives power up and begin accelerating simultaneously. This function works when the drives all have different P4-17 settings to spread out the power draw during acceleration.

No.	Parameter Name	Setting Range	Default
P4-17	Utility Start Delay	0.0 to 1000.0	0.2 min

■ P5-02: HAND Reference 1

Sets the frequency reference of HAND mode. When the drive is stopped, pressing the HAND key will start the drive and the drive will accelerate to the P5-02 setting.

No.	Parameter Name	Setting Range	Default
P5-02	HAND Reference 1	0.0 to E1-04	40.0 Hz

■ P5-04: HAND Key Function Selection

Selects whether the HAND key on the HOA keypad is active. Disabling this function by setting P5-04 to 0 will prevent the drive from entering HAND Mode.

No.	Parameter Name	Setting Range	Default
P5-04	HAND Key Function Selection	0, 1	1

Setting 0: Disabled

Setting 1: Enabled

■ Q1-01: PID Controller Setpoint 1

Sets the PID setpoint for the controller. The drive will use the system feedback signal and modulate the pump speed to regulate the feedback at the Q1-01 setpoint. The units for Q1-01 are selected by b1-01 and the scaling is set in parameter P1-03. This parameter is active when b1-01 (Reference Source) is set to 0 (HOA keypad).

No.	Parameter Name	Setting Range	Default
Q1-01	PID Controller Setpoint 1	0.0 to 6000.0	0.0

■ Q5-03: Suction Pressure Setpoint

Sets the Suction Pressure setpoint. The units of Q5-03 are selected in Q5-01 and the scaling is set in Q5-02 (Suction Transducer Scaling). The Suction Pressure function is enabled by setting Q5-01 = 1 (Suction Pressure). This function uses Q5-03 as the setpoint instead of Q1-01, and Q5-02 as the feedback scaling instead of P1-02. Set b5-01 to a value other than 0 to enable the drive PID controller and use this function.

This feature can be used to allow the drive to control (outlet) pressure when there is adequate pressure on the inlet side of the pump by setting Q5-01 to 1 (Suction Pressure). When the suction pressure (pump inlet pressure) drops to the Suction Pressure Setpoint (Q5-03), it will regulate the suction pressure and the outlet pressure will be allowed to drop. This requires both a suction pressure transducer on the pump inlet and a pressure feedback transducer on the pump output.

No.	Parameter Name	Setting Range	Default
Q5-03	Suction Pressure Setpoint	0.0 to 1200.0	20.0

■ Q5-06: Wake-Up Suction Pressure

Sets the wake up level for the suction pressure control function. The drive falls asleep based on the Q5-04 level and Q5-05 delay time. The drive will wake up when the suction pressure feedback rises above the Q5-06 setting for the time set in Q5-07 AND the standard sleep function calls for a wake up (P1-04 and P1-05).

No.	Parameter Name	Setting Range	Default
Q5-06	Wake-Up Suction Pressure	0.0 to 1200.0	30.0

■ Q5-09: Low Suction Pressure Detection Level

Sets the level at which a Low Suction Pressure alarm or fault will occur. When the suction pressure feedback falls below the Q5-09 setting for the time set in Q5-10, the drive will respond based on the setting in Q5-11.

No.	Parameter Name	Setting Range	Default
Q5-09	Low Suction Pressure Detection Level	0.0 to 1200.0	0.0

■ Q5-10: Low Suction Pressure Detection Time

Sets the delay time after which a Low Suction Pressure alarm or fault will occur. When the suction pressure feedback falls below the Q5-09 setting for the time set in Q5-10, the drive will respond based on the setting in Q5-11.

No.	Parameter Name	Setting Range	Default
Q5-10	Low Suction Pressure Detection Time	0.0 to 300.0	0.1

■ Q5-11: Low Suction Pressure Behavior Select

Selects the drive response to a Low Suction Pressure condition. When the suction pressure feedback falls below the Q5-09 setting for the time set in Q5-10, the drive will respond based on the setting in Q5-11. By setting Q5-11 to 3 (Restart Q5-15), the drive will attempt to reset itself for the number of times set in L5-01 waiting for the Q5-15 reset time before each reset attempt. The drive will fault if the L5-01 attempts are exceeded.

No.	Parameter Name	Setting Range	Default
Q5-11	Low Suction Pressure Behavior Select	0 to 3	1

Setting 0: No display (digital output only)

Setting 1: Alarm only

Setting 2: Fault

Setting 3: Auto-restart (time set in Q5-15)

■ Q5-16: Suction Control Proportional Gain

Sets the proportional gain of the Suction Pressure controller. Increasing this value will make the system more responsive but can lead to instability. Q5-16 is used in place of b5-02 for suction pressure control.

No.	Parameter Name	Setting Range	Default
	Suction Control Proportional Gain	0.00 to 25.00	2.00

■ Q5-17: Suction Control Integral Time

Sets the integral time of the Suction Pressure controller. Decreasing this value will make the system more responsive but can lead to overshoot. Q5-17 is used in place of b5-03 for suction pressure control.

No.	Parameter Name	Setting Range	Default
	Suction Control Integral Time	0.0 to 360.0	5.0 s

4.7 Test Run with No Load

◆ No-Load Operation Test Run

This section explains how to operate the drive with the motor decoupled from the load during a test run.

■ Before Starting the Motor

Check the following items before operation:

- Ensure the area around the motor is safe.
- Ensure external emergency stop circuitry is working properly and other safety precautions have been taken.

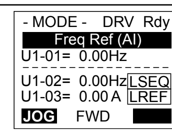
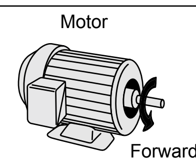
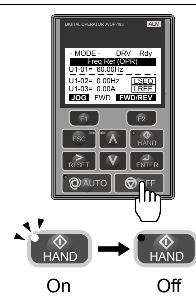
■ During Operation

Check the following items during operation:

- The motor should rotate smoothly (i.e., no abnormal noise or oscillation).
- The motor should accelerate and decelerate smoothly.

■ No-Load Operation Instructions

The following example illustrates a test run procedure using the HOA keypad.

	Step		Display/Result
1.	Before starting the motor, set parameter d1-01, Frequency Reference, to 6 Hz. The Run command from AUTO mode must be OFF.	–	–
2.	Turn on the power to the drive. The initial display appears.	➡	
3.	Press  to give the drive a Run command from HAND mode. The HAND light will turn on and the motor will rotate at 6 Hz.	➡	
4.	Ensure the motor is rotating in the correct direction and that no faults or alarms occur.	➡	
5.	If there is no error in step 3, press  to increase the frequency reference. Increase the frequency in increments of 10 Hz, verifying smooth operation at all speeds. For each frequency, check the drive output current using monitor U1-03. The current should be well below the motor rated current.	–	–
6.	The drive should operate normally. Press  to stop the motor. The HAND light is OFF and the motor coasts to stop.	➡	

Start-Up Programming & Operation

4

4.8 Test Run with Load Connected

◆ Test Run with the Load Connected

After performing a no-load test run, connect the motor and proceed to run the motor and load together.

■ Precautions for Connected Machinery

WARNING! *Sudden Movement Hazard. Clear all personnel from the drive, motor, and machine area before applying power. System may start unexpectedly upon application of power, causing death or serious injury.*

WARNING! *Sudden Movement Hazard. Always check the operation of any fast stop circuits after they are wired. Fast stop circuits are required to provide safe and quick shutdown of the drive. Prepare to initiate an emergency stop during the test run. Operating a drive with untested emergency circuits could result in death or serious injury.*

- The motor should come to a complete stop without problems.
- Connect the load and machinery to the motor.
- Fasten all installation screws properly and check that the motor and connected machinery are held in place.

■ Checklist Before Operation

- The motor should rotate in the proper direction.
- The motor should accelerate and decelerate smoothly.

■ Operating the Motor under Loaded Conditions

Test run the application similarly to the no-load test procedure when connecting the machinery to the motor.

- Monitor U1-03 for overcurrent during operation.
- If the application permits running the load in the reverse direction, change the motor direction and the frequency reference while watching for abnormal motor oscillation or vibration.
- Correct any problems that occur with hunting, oscillation, and other control-related issues.

5

Troubleshooting

This chapter provides descriptions of the drive faults, alarms, errors, and messages. Guidance information for troubleshooting is also included. This chapter can also serve as a reference guide for tuning the drive during a trial run.

5.1 Drive Alarms, Faults, Errors, and Messages

◆ Types of Alarms, Faults, and Errors

Check the HOA keypad for information about possible faults if the drive or motor fails to operate. *Refer to Using the HOA Keypad on page 111*.

If problems occur that are not covered in this manual, contact the nearest Yaskawa representative with the following information:

- Drive model
- Software version
- Date of purchase
- Description of the problem
- List of modified parameters.

Table 5.1 contains descriptions of the various types of alarms, faults, and errors that may occur while operating the drive.

Table 5.1 Types of Alarms, Faults, and Errors

Type	Drive Response
Faults	When the drive detects a fault: • The HOA keypad displays text indicating the specific fault and the ALM indicator LED remains lit until the fault is reset. • The fault interrupts drive output and the motor coasts to a stop. • Some faults allow the user to select the stopping method when the fault occurs. • Fault output terminals MA-MC will close, and MB-MC will open. The drive will remain inoperable until the fault is cleared. *Refer to Fault Reset Methods on page 213*.
Minor Faults and Alarms	When the drive detects an alarm or a minor fault: • The HOA keypad displays text indicating the specific alarm or minor fault, and the ALM indicator LED flashes. • The drive continues running the motor, although some alarms allow the user to select a stopping method when the alarm occurs. • A multi-function contact output set to be tripped by a minor fault (H2- □□ = 10) closes. If the output is set to be tripped by an alarm, the contact will not close. • The HOA keypad displays text indicating a specific alarm and the ALM indicator LED flashes. Remove the cause of the problem to reset a minor fault or alarm.
Operation Errors	An operation error occurs when parameter settings conflict or do not match hardware settings (such as with an option card). When the drive detects an operation error: • The HOA keypad displays text indicating the specific error. • Multi-function contact outputs do not operate. The drive will not operate the motor until the error has been reset. Correct the settings that caused the operation error to clear the error.
Tuning Errors	Tuning errors occur while performing Auto-Tuning. When the drive detects a tuning error: • The HOA keypad displays text indicating the specific error. • Multi-function contact outputs do not operate. • Motor coasts to stop. Remove the cause of the error and repeat the Auto-Tuning process.
Copy Function Errors	Copy Function Errors occur when using the HOA keypad or the USB Copy Unit to copy, read, or verify parameter settings. • The HOA keypad displays text indicating the specific error. • Multi-function contact outputs do not operate. Pressing any key on the HOA keypad will clear the fault. Investigate the cause of the problem (such as model incompatibility) and try again.
Drive LCD Display Messages	The drive will display messages on the LCD display to indicate temporary drive statuses during normal pump operation. Messages do not require any action from the user and will clear from the LCD display automatically.

5.2 Fault Detection

◆ Fault Displays, Causes, and Possible Solutions

Faults are detected for drive protection, and cause the drive to stop while triggering the fault output terminal MA-MB-MC. Remove the cause of the fault and manually clear the fault before attempting to run the drive again.

Table 5.2 Detailed Fault Displays, Causes, and Possible Solutions

HOA Keypad Display	Fault Name
ACCUM Accum Level	Accumulated Level Fault
	The total volume of water flow measured over time by the flow meter has exceeded the fault level setting.
Cause	**Possible Solution**
The accumulated level has exceeded the values set in P6-11 to P6-14. This is only effective when P1-15, Accumulated Behavior is set to 2 (fault with manual monitor reset) or 3 (fault with automatic monitor reset.	Set the Accumulated Level fault characteristics in P6-11 to P6-14 and P6-16. Drive response to this condition is controlled by P6-15, Accumulated Behavior. Auto-restart of this fault is controlled by P6-15, Accumulated Behavior and P6-05, Flow Accumulation Reset.

HOA Keypad Display	Fault Name
AJF Anti-Jam Fault	Anti-Jam Fault
Cause	**Possible Solution**
The drive was not able to clear debris from the impeller in fewer than the number of attempts set in P7-02. This is only effective when P7-01, Anti-jam Operation is set to 1 (enabled).	• Check for proper pump operation. Remove debris from the pump impeller. • Set the Anti-jam fault characteristics in P7-02 to P7-08. • Drive response to this condition is controlled by P7-01, Anti-jam Operation Selection.

HOA Keypad Display	Fault Name
Ana GeoTemp Lost Switched to Net	Analog Geothermal Temperature Lost
	Analog Geothermal Temperature has not been detected, and the Network Geothermal signal is now being used.
Cause	**Possible Solution**
• Defective or broken analog input source. • H3-0□ ≠ 21 (Geothermal Temperature).	• Ensure that the Geothermal Temperature source is installed and working properly. If there is none present, set P9-60 to 3 so it will always read the Geothermal Temperature of another drive on the network . • Set H3-0□ = 21 (Geothermal Temperature) if the analog input source is to be used for Geothermal. Otherwise, set P9-02 to 3 if the drive does not have an analog Geothermal Temperature source.

HOA Keypad Display	Fault Name
AnalogWL/SP Lost Switched to Net	Analog Water Level / Suction Pressure Lost
	Network Water Level / Suction Pressure is now being used because a wire-break was detected with the analog signal. Water Level Analog Input Wire Break (WL Wire Break) is effective when Q4-16 is set to 2 (Fault). Suction Pressure Analog Input Wire Break (SP Wire Break) is effective when Q5-19 is set to 2 (Fault).
Cause	**Possible Solution**
• Defective or broken analog input source. • Wire-break detected with the Water Level / Suction Pressure analog signal (H3-□□ = 23).	• Confirm that the Water Level or Suction Pressure source is installed and working properly. • Confirm that the Q4-16 and Q5-19 settings are correct. • Set P9-50 to 3 if the drive does not have an analog input source.

HOA Keypad Display	Fault Name
bAT	Digital Operator Battery Voltage Low
Cause	**Possible Solution**
The digital operator battery is low	Replace the digital operator battery.

HOA Keypad Display	Fault Name
boL	Braking Transistor Overload Fault
	The braking transistor reached its overload level.
Cause	**Possible Solution**

The wrong braking resistor is installed	Select the correct braking resistor.

HOA Keypad Display	Fault Name
bUS	Option Communication Error
	• The connection was lost after establishing initial communication. • Only detected when the run command frequency reference is assigned to an option card.
Cause	**Possible Solution**
No signal was received from the PLC	• Check for faulty wiring. • Correct the wiring. • Check for disconnected cables and short circuits and repair as needed.
Faulty communications wiring or an existing short circuit	
Communication data error occurred due to noise	• Check the various options available to minimize the effects of noise. • Counteract noise in the control circuit, main circuit, and ground wiring. • Ensure that other equipment such as switches or relays do not cause noise. Use surge absorbers if necessary. • Use only recommended cables or other shielded line. Ground the shield on the controller side or the drive input power side. • Separate all communication wiring from drive power lines. Install an EMC noise filter to the drive power supply input.
The option card is damaged	Replace the option card if there are no problems with the wiring and the error continues to occur.
The option card is not properly connected to the drive	• The connector pins on the option card do not line up properly with the connector pins on the drive. • Reinstall the option card.

HOA Keypad Display	Fault Name
CE	MEMOBUS/Modbus Communication Error
	Control data was not received for the CE detection time set to H5-09.
Cause	**Possible Solution**
Faulty communications wiring or an existing short circuit	• Check for faulty wiring. • Correct the wiring. • Check for disconnected cables and short circuits and repair as needed.
Communication data error occurred due to noise	• Check the various options available to minimize the effects of noise. • Counteract noise in the control circuit, main circuit, and ground wiring. • Use only recommended cables or other shielded line. Ground the shield on the controller side or the drive input power side. • Ensure that other equipment such as switches or relays do not cause noise. Use surge suppressors if required. • Separate all communication wiring from drive power lines. Install an EMC noise filter to the drive power supply input.

HOA Keypad Display	Fault Name
CPF11 to CPF14 CPF16 to CPF19	Control Circuit Error
Cause	**Possible Solution**
There is a self-diagnostic error in the control circuit	• Cycle power to the drive. • If the problem continues, replace the control board or the entire drive. Contact Yaskawa or a Yaskawa representative for instructions on replacing the control board.
Connector on the operator is damaged	Replace the operator.

HOA Keypad Display	Fault Name
CPF02	A/D Conversion Error
	An A/D conversion error or control circuit error occurred.
Cause	**Possible Solution**
Control circuit is damaged	• Cycle power to the drive. • If the problem continues, replace the control board or the entire drive. Contact Yaskawa or a Yaskawa representative for instructions on replacing the control board.

HOA Keypad Display	Fault Name
CPF03	Control Board Connection Error
	Connection error between the control board and the drive
Cause	**Possible Solution**

There is a connection error	• Turn off the power and check the connection between the control board and the drive. • If the problem continues, replace the control board or the entire drive. Contact Yaskawa or a Yaskawa representative for instructions on replacing the control board.
Drive fails to operate properly due to noise interference	• Check the various options available to minimize the effects of noise. • Counteract noise in the control circuit, main circuit, and ground wiring. • Use only recommended cables or other shielded line. Ground the shield on the controller side or the drive input power side. • Ensure that other equipment such as switches or relays do not cause noise. Use surge suppressors if required. • Separate all communication wiring from drive power lines. Install an EMC noise filter to the drive power supply input.

HOA Keypad Display	Fault Name
CPF06	EEPROM Memory Data Error
	Error in the data saved to EEPROM
Cause	**Possible Solution**
There is an error in EEPROM control circuit	• Turn off the power and check the connection between the control board and the drive. • If the problem continues, replace the control board or the entire drive. Contact Yaskawa or a Yaskawa representative for instructions on replacing the control board.
The power supply was switched off while parameters were being saved to the drive	Reinitialize the drive (A1-03 = 2220, 3330).

HOA Keypad Display	Fault Name
CPF07 or CPF08	Terminal Board Connection Error
Cause	**Possible Solution**
There is a faulty connection between the terminal board and the control board	• Turn off the power and reconnect the terminal board. • If the problem continues, replace the control board or the entire drive. Contact Yaskawa or a Yaskawa representative for instructions on replacing the control board.

HOA Keypad Display	Fault Name
CPF20 or CPF21	Control Circuit Error
Cause	**Possible Solution**
Hardware is damaged	• Cycle power to the drive. • If the problem continues, replace the control board or the entire drive. Contact Yaskawa or a Yaskawa representative for instructions on replacing the control board.

HOA Keypad Display	Fault Name
CPF22	Hybrid IC Failure
Cause	**Possible Solution**
Hybrid IC failure on the power board	• Cycle power to the drive. • If the problem continues, replace the power board or the entire drive. Contact Yaskawa or a Yaskawa representative for instructions on replacing the power board.

HOA Keypad Display	Fault Name
CPF23	Control Board Connection Error
	Connection error between the control board and the drive
Cause	**Possible Solution**
Hardware is damaged	• Turn off the power and check the connection between the control board and the drive. • If the problem continues, replace the control board or the entire drive. Contact Yaskawa or a Yaskawa representative for instructions on replacing the control board.

HOA Keypad Display	Fault Name
CPF24	Drive Unit Signal Fault
	The drive capacity cannot be detected correctly (drive capacity is checked when the drive is powered up).
Cause	**Possible Solution**
Hardware is damaged	If the problem continues, replace the control board or the entire drive. Contact Yaskawa or a Yaskawa representative for instructions on replacing the control board.

HOA Keypad Display	Fault Name
CPF25	Terminal Board Not Connected
Cause	**Possible Solution**
Terminal board is not connected correctly	Reconnect the terminal board to the connector on the drive, then cycle the power to the drive.

HOA Keypad Display	Fault Name
CPF26 to CPF35 CPF40 to CPF43	Control Circuit Error
	CPU error
Cause	**Possible Solution**
Hardware is damaged	If the problem continues, replace the control board or the entire drive. Contact Yaskawa or a Yaskawa representative for instructions on replacing the control board.

HOA Keypad Display	Fault Name
E5	SI-T3 Watchdog Timer Error
	The watchdog timed out.
Cause	**Possible Solution**
Data has not been received from the PLC	Execute DISCONNECT or ALM_CLR, then issue a CONNECT command or SYNC_SET command and proceed to phase 3. Refer to the SI-T3 Option Technical Manual for more details on troubleshooting.

HOA Keypad Display	Fault Name
EF0	Option Card External Fault
	An external fault condition is present.
Cause	**Possible Solution**
An external fault was received from the PLC and F6-03 is set to a value other than 3.	• Remove the cause of the external fault. • Remove the external fault input from the PLC.
Problem with the PLC program	Check the PLC program and correct problems.

HOA Keypad Display	Fault Name
EF1	Pump Fault (input terminal S1)
	External fault at multi-function input terminal S1.
EF2	Pump Fault (input terminal S2)
	External fault at multi-function input terminal S2.
EF3	Pump Fault (input terminal S3)
	External fault at multi-function input terminal S3.
EF4	Pump Fault (input terminal S4)
	External fault at multi-function input terminal S4.
EF5	Pump Fault (input terminal S5)
	External fault at multi-function input terminal S5.
EF6	Pump Fault (input terminal S6)
	External fault at multi-function input terminal S6.
EF7	Pump Fault (input terminal S7)
	External fault at multi-function input terminal S7.
EF8	Pump Fault (input terminal S8)
	External fault at multi-function input terminal S8.
Cause	**Possible Solution**
An external device tripped an alarm function	Remove the cause of the external fault and reset the fault.
Wiring is incorrect	• Properly connect the signal lines to the terminals assigned for external fault detection (H1-☐☐ = 20 to 2B). • Reconnect the signal line.
Multi-function contact input setting is incorrect	• Check for unused terminals set for H1-☐☐ = 20 to 2B (External Fault). • Change the terminal settings.

HOA Keypad Display	Fault Name
Err	EEPROM Write Error
	Data cannot be written to the EEPROM
Cause	**Possible Solution**
Noise has corrupted data while writing to the EEPROM	• Press “ENTER” on the digital operator. • Correct the parameter setting. • Cycle power to the drive. • If the problem continues, replace the control board or the entire drive. Contact Yaskawa or a Yaskawa representative for instructions on replacing the control board.
Hardware problem	If the problem continues, replace the control board or the entire drive. Contact Yaskawa or a Yaskawa representative for instructions on replacing the control board.

HOA Keypad Display	Fault Name
FAn	Internal Fan Fault
	Fan or magnetic contactor failure
Cause	**Possible Solution**
Internal cooling fan has malfunctioned	• Cycle power to the drive. • Check for fan operation. • Verify the cumulative operation time of the fan with monitor U4-03, and verify the cumulative operation time of the fan maintenance timer with U4-04. • If the cooling fan has exceeded its expected performance life or is damaged in any other way, follow the replacement instructions in the ***Peripheral Devices & Options*** chapter.
Fault detected in the internal cooling fan or magnetic contactor to the power supply.	• Cycle power to the drive. • If the fault continues to occur, replace the power board/gate drive board or the entire drive. • Contact Yaskawa or a Yaskawa representative for instructions on replacing the power board/gate drive board.

HOA Keypad Display	Fault Name
FDBKL Wire Break	PID Feedback Loss
	The analog input programmed for PID feedback has risen above 21 mA or fallen below 3 mA.
Cause	**Possible Solution**
The analog input programmed for PID feedback loss has risen above 21 mA or fallen below 3 mA. This is effective only when b5-12 Feedback Loss 4 to 20 mA Detection Selection is set to 2 (fault).	• Confirm that the PID feedback source is installed and working properly. • Drive response to this condition is controlled by b5-12, Feedback Loss 4 to 20 mA Detection Selection and b5-13, Feedback Loss Go To Frequency. • Auto-restart of this fault is controlled by L5-42, Feedback Loss Fault Retry Selection.

HOA Keypad Display	Fault Name
GF	Ground Fault
	• A current short to ground exceeded 50% of rated current on the output side of the drive. • Setting L8-09 to 1 enables ground fault detection.
Cause	**Possible Solution**
Motor insulation is damaged	• Check the insulation resistance of the motor. • Replace the motor.
A damaged motor cable is creating a short circuit	• Check the motor cable. • Remove the short circuit and reapply power to the drive
	• Check the resistance between the cable and the ground terminal ⏚. • Replace the cable.
Excessive leakage current at the drive output	• Reduce the carrier frequency. • Reduce the amount of stray capacitance.
The drive started to run during a current offset fault or while coasting to a stop	• Set b3-01 to 1 to enable Speed Search at Start. • Perform Speed Search 1 or 2 (H1-□□ = 61 or 62) via one of the external terminals.
Hardware problem	If the problem continues, replace the control board or the entire drive. Contact Yaskawa or a Yaskawa representative for instructions on replacing the control board.

HOA Keypad Display	Fault Name
HFB	High Feedback
	The feedback signal is too high.

Cause	Possible Solution
The feedback signal has risen above the level set in P1-11, High Feedback Level, for the time set in P1-12, High Feedback Level Fault Delay Time. This is effective only when P1-13, High Feedback Selection, is set to 0 (Fault and digital outt).	• Set the High Feedback fault characteristics in P1-11 and P1-12. • Drive response to this condition is controlled by P1-13, High Feedback Selection. Auto-restart of this fault is controlled by L5-41, High Feedback Fault Retry Selection.

HOA Keypad Display	Fault Name
HIFLO High Flow	High Flow
	The meter has detected a high flow condition.
Cause	**Possible Solution**
The flow is too high	Reduce the flow
The measured water flow has risen above the P6-17 level for the time set in P6-18. This is only effective when P1-19, High Flow Select is set to 2 (fault).	• Set the High Flow fault characteristics in P6-17 and P6-18. • Drive response to this condition is controlled by P1-19, High Flow Select. • Auto-restart of this fault is controlled by P1-19, High Flow Select.

HOA Keypad Display	Fault Name
HISUC High Suction	High Section Pressure
Cause	**Possible Solution**
The suction pressure has fallen below the level set in Q5-12 for longer than the time set in Q5-13. This is only effective when Q5-14, High Suction Pressure Behavior Select is set to 2 (fault).	• Reduce the system pressure. • Set the High Suction Pressure fault characteristics in Q5-12, Q5-13, and Q5-18. • Drive response to this condition is controlled by Q5-14, High Suction Pressure Behavior Select. • Auto-restart of this fault is controlled by Q5-14, High Suction Pressure Behavior Select and Q5-15, Suction Pressure Auto-restart Time.

HOA Keypad Display	Fault Name
HWL	High Water Level
	The “High Water Level” digital input is active (H1-0☐ = 90).
Cause	**Possible Solution**
The Low Water Level switch is activated or P1-31, High Water Digital Input Configuration, is programmed incorrectly.	Lower the water level and/or adjust the High Water Level switch.

HOA Keypad Display	Fault Name
LF	Output Phase Loss
	• Phase loss on the output side of the drive. • Setting L8-07 to 1 or 2 enables Phase Loss Detection.
Cause	**Possible Solution**
The output cable is disconnected	• Check for wiring errors and properly connect the output cable. • Correct the wiring.
The motor winding is damaged	• Check the resistance between motor lines. • Replace the motor if the winding is damaged.
The output terminal is loose	• Apply the tightening torque specified in this manual to fasten the terminals. ***Refer to Wire Gauges and Tightening Torque on page 87*** for details.
The rated current of the motor being used is less than 5% of the drive rated current	Check the drive and motor capacities.
An output transistor is damaged	If the problem continues, replace the control board or the entire drive. Contact Yaskawa or a Yaskawa representative for instructions on replacing the control board.
A single-phase motor is being used	The drive cannot operate a single phase motor.

HOA Keypad Display	Fault Name
LFB	Low Feedback
	The feedback signal is too low.
Cause	**Possible Solution**

The feedback signal has dropped below the level set in P1-08, Low Feedback Level, for the time set in P1-09, Low Feedback Level Fault Delay Time. This is effective only when P1-10, Low Feedback Selection, is set to 0 (Fault and digital out).	• Set the Low Feedback fault characteristics in P1-08 and P1-09. • Drive response to this condition is controlled by P1-10, Low Feedback Selection. • Auto-restart of this fault is controlled by L5-40, Low Feedback Fault Retry Selection.

HOA Keypad Display	Fault Name
LOP	Loss of Prime
	The pump has lost its prime.
Cause	**Possible Solution**
The pump load, measured based on the P1-18 setting (output current, kilowatts, or power), has dropped below the level set in P1-19, Prime Loss Level, for the time set in P1-20, Loss of Prime Time, and the output frequency has risen above P1-21, Prime Loss Frequency. This is effective only when P1-22 Loss of Prime Selection is set to 0 (fault).	• Check for a dry well, air in the system, or no water in the system. Restart the pump using the preferred priming method suggested by the pump manufacturer. • Set the Loss of Prime fault characteristics in P1-18, P1-19, P1-20, and P1-21. • Drive response to this condition is controlled by P1-21, Loss of Prime Selection. • Auto-restart of this fault is controlled by L5-51, Loss of Prime Fault Retry Selection and P1-23, Loss of Prime Maximum Restart Time after Fault

HOA Keypad Display	Fault Name
LOSUC Low Suction	Low Section Pressure
Cause	**Possible Solution**
The suction pressure has fallen below the level set in Q5-09 for longer than the time set in Q5-10. This is only effective when Q5-11, Low Suction Pressure Behavior Select is set to 2 (fault).	• Increase the system pressure. • Set the Low Suction fault characteristics in Q5-09, Q5-10, and Q5-18. • Drive response to this condition is controlled by Q5-11, Low Suction Pressure Behavior Select. • Auto-restart of this fault is controlled by Q5-11, Low Suction Pressure Behavior Select and Q5-15, Suction Pressure Auto-restart Time.

HOA Keypad Display	Fault Name
LOWFL Low Flow	Low Flow
Cause	**Possible Solution**
Insufficient flow	Increase flow
After waiting the P6-08 delay time at start, the measured water flow has fallen below the P6-06 level for the time set in P6-07. This is only effective when P1-09, Low Flow Select is set to 2 (fault).	• Set the Low Flow fault characteristics in P6-06, P6-07, and P6-08. • Drive response to this condition is controlled by P6-09, Low Flow Select. • Auto-restart of this fault is controlled by P6-09, Low Flow Select and P6-10, Low Flow Auto-restart Time.

HOA Keypad Display	Fault Name
LOWWL Low Water Level	Low Water Level
Cause	**Possible Solution**
The water level has fallen below the level set in Q4-09 for the longer than the time set in Q4-10. This is only effective when Q4-11, Low Level Behavior is set to 2 (fault).	• Raise the water level. • Set the Low Water Level fault characteristics in Q4-09 and Q4-10. • Drive response to this condition is controlled by Q4-11, Low Level Behavior. • Auto-restart of this fault is controlled by Q4-11, Low Level Behavior and Q4-12 Water Level Control Auto-restart Time.

HOA Keypad Display	Fault Name
LWL	Low Water Level
	The “Low Water Level” digital input is active (H1-0☐ = 8F).
Cause	**Possible Solution**
The Low Water Level switch is activated, defective, or P1-30, Low Water Digital Input Configuration, is programmed incorrectly.	Raise the water level and/or adjust the Low Water Level switch.

HOA Keypad Display	Fault Name
MSL Net Master Lost	Net Master Lost
	The MEMOBUS master has been lost
Cause	**Possible Solution**
Network Recovery is set to Fault MSL P9-27 = 3) and no message has been received from the master within the time set in P9-26.	• Increase the P9-26 setting to account for network latency. • Verify that there is a drive on the network with parameter P1-01 set to 3 and P9-27 to 0. • Check network connections and verify H5-01 and P9-25 settings for all drives on the network.

HOA Keypad Display	Fault Name
NMS	Not Maintaining Setpoint
	The setpoint cannot be maintained and P1-17 is set to 0.
Cause	**Possible Solution**
When the feedback deviates from the setpoint at a level greater than P1-15, for a time set in P1-16. This is effective only when P1-17 is set to 0 (fault).	• Check for a blocked impeller, over cycling, or broken pipe. • Set the Not Maintaining Setpoint fault characteristics in P1-16 and P1-17. • Drive response to this condition is controlled by P1-17, Not Maintaining Setpoint Selection. • Auto-restart of this fault is controlled by L5-50, Setpoint Not Met Retry.

HOA Keypad Display	Fault Name
nSE	Node Setup Error
	A terminal assigned to the node setup function closed during run.
Cause	**Possible Solution**
The node setup terminal closed during run.	Stop the drive when using the node setup function.
A Run command was issued while the node setup function was active.	

HOA Keypad Display	Fault Name
oC	Overcurrent
	Drive sensors detected an output current greater than the specified overcurrent level.
Cause	**Possible Solution**
The motor has been damaged due to overheating or the motor insulation is damaged	• Check the insulation resistance. • Replace the motor.
One of the motor cables has shorted out or there is a grounding problem	• Check the motor cables. • Remove the short circuit and reapply power to the drive.
	• Check the resistance between the motor cables and the ground terminal ⏚. • Replace damaged cables.
The load is too heavy	• Measure the current flowing into the motor. • Replace the drive with a larger capacity drive if the current value exceeds the rated current. • Determine if there is sudden fluctuation in the current level. • Reduce the load to avoid sudden changes in the current level or switch to a larger drive.
The acceleration or deceleration times are too short	Calculate the torque needed during acceleration relative to the load inertia and the specified acceleration time. If it is not possible to set the proper amount of torque, make the following changes: • Increase the acceleration time (C1-01, C1-03). • Increase the S-curve characteristics (C2-01 through C2-04). • Increase the capacity of the drive.
The drive is attempting to operate a specialized motor or a motor larger than the maximum size allowed	• Check the motor capacity. • Ensure that the rated capacity of the drive is greater than or equal to the capacity rating found on the motor nameplate.
Magnetic contactor (MC) on the output side of the drive has turned on or off	Set up the operation sequence so the MC does not trip while the drive is outputting current.
V/f setting is not operating as expected	• Check the ratios between the voltage and frequency. • Set parameters E1-04 through E1-10 appropriately. • Lower the voltage if it is too high relative to the frequency.
Excessive torque compensation	• Check the amount of torque compensation. • Reduce the torque compensation gain (C4-01) until there is no speed loss and less current.

Drive fails to operate properly due to noise interference	• Review the possible solutions provided for handling noise interference. • Review the section on handling noise interference and check the control circuit lines, main circuit lines, and ground wiring.
Overexcitation gain is set too high	• Check if the fault occurs simultaneously with overexcitation function operation. • Consider motor flux saturation and reduce the value of n3-13 (Overexcitation Deceleration Gain).
Run command was applied while motor was coasting	• Set b3-01 to 1 to enable Speed Search at Start. • Program the Speed Search command input through one of the multi-function contact input terminals (H1-□□ = 61 or 62).
The rated output current of the drive is too small	Use a larger drive.

HOA Keypad Display	Fault Name
oFA00	Option Card Connection Error at Option Port CN5-A
	Option compatibility error
Cause	**Possible Solution**
The option card installed into port CN5-A is incompatible with the drive	Check if the drive supports the option card to be installed. Contact Yaskawa for assistance.

HOA Keypad Display	Fault Name
oFA01	Option Card Fault at Option Port CN5-A
	Option not properly connected
Cause	**Possible Solution**
The option card connection to port CN5-A is faulty	• Turn off the power and reconnect the option card. • Check if the option card is properly plugged into the option port. Make sure the card is fixed properly. • If the option is not a communication option card, try to use the card in a different option port. If the option card works properly in a different option port, CN5-A is damaged, and the drive requires replacement. If the error persists (oFb01 or oFC01 occur), replace the option card.

HOA Keypad Display	Fault Name
oFA03 to oFA06	Option Card Error Occurred at Option Port CN5-A
oFA10, oFA11	
oFA12 to oFA17	Option Card Connection Error (CN5-A)
oFA30 to oFA43	Communication Option Card Connection Error (CN5-A)
Cause	**Possible Solution**
Option card or hardware is damaged	• Cycle power to the drive. • If the problem continues, replace the control board or the entire drive. Contact Yaskawa or a Yaskawa representative for instructions on replacing the control board.

HOA Keypad Display	Fault Name
oFb00	Option Card Fault at Option Port CN5-B
	Option compatibility error
Cause	**Possible Solution**
The option card installed into port CN5-B is incompatible with the drive	Make sure the drive supports the option card to be installed. Contact Yaskawa for assistance.
A communication option card has been installed in option port CN5-B	Communication option cards are only supported by option port CN5-A. It is not possible to install more than one communication option.

HOA Keypad Display	Fault Name
oFb01	Option Card Fault at Option Port CN5-B
	Option not properly connected
Cause	**Possible Solution**
The option card connection to port CN5-B is faulty	• Turn off the power and reconnect the option card. • Check if the option card is properly plugged into the option port. Make sure the card is fixed properly. • Try to use the card in a different option port. If the option card works properly in a different option port, CN5-B is damaged, and the drive requires replacement. If the error persists (oFA01 or oFC01 occur), replace the option card.

HOA Keypad Display	Fault Name
oFb02	Option Card Fault at Option Port CN5-B
	Same type of option card is currently connected
Cause	**Possible Solution**
An option card of the same type is already installed in option port CN5-A	Only one of each option card type can only be installed simultaneously. Make sure only one type of option card is connected.
An input option card is already installed in option port CN5-A	Install a communication option. More than one of the same type of card cannot be installed simultaneously.

HOA Keypad Display	Fault Name
oFb03 to oFb11	Option card error occurred at Option Port CN5-B
oFb12 to oFb17	
Cause	**Possible Solution**
Option card or hardware is damaged	• Cycle power to the drive. • If the problem continues, replace the control board or the entire drive. Contact Yaskawa or a Yaskawa representative for instructions on replacing the control board.

HOA Keypad Display	Fault Name
oFC00	Option Card Connection Error at Option Port CN5-C
	Option compatibility error
Cause	**Possible Solution**
The option card installed into port CN5-C is incompatible with the drive	Confirm that the drive supports the option card to be installed. Contact Yaskawa for assistance.
A communication option card has been installed in option port CN5-C	Communication option cards are only supported by option port CN5-A. It is not possible to install more than one communication option.

HOA Keypad Display	Fault Name
oFC01	Option Card Fault at Option Port CN5-C
	Option not properly connected
Cause	**Possible Solution**
The option card connection to port CN5-C is faulty.	• Turn the power off and reconnect the option card. • Check if the option card is properly plugged into the option port. Make sure the card is fixed properly. • Try to use the card in a different option port. If the option card works properly in a different option port, CN5-C is damaged, and the drive requires replacement. If the error persists (oFA01 or oFb01 occur), replace the option card.

HOA Keypad Display	Fault Name
oFC02	Option Card Fault at Option Port CN5-C
	Same type of option card is currently connected
Cause	**Possible Solution**
An option card of the same type is already installed in option port CN5-A or CN5-B.	Only one of each option card type can only be installed simultaneously. Make sure only one type of option card is connected.
An input option card is already installed in option port CN5-A or CN5-B.	Install a communication option, a digital input option, or an analog input option. More than one of the same type of card cannot be installed simultaneously.

HOA Keypad Display	Fault Name
oFC03 to oFC11	Option Card Error Occurred at Option Port CN5-C
oFC12 to oFC17	
Cause	**Possible Solution**
Option card or hardware is damaged	• Cycle power to the drive. • If the problem continues, replace the control board or the entire drive. Contact Yaskawa or a Yaskawa representative for instructions on replacing the control board.

HOA Keypad Display	Fault Name
oFC50 to oFC55	Option Card Error Occurred at Option Port CN5-C
Cause	**Possible Solution**
Option card or hardware is damaged	Refer to the option manual for details.

HOA Keypad Display	Fault Name
oH	Heatsink Overheat
	The heatsink temperature exceeded the overheat pre-alarm level set to L8-02.
Cause	**Possible Solution**
Surrounding temperature is too high	• Check the temperature surrounding the drive. Verify temperature is within drive specifications. • Improve the air circulation within the enclosure panel. • Install a fan or air conditioner to cool the surrounding area. • Remove anything near the drive that might be producing excessive heat.
Load is too heavy	• Measure the output current. • Decrease the load. • Lower the carrier frequency (C6-02).
Internal cooling fan is stopped	• Replace the cooling fan. . • After replacing the cooling fan, set parameter o4-03 to 0 to reset the cooling fan maintenance.

HOA Keypad Display	Fault Name
oH1	Overheat 1 (Heatsink Overheat)
	The heatsink temperature exceeded the drive overheat level.
Cause	**Possible Solution**
Surrounding temperature is too high	• Check the temperature surrounding the drive. • Improve the air circulation within the enclosure panel. • Install a fan or air conditioner to cool the surrounding area. • Remove anything near the drive that might be producing excessive heat.
Load is too heavy	• Measure the output current. • Lower the carrier frequency (C6-02). • Reduce the load.

HOA Keypad Display	Fault Name
oL1	Motor Overload
	The electronic motor overload protection tripped
Cause	**Possible Solution**
Load is too heavy	Reduce the load.
Cycle times are too short during acceleration and deceleration	Increase the acceleration and deceleration times (C1-01 through C1-04).
A general-purpose motor is driven below the rated speed with a high load	• Reduce the load. • Increase the speed. • If the motor is supposed to operate at low speeds, either increase the motor capacity or use a motor specifically designed to operate in the desired speed range.
The output voltage is too high	• Adjust the user-set V/f pattern (E1-04 through E1-10) by reducing E1-08 and E1-10. • Do not set E1-08 and E1-10 too low. This reduces load tolerance at low speeds.
The wrong motor rated current is set to E2-01	• Check the motor-rated current. • Enter the motor rated current to parameter E2-01 as indicated on the motor nameplate.
The base frequency is set incorrectly	• Check the rated frequency indicated on the motor nameplate. • Enter the rated frequency to E1-06 (Base Frequency).
The electrical thermal protection characteristics and motor overload characteristics do not match	• Check the motor characteristics. • Correct the type of motor protection that has been selected (L1-01). • Install an external thermal relay.
The electrical thermal relay is operating at the wrong level	• Check the current rating listed on the motor nameplate. • Check the value set for the motor rated current (E2-01).
Motor overheated by overexcitation operation	• Overexcitation increases the motor loss and the motor temperature. Excessive duration of overexcitation may cause motor damage. Prevent excessive overexcitation operation or apply proper cooling to the motor. • Reduce the excitation deceleration gain (n3-13). • Set L3-04 (Stall Prevention during Deceleration) to a value other than 4.
Parameters related to Speed Search are set incorrectly	• Check values set to Speed Search related parameters. • Adjust the Speed Search current and Speed Search deceleration times (b3-02 and b3-03 respectively). • After Auto-Tuning, set b3-24 to 1 to enable Speed Estimation Speed Search.

Output current fluctuation due to power supply loss	Check the power supply for phase loss.

HOA Keypad Display	Fault Name
oL2	Drive Overload
	The thermal sensor of the drive triggered overload protection.
Cause	**Possible Solution**
Load is too heavy	Reduce the load.
Acceleration or deceleration time is too short	Increase the settings for the acceleration and deceleration times (C1-01 through C1-04).
The output voltage is too high	• Adjust the preset V/f pattern (E1-04 through E1-10) by reducing E1-08 and E1-10. • Do not lower E1-08 and E1-10 excessively. This reduces load tolerance at low speeds.
Drive capacity is too small	Replace the drive with a larger model.
Overload occurred when operating at low speeds	• Reduce the load when operating at low speeds. • Replace the drive with a model that is one frame size larger. • Lower the carrier frequency (C6-02).
Excessive torque compensation	Reduce the torque compensation gain in parameter C4-01 until there is less current but no speed loss.
Parameters related to Speed Search are set incorrectly	• Check the settings for all Speed Search related parameters. • Adjust the current used during Speed Search (b3-03) and the Speed Search deceleration time (b3-02). • After Auto-Tuning, set b3-24 to 1 to enable Speed Estimation Speed Search.
Output current fluctuation due to input phase loss	Check the power supply for phase loss.

HOA Keypad Display	Fault Name
oL3	Overtorque Detection 1
	The current has exceeded the value set for torque detection (L6-02) for longer than the allowable time (L6-03).
Cause	**Possible Solution**
Parameter settings are not appropriate for the load	Check L6-02 and L6-03 settings.
Fault on the machine side (e.g., machine is locked up)	Check the status of the load. Remove the cause of the fault.

HOA Keypad Display	Fault Name
oL4	Overtorque Detection 2
	The current has exceeded the value set for Overtorque Detection 2 (L6-05) for longer than the allowable time (L6-06).
Cause	**Possible Solution**
Parameter settings are not appropriate for the load	Check the settings of parameters L6-05 and L6-06.

HOA Keypad Display	Fault Name
oL7	High Slip Braking oL
	The output frequency stayed constant for longer than the time set to n3-04 during High Slip Braking.
Cause	**Possible Solution**
Excessive load inertia	• Reduce deceleration times in parameters C1-02 and C1-04 for applications that do not use High Slip Braking. • Use a braking resistor to shorten deceleration time.
Motor is driven by the load	
Something on the load side is restricting deceleration	
The overload time during High Slip Braking is too short	• Increase parameter n3-04 (High-slip Braking Overload Time). • Install a thermal relay and increase the setting of n3-04 to maximum value.

HOA Keypad Display	Fault Name
oPr	External HOA Keypad Connection Fault
	The HOA keypad has been disconnected from the drive. **Note:** An oPr fault will occur when all of the following conditions are true: • Output is interrupted when the keypad is disconnected (o2-06 = 1). • The Run command is assigned to the operator (b1-02 = 0 and LOCAL has been selected).

Cause	Possible Solution
HOA keypad is not properly connected to the drive	• Check the connection between the keypad and the drive. • Replace the cable if damaged. • Turn off the drive input power and disconnect the keypad. Reconnect the keypad and reapply drive input power.

HOA Keypad Display	Fault Name
ov	Overvoltage
	Voltage in the DC bus has exceeded the overvoltage detection level. • For 200 V class drives: approximately 410 V • For 400 V class drives: approximately 820 V (740 V when E1-01 is less than 400) • For 600 V class drives: approximately 1040 V
Cause	**Possible Solution**
Deceleration time is too short and regenerative energy is flowing from the motor into the drive	• Increase the deceleration time (C1-02 and C1-04). • Install a dynamic braking resistor or a dynamic braking resistor unit. • Set L3-04 to 1 to enable stall prevention during deceleration. Stall Prevention is enabled as the default setting.
Fast acceleration time causes the motor to overshoot the speed reference	• Check if sudden drive acceleration triggers an overvoltage alarm. • Increase the acceleration time. • Use longer S-curve acceleration and deceleration times. • Enable the Overvoltage Suppression function (L3-11 = 1). • Lengthen the S-curve at acceleration end.
Excessive braking load	The braking torque was too high, causing regenerative energy to charge the DC bus. Reduce the braking torque, use a dynamic braking option, or lengthen decel time.
Surge voltage entering from the drive input power	Install a DC link choke. **Note:** Voltage surge can result from a thyristor convertor and phase advancing capacitor using the same input power supply.
Ground fault in the output circuit causes the DC bus capacitor to overcharge	• Check the motor wiring for ground faults. • Correct grounding shorts and reapply power.
Improper parameters related to Speed Search (including Speed Search after a momentary power loss and after a fault restart)	• Check the settings for Speed Search-related parameters. • Enable Speed Search restart function (b3-19 greater than or equal to 1 to 10). • Adjust the current level during Speed Search and the deceleration time (b3-02 and b3-03 respectively). • Perform Stationary Auto-Tuning for line-to-line resistance and then set b3-14 to 1 to enable Speed Estimation Speed Search.
Drive input power voltage is too high	• Check the voltage. • Lower drive input power voltage within the limits listed in the specifications.
The braking transistor or braking resistor are wired incorrectly	• Check braking transistor and braking resistor wiring for errors. • Properly rewire the braking resistor device.
Drive fails to operate properly due to noise interference	• Review the list of possible solutions provided for controlling noise. • Review the section on handling noise interference and check the control circuit lines, main circuit lines, and ground wiring.
Load inertia is set incorrectly	• Check the load inertia settings when using KEB, overvoltage suppression, or Stall Prevention during deceleration. • Adjust the load inertia ratio in L3-25 to better match the load.
Motor hunting occurs	• Adjust the parameters that control hunting. • Set the gain for Hunting Prevention (n1-02). • Adjust the AFR time constant (n2-02 and n2-03).

HOA Keypad Display	Fault Name
PF	Input Phase Loss
	Drive input power has an open phase or has a large imbalance of voltage between phases. Detected when L8-05 is set 1 (enabled).
Cause	**Possible Solution**
There is phase loss in the drive input power	• Check for wiring errors in the main circuit drive input power. • Correct the wiring.

There is loose wiring in the drive input power terminals	• Ensure the terminals are tightened properly. • Apply the tightening torque as specified in this manual. ***Refer to Wire Gauges and Tightening Torque on page 87*** for details.
There is excessive fluctuation in the drive input power voltage	• Check the voltage from the drive input power. • Review the possible solutions for stabilizing the drive input power.
There is poor balance between voltage phases	Stabilize drive input power or disable phase loss detection.
The main circuit capacitors are worn out	• Check the maintenance time for the capacitors (U4-05). • Replace the capacitor if U4-05 is greater than 90%. For instructions on replacing the capacitor, contact Yaskawa or a Yaskawa representative.
	Check for problems with the drive input power. If drive input power appears normal but the alarm continues to occur, replace either the control board or the entire drive. For instructions on replacing the control board, contact Yaskawa or a Yaskawa representative.

HOA Keypad Display	Fault Name
PoC	Pump Over Cycle
Cause	**Possible Solution**
The pump has exceeded the number of cycles set in P2-10 in the time set in P2-11 and P2-12 is set to 2 (fault).	• Set the Pump Over Cycle fault characteristics in P2-10 and P2-11. • Drive response to this condition is controlled by P2-12, Over Cycling Mode. • Auto-restart of this fault is controlled by L5-52, Pump Over Cycle Fault Retry Selection. • Set the Pump Over Cycle automatic setpoint compensation in P2-12, Over Cycling Mode, P2-13, Setpoint Compensation, and P2-14, Maximum Setpoint Compensation.

HOA Keypad Display	Fault Name
rF	Braking Resistor Fault
	The resistance of the braking resistor is too low.
Cause	**Possible Solution**
The proper braking resistor option has not been installed	Select a braking resistor option that it fits the drive braking transistor specification.
A regenerative converter, regenerative unit, or braking unit is being used	Set L8-55 to 0 to disable the braking transistor protection selection.

HOA Keypad Display	Fault Name
rH	Braking Resistor Overheat
	Braking resistor protection was triggered. Fault detection is enabled when L8-01 = 1 (disabled as a default).
Cause	**Possible Solution**
Deceleration time is too short and excessive regenerative energy is flowing back into the drive	• Check the load, deceleration time, and speed. • Reduce the load inertia. • Increase the deceleration times (C1-01 to C1-04). • Replace the dynamic braking option with a larger device that can handle the power that is discharged.
The duty cycle is too high	Check the duty cycle. Maximum of 3% duty cycle is available when L8-01 = 1.
Excessive braking inertia	Recalculate braking load and braking power. Reduce the braking load by adjusting braking resistor settings.
The braking operation duty cycle is too high	Check the braking operation duty cycle. Braking resistor protection for ERF-type braking resistors (L8-01 = 1) allows a braking duty cycle of maximum 3%.
The proper braking resistor has not been installed	• Check the specifications and conditions for the braking resistor device. • Select the optimal braking resistor.
Note:	The magnitude of the braking load trips the braking resistor overheat alarm, NOT the surface temperature. Using the braking resistor more frequently than its rating permits will trip the alarm even when the braking resistor surface is not very hot.

HOA Keypad Display	Fault Name
rr	Dynamic Braking Transistor
	The built-in dynamic braking transistor failed.
Cause	**Possible Solution**
The braking transistor is damaged	• Cycle power to the drive and check for reoccurrence of the fault.
The control circuit is damaged	• Replace either the control board or the entire drive. For instructions on replacing the control board, contact Yaskawa or a Yaskawa representative.

HOA Keypad Display	Fault Name
SC	IGBT Short Circuit or Ground Fault
Cause	**Possible Solution**
IGBT fault	• Check motor wiring. • Turn off the power supply, then turn it on. If the problem continues, contact your Yaskawa representative or the nearest Yaskawa sales office.
IGBT short circuit detection circuit fault	
The drive is damaged	• Check the drive output side short circuit for a broken output transistor B1 and U/T1, V/T2, W/T3 – and U/T1, V/T2, W/T3 • Contact your Yaskawa representative or nearest Yaskawa sales office.

HOA Keypad Display	Fault Name
SEr	Too Many Speed Search Restarts
	The number of Speed Search restarts exceeded the value set to b3-19.
Cause	**Possible Solution**
Parameters related to Speed Search are set to the wrong values	• Reduce the detection compensation gain during Speed Search (b3-10). • Increase the current level when attempting Speed Search (b3-17). • Increase the detection time during Speed Search (b3-18). • Repeat Auto-Tuning.
The motor is coasting in the opposite direction of the Run command	Set b3-14 to 1 to enable Bi-Directional Speed Search.

HOA Keypad Display	Fault Name
Single Phase Foldback	Single Phase Foldback
	Output speed is being limited due to excessive DC Bus voltage ripple.
Cause	**Possible Solution**
An input phase has been lost. In single phase applications, excess load is being drawn by the motor.	Reduce the output load.

HOA Keypad Display	Fault Name
SPL Suction Pressure Loss	Suction Pressure Loss
	Wire-break detection for suction pressure.
Cause	**Possible Solution**
An analog input programmed for setting 23 “WaterLvl/Suction” has dropped below 3 mA or risen above 21 mA for longer than 1 second.	Repair pressure sensor or wiring.

HOA Keypad Display	Fault Name
TdE	Time Data Error
Cause	**Possible Solution**
An error has occurred in the Real-Clock Time function of the HOA keypad.	Replace the HOA keypad. For instructions on replacing the HOA keypad, contact Yaskawa or your nearest sales representative.

HOA Keypad Display	Fault Name
TIE	Time Interval Error
Cause	**Possible Solution**
An error has occurred in the Real-Clock Time function of the HOA keypad.	Replace the HOA keypad. For instructions on replacing the HOA keypad, contact Yaskawa or your nearest sales representative.

HOA Keypad Display	Fault Name
TIM	Time Not Set
Cause	**Possible Solution**

The Real-Time Clock for the HOA keypad is not set in parameter o4-17 and a feature that requires RTC information is enabled. • The drive is a new drive, first power-up condition • o4-17 was set to 2, Reset, by the user, manually clearing the Real-Time Clock data.	Set o4-17 to 1 to set the time for the HOA keypad. The drive will display the "Clock Not Set" alarm when the Real time Clock is not set. Additionally, at power up, if the "TIM" condition is present, the drive will automatically switch to the time setting screen (o4-17 = 1) for 30 seconds to prompt the user to set the Real-Time Clock.
The user did not set the Real Time Clock when prompted following power-up.	Cycle power to the drive and set the Real Time Clock within 30 seconds of power-up, or set the clock manually via parameter o4-17.
The HOA keypad battery is low or the battery has been replaced.	Replace the HOA keypad battery and set the Real-Time Clock.
An error has occurred in the Real-Time Clock function of the HOA keypad.	Replace the digital operator. For instructions on replacing the HOA keypad, contact Yaskawa or your nearest sales representative.

HOA Keypad Display	Fault Name
TLGI Geothermal Input	Temperature Lost Geothermal Input
	The geothermal input is not present.
Cause	**Possible Solution**
The input signal level has dropped below 3 mA or risen above 21 mA when the drive was running and b1-01 = 5, H3-0□ = 21 (Geothermal Input), H3-0□ = 2 (4 to 20 mA), and Q2-09 = 2 (Fault).	Confirm that the device connected to the analog input terminal is installed and working properly.
The drive was running while b1-01 = 5, H3-0□≠ 21 (Geothermal Temp), and Q2-09 = 2 (Fault).	Assign one of the analog inputs to “Geothermal Temperature”, H3-0□ = 21.

HOA Keypad Display	Fault Name
UL3	Undertorque Detection 1
	The current has fallen below the minimum value set for torque detection (L6-02) for longer than the allowable time (L6-03).
Cause	**Possible Solution**
Parameter settings are not appropriate for the load	Check the settings of parameters L6-02 and L6-03.
There is a fault on the machine side	Check the load for any problems.

HOA Keypad Display	Fault Name
UL4	Undertorque Detection 2
	The current has fallen below the minimum value set for torque detection (L6-05) for longer than the allowable time (L6-06).
Cause	**Possible Solution**
Parameter settings are not appropriate for the load	Check L6-05 and L6-06 settings
There is a fault on the machine side	Check the load for any problems.

HOA Keypad Display	Fault Name
UL6	Motor Underload
	The load has fallen below the underload curve defined in L6-14.
Cause	**Possible Solution**
The output current has fallen below the motor underload curve defined in L6-14 for longer than the time set to L6-03	Adjust the value set to L6-14 so that output current remains above the motor underload curve during normal operation.

HOA Keypad Display	Fault Name
Uv1	DC Bus Undervoltage
	One of the following conditions occurred while the drive was running: • Voltage in the DC bus fell below the undervoltage detection level (L2-05). • For 200 V class drives: approximately 190 V • For 400 V class drives: approximately 380 V (350 V when E1-01 is less than 400) • For 600 V class drives: approximately 475 V The fault is output only if L2-01 is set to 0 or 1 and the DC bus voltage has fallen below the level set to L2-05 for longer than the time set to L2-02.
Cause	**Possible Solution**
Input power phase loss	• The main circuit drive input power is wired incorrectly. • Correct the wiring.
One of the drive input power wiring terminals is loose	• Ensure there are no loose terminals. • Apply the tightening torque specified in this manual to fasten the terminals. ***Refer to Wire Gauges and Tightening Torque on page 87*** for details.
There is a problem with the voltage from the drive input power	• Check the voltage. • Correct the voltage to be within the range listed in drive input power specifications. • If there is no problem with the power supply to the main circuit, check for problems with the main circuit magnetic contactor.
The power has been interrupted	Correct the drive input power.
The main circuit capacitors are worn	• Check the maintenance time for the capacitors (U4-05). • Replace either the control board or the entire drive if U4-05 exceeds 90%. For instructions on replacing the control board, contact Yaskawa or a Yaskawa representative.
The relay or contactor on the soft-charge bypass circuit is damaged	• Cycle power to the drive and see if the fault reoccurs. • If the problem continues, replace either the control board or the entire drive. For instructions on replacing the control board, contact Yaskawa or a Yaskawa representative. • Check monitor U4-06 for the performance life of the soft-charge bypass. • Replace either the control board or the entire drive if U4-06 exceeds 90%. For instructions on replacing the control board, contact Yaskawa or a Yaskawa representative.

HOA Keypad Display	Fault Name
Uv2	Control Power Supply Voltage Fault
	Voltage is too low for the control drive input power.
Cause	**Possible Solution**
In drive models 2A0004 to 2A0056 or 4A0002 to 4A0031, L2-02 was changed from its default value without installing a Momentary Power Loss Ride-Thru unit	Correct the setting to L2-02 or install an optional Momentary Power Loss Ride-Thru unit.
Control power supply wiring is damaged	• Cycle power to the drive. Check if the fault reoccurs. • If the problem continues, replace the control board, the entire drive, or the control power supply. For instructions on replacing the control board, contact Yaskawa or a Yaskawa representative.
Internal circuitry is damaged	• Cycle power to the drive. Check if the fault reoccurs. • If the problem continues, replace either the control board or the entire drive. For instructions on replacing the control board, contact Yaskawa or a Yaskawa representative.

HOA Keypad Display	Fault Name
Uv3	Undervoltage 3 (Soft-Charge Bypass Circuit Fault)
	The soft-charge bypass circuit failed.
Cause	**Possible Solution**
The relay or contactor on the soft-charge bypass circuit is damaged	• Cycle power to the drive and see if the fault reoccurs. • If the problem continues, replace either the control board or the entire drive. For instructions on replacing the control board, contact Yaskawa or a Yaskawa representative. • Check monitor U4-06 for the performance life of the soft-charge bypass. • Replace either the control board or the entire drive if U4-06 exceeds 90%. For instructions on replacing the control board, contact Yaskawa or a Yaskawa representative.

HOA Keypad Display	Fault Name
VLTS	Volute-Thermostat Fault
Cause	**Possible Solution**

The digital input assigned to the volute/thermostat input (H1-0☐ = 88 or 89) is active.	Check the wiring or wait for the volute or motor to cool.
Both volute/thermostat inputs are programmed simultaneously (H1-0☐ = 88 and 89).	• Program only one digital input to either H1-0☐ = 88 or H1-0☐ = 89. • Auto-restart of this fault is controlled by parameter L5-53, Volute-TStat Retry Selection.

HOA Keypad Display	Fault Name
voF	Output Voltage Detection Fault
	Problem detected with the voltage on the output side of the drive.
Cause	**Possible Solution**
Hardware is damaged. Internal drive module MC / FAN overheat protection circuit board is due to abnormal ambient operating power.	• Lower ambient temperature. • Replace the control board or the entire drive. For instructions on replacing the control board, contact Yaskawa or a Yaskawa representative.

HOA Keypad Display	Fault Name
vToL	VT Overload
Cause	**Possible Solution**
The output current of the drive has been elevated for a set length of time.	The application may not be suited for the drive • The application may not be suited for the drive • The drive is undersized for the load

HOA Keypad Display	Fault Name
WLL Water Level Loss	Water Level Loss
Cause	**Possible Solution**
An analog input programmed for setting 23 “WaterLvl/Suction” has dropped below 3 mA or risen above 21 mA for longer than 1 second.	Repair level sensor or wiring.

5.3 Alarm Detection

◆ Alarm Codes, Causes, and Possible Solutions

Alarms are drive protection functions that do not necessarily cause the drive to stop. After removing the cause of an alarm, the drive will return to the same status is was before the alarm occurred.

When an alarm has been triggered, the ALM light on the HOA keypad display blinks and the alarm code display flashes. If a multi-function output is set for an alarm (H2-☐☐ = 10), that output terminal will be triggered.

Note: If a multi-function output is set to close when an alarm occurs (H2-☐☐ = 10), it will also close when maintenance periods are reached, triggering alarms LT-1 through LT-4 (triggered only if H2-☐☐ = 2F).

Table 5.3 Alarm Codes, Causes, and Possible Solutions

HOA Keypad Display	Minor Fault Name
AnalogFB Lost Switched to Net	Analog Feedback Lost
	Analog feedback has not been detected and the network PI feedback signal is now used.
Cause	**Possible Solution**
Defective or broken analog input source.	Confirm that the PI feedback source is installed and working properly. If there is no feedback source, set P9-02 to 3 so the drive will read the network PI feedback from another drive.
H3-0☐ is not set to B (PI Feedback)	Set H3-0☐ to B if the analog input source is to be used for PI feedback. Set P9-02 to 3 if the drive does not have an analog PI feedback source.

HOA Keypad Display	Minor Fault Name
AnalogWL/SP Lost Switched to Net	Analog Water Level / Suction Pressure Lost
	Network Water Level / Suction Pressure is now being used because a wire-break was detected with the analog signal. Water Level Analog Input Wire Break (WL Wire Break) is effective when Q4-16 is set to 1 (Alarm). Suction Pressure Analog Input Wire Break (SP Wire Break) is effective when Q5-19 is set to 1 (Alarm).
Cause	**Possible Solution**
• Defective or broken analog input source. • Wire-break detected with the Water Level / Suction Pressure analog signal (H3-☐☐ = 23).	• Confirm that the Water Level or Suction Pressure source is installed and working properly. • Confirm that the Q4-16 and Q5-19 settings are correct. • Set P9-50 to 3 if the drive does not have an analog input source.

HOA Keypad Display	Minor Fault Name
Anti-Jam Active	Anti-Jam Alarm
Cause	**Possible Solution**
The drive was not able to clear debris from the impeller in fewer than the attempts set in P7-02. This is only effective when P7-01, Anti-jam Operation is set to 1 (enabled).	• Check for proper pump operation. • Set the Anti-jam fault characteristics in P7-02 to P7-08. • Drive response to this condition is controlled by P7-01, Anti-jam Operation Selection.

HOA Keypad Display	Minor Fault Name
bb	Baseblock
	Drive output interrupted as indicated by an external baseblock signal.
Cause	**Possible Solution**
External baseblock signal was entered via one of the multi-function input terminals (S1 to S8).	Check external sequence and baseblock signal input timing.

HOA Keypad Display	Minor Fault Name
boL	Braking Transistor Overload Fault
	The braking transistor in the drive has been overloaded.
Cause	**Possible Solution**
The proper braking resistor has not been installed.	Select the proper braking resistor.

HOA Keypad Display	Minor Fault Name
bUS	Option Communication Error
	• The connection was lost after initial communication was established. • Assign a Run command frequency reference to the option.
Cause	**Possible Solution**
Connection is broken or master controller stopped communicating.	• Check for faulty wiring. • Correct the wiring. • Check for disconnected cables and short circuits. Repair as needed.
Option is damaged.	If there are no problems with the wiring and the fault continues to occur, replace the option.
The option is not properly connected to the drive.	• The connector pins on the option are not properly lined up with the connector pins on the drive. • Reinstall the option.
A data error occurred due to noise.	• Check options available to minimize the effects of noise. • Take steps to counteract noise in the control circuit wiring, main circuit lines and ground wiring. • Try to reduce noise on the controller side. • Use surge absorbers on magnetic contactors or other equipment causing the disturbance. • Use recommended cables or some other type of shielded line. Ground the shield to the controller side or on the input power side. • Separate the wiring for communication devices from the drive input power lines. Install an EMC noise filter to the drive input power.

HOA Keypad Display	Minor Fault Name
CALL	Serial Communication Transmission Error
	Communication has not yet been established.
Cause	**Possible Solution**
Communications wiring is faulty, there is a short circuit, or something is not connected properly.	• Check for wiring errors. • Correct the wiring. • Check for disconnected cables and short circuits. Repair as needed.
Programming error on the master side.	Check communications at start-up and correct programming errors.
Communications circuitry is damaged.	• Perform a self-diagnostics check. • If the problem continues, replace either the control board or the entire drive. For instructions on replacing the control board, contact Yaskawa or your nearest sales representative.
Termination resistor setting is incorrect.	Install a termination resistor at both ends of a communication line. Set the internal termination resistor switch correctly on slave drives. Place DIP switch S2 to the ON position.

HOA Keypad Display	Minor Fault Name
CE	MEMOBUS/Modbus Communication Error
	Control data was not received correctly for two seconds.
Cause	**Possible Solution**
A data error occurred due to noise.	• Check options available to minimize the effects of noise. • Take steps to counteract noise in the control circuit wiring, main circuit lines, and ground wiring. • Reduce noise on the controller side. • Use surge absorbers for the magnetic contactors or other components that may be causing the disturbance. • Use only recommended shielded line. Ground the shield on the controller side or on the drive input power side. • Separate all wiring for communication devices from drive input power lines. Install an EMC noise filter to the drive input power supply.
Communication protocol is incompatible.	• Check the H5 parameter settings and the protocol setting in the controller. • Ensure settings are compatible.
The CE detection time (H5-09) is set shorter than the time required for a communication cycle to take place.	• Check the PLC. • Change the software settings in the PLC. • Set a longer CE detection time using parameter H5-09.
Incompatible PLC software settings or there is a hardware problem.	• Check the PLC. • Remove the cause of the error on the controller side.
Communications cable is disconnected or damaged.	• Check the connector to make sure the cable has a signal. • Replace the communications cable.

HOA Keypad Display	Minor Fault Name
CrST	Cannot Reset
Cause	**Possible Solution**
Fault reset was being executed when a Run command was entered.	• Ensure that a Run command cannot be entered from the external terminals or option during fault reset. • Turn off the Run command.

HOA Keypad Display	Minor Fault Name
dnE	Drive Disabled
Cause	**Possible Solution**
“Drive Enable” is set to a multi-function contact input (H1-☐☐ = 6A) and the contact is open.	Check the operation sequence.

HOA Keypad Display	Minor Fault Name
EF	Forward/Reverse Run Command Input Error
	Both forward run and reverse run closed simultaneously for longer than 0.5 s.
Cause	**Possible Solution**
Sequence error	Check the forward and reverse command sequence and correct the problem. **Note:** When minor fault EF detected, motor ramps to stop.

HOA Keypad Display	Minor Fault Name
EF0	Option Card External Fault
	An external fault condition is present.
Cause	**Possible Solution**
An external fault was received from the PLC with F6-03 set to 3, which allows the drive to continue running after an external fault occurs.	• Remove the cause of the external fault. • Remove the external fault input from the PLC.
There is a problem with the PLC program.	Check the PLC program and correct problems.

HOA Keypad Display	Minor Fault Name
EF1	Pump Fault (Input Terminal S1)
	External fault at multi-function input terminal S1.
EF2	Pump fault (input terminal S2)
	External fault at multi-function input terminal S2.
EF3	Pump fault (input terminal S3)
	External fault at multi-function input terminal S3.
EF4	Pump fault (input terminal S4)
	External fault at multi-function input terminal S4.
EF5	Pump fault (input terminal S5)
	External fault at multi-function input terminal S5.
EF6	Pump fault (input terminal S6)
	External fault at multi-function input terminal S6.
EF7	Pump fault (input terminal S7)
	External fault at multi-function input terminal S7.
EF8	Pump fault (input terminal S8)
	External fault at multi-function input terminal S8.
Cause	**Possible Solutions**
An external device has tripped an alarm function.	Remove the cause of the external fault and reset the multi-function input value.
Wiring is incorrect.	• Ensure the signal lines have been connected properly to the terminals assigned for external fault detection (H1-☐☐ = 2C to 2F). • Reconnect the signal line.
Multi-function contact inputs are set incorrectly.	• Check if the unused terminals have been set for H1-☐☐ = 2C to 2F (External Fault). • Change the terminal settings.

Troubleshooting

5

HOA Keypad Display	Minor Fault Name
EoF	Emergency Override Forward Run
Cause	**Possible Solution**
The multi-function digital input for EmergOverrideFWD (H1-☐☐ = AF) has been closed.	Open H1-☐☐ = AF if the emergency condition is no longer present

HOA Keypad Display	Minor Fault Name
Eor	Emergency Override Reverse Run
Cause	**Possible Solution**
The multi-function digital input for EmergOverrideREV (H1-☐☐ = B0) has been closed.	Open H1-☐☐ = B0 if the emergency condition is no longer present

HOA Keypad Display	Minor Fault Name
Feedback Loss Go To Freq. b5-13	PI Feedback Loss The drive will run at the speed set in b5-13, Feedback Loss Goto Frequency.
Cause	**Possible Solutions**
PI feedback source is incorrectly installed or is not working. Effective only when b5-12 is set to 3 (Run at b5-13).	• Confirm that the PID feedback source is installed and working properly. • Drive response to this condition is controlled by b5-12, Feedback Loss 4 to 20 mA Detection Selection, and b5-13, Feedback Loss Go To Frequency.

HOA Keypad Display	Minor Fault Name
Feedback Loss Wire Break	PI Feedback Loss
	The analog input programmed for PID feedback has gone above 21 mA or fallen below 3 mA.
Cause	**Possible Solutions**
PI feedback source is incorrectly installed or is not working. This is effective only when b5-12 Feedback Loss 4 to 20 mA Detection Selection is set to 1 (alarm).	• Confirm that the PID feedback source is installed and working properly. • Drive response to this condition is controlled by b5-12, Feedback Loss 4 to 20 mA Detection Selection, and b5-13, Feedback Loss Go To Frequency. • Auto-restart of this fault is controlled by L5-42, Feedback Loss Fault Retry Selection.

HOA Keypad Display	Minor Fault Name
Freq. Ref Pump Min (P1-06)	Minimum Pump Frequency Reference
	Drive frequency reference is set lower than P1-06, Minimum Pump Frequency.
Cause	**Possible Solutions**
The frequency reference is set lower than P1-06. The frequency reference is internally set to the P1-06 value during this time. This will only be active when the following conditions are true: • Drive is NOT in PI Mode • Minimum Pump Frequency is enabled (P1-06 > 0.00)	Increase the frequency reference to a value greater than P1-06.

HOA Keypad Display	Minor Fault Name
Freq. Ref Thrust (P4-12)	Thrust Frequency Reference
	The fixed frequency reference is set to a value lower than the P4-12, Thrust Frequency, setting.
Cause	**Possible Solutions**
The frequency reference is set lower than P4-12. The frequency reference is internally set to the P4-12 value during this time. This will only be active when the following conditions are true: • Drive is NOT in PI Mode • Thrust bearing is enabled (P4-12 > 0.00)	Increase the frequency reference to a value greater than P4-12.

HOA Keypad Display	Minor Fault Name
Geo Params Chk Q2-05 to Q2-08	Geothermal Mode Parameters
	The drive is running at the level set in Q2-03 due to an incorrect setting.

Cause	Possible Solutions
The temperature parameter values are set incorrectly.	Set the temperature parameters in the following order: Q2-08 > Q2-07 > Q2-06 > Q2-05

HOA Keypad Display	Minor Fault Name
HCA	Current Alarm
	Drive current exceeded overcurrent warning level (150% of the rated current).
Cause	**Possible Solutions**
Load is too heavy.	Reduce the load for applications with repetitive operations (i.e., stops and starts), or replace the drive.
Acceleration and deceleration times are too short.	• Calculate the torque required during acceleration and for the inertia moment. • If the torque level is not right for the load, take the following steps: • Increase the acceleration and deceleration times (C1-01 through C1-04). • Increase the capacity of the drive.
A special-purpose motor is being used, or the drive is attempting to run a motor greater than the maximum allowable capacity.	• Check the motor capacity. • Use a motor appropriate for the drive. Ensure the motor is within the allowable capacity range.
The current level increased due to Speed Search after a momentary power loss or while attempting to perform a fault restart.	The alarm will only appear briefly. There is no need to take action to prevent the alarm from occurring in such instances.

HOA Keypad Display	Minor Fault Name
High Feedback High FB Sensed	High Feedback Level Alarm
	The feedback signal is too high.
Cause	**Possible Solutions**
The feedback level has risen above the level set in P1-11, High Feedback Level This is only effective when P1-13, High Feedback Selection, is set to 1 (Alarm and digital out).	• Decrease the feedback signal. • Set the High Feedback alarm characteristics in P1-11 and P-12. • Drive response to this condition is controlled by P1-13, High Feedback Selection.

HOA Keypad Display	Fault Name
LOP	Loss of Prime
	The pump has lost its prime and P1-22 is set to 1.
Cause	**Possible Solution**
The measured quantity of water has dropped below the level set in P1-19, Prime Loss Level, for the time set in P1-20, Loss of Prime Time, and the output frequency has risen above P1-21, Prime Loss Frequency. This could be due to a dry well, air in the system, or no water in the system. This is effective only when P1-22 Loss of Prime Selection is set to 1 (alarm).	• If there is resistance in the pump, allow the system to pump water again. • Set the Loss of Prime alarm characteristics in P1-18, P1-19, P1-20, and P1-21. • Drive response to this condition is controlled by P1-21, Loss of Prime Selection.

HOA Keypad Display	Minor Fault Name
Low City Pressure	Low City Pressure
Cause	**Possible Solution**
Insufficient pressure is present on the inlet to the pump.	• Check pressure switch contact for correct operation. • Check control wiring to drive terminal strip from pressure switch contact. • Check to make sure that suction pressure is present by means of a separate measuring device.

HOA Keypad Display	Minor Fault Name
Low Feedback Low FB Sensed	Low Feedback Level Alarm
	The feedback signal is too low.
Cause	**Possible Solutions**
The feedback level has dropped below the level set in P1-08, Low Feedback Level This is only effective when P1-10, Low Feedback Selection, is set to 1 (Alarm and digital out).	• Increase the feedback signal. • Set the Low Feedback alarm characteristics in P1-08 and P1-09. • Drive response to this condition is controlled by P1-10, Low Feedback Selection.

HOA Keypad Display	Minor Fault Name
Low Suction Pressure	Low Suction Pressure
Cause	**Possible Solution**
Insufficient suction pressure is present. This is only effective when Q5-11, Low Suction Pressure Behavior Select is set to 1 (alarm).	• Check pressure switch contact for correct operation. • Check control wiring to drive terminal strip from pressure switch contact. • Check to make sure that suction pressure is present by means of a separate measuring device. • Increase the system pressure. • Set the Low Suction alarm characteristics in Q5-09, Q5-10, and Q5-18. • Drive response to this condition is controlled by Q5-11, Low Suction Pressure Behavior Select.

HOA Keypad Display	Minor Fault Name
Low Water in Tank	Low Water in Tank
Cause	**Possible Solution**
The water level in the tank is too low. This is only effective when Q4-11, Low Level Behavior is set to 1 (alarm).	• Check pressure switch contact for correct operation. • Check control wiring to drive terminal strip from pressure switch contact. • Check to make sure that suction pressure is present by means of a separate measuring device. • Raise the water level. • Set the Low Water Level alarm characteristics in Q4-09 and Q4-10. • Drive response to this condition is controlled by Q4-11, Low Level Behavior.

HOA Keypad Display	Fault Name
Low WL/SP Drive Disabled	Low Water Level / Suction Pressure Disabled
	Water Level or Suction Pressure is below the Q4-06/Q5-06 setting.
Cause	**Possible Solution**
Drive is not allowed to run in MEMOBUS multiplex when P9-51 is set to 1, the Water Level or Suction Pressure is below the Q4-06/Q5-06 setting, and the drive is stopped or running as a lag drive.	• Confirm that the Water Level or Suction Pressure source is installed and working properly. • Wait for the Water Level or Suction Pressure to recover.

HOA Keypad Display	Minor Fault Name
LT-1	Cooling Fan Maintenance Time
	The cooling fan has reached its expected maintenance period and may need to be replaced. **Note:** An alarm output (H2-☐☐ = 10) will only be triggered if both (H2-☐☐ = 2F and H2-☐☐ = 10) are set.
Cause	**Possible Solution**
The cooling fan has reached 90% of its expected performance life.	Replace the cooling fan and set o4-03 to 0 to reset the Maintenance Monitor.

HOA Keypad Display	Minor Fault Name
LT-2	Capacitor Maintenance Time
	The main circuit and control circuit capacitors are nearing the end of their expected performance life. **Note:** An alarm output (H2-☐☐ = 10) will only be triggered if H2-☐☐ = 2F.
Cause	**Possible Solution**
The main circuit and control circuit capacitors have reached 90% of their expected performance lives.	Replace either the control board or the entire drive. For instructions on replacing the control board, contact Yaskawa or your nearest sales representative.

HOA Keypad Display	Minor Fault Name
LT-3	Soft Charge Bypass Relay Maintenance Time
	The DC bus soft charge relay is nearing the end of its expected performance life. **Note:** An alarm output (H2-☐☐ = 10) will only be triggered if H2-☐☐ = 2F.
Cause	**Possible Solution**
The DC bus soft charge relay has reached 90% of expected performance life.	Replace either the control board or the entire drive. For instructions on replacing the control board, contact Yaskawa or your nearest sales representative.

HOA Keypad Display	Minor Fault Name
LT-4	IGBT Maintenance Time (50%)
	IGBTs have reached 50% of their expected performance life. **Note:** An alarm output (H2-☐☐ = 10) will only be triggered if H2-☐☐ = 2F.
Cause	**Possible Solution**
IGBTs have reached 50% of their expected performance life.	Check the load, carrier frequency, and output frequency.

HOA Keypad Display	Minor Fault Name
Net Flow Meter Lost, Chk Source	Net Flow Meter Loss
	There is no drive on the MEMOBUS network with an analog flow meter.
Cause	**Possible Solution**
When P1-01 = 3, P6-01 > 0, and P9-40 = 3, the flow meter function has not received a valid flow rate from another drive that is also running the flow meter function.	• Set P9-40 to 0 if the drive has an operational flow meter connected to an analog or pulse input terminal. • If another drive on the MEMOBUS network has a flow meter connected to an analog or pulse input terminal, confirm that drive is online with parameter settings P6-01 > 0 and P9-40 = 0.

HOA Keypad Display	Minor Fault Name
NETSCAN Waiting for Master	NETSCAN
	Drive is waiting for a message from the master.
Cause	**Possible Solution**
No message was received from the master within the time set in P9-28.	• Increase the P9-26 setting to account for network latency. • Verify that there is a drive on the network with parameter P1-01 set to 3 and P9-27 to 0. • Check network connections and verify H5-01 and P9-25 settings for all drives on the network.

HOA Keypad Display	Minor Fault Name
NMS	Not Maintaining Setpoint
	The setpoint cannot be maintained and P1-17 is set to 1.
Cause	**Possible Solution**
When the feedback deviates from the setpoint at a level greater than P1-15, for a time set in P1-16. This is effective only when P1-17 is set to 1 (alarm).	• Check for a blocked impeller, over cycling, or broken pipe. • Set the Not Maintaining Setpoint alarm characteristics in P1-16 and P1-17. • Drive response to this condition is controlled by P1-17, Not Maintaining Setpoint Selection.

HOA Keypad Display	Minor Fault Name
oH	Heatsink Overheat
	The temperature of the heatsink exceeded the overheat pre-alarm level set to L8-02.
Cause	**Possible Solution**
Surrounding temperature is too high	• Check the surrounding temperature. • Improve the air circulation within the enclosure panel. • Install a fan or air conditioner to cool surrounding area. • Remove anything near drive that may cause extra heat.
Internal cooling fan has stopped.	• Replace the cooling fan. • After replacing the drive, set parameter o4-03 to 0 to reset the cooling fan operation time.
Airflow around the drive is restricted.	• Provide proper installation space around the drive as indicated in the manual. ***Refer to Installation Orientation and Spacing on page 34*** for details. • Allow for the proper space and ensure that there is sufficient circulation around the control panel.
	• Check for dust or other foreign materials clogging the cooling fan. • Clear debris caught in the fan that restricts air circulation.

HOA Keypad Display	Minor Fault Name
oH2	Drive Overheat Warning
	"Drive Overheat Warning" was input to a multi-function input terminal, S1 through S8 (H1-☐☐= B).
Cause	**Possible Solution**
An external device triggered an overheat warning in the drive.	Search for the device that tripped the overheat warning. Remove the cause of the problem.

HOA Keypad Display	Minor Fault Name
oH3	Motor Overheat
	The motor overheat signal entered to a multi-function analog input terminal exceeded the alarm level (H3-02, H3-06 or H3-10 = E).
Cause	**Possible Solutions**
Motor thermostat wiring is faulty (PTC input).	Repair the PTC input wiring.
There is a fault on the machine side (e.g., the machine is locked up).	• Check the status of the machine. • Remove the cause of the fault.
Motor has overheated.	• Check the load size, accel/decel times, and cycle times. • Decrease the load. • Increase accel and decel times (C1-01 to C1-04). • Adjust the preset V/f pattern (E1-04 through E1-10). This involves reducing E1-08 and E1-10. **Note:** Refrain from lowering E1-08 and E1-10 excessively to prevent a reduction in load tolerance at low speeds. • Check the motor-rated current. • Enter motor-rated current on motor nameplate (E2-01). • Ensure the motor cooling system is operating normally. • Repair or replace the motor cooling system.

HOA Keypad Display	Fault Name
oH4	Motor Overheat Fault (PTC Input)
	• The motor overheat signal to analog input terminal A1, A2, or A3 exceeded the fault detection level. • Detection requires setting multi-function analog inputs H3-02, H3-10, or H3-06 to E.
Cause	**Possible Solution**
Motor has overheated	• Check the size of the load, the accel/decel times, and the cycle times. • Decrease the load. • Increase the acceleration and deceleration times (C1-01 through C1-04).
	• Adjust the preset V/f pattern (E1-04 through E1-10) by reducing E1-08 and E1-10. • Do not set E1-08 and E1-10 too low. This reduces load tolerance at low speeds.
	• Check the motor rated current. • Enter the motor rated current to parameter E2-01 as indicated on the motor nameplate. • Ensure the motor cooling system is operating normally. • Repair or replace the motor cooling system.

HOA Keypad Display	Minor Fault Name
ov	DC Bus Overvoltage
	The DC bus voltage exceeded the trip point. • For 200 V class drives: approximately 410 V • For 400 V class drives: approximately 820 V (740 V when E1-01 is less than 400) • For 600 V class drives: approximately 1040 V
Cause	**Possible Solutions**
Surge voltage present in the drive input power.	• Install a DC link choke or an AC reactor. • Voltage surge can result from a thyristor convertor and a phase advancing capacitor operating on the same drive input power system.
The motor is short-circuited.	• Check the motor power cable, relay terminals and motor terminal box for short circuits. • Correct grounding shorts and turn the power back on.
Ground current has overcharged the main circuit capacitors via the drive input power.	
Noise interference causes the drive to operate incorrectly.	• Review possible solutions for handling noise interference. • Review section on handling noise interference and check control circuit lines, main circuit lines and ground wiring. • If the magnetic contactor is identified as a source of noise, install a surge protector to the MC coil.
	Set number of fault restarts (L5-01) to a value other than 0.

HOA Keypad Display	Minor Fault Name
PASS	MEMOBUS/Modbus Comm. Test Mode Complete
Cause	**Possible Solution**

MEMOBUS/Modbus test has finished normally.	This verifies that the test was successful.

HOA Keypad Display	Minor Fault Name
PoC	Pump Over Cycle
Cause	**Possible Solution**
The pump has exceeded the number of cycles set in P2-10 in the time set in P2-11 and P2-12 is set to 1 (alarm).	• Set the Pump Over Cycle alarm characteristics in P2-10 and P2-11. • Drive response to this condition is controlled by P2-12, Over Cycling Mode.

HOA Keypad Display	Minor Fault Name
R-DNE-S☐	Remote Drive Disable
Cause	**Possible Solution**
Terminal S☐ (H1-0☐ = 95) has been closed for the time set in P4-26, Remote Drive Disable On-Delay, when P4-25, Remote Drive Disable Selection, was set to 0 (N.O.).	Remove conditions causing the terminal to close.
Terminal S☐ (H1-0☐ = 95) has been open for the time set in P4-26, Remote Drive Disable On-Delay, when P4-25, Remote Drive Disable Selection, was set to 1 (N.C.).	Remove conditions causing the terminal to open.

HOA Keypad Display	Minor Fault Name
rUn	Motor Switch during Run
	A command to switch motors was entered during run.
Cause	**Possible Solution**
A motor switch command was entered during run.	Change the operation pattern so that the motor switch command is entered while the drive is stopped.

HOA Keypad Display	Minor Fault Name
SE	MEMOBUS/Modbus Communication Test Mode Error **Note:** This alarm will not trigger a multi-function output terminal that is set for alarm output (H2-☐☐ = 10).
Cause	**Possible Solution**
A digital input set to 67H (MEMOBUS/Modbus test) was closed while the drive was running.	Stop the drive and run the test again.

HOA Keypad Display	Minor Fault Name
Temperature Lost Geothermal Input	Temperature Lost Geothermal Input
	The geothermal input is not present.
Cause	**Possible Solution**
The input signal level has dropped below 3 mA or risen above 21 mA and b1-01 = 5, H3-0☐ = 21 (Geothermal Input), H3-0☐ = 2 (4 to 20 mA), and Q2-09 = 1 (Alarm).	Confirm that the device connected to the analog input terminal is installed and working properly.
Parameter b1-01 = 5, H3-0☐≠ 21 (Geothermal Temp), and Q2-09 = 1 (Alarm).	Assign one of the analog inputs to “Geothermal Temperature”, H3-0☐ = 21.
The input signal level has dropped below 3 mA or risen above 21 mA when the drive was in HAND Mode or had no Run command and b1-01 = 5, H3-0☐ = 21 (Geothermal Input), H3-0☐ = 2 (4 to 20 mA), and Q2-09 = 1 (Alarm).	Confirm that the device connected to the analog input terminal is installed and working properly.

HOA Keypad Display	Minor Fault Name
TrPC	IGBT Maintenance Time (90%)
	IGBTs have reached 90% of their expected performance life.
Cause	**Possible Solution**

IGBTs have reached 90% of their expected performance life.	Replace the drive.

HOA Keypad Display	Minor Fault Name
Uv	Undervoltage
	One of the following conditions was true when the drive was stopped and a Run command was entered: • DC bus voltage dropped below the level specified in L2-05. • Contactor to suppress inrush current in the drive was opened. • Low voltage in the control drive input power. This alarm outputs only if L2-01 is not 0 and DC bus voltage is under L2-05.
Cause	**Possible Solution**
Phase loss in the drive input power.	Check for wiring errors in the main circuit drive input power. Correct the wiring.
Loose wiring in the drive input power terminals.	• Ensure the terminals have been properly tightened. • Apply the tightening torque to the terminals as specified. ***Refer to Wire Gauges and Tightening Torque on page 87***.
There is a problem with the drive input power voltage.	• Check the voltage. • Lower the voltage of the drive input power so that it is within the limits listed in the specifications.
Drive internal circuitry is worn.	• Check the maintenance time for the capacitors (U4-05). • Replace either the control board or the entire drive if U4-05 exceeds 90%. For instructions on replacing the control board, contact Yaskawa or your nearest sales representative.
The drive input power transformer is too small and voltage drops when the power is switched on.	• Check for an alarm when the magnetic contactor, line breaker, and leakage breaker are closed. • Check the capacity of the drive input power transformer.
Air inside the drive is too hot.	Check the temperature inside the drive.
The CHARGE light is broken or disconnected.	Replace either the control board or the entire drive. For instructions on replacing the control board, contact Yaskawa or your nearest sales representative.

HOA Keypad Display	Minor Fault Name
WrUn	Waiting for Run
Cause	**Possible Solutions**
The Run command has been applied and the b1-11 timer is active.	Adjust b1-11 to the desired delay time. The drive sill start normally after the b1-11 timer expires.

5.4 Operator Programming Errors

◆ Operator Programming Error Codes, Causes, and Possible Solutions

An Operator Programming Error (oPE) occurs when a contradictory parameter is set or an individual parameter is set to an inappropriate value.

The drive will not operate until the parameter or parameters causing the problem are set correctly. An oPE, however, does not trigger an alarm or fault output. If an oPE occurs, investigate the cause and refer to *Table 5.4* for the appropriate action. When an oPE appears on the operator display, press the ENTER button to view U1-18 and see which parameter is causing the oPE.

Table 5.4 oPE Codes, Causes, and Possible Solutions

HOA Keypad Display	Error Name
oPE01	Drive Capacity Setting Fault
	Drive capacity and the value set to o2-04 do not match.
Cause	**Possible Solutions**
The drive model selection (o2-04) and the actual capacity of the drive are not the same.	Correct the value set to o2-04.

HOA Keypad Display	Error Name
oPE02	Parameter Range Setting Error
	Use U1-18 to find parameters set outside the range.
Cause	**Possible Solutions**
Parameters were set outside the possible setting range.	Set parameters to the proper values.
Note: When multiple errors occur simultaneously, other errors are given precedence over oPE02.	

HOA Keypad Display	Error Name
oPE03	Multi-Function Input Selection Error
	A contradictory setting is assigned to multi-function contact inputs H1-01 to H1-08.
Cause	**Possible Solutions**
• The same function is assigned to two multi-function inputs. • Excludes “Not used” and “External Fault.”	• Ensure all multi-function inputs are assigned to different functions. • Re-enter the multi-function settings to ensure this does not occur.
The Up command was set but the Down command was not, or vice versa (settings 10 vs. 11).	Properly set the functions that required for use in combination with other functions.
The Up 2 command was set but the Down 2 command was not, or vice versa (settings 75 vs. 76).	
• Run/Stop command for a 2-wire sequence was set (H1-☐☐ = 42), but Forward/Reverse command (H1-☐☐ = 43) was not. • “Drive Enable” is set to multi-function input S1 or S2 (H1-01 = 6A or H1-02 = 6A).	Properly set the functions that required for use in combination with other functions.
Two of the following functions are set simultaneously: • Up/Down Command (10 vs. 11) • Up 2/Down 2 Command (75 vs. 76) • Hold Accel/Decel Stop (A) • Analog Frequency Reference Sample/Hold (1E) • Offset Frequency 1, 2, 3 Calculations (44, 45, 46)	• Check if contradictory settings have simultaneously been assigned to the multi-function input terminals. • Correct setting errors.
The Up/Down command (10, 11) and PID control (b5-01) are enabled simultaneously.	Set b5-01 to 0 to disable control PID or disable the Up/Down command.

Settings for N.C. and N.O. input for the following functions were selected simultaneously: • External Search Command 1 and External Search Command 2 (61 vs. 62) • Fast Stop N.O. and Fast Stop N.C. (15 vs. 17) • KEB for Momentary Power Loss and High Slip Braking (65, 66, 7A, 7B vs. 68) • Motor Switch Command and Accel/Decel Time 2 (16 vs. 1A) • KEB Command 1 and KEB Command 2 (65, 66 vs. 7A, 7B) • FWD Run Command (or REV) and FWD/REV Run Command (2-wire) (40, 41 vs. 42, 43) • External DB Command and Drive Enable (60 vs. 6A) • Motor Switch Command and Up 2/Down 2 Command (16 vs. 75, 76)	• Check if contradictory settings have simultaneously been assigned to the multi-function input terminals. • Correct setting errors.
One of the following settings was entered while H1-□□ = 2 (External Reference 1/2): • b1-15 = 4 (Pulse Train Input) but the pulse train input selection is not set for the frequency reference (H6-01 > 0) • b1-15 or b1-16 set to 3 but no option card is connected • Although b1-15 = 1 (Analog Input) and H3-02 or H3-10 are set to 0 (Frequency Bias)	Correct the settings for the multi-function input terminal parameters.
H2-□□ is set to 38 (Drive Enabled) and H1-□□ is not set to 6A (Drive Enable).	

HOA Keypad Display	Error Name
oPE04	Initialization Required, Term <–> Ctrl Chg
Cause	**Possible Solutions**
The drive, control board, or terminal board have been replaced and the parameter settings between the control board and the terminal board no longer match.	Set A1-03 to 5550 to load the parameter settings stored in the terminal board to the drive. Initialize parameters after drive replacement by setting A1-03 to 1110 or 2220.

HOA Keypad Display	Error Name
oPE05	Run Command/Frequency Reference Source Selection Error
Cause	**Possible Solutions**
Frequency reference is assigned to an option card (b1-01 = 3) and an input option card is not connected to the drive.	Reconnect the input option card to the drive.
The Run command is assigned to an option card (b1-02 = 3) and an input option card is not connected to the drive.	
Frequency reference is assigned to the pulse train input (b1-01 = 4) and terminal RP is not set for frequency reference input (H6-01 > 0)	Set H6-01 to 0.

HOA Keypad Display	Error Name
oPE07	Multi-Function Analog Input Selection Error
	A contradictory setting is assigned to multi-function analog inputs H3-02, H3-10, or H3-06 and PID functions conflict.
Cause	**Possible Solutions**
At least two analog input terminals are set to the same function (i.e., at least two of these parameters have the same setting: H3-02, H3-10, or H3-06).	Change the settings to H3-02, H3-10, and H3-06 so that functions no longer conflict. **Note:** Both 0 (Frequency Reference Bias) and F (Not Used) can be set to H3-02, H3-10, or H3-06 simultaneously.

The following simultaneous contradictory settings: • H3-02, H3-10, or H3-06 = B (PID Feedback) while H6-01 (Pulse Train Input) = 1 (PID Feedback) • H3-02, H3-10, or H3-06 = C (PID Target Value) while H6-01 = 2 (pulse train input sets the PID target value) • H3-02, H3-10, or H3-06 = C (PID Target Value) while b5-18 = 1 (enables b5-19 as the target PID value) • H6-01 = 2 (PID target) while b5-18 = 1 (enables b5-19 as the target PID value)	Disable one of the PID selections.

HOA Keypad Display	Error Name
oPE09	PID Control Selection Fault
	PID control function selection is incorrect. Requires that PID control is enabled (b5-01 = 1 to 4).
Cause	**Possible Solutions**
The following simultaneous contradictory settings have occurred: • b5-15 is not set to 0.0 (PID Sleep Function Operation Level) • The stopping method is set to either DC Injection Braking or coast to stop with a timer (b1-03 = 2 or 3).	• Set b5-15 to a value other than 0.0. • Set the stopping method to coast to stop or ramp to stop (b1-03 = 0 or 1).
b5-01 is set to 1 or 2, enabling PID control, but the lower limit for the frequency reference (d2-02) is not set to 0 while reverse output is enabled (b5-11 = 1).	Correct the parameter settings.
b5-01 is set to 3 or 4, enabling PID control, but the lower limit for the frequency reference (d2-01) is not 0.	Correct the parameter settings.

HOA Keypad Display	Error Name
oPE10	V/f Data Setting Error
	One of the following setting errors has occurred: E1-09 ≤ E1-07 < E1-06 ≤ E1-11 ≤ E1-04
Cause	**Possible Solutions**
V/f pattern setting error.	Correct the settings for E1-04, E1-06, E1-07, E1-09, and E1-11.

HOA Keypad Display	Error Name
oPE11	Carrier Frequency Setting Error
	Correct the setting for the carrier frequency.
Cause	**Possible Solutions**
The following simultaneous contradictory settings have occurred: C6-05 > 6 and C6-04 > C6-03 (carrier frequency lower limit is greater than the upper limit). If C6-05 ≤ 6, the drive operates at C6-03.	Correct the parameter settings.
The upper and lower limits between C6-02 and C6-05 are contradictory.	

HOA Keypad Display	Error Name
oPE28	Sequence Timer Error
	One or more of the sequence timers is not set in the correct order.
Cause	**Possible Solutions**
One of the following contradictory settings is true: • S2-01 > S2-02 • S2-06 > S2-07 • S2-11 > S2-12 • S2-16 > S2-17	Correct the parameter settings.

HOA Keypad Display	Error Name
oPE29	Geothermal Set Error
Cause	**Possible Solutions**
P1-01 parameter selection is not compatible with Geothermal Mode (b1-01 = 5).	Confirm b1-01 and P1-01 parameter settings.

HOA Keypad Display	Error Name
oPE30	Flow Meter Input Error
Cause	**Possible Solutions**
Analog and pulse flow meters are programmed simultaneously. H6-01 is set to 5 and either H3-02, H3-06, or H3-10 is set to 22.	Reprogram H6-01, H3-02, H3-06, or H3-10.
Flow meter scaling is set to 0 and the flow meter is being used as PID feedback. P6-01 is set to 0.0, P1-02 is set to 25 and b5-01 is set to a value higher than 0.	Reprogram P6-01, P1-02, or b5-01.

HOA Keypad Display	Error Name
oPE31	Water Level/Suction
Cause	**Possible Solutions**
Both Q4-01, Water Level Selection, and Q5-01, Suction Pressure Select, are set to a non-zero value.	Reprogram Q4-01 or Q5-01.

HOA Keypad Display	Error Name
oPE32	Incompatible Network Water Level/Suction Pressure Mode
Cause	**Possible Solutions**
Low Water Level or Suction Pressure Turn-Off Method (P9-51) is restricted to Water Level Source of Analog Only (P9-50 = 0).	Confirm parameter settings for P9-50 and P9-51.

HOA Keypad Display	Error Name
oPE33	Parameter selection is incompatible with the selected network P9-99
Cause	**Possible Solutions**
When P1-01 = 3 (MEMOBUS Networking) and P9-99 = 0 (A-Version 30034), one of the following parameters has been set: • P9-01 = 2 (Stop History) • P9-05 = 3 (Follow Lead Speed) • Q4-01 > 0 (Water Level Enabled) • Q5-01 > 0 (Suction Pressure Control Enabled) • P6-01 > 0 (Flow Meter Enabled) and P9-40 = 3 (Network)	Confirm parameter settings for P1-01, P9-99, P6-01, P9-05, P9-40, Q4-01, and Q5-01.

5.5 Auto-Tuning Fault Detection

When the Auto-Tuning faults shown below are detected, the fault is displayed on the HOA keypad and the motor coasts to a stop. Auto-Tuning faults do not trigger a multi-function terminal set for fault or alarm output.

An End□ error indicates that although Auto-Tuning has successfully completed, there is some discrepancy in the calculations. If an End□ error occurs, check for the cause of the error using the table in this section, and perform Auto-Tuning again or manually set the motor parameters after fixing the problem. Start the application if no problem can be diagnosed despite the existence of the End□ error.

◆ Auto-Tuning Codes, Causes, and Possible Solutions

Table 5.5 Auto-Tuning Codes, Causes, and Possible Solutions

HOA Keypad Display	Error Name
End1	Excessive V/f Setting (detected only during Rotational Auto-Tuning and displayed after Auto-Tuning is complete)
Cause	**Possible Solutions**
The torque reference exceeded 20% during Auto-Tuning.	• Prior to Auto-Tuning, verify the information on the motor nameplate. • Enter proper values from motor nameplate to parameters T1-02 and T1-04 and repeat Auto-Tuning. • If possible, disconnect the motor from the load and perform Auto-Tuning. If the load cannot be uncoupled, use the current Auto-Tuning results.
The results from Auto-Tuning the no-load current exceeded 80%.	

HOA Keypad Display	Error Name
End2	Motor Iron-Core Saturation Coefficient (detected only during Rotational Auto-Tuning and displayed after Auto-Tuning is complete)
Cause	**Possible Solutions**
Motor data entered during Auto-Tuning was incorrect.	• Make sure the data entered to the T1 parameters match the information written on the motor nameplate. • Restart Auto-Tuning and enter the correct information.
Results from Auto-Tuning are outside the parameter setting range, assigning the iron-core saturation coefficients (E2-07 and E2-08) to temporary values.	• Check and correct faulty motor wiring. • Disconnect the motor from machine and perform Rotational Auto-Tuning.

HOA Keypad Display	Error Name
End3	Rated Current Setting Alarm (displayed after Auto-Tuning is complete)
Cause	**Possible Solutions**
The correct current rating printed on the motor nameplate was not entered into T1-04.	• Check the setting of parameter T1-04. • Check the motor data and repeat Auto-Tuning.

HOA Keypad Display	Error Name
End4	Adjusted Slip Calculation Error
Cause	**Possible Solutions**
The calculated slip is outside the allowable range.	• Make sure the data entered for Auto-Tuning is correct. • If possible, perform Rotational Auto-Tuning. If not possible, perform Stationary Auto-Tuning 2.

HOA Keypad Display	Error Name
End5	Resistance Tuning Error
Cause	**Possible Solutions**
The calculated resistance value is outside the allowable range.	• Double-check the data entered for the Auto-Tuning process. • Check the motor and motor cable connection for faults.

HOA Keypad Display	Error Name
End6	Leakage Inductance Alarm
Cause	**Possible Solutions**
The calculated leakage inductance value is outside the allowable range.	Double-check the data entered for the Auto-Tuning process.

HOA Keypad Display	Error Name
End7	No-Load Current Alarm
Cause	**Possible Solutions**
The entered no-load current value was outside the allowable range.	Check and correct faulty motor wiring.
Auto-Tuning results were less than 5% of the motor rated current.	Double-check the data entered for the Auto-Tuning process.

HOA Keypad Display	Error Name
Er-01	Motor Data Error
Cause	**Possible Solutions**
Motor data or data entered during Auto-Tuning was incorrect .	• Check that the motor data entered to T1 parameters matches motor nameplate input before Auto-Tuning. • Restart Auto-Tuning and enter the correct information.
Motor output power and motor-rated current settings (T1-02 and T1-04) do not match.	• Check the drive and motor capacities. • Correct the settings of parameters T1-02 and T1-04.
Motor rated current and detected no-load current are inconsistent.	• Check the motor rated current and no-load current. • Correct the settings of parameters T1-04 and E2-03.

HOA Keypad Display	Error Name
Er-02	Minor Fault
Cause	**Possible Solutions**
An alarm was triggered during Auto-Tuning.	Exit the Auto-Tuning menu, check the alarm code, remove the alarm cause, and repeat Auto-Tuning.

HOA Keypad Display	Error Name
Er-03	STOP Button Input
Cause	**Possible Solutions**
Auto-Tuning canceled by pressing STOP button.	Auto-Tuning did not complete properly. Restart Auto-Tuning.

HOA Keypad Display	Error Name
Er-04	Line-to-Line Resistance Error
Cause	**Possible Solutions**
Motor data entered during Auto-Tuning was incorrect.	• Make sure the data entered to the T1 parameters match the information written on the motor nameplate. • Restart Auto-Tuning and enter the correct information.
Results from Auto-Tuning are outside the parameter setting range or the tuning process took too long.	Check and correct faulty motor wiring.
Faulty motor cable or cable connection.	

HOA Keypad Display	Error Name
Er-05	No-Load Current Error
Cause	**Possible Solutions**
Motor data entered during Auto-Tuning was incorrect.	• Make sure the data entered to the T1 parameters match the information written on the motor nameplate. • Restart Auto-Tuning and enter the correct information.
Results from Auto-Tuning are outside the parameter setting range or the tuning process took too long.	• Check and correct faulty motor wiring. • Perform Rotational Auto-Tuning.
The load was too high during Rotational Auto-tuning.	• Disconnect the motor from machine and restart Auto-Tuning. If motor and load cannot be uncoupled make sure the load is lower than 30%. • If a mechanical brake is installed, make sure it is fully lifted during tuning.

HOA Keypad Display	Error Name
Er-08	Rated Slip Error
Cause	**Possible Solutions**
Motor data entered during Auto-Tuning was incorrect.	• Make sure the data entered to the T1 parameters match the information written on the motor nameplate. • Restart Auto-Tuning and enter the correct information.
Results from Auto-Tuning are outside the parameter setting range or the tuning process took too long.	• Check and correct faulty motor wiring. • Perform Rotational Auto-Tuning.
The load was too high during rotational Auto-tuning.	• Disconnect the motor from machine and restart Auto-Tuning. If motor and load cannot be uncoupled make sure the load is lower than 30%. • If a mechanical brake is installed, make sure it is fully lifted during tuning.

HOA Keypad Display	Error Name
Er-09	Acceleration Error
Cause	**Possible Solutions**
The motor did not accelerate for the specified acceleration time.	• Increase the acceleration time (C1-01). • Disconnect the machine from the motor if possible.
Torque limit when motoring is too low (L7-01 and L7-02)	• Check L7-01 and L7-02 settings. • Increase the setting.
The load was too high during Rotational Auto-Tuning.	• Disconnect the motor from machine and restart Auto-Tuning. If motor and load cannot be uncoupled make sure the load is lower than 30%. • If a mechanical brake is installed, make sure it is fully lifted during tuning.

HOA Keypad Display	Error Name
Er-11	Motor Speed Fault
Cause	**Possible Solutions**
Torque reference is too high.	• Increase the acceleration time (C1-01). • Disconnect the machine from the motor if possible.

HOA Keypad Display	Error Name
Er-12	Current Detection Error
Cause	**Possible Solutions**
One of the motor phases is missing: (U/T1, V/T2, W/T3).	Check motor wiring and correct any problems.
The current exceeded the current rating of the drive.	• Check motor wiring for a short between motor lines. • Close any magnetic contactors used between motors. • Replace the control board or the entire drive. For instructions on replacing the control board, contact Yaskawa or your nearest sales representative.
The current is too low.	
Attempted Auto-Tuning without motor connected to the drive.	Connect the motor and restart Auto-Tuning.
Current detection signal error.	Replace the control board or the entire drive. For instructions on replacing the control board, contact Yaskawa or your nearest sales representative.

HOA Keypad Display	Error Name
Er-13	Leakage Inductance Error
Cause	**Possible Solutions**
Drive was unable to complete tuning for leakage inductance within 300 seconds.	• Check all wiring and correct any mistakes. • Check the motor rated current value written on the motor nameplate and enter the correct value to T1-04.

HOA Keypad Display	Error Name
Er-17	Reverse Prohibited Error
Cause	**Possible Solutions**

Drive is prohibited from rotating the motor in reverse while attempting to perform Inertia Tuning.	• Inertia Auto-Tuning cannot be performed if the drive is restricted from rotating in reverse. • Assuming it is acceptable for the application to rotate in reverse, set b1-04 to 0 and then perform Inertia Tuning.

5.6 Copy Function Related Displays

◆ Tasks, Errors, and Troubleshooting

The table below lists the messages and errors that may appear when using the Copy function.

When executing the tasks offered by the Copy function, the keypad will indicate the task being performed. When an error occurs, a code appears on the keypad to indicate the error. Note that errors related to the Copy function do not trigger a multi-function output terminal that has been set up to close when a fault or alarm occurs. To clear an error, simply press any key on the keypad and the error display will disappear.

Table 5.6 lists the corrective action that can be taken when an error occurs.

Note:
1. Whenever using the copy function, the drive should be fully stopped.
2. The drive will not accept a Run command while the Copy function is being executed.
3. Parameters can only be saved to a drive when the voltage class, capacity, control mode, and software version match.

Table 5.6 Copy Function Task and Error Displays

HOA Keypad Display	Task
CoPy	Writing Parameter Settings (flashing)
Cause	**Possible Solutions**
Parameters are being written to the drive.	This is not an error.

HOA Keypad Display	Task
CPyE	Error Writing Data
Cause	**Possible Solutions**
Failed writing parameters	Attempt to write parameters again.

HOA Keypad Display	Task
CSEr	Copy Unit Error
Cause	**Possible Solutions**
Hardware fault	Replace the HOA keypad or the USB Copy Unit.

HOA Keypad Display	Task
dFPS	Drive Model Mismatch
Cause	**Possible Solutions**
The drives used in the copy and write process are not the same model. • The drive from which the parameters were copied is a different model. • The drive to be written to is a different model.	• Verify the model number of the drive from which the parameters were copied and the model of the drive to which those parameters will be written. • Make sure the two drives are the same model and have the same software version.

HOA Keypad Display	Task
End	Task Complete
Cause	**Possible Solutions**
Finished reading, writing, or verifying parameters.	This is not an error.

HOA Keypad Display	Task
iFEr	Communication Error
Cause	**Possible Solutions**
A communication error occurred between the drive and the HOA keypad or the USB copy unit.	Check the cable connection.
A non-compatible cable is being used to connect the USB Copy Unit and the drive.	Use the cable originally packaged with the USB Copy Unit.

HOA Keypad Display	Task
ndAT	Model, Voltage Class, Capacity Mismatch
Cause	**Possible Solutions**

The drive from which the parameters were copied and the drive to which the parameters will be written have different electrical specifications, capacities, are set to different control modes, or are different models.	Make sure model numbers and specifications are the same for both drives.
The device being used to write the parameters is blank and does not have any parameters saved on it.	Make sure all connections are correct, and copy the parameter settings onto the USB Copy Unit or the HOA keypad.

HOA Keypad Display	Task
rdEr	Error Reading Data
Cause	**Possible Solutions**
Failed while attempting to read parameter settings from the drive.	Press and hold the READ key on the USB Copy Unit for at least one second to have the unit read parameters from the drive.

HOA Keypad Display	Task
rEAd	Reading Parameter Settings (flashing)
Cause	**Possible Solutions**
Displayed while the parameter settings are being read onto the USB Copy Unit.	This is not an error.

HOA Keypad Display	Task
vAEr	Voltage Class, Capacity Mismatch
Cause	**Possible Solutions**
The drive from which the parameters were copied and the drive on which the Verify mode is being performed have different electrical specifications or are a different capacity.	Make sure electrical specifications and capacities are the same for both drives.

HOA Keypad Display	Task
vFyE	Parameter settings in the drive and those saved to the copy function are not the same
Cause	**Possible Solutions**
Indicates that parameter settings that have been Read and loaded onto the Copy Unit or HOA keypad are different.	To synchronize parameters, either write the parameters saved on the USB Copy Unit or HOA keypad onto the drive, or Read the parameter settings on the drive onto the USB Copy Unit.

HOA Keypad Display	Task
vrFy	Comparing Parameter Settings (flashing)
Cause	**Possible Solutions**
The Verify mode has confirmed that parameters settings on the drive and parameters read to the copy device are identical.	This is not an error.

5.7 HOA Keypad Display Messages

The table below lists messages and errors that may appear during normal pump operation.

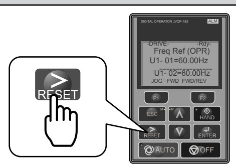
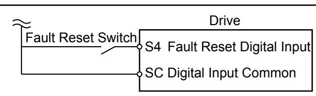
These messages do not trigger multi-function output terminals that have been set up to close when a fault or alarm occurs.

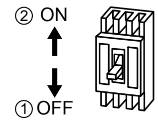
Table 5.7 HOA Keypad Display Messages

HOA Keypad Display	Description
Start Delay Timer Active	Displayed when the feedback level has reached the level set in P1-04, Start Level, and the Start Delay timer is incrementing.
Sleep Active Wait for Start	Displayed when the drive is in Sleep Mode or when the drive is waiting for the feedback level to reach the level set in P1-04, Start Level.
Sleep Boost Active	Displayed when the drive entering Sleep Mode and the pressure setpoint is being boosted. During this time, the U1-01, Frequency Reference, monitor will be updated with the boosted setpoint.
Start Delay Adjust b1-11	Displayed when the drive start is being delayed by Coast to Stop with Timer. This time is adjusted by parameter b1-11, Coast to Stop with Timer Time.
Feedback Drop Check	Displayed when the drive is determining whether the feedback will change abruptly when the drive enters Sleep Mode. Drop Level is configured by P2-08, Delta Sleep Feedback Drop Level, and P2-09 Feedback Detection Drop Time.
Pre Chg Mode Pre-chy Active	Displayed during Pre-Charge Mode.
Thrust Mode Thrust Active	Displayed during Thrust Mode.
Utility Delay Adjust by P4-17	Displayed when the drive is delaying the Run command due to the Utility Start Delay Function.
Lube Pump Active	Displayed when the drive is delaying the start of the motor and the Lube Pump digital output is energized.
LOCK Parameter Locked	Displayed after an attempt to change a parameter when A1-01 = 3. Unlock the keypad by setting A1-01 = 2.
Anti Jam Active	Displayed when the drive is performing the anti-jam function.
Sleep Active Min Water Level	Displayed when the drive has gone to sleep because the water level has dropped below the level set in Q4-04 for longer than the time set in Q4-05.
Sleep Active Min Suction Pres	Displayed when the drive has gone to sleep because the suction level has dropped below the level set in Q5-04 for longer than the time set in Q5-05.
Net Start Delay P9-29 Active	Displayed when the MEMOBUS network is waiting for the P9-29 timer to elapse.
Network FB Lost Check FB Source	Displayed when no valid analog PI feedback source can be found on the network and network PI feedback has been lost.
Net Pump Err Chk Faulted Pump	Displayed when the drive has been stopped because another drive in the network has a system fault or a Low City Pressure alarm.
Net Water Level or Suction Lost	Displayed when the network source for Water Level or Suction Control Pressure has been lost.
Net Geothm Tmp Lost, Chk Source	Displayed when no valid analog Geothermal Temperature source can be found on the network.

◆ Fault Reset Methods

When a fault occurs, the cause of the fault must be removed and the drive must be restarted. The table below lists the different ways to restart the drive.

After the Fault Occurs	Procedure	
Fix the cause of the fault, restart the drive, and reset the fault	Press RESET on the HOA keypad.	
Resetting via a multi-function digital input programmed for Fault Reset (H1-□□ = 14).	For example, close then open the fault signal digital input via terminal S4. S4 is set for "Fault Reset" as default (H1-04 = 14).	

After the Fault Occurs	Procedure
Turn off the main power supply if the above methods do not reset the fault. Reapply power after the HOA keypad display has turned off. When an “SC” error occurs, contact Yaskawa or a Yaskawa agent before cycling the power to the drive.	

Note: If the Run command is present, the drive will disregard any attempts to reset the fault. Remove the Run command before attempting to clear a fault situation.

5.8 Auto-Tuning

◆ Types of Auto-Tuning

The drive offers different types of Auto-Tuning for induction motors. Refer to the tables below to select the type of Auto-Tuning that bests suits the application.

■ Auto-Tuning for Induction Motors

This feature automatically sets the V/f pattern and motor parameters E1-□□ and E2-□□ for an induction motor.

Table 5.8 Types of Auto-Tuning for Induction Motors

Type	Setting	Application Conditions and Benefits	Control Mode	
			V/f	OLV
Stationary Auto-Tuning for Line-to-Line Resistance	T1-01 = 2	• The drive is used in V/f Control and other Auto-Tuning selections are not possible. • Perform when entering motor data manually while using motor cables longer than 50 m. • Drive and motor capacities differ. • Tunes the drive after the cable between the drive and motor has been replaced with a cable over 50 m long. Assumes Auto-Tuning has already been performed. • Should not be used for any vector control modes unless the motor cable has changed.	YES	YES
Rotational Auto-Tuning for V/f Control	T1-01 = 3	• Recommended for applications using Speed Estimation Speed Search or using the Energy Saving function in V/f Control. • Assumes motor can rotate while Auto-Tuning is executed. Increases accuracy for certain functions like torque compensation, slip compensation, Energy Saving, and Speed Search.	YES	–
Stationary Auto-Tuning 2	T1-01 = 4	• Motor and load cannot be decoupled and the load is higher than 30%. • A motor test report is available. After entering the no-load current and the rated slip, the drive calculates and sets all other motor-related parameters.	–	YES

Table 5.9 lists the data that must be entered for Auto-Tuning. Make sure this data is available before starting Auto-Tuning. The necessary information is usually listed on the motor nameplate or in the motor test report provided by the motor manufacturer.

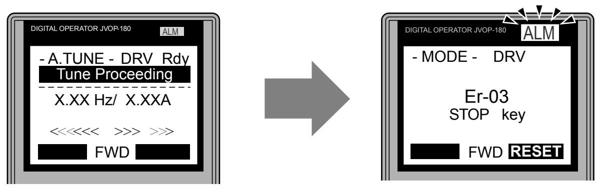
Table 5.9 Auto-Tuning Input Data

Input Value	Input Parameter	Unit	Tuning Type (T1-01)		
			2 Line-to-Line Resistance	3 Rotational for V/f Control	4 Stationary 2
Control Mode	**A1-02**	**–**	**0, 2**	**0**	**2**
Motor rated power	T1-02	kW	YES	YES	YES
Motor rated voltage	T1-03	Vac	–	YES	YES
Motor rated current	T1-04	A	YES	YES	YES
Motor rated frequency	T1-05	Hz	–	YES	YES
Number of motor poles	T1-06	-	–	YES	YES
Motor rated speed	T1-07	r/min	–	YES	YES
Motor no-load current	T1-09	A	–	–	YES
Motor rated slip	T1-10	Hz	–	–	YES
Motor iron loss	T1-11	W	–	YES	–

◆ Auto-Tuning Interruption and Fault Codes

If tuning results are abnormal or the OFF key is pressed before completion, Auto-Tuning will be interrupted and a fault code will appear on the HOA keypad.

A B



A – During Auto-Tuning B – Auto-Tuning Aborted

Figure 5.1 Auto-Tuning Aborted Display

◆ Auto-Tuning Operation Example

The following example demonstrates Stationary Auto-Tuning for Line-to-Line Resistance.

■ Selecting the Type of Auto-Tuning

Step			Display/Result
1.	Turn on the power to the drive. The initial display appears.	➡	- MODE - DRV Rdy Auto Setpoint U5-99= 0.0PSI U1-02= 0.00Hz LSEQ U1-91= 0.0PSI LREF <-MONITOR->
2.	Press ∧ or ∨ until the Auto-Tuning display appears.	➡	- MODE - PRG Auto-Tuning AUTO HELP FWD DATA
3.	Press ENTER to begin setting parameters.	➡	- A.TUNE - PRG Rdy Tuning Mode Sel T1-01= 2 *2* Term Resistance ESC FWD DATA
4.	Press ENTER to display the value for T1-01.	➡	- A.TUNE - PRG Rdy Tuning Mode Sel T1-01= 2 *2* Term Resistance "2" ← FWD →
5.	Save the setting by pressing ENTER.	➡	Entry Accepted
6.	The display automatically returns to the display shown in Step 3.	➡	- A.TUNE - PRG Rdy Tuning Mode Sel T1-01= 2 *2* Term Resistance ESC FWD DATA

■ Selecting the Type of Auto-Tuning

Step			Display/Result
1.	Turn on the power to the drive. The initial display appears.	➡	- MODE - DRV Rdy FREF (OPR) U1-01= 0.00Hz U1-02= 0.00Hz LSEQ U1-03= 0.00A LREF JOG FWD FWD/REV
2.	Press ∧ or ∨ until the Auto-Tuning display appears.	➡	- MODE - PRG Auto-Tuning AUTO HELP FWD DATA

Step			Display/Result
3.	Press ENTER to begin setting parameters.	➡	- A.TUNE - PRG Rdy Tuning Mode Sel T1-01= 2 *2* Term Resistance ESC FWD DATA
4.	Press ENTER to display the value for T1-01.	➡	- A.TUNE - PRG Rdy Tuning Mode Sel T1-01= 2 *2* Term Resistance "2" ← FWD →
5.	Save the setting by pressing ENTER.	➡	Entry Accepted
6.	The display automatically returns to the display shown in Step 3.	➡	- A.TUNE - PRG Rdy Tuning Mode Sel T1-01= 2 *2* Term Resistance ESC FWD DATA

■ Enter Data from the Motor Nameplate

After selecting the type of Auto-Tuning, enter the data required from the motor nameplate.

Note: These instructions continue from Step 6 in "Selecting the Type of Auto-Tuning".

Step			Display/Result
1.	Press ∧ to access the motor output power parameter T1-02.	➡	- A.TUNE - PRG Rdy Mtr Rated Power T1-02= 0.75kW (0.00 ~ 650.00) "0.75kW" ESC FWD DATA
2.	Press ENTER to view the default setting.	➡	- A.TUNE - PRG Rdy Mtr Rated Power T1-02= 000.75kW (0.00 ~ 650.00) "0.75kW" ← FWD →
3.	Press F1 left, F2 right, > RESET, ∧, and ∨ to enter the motor power nameplate data in kW.	➡	- A.TUNE - PRG Rdy Mtr Rated Power T1-02= 000.40kW (0.00 ~ 650.00) "0.75kW" ← FWD →
4.	Press ENTER to save the setting.	➡	Entry Accepted
5.	The display automatically returns to the display in Step 1.	➡	- A.TUNE - PRG Rdy Mtr Rated Power T1-02= 0.40kW (0.00 ~ 650.00) "0.75kW" ESC FWD DATA
6.	Repeat Steps 1 through 5 to set the following parameters: • T1-03, Motor Rated Voltage (Rotational Auto-Tuning for V/f Control only) • T1-04, Motor Rated Current • T1-05, Motor Base Frequency • T1-06, Number of Motor Poles • T1-07, Motor Base Frequency (Rotational Auto-Tuning for V/f Control only) • T1-09, Motor No-Load Current (Stationary Auto-Tuning 2 only) • T1-10, Motor Rated Slip (Stationary Auto-Tuning 2 only)	➡	- A.TUNE - PRG Rated Voltage T1-03= 200.0VAC (0.0 ~ 255.0) "200.0VAC" ESC FWD DATA ⋮ - A.TUNE - PRG Rated Current T1-04= X.XX A (0.35 ~ 7.00) "X.XX A" ESC FWD DATA

Note: To execute Stationary Auto-Tuning for line-to-line resistance only, set parameters T1-02 and T1-04.

■ Starting Auto-Tuning

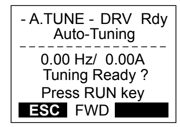
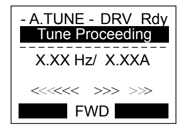
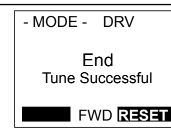
WARNING! *Sudden Movement Hazard. The drive and motor may start unexpectedly during Auto-Tuning, which could result in death or serious injury. Ensure the area surrounding the drive motor and load are clear before proceeding with Auto-Tuning.*

WARNING! *Electrical Shock Hazard. High voltage will be supplied to the motor when Stationary Auto-Tuning is performed even with the motor stopped, which could result in death or serious injury. Do not touch the motor until Auto-Tuning has been completed.*

NOTICE: *Rotational Auto-Tuning will not function properly if a holding brake is engaged on the load. Failure to comply could result in improper operation of the drive. Ensure the motor can freely spin before beginning Auto-Tuning.*

Enter the required information from the motor nameplate. Press to proceed to the Auto-Tuning start display.

Note: These instructions continue from Step 6 in "Enter Data from the Motor Nameplate".

Step			Display/Result
1.	After entering the data listed on the motor nameplate, press to confirm.	➡	
2.	Press RUN to activate Auto-Tuning. DRV flashes. The drive begins by injecting current into the motor for about 1 min, and then starts to rotate the motor. **Note:** The first digit on the display indicates which motor is undergoing Auto-Tuning. The second digit indicates the type of Auto-Tuning being performed.	➡	
3.	Auto-Tuning finishes in approximately one to two minutes.	➡	

6

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.

6.1 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 Periodic Inspection

Table 6.1 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 6.1 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.	

Inspection Area	Inspection Points	Corrective Action	Checked
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.	
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.	
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.	

6.2 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 6.2 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 6.2 Estimated Performance Life

Component	Estimated Performance Life
Cooling Fan, Circulation Fan	10 years
Electrolytic Capacitors	10 years <1>

<1> Electrolytic capacitors cannot be replaced on some lower capacity models. Complete drive replacement may be required for these models.

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 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 220 for more details.

Table 6.3 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 operator will display an alarm like shown in *Table 6.4* to indicate the specific components that may need maintenance.

Table 6.4 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 pre-charge circuit has reached 90% of its designated life time.	Contact a Yaskawa representative or the nearest Yaskawa sales office on possible drive replacement.
LT-4 <1>	LT-4	The IGBTs have reached 50% of their designated life time.	Check the load, carrier frequency, and output frequency.
TrPC <2>	TrPC	The IGBTs have reached 90% of their 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 255* 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.*

6.3 Drive Replacement

◆ Replacing the Drive

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.*

WARNING! *Electrical Shock Hazard. Do not allow unqualified personnel to perform work on the drive. Failure to comply could result in serious injury. Installation, maintenance, inspection and servicing must be performed only by authorized personnel familiar with installation, adjustment and maintenance of AC drives.*

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.*

The following procedure explains how to replace a drive.

This section provides instructions for drive replacement only.

To install option boards or other types of options, refer to the specific manuals for those options.

NOTICE: *When transferring a braking transistor, braking resistor, or other type of option from a damaged drive to a new replacement drive, make sure it is working properly before reconnecting it to the new drive. Replace broken options to prevent immediate breakdown of the replacement drive.*

1. Remove the terminal cover.

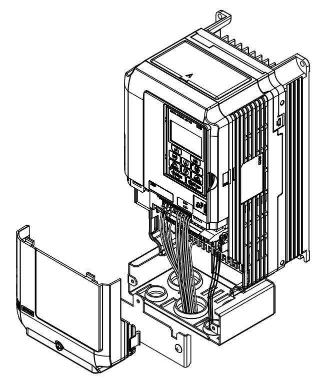


Figure 6.1 Remove the Terminal Cover

2. Loosen the screws holding the terminal board in place. Remove the screw securing the bottom cover and remove the bottom cover from the drive.

Note: IP00/Open Type enclosure drives do not have a bottom cover or conduit.

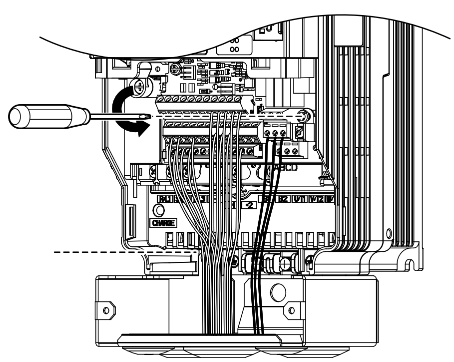


Figure 6.2 Unscrew the Terminal Board and Remove the Bottom Cover

3. Slide the terminal board as illustrated by the arrows to remove it from the drive along with the bottom cover.

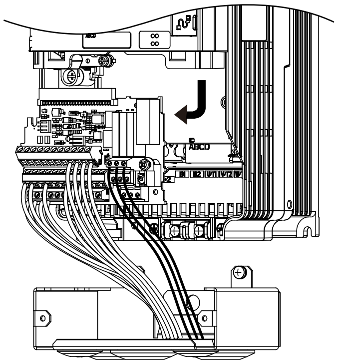


Figure 6.3 Remove the Terminal Board

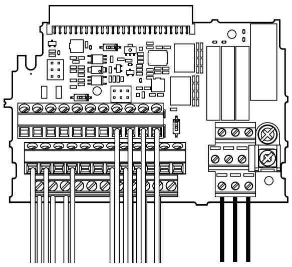


Figure 6.4 Disconnected Removable Terminal Board

4. Disconnect all option cards and options, making sure they are intact before reusing.
5. Replace the drive and wire the main circuit.

■ Installing the Drive

1. After wiring the main circuit, connect the terminal block to the drive as shown in ***Figure 6.5***. Use the installation screw to fasten the terminal block into place.

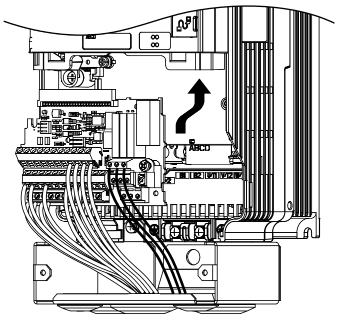


Figure 6.5 Install the Terminal Board

2. Reconnect options for the new drive the same way the options were connected in the old drive. Connect option boards to the same option ports in the new drive that were used in the old drive.
3. Replace the terminal cover.
4. After powering on the drive, all parameter settings are transferred from the terminal board to the drive memory. If an oPE04 error occurs, load the parameter settings saved on the terminal board to the new drive by setting parameter A1-03 to 5550. Reset the Maintenance Monitor function timers by setting parameters o4-01 through o4-12 to 0, and parameter o4-13 to 1.

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7

Peripheral Devices & Options

This chapter explains option installation procedures for the drive.

7.1 Option Card Installation

This section provides instructions on installing option cards.

◆ Prior to Installing the Option

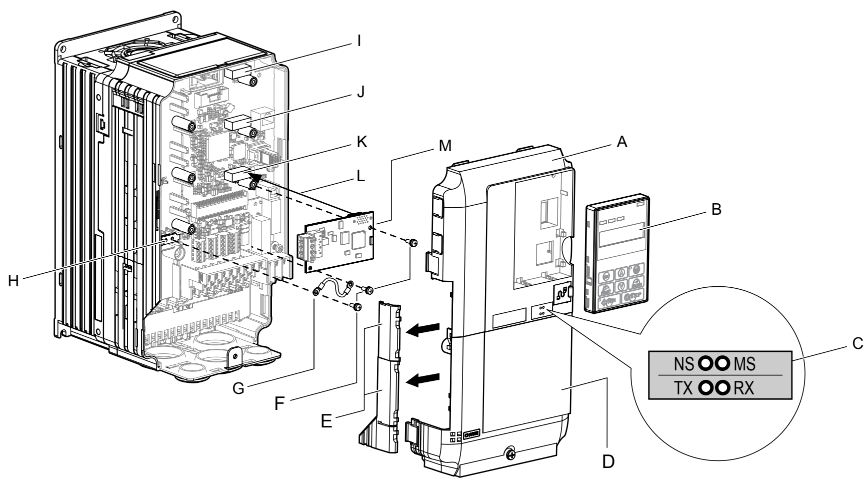
Prior to installing the option, wire the drive, make necessary connections to the drive terminals, and verify that the drive functions normally without the option installed.

Table 7.1 below lists the number of options that can be connected to the drive and the drive ports for connecting those options.

Table 7.1 Option Installation

Option	Port/Connector	Number of Options Possible
SI-P3, SI-EP3, SI-N3, SI-EN3, SI-EM3, SI-B3, SI-W3, SI-J3	CN5-A	1
AO-A3, DO-A3	CN5-A, B, C	1

Figure 7.1 shows an exploded view of the drive with the option and related components for reference.



A – Drive front cover
B – HOA keypad
C – LED label (for communication options)
D – Drive terminal cover
E – Removable tabs for wire routing
F – Included screws
G – Ground wire
H – Drive grounding terminal (FE)
I – Connector CN5-C
J – Connector CN5-B
K – Connector CN5-A
L – Insertion point for CN5 connector
M – Option

Figure 7.1 Drive Components with Option

◆ Communication Option Installation Example

Remove the front covers of the drive before installing the option. Communication options can inserted only into the CN5-A connector located on the drive control board.

Preparing the Drive

1. Shut off power to the drive, wait the appropriate amount of time for voltage to dissipate, then remove the HOA keypad (B) and front covers (A, D). Front cover removal varies by model.

   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 installing the option, disconnect all power to the drive. 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 five minutes after all indicators are off and measure the DC bus voltage level to confirm safe level.*

   NOTICE: *Damage to Equipment. Observe proper electrostatic discharge procedures (ESD) when handling the option, drive, and circuit boards. Failure to comply may result in ESD damage to circuitry.*

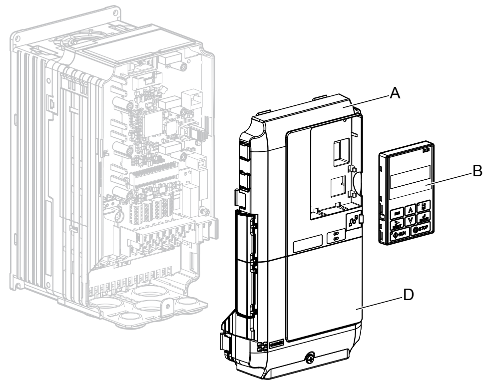


Figure 7.2 Remove the Front Covers and HOA Keypad

2. With the front covers and HOA keypad removed, apply the LED label (C) in the appropriate position on the drive top front cover (A).

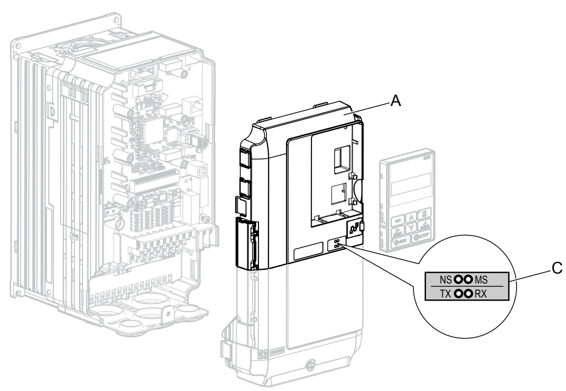


Figure 7.3 Apply the LED Label

Connecting Option and Ground Wire

1. Insert the option (M) into the **CN5-A** connector (K) located on the drive and fasten it using one of the included screws (F).

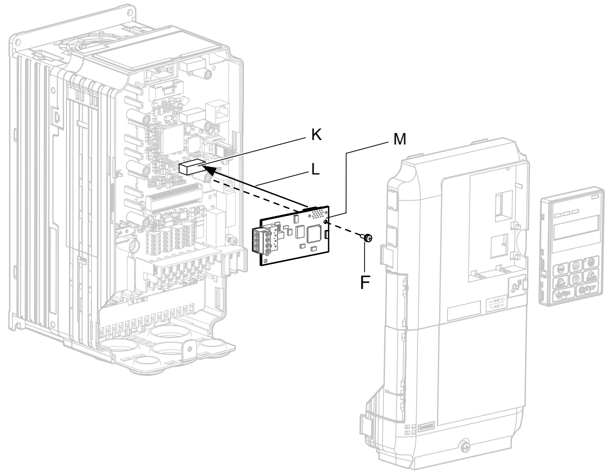


Figure 7.4 Insert the Option

2. Connect the ground wire (G) to the ground terminal (H) using one of the remaining provided screws (F). Connect the other end of the ground wire (G) to the remaining ground terminal and installation hole on the option (M) using the last remaining provided screw (F) and tighten both screws to 0.5 ~ 0.6 N m or (4.4 ~ 5.3 in lbs).

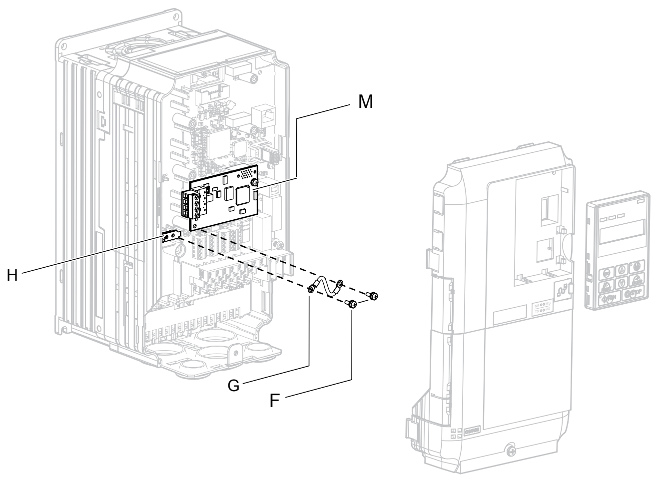


Figure 7.5 Connect the Ground Wire

Note: There are two screw holes on the drive for use as ground terminals. When connecting three options, two ground wires will need to share the same drive ground terminal.

Wiring the Option

1. Route the option wiring.

   Depending on the drive model, some drives may require routing the wiring through the side of the front cover to the outside to provide adequate space for the wiring. In these cases, using diagonal cutting pliers, cut out the perforated openings on the left side of the drive front cover. Sharp edges along the cut out should be smoothed down with a file or sand paper to prevent any damage to the wires.

   When installing option cards to models 2A0004 to 2A0040, 4A0002 to 4A0023, and 5A0003 to 5A0011, it may be necessary to route the cables connected to the option through the top cover to the outside. Models 2A0056 to 2A0415, 4A0031 to 4A1200, and 5A0017 to 5A0242 have enough space to keep all wiring inside the unit.

2. Connect the communication cables to the option terminal block (TB1).

Note: Separate the communications cables from the main circuit cables and other wiring and power cables. Use properly grounded shielded cables for the communication cables to prevent problems caused by electrical interference.

Replacing the Drive Covers and HOA Keypad

1. Replace and secure the front covers of the drive (A, D) and replace the HOA keypad (B).

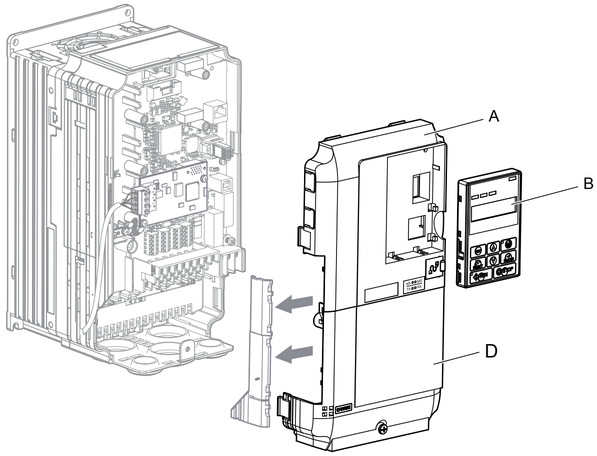


Figure 7.6 Replace the Front Covers and HOA Keypad

Note: Take proper precautions when wiring the option so that the front covers will easily fit back onto the drive. Make sure no cables are pinched between the front covers and the drive when replacing the covers.

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Appendix: A

Specifications

A.1 Power Ratings

◆ Three-Phase 200 V Class Drive Models 2A0004 to 2A0030

Table A.1 Power Ratings (Three-Phase 200 V Class)

Item			Specification							
Drive Model			2A0004	2A0006	2A0008	2A0010	2A0012	2A0018	2A0021	2A0030
Maximum Applicable Motor Capacity (HP) <1>		ND Rating	0.75	1	2	3	3	5	7.5	10
Input	Input Current (A) <2>	ND Rating	3.9	7.3	8.8	10.8	13.9	18.5	24	37
	Rated Voltage Rated Frequency		Three-phase 200 to 240 Vac 50/60 Hz/270 to 340 Vdc <3>							
	Allowable Voltage Fluctuation		-15 to 10%							
	Allowable Frequency Fluctuation		±5%							
	Input Power (kVA)	ND Rating	2.2	3.1	4.1	5.8	7.8	9.5	14	18
Output	Rated Output Capacity (kVA) <4>	ND Rating <5>	1.3	2.3	3	3.7	4.6	6.7	8	11.4
	Rated Output Current (A)	ND Rating <5>	3.5	6	8	9.6	12	17.5	21	30
	Overload Tolerance		ND Rating: 120% of rated output current for 60 s (Derating may be required for applications that start and stop frequently)							
	Carrier Frequency		User-adjustable between 1 and 15 kHz <5>							
	Maximum Output Voltage (V)		Three-phase 200 to 240 V (proportional to input voltage)							
	Maximum Output Frequency (Hz)		400 Hz (user-set)							

<1> The motor capacity (HP) refers to a NEC rated 4-pole motor. The rated output current of the drive output amps should be equal to or greater than the motor current. Select the appropriate capacity drive if operating the motor continuously above motor nameplate current.

<2> Assumes operation at the rated output current. Input current rating varies depending on the power supply transformer, input reactor, wiring connections, and power supply impedance.

<3> DC is not available for UL/CE standards.

<4> Rated motor capacity is calculated with a rated output voltage of 220 V.

<5> Carrier frequency default setting is Swing PWM 1 (C6-02 = 7). C6-02 settings 1, 7, 8, 9, and A do not require current derating. All other settings raise the carrier frequency and require current derating.

◆ Three-Phase 200 V Class Drive Models 2A0040 to 2A0211

Table A.2 Power Ratings Continued (Three-Phase 200 V Class)

Item			Specification							
Drive Model			2A0040	2A0056	2A0069	2A0081	2A0110	2A0138	2A0169	2A0211
Maximum Applicable Motor Capacity (HP) <1>		ND Rating	15	20	25	30	40	50	60	75
Input	Input Current (A) <2>	ND Rating	52	68	80	96	111	136	164	200
Input	Rated Voltage Rated Frequency		Three-phase 200 to 240 Vac 50/60 Hz/270 to 340 Vdc <3>							
Input	Allowable Voltage Fluctuation		-15 to 10%							
Input	Allowable Frequency Fluctuation		±5%							
Input	Input Power (kVA)	ND Rating	27	36	44	52	51	62	75	91
Output	Rated Output Capacity (kVA) <4>	ND Rating <5>	15.2	21	26	31	42	53	64	80
Output	Rated Output Current (A)	ND Rating <5>	40	56	69	81	110	138	169	211
Output	Overload Tolerance		ND Rating: 120% of rated output current for 60 s (Derating may be required for applications that start and stop frequently)							
Output	Carrier Frequency		User-adjustable between 1 and 15 kHz <5>							User-adjustable between 1 and 10 kHz <5>
Output	Maximum Output Voltage (V)		Three-phase 200 to 240 V (proportional to input voltage)							
Output	Maximum Output Frequency (Hz)		400 Hz (user-set)							

<1> The motor capacity (HP) refers to a NEC rated 4-pole motor. The rated output current of the drive output amps should be equal to or greater than the motor current. Select the appropriate capacity drive if operating the motor continuously above motor nameplate current.

<2> Assumes operation at the rated output current. Input current rating varies depending on the power supply transformer, input reactor, wiring connections, and power supply impedance.

<3> DC is not available for UL/CE standards.

<4> Rated motor capacity is calculated with a rated output voltage of 220 V.

<5> Carrier frequency default setting is Swing PWM 1 (C6-02 = 7). C6-02 settings 1, 7, 8, 9, and A do not require current derating. All other settings raise the carrier frequency and require current derating.

◆ Three-Phase 200 V Class Drive Models 2A0250 to 2A0415

Table A.3 Power Ratings Continued (Three-Phase 200 V Class)

Item			Specification			
Drive Models			2A0250	2A0312	2A0360	2A0415
Maximum Applicable Motor Capacity (HP) <1>		ND Rating	100	125	150	175
Input	Input Current (A) <2>	ND Rating	271	324	394	471
	Rated Voltage Rated Frequency		Three-phase 200 to 240 Vac 50/60 Hz/270 to 340 Vdc <3>			
	Allowable Voltage Fluctuation		-15 to 10%			
	Allowable Frequency Fluctuation		±5%			
	Input Power (kVA)	ND Rating	124	148	180	215
Output	Rated Output Capacity (kVA) <4>	ND Rating <5>	95	119	137	158
	Rated Output Current (A)	ND Rating <5>	250	312	360	415
	Overload Tolerance		ND Rating: 120% of rated output current for 60 s (Derating may be required for applications that start and stop frequently)			
	Carrier Frequency		User-adjustable between 1 and 10 kHz <5>			
	Maximum Output Voltage (V)		Three-phase 200 to 240 V (proportional to input voltage)			
	Maximum Output Frequency (Hz)		400 Hz (user-set)			

<1> The motor capacity (HP) refers to a NEC rated 4-pole motor. The rated output current of the drive output amps should be equal to or greater than the motor current. Select the appropriate capacity drive if operating the motor continuously above motor nameplate current.

<2> Assumes operation at the rated output current. Input current rating varies depending on the power supply transformer, input reactor, wiring connections, and power supply impedance.

<3> DC is not available for UL/CE standards.

<4> Rated motor capacity is calculated with a rated output voltage of 220 V.

<5> Carrier frequency default setting is Swing PWM 1 (C6-02 = 7). C6-02 settings 1, 7, 8, 9, and A do not require current derating. All other settings raise the carrier frequency and require current derating.

◆ Three-Phase 400 V Class Drive Models 4A0002 to 4A0031

Table A.4 Power Ratings (Three-Phase 400 V Class)

Item			Specification								
Drive Models			4A0002	4A0004	4A0005	4A0007	4A0009	4A0011	4A0018	4A0023	4A0031
Maximum Applicable Motor Capacity (HP) <1>		ND Rating	0.75	2	3	3	5	7.5	10	15	20
Input	Input Current (A) <2>	ND Rating	2.1	4.3	5.9	8.1	9.4	14	20	24	38
	Rated Voltage Rated Frequency		Three-phase: 380 to 480 Vac 50/60 Hz/510 to 680 Vdc <3>								
	Allowable Voltage Fluctuation		-15 to 10%								
	Allowable Frequency Fluctuation		±5%								
	Input Power (kVA)	ND Rating	2.3	4.3	6.1	8.1	10.0	14.5	19.4	28.4	37.5
Output	Rated Output Capacity (kVA) <4>	ND Rating <5>	1.6	3.1	4.1	5.3	6.7	8.5	13.3	17.5	24
	Rated Output Current (A)	ND Rating <5>	2.1	4.1	5.4	6.9	8.8	11.1	17.5	23	31
	Overload Tolerance		ND Rating: 120% of rated output current for 60 s (Derating may be required for applications that start and stop frequently)								
	Carrier Frequency		User-adjustable between 1 and 15 kHz <5>								
	Maximum Output Voltage (V)		Three-phase: 380 to 480 V (proportional to input voltage)								
	Maximum Output Frequency (Hz)		400 Hz (user-adjustable)								

<1> The motor capacity (HP) refers to a NEC rated 4-pole motor. The rated output current of the drive output amps should be equal to or greater than the motor current. Select the appropriate capacity drive if operating the motor continuously above motor nameplate current.

<2> Assumes operation at the rated output current. Input current rating varies depending on the power supply transformer, input reactor, wiring conditions, and power supply impedance.

<3> DC is not available for UL/CE standards.

<4> Rated motor capacity is calculated with a rated output voltage of 440 V.

<5> Carrier frequency default setting is Swing PWM 1 (C6-02 = 7). C6-02 settings 1, 7, 8, 9, and A do not require current derating. All other settings raise the carrier frequency and require current derating.

◆ Three-Phase 400 V Class Drive Models 4A0038 to 4A0165

Table A.5 Power Ratings Continued (Three-Phase 400 V Class)

Item			Specification							
Drive Models			4A0038	4A0044	4A0058	4A0072	4A0088	4A0103	4A0139	4A0165
Maximum Applicable Motor Capacity (HP) <1>		ND Rating	25	30	40	50	60	75	100	125
Input	Input Current (A) <2>	ND Rating	44	52	58	71	86	105	142	170
	Rated Voltage Rated Frequency		Three-phase: 380 to 480 Vac 50/60 Hz/510 to 680 Vdc <3>							
	Allowable Voltage Fluctuation		-15 to 10%							
	Allowable Frequency Fluctuation		±5%							
	Input Power (kVA)	ND Rating	46.6	54.9	53.0	64.9	78.6	96.0	130	156
Output	Rated Output Capacity (kVA) <4>	ND Rating <5>	29	34	44	55	67	78	106	126
	Rated Output Current (A)	ND Rating <5>	38	44	58	72	88	103	139	165
	Overload Tolerance		ND Rating: 120% of rated output current for 60 s (Derating may be required for applications that start and stop frequently)							
	Carrier Frequency		User-adjustable between 1 and 15 kHz <5>						User-adjustable between 1 and 10 kHz <5>	
	Maximum Output Voltage (V)		Three-phase: 380 to 480 V (proportional to input voltage)							
	Maximum Output Frequency (Hz)		400 Hz (user-adjustable)							

<1> The motor capacity (HP) refers to a NEC rated 4-pole motor. The rated output current of the drive output amps should be equal to or greater than the motor current. Select the appropriate capacity drive if operating the motor continuously above motor nameplate current.

<2> Assumes operation at the rated output current. Input current rating varies depending on the power supply transformer, input reactor, wiring conditions, and power supply impedance.

<3> DC is not available for UL/CE standards.

<4> Rated motor capacity is calculated with a rated output voltage of 440 V.

<5> Carrier frequency default setting is Swing PWM 1 (C6-02 = 7). C6-02 settings 1, 7, 8, 9, and A do not require current derating. All other settings raise the carrier frequency and require current derating.

◆ Three-Phase 400 V Class Drive Models 4A0208 to 4A0675

Table A.6 Power Ratings Continued (Three-Phase 400 V Class)

Item			Specification						
Drive Models			4A0208	4A0250	4A0296	4A0362	4A0414	4A0515	4A0675
Maximum Applicable Motor Capacity (HP) <1>		ND Rating	150	200	250	300	350	400-450	500-550
Input	Input Current (A) <2>	ND Rating	207	248	300	346	410	465	657
	Rated Voltage Rated Frequency		Three-phase: 380 to 480 Vac 50/60 Hz/510 to 680 Vdc <3>						
	Allowable Voltage Fluctuation		-15 to 10%						
	Allowable Frequency Fluctuation		±5%						
	Input Power (kVA)	ND Rating	189	227	274	316	375	425	601
Output	Rated Output Capacity (kVA) <4>	ND Rating <5>	159	191	226	276	316	392	514
	Rated Output Current (A)	ND Rating <5>	208	250	296	362	414	515	675
	Overload Tolerance		ND Rating: 120% of rated output current for 60 s (Derating may be required for applications that start and stop frequently)						
	Carrier Frequency		User-adjustable between 1 and 10 kHz <5>				User-adjustable between 1 and 5 kHz <5>		
	Maximum Output Voltage (V)		Three-phase: 380 to 480 V (proportional to input voltage)						
	Maximum Output Frequency (Hz)		400 Hz (user-adjustable)						

<1> The motor capacity (HP) refers to a NEC rated 4-pole motor. The rated output current of the drive output amps should be equal to or greater than the motor current. Select the appropriate capacity drive if operating the motor continuously above motor nameplate current.

<2> Assumes operation at the rated output current. Input current rating varies depending on the power supply transformer, input reactor, wiring conditions, and power supply impedance.

<3> DC is not available for UL/CE standards.

<4> Rated motor capacity is calculated with a rated output voltage of 440 V.

<5> Carrier frequency default setting is Swing PWM 1 (C6-02 = 7). C6-02 settings 1, 7, 8, 9, and A do not require current derating. All other settings raise the carrier frequency and require current derating.

◆ Three-Phase 600 V Class Drive Models 5A0003 to 5A0032

Table A.7 Power Ratings (Three-Phase 600 V Class)

Item			Specification								
Drive Models			5A0003	5A0004	5A0006	5A0009	5A0011	5A0017	5A0022	5A0027	5A0032
Maximum Applicable Motor Capacity (HP) <1>		ND Rating	2	3	5	7.5	10	15	20	25	30
Input	Input Current (A) <2>	ND Rating	3.6	5.1	8.3	12	16	23	31	38	45
	Rated Voltage Rated Frequency		Three-phase 500 to 600 Vac 50/60 Hz								
	Allowable Voltage Fluctuation		-10 (-15) to +10%								
	Allowable Frequency Fluctuation		±5%								
	Input Power (kVA)	ND Rating	4.1	5.8	9.5	14	18	26	35	43	51
Output	Rated Output Capacity (kVA) <3>	ND Rating <4>	2.7	3.9	6.1	9	11	17	22	27	32
	Rated Output Current (A)	ND Rating <4>	2.7	3.9	6.1	9	11	17	22	27	32
	Overload Tolerance		ND Rating: 120% of rated output current for 60 s (Derating may be required for applications that start and stop frequently)								
	Carrier Frequency		User-adjustable between 1 and 15 kHz <4>					User-adjustable between 1 and 10 kHz <4>			
	Maximum Output Voltage (V)		Three-phase 500 to 600 V (proportional to input voltage)								
	Maximum Output Frequency (Hz)		400 Hz (user-set)								

<1> The motor capacity (HP) refers to a NEC rated 4-pole motor. The rated output current of the drive output amps should be equal to or greater than the motor current. Select the appropriate capacity drive if operating the motor continuously above motor nameplate current.

<2> Assumes operation at the rated output current. Input current rating varies depending on the power supply transformer, input reactor, wiring connections, and power supply impedance.

<3> Rated motor capacity is calculated with a rated output voltage of 575 V.

<4> Carrier frequency default setting is Swing PWM 1 (C6-02 = 7). C6-02 settings 1, 7, 8, 9, and A do not require current derating. All other settings raise the carrier frequency and require current derating.

◆ Three-Phase 600 V Class Drive Models 5A0041 to 5A0099

Table A.8 Power Ratings Continued (Three-Phase 600 V Class)

Item			Specification				
Drive Models			5A0041	5A0052	5A0062	5A0077	5A0099
Maximum Applicable Motor Capacity (HP) <1>		ND Rating	40	50	60	75	100
Input	Input Current (A) <2>	ND Rating	44	54	66	80	108
Input	Rated Voltage Rated Frequency		Three-phase 500 to 600 Vac 50/60 Hz				
Input	Allowable Voltage Fluctuation		-10 (-15) to +10%				
Input	Allowable Frequency Fluctuation		±5%				
Input	Input Power (kVA)	ND Rating	50	62	75	91	123
Output	Rated Output Capacity (kVA) <3>	ND Rating <4>	41	52	62	77	99
Output	Rated Output Current (A)	ND Rating <4>	41	52	62	77	99
Output	Overload Tolerance		ND Rating: 120% of rated output current for 60 s (Derating may be required for applications that start and stop frequently)				
Output	Carrier Frequency		User-adjustable between 1 and 10 kHz <4>				User-adjustable between 1 and 8 kHz <4>
Output	Maximum Output Voltage (V)		Three-phase 500 to 600 V (proportional to input voltage)				
Output	Maximum Output Frequency (Hz)		400 Hz (user-set)				

<1> The motor capacity (HP) refers to a NEC rated 4-pole motor. The rated output current of the drive output amps should be equal to or greater than the motor current. Select the appropriate capacity drive if operating the motor continuously above motor nameplate current.

<2> Assumes operation at the rated output current. Input current rating varies depending on the power supply transformer, input reactor, wiring connections, and power supply impedance.

<3> Rated motor capacity is calculated with a rated output voltage of 575 V.

<4> Carrier frequency default setting is Swing PWM 1 (C6-02 = 7). C6-02 settings 1, 7, 8, 9, and A do not require current derating. All other settings raise the carrier frequency and require current derating.

◆ Three-Phase 600 V Class Drive Models 5A0125 to 5A0242

Table A.9 Power Ratings Continued (Three-Phase 600 V Class)

Item			Specification			
Drive Models			5A0125	5A0145	5A0192	5A0242
Maximum Applicable Motor Capacity (HP) <1>		ND Rating	125	150	200	250
Input	Input Current (A) <2>	ND Rating	129	158	228	263
	Rated Voltage Rated Frequency		Three-phase 500 to 600 Vac 50/60 Hz			
	Allowable Voltage Fluctuation		-10 (-15) to +10%			
	Allowable Frequency Fluctuation		±5%			
	Input Power (kVA)	ND Rating	147	181	261	301
Output	Rated Output Capacity (kVA) <3>	ND Rating <4>	124	144	191	241
	Rated Output Current (A)	ND Rating <4>	125	145	192	242
	Overload Tolerance		ND Rating: 120% of rated output current for 60 s (Derating may be required for applications that start and stop frequently)			
	Carrier Frequency		User-adjustable between 1 and 3 kHz <4>			
	Maximum Output Voltage (V)		Three-phase 500 to 600 V (proportional to input voltage)			
	Maximum Output Frequency (Hz)		400 Hz (user-set)			

<1> The motor capacity (HP) refers to a NEC rated 4-pole motor. The rated output current of the drive output amps should be equal to or greater than the motor current. Select the appropriate capacity drive if operating the motor continuously above motor nameplate current.

<2> Assumes operation at the rated output current. Input current rating varies depending on the power supply transformer, input reactor, wiring connections, and power supply impedance.

<3> Rated motor capacity is calculated with a rated output voltage of 575 V.

<4> Carrier frequency default setting is Swing PWM 1 (C6-02 = 7). C6-02 settings 1, 7, 8, 9, and A do not require current derating. All other settings raise the carrier frequency and require current derating.

A.2 Drive Specifications

Note:
1. Perform rotational Auto-Tuning to obtain the performance specifications given below.
2. For optimum performance life of the drive, install the drive in an environment that meets the required specifications.

Item		Specification
Control Characteristics	**Control Method**	The following control methods can be set using drive parameters: • V/f Control (V/f) • Open Loop Vector Control (OLV)
	Frequency Control Range	0.01 to 400 Hz
	Frequency Accuracy (Temperature Fluctuation)	Digital input: within ±0.01% of the max output frequency (-10 to +40 °C) Analog input: within ±0.1% of the max output frequency (25 °C ±10 °C)
	Frequency Setting Resolution	Digital inputs: 0.01 Hz Analog inputs: 1/2048 of the maximum output frequency setting (11 bit plus sign) Resolution of analog inputs A1 and A3 is 10 bit + sign in current mode
	Output Frequency Resolution	0.001 Hz
	Frequency Setting Signal	Main speed frequency reference: DC -10 to +10 V (20 kΩ), DC 0 to +10 V (20 kΩ), 4 to 20 mA (250 Ω), 0 to 20 mA (250 Ω) Main speed reference: Pulse train input (max. 32 kHz)
	Starting Torque <1>	V/f: 150% at 3 Hz OLV: 200% at 0.3 Hz
	Speed Control Range <1>	V/f: 1:40 OLV: 1:200
	Speed Control Accuracy <1>	OLV: ±0.2% (25 °C ±10 °C)
	Speed Response <1>	OLV
	Torque Limit	Parameters setting allow separate limits in four quadrants (available in OLV)
	Accel/Decel Time	0.0 to 6000.0 s (2 selectable combinations of independent acceleration and deceleration settings)
	Braking Torque	Approx. 20% (approx. 125% when using braking resistor) <2> • Short-time decel torque <3>: over 100% for 0.4/ 0.75 kW motors, over 50% for 1.5 kW motors, and over 20% for 2.2 kW and above motors <4> (overexcitation braking/High Slip Braking: approx. 40%) • Continuous regenerative torque: approx. 20% <4> (approx. 125% with dynamic braking resistor option <2>: 10% ED, 10s)
	Braking Transistor	Models 2A0004 to 2A0138, 4A0002 to 4A0072, and 5A0003 to 5A0052 have a built-in braking transistor.
	V/f Characteristics	User-selected programs and V/f preset patterns possible
	Main Control Functions	Momentary Power Loss Ride-Thru, Speed Search, Overtorque/Undertorque Detection, Torque Limit, 17 Step Speed (max), Accel/decel Switch, S-curve Accel/decel, 3-wire Sequence, Auto-tuning (rotational, stationary tuning), Dwell, Cooling Fan on/off Switch, Slip Compensation, Frequency Jump, Upper/lower Limits for Frequency Reference, DC Injection Braking at Start and Stop, Overexcitation Braking, High Slip Braking, PID Control (with sleep function), Energy Saving Control, MEMOBUS/Modbus Comm. (RS-422/RS-485 max, 115.2 kbps), Fault Restart, Application Presets, DriveWorksEZ (customized function), Removable Terminal Block with Parameter Backup Function, Online Tuning, KEB, Overexcitation Deceleration, Overvoltage Suppression, Dynamic Noise Control.
Protection Functions	**Motor Protection**	Electronic thermal overload relay
	Momentary Overcurrent Protection	Drive stops when output current exceeds 170% of rated output current
	Overload Protection	Drive stops when rated output current is 120% for 60 s <5>
	Overvoltage Protection	200 V class: Stops when DC bus voltage exceeds approx. 410 V 400 V class: Stops when DC bus voltage exceeds approx. 820 V 600 V class: Stops when DC bus voltage exceeds approx. 1040 V
	Undervoltage Protection	200 V class: Stops when DC bus voltage falls below approx. 190 V 400 V class: Stops when DC bus voltage falls below approx. 380 V 600 V class: Stops when DC bus voltage falls below approx. 475 V

A.2 Drive Specifications

Item		Specification
Protection Functions	**Momentary Power Loss Ride-Thru**	Immediately stop after 15 ms or longer power loss <6> . Continuous operation during power loss than 2 s (standard) <7>
	Heatsink Overheat Protection	Thermistor
	Braking Resistor Overheat Protection	Overheat input signal for braking resistor (Optional ERF-type, 3% ED)
	Stall Prevention	Stall Prevention is available during acceleration, deceleration, and during run.
	Ground Protection	Electronic circuit protection <8>
	DC Bus Charge LED	Remains lit until DC bus voltage falls below 50 V
Environment	**Area of Use**	Indoors
	Ambient Temperature	-10 to +40 °C (IP20/NEMA Type 1 enclosure), -10 to +50 °C (IP00/Open Type enclosure)
	Humidity	95 RH% or less (no condensation)
	Storage Temperature	-20 to +60 °C (short-term temperature during transportation)
	Altitude	Up to 1000 meters without derating, up to 3000 m with output current and voltage derating.
	Vibration/Shock	10 to 20 Hz: 9.8 m/s^2 20 to 55 Hz: 5.9 m/s^2 (2A0004 to 2A0211, 4A0002 to 4A0165, and 5A0003 to 5A0099) 2.0 m/s^2 (2A0250 to 2A0415, 4A0208 to 4A0675, and 5A0125 to 5A0242)
Safety Standard		UL 508C (Power Conversion), UL/cUL listed, CSA 22.2 No. 14-05 (Industrial Control Equipment), CE marked, RoHS compliant, EN 61800-5-1 (LVD), EN 61800-3 (EMC), IEC60529
Protection Design		IP00/Open Type enclosure, IP20/NEMA Type 1 enclosure <9>

<1> The accuracy of these values depends on motor characteristics, ambient conditions, and drive settings. Specifications may vary with different motors and with changing motor temperature. Contact Yaskawa for consultation.

<2> Disable Stall Prevention during deceleration (L3-04 = 0) when using a regenerative converter, a regenerative unit, a braking resistor or the Braking Resistor Unit. The default setting for the Stall Prevention function will interfere with the braking resistor.

<3> Instantaneous average deceleration torque refers to the torque required to decelerate the motor (uncoupled from the load) from the rated motor speed down to zero in the shortest time.

<4> Actual specifications may vary depending on motor characteristics.

<5> Overload protection may be triggered when operating with 150% of the rated output current if the output frequency is less than 6 Hz.

<6> May be shorter due to load conditions and motor speed.

<7> A separate Momentary Power Loss Ride-Thru Unit is required for models 2A0004 to 2A0056 and 4A0002 to 4A0031 if the application needs to continue running for up to 2 seconds during a momentary power loss.

<8> Ground protection cannot be provided when the impedance of the ground fault path is too low, or when the drive is powered up while a ground fault is present at the output.

<9> Removing the top protective cover or bottom conduit bracket from an IP20/NEMA Type 1 enclosure drive voids NEMA Type 1 protection while maintaining IP20 conformity. This is applicable to models 2A0004 to 2A0211, 4A0002 to 4A0165, and 5A0003 to 5A0242.

A.3 Drive Watt Loss Data

Table A.10 Watt Loss 200 V Class Three-Phase Models

Drive Model	Normal Duty			
	Rated Amps (A) <1>	Heatsink Loss (W)	Interior Unit Loss (W)	Total Loss (W)
2A0004	3.5	18.4	47	66
2A0006	6.0	31	51	82
2A0008	8.0	43	52	95
2A0010	9.6	57	58	115
2A0012	12.0	77	64	141
2A0018	17.5	101	67	168
2A0021	21	138	83	222
2A0030	30	262	117	379
2A0040	40	293	145	437
2A0056	56	371	175	546
2A0069	69	491	205	696
2A0081	81	527	257	785
2A0110	110	719	286	1005
2A0138	138	842	312	1154
2A0169	169	1014	380	1394
2A0211	211	1218	473	1691
2A0250	250	1764	594	2358
2A0312	312	2020	665	2686
2A0360	360	2698	894	3591
2A0415	415	2672	954	3626

<1> Value assumes the carrier frequency is 2 kHz (C6-02 = 1, 7, 8, 9, or A).

Table A.11 Watt Loss 400 V Class Three-Phase Models

Drive Model	Normal Duty			
	Rated Amps (A) <1>	Heatsink Loss (W)	Interior Unit Loss (W)	Total Loss (W)
4A0002	2.1	20	48	68
4A0004	4.1	32	49	81
4A0005	5.4	45	53	97
4A0007	6.9	62	59	121
4A0009	8.8	66	60	126
4A0011	11.1	89	73	162
4A0018	17.5	177	108	285
4A0023	23	216	138	354
4A0031	31	295	161	455
4A0038	38	340	182	521
4A0044	44	390	209	599
4A0058	58	471	215	686
4A0072	72	605	265	870
4A0088	88	684	308	993
4A0103	103	848	357	1205
4A0139	139	1215	534	1749
4A0165	165	1557	668	2224
4A0208	208	1800	607	2408
4A0250	250	2379	803	3182
4A0296	296	2448	905	3353
4A0362	362	3168	1130	4298

Drive Model	Normal Duty			
	Rated Amps (A) <1>	Heatsink Loss (W)	Interior Unit Loss (W)	Total Loss (W)
4A0414	414	3443	1295	4738
4A0515	515	4850	1668	6518
4A0675	675	4861	2037	6898

<1> Value assumes the carrier frequency is 2 kHz (C6-02 = 1, 7, 8, 9, or A).

Table A.12 Watt Loss Three-Phase 600 V Class Three-Phase Models

Drive Model	Normal Duty			
	Rated Amps (A) <1>	Heatsink Loss (W)	Interior Unit Loss (W)	Total Loss (W)
5A0003	2.7	21.5	23.3	44.8
5A0004	3.9	27.5	33.6	61.1
5A0006	6.1	28.1	43.7	71.8
5A0009	9.0	43.4	68.9	112.3
5A0011	11	56.1	88.0	144.0
5A0017	17	96.6	146.7	243.2
5A0022	22	99.4	178.3	277.7
5A0027	27	132.1	227.2	359.3
5A0032	32	141.6	279.9	421.5
5A0041	41	330.8	136.2	467.0
5A0052	52	427.8	166.2	594.0
5A0062	62	791.2	279.0	1070.2
5A0077	77	959.1	329.4	1288.6
5A0099	99	1253.2	411.7	1664.9
5A0125	125	1641	537	2178
5A0145	145	1860	603	2463
5A0192	192	2420	769	3189
5A0242	242	3100	1131	4231

<1> Value assumes the carrier frequency is 2 kHz (C6-02 = 1, 7, 8, 9, or A).

A.4 Drive Derating Data

The drive can be operated at above the rated temperature, altitude, and default carrier frequency by derating the drive capacity.

◆ Single-Phase Derating

iQpump1000 drives are compatible for use with both three-phase and single-phase input power supplies. The drive output to the motor is always three-phase, regardless of number of input phases.

Output capacity to the motor is derated when using single-phase input power and the drive firmware includes protection for single-phase input applications. This protection is enabled by default. Disabling this protection for single-phase input applications can void warranty and result in premature failure.

Selection of larger models always results in greater output capacity to the motor when supplying the drive with three-phase input power. However, the selection of larger models does not always yield greater output capacity when using the drive with single-phase input power.

Several factors affect the amount of derated drive output capacity when single-phase input power is supplied to the drive, such as:

- single-phase input voltage level
- motor voltage rating
- amount of input impedance.

The tables in this section assist in model selection by considering factors that affect the amount of derating in single-phase input power applications. There are two sizing methods based on the maximum load applied to the motor. Sizing Method A provides continuous full power and Sizing Method B may allow the connection of a larger motor compared to Method A, but the load is limited to 86% motor power, which is often (but not always) adequate for fan and pump loads.

■ Single-Phase Input Sizing Method A (Continuous Full Power)

Use single-phase input Sizing Method A for applications requiring more than 86% motor power. The Output Capacity Motor FLA listed in the tables allows for a 120% overload for 60 seconds. Contact Yaskawa if assistance is needed in selecting drive models for heavy duty/single-phase applications with higher overload requirements.

Note: Adding more impedance than is specified will degrade performance.

Table A.13 Sizing Method A, 240 V Single-Phase Input (-5% to +10%), 230 V Three-Phase Motor

Drive Model	Without Additional Impedance				With Additional Impedance (use either DC type or AC type)					
	Output Capacity		Single Phase Input Load		Yaskawa Reactor Part Number		Output Capacity		Single Phase Input Load	
	Motor Power (HP)	Motor FLA	Power (kVA)	Current (A)	DC Type	AC Type	Motor Power (HP)	Motor FLA	Power (kVA)	Current (A)
2A0004	0.33	1.52	0.99	4.3	URX000043	URX000303	0.5	2.2	0.94	4.1
2A0006	0.5	2.2	1.3	5.7	URX000043	URX000303	0.75	3.2	1.3	5.7
2A0008	0.75	3.2	1.7	7.7	05P00620-0113	URX000307	1	4.2	1.6	7.2
2A0010	0.75	3.2	1.8	7.7	05P00620-0113	URX000311	1	4.2	1.8	7.8
2A0012	1	4.2	2.3	10	URX000048	URX000316	2	7.5	2.9	13
2A0018	2	6.8	4.3	19	05P00620-0120	URX000319	3	9.6	4.3	19
2A0021	2	6.8	4.3	19	05P00620-0120	URX000323	3	9.6	4.4	19
2A0030	2	6.8	4.5	20	05P00620-0120	URX000323	3	9.6	4.4	19
2A0040	3	9.6	6.2	27	05P00620-0124	URX000323	5	15.2	6.7	30
2A0056	5	15.2	9.9	43	URX000059	URX000326	7.5	22	9.6	42
2A0069	5	15.2	10	45	URX000063	URX000332	10	28	13	56
2A0081	10	28	18	79	URX000072	URX000338	15	42	19	84

Drive Model	Without Additional Impedance				With Additional Impedance (use either DC type or AC type)					
	Output Capacity		Single Phase Input Load		Yaskawa Reactor Part Number		Output Capacity		Single Phase Input Load	
	Motor Power (HP)	Motor FLA	Power (kVA)	Current (A)	DC Type	AC Type	Motor Power (HP)	Motor FLA	Power (kVA)	Current (A)
2A0110	10	28	14	60	DC Link Choke Built-in	Do Not Use AC Reactor	10	28	14	60
2A0138	15	42	20	87			15	42	20	87
2A0169	20	54	26	114			20	54	26	114
2A0211	20	54	26	116			20	54	26	116
2A0250	25	68	32	143			25	68	32	143
2A0312	30	80	39	170			30	80	39	170
2A0360	40	104	51	224			40	104	51	224
2A0415	50	130	63	275			50	130	63	275

Table A.14 Sizing Method A, 240 V Single-Phase Input (-5% to +10%), 208 V Three-Phase Motor

Drive Model	Without Additional Impedance				With Additional Impedance (use either DC type or AC type)					
	Output Capacity		Single Phase Input Load		Yaskawa Reactor Part Number		Output Capacity		Single Phase Input Load	
	Motor Power (HP)	Motor FLA	Power (kVA)	Current (A)	DC Type	AC Type	Motor Power (HP)	Motor FLA	Power (kVA)	Current (A)
2A0004	0.33	1.7	0.99	4.3	URX000043	URX000303	0.5	2.4	0.94	4.1
2A0006	0.5	2.4	1.3	5.7	URX000043	URX000303	0.75	3.5	1.3	5.7
2A0008	0.75	3.5	1.7	7.7	05P00620-0113	URX000307	1	4.6	1.6	7.2
2A0010	0.75	3.5	1.8	7.7	05P00620-0113	URX000311	1	4.6	1.8	7.8
2A0012	1	4.6	2.3	10	05P00620-0115	URX000315	2	7.5	2.9	13
2A0018	2	7.5	4.3	19	05P00620-0120	URX000319	3	10.6	4.3	19
2A0021	2	7.5	4.3	19	05P00620-0120	URX000323	3	10.6	4.4	19
2A0030	2	7.5	4.5	20	05P00620-0120	URX000323	3	10.6	4.4	19
2A0040	3	10.6	6.2	27	05P00620-0124	URX000323	5	17	6.7	30
2A0056	5	17	9.9	43	URX000059	URX000326	7.5	24	9.6	42
2A0069	5	17	10	45	URX000063	URX000332	10	31	13	56
2A0081	10	31	18	79	URX000072	URX000339	15	46	19	84
2A0110	10	31	14	60	DC Link Choke Built-in	URX000340	15	46	17	76
2A0138	15	46	20	87		URX000343	15	46	18	77
2A0169	20	59	26	114		URX000342	20	59	23	102
2A0211	20	59	26	116		URX000344	25	75	29	129
2A0250	25	75	32	143		URX000347	30	88	35	156
2A0312	30	88	39	170		URX000350	40	114	47	204
2A0360	40	114	51	224		URX000353	50	143	57	252
2A0415	50	143	63	275		URX000356	60	169	69	301

Table A.15 Sizing Method A, 480 V Single-Phase Input (-5% to +10%), 460 V Three-Phase Motor

Drive Model	Without Additional Impedance				With Additional Impedance (use either DC type or AC type)					
	Output Capacity		Single Phase Input Load		Yaskawa Reactor Part Number		Output Capacity		Single Phase Input Load	
	Motor Power (HP)	Motor FLA	Power (kVA)	Current (A)	DC Type	AC Type	Motor Power (HP)	Motor FLA	Power (kVA)	Current (A)
4A0002	0.33	0.76	1.1	2.4	URX000041	URX000295	0.5	1.1	0.98	2.1
4A0004	0.75	1.6	1.9	4.2	URX000041	URX000299	1	2.1	1.7	3.8
4A0005	1	2.1	2.3	5.1	05P00620-0110	URX000303	1.5	3	2.5	5.5
4A0007	1	2.1	2.5	5.6	05P00652-0213	URX000308	2	3.4	3	6.7
4A0009	2	3.4	4.6	10	URX000048	URX000312	3	4.8	4.3	9.5
4A0011	2	3.4	4.6	10	URX000053	URX000316	3	4.8	4.7	10
4A0018	2	3.4	4.4	9.7	URX000052	URX000316	3	4.8	4.6	10
4A0023	3	4.8	6.3	14	URX000052	URX000316	5	7.6	7	15
4A0031	5	7.6	10	22	URX000055	URX000324	7.5	11	9.9	22
4A0038	7.5	11	14	31	05P00620-0123	URX000327	10	14	14	31
4A0044	7.5	11	14	31	URX000061	URX000327	10	14	13	28
4A0058	10	14	14	30	DC Link Choke Built-in	URX000332	15	21	19	41
4A0072	15	21	20	43		Do Not Use AC Reactor	15	21	20	43
4A0088	15	21	20	44			15	21	20	44
4A0103	15	21	20	45		URX000335	20	27	25	54
4A0139	30	40	38	84		URX000341	30	40	36	80
4A0165	30	40	39	85		URX000341	30	40	37	81
4A0208	50	65	62	136		URX000347	50	65	59	130
4A0250	60	77	74	162		URX000347	60	77	70	154
4A0296	60	77	75	165		URX000350	75	96	87	192
4A0362	75	96	93	205		URX000353	100	124	115	251
4A0414	100	124	122	267		URX000356	125	156	143	314
4A0515	100	124	125	275		URX000353	100	124	116	255
4A0675	125	156	157	345		Do Not Use	125	156	157	345

Table A.16 Sizing Method A, 480 V Single-Phase Input (-5% to +10%), 400 V Three-Phase Motor

Drive Model	Without Additional Impedance				With Additional Impedance (use either DC type or AC type)					
	Output Capacity		Single Phase Input Load		Yaskawa Reactor Part Number		Output Capacity		Single Phase Input Load	
	Motor Power (HP)	Motor FLA	Power (kVA)	Current (A)	DC Type	AC Type	Motor Power (HP)	Motor FLA	Power (kVA)	Current (A)
4A0002	0.33	0.88	1.1	2.4	URX000041	URX000295	0.5	1.26	0.98	2.1
4A0004	0.75	1.8	1.9	4.2	URX000041	URX000299	1	2.4	1.7	3.8
4A0005	1	2.4	2.3	5.1	05P00620-0110	URX000303	1.5	3.4	2.5	5.5
4A0007	1	2.4	2.5	5.6	05P00652-0213	URX000308	2	3.9	3	6.7
4A0009	2	3.9	4.6	10	URX000048	URX000312	3	5.5	4.3	9.5
4A0011	2	3.9	4.6	10	URX000053	URX000316	3	5.5	4.7	10
4A0018	2	3.9	4.4	9.7	URX000052	URX000316	3	5.5	4.6	10
4A0023	3	5.5	6.3	14	URX000052	URX000316	5	8.7	7	15
4A0031	5	8.7	10	22	URX000055	URX000324	7.5	12.7	9.9	22
4A0038	7.5	12.7	14	31	05P00620-0123	URX000327	10	16	14	31
4A0044	7.5	12.7	14	31	URX000061	URX000327	10	16	13	28

Drive Model	Without Additional Impedance				With Additional Impedance (use either DC type or AC type)					
	Output Capacity		Single Phase Input Load		Yaskawa Reactor Part Number		Output Capacity		Single Phase Input Load	
	Motor Power (HP)	Motor FLA	Power (kVA)	Current (A)	DC Type	AC Type	Motor Power (HP)	Motor FLA	Power (kVA)	Current (A)
4A0058	10	16	14	30		URX000332	15	24	19	41
4A0072	15	24	20	43		URX000336	20	31	24	52
4A0088	15	24	20	44		URX000336	20	31	24	52
4A0103	15	24	20	45		URX000335	20	31	25	54
4A0139	30	46	38	84		URX000341	30	46	36	80
4A0165	30	46	39	85		URX000341	30	46	37	81
4A0208	50	75	62	136	DC Link Choke Built-in	URX000347	50	75	59	130
4A0250	60	89	74	162		URX000347	60	89	70	154
4A0296	60	89	75	165		URX000350	75	110	87	192
4A0362	75	110	93	205		URX000353	100	143	115	251
4A0414	100	143	122	267		URX000356	125	179	143	314
4A0515	100	143	125	275		URX000353	100	143	116	255
4A0675	125	179	157	345		URX000360	150	207	169	371

Table A.17 Sizing Method A, 600 V Single-Phase Input (-5% to +10%), 575 V Three-Phase Motor

Drive Model	Without Additional Impedance				With Additional Impedance (use either DC type or AC type)					
	Output Capacity		Single Phase Input Load		Yaskawa Reactor Part Number		Output Capacity		Single Phase Input Load	
	Motor Power (HP)	Motor FLA	Power (kVA)	Current (A)	DC Type	AC Type	Motor Power (HP)	Motor FLA	Power (kVA)	Current (A)
5A0003	1	1.7	2	3.5	05P00620-0110	URX000303	1.5	2.4	2.6	4.6
5A0004	1.5	2.4	2.7	4.8	URX000044	URX000306	2	2.7	2.9	5
5A0006	2	2.7	4	7	05P00652-0213	URX000308	3	3.9	4.3	7.6
5A0009	3	3.9	5.4	9.5	URX000049	URX000313	5	6.1	6.5	11
5A0011	2	2.7	4.1	7.1	05P00652-0213	URX000308	3	3.9	4.4	7.7
5A0017	5	6.1	9.1	16	URX000048	URX000316	5	6.1	7.1	12
5A0022	5	6.1	9.2	16	URX000053	URX000320	7.5	9	10	18
5A0027	7.5	9	14	24	URX000055	URX000324	10	11	13	23
5A0032	7.5	9	14	24	URX000055	URX000324	10	11	13	23
5A0041	10	11	14	24		URX000326	15	17	18	32
5A0052	15	17	19	34		URX000326	15	17	19	32
5A0062	20	22	27	47		URX000335	25	27	31	54
5A0077	25	27	32	57		URX000338	30	32	36	64
5A0099	30	32	38	66	DC Link Choke Built-in	URX000338	30	32	37	64
5A0125	40	41	49	86		URX000344	50	52	58	102
5A0145	40	41	49	86		URX000344	50	52	58	102
5A0192	60	62	74	130		URX000347	75	77	87	152
5A0242	75	77	91	159		URX000347	75	77	87	152

■ Single-Phase Input Sizing Method B (86% Maximum Power of Connected Motor Size)

Use single-phase input Sizing Method B for applications requiring a maximum of 86% motor power, such as a fully loaded fan or pump that does not draw full power from motor or a fan or pump that is never run at full load.

There is no overload capacity for Sizing Method B.

Table A.18 Sizing Method B, 240 V Single-Phase Input (230 V to 240 V), 230 V Three-Phase Motor

Drive Model	Output Capacity		Single Phase Input Load	
	Motor Power (HP)	Motor FLA	Power (kVA)	Current (A)
2A0004	0.5	2.2	0.989	4.30
2A0006	1	4.2	1.68	7.30
2A0008	1	4.2	1.75	7.60
2A0010	1.5	6	2.44	10.6
2A0012	2	6.8	3.20	13.9
2A0018	3	9.6	4.83	21.0
2A0021	3	9.6	4.83	21.0
2A0030	4	15.2	7.82	34.0
2A0040	4	15.2	7.82	34.0
2A0056	7.5	22	11.0	48.0
2A0069	10	28	14.7	64.0
2A0081	15	42	21.2	92.0
2A0110	15	42	18.4	80.0
2A0138	20	54	23.9	104
2A0169	25	68	29.9	130
2A0211	30	80	35.4	154
2A0250	40	104	46.5	202
2A0312	50	130	57.3	249
2A0360	60	154	68.5	298
2A0415	75	192	84.2	366

Table A.19 Sizing Method B, 480 V Single-Phase Input (460 V to 480 V), 460 V Three-Phase Motor

Drive Model	Output Capacity		Single Phase Input Load	
	Motor Power (HP)	Motor FLA	Power (kVA)	Current (A)
4A0002	0.3	0.76	0.96	2.10
4A0004	1	2.1	1.98	4.30
4A0005	1.5	3	2.85	6.20
4A0007	2	3.4	3.59	7.80
4A0009	3	4.8	5.15	11.2
4A0011	3	4.8	5.15	11.2
4A0018	5	7.6	8.33	18.1
4A0023	5	7.6	8.33	18.1
4A0031	10	14	16.1	35.0
4A0038	10	14	16.1	35.0
4A0044	15	21	22.6	49.2
4A0058	20	27	23.9	52.0
4A0072	25	34	30.4	66.0
4A0088	25	34	30.4	66.0
4A0103	25	34	30.8	67.0
4A0139	50	65	58.0	126
4A0165	50	65	58.9	128
4A0208	60	77	70.4	153
4A0250	75	96	86.5	188
4A0296	100	124	114	248

Drive Model	Output Capacity		Single Phase Input Load	
	Motor Power (HP)	Motor FLA	Power (kVA)	Current (A)
4A0362	125	156	142	308
4A0414	150	180	168	365
4A0515	150	180	171	371
4A0675	200	240	225	489

Table A.20 Sizing Method B, 600 V Single-Phase Input (575 V to 600 V), 575 V Three-Phase Motor

Drive Model	Output Capacity		Single Phase Input Load	
	Motor Power (HP)	Motor FLA	Power (kVA)	Current (A)
5A0003	1	1.7	1.78	3.10
5A0004	2	2.7	2.93	5.10
5A0006	3	3.9	4.37	7.60
5A0009	5	6.1	6.90	12.0
5A0011	3	3.9	4.95	8.60
5A0017	7.5	9	11.4	19.8
5A0022	7.5	9	11.4	19.8
5A0027	10	11	16.1	28.0
5A0032	10	11	16.1	28.0
5A0041	20	22	24.0	41.8
5A0052	20	22	24.0	41.8
5A0062	30	32	36.8	64.0
5A0077	40	41	46.0	80.0
5A0099	40	41	47.2	82.0
5A0125	60	62	68.4	119
5A0145	60	62	68.4	119
5A0192	100	99	113	196
5A0242	100	99	113	196

◆ Temperature Derating

To ensure the maximum performance life, the drive output current must be derated as shown in *Figure A.1* when the drive is installed in areas with high ambient temperature or if drives are mounted side-by-side in a cabinet. In order to ensure reliable drive overload protection, set parameters L8-12 and L8-35 according to the installation conditions.

■ Parameter Settings

No.	Name	Description	Range	Def.
L8-12	Ambient Temperature Setting	Adjust the drive overload (oL2) protection level when the drive is installed in an environment that exceeds its ambient temperature rating.	-10 to +50	+40 °C
L8-35	Installation Method Selection	0: IP00/Open-Chassis Enclosure 1: Side-by-Side Mounting 2: IP20/NEMA Type 1 Enclosure 3: Finless Drive or External Heatsink Installation	0 to 3	<1>

<1> Default setting is determined by drive model.
Setting 0: (Models 2A0250 to 2A0415 and 4A0208 to 4A0675)
Setting 2: (Models 2A0004 to 2A0211, 4A0002 to 4A0165, and 5A0003 to 5A0242).

IP00/Open-Chassis Enclosure

Drive operation between -10 °C and +50 °C allows 100% continuous current without derating.

Side-by-Side Mounting

Drive operation between -10 °C and +30 °C allows 100% continuous current without derating. Operation between +30 °C and +50 °C requires output current derating.

IP20/NEMA Type 1 Enclosure

Drive operation between -10 °C and +40 °C allows 100% continuous current without derating. Operation between +40 °C and +50 °C requires output current derating.

External Heatsink Installation, Finless Drive

Drive operation between -10 °C and +40 °C allows 100% continuous current without derating. Operation between +40 °C and +50 °C requires output current derating.

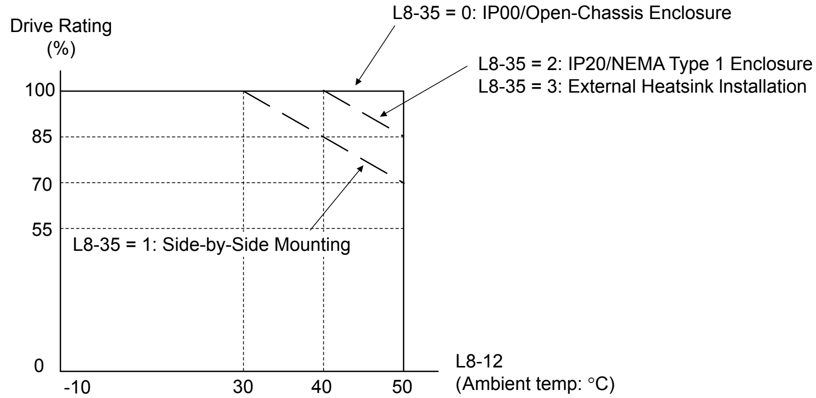

Figure A.1 Ambient Temperature and Installation Method Derating

◆ Altitude Derating

The drive standard ratings are valid for installation altitudes up to 1000 m. For installations from 1000 m to 3000 m, the drive rated voltage and the rated output current must be derated for 0.2% per 100 m.

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Appendix: B

Parameter List

This appendix contains a full listing of all parameters and settings available in the drive.

B.1 A: Initialization Parameters

Table B.1 Symbols and Icons Used in Parameter Descriptions

Symbol	Description
V/f	Parameter is ONLY available when operating the drive with V/f control.
OLV	Parameter is ONLY available when operating the drive with Open Loop Vector control.
RUN	Parameter can be changed during run.

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 (0100) RUN <1>	Language Selection	Select Language 0: English 1: ニホンゴ (Japanese) 2: Deutsch 3: Français 4: Italiano 5: Español 6: Português 7: 中文	0: English 1: Japanese 2: German 3: French 4: Italian 5: Spanish 6: Portuguese 7: Chinese	Default: 0 Range: 0 to 7	–
A1-01 (0101) 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 parameters selected by the user, A2-01 to A2-32) 2: Advanced Access (access to view and set all parameters) 3: Lock parameters	Default: 2 Range: 0 to 3	–
A1-03 (0103)	Initialize Parameters	Init Parameters 0: No Initialize 1110: User Initialize 2220: 2-Wire Initial 3330: 3-Wire Initial 5550: Term->Cntrl Int 6008: Pressure Control 6009: Pump down level 6010: Geothermal mode 6011: VTC Pressure Ctl 7770: General purpose	0: No initialization 1110: User Initialize (parameter values must be stored using parameter o2-03) 2220: 2-Wire initialization 3330: 3-Wire initialization 5550: Terminal->Control Initialize 6008: Pressure Control 6009: Pump down level 6010: Geothermal mode 6011: VTC pressure control 7770: General purpose	Default: 0 Range: 0 to 5550; 6008 to 6011; 7770	*149*
A1-04 (0104)	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 and A2-01 through A2-33 cannot be changed.	Default: 0000 Min.: 0000 Max.: 9999	–
A1-05 (0105)	Password Setting	Select Password		Default: 0000 Min.: 0000 Max.: 9999	–
A1-06 (0127)	Application Preset	Application Sel 0: General 8: Pressure Control 9: Pump Down Level 10: Geothermal Mode 11: VTC Pressure Ctl	0: General-purpose 8: Pressure control 9: Pump down level 10: Geothermal mode 11: VTC pressure control **Note:** This parameter is not settable. It is used as a monitor only.	Default: 0 Range: 0; 8 to 11	–

<1> Parameter setting value is not reset to the default value when the drive is initialized.

<2> Default setting value is dependent on the Initialization parameter A1-03.

◆ A2: User Parameters

No. (Addr. Hex)	Name	LCD Display	Description	Values	Page
A2-01 to A2-32 (0106 to 0125)	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: b1-01 to S6-07	–
A2-33 (0126)	User Parameter Automatic Selection	User Parms Sel 0: Disabled 1: Enabled	0: 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: 0 Range: 0, 1	–

<1> Default setting value is dependent on the Initialization parameter A1-03.

B.2 b: Application

Application parameters configure the source of the Run command, DC Injection Braking, Speed Search, timer functions, PID control, the Dwell function, Energy Savings, and other application-related settings.

◆ b1: Operation Mode Selection

No. (Addr. Hex)	Name	LCD Display	Description	Values	Page
b1-01 (0180)	Frequency Reference Selection 1	Ref Source 1 0: Operator 1: Analog Input 2: Serial Com 3: Option PCB 4: Pulse Input 5: Geothermal	0: HOA keypad 1: Analog input terminals 2: MEMOBUS/Modbus communications 3: Option PCB 4: Pulse input (terminal RP) 5: Geothermal Mode (Frequency reference dependent on temperature input (H3-0☐ = 21)	Default: 0 Range: 0 to 5	151
b1-02 (0181)	Run Command Selection 1	Run Source 1 0: Operator 1: Digital Inputs 2: Communication 3: Option PCB	0: HOA keypad 1: Digital input terminals 2: MEMOBUS/Modbus communications 3: Option PCB	Default: 0 Range: 0 to 3	153
b1-03 (0182)	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	154
b1-04 (0183)	Reverse Operation Selection	Reverse Oper 0: Reverse Enabled 1: Reverse Disabled	0: Reverse enabled 1: Reverse disabled	Default: 1 Range: 0, 1	–
b1-08 (0187)	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 Mode. 2: Prohibit entering Programming Mode during run.	Default: 0 Range: 0 to 2	–
b1-11 (01DF)	Coast to Stop with Timer Time	Coast Timer	Sets the amount of time that the drive will disallow the reapplication of the Run command after the Run command is lost. When set to 0.0, a combination of C1-02 and the output frequency will determine the length of time. **Note:** This parameter is effective only when b1-03 is set to 3 (Coast to Stop w/Timer).	Default: 120.0 s Min.: 0.0 Max.: 6000.0	–
b1-14 (01C3)	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	–
b1-17 (01C6)	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	–

◆ b2: DC Injection Braking and Short Circuit Braking

No. (Addr. Hex)	Name	LCD Display	Description	Values	Page
b2-01 (0189)	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: 0.5 Hz Min.: 0.0 Max.: 10.0	–
b2-02 (018A)	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	–
b2-03 (018B)	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	–

No. (Addr. Hex)	Name	LCD Display	Description	Values	Page
b2-04 (018C)	DC Injection Braking Time at Stop	DCInj Time@Stop	Sets DC Injection Braking time at stop.	Default: 0.50 s Min.: 0.00 Max.: 10.00	–
b2-08 (0190)	Magnetic Flux Compensation Value	Field Comp	OLV Sets the magnetic flux compensation as a percentage of the no-load current value (E2-03).	Default: 0% Min.: 0 Max.: 1000	–

◆ b3: Speed Search

No. (Addr Hex.)	Name	LCD Display	Description	Values	Page
b3-01 (0191)	Speed Search Selection at Start	SpdSrch at Star 0: Disabled 1: Enabled	0: Disabled 1: Enabled	Default: 0 Range: 0, 1	156
b3-02 (0192)	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: 120% (V/f) 100% (OLV) Min.: 0 Max.: 200	–
b3-03 (0193)	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	–
b3-04 (0194)	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: <1> Min.: 10% Max.: 100%	–
b3-05 (0195)	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	–
b3-06 (0196)	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: <1> Min.: 0.0 Max.: 2.0	–
b3-07 (0197)	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.	Default: <1> Min.: 0.0 Max.: 5.0	–
b3-08 (0198)	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: 0.8 Min.: 0.00 Max.: 6.00	–
b3-10 (019A)	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	–
b3-12 (019C)	Minimum Current Detection Level during Speed Search	Srch I Deadband	Sets the minimum current detection level during Speed Search.	Default: 6.0 Min.: 2.0 Max.: 10.0	–
b3-14 (019E)	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	–
b3-17 (01F0)	Speed Search Restart Current Level	SrchRestart Lvl	Sets the Speed Search restart current level as a percentage of the drive rated current.	Default: 150% Min.: 0 Max.: 200	–
b3-18 (01F1)	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	–
b3-19 (01F2)	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	–
b3-24 (01C0)	Speed Search Method Selection	SpdSrch Method 0: CurrentDetection 1: Speed Estimation	0: Current Detection 1: Speed Estimation	Default: 0 Range: 0, 1	–

No. (Addr Hex.)	Name	LCD Display	Description	Values	Page
b3-25 (01C8)	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.: 30.0	–
b3-27 (01C9)	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	–

<1> 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 (01A3)	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	–
b4-02 (01A4)	Timer Function Off-Delay Time	Delay-OFF Timer		Default: 0.0 s Min.: 0.0 Max.: 3000.0	–

◆ b5: PID Control

No. (Addr. Hex)	Name	LCD Display	Description	Values	Page
b5-01 (01A5)	PID Function Setting	PID Mode 0: Disabled 1: Enabled D=Fdbk	0: Disabled 1: Enabled (PID output becomes output frequency reference, deviation D controlled)	Default: 1 Range: 0, 1	–
b5-02 (01A6) RUN	Proportional Gain Setting (P)	PID Gain	Sets the proportional gain of the PID controller.	Default: 2.00 Min.: 0.00 Max.: 25.00	–
b5-03 (01A7) RUN	Integral Time Setting (I)	PID I Time	Sets the integral time for the PID controller.	Default: 3.0 s Min.: 0.0 Max.: 360.0	–
b5-04 (01A8) 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	–
b5-05 (01A9) RUN	Derivative Time (D)	PID D Time	Sets D control derivative time.	Default: 0.00 s Min.: 0.00 Max.: 10.00	–
b5-06 (01AA) RUN	PID Output Limit	PID Limit	Sets the maximum output possible from the entire PID controller as a percentage of the maximum output frequency.	Default: 100.0% Min.: 0.0 Max.: 100.0	–
b5-07 (01AB) RUN	PID Offset Adjustment	PID Offset	Applies an offset to the PID controller output. Set as a percentage of the maximum output frequency.	Default: 0.0% Min.: -100.0 Max.: 100.0	–
b5-08 (01AC) RUN	PID Primary Delay Time Constant	PID Delay Time	Sets a low pass filter time constant on the output of the PID controller.	Default: 0.00 s Min.: 0.00 Max.: 10.00	–
b5-09 (01AD)	PID Output Level Selection	Output Level Sel 0: Direct Acting 1: Inverse Acting	0: Direct acting 1: Inverse acting	Default: 0 Range: 0, 1	–
b5-10 (01AE) RUN	PID Output Gain Setting	Output Gain	Sets the gain applied to the PID output.	Default: 1.00 Min.: 0.00 Max.: 25.00	–

No. (Addr. Hex)	Name	LCD Display	Description	Values	Page
b5-11 (01AF)	PID Output Reverse Selection	Output Rev Sel 0: 0 limit 1: Reverse	0: Negative PID output triggers zero limit. 1: Rotation direction reverses with negative PID output. **Note:** When using setting 1, make sure reverse operation is permitted by b1-04.	Default: 0 Range: 0, 1	–
b5-12 (01B0)	Feedback Loss 4 to 20 mA Detection Selection	Fdbk 4-20mA Det 0: Disabled 1: Alarm only 2: Fault 3: Run At b5-13	Performs a 4 to 20 mA wire break detection on the analog input that is programmed for PID feedback. 0: Disabled 1: Alarm only 2: Fault 3: Run at b5-13	Default: 2 Range: 0 to 3	–
b5-13 (01B1)	Feedback Loss Goto Frequency	FdbkLossGotoFreq	Sets the speed at which the drive will run if a 4 to 20 mA wire break is detected on the PID Feedback and when b5-12 is set to 3 (Run at b5-13).	Default: 0.0 Hz Min.: 0.0 Max.: 400.0	–
b5-14 (01B2) RUN	Feedback Loss of Prime Level	FdbkLoss LOP Lvl	Detects loss of prime in the pump when a wire break condition has occurred. When the measured quantity determined by P1-18 (output current, kilowatts, or power) drops below this level for the time set in P1-20 and the output frequency is at the level set in b5-13, a "Loss of Prime" condition occurs. The drive responds to the "Loss of Prime" condition depending on the setting of P1-22, Loss of Prime Selection.	Default: 0.0 A <1> Min.: 0.0 Max.: 1000.0	–
b5-17 (01B5)	PID Accel/Decel Time	PID Acc/Dec Time	Sets the acceleration and deceleration time to PID setpoint.	Default: 0.0 s Min.: 0.0 Max.: 6000.0	–
b5-34 (019F) RUN	PID Output Lower Limit	PID Out Low Lim	Sets the minimum output possible from the PID controller as a percentage of the maximum output frequency.	Default: 0.00% Min.: -100.00 Max.: 100.00	–
b5-35 (01A0) RUN	PID Input Limit	PID Input Limit	Limits the PID 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	–
b5-39 (01FF)	PID 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: 1 Range: 0 to 3	–
b5-40 (017F)	Frequency Reference Monitor Content during PID	Fref Mon Sel@PID 0: Fref Mon w PID 1: Fref Mon w/o PID	0: Display the frequency reference (U1-01) after PID compensation has been added. 1: Display the frequency reference (U1-01) before PID compensation has been added.	Default: 0 Range: 0, 1	–
b5-41 (0160)	PI Output 2 Unit Selection	PI Out2 Unit Sel 0: No Unit 1: PSI :lb/SqrInch 2: Pa:Pascals 3: Bar:Bar 4: "WC: InchOfWater 5: "Hg:Inch Mercury 6: ft: feet 7: m: meters 8: °F:DegFarenheit 9: °C:DegCelsius 10: %: Percent 25: Flow (use P6-04)	0: No Unit 1: Pounds per square inch 2: Pascals 3: Bar 4: Inch of Water 5: Inch of Mercury 6: Feet 7: Meters 8: Degrees Fahrenheit 9: Degrees Celsius 10: Percent 25: Flow (use P6-04)	Default: 0 Range: 0 to 10; 25	–
b5-42 (0161) RUN	PI Output 2 Calculation Mode	PI Out2 Calc Mode 0: Linear 1: Square root 2: 1/f2 3: 1/f3	0: Linear - the monitor displays PID output 1: Square root - the monitor displays square root PID output 2: Quadratic - the monitor displays 1/(PID output)^2 3: Cubic - the monitor displays 1/(PID output)^3 **Note:** Used for U5-14 and U5-15 only.	Default: 0 Range: 0 to 3	–
b5-43 (0162) RUN	PI Output 2 Monitor Max Upper 4 Digits	PI Out2 MonMax U	Sets the upper 4 digits of the maximum monitor value. Used with b5-44 to set maximum monitor value of U5-14 and U5-15 at maximum frequency. **Note:** Used for U5-14 and U5-15 only.	Default: 0 Min.: 0 Max.: 9999	–

No. (Addr. Hex)	Name	LCD Display	Description	Values	Page
b5-44 (0163) RUN	PI Output 2 Monitor Max Lower 4 Digits	PI Out2 MonMax L	Sets the lower 4 digits of the maximum monitor value. Used with b5-43 to set maximum monitor value of U5-14 and U5-15 at maximum frequency. **Note:** Used for U5-14 and U5-15 only.	Default: 0 Min.: 0 Max.: 99.99	–
b5-45 (0164) RUN	PI Output 2 Monitor Minimum	PI Out2 MonMin	Sets the minimum display value at zero speed. This function is effective when b5-42 is set to 0 (Linear output mode). **Note:** Used for U5-14 and U5-15 only.	Default: 0 Min.: 0 Max.: 999.9	–
b5-47 (017D)	Reverse Operation Selection 2 by PID Output	Output Rev Sel2	0: Zero limit when PID output is a negative value. 1: Reverse operation when PID output is a negative value (Zero limit if the reverse operation is prohibited by b1-04).	Default: 1 Range: 0, 1	–

<1> Unit text is set by P1-18, Prime Loss Detection Method.

b6: Dwell Function

No. (Addr. Hex)	Name		Description	Values	Page
b6-01 (01B6)	Dwell Reference at Start	Dwell Ref @Start	Parameters b6-01 and b6-02 set the frequency to hold and the time to maintain that frequency at start.	Default: 0.0 Hz Min.: 0.0 Max.: 400.0	–
b6-02 (01B7)	Dwell Time at Start	Dwell Time @Start		Default: 0.0 s Min.: 0.0 Max.: 10.0	–
b6-03 (01B8)	Dwell Reference at Stop	Dwell Ref @Stop	Parameters b6-03 and b6-04 set the frequency to hold and the time to maintain that frequency at stop.	Default: 0.0 Hz Min.: 0.0 Max.: 400.0	–
b6-04 (01B9)	Dwell Time at Stop	Dwell Time @Stop		Default: 0.0 s Min.: 0.0 Max.: 10.0	–

b8: Energy Saving

No. (Addr. Hex)	Name	LCD Display	Description	Values	Page
b8-01 (01CC)	Energy Saving Control Selection	Energy Save Sel 0: Disabled 1: Enabled	0: Disabled 1: Enabled	Default: 0 Range: 0, 1	–
b8-02 (01CD) RUN	Energy Saving Gain	Energy Save Gain	OLV Sets the gain used for Energy Saving.	Default: 0.7 Min.: 0.0 Max.: 10.0	–
b8-03 (01CE) RUN	Energy Saving Control Filter Time Constant	Energy Save F.T	OLV Sets a time constant for Energy Saving.	Default: <1> Min.: 0.00 s Max.: 10.00 s	–
b8-04 (01CF)	Energy Saving Coefficient Value	Energy Save COEF	V/f Determines the level of maximum motor efficiency. Setting range is 0.0 to 2000.0 for drives 3.7 kW and smaller. The display resolution depends on the rated output power of the drive.	Default: <1> <2> Min.: 0.00 Max.: 655.00	–
b8-05 (01D0)	Power Detection Filter Time	kW Filter Time	V/f Sets a time constant filter for output power detection.	Default: 20 ms Min.: 0 Max.: 2000	–
b8-06 (01D1)	Search Operation Voltage Limit	Search V Limit	V/f Sets the limit for the voltage search operation as a percentage of the motor rated voltage.	Default: 0% Min.: 0 Max.: 100	–

<1> Default setting is dependent on parameter o2-04, Drive Model Selection.

<2> Parameter value changes automatically if E2-11 is manually changed or changed by Auto-Tuning.

B.3 C: Tuning

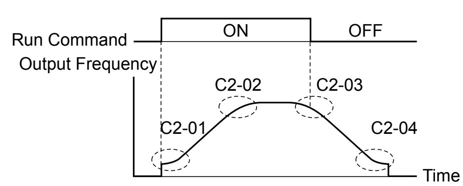
C parameters are used to adjust the acceleration and deceleration times, S-curves, torque compensation, and carrier frequency selections.

◆ C1: Acceleration and Deceleration Times

No. (Addr. Hex)	Name	LCD Display	Description	Values	Page
C1-01 (0200) RUN	Acceleration Time 1	Accel Time 1	Sets the time to accelerate from 0 to maximum frequency.	Default: 20.0 s Min.: 0.0 Max.: 6000.0 <1>	157
C1-02 (0201) RUN	Deceleration Time 1	Decel Time 1	Sets the time to decelerate from maximum frequency to 0.	Default: 10.0 s Min.: 0.0 Max.: 6000.0 <1>	157
C1-03 (0202) RUN	Acceleration Time 2	Accel Time 2	Sets the time to accelerate from 0 to maximum frequency.		157
C1-04 (0203) RUN	Deceleration Time 2	Decel Time 2	Sets the time to decelerate from maximum frequency to 0.		157
C1-05 (0204) RUN	Acceleration Time 3	Accel Time 3	Sets the time to accelerate from 0 to maximum frequency.		
C1-06 (0205) RUN	Deceleration Time 3	Decel Time 3	Sets the time to decelerate from maximum frequency to 0.		
C1-09 (0208) RUN	Fast Stop Time	Fast Stop Time	Sets the time for the Fast Stop function.	Default: 10.0 s Min.: 0.0 Max.: 6000.0 <1>	–
C1-10 (0209)	Accel/Decel Time Setting Units	Acc/Dec Units 0: 0.01 Seconds 1: 0.1 Seconds	0: 0.01 s (0.00 to 600.00 s) 1: 0.1 s (0.0 to 6000.0 s)	Default: 1 Range: 0, 1	–
C1-11 (020A)	Accel/Decel Time Switching Frequency	Acc/Dec SW Freq	Sets the frequency to switch between accel/decel time settings	Default: 0.0 Hz Min.: 0.0 Max.: 400.0	–

<1> Setting range value is dependent on parameter C1-10, Accel/Decel Time Setting Units. When C1-10 = 0 (units of 0.01 seconds), the setting range becomes 0.00 to 600.00 seconds.

◆ C2: S-Curve Characteristics

No. (Addr. Hex)	Name	LCD Display	Description	Values	Page
C2-01 (020B)	S-Curve Characteristic at Accel Start	SCrv Acc @ Start	The S-curve can be controlled at the four points shown below. 	Default: 0.20 s Min.: 0.00 Max.: 10.00	–
C2-02 (020C)	S-Curve Characteristic at Accel End	SCrv Acc @ End		Default: 0.20 s Min.: 0.00 Max.: 10.00	–
C2-03 (020D)	S-Curve Characteristic at Decel Start	SCrv Dec @ Start		Default: 0.20 s Min.: 0.00 Max.: 10.00	–
C2-04 (020E)	S-Curve Characteristic at Decel End	SCrv Dec @ End		Default: 0.00 s Min.: 0.00 Max.: 10.00	–

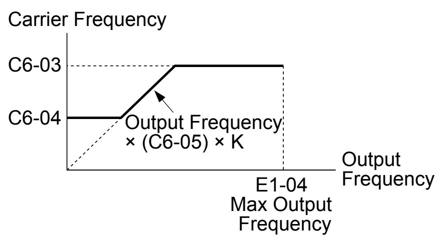
◆ C3: Slip Compensation

No. (Addr. Hex)	Name	LCD Display	Description	Values	Page
C3-01 (020F) RUN	Slip Compensation Gain	Slip Comp	Sets the gain for the motor slip compensation function used for motor 1.	Default: 0.0 (V/f) 1.0 (OLV) Min.: 0.0 Max.: 2.5	–
C3-02 (0210) RUN	Slip Compensation Primary Delay Time	Slip Comp Time	Adjusts the slip compensation function delay time used for motor 1.	Default: 2000 ms (V/f) 200 ms (OLV) Min.: 0 Max.: 10000	–
C3-03 (0211)	Slip Compensation Limit	Slip Comp Limit	Sets an upper limit for the slip compensation function as a percentage of motor rated slip for motor 1 (E2-02).	Default: 200% Min.: 0 Max.: 250	–
C3-04 (0212)	Slip Compensation Selection during Regeneration	Slip Comp Regen 0: Disabled 1: Above 6 Hz 2: Lowst possbl spd	0: Disabled. 1: Enabled above 6 Hz 2: Enabled whenever slip compensation is possible.	Default: 0 Range: 0 to 2	–
C3-05 (0213)	Output Voltage Limit Operation Selection	Output V Lim Sel 0: Disabled 1. Enabled	OLV 0: Disabled. 1: Enabled. Automatically decreases motor flux when output voltage saturation is reached.	Default: 0 Range: 0, 1	–

◆ C4: Torque Compensation

No. (Addr. Hex)	Name	LCD Display	Description	Values	Page
C4-01 (0215) 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: 1.00 Min.: 0.00 Max.: 2.50	–
C4-02 (0216) RUN	Torque Compensation Primary Delay Time 1	Torq Comp Time	Sets the torque compensation filter time.	Default: 200 ms (V/f) 20 ms (OLV) Min.: 0 Max.: 60000	–
C4-03 (0217)	Torque Compensation at Forward Start	F TorqCmp@start	OLV Sets torque compensation at forward start as a percentage of motor torque.	Default: 0.0% Min.: 0.0 Max.: 200.0	–
C4-04 (0218)	Torque Compensation at Reverse Start	R TorqCmp@start	OLV Sets torque compensation at reverse start as a percentage of motor torque.	Default: 0.0% Min.: -200.0 Max.: 0.0	–
C4-05 (0219)	Torque Compensation Time Constant	TorqCmp Delay T	OLV Sets the time constant for torque compensation at forward start and reverse start (C4-03 and C4-04).	Default: 10 ms Min.: 0 Max.: 200	–
C4-06 (021A)	Torque Compensation Primary Delay Time 2	Start Torq Time	OLV Sets the torque compensation time 2.	Default: 150 ms Min.: 0 Max.: 10000	–

◆ C6: Carrier Frequency

No. (Addr. Hex)	Name	LCD Display	Description	Values	Page
C6-02 (0224)	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 (4.0 kHz) 3: 8.0 kHz (6.0 kHz) 4: 10.0 kHz (8.0 kHz) 5: 12.5 kHz (10.0 kHz) 6: 15.0 kHz (12.0 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: 7 Range: 1 to 9; A, F	–
C6-03 (0225)	Carrier Frequency Upper Limit	CarrierFreq Max	Determines the upper and lower limits for the carrier frequency.  	Default: 2.0 kHz Min.: 1.0 Max.: 15.0	–
C6-04 (0226)	Carrier Frequency Lower Limit	CarrierFreq Min		Default: 2.0 kHz Min.: 1.0 Max.: 15.0	–
C6-05 (0227)	Carrier Frequency Proportional Gain	CarrierFreq Gain		Default: 0 Min.: 0 Max.: 99	–

B.4 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 (0280) 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.: 400.00 <1>	–
d1-02 (0281) 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.: 400.00 <1>	–
d1-03 (0282) 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.: 400.00 <1>	–
d1-04 (0283) 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.: 400.00 <1>	–
d1-05 (0284) RUN	Frequency Reference 5	Reference 5	Sets the frequency reference for the drive. Setting units are determined by parameter o1-03.	Default: 0.00 Hz Min.: 0.00 Max.: 400.00 <1>	–
d1-06 (0285) RUN	Frequency Reference 6	Reference 6	Sets the frequency reference for the drive. Setting units are determined by parameter o1-03.	Default: 0.00 Hz Min.: 0.00 Max.: 400.00 <1>	–
d1-07 (0286) RUN	Frequency Reference 7	Reference 7	Sets the frequency reference for the drive. Setting units are determined by parameter o1-03.	Default: 0.00 Hz Min.: 0.00 Max.: 400.00 <1>	–
d1-08 (0287) RUN	Frequency Reference 8	Reference 8	Sets the frequency reference for the drive. Setting units are determined by parameter o1-03.	Default: 0.00 Hz Min.: 0.00 Max.: 400.00 <1>	–
d1-09 (0288) RUN	Frequency Reference 9	Reference 9	Sets the frequency reference for the drive. Setting units are determined by parameter o1-03.	Default: 0.00 Hz Min.: 0.00 Max.: 400.00 <1>	–
d1-10 (028B) RUN	Frequency Reference 10	Reference 10	Sets the frequency reference for the drive. Setting units are determined by parameter o1-03.	Default: 0.00 Hz Min.: 0.00 Max.: 400.00 <1>	–
d1-11 (028C) RUN	Frequency Reference 11	Reference 11	Sets the frequency reference for the drive. Setting units are determined by parameter o1-03.	Default: 0.00 Hz Min.: 0.00 Max.: 400.00 <1>	–
d1-12 (028D) RUN	Frequency Reference 12	Reference 12	Sets the frequency reference for the drive. Setting units are determined by parameter o1-03.	Default: 0.00 Hz Min.: 0.00 Max.: 400.00 <1>	–
d1-13 (028E) RUN	Frequency Reference 13	Reference 13	Sets the frequency reference for the drive. Setting units are determined by parameter o1-03.	Default: 0.00 Hz Min.: 0.00 Max.: 400.00 <1>	–

No. (Addr. Hex)	Name	LCD Display	Description	Values	Page
d1-14 (028F) RUN	Frequency Reference 14	Reference 14	Sets the frequency reference for the drive. Setting units are determined by parameter o1-03.	Default: 0.00 Hz Min.: 0.00 Max.: 400.00 <1>	–
d1-15 (0290) RUN	Frequency Reference 15	Reference 15	Sets the frequency reference for the drive. Setting units are determined by parameter o1-03.	Default: 0.00 Hz Min.: 0.00 Max.: 400.00 <1>	–
d1-16 (0291) 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.: 400.00 <1>	–
d1-17 (0292) 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.: 400.00 <1>	–

<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 (0289)	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	–
d2-02 (028A)	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	–
d2-03 (0293)	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	–

◆ d3: Jump Frequency

No. (Addr. Hex)	Name	LCD Display	Description	Values	Page
d3-01 (0294)	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. Parameters must be set so that d3-01 ≥ d3-02 ≥ d3-03. Setting this parameter to 0.0 disables the function.	Default: 0.0 Hz Min.: 0.0 Max.: 400.0	–
d3-02 (0295)	Jump Frequency 2	Jump Freq 2		Default: 0.0 Hz Min.: 0.0 Max.: 400.0	–
d3-03 (0296)	Jump Frequency 3	Jump Freq 3		Default: 0.0 Hz Min.: 0.0 Max.: 400.0	–
d3-04 (0297)	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	–

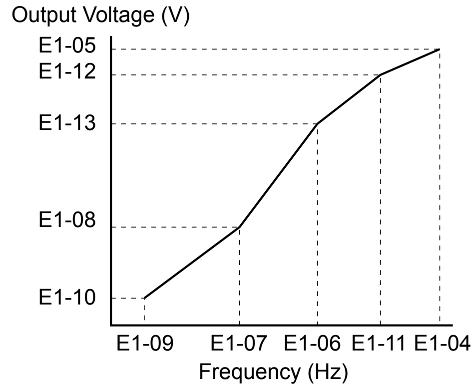
◆ d4: Frequency Reference Hold and Up/Down 2 Function

No. (Addr. Hex)	Name	LCD Display	Description	Values	Page
d4-01 (0298)	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	–
d4-03 (02AA) RUN	Frequency Reference Bias Step (Up/Down 2)	Up/Dn 2 Step Lvl	Sets the bias added to the frequency reference when the Up 2 and Down 2 digital inputs are enabled (H1-□□ = 75, 76).	Default: 0.00 Hz Min.: 0.00 Max.: 99.99	–
d4-04 (02AB) RUN	Frequency Reference Bias Accel/Decel (Up/Down 2)	Up/Dn 2 Ramp Sel 0: Sel Acc/Dec Time 1: Acc/Dec Time 4	0: Use selected accel/decel time. 1: Use accel/decel time 4 (C1-07 and C1-08). **Note:** The functionality of setting 1 is only accessible via MEMOBUS/Modbus communication.	Default: 0 Range: 0, 1	–
d4-05 (02AC) RUN	Frequency Reference Bias Operation Mode Selection (Up/Down 2)	Up/Dn 2 Bias Sel 0: Hold Bias Value 1: Reset Bias Value	0: Bias value is held if no input Up 2 or Down 2 is active. 1: When the Up 2 reference and Down 2 reference are both on or both off, the applied bias becomes 0. The specified accel/decel times are used for acceleration or deceleration.	Default: 0 Range: 0, 1	–
d4-06 (02AD)	Frequency Reference Bias (Up/Down 2)	Up/Dn 2 Bias Lvl	The Up/Down 2 bias value is saved in d4-06 when the frequency reference is not input by the digital operator. Set as a percentage of the maximum output frequency.	Default: 0.0% Min.: -99.9 Max.: 100.0	–
d4-07 (02AE) RUN	Analog Frequency Reference Fluctuation Limit (Up/Down 2)	Up/Dn 2 FluctLim	Limits how much the frequency reference is allowed to change while an input terminal set for Up 2 or Down 2 is enabled. If the frequency reference changes for more than the set value, then the bias value is held and the drive accelerates or decelerates to the frequency reference. Set as a percentage of the maximum output frequency.	Default: 1.0% Min.: 0.01 Max.: 100.0	–
d4-08 (2AF) RUN	Frequency Reference Bias Upper Limit (Up/Down 2)	Up/Dn 2 UpperLim	Sets the upper limit for the bias and the value that can be saved in d4-06. Set as a percentage of the maximum output frequency.	Default: 100.0% Min.: 0.0 Max.: 100.0	–
d4-09 (02B0) RUN	Frequency Reference Bias Lower Limit (Up/Down 2)	Up/Dn 2 LowerLim	Sets the lower limit for the bias and the value that can be saved in d4-06. Set as a percentage of the maximum output frequency.	Default: 0.0% Min.: -99.9 Max.: 0.0	–
d4-10 (02B6)	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	–

B.5 E: Motor Parameters

◆ E1: V/f Pattern

No. (Addr. Hex)	Name	LCD Display	Description	Values	Page
E1-01 (0300)	Input Voltage Setting	Input Voltage	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.*	Default: 230 V <1> Min.: 155 Max.: 255 <1>	–
E1-03 (0302)	V/f Pattern Selection	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	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	Default: F <2> Range: 0 to 9; A to FF	–

No. (Addr. Hex)	Name	LCD Display	Description	Values	Page
E1-04 (0303)	Maximum Output Frequency	Max Frequency	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 	Default: 60.0 Hz Min.: 40.0 Max.: 400.0	–
E1-05 (0304)	Maximum Voltage	Max Voltage		Default: 230 V <1> Min.: 0.0 Max.: 255.0 <1>	–
E1-06 (0305)	Base Frequency	Base Frequency		Default: 60.0 Hz Min.: 0.0 Max.: E1-04	–
E1-07 (0306)	Middle Output Frequency	Mid Frequency A		Default: 3.0 Hz Min.: 0.0 Max.: E1-04	–
E1-08 (0307)	Middle Output Frequency Voltage	Mid Voltage A		Default: 15.0 V <1> Min.: 0.0 Max.: 255.0 <1>	–
E1-09 (0308)	Minimum Output Frequency	Min Frequency		Default: 1.5 Hz (V/f) 0.5 Hz (OLV) Min.: 0.0 Max.: E1-04	–
E1-10 (0309)	Minimum Output Frequency Voltage	Min Voltage		Default: 9.0 V (V/f) 2.0 V (OLV) <1> Min.: 0.0 Max.: 255.0 <1>	–
E1-11 (030A) <4>	Middle Output Frequency 2	Mid Frequency B		Default: 0.0 Hz Min.: 0.0 Max.: E1-04	–
E1-12 (030B) <4>	Middle Output Frequency Voltage 2	Mid Voltage B		Default: 0.0 V Min.: 0.0 Max.: 255.0 <1>	–
E1-13 (030C)	Base Voltage	Base Voltage		Default: 0.0 V <3> Min.: 0.0 Max.: 255.0 <1>	–

<1> Values shown are specific to 200 V class drives. Double the value for 400 V class drives. Multiply the value by 2.875 for 600 V class drives.
<2> Parameter setting value is not reset to the default value when the drive is initialized.
<3> When Auto-Tuning is performed, E1-13 and E1-05 will be set to the same value.
<4> 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 1 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>	157
E2-02 (030F)	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	–
E2-03 (0310)	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>	–

No. (Addr. Hex)	Name	LCD Display	Description	Values	Page
E2-04 (0311)	Number of Motor Poles	Number of Poles	Sets the number of motor poles. Automatically set during Auto-Tuning.	Default: 2 Min.: 2 Max.: 48	–
E2-05 (0312)	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	–
E2-06 (0313)	Motor Leakage Inductance	Leak Inductance	Sets the voltage drop due to motor leakage inductance as a percentage of motor rated voltage. Automatically set during Auto-Tuning.	Default: <1> Min.: 0.0% Max.: 40.0%	–
E2-07 (0314)	Motor Iron-Core Saturation Coefficient 1	Saturation Comp1	OLV Sets the motor iron saturation coefficient at 50% of magnetic flux. Automatically set during Auto-Tuning.	Default: 0.50 Min.: E2-07 Max.: 0.50	–
E2-08 (0315)	Motor Iron-Core Saturation Coefficient 2	Saturation Comp2	OLV Sets the motor iron saturation coefficient at 75% of magnetic flux. Automatically set during Auto-Tuning.	Default: 0.75 Min.: E2-07 Max.: 0.75	–
E2-09 (0316)	Motor Mechanical Loss	Mechanical Loss	OLV Sets the motor mechanical loss as a percentage of motor rated power (kW).	Default: 0.0% Min.: 0.0 Max.: 10.0	–
E2-10 (0317)	Motor Iron Loss for Torque Compensation	Motor Iron Loss	V/f Sets the motor iron loss.	Default: <1> Min.: 0 W Max.: 65535 W	–
E2-11 (0318)	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.: 650.00 kW	–

<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, and one decimal place (0.1 A) if the maximum applicable motor capacity is higher than 11 kW.

B.6 F: Options

◆ F4: Analog Monitor Card (AO-A3)

No. (Addr. Hex)	Name	LCD Display	Description	Values	Page
F4-01 (0391)	Terminal V1 Monitor Selection	AO Ch1 Select	Sets the monitor signal for output from terminal V1. Set this parameter to the last three digits of the desired U□-□□ monitor. Some U parameters are available only in certain control modes.	Default: 102 Range: 000 to 999	–
F4-02 (0392) RUN	Terminal V1 Monitor Gain	AO Ch1 Gain	Sets the gain for voltage output via terminal V1.	Default: 100.0% Min.: -999.9 Max.: 999.9	–
F4-03 (0393)	Terminal V2 Monitor Selection	AO Ch2 Select	Sets the monitor signal for output from terminal V2. Set this parameter to the last three digits of the desired U□-□□ monitor. Some U parameters are available only in certain control modes.	Default: 103 Range: 000 to 999	–
F4-04 (0394) RUN	Terminal V2 Monitor Gain	AO Ch2 Gain	Sets the gain for voltage output via terminal V2.	Default: 50.0% Min.: -999.9 Max.: 999.9	–
F4-05 (0395) RUN	Terminal V1 Monitor Bias	AO Ch1 Bias	Sets the amount of bias added to the voltage output via terminal V1.	Default: 0.0% Min.: -999.9 Max.: 999.9	–
F4-06 (0396) RUN	Terminal V2 Monitor Bias	AO Ch2 Bias	Sets the amount of bias added to the voltage output via terminal V2.	Default: 0.0% Min.: -999.9 Max.: 999.9	–
F4-07 (0397)	Terminal V1 Signal Level	AO Opt Level Ch1 0: 0-10 VDC 1: -10 +10 VDC	0: 0 to 10 V 1: -10 to 10 V	Default: 0 Range: 0, 1	–
F4-08 (0398)	Terminal V2 Signal Level	AO Opt Level Ch2 0: 0-10 VDC 1: -10 +10 VDC	0: 0 to 10 V 1: -10 to 10 V	Default: 0 Range: 0, 1	–

◆ F5: Digital Output Card (DO-A3)

No. (Addr. Hex)	Name	LCD Display	Description	Values	Page
F5-01 (399)	Terminal P1-PC Output Selection	DO Ch1 Select	Sets the function for contact output terminals M1-M2, M3-M4, and photocoupler output terminals P1 through P6. ***Refer to H2: Multi-Function Digital Outputs on page 280*** for setting selections.	Default: 0 Range: 0 to 192	–
F5-02 (39A)	Terminal P2-PC Output Selection	DO Ch2 Select		Default: 1 Range: 0 to 192	–
F5-03 (39B)	Terminal P3-PC Output Selection	DO Ch3 Select		Default: 2 Range: 0 to 192	–
F5-04 (39C)	Terminal P4-PC Output Selection	DO Ch4 Select		Default: 4 Range: 0 to 192	–
F5-05 (39D)	Terminal P5-PC Output Selection	DO Ch5 Select		Default: 6 Range: 0 to 192	–
F5-06 (39E)	Terminal P6-PC Output Selection	DO Ch6 Select		Default: 37 Range: 0 to 192	–
F5-07 (39F)	Terminal M1-M2 Output Selection	DO Ch7 Select		Default: F Range: 0 to 192	–
F5-08 (3A0)	Terminal M3-M4 Output Selection	DO Ch8 Select		Default: F Range: 0 to 192	–
F5-09 (3A1)	DO-A3 Output Mode Selection	DO Function Sel 0: 8ch Individual 1: Binary Output 2: 8ch Selected	0: Output terminals are each assigned separate output functions. 1: Binary code output. 2: Use output terminal functions selected by parameters F5-01 through F5-08.	Default: 0 Range: 0 to 2	–

◆ F6, F7: Communication Option Card

Parameters F6-01 through F6-03 and F6-06 through F6-08 are used for DeviceNet and PROFIBUS-DP options. Other parameters in the F6 group are used for communication-protocol-specific settings.

No. (Addr. Hex)	Name	LCD Display	Description	Values	Page
F6-01 (03A2)	Communications Error Operation Selection	Comm Bus Flt Sel 0: Ramp to Stop 1: Coast to Stop 2: Fast-Stop 3: Alarm Only	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.	Default: 1 Range: 0 to 3	–
F6-02 (03A3)	External Fault from Comm. Option Detection Selection	EF0 Detection 0: Always Detected 1: Only During Run	0: Always detected. 1: Detection during run only.	Default: 0 Range: 0, 1	–
F6-03 (03A4)	External Fault from Comm. Option Operation Selection	EF0 Fault Action 0: Ramp to Stop 1: Coast to Stop 2: Fast-Stop 3: Alarm Only	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.	Default: 1 Range: 0 to 3	–
F6-04 (03A5)	bUS Error Detection Time	BUS Err Det Time	Sets the delay time for error detection if a bus error occurs.	Default: 2.0 s Min.: 0.0 Max.: 5.0	–
F6-07 (03A8)	Multi-Step Speed Enable/Disable Selection when NefRef/ ComRef is Selected	Fref PrioritySel 0: Net/Com REF 1: MultiStep Speed	0: Multi-step reference disabled 1: Multi-step reference enabled	Default: 0 Range: 0, 1	–
F6-08 (036A) <1>	Reset Communication Parameters	Com Prm Init Sel 0: Init Com Prms 1: No Init Com Prms	0: Reset all communication-related parameters (F6-☐☐) when the drive is initialized using A1-03. 1: Communication-related parameters (F6-☐☐) are not reset when the drive is initialized using A1-03.	Default: 0 Range: 0, 1	–
F6-30 (03CB)	PROFIBUS-DP Node Address	PB Node Address	Sets the node address.	Default: 0 Min.: 0 Max.: 125	–
F6-31 (03CC)	PROFIBUS-DP Clear Mode Selection	PB Clear Select 0: Reset to Zero 1: Hold Prev Value	0: Resets drive operation with a Clear mode command. 1: Maintains the previous operation state when Clear mode command is given.	Default: 0 Range: 0, 1	–
F6-32 (03CD)	PROFIBUS-DP Data Format Selection	PB Map Select 0: PPO Type 1: Conventional	0: PPO Type 1: Conventional	Default: 0 Range: 0, 1	–
F6-45 (02FB)	BACnet Node Address	BAC Node Address	Sets the node address.	Default: 1 Min.: 0 Max.: 127	–
F6-46 (02FC)	BACnet Communication Speed	BAC Baud Rate 0: 93.75 kbps 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: 93.75 kbps 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	Default: 3 Range: 0 to 8	–
F6-47 (02FC)	Rx to Tx Wait Time	Rx to Tx Wait T	Rx to Tx Wait Time	Default: 5 ms Min.: 5 Max.: 65	–
F6-48 (02FE)	BACnet Device Objcet ID 0	BAC Dev Obj Id 0	BACnet device object ID	Default: 0 Min.: 0 Max.: FFFF	–
F6-49 (02FF)	BACnet Device Objcet ID 1	BAC Dev Obj Id 1	BACnet device object ID	Default: 0 Min.: 0 Max.: 3F	–
F6-50 (03C1)	DeviceNet MAC Address	DN MAC Address	Selects the drive MAC address.	Default: 64 Min.: 0 Max.: 64	–

No. (Addr. Hex)	Name	LCD Display	Description	Values	Page
F6-51 (03C2)	DeviceNet Communication Speed	DN Baud Rate 0: 125 kbps 1: 250 kbps 2: 500 kbps 3: Set from Network 4: Auto Detect	0: 125 kbps 1: 250 kbps 2: 500 kbps 3: Adjustable from network 4: Detect automatically	Default: 4 Range: 0 to 4	–
F6-52 (03C3)	DeviceNet PCA Setting	DN PCA Selection	Sets the format of the data set from the DeviceNet master to the drive.	Default: 21 Min.: 0 Max.: 255	–
F6-53 (03C4)	DeviceNet PPA Setting	DN PPA Selection	Sets the format of the data set from the drive to the DeviceNet master.	Default: 71 Min.: 0 Max.: 255	–
F6-54 (03C5)	DeviceNet Idle Mode Fault Detection	DN Idle Flt Det 0: Stop 1: Ignore	0: Enabled 1: Disabled, no fault detection	Default: 0 Range: 0, 1	–
F6-55 (03C6)	DeviceNet Baud Rate Monitor	DN BAUD RATE MEM 0: 125 kbps 1: 250 kbps 2: 500 kbps	Verifies the baud rate running on the network. 0: 125 kbps 1: 250 kbps 2: 500 kbps	Default: 0 Range: 0 to 2	–
F6-56 (03D7)	DeviceNet Speed Scaling	DN Speed Scale	Sets the scaling factor for the speed monitor in DeviceNet.	Default: 0 Min.: -15 Max.: 15	–
F6-57 (03D8)	DeviceNet Current Scaling	DN Current Scale	Sets the scaling factor for the output current monitor in DeviceNet.	Default: 0 Min.: -15 Max.: 15	–
F6-58 (03D9)	DeviceNet Torque Scaling	DN Torque Scale	Sets the scaling factor for the torque monitor in DeviceNet.	Default: 0 Min.: -15 Max.: 15	–
F6-59 (03DA)	DeviceNet Power Scaling	DN Power Scale	Sets the scaling factor for the power monitor in DeviceNet.	Default: 0 Min.: -15 Max.: 15	–
F6-60 (03DB)	DeviceNet Voltage Scaling	DN Voltage Scale	Sets the scaling factor for the voltage monitor in DeviceNet.	Default: 0 Min.: -15 Max.: 15	–
F6-61 (03DC)	DeviceNet Time Scaling	DN Time Scale	Sets the scaling factor for the time monitor in DeviceNet.	Default: 0 Min.: -15 Max.: 15	–
F6-62 (03DD)	DeviceNet Heartbeat Interval	DN Heart Beat	Sets the heartbeat interval for DeviceNet communications.	Default: 0 Min.: 0 Max.: 10	–
F6-63 (03DE)	DeviceNet Network MAC ID	DN MAC ID MEM	Saves and monitors settings 0 to 63 of F6-50 (DeviceNet MAC Address).	Default: 63 Min.: 0 Max.: 63	–
F6-64 to F6-71 (03DF to 03C8)	Dynamic I/O Assembly Parameters	–	Dynamic I/O Assembly Parameters	–	–
F7-01 (03E5) <2>	IP Address 1	IP Address 1	Sets the most significant octet of network static IP address.	Default: 192 Range: 0 to 255	–
F7-02 (03E6) <2>	IP Address 2	IP Address 2	Sets the second most significant octet of network static IP address.	Default: 168 Range: 0 to 255	–
F7-03 (03E7) <2>	IP Address 3	IP Address 3	Sets the third most significant octet of network static IP address.	Default: 1 Range: 0 to 255	–
F7-04 (03E8) <2>	IP Address 4	IP Address 4	Sets the fourth most significant octet of network static IP address.	Default: 20 Range: 0 to 255	–
F7-05 (03E9)	Subnet Mask 1	Subnet Mask 1	Sets the most significant octet of network static Subnet Mask.	Default: 255 Range: 0 to 255	–

No. (Addr. Hex)	Name	LCD Display	Description	Values	Page
F7-06 (03EA)	Subnet Mask 2	Subnet Mask 2	Sets the second most significant octet of network static Subnet Mask.	Default: 255 Range: 0 to 255	–
F7-07 (03EB)	Subnet Mask 3	Subnet Mask 3	Sets the third most significant octet of network static Subnet Mask.	Default: 255 Range: 0 to 255	–
F7-08 (03EC)	Subnet Mask 4	Subnet Mask 4	Sets the fourth most significant octet of network static Subnet Mask.	Default: 0 Range: 0 to 255	–
F7-09 (03ED)	Gateway Address 1	Gateway IP Add 1	Sets the most significant octet of network Gateway address.	Default: 192 Range: 0 to 255	–
F7-10 (03EE)	Gateway Address 2	Gateway IP Add 2	Sets the second most significant octet of network Gateway address.	Default: 168 Range: 0 to 255	–
F7-11 (03EF)	Gateway Address 3	Gateway IP Add 3	Sets the third most significant octet of network Gateway address.	Default: 1 Range: 0 to 255	–
F7-12 (03E0)	Gateway Address 4	Gateway IP Add 4	Sets the fourth most significant octet of network Gateway address.	Default: 1 Range: 0 to 255	–
F7-13 (03F1)	Address Mode at Startup	IP Add Mode Sel 0: User Defined 1: BOOTP 2: DHCP	Select the option address setting method 0: Static <3> 1: BOOTP 2: DHCP	Default: 2 Range: 0 to 2	–
F7-14 (03F2)	Duplex Mode Selection	Duplex Select 0: Half Duplex 1: Auto Negotiate 2: Full Duplex	Selects duplex mode setting. 0: Half duplex forced 1: Auto-negotiate duplex mode and communication speed 2: Full duplex forced	Default: 1 Range: 0 to 2	–
F7-15 (03F3)	Communication Speed Selection	Baud Rate 10: 10 Mbps 100: 100 Mbps	Sets the communication speed 10: 10 Mbps 100: 100 Mbps	Default: 10 Range: 10, 100	–
F7-16 (03F4)	Communication Loss Timeout	CommLoss Tout	Sets the timeout value for communication loss detection in tenths of a second. A value of 0 disables the connection timeout. Example: An entered value of 100 represents 10.0 seconds.	Default: 0 Min.: 0 Max.: 300	–
F7-17 (03F5)	EtherNet/IP Speed Scaling Factor	EN Speed Scale	Sets the scaling factor for the speed monitor in EtherNet/IP Class ID 2AH Object.	Default: 0 Min.: -15 Max.: 15	–
F7-18 (03F6)	EtherNet/IP Current Scaling Factor	EN Current Scale	Sets the scaling factor for the output current monitor in EtherNet/IP Class ID 2AH Object.	Default: 0 Min.: -15 Max.: 15	–
F7-19 (03F7)	EtherNet/IP Torque Scaling Factor	EN Torque Scale	Sets the scaling factor for the torque monitor in EtherNet/IP Class ID 2AH Object.	Default: 0 Min.: -15 Max.: 15	–
F7-20 (03F8)	EtherNet/IP Power Scaling Factor	EN Power Scale	Sets the scaling factor for the power monitor in EtherNet/IP Class ID 2AH Object.	Default: 0 Min.: -15 Max.: 15	–
F7-21 (03F9)	EtherNet/IP Voltage Scaling Factor	EN Voltage Scale	Sets the scaling factor for the voltage monitor in EtherNet/IP Class ID 2AH Object.	Default: 0 Min.: -15 Max.: 15	–
F7-22 (03FA)	EtherNet/IP Time Scaling	EN Time Scale	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 (03FB to 0374)	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 (0375 to 037E)	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> Parameter setting value is not reset to the default value when the drive is initialized.

<2> Cycle power for setting changes to take effect.

<3> If F7-13 is set to 0, all IP addresses (F7-01 to F7-04) must be unique.

B.7 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 (0438)	Multi-Function Digital Input Terminal S1 Function Selection	Term S1 Func Sel	Assigns a function to the multi-function digital inputs. Refer to pages 158 to 159 for descriptions of setting values. **Note:** Set unused terminals to F.	Default: 40 (F) <1> Min.: 1 Max.: 9F	158
H1-02 (0439)	Multi-Function Digital Input Terminal S2 Function Selection	Term S2 Func Sel	Assigns a function to the multi-function digital inputs. Refer to pages 158 to 159 for descriptions of setting values. **Note:** Set unused terminals to F.	Default: F Min.: 1 Max.: 9F	158
H1-03 (0400)	Multi-Function Digital Input Terminal S3 Function Selection	Term S3 Func Sel	Assigns a function to the multi-function digital inputs. Refer to pages 158 to 159 for descriptions of setting values. **Note:** Set unused terminals to F.	Default: 26 Min.: 0 Max.: 9F	158
H1-04 (0401)	Multi-Function Digital Input Terminal S4 Function Selection	Term S4 Func Sel	Assigns a function to the multi-function digital inputs. Refer to pages 158 to 159 for descriptions of setting values. **Note:** Set unused terminals to F.	Default: 14 Min.: 0 Max.: 9F	158
H1-05 (0402)	Multi-Function Digital Input Terminal S5 Function Selection	Term S5 Func Sel	Assigns a function to the multi-function digital inputs. Refer to pages 158 to 159 for descriptions of setting values. **Note:** Set unused terminals to F.	Default: 8D (0) <1> Min.: 0 Max.: 9F	158
H1-06 (0403)	Multi-Function Digital Input Terminal S6 Function Selection	Term S6 Func Sel	Assigns a function to the multi-function digital inputs. Refer to pages 158 to 159 for descriptions of setting values. **Note:** Set unused terminals to F.	Default: 80 (3) <1> Min.: 0 Max.: 9F	158
H1-07 (0404)	Multi-Function Digital Input Terminal S7 Function Selection	Term S7 Func Sel	Assigns a function to the multi-function digital inputs. Refer to pages 158 to 159 for descriptions of setting values. **Note:** Set unused terminals to F.	Default: 81 (4) <1> Min.: 0 Max.: 9F	158
H1-08 (0405) RUN	Multi-Function Digital Input Terminal S8 Function Selection	Term S8 Func Sel	Assigns a function to the multi-function digital inputs. Refer to pages 158 to 159 for descriptions of setting values. **Note:** Set unused terminals to F.	Default: F (6) <1> Min.: 0 Max.: 9F	158
H1-21 (02D7) RUN	External Fault 1 Delay Time	EF1 Delay Time	Sets the amount of time delay applied to the EF1 fault. (20 ≤ H1-01 ≤ 2F)	Default: 0.00 s Min.: 0.00 Max.: 300.00	–
H1-22 (02D8) RUN	External Fault 2 Delay Time	EF2 Delay Time	Sets the amount of time delay applied to the EF2 fault. (20 ≤ H1-02 ≤ 2F)	Default: 0.00 s Min.: 0.00 Max.: 300.00	–
H1-23 (02D9) RUN	External Fault 3 Delay Time	EF3 Delay Time	Sets the amount of time delay applied to the EF3 fault. (20 ≤ H1-03 ≤ 2F)	Default: 0.00 s Min.: 0.00 Max.: 300.00	–
H1-24 (02DA) RUN	External Fault 4 Delay Time	EF4 Delay Time	Sets the amount of time delay applied to the EF4 fault. (20 ≤ H1-04 ≤ 2F)	Default: 0.00 s Min.: 0.00 Max.: 300.00	–
H1-25 (02DB) RUN	External Fault 5 Delay Time	EF5 Delay Time	Sets the amount of time delay applied to the EF5 fault. (20 ≤ H1-05 ≤ 2F)	Default: 0.00 s Min.: 0.00 Max.: 300.00	–
H1-26 (02DC) RUN	External Fault 6 Delay Time	EF6 Delay Time	Sets the amount of time delay applied to the EF6 fault. (20 ≤ H1-06 ≤ 2F)	Default: 0.00 s Min.: 0.00 Max.: 300.00	–
H1-27 (02DD) RUN	External Fault 7 Delay Time	EF7 Delay Time	Sets the amount of time delay applied to the EF7 fault. (20 ≤ H1-07 ≤ 2F)	Default: 0.00 s Min.: 0.00 Max.: 300.00	–

No. (Addr. Hex)	Name	LCD Display	Description	Values	Page
H1-28 (02DE) RUN	External Fault 8 Delay Time	EF8 Delay Time	Sets the amount of time delay applied to the EF8 fault. (20 ≤ H1-08 ≤ 2F)	Default: 0.00 s Min.: 0.00 Max.: 300.00	–

<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.	
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.	–
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.	–
5	Multi-Step Speed Reference 3	Multi-Step Ref 3	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.	–
6	Jog reference selection	jog Freq Ref	Closed: Jog frequency reference (d1-17) selected. Jog has priority over all other reference sources.	–
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).	–
8	Baseblock command (N.O.)	Ext BaseBlk N.O.	Closed: No drive output	–
9	Baseblock command (N.C.)	Ext BaseBlk N.C.	Open: No drive output	–
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.	–
B	Drive overheat alarm (oH2)	OH2 Alarm Signal	Closed: Closes when an oH2 alarm occurs	–
C	Analog terminal input selection	Term A2 Enable	Open: Function assigned by H3-14 is disabled. Closed: Function assigned by H3-14 is enabled.	–
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 can be used as digital input for the controller the drive is connected to.	–
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.	–
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.	–
12	Forward Jog	Forward Jog	Closed: Runs forward at the Jog frequency d1-17.	–
13	Reverse Jog	Reverse Jog	Closed: Runs reverse at the Jog frequency d1-17.	–
14	Fault reset	Fault Reset	Closed: Resets faults if the cause is cleared and the Run command is removed.	–
15	Fast Stop (N.O.)	Fast-Stop N.O.	Closed: Decelerates at the Fast Stop time set to C1-09.	–
17	Fast Stop (N.C.)	Fast-Stop N.C.	Open: Decelerates to stop at the Fast Stop time set to C1-09.	–
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).	–
19	PID disable	PID Disable	Open: PID control enabled Closed: PID control disabled	–
1A	Accel/decel time selection 2	Multi-Acc/Dec 2	Used in conjunction with an input terminal set for “Accel/decel time selection 1” (H1-□□ = 7), and allows the drive to switch between accel/decel times 3 and 4.	–

H1 Multi-Function Digital Input Selections				
H1-☐☐ Setting	Function	LCD Display	Description	Page
1B	Program lockout	Program Lockout	Open: Parameters cannot be edited (except for U1-01 if the reference source is assigned to the digital operator). Closed: Parameters can be edited and saved.	–
1E	Reference sample hold	Ref Sample Hold	Closed: Samples the analog frequency reference and operates the drive at that speed.	–
20 to 2F	External pump fault	Ext Pump 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)	–
30	PID integral reset	PID Intgrl Reset	Closed: Resets the PID control integral value.	–
31	PID integral hold	PID Intgrl Hold	Open: Performs integral operation. Closed: Maintains the current PID control integral value.	–
32	Multi-Step Speed Reference 4	Multi-Step Ref 4	Used in combination with input terminals set to Multi-Step Speed Reference 1, 2, and 3. Use parameters d1-09 to d1-16 to set reference values.	–
34	PID soft starter cancel	PID SFS Cancel	Open: PID soft starter is enabled. Closed: Disables the PID soft starter b5-17.	–
35	PID input level selection	PID Input Invert	Closed: Inverts the PID input signal.	–
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.	–
41	Reverse run command (2-Wire sequence)	RevRun 2WireSeq	Open: Stop Closed: Reverse run **Note:** Cannot be set together with settings 42 or 43.	–
42	Run command (2-Wire sequence 2)	Run/Stp 2WireSeq	Open: Stop Closed: Run **Note:** Cannot be set together with settings 40 or 41.	–
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.	–
47	Node setup	CanOpenNID Setup	Closed: Node setup for SI-S3 enabled.	–
51	Sequence Timer Disable	SeqTimer Disable	Closed: Drive ignores sequence timers and runs normally (based on b1-02/b1-16 source).	–

H1 Multi-Function Digital Input Selections				
H1-□□ Setting	Function	LCD Display	Description	Page
52	Sequence Timer Cancel	SeqTimer Cancel	Closed: When the input changes from open to closed, the currently active sequence timer is disabled. Operation will resume with the next scheduled sequence timer. Cycling the Run command after the current sequence timer has been canceled will re-enable the sequence timer.	–
60	DC Injection Braking command	DCInj Activate	Closed: Triggers DC Injection Braking.	–
61	External Speed Search command 1	Speed Search 1	Closed: Activates Current Detection Speed Search from the maximum output frequency (E1-04).	–
62	External Speed Search command 2	Speed Search 2	Closed: Activates Current Detection Speed Search from the frequency reference.	–
63	Field weakening	Field Weak	Closed: The drive performs Field Weakening control as set for d6-01 and d6-02.	–
65	KEB Ride-Thru 1 (N.C.)	KEB Ridethru NC	Open: KEB Ride-Thru 1 enabled.	–
66	KEB Ride-Thru 1 (N.O.)	KEB Ridethru NO	Closed: KEB Ride-Thru 1 enabled.	–
67	Communications test mode	Comm Test Mode	Tests the MEMOBUS/Modbus RS-422/RS-485 interface. Displays “PASS” if the test completes successfully.	–
68	High Slip Braking (HSB)	HighSlipBraking	V/f Closed: Activates High Slip Braking to stop the drive during a Run command.	–
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.	–
73	Low City Press	Low City Press	Indicates that sufficient or insufficient pressure is present on the inlet to the pump. Used mainly for pressure booster situations. **Note:** Parameter P4-21 determines if this input is normally open or normally closed.	–
75	Up 2 command	Up Command 2	Controls the bias added to the frequency reference by the Up/Down 2 function. The Up 2 and Down 2 commands must always be used in conjunction with one another.	–
76	Down 2 command	Down Command 2	Controls the bias added to the frequency reference by the Up/Down 2 function. The Up 2 and Down 2 commands must always be used in conjunction with one another.	–
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.	–
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.	–
7F	PID Bi-Direction Enable	PID BiDir Enable	PID Bi-Direction Enable	–
80	HAND Mode	Hand Mode	Closed: HAND Mode operation. Frequency reference determined by P5-01 and P5-02. Open: Stop Mode when no Run command.	–
81	HAND Mode 2	Hand Mode 2	Closed: HAND Mode operation. Frequency reference determined by P5-05. Open: Stop Mode when no Run command.	–
88	Volute-Thermostat Normally Open	Volute-TStat NO	Function active when the drive is running. Closed: Drive will trip on “VLTS - Volute-TStat Flt” Open: Thermostat fault not active **Note:** Setting H1-□□ = 88 and 89 simultaneously will trigger a “VLTS - Volute-TStat Flt”.	
89	Volute-Thermostat Normally Closed	Volute-TStat NC	Function active when the drive is running. Closed: Thermostat fault not active Open: Drive will trip on “VLTS - Volute-TStat Flt” **Note:** Setting H1-□□ = 88 and 89 simultaneously will trigger a “VLTS - Volute-TStat Flt”.	
8C	Disable Pre-Charge	Disable Pre-Chrg	Closed: Pre-Charge disabled.	–
8D	Multi Setpoint 1	Multi Setpoint 1	Open: Frequency reference, Q1-01, or Q1-03 is PID Setpoint. Closed: Q1-02 or Q1-04 is PID Setpoint.	–
8E	Multi Setpoint 2	Multi Setpoint 2	Open: Frequency reference, Q1-01, or Q1-02 is PID Setpoint. Closed: Q1-03 or Q1-04 is PID Setpoint.	–

H1 Multi-Function Digital Input Selections				
H1-☐☐ Setting	Function	LCD Display	Description	Page
8F	Low Water Level	Low Water	Function active in AUTO Mode during normal operation, also used with Pre-Charge function. Function logic depends on P1-30, Low Water Digital Input Configuration. P1-30 = 0 (Normally open) Closed: Low water level fault Open: Reservoir/Tank is filled to normal level P1-30 = 1 (Normally closed) Closed: Reservoir/Tank is filled to normal level Open: Low water level fault Pre-Charge function: Function uses the low water level input as "Tank/Reservoir" feedback to indicate that the water level has been reached.	–
90	High Water Level	High Water	Function active when the drive is running. Function logic depends on P1-31, High Water Digital Input Configuration. P1-31 = 0 (Normally open) Closed: High water level fault Open: Reservoir/Tank is filled to normal level P1-31 = 1 (Normally closed) Closed: Reservoir/Tank is filled to normal level Open: High water level fault	–
92	Reset Accumulated Volume	Reset Accum	Closed: Accumulated volume is reset to 0 and held at 0 if digital input remains closed.	–
95	Remove Drive Disable	Remote Drv Disbl	Closed: Prevents the drive from running when active for the time set in P4-26. Must be inactive for the time set in P4-27 to allow the drive to run again. **Note:** Parameter P4-25 determines if this input is normally open or normally closed.	–
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.	–
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.	–
AA	Secondary PI Inverse Operation	PI2 Invert	Closed: Changes the sign of the secondary PI controller input (reverse acting PI control).	–
AB	Secondary PI Integral Reset	PI2 Intgrl Reset	Closed: Resets the secondary PI controller integral value.	–
AC	Secondary PI Integral Hold	PI2 Intgrl Hold	Closed: Locks the value of the secondary PI controller integral value.	–
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-☐☐).	–
AF	Emergency Override Forward Run	EmergOverrideFWD	Closed: Run the drive forward using the speed set in S6-02.	–
B0	Emergency Override Reverse Run	EmergOverrideREV	Closed: Run the drive in reverse using the speed set in S6-02.	–

◆ H2: Multi-Function Digital Outputs

No. (Addr. Hex)	Name	LCD Display	Description	Values	Page
H2-01 (040B)	Terminal M1-M2 function selection (relay)	M1-M2 Func Sel	Refer to H2 Multi-Function Digital Output Settings on pages *159* to *160* for descriptions of setting values.	Default: 37 Range: 0 to 192	*159*
H2-02 (040C)	Terminal M3-M4 function selection (relay)	M3/M4 Func Sel		Default: F Range: 0 to 192	*159*
H2-03 (040D)	Terminal MD-ME-MF Function Selection	MD/ME/MF Func Sel		Default: E Range: 0 to 192	*159*

No. (Addr. Hex)	Name	LCD Display	Description	Values	Page
H2-06 (0437)	Watt Hour Output Unit Selection	Pwr Mon Unit Sel	Outputs a 200 ms pulse signal when the watt-hour counter increases by the units selected. 0: 0.1 kWh units 1: 1 kWh units 2: 10 kWh units 3: 100 kWh units 4: 1000 kWh units	Default: 0 Range: 0 to 4	–

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.	–
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.	–
2	Speed agree 1	Fref/Fout Agree1	Closed: Output frequency equals the speed reference (plus or minus the hysteresis set to L4-02).	
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).	
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.	–
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.	–
6	Drive ready	Drive Ready	Closed: Power up is complete and the drive is ready to accept a Run command.	–
7	DC bus undervoltage	DC Bus Undervolt	Closed: DC bus voltage is below the Uv trip level set in L2-05.	–
8	During baseblock (N.O.)	BaseBlk 1	Closed: Drive has entered the baseblock state (no output voltage).	–
9	Frequency reference source	Ref Source	Open: External Reference 1 or 2 supplies the frequency reference (set in b1-01 or b1-15). Closed: Digital operator supplies the frequency reference.	–
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: Digital operator supplies the Run command.	–
B	Torque detection 1 (N.O.)	Trq Det 1 N.O.	Closed: An overtorque or undertorque situation has been detected.	–
C	Frequency reference loss	Loss of Ref	Closed: Analog frequency reference has been lost. Frequency reference loss is detected when the frequency reference drops below 10% of the reference within 400 ms.	–
D	Braking resistor fault	DB Overheat	Closed: Braking resistor or transistor is overheated or faulted out.	–
E	Fault	Fault	Closed: Fault occurred.	–
F	Through mode	Not Used	Set this value when using the terminal in the pass-through mode.	–
10	Minor fault	Minor Fault	Closed: An alarm has been triggered, or the IGBTs have reached 90% of their expected life span.	–
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.	–
12	Timer output	Timer Output	Closed: Timer output.	–
13	Speed agree 2	Fref/Fout Agree2	Closed: When drive output frequency equals the frequency reference ±L4-04.	–
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.	–
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.	–
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.	–
17	Torque detection 1 (N.C.)	Trq Det 1 N.C.	Open: Overtorque or undertorque has been detected.	–
18	Torque detection 2 (N.O.)	Trq Det 2 N.O.	Closed: Overtorque or undertorque has been detected.	
19	Torque detection 2 (N.C.)	Trq Det 2 N.C.	Open: Overtorque or undertorque has been detected.	–
1A	During reverse	Reverse Dir	Closed: Drive is running in the reverse direction.	–

H2 Multi-Function Digital Output Settings				
H2-□□ Setting	Function	LCD Display	Description	Page
1B	During baseblock (N.C.)	BaseBlk 2	Open: Drive has entered the baseblock state (no output voltage).	–
1E	Restart enabled	Dur Flt Restart	Closed: An automatic restart is performed	–
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.	–
20	Drive overheat pre-alarm (oH)	OH Prealarm	Closed: Heatsink temperature exceeds the parameter L8-02 value.	–
22	Mechanical weakening detection	MechFatigue(OL5)	Closed: Mechanical weakening detected.	–
2F	Maintenance period	Maintenance	Closed: Cooling fan, electrolytic capacitors, IGBTs, or the soft charge bypass relay may require maintenance.	–
30	During torque limit	Torque Limit	OLV Closed: The torque limit has been reached.	–
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).	–
38	Drive enabled	Drive Enable	Closed: Multi-function input set for “Drive enable” is closed (H1-□□ = 6A)	–
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.	–
3C	LOCAL/REMOTE status	Local	Open: REMOTE Closed: LOCAL	–
3D	During speed search	During SpdSrch	Closed: Speed Search is being executed.	–
3E	PID feedback low	PID Feedback Low	Closed: PID feedback level is too low.	–
3F	PID feedback high	PID FeedbackHigh	Closed: The PID feedback level is too high.	–
4A	During KEB Ride-Thru	During KEB	Closed: KEB Ride-Thru is being performed.	–
4C	During fast stop	During Fast Stop	Closed: A Fast Stop command has been entered from the operator or input terminals.	–
4D	oH Pre-alarm time limit	OH Pre-Alarm	Closed: oH pre-alarm time limit has passed.	–
4E	Braking transistor fault (rr)	Brk Trans Fault	Closed: The built-in dynamic braking transistor failed.	–
4F	Braking resistor overheat (oH)	BrkResistOvHeat	Closed: The dynamic braking resistor has overheated.	–
50	Waiting to Run	Waiting for Run	Closed: b1-11 Timer is active.	–
51	Sequence timer 1	SeqTimer Disable	Closed: Sequence timer 1 is active.	–
52	Sequence timer 2	SeqTimer Cancel	Closed: Sequence timer 2 is active.	–
53	Sequence timer 3	Sequence timer 3	Closed: Sequence timer 3 is active.	–
54	Sequence timer 4	Sequence Timer 4	Closed: Sequence timer 4 is active.	–
58	Underload detection	UL6	Closed: Underload is detected.	–
60	Internal cooling fan alarm	Fan Alrm Det	Closed: Internal cooling fan alarm	–
71	Secondary PI Feedback Low	PI2 Feedback Low	Closed: PI2 feedback level is too low.	–
72	Secondary PI Feedback High	PI2 FeedbackHigh	Closed: The PI2 feedback level is too high.	–
80	Pump 2 Control	Pump 2 Control	Contactor control for a second pump. The function is active in contactor multiplex mode only (P1-01 = 1).	–
81	Pump 3 Control	Pump 3 Control	Contactor control for a third pump. The function is active in contactor multiplex mode only (P1-01 = 1) and when P3-01 is set to a value greater than 1.	–
82	Pump 4 Control	Pump 4 Control	Contactor control for a fourth pump. The function is active in contactor multiplex mode only (P1-01 = 1) and when P3-01 is set to a value greater than 2.	–
83	Pump 5 Control	Pump 5 Control	Contactor control for a fifth pump. The function is active in contactor multiplex mode only (P1-01 = 1) and when P3-01 is set to a value greater than 3.	–

H2 Multi-Function Digital Output Settings				
H2-□□ Setting	Function	LCD Display	Description	Page
84	Pump 6 Control	Pump 6 Control	Contactor control for a sixth pump. The function is active in contactor multiplex mode only (P1-01 = 1) and when P3-01 is set to a value greater than 4.	–
89	Output 1 Limit	Output I Lim	Closed: Drive output speed is being limited due to the output current limit or the single phase foldback regulator.	–
8B	Lube Pump	Lube Pump	Closed: Energizes for the time set in P4-31 each time the drive is supposed to start.	–
8F	Internal Fan On	Internal Fan On	Internal Fan On	–
91	Pump Fault	Pump Fault	Closed when any of the following faults are active: • Low feedback • High feedback • Low water • High water • NMS-Setpoint not met • POC-Pump over cycle • THMS-Thermostat input • External pump fault	–
92	Transducer Loss	Transducer Loss	Closed: The analog output associated with PID feedback has risen above 21 mA or fallen below 3 mA or a Transducer Loss alarm or fault is active.	–
93	Setptoint Not Met	SetPoint Not Met	Closed: During an “NMS-Setpoint Not Met” condition.	–
94	Loss of Prime	Loss of Prime	Closed: During an “LOP-Loss of Prime” condition.	–
95	Volute Thermostat Fault	Volute-TStat Flt	Closed: Volute-Thermostat digital input is active.	
96	High Feedback	High Feedback	Closed: During a “High Feedback” condition as defined by P1-11 and P1-12 OR Closed: During a “High FB/Water” fault OR Closed: During a “High Feedback” alarm	–
97	Low Feedback	Low Feedback	Closed: During a “Low Feedback” condition as defined by P1-08 and P1-12 OR Closed: During a “Low FB/Water” fault OR Closed: During a “Low Feedback” alarm	–
98	Low Flow	Low Flow	Closed: During the “Low Flow Fault” condition OR Closed: During a Low Flow condition set by P6-06 to P6-08, including a “Low Flow” alarm	–
99	Accum Level	Accum Level	Closed: Accumulated level has exceeded the P6-11 to P6-14 settings OR Closed: During the “Accum Level” fault	–
9A	High Flow	High Flow	Closed: During the “High Flow Fault” condition OR Closed: During a “High Flow” condition set by P6-17 and P6-18, including a “High Flow” alarm	–
9B	Low Water Level	Low Water Level	Closed: The water level has dropped below the Low Detection Level set in Q4-09 for longer than the Low Level Detection Delay Time set in Q4-09 or if there is a LOWWL – Low Water Level Fault.	–
9C	Low Suction	Low Suction	Closed: The suction pressure has dropped below the Low Suction Pressure Detection Level set in Q5-09 for longer than the Low Suction Pressure Delay Time set in Q5-10 or if there is a LOSUC – Low Suction Pressure Fault.	–
9D	High Suction	High Suction	Closed: The suction pressure has risen above the High Suction Pressure Detection Level set in Q5-12 for longer than the High Suction Pressure Delay Time set in Q5-13 or if there is a HISUC – High Suction Pressure Fault.	–
A2	Sleep Active	Sleep Active	Closed: The drive is not running due to the Sleep function (does not include Sleep Boost).	–
A3	Start Delay	Start Delay	Closed: Feedback has risen above the start level (or fallen below for Inverse PID) and the start timer is timing.	–
A4	Pre-Charge	Pre-Chg Active	Closed: Drive is in Pre-Charge mode.	–
A5	Anti-Jam Active	Anti-Jam Active	Closed: The anti-jam function is active (configured by P7-□□).	–
A9	Thrust Mode	Thrust Mode	Closed: The Thrust Bearing feature is active (output frequency is between 0 and the value of P4-12).	–
AA	Utility Start Delay	Utility Delay	Closed: The drive is stopped and waiting for the utility delay timer set in P4-17 to expire.	–
100 to 1AA	Function 0 to AA with inverse output	–	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.	–

◆ H3: Multi-Function Analog Inputs

No. (Addr. Hex)	Name	LCD Display	Description	Values	Page
H3-01 (0410)	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 1: -10 to 10 V 2: 4 to 20 mA 3: 0 to 20 mA **Note:** Use Jumper S1 to set input terminal A1 for a current or voltage input signal.	Default: 0 Range: 0 to 3	*160*
H3-02 (0434)	Terminal A1 Function Selection	Term A1 FuncSel	Sets the function of terminal A1.	Default: 0 Range: 0 to 32	*160*
H3-03 (0411) 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	*160*
H3-04 (0412) 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	*160*
H3-05 (0413)	Terminal A3 Signal Level Selection	Term A3 Level 0: 0-10V, (LowLim=0) 1: 0-10V, (BipolRef) 2: 4-20 mA 3: 0-20 mA	0: 0 to 10 V 1: -10 to 10 V 2: 4 to 20 mA 3: 0 to 20 mA **Note:** Use Jumper S1 to set input terminal A3 for a current or voltage input signal.	Default: 0 Range: 0 to 3	*161*
H3-06 (0414)	Terminal A3 Function Selection	Term A3 FuncSel	Sets the function of terminal A3.	Default: 20 Range: 0 to 32	*161*
H3-07 (0415) RUN	Terminal A3 Gain Setting	Terminal A3 Gain	Sets the level of the input value selected in H3-06 when 10 V is input at terminal A3.	Default: 100.0% Min.: -999.9 Max.: 999.9	*162*
H3-08 (0416) RUN	Terminal A3 Bias Setting	Terminal A3 Bias	Sets the level of the input value selected in H3-06 when 0 V is input at terminal A3.	Default: 0.0% Min.: -999.9 Max.: 999.9	*162*
H3-09 (0417)	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 1: -10 to 10 V 2: 4 to 20 mA 3: 0 to 20 mA **Note:** Use Jumper S1 to set input terminal A2 for a current or voltage input signal.	Default: 2 Range: 0 to 3	*162*
H3-10 (0418)	Terminal A2 Function Selection	Term A2 FuncSel	Sets the function of terminal A2.	Default: B Range: 0 to 32	*162*
H3-11 (0419) 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	*162*
H3-12 (041A) 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	*162*
H3-13 (041B)	Analog Input Filter Time Constant	A1/A2 Filter T	Sets a primary delay filter time constant for terminals A1, A2, and A3. Used for noise filtering.	Default: 0.03 s Min.: 0.00 Max.: 2.00	–
H3-14 (041C)	Analog Input Terminal Enable Selection	A1/A2 Sel 1: A1 Available 2: A2 Available 3: A1/A2 Available 4: A3 Available 5: A1/A3 Available 6: A2/A3 Available 7: All 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 only 4: Terminal A3 only 5: Terminals A1 and A3 6: Terminals A2 and A3 7: All terminals enabled	Default: 7 Range: 1 to 7	–
H3-16 (02F0)	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	–

No. (Addr. Hex)	Name	LCD Display	Description	Values	Page
H3-17 (02F1)	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	–
H3-18 (02F2)	Terminal A3 Offset	Term A3 Offset	Adds an offset when the analog signal to terminal A3 is at 0 V.	Default: 0 Min.: -500 Max.: 500	–

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)	–
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%.	–
2	Auxiliary frequency reference 1	Aux Reference1	10 V = E1-04 (maximum output frequency)	–
3	Auxiliary frequency reference 2	Aux Reference2	10 V = E1-04 (maximum output frequency)	–
4	Output voltage bias	Voltage Bias	V/f 10 V = E1-05 (motor rated voltage)	–
5	Accel/decel time gain	Acc/Dec Change	10 V = 100%	–
6	DC Injection Braking current	DC Brake Current	10 V = Drive rated current	–
7	Overtorque/ undertorque detection level	Torque Det Level	10 V = Drive rated current (V/f)	–
8	Stall Prevention level during run	Stall Prev Level	V/f 10 V = Drive rated current	–
9	Output frequency lower limit level	Ref Lower Limit	10 V = E1-04 (maximum output frequency)	–
B	PID feedback	PID Feedback1	10 V = 100%	–
C	PID setpoint	PID Set Point	10 V = 100%	–
D	Frequency bias	Freq Ref Bias 2	10 V = E1-04 (maximum output frequency)	–
E	Motor Temperature (PTC Input)	E Motor PTC	10 V = 100% **Note:** A 12 kΩ resistor must be connected between terminals A1, A2, or A3 and V+ for PTC functionality.	–
F	Through mode	Not Used	Select this setting when using the terminal in a pass-through mode. The terminal does not trigger a drive function but can be used as digital input for the controller the drive is connected to.	–
10	Forward torque limit	Fwd Torque Limit	OLV 10 V = Motor rated torque	–
11	Reverse torque limit	Rev Torque Limit	OLV 10 V = Motor rated torque	–
12	Regenerative torque limit	Regen Torq Limit	OLV 10 V = Motor rated torque	–
15	General torque limit	Torque Limit	OLV 10 V = Motor rated torque	–
16	Differential PID feedback	PID Feedback 2	10 V = 100%	–
1F	Through mode	Not Used	Set this value when using the terminal in the pass-through mode.	–
20	HAND Frequency Reference	Hand Freq. Ref.	Full scale: Max. frequency (E1-04)	–
21	Geothermal Temperature	Geothermal Temp	Full scale: Q2-02 = 10 V (or 20 mA), Q2-01 = 0 V (or 4 mA) This input is internally limited to -110.0 °F to +320.0 °F after gain and bias.	–
22	Flow Meter	Flow Meter	Full scale: P6-01	–

H3 Multi-Function Analog Input Settings				
H3-□□ Setting	Function	LCD Display	Description	Page
23	Water Level or Suction Input	WaterLvl/Suction	When Water Level Control is enabled (Q4-01 = 1): 0 V or 4 mA = 0 (ft) 10 V or 20 mA = Q4-02 (PSI) * 2.308 ft/PSI OR When Suction Pressure Control is enabled (Q5-01 = 1) <1> 0 V or 4 mA = 9 (PSI) 10 V or 20 mA = Q5-02 (PSI) OR When Vacuum Control is enabled (Q5-01 = 2) <2> 0 V or 4 mA = 0 (”Hg) 10 V or 20 mA = Q5-02 (”Hg)	–
25	Secondary PI Setpoint	PI2 Setpoint	10 V = S3-02 (maximum output frequency)	–
26	Secondary PI Feedback	PI2 Feedback	10 V = S3-02 (maximum output frequency)	–

<1> When Pressure Control is enabled (Q5-01 = 1), the action of the analog input is normal. A higher voltage or current on the input causes a higher pressure to be read in the drive.

<2> When Vacuum Control is enabled (Q5-01 = 2), the action of the analog input is reversed. A higher voltage or current on the input causes a lower pressure (or higher level of vacuum) to be read in the drive.

◆ H4: Analog Outputs

No. (Addr. Hex)	Name	LCD Display	Description	Values	Page
H4-01 (041D)	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 999	162
H4-02 (041E) 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	163
H4-03 (041F) 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	163
H4-04 (0420)	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 999	162
H4-05 (0421) 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	163
H4-06 (0422) 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	163
H4-07 (0423)	Multi-Function Analog Output Terminal FM Signal Level Selection	Level Select1 0: 0-10 VDC 1: -10 +10 VDC 2: 4-20 mA	0: 0 to 10 V 1: -10 to 10 V 2: 4 to 20mA	Default: 0 Range: 0 to 2	164
H4-08 (0424)	Multi-Function Analog Output Terminal AM Signal Level Selection	AO Level Select2 0: 0-10 VDC 1: -10 +10 VDC 2: 4-20 mA	0: 0 to 10 V 1: -10 to 10 V 2: 4 to 20 mA	Default: 0 Range: 0 to 2	164

◆ H5: MEMOBUS/Modbus Serial Communication

No. (Addr. Hex)	Name	LCD Display	Description	Values	Page
H5-01 (0425) <1>	Drive Node Address	Serial Comm Adr	Selects drive station node 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 <2>	–
H5-02 (0426)	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	–
H5-03 (0427)	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	–
H5-04 (0428)	Stopping Method after Communication Error (CE)	Serial Fault Sel 0: Ramp to Stop 1: Coast to Stop 2: Fast-Stop 3: Alarm Only	0: Ramp to stop 1: Coast to stop 2: Fast Stop 3: Alarm only	Default: 3 Range: 0 to 3	–
H5-05 (0429)	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	–
H5-06 (042A)	Drive Transmit Wait Time	Transmit WaitTIM	Set the wait time between receiving and sending data.	Default: 5 ms Min.: 5 Max.: 65	–
H5-07 (042B)	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	–
H5-09 (0435)	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	–
H5-10 (0436)	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	–
H5-11 (043C)	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.	Default: 1 Range: 0, 1	–
H5-12 (043D)	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	–

<1> If this parameter is set to 0, the drive will be unable to respond to MEMOBUS/Modbus commands.

<2> When P1-01, Pump Mode, is set to 3 (MEMOBUS network), the range is dependent on P9-25, Highest Node Address.

◆ H6: Pulse Train Input

No. (Addr. Hex)	Name	LCD Display	Description	Values	Page
H6-01 (042C)	Pulse Train Input Terminal RP Function Selection	Term RP Func Sel 0: Frequency Ref 1: PID Feedback 2: PID Set Point 5: Flow Meter	0: Frequency reference 1: PID feedback value 2: PID setpoint value 5: Flow meter **Note:** When this parameter is set to 5, parameters H6-02 to H6-04 and H6-08 are ignored.	Default: 0 Range: 0 to 2; 5	–
H6-02 (042D) RUN	Pulse Train Input Scaling	Term RP Scaling	Sets the terminal RP input signal frequency that is equal to 100% of the value selected in H6-01.	Default: 1440 Hz Min.: 100 Max.: 32000	–
H6-03 (042E) RUN	Pulse Train Input Gain	Term RP Gain	Sets the level of the value selected in H6-01 when a frequency with the value set in H6-02 is input.	Default: 100.0% Min.: 0.0 Max.: 1000.0	–
H6-04 (042F) RUN	Pulse Train Input Bias	Term RP Bias	Sets the level of the value selected in H6-01 when 0 Hz is input.	Default: 0.0% Min.: -100.0 Max.: 100.0	–
H6-05 (0430) RUN	Pulse Train Input Filter Time	Term RP Flt Time	Sets the pulse train input filter time constant.	Default: 0.50 s Min.: 0.00 Max.: 2.00	–
H6-08 (043F)	Pulse Train Input Minimum Frequency	RP Lower Limit	Sets the minimum frequency for the pulse train input to be detected. Enabled when H6-01 = 0, 1, or 2.	Default: 0.5 Hz Min.: 0.1 Max.: 1000.0	–

B.8 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 (0480)	Motor Overload Protection Selection	Mtr OL Charact 0: OL1 Disabled 1: VT Motor 2: CT Motor 3: Vector Motor 6: 50Hz VT Motor	0: Disabled 1: General purpose motor (standard fan cooled) 2: Drive dedicated motor with a speed range of 1:10 3: Vector motor with a speed range of 1:100 6: General purpose motor (50 Hz) 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 to 3; 6	–
L1-02 (0481)	Motor Overload Protection Time	MOL Time Const	Sets the motor thermal overload protection (oL1) time.	Default: 1.0 min Min.: 0.1 Max.: 5.0	–
L1-03 (0482)	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, H3-10, or H3-06 = E) exceeds the oH3 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	–
L1-04 (0483)	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, H3-10, or H3-06 = 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	–
L1-05 (0484)	Motor Temperature Input Filter Time (PTC input)	Mtr Temp Filter	Adjusts the filter for the motor temperature analog input (H3-02, H3-10, or H3-06 = E).	Default: 0.20 s Min.: 0.00 Max.: 10.00	–
L1-13 (046D)	Continuous Electrothermal Operation Selection	Mtr OL Mem Sel 0: Disabled 1: Enabled 2: Enabled(RTC)	0: Disabled 1: Enabled 2: Enabled (RTC)	Default: 1 Range: 0 to 2	–

◆ L2: Momentary Power Loss Ride-Thru

No. (Addr. Hex)	Name	LCD Display	Description	Values	Page
L2-01 (0485)	Momentary Power Loss Operation Selection	PwrL Selection 0: Disabled 1: Enbl with Timer 2: Enbl whl CPU act 3: KEB Mode 4: KEB Stop Mode 5: KEB Decel Stop	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. 3: KEB deceleration for the time set to L2-02. 4: KEB deceleration as long as CPU has power. 5: KEB deceleration to stop.	Default: 2 Range: 0 to 5	–
L2-02 (0486)	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	–
L2-03 (0487)	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	–

No. (Addr. Hex)	Name	LCD Display	Description	Values	Page
L2-04 (0488)	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	–
L2-05 (0489)	Undervoltage Detection Level (Uv1)	PUV Det Level	Sets the DC bus undervoltage trip level.	Default: 190 Vdc <2> <3> Min.: 150 Vdc Max.: 210 Vdc <3>	–
L2-06 (048A)	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 <4>	–
L2-07 (048B)	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 <4>	–
L2-08 (048C)	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	–
L2-10 (048E)	KEB Detection Time (Minimum KEB Time)	KEB Detect Time	Sets the time to perform KEB Ride-Thru.	Default: 50 ms Min.: 0 Max.: 2000	–
L2-11 (0461)	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 <5>	–
L2-29 (0475)	KEB Method Selection	KEB Mode Sel 0: Single Mode KEB1 1: Single Mode KEB2 2: System Mode KEB1 3: System Mode KEB2	0: Single Drive KEB Ride-Thru 1 1: Single Drive KEB Ride-Thru 2 2: System KEB Ride-Thru 1 3: System KEB Ride-Thru 2	Default: 0 Range: 0 to 3	–

<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. Multiply the value by 2.875 for 600 V class drives.

<4> Setting range value is dependent on parameter C1-10, Accel/Decel Time Setting Units. When C1-10 = 0 (units of 0.01 seconds), the setting range becomes 0.00 to 600.00 seconds.

<5> Values shown are specific to 200 V class drives. Double the value for 400 V class drives. Multiply the value by 2.875 for 600 V class drives, but set the value below 1040 Vdc (overvoltage protection level).

◆ L3: Stall Prevention

No. (Addr. Hex)	Name	LCD Display	Description	Values	Page
L3-01 (048F)	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.	Default: 1 Range: 0 to 2	–
L3-02 (0490)	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>	–
L3-03 (0491)	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	–

No. (Addr. Hex)	Name	LCD Display	Description	Values	Page
L3-04 (0492)	Stall Prevention Selection during Deceleration	StallP Decel Sel 0: Disabled 1: General purpose 2: Intelligent 3: StallP +Resistor 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. 3: Stall Prevention with braking resistor. Stall Prevention during deceleration is enabled in coordination with dynamic braking. 4: Overexcitation Deceleration. Decelerates while increasing the motor flux. 5: Overexcitation Deceleration 2. Adjust the deceleration rate according to the DC bus voltage.	Default: 0 Range: 0 to 5	–
L3-05 (0493)	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: 0 Range: 0 to 2	–
L3-06 (0494)	Stall Prevention Level during Run	StallP Run Level	V/f 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>	–
L3-11 (04C7)	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	–
L3-17 (0462)	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: 375 Vdc <2> <3> Min.: 150 Max.: 400 <3>	–
L3-20 (0465)	DC Bus Voltage Adjustment Gain	DC Bus P Gain	Sets the proportional gain for KEB Ride-Thru, Stall Prevention, and overvoltage suppression.	Default: 1.00 (V/f) 0.30 (OLV) Min.: 0.00 Max.: 5.00	–
L3-21 (0466)	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: 1.00 Min.: 0.10 Max.: 10.00	–
L3-23 (04FD)	Automatic Reduction Selection for Stall Prevention during Run	CHP Stall P Sel 0: Lv1 set in L3-06 1: Autom. Reduction	V/f 0: Sets the Stall Prevention level set in L3-06 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	–
L3-24 (046E)	Motor Acceleration Time for Inertia Calculations	Mtr Accel Time	Sets the time needed to accelerate the uncoupled motor at rated torque from stop to the maximum frequency.	Default: <4> <5> Min: 0.001 s Max: 10.000 s	–
L3-25 (046F)	Load Inertia Ratio	Load Inertia Rat	Sets the ratio between the motor and machine inertia.	Default: 1.0 Min.: 1.0 Max.: 1000.0	–
L3-26 (0455)	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	–
L3-27 (0456)	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	–

<1> Upper limit is dependent on parameter L8-38, Frequency Reduction 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. Multiply the value by 2.875 for 600 V class drives, but set the value below 1040 Vdc (overvoltage protection level).

<4> Parameter value changes automatically if E2-11 is manually changed or changed by Auto-Tuning.

<5> 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 (0499)	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.: 400.0	–
L4-02 (049A)	Speed Agreement Detection Width	Spd Agree Width	L4-02 sets the hysteresis or allowable margin for speed detection.	Default: 2.0 Min.: 0.0 Max.: 20.0	–
L4-03 (049B)	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.: -400.0 Max.: 400.0	–
L4-04 (049C)	Speed Agreement Detection Width (+/-)	Spd Agree Wdth+-	L4-04 sets the hysteresis or allowable margin for speed detection.	Default: 2.0 Min.: 0.0 Max.: 20.0	–
L4-05 (049D)	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: 0 Range: 0, 1	–
L4-06 (04C2)	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	–
L4-07 (0470)	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	–

◆ L5: Fault Restart

No. (Addr. Hex)	Name	LCD Display	Description	Values	Page
L5-01 (049E)	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, rH, rr, oL1, oL2, oL3, oL4, STo, Uv1.	Default: 5 Min.: 0 Max.: 10	–
L5-02 (049F)	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	–
L5-04 (046C)	Fault Reset Interval Time	Flt Reset Wait T	Sets the amount of time to wait between performing fault restarts.	Default: 20.0 s Min.: 10.0 Max.: 3600.0	–
L5-40 (0670)	Low Feedback Fault Retry Selection	Low Feedback 0: No retry 1: Retry	Determines whether the LFB-Low Feedback fault can be auto-restarted. 0: No retry 1: Retry	Default: 0 Range: 0, 1	–
L5-41 (0671)	High Feedback Fault Retry Selection	High Feedback 0: No retry 1: Retry	Determines whether the HFB-High Feedback fault can be auto-restarted. 0: No retry 1: Retry	Default: 0 Range: 0, 1	–
L5-42 (0672)	Feedback Loss Fault Retry Selection	Feedback Loss 0: No retry 1: Retry	Determines whether the FBL-Feedback Loss fault can be auto-restarted. 0: No retry 1: Retry	Default: 0 Range: 0, 1	–
L5-50 (067A)	Setpoint Not Met Retry Selection	SetPoint Not Met 0: No retry 1: Retry	Determines whether the NMS-Setpoint not Met fault can be auto-restarted. 0: No retry 1: Retry	Default: 0 Range: 0, 1	–
L5-51 (067B)	Loss of Prime Fault Retry Selection	High Feedback 0: No retry 1: Retry	Determines whether the LOP-Loss of Prime fault can be auto-restarted. 0: No retry 1: Retry	Default: 0 Range: 0, 1	–
L5-52 (067C)	Pump Over Cycle Fault Retry Selection	Pump Over Cycle 0: No retry 1: Retry	Determines whether the POC-Pump Over Cycle fault can be auto-restarted. 0: No retry 1: Retry	Default: 0 Range: 0, 1	–

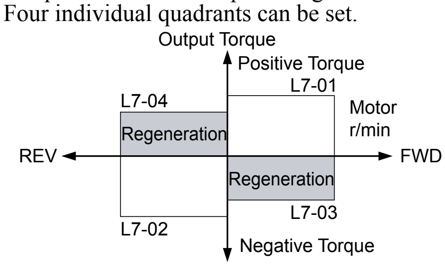
No. (Addr. Hex)	Name	LCD Display	Description	Values	Page
L5-53 (067D)	Volute-TStat Retry Selection	Volute-TStat Flt 0: No retry 1: Retry	Determines whether the Volute T-Stat fault can be auto-restarted. 0: No retry 1: Retry **Note:** The drive will restart only after the Volute-Tstat digital input deactivates and the L5-04 timer expires.	Default: 0 Range: 0, 1	–

◆ L6: Torque Detection

No. (Addr. Hex)	Name	LCD Display	Description	Values	Page
L6-01 (04A1)	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 Alarm at Speed Agree 10: UL6 Alarm during Run 11: UL6 Fault at Speed Agree 12: UL6 Fault during Run	Default: 0 Range: 0 to 12	–
L6-02 (04A2)	Torque Detection Level 1	Torq Det 1 Lvl	Sets the overtorque and undertorque detection level.	Default: 15% Min.: 0 Max.: 300	–
L6-03 (04A3)	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	–
L6-04 (04A4)	Torque Detection Selection 2	Torq Det 2 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	0: Disabled 1: oL4 detection only active during speed agree, operation continues after detection 2: oL4 detection always active during run, operation continues after detection 3: oL4 detection only active during speed agree, output shuts down on an oL4 fault 4: oL4 detection always active during run, output shuts down on an oL4 fault 5: UL4 detection only active during speed agree, operation continues after detection 6: UL4 detection always active during run, operation continues after detection 7: UL4 detection only active during speed agree, output shuts down on an oL4 fault 8: UL4 detection always active during run, output shuts down on an oL4 fault	Default: 0 Range: 0 to 8	–
L6-05 (04A5)	Torque Detection Level 2	Torq Det 2 Lvl	Sets the overtorque and undertorque detection level.	Default: 150% Min.: 0 Max.: 300	–
L6-06 (04A6)	Torque Detection Time 2	Torq Det 2 Time	Sets the time an overtorque or undertorque condition must exist to trigger torque detection 2.	Default: 0.1 s Min.: 0.0 Max.: 10.0	–
L6-13 (062E)	Motor Underload Protection Selection	Underload Select 0: Base Freq Enable 1: Max Freq Enable	Sets the motor underload protection (UL6) based on motor load. 0: Base frequency enable 1: Max frequency enable	Default: 0 Range: 0, 1	–

No. (Addr. Hex)	Name	LCD Display	Description	Values	Page
L6-14 (062F)	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	–

◆ L7: Torque Limit

No. (Addr. Hex)	Name	LCD Display	Description	Values	Page
L7-01 (04A7)	Forward Torque Limit	Torq Limit Fwd	OLV Sets the torque limit value as a percentage of the motor rated torque. Four individual quadrants can be set. 	Default: 200% Min.: 0 Max.: 300	–
L7-02 (04A8)	Reverse Torque Limit	Torq Limit Rev		Default: 200% Min.: 0 Max.: 300	–
L7-03 (04A9)	Forward Regenerative Torque Limit	Torq Lmt Fwd Rgn		Default: 200% Min.: 0 Max.: 300	–
L7-04 (04AA)	Reverse Regenerative Torque Limit	Torq Lmt Rev Rgn		Default: 200% Min.: 0 Max.: 300	–
L7-06 (04AC)	Torque Limit Integral Time Constant	Trq Lim I Time	OLV Sets the integral time constant for the torque limit.	Default: 200 ms Min: 5 Max: 10000	–
L7-07 (04C9)	Torque Limit Control Method Selection during Accel/Decel	Trq Lim d AccDec 0: P-ctrl @ Acc/Dec 1: I-ctrl @ Acc/Dec	OLV 0: Proportional control (changes to integral control at constant speed). Use this setting when acceleration to the desired speed should take precedence over the torque limit. 1: Integral control. Set L7-07 to 1 if the torque limit should take precedence.	Default: 0 Range: 0, 1	–

◆ L8: Drive Protection

No. (Addr. Hex)	Name	LCD Display	Description	Values	Page
L8-01 (04AD)	Internal Dynamic Braking Resistor Protection Selection (ERF type)	DB Resistor Prot 0: Not Provided 1: Provided	0: Resistor overheat protection disabled 1: Resistor overheat protection enabled	Default: 0 Range: 0, 1	–
L8-02 (04AE)	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	–
L8-03 (04AF)	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: 3 Range: 0 to 4	–
L8-05 (04B1)	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	–
L8-07 (04B3)	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	–
L8-09 (04B5)	Output Ground Fault Detection Selection	Grnd Flt Det Sel 0: Disabled 1: Enabled	0: Disabled 1: Enabled	Default: 1 Range: 0, 1	–

No. (Addr. Hex)	Name	LCD Display	Description	Values	Page
L8-10 (04B6)	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	–
L8-11 (04B7)	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	–
L8-12 (04B8)	Ambient Temperature Setting	Ambient Temp	Enter the ambient temperature. This value adjusts the oL2 detection level.	Default: 40 °C Min.: -10 Max.: 50	–
L8-15 (04BB)	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	–
L8-18 (04BE)	Software Current Limit Selection	Soft CLA Sel 0: Disabled 1: Enabled	0: Disabled 1: Enabled	Default: 0 Range: 0, 1	–
L8-19 (04BF)	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: 0.8 Min.: 0.1 Max.: 0.9	–
L8-32 (04E2)	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	–
L8-35 (04EC)	Installation Method Selection	Installation Sel 0: IP00/OpenChassis 1: Side-by-Side 2: IP20/Nema Type 1 3: ExternalHeatsink	0: IP00/Open-Chassis enclosure 1: Side-by-Side mounting 2: IP20/NEMA Type 1 enclosure 3: Finless model drive or external heatsink installation	Default: <2> <3> Range: 0 to 3	–
L8-38 (04EF)	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: 2 Range: 0 to 2	–
L8-40 (04F1)	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: 0.5 s Min.: 0.00 Max.: 2.00	–
L8-41 (04F2)	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	–
L8-55 (045F)	Internal Braking Transistor Protection	FC Sel dur OHAlm 0: Disabled 1: Enabled	0: Disabled. Disable when using a regen converter or optional braking unit. 1: Protection enabled.	Default: 1 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: Model code 2A0004 to 2A0211, 4A0002 to 4A0165, and 5A0003 to 5A0242
Setting 0: Model code 2A0250 to 2A0415 and 4A0208 to 4A0675

B.9 n: Special Adjustment

The n parameters adjust more advanced performance characteristics such as Hunting Prevention, High Slip Braking, and Overexcitation Braking.

◆ n1: Hunting Prevention

No. (Addr. Hex)	Name	LCD Display	Description	Values	Page
n1-01 (0580)	Hunting Prevention Selection	Hunt Prev Select 0: Disabled 1: Enabled	V/f 0: Disabled 1: Enabled	Default: 1 Range: 0, 1	–
n1-02 (0581)	Hunting Prevention Gain Setting	Hunt Prev Gain	V/f 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	–
n1-03 (0582)	Hunting Prevention Time Constant	Hunt Prev Time	V/f Sets the time constant used for Hunting Prevention.	Default: <1> Min.: 0 ms Max.: 500 ms	–
n1-05 (0530)	Hunting Prevention Gain while in Reverse	Hprev Gain @Rev	V/f 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	–

<1> Default setting is dependent on parameter o2-04, Drive Model Selection.

◆ n2: Speed Feedback Detection Control (AFR) Tuning

No. (Addr. Hex)	Name	LCD Display	Description	Values	Page
n2-01 (0584)	Speed Feedback Detection Control (AFR) Gain	AFR Gain	OLV Sets the internal speed feedback detection control gain in the automatic frequency regulator (AFR). If hunting occurs, increase the set value. If response is low, decrease the set value.	Default: 1.00 Min.: 0.00 Max.: 10.00	–
n2-02 (0585)	Speed Feedback Detection Control (AFR) Time Constant 1	AFR Time	OLV Sets the time constant used for speed feedback detection control (AFR).	Default: 50 ms Min.: 0 Max.: 2000	–
n2-03 (0586)	Speed Feedback Detection Control (AFR) Time Constant 2	AFR Time 2	OLV Sets the AFR time constant to be used during Speed Search and during regen.	Default: 750 ms Min.: 0 Max.: 2000	–

◆ n3: High Slip Braking (HSB) and Overexcitation Braking

No. (Addr. Hex)	Name	LCD Display	Description	Values	Page
n3-01 (0588)	High-Slip Braking Deceleration Frequency Width	HSB DecStepWidth	V/f 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	–
n3-02 (0589)	High-Slip Braking Current Limit	HSB Current Lim	V/f Sets the current limit during HSB as a percentage of the motor rated current.	Default: <1> Min.: 100% Max.: 200%	–
n3-03 (058A)	High-Slip Braking Dwell Time at Stop	HSB DwelTim@Stp	V/f 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	–

No. (Addr. Hex)	Name	LCD Display	Description	Values	Page
n3-04 (058B)	High-Slip Braking Overload Time	HSB OL Time	V/f 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	–
n3-13 (0531)	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	–
n3-14 (0532)	High Frequency Injection during Overexcitation Deceleration	HarmInj@HiFlxBrk	0: Disabled 1: Enabled	Default: 0 Range: 0, 1	–
n3-21 (0579)	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	–
n3-23 (057B)	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	–

<1> Default setting is dependent on parameter L8-38, Frequency Reduction Selection.

◆ n6: Online Tuning

No. (Addr. Hex)	Name	LCD Display	Description	Values	Page
n6-01 (0570)	Online Tuning Selection	Online Tune Sel 0: Disabled 1: TerminalResAdj 2: VoltageAdjustm	OLV 0: Disabled 1: Line-to-line resistance tuning 2: Voltage correction. Setting not possible when Energy Saving is enabled (b8-01).	Default: 0 Range: 0 to 2	–
n6-05 (05C7)	Online Tuning Gain	R1 Comp Gain	OLV Decrease this setting for motors with a relatively large rotor time constant. If overload occurs, increase this setting slowly in increments of 0.10.	Default: 1.0 Min.: 0.1 Max.: 50.0	–

B.10 o: Operator-Related Settings

The o parameters set up the HOA keypad displays.

◆ o1: HOA Keypad Display Selection

No. (Addr. Hex)	Name	LCD Display	Description	Values	Page
o1-01 (0500) 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 (Monitor U1-06) Range: 104 to 699	–
o1-02 (0501) 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-selected monitor (set by o1-01)	Default: 1 Range: 1 to 5	–
o1-03 (0502)	Digital 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) 3: User-selected units (set by o1-09, o1-10 and o1-11)	Default: 0 Range: 0 to 3	–
o1-06 (0517)	User Monitor Selection Mode	Monitor Mode Sel 0: 3 Mon Sequential 1: 3 Mon Selectable	Selects the monitors displayed on the second and third lines of the digital operator display. 0: 3 Monitor Sequential (displays the next two sequential monitors) 1: 3 Monitor Selectable (set by o1-07 and o1-08)	Default: 1 Range: 0, 1	–
o1-07 (0518)	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. **Note:** Parameter is effective only when o1-06 is set to 1.	Default: 102 Range: 101 to 699	–
o1-08 (0519)	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. **Note:** Parameter is effective only when o1-06 is set to 1.	Default: 191 Range: 101 to 699	–
o1-09 (051C)	Frequency Reference Display Units	Fref Disp Unit 0: "WC:InchOfWater 1: PSI :lb/SqrInch 2: GPM:Gallons/Min 3: °F:DegFarenheit 4: CFM:Cubic ft/Min 5: CMH:Cubic m/Hr 6: LPH:Litres/Hr 7: LPS:Litres/Sec 8: Bar:Bar 9: Pa:Pascals 10: °C:DegCelsius 11: m: meters 12: ft: feet 13: LPM:Litres/Min 14: CMM:Cubic M/Min 15: "Hg:Inch Mercury 24: Custom Unit 25: No Unit	Sets unit display for the frequency reference parameters and frequency related monitors when o1-03 = 3. 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: “Hg (inches of mercury) 24: Custom units (determined by o1-13 to o1-15) 25: None	Default: 25 Range: 0 to 15; 24, 25	–
o1-10 (0520)	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	–
o1-11 (0521)	User-Set Display Units Decimal Display	UserDisp Dec		Default: <1> Range: 0 to 3	–

No. (Addr. Hex)	Name	LCD Display	Description	Values	Page
o1-12 (0522) RUN	Home Help Text	Top Help on Home 0: Disabled 1: Enabled	Switches the top line of the Home Screen from the Drive Status to defined Help messages. 0: Disabled 1: Enabled	Default: 1 Range: 0, 1	–
o1-13 (3105)	Frequency Reference and Frequency Related Monitor Custom Units 1	Fref Cust Unit 1	Sets the first character of the customer-specified unit display when o1-03 is set to 3 and o1-09 is set to 24.	Default: 41 Range: 30 to 7A	–
o1-14 (3106)	Frequency Reference and Frequency Related Monitor Custom Units 2	Fref Cust Unit 2	Sets the second character of the customer-specified unit display when o1-03 is set to 3 and o1-09 is set to 24.	Default: 41 Range: 30 to 7A	–
o1-15 (3107)	Frequency Reference and Frequency Related Monitor Custom Units 3	Fref Cust Unit 3	Sets the third character of the customer-specified unit display when o1-03 is set to 3 and o1-09 is set to 24.	Default: 41 Range: 30 to 7A	–

<1> Default setting is dependent on parameter o1-03, Digital Operator Display Selection.

◆ o2: HOA Keypad Keypad Functions

No. (Addr. Hex)	Name	LCD Display	Description	Values	Page
o2-02 (0506)	STOP Key Function Selection	Oper STOP Key 0: Disabled 1: Enabled	0: Disabled. STOP key is disabled in REMOTE operation. 1: Enabled. STOP key is always enabled.	Default: 1 Range: 0, 1	–
o2-03 (0507)	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	–
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	–
o2-05 (0509)	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	–
o2-06 (050A)	Operation Selection when Digital Operator is Disconnected	Oper Discon Det 0: Disabled 1: Enabled	0: The drive continues operating if the digital operator is disconnected. 1: An oPr fault is triggered and the motor coasts to stop.	Default: 1 Range: 0, 1	–
o2-07 (0527)	Motor Direction at Power Up when Using Operator	For/RevSel@PwrUp 0: Forward 1: Reverse	This parameter requires assigning drive operation to the digital operator. 0: Forward 1: Reverse	Default: 0 Range: 0, 1	–
o2-19 (0527)	Parameter Set Selection	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	–
o2-30 (1230) RUN	Monitor Position Save	Mon Pos Save 0: Disabled 1: Enabled	Saves the monitor position and Home Screen quick monitor selection. Setting this parameter to 0 and then entering the Monitor Menu will jump the selection to the monitor number instead of the group number. 0: Disabled 1: Enabled	Default: 0 Range: 0, 1	–

◆ o3: Copy Function

No. (Addr. Hex)	Name	LCD Display	Description	Values	Page
o3-01 (0515)	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 digital operator. 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 operator.	Default: 0 Range: 0 to 3	–
o3-02 (0516)	Copy Allowed Selection	Read Allowable 0: Disabled 1: Enabled	0: Read operation prohibited 1: Read operation allowed	Default: 1 Range: 0, 1	–

◆ o4: Maintenance Monitor Settings

No. (Addr. Hex)	Name	LCD Display	Description	Values	Page
o4-01 (050B)	Cumulative Operation Time Setting	DrvElapsTimeCnt	Sets the value for the cumulative operation time of the drive in units of 10 h.	Default: 0 Min.: 0 Max.: 9999	–
o4-02 (050C)	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	–
o4-03 (050E)	Cooling Fan Operation Time Setting	FanElapsTimeCn	Sets the value of the fan operation time monitor U4-03 in units of 10 h.	Default: 0 Min.: 0 Max.: 9999	–
o4-05 (051D)	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	–
o4-07 (0523)	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	–
o4-09 (0525)	IGBT Maintenance Setting	IGBT Maint Set	Sets the value of the Maintenance Monitor for the IGBTs. See U4-07 for IGBT replacement times.	Default: 0% Min.: 0 Max.: 150	–
o4-11 (0510)	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	–
o4-12 (0512)	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	–
o4-13 (0528)	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	–
o4-17 (3100)	Set/Reset Real-Time Clock	Date/Time Config 0: — — 1: Set 2: Reset	Sets the current date and time for the Real-Time Clock. 0: - - 1: Set 2: Reset	Default: 0 Range: 0 to 2	*110*
o4-20 (081F)	Time Display Format	Time Disp Format 0: 12-hour (AM/PM) 1: 24-hour	Sets the time display format. 0: 12-hour 1: 24-hour	Default: 0 Range: 0, 1	–

B.11 P: Pump Parameters

◆ P1: Pump Basic

No. (Addr. Hex)	Name	LCD Display	Description	Values	Page
P1-01 (0C00)	Pump Mode	Pump Mode 0: Drive Only 1: Contactor Lag 3: Memobus Network	0: Drive only 1: Contactor lag 3: MEMOBUS network	Default: 0 Range: 0, 1, 3	164
P1-02 (0C01)	System Units	System Units 0: No Unit 1: PSI :lb/SqrInch 2: Pa:Pascals 3: Bar:Bar 4: "WC:InchOfWater 5: "Hg:Inch Mercury 6: ft: feet 7: m: meters 8: °F:DegFarenheit 9: °C:DegCelsius 10: %: Percent 25: Flow (use P6-04)	0: No unit 1: PSI: Pounds per square inch 2: Pa: Pascals 3: Bar: Bar 4: ”WC: Inch of water 5: ”Hg: Inch of Mercury 6: ft: feet 7: m: meters 8: °F: Degrees Fahrenheit 9: °C: Degrees Celsius 10: Percent 25: Flow (Use P6-04) <1>	Default: 1 Range: 0 to 10; 25	165
P1-03 (0C02)	Feedback Device Scaling	FB Dev. Scaling	Sets the scaling of feedback device in user-set units.	Default: 145.0 PSI <2> Min.: 0.1 Max.: 6000.0	165
P1-04 (0C03) RUN	Start / Draw Down Level	Start-DrawDn Lvl	The system starts when the feedback level drops below the start level for the time set in P1-05. This level also specifies the wake-up level when the drive is in Sleep Mode. When this parameter is set to a negative value, the feedback level must drop that amount below the setpoint. Setting this parameter to 0.0 disables the function. When P1-01, Pump Mode, is set to 3 (MEMOBUS network), this function is active only on the first drive in the network. **Note:** When PID operates in reverse mode, the system will start when the feedback has risen above the start level for the time set to P1-05.	Default: 0.0 Min.: -999.9 Max.: 999.9	165
P1-05 (0C02) RUN	Start Level Delay Time	S-Lev Delay Time	The system starts when the feedback level drops below the start level for the time set in this parameter.	Default: 1 s Min.: 0 Max.: 3600	165
P1-06 (0C05) RUN	Minimum Pump Speed	Min. Pump Speed	Minimum frequency at which the drive will run. Applies to both HAND and Automatic modes. **Note:** For minimum pump frequency, the drive will use the highest setting from among P1-06, P4-12 (Thrust Bearing Frequency), or d2-02 (Reference Lower Limit).	Default: 40.0 Hz <3> Min.: 0.0 Max.: [E1-04]	166
P1-07 (0C06) <3>	Minimum Pump Speed Units	MinPumpSpdUnits 0: Hz 1: RPM	Sets the units and decimal place for parameter P1-06. 0: Hz 1: RPM **Note:** Changing this parameter will reset the P1-06 default value.	Default: 0 Range: 0, 1	–
P1-08 (0C07) RUN	Low Feedback Level	Low FB Level	Sets the lower detection level for the PID feedback.	Default: 0.0 PSI <2> Min.: 0.0 Max.: 6000.0	166
P1-09 (0C08) RUN	Low Feedback Level Fault Delay Time	Low Lvl FLT Time	Sets the amount of delay time from when the low feedback is detected until the drive faults on an “LFB Low Feedback” fault. **Note:** 1. This parameter is effective only when P1-10 is set to 0 (Fault). 2. When P1-01 is set to 3, parameter P9-18 uses this value to calculate the quick de-stage feedback level.	Default: 10 s Min.: 0 Max.: 3600	166

Parameter List

B

No. (Addr. Hex)	Name	LCD Display	Description	Values	Page
P1-10 (0C09)	Low Feedback Selection	Low FB Sel 0: Fault 1: Alarm 2: Digital Output	Selects drive response during the “Low Feedback” condition. 0: Fault 1: Alarm 2: Digital out only	Default: 0 Range: 0 to 2	166
P1-11 (0C0A) RUN	High Feedback Level	High FB Level	Sets the upper detection level for the PID feedback.	Default: 155.0 PSI <2> Min.: 0.0 Max.: 6000.0	166
P1-12 (0C0B) RUN	High Feedback Level Fault Delay Time	High Lvl FLT Time	Sets the amount of delay time from when the high feedback is detected until the drive faults on a “HFB High Feedback” fault. **Note:** This parameter is effective only when P1-13 is set to 0 (Fault (and digital out)).	Default: 5 s Min.: 0 Max.: 3600	166
P1-13 (0C0C)	High Feedback Selection	High FB Sel 0: Fault 1: Alarm 2: Digital Output	Selects drive response during the “High Feedback” condition. 0: Fault 1: Alarm 2: Digital out only	Default: 0 Range: 0 to 2	166
P1-14 (0C0D) RUN	Hysteresis Level	Hysteresis Level	Sets the hysteresis level used for low and high level feedback detection.	Default: 0.0 PSI <2> Min.: 0.0 Max.: 100.0	–
P1-15 (0C0E) RUN	Maximum Setpoint Difference	Max Set Pnt Diff	Sets the level that the difference between the setpoint and the feedback must exceed for the time set in P1-16 to trigger the drive response set in P1-17. If P1-17 is set to 1 (Fault and digital out), the will coast to stop. This function is active when the drive is running during AUTO Mode. When P1-01 is set to 3 (MEMOBUS network), the function is active on the lead drive and will stop all drives running on the network when The NMS fault occurs. Setting this parameter to 0.0 disables the function.	Default: 0.0 PSI <2> Min.: 0.0 Max.: 6000.0	–
P1-16 (0C0F) RUN	Not Maintaining Setpoint Time	Not Maint SP Tm	Sets the delay time before a “Setpoint Not Met” condition occurs. The pump protection criteria set in P1-15 must be met before the timer will start. Setting P1-15 to 0.0 disables this function.	Default: 60 s Min.: 0 Max.: 3600	–
P1-17 (0C10)	Not Maintaining Setpoint Selection	Not Maint SP Sel 0: Fault 1: Alarm 2: Digital Output	Selects the drive response method during the “Not Maintaining Setpoint” condition. 0: Fault 1: Alarm 2: Digital out only	Default: 0 Range: 0 to 2	–
P1-18 (0C11)	Prime Loss Detection Method	Prime Loss Mthd 0: Current (A) 1: Power (kW) 2: Torque (%)	Determines the quantity used to determine loss of prime. 0: Current (A) 1: Power (kW) 2: Torque (%)	Default: 0 Range: 0 to 2	–
P1-19 (0C12) RUN	Prime Loss Level	Prime Loss Level	Detects loss of prime in the pump when in Auto or Sleep Boost Mode. When the measured quantity determined by P1-18 drops below this level for the time set in P1-20 and the output frequency is above the level set in P1–21, a “Loss of Prime” condition occurs. The drive responds to the “Loss of Prime” condition depending on the setting of P1-22, Loss of Prime Selection.	Default: 0.0 A <4> Min.: 0.0 Max.: 1000.0	–
P1-20 (0C13) RUN	Loss of Prime Time	Prime Loss Time	Sets the delay time before a “Loss of Prime” condition occurs. The pump protection criteria set in P1-18 and P1-19 must be met before the timer will start.	Default: 20 s Min.: 0 Max.: 600	–
P1-21 (0C14)	Loss of Prime Frequency	Prime Loss Freq	Sets the frequency level above which the “Loss of Prime” detection is enabled when set to a value other than 0. When set to 0 (default), the frequency level is determined by the smaller value between (Fmax - 1 Hz) and (d2-01 - 1 Hz).	Default: 0.0 Hz Min.: 0.0 Max.: [E1-04]	–
P1-22 (0C15)	Loss of Prime Selection	Prime Loss Sel 0: Fault 1: Alarm 2: Digital Output	Sets the drive response method during the “Loss of Prime” condition. 0: Fault 1: Alarm 2: Digital out only	Default: 0 Range: 0 to 2	–
P1-23 (0C16)	Loss of Prime Maximum Restart Time after Fault	LOP Max Rstrt T	Sets the time in minutes that the drive will wait before attempting another restart when the restart fails or is not attempted due to a continuing fault condition.	Default: 0.2 min Min.: 0.2 Max.: 6000.0	–

No. (Addr. Hex)	Name	LCD Display	Description	Values	Page
P1-30 (0C1D)	Low Water Digital Input Configuration	Low Water DI Sel 0: Normally Open 1: Normally Closed	Selects the configuration of the low water level digital input. 0: Normally open 1: Normally closed	Default: 0 Range: 0, 1	–
P1-31 (0C1E)	High Water Digital Input Configuration	HighWater DI Sel 0: Normally Open 1: Normally Closed	Selects the configuration of the high water level digital input. 0: Normally open 1: Normally closed	Default: 0 Range: 0, 1	–

<1> System units are set by P6-04, Water Flow Units. The PID Feedback is re-routed to come from the flow meter, pulse input (H6-01 = 5), or analog (H3-0□ = 22).

<2> Unit text is set by P1-02, System Units.

<3> Unit range and resolution are determined by P1-07, Minimum Pump Speed Units. Setting P1-07 to 1 (RPM) will set a default value of 1800 RPM (VTC) and 2400 RPM (all others). Setting P1-07 to 0 (Hz, default) will set a default value of 40.0 Hz.

<4> Unit text is set by P1-18, Prime Loss Detection Method.

◆ P2: Pump Protection

No. (Addr. Hex)	Name	LCD Display	Description	Values	Page
P2-01 (0C64)	Sleep Level Type	Sleep Lvl Type 0: Output Frequency 1: Output Current 2: Feedback 3: Output Speed-RPM 4: Flow Meter	0: Output frequency 1: Output current 2: Feedback 3: Output speed (RPM) 4: Flow meter (requires flow meter) **Note:** Feedback depends on PID direction operation.	Default: 0 Range: 0 to 4	167
P2-02 (0C65) RUN	Sleep Level	Sleep Level	Sleep activates when the selected level type (P2-01 setting) reaches the programmed sleep level for the time set in P2-03. This function is active when the drive is running during AUTO Mode. When P1-01 is set to 3 (MEMOBUS network), the function is active when there is only one drive running on the network. Setting this parameter to 0.0 disables the function.	Default: 0.0 Hz <1> Min.: 0.0 Max.: 6000.0	167
P2-03 (0C66) RUN	Sleep Delay Time	Sleep Delay Time	Sets the delay time before the drive enters Sleep Mode when the sleep level set in P2-02 is reached.	Default: 0 s Min.: 0 Max.: 3600	167
P2-04 (0C67) RUN	Sleep Activate Level	Sleep Act. Level	Sets the level above which the output frequency must rise to activate the sleep function when P2-01, Sleep Level Type, is set to 0 (Output Frequency / Speed). Setting this parameter to 0.0 disables the function and the sleep function will activate when P2-02, Sleep Level, is reached.	Default: 0.0 Hz <2> Min.: 0.0 Max.: 6000.0	–
P2-05 (0C68) RUN	Sleep Boost Level	Sleep Boost Lvl	Sets the amount of boost applied to the setpoint before going to sleep. Setting this parameter to 0.0 disables the function.	Default: 0.0 PSI <3> Min.: 0.0 Max.: 6000.0	–
P2-06 (0C69) RUN	Sleep Boost Hold Time	SleepBoost HldTm	Sets the amount of time that the boosted pressure will be maintained before the drive goes to sleep.	Default: 5.0 s Min.: 0.5 Max.: 160.0	–
P2-07 (0C6A) RUN	Sleep Boost Maximum Time	SleepBoost MaxTm	Sets the amount of time that the system (feedback) has to reach the boosted setpoint. The drive will go to sleep when the amount of time set in this parameter has been exceeded.	Default: 20.0 s Min.: 1.0 Max.: 160.0	–
P2-08 (0C6B) RUN	Delta Sleep Feedback Drop Level	D Fb Drop Level	If the PID Error (setpoint minus feedback) exceeds the level programmed in this parameter within the time window set in P2-09 and the output frequency is greater than the level set in P1-06, the sleep operation deactivates and the drive returns to normal operation. Setting this parameter to 0.0 disables the function.	Default: 0.0 PSI <3> Min.: 0.0 Max.: 6000.0	–
P2-09 (0C6C) RUN	Feedback Detection Drop Time	FB Drop Det. Time	Defines the time window in which the software monitors the feedback to detect a flow/no-flow condition.	Default: 10.0 s Min.: 0.0 Max.: 3600.0	–

No. (Addr. Hex)	Name	LCD Display	Description	Values	Page
P2-10 (0C6D) RUN	Sleep Mode: Cycling Protection	Cycle Protection	Sets the maximum number of cycles that are allowed within the time specified in P2-11 before tripping the PoC "Pump Over Cycle" fault. One cycle is defined when the drive transfers from normal operation in AUTO Mode to Sleep Mode. This function is active when the drive is running during AUTO Mode. When P1-01 is set to 3 (MEMOBUS network), the function is active when there is only one drive running on the network. Setting this parameter to 0 disables the function.	Default: 0 Min.: 0 Max.: 10	–
P2-11 (0C6E) RUN	Sleep Mode: Maximum Cycling Protection Time	Max. Cycle Time	Sets the maximum time allowed between cycles. When no cycling occurs within the programmed time, the drive will decrease the internal cycle register.	Default: 300 s Min.: 0 Max.: 3600	–
P2-12 (0C6F)	Over Cycling Mode	Over Cycle Mode 0: Disabled 1: Alarm Only 2: Fault 3: Auto SP Comp.	0: Disabled 1: Alarm 2: Fault 3: Auto SP Compensation	Default: 0 Range: 0 to 3	–
P2-13 (0C70)	Setpoint Compensation	Setpoint Comp.	Allows for the software to automatically compensate the setpoint in the event of excessive cycling.	Default: 0.0 PSI <3> Min.: 0.0 Max.: 6000.0	–
P2-14 (0C71)	Maximum Setpoint Compensation	Max. SP Comp.	Sets the maximum allowed setpoint compensation for over-cycling function.	Default: 0.0 PSI <3> Min.: 0.0 Max.: 6000.0	–
P2-23 (0C7A) RUN	Anti-No-Flow Bandwidth	ANF Bandwidth	Sets the amount of PI error bandwidth used to detect the Anti-No-Flow condition. Avoid setting this parameter value too high, as operation may become unstable. Setting this parameter to 0.00 will disable the function.	Default: 0.40% Min.: 0.00 Max.: 2.00	–
P2-24 (0C7B) RUN	Anti-No-Flow Detection Time	ANF Det. Time	Sets the time delay before the drive starts the increased deceleration rate after Anti-No-Flow is detected.	Default: 10.0 s Min.: 1.0 Max.: 60.0	–
P2-25 (0C7C) RUN	Anti-No-Flow Release Level	ANF Release Lvl	Sets the amount below the setpoint which the feedback must drop to disengage the Anti-No-Flow and return to normal PI operation.	Default: 3.0 PSI <3> Min.: 0.0 Max.: 100.0	–

<1> Display units vary depending on the setting for P2-01, Sleep Level Type. When P2-01 is set to 0, the display units are "Hz"; setting 1 is "A"; setting 2 is P1-02 Selection; setting 3 is "RPM"; setting 4 is P6-04 selection.

<2> Display units vary depending on the setting for P2-01, Sleep Level Type. When P2-01 is set to 0, 1, 2, or 4, the display units are "Hz"; setting 3 is "RPM".

<3> Unit is determined by P1-02, Ssytem Units, setting.

◆ P3: Contactor Multiplexing

No. (Addr. Hex)	Name	LCD Display	Description	Values	Page
P3-00 (0CC7)	Number of Lag Pumps	Num of Lag Pumps	Sets the number of lag pumps present.	Default: 1 Min.: 1 Max.: 5	167
P3-01 (0CC8)	Add Pump Control	Add Pump Control 0: Output Frequency 1: Feedback 2: Feedback + Fout	Selects the method for adding contactor pumps to the system. 0: Output frequency (Uses P3-03 and P3-05) 1: Feedback (Uses P3-04 and P3-05) 2: Feedback + Fout (Uses P3-03, P3-04, and P3-05)	Default: 0 Range: 0 to 2	–
P3-02 (0CC9)	Shutdown Pump Control	Shutdown Pump Ctl 0: Output Frequency 1: Feedback 2: Feedback + Fout	Selects the method for removing contactor pumps from the system. 0: Output frequency (Uses P3-09, P3-50 P3-60, P3-70, P3-80, and P3-90) 1: Feedback (Uses P3-08 and P3-09) 2: Feedback + Fout (Uses P3-08, P3-09, P3-50, P3-60, P3-70, P3-80, and P3-90)	Default: 0 Range: 0 to 2	–

No. (Addr. Hex)	Name	LCD Display	Description	Values	Page
P3-03 (0CCA) RUN	Drive Multi/Maximum Level	Max-Multi Level	Sets the maximum level used for the multiplex pumping operation. Parameter is active only when P3-01 is set to 0 or 2. When P3-01 is set to 0, the next available pump will be added to the system by a multi-function Discrete Output closure (H2-0☐ = 80 to 84) when the output frequency rises above the level set in this parameter for the time set in P3-05. When P3-01 is set to 2, the next available pump will be added to the system by a multi-function Discrete Output closure (H2-0☐ = 80 to 84) when the output frequency rises above the level set in this parameter and the delta feedback (setpoint minus feedback) has exceeded the level programmed in P3-04 for the time set in P3-05.	Default: 59.0 Hz Min.: 0.0 Max.: 400.0	–
P3-04 (0CCB) RUN	Add Pump Delta Level	Add Pump D-Lvl	Sets the level used for the multiplex pumping operation. Parameter is active only when P3-01 is set to 1 or 2. When P3-01 is set to 1, the next available pump will be added to the system by a multi-function Discrete Output closure (H2-0☐ = 80 to 84) when the delta feedback (setpoint minus feedback) has exceeded the level set in this parameter for the time set in P3-05. When P3-01 is set to 2, the next available pump will be added to the system by a multi-function Discrete Output closure (H2-0☐ = 80 to 84) when the output frequency rises above the level set in P3-03 and the delta feedback (setpoint minus feedback) has exceeded the level set in this parameter for the time set in P3-05. **Note:** Programming this parameter too close to the system setpoint may cause the pump system to cycle excessively.	Default: 0.0 PSI <1> Min.: 0.0 Max.: 6000.0	–
P3-05 (0CCC) RUN	Add Pump Delay Time	Add Pump Dly Tm	Sets the delay time before a pump is added to the system.	Default: 2 s Min.: 0 Max.: 3600	–
P3-06 (0CCD) RUN	Frequency Reduction after Staging	FreqReduce@Stage	Sets the upper limit of the output frequency after a lag pump is staged. The upper limit of the output frequency is calculated by subtracting the value of this parameter from parameter P3-03. Output limit = P3-03 - P3-06	Default: 0.0 Hz Min.: 0.0 Max.: 30.0	–
P3-07 (0CCE) RUN	Frequency Reduction after Staging Time	FreqReduce Time	Sets the amount of time that the output frequency will be limited after lag pump is staged.	Default: 0.0 s Min.: 0.0 Max.: 240.0	–
P3-08 (0CCF) RUN	Shutdown Pump Delta Level	Shdn Pump D-Lvl	Sets the level used for the multiplex pumping operation. Parameter is active only when P3-02 is set to 1 or 2. When P3-02 is set to 1, the last pump that was brought online will be shut down by opening the dedicated mult-function discrete output (H2-0☐ = 80 to 84) when the delta feedback (feedback minus setpoint) has exceeded the level programmed in this parameter for the time set in P3-09. When the P3-02 is set to 2, the last pump that was brought online will be shut down by opening the dedicated multi-function discrete output (H2-0☐ = 80 to 84) when the output frequency drops below the level programmed in P3-50, P3-60, P3-70, P3-80, or P3-90 and the delta feedback (feedback minus setpoint) has exceeded the level set in this parameter for the time set in P3-09. **Note:** Programming this parameter too close to the system setpoint may cause the pump system to cycle excessively.	Default: 0.0 PSI <1> Min.: 0.0 Max.: 6000.0	–
P3-09 (0CD0) RUN	Shutdown Pump Delay Time	Shdn Pump Dly Tm	Sets the delay time before one of the additional line pumps is shut down.	Default: 5 s Min.: 0 Max.: 3600	–
P3-10 (0CD1) RUN	Setpoint Boost Maximum at De-Stage	MaxBoost@DeStage	Sets the maximum amount of boost that can be added to the setpoint after a de-stage occurs. Setting this parameter to 0.0 disables the function.	Default: 0.0 PSI <1> Min.: -20.0 Max.: 20.0	–

B.11 P: Pump Parameters

No. (Addr. Hex)	Name	LCD Display	Description	Values	Page
P3-11 (0CD2) RUN	Setpoint Boost after De-Stage Time	SP Boost Time	Sets the amount of time that the setpoint will remain boosted after lag pump is de-staged.	Default: 5.0 s Min.: 0.0 Max.: 60.0	–
P3-12 (0CD3) RUN	Multi Pump Setpoint Increase during Transition	MP Setpoint Inc	Sets the system setpoint increase each time a new pump is brought online. Pump 1: Setpoint Pump 1 + 2: Setpoint + P3-12 Pump 1 + 2 + 3: Setpoint + 2 x P3-12	Default: 0.0 PSI <1> Min.: 0.0 Max.: 6000.0	–
P3-13 (0CD4) RUN	Multi Pump Setpoint Decrease during Transition	MP Setpoint Dec	Sets the system setpoint decrease each time a new pump is brought online. Pump 1: Setpoint Pump 1 + 2: Setpoint - P3-13 Pump 1 + 2 + 3: Setpoint - 2 x P3-13	Default: 0.0 PSI <1> Min.: 0.0 Max.: 6000.0	–
P3-14 (0CD5) RUN	Multiplex Stabilization Time	M-Stabilize Time	Sets the time used to stabilize the system when a pump is added or shut down during multiplex operation. When a pump is added, the stabilize timer temporarily disables the lead/lag functionality for the programmed time to prevent pump cycling. Function is active in contactor multiplex mode (P1-01 = 1). Time pump protection and lead/lag control is suspended during stabilization time.	Default: 2 s Min.: 0 Max.: 3600	–
P3-30 (0CD5)	Stage Selection Mode	Stage Sel Mode 0: Sequential 1: Stop History	Sets the method of staging for the pumps. 0: Sequential 1: Stop history	Default: 0 Range: 0, 1	–
P3-31 (0CE6)	De-Stage Selection Mode	Destage Sel Mode 0: LastInFirstOut 1: FirstInFirstOut	Sets the method for removing contactor pumps. 0: Last in, first out (LIFO) 1: First in, first out (FIFO)	Default: 0 Range: 0, 1	–
P3-40 (0CEF)	Pre-Charge Lag Pump Select	Precharge LagSel 0: Disabled 2: Pump2 (H2-0X=80) 3: Pump3 (H2-0X=81) 4: Pump4 (H2-0X=82) 5: Pump5 (H2-0X=83) 6: Pump6 (H2-0X=84)	Selects which of the lag pumps can come on during a pre-charge. 0: Disabled 2: Pump 2 (H2-0☐ = 80) 3: Pump 3 (H2-0☐ = 81) 4: Pump 4 (H2-0☐ = 82) 5: Pump 5 (H2-0☐ = 83) 6: Pump 6 (H2-0☐ = 84)	Default: 0 Range: 0; 2 to 6	–
P3-41 (0CF0)	Pre-Charge Lag Pump Run Time	Precharge Lag Tm	Sets the length of time that the lag pump specified in P3-40 is energized.	Default: 0.0 min Min.: 0.0 Max.: 3600.0	–
P3-42 (0CF1)	Post-Pre-Charge Lag Pump Operation Time	Post PreChg Lag 0: Turn Off 1: Continue	Determines whether the lag pump set in pre-charge (P3-40) turns off or maintains its state when pre-charge is completed. 0: Turn off 1: Continue	Default: 0 Range: 0, 1	–
P3-43 (0CF2)	Pre-Charge Lag Pump Delay Time	PreChg Lag Delay	Sets the length of time that the drive is in the pre-charge mode before the lag pump set in P3-40 is energized.	Default: 2.0 min Min.: 0.0 Max.: 600.0	–
P3-50 (0CF9) RUN	Pump 2 Frequency Shutdown Level	P2 Shutdown Freq	Sets the level used for the multiplex pumping operation. Parameter is active only when P3-02 is set to 0 or 2. When P3-02 is set to 0 and a total of two pumps are running, the last pump (Pump 2) that was brought online will be shut down by opening the dedicated mult-function discrete output (H2-0☐ = 80 to 84) when the output frequency falls below the level set in this parameter for the time set in P3-09. When P3-02 is set to 2 and a total of two pumps are running, the last pump (Pump 2) that was brought online will be shut down by opening the dedicated mult-function discrete output (H2-0☐ = 80 to 84) when the delta feedback (setpoint minus feedback) has exceeded the level programmed in this parameter for the time set in P3-09.	Default: 40.0 Hz Min.: 0.0 Max.: 400.0	167
P3-60 (11E5) RUN	Pump 3 Frequency Shutdown Level	P3 Shutdown Freq	Sets the level used for the multiplex pumping operation. Parameter is active only when P3-02 is set to 0 or 2. Parameter function is similar to P3-50, except for Pump 3 instead of Pump 2.	Default: 40.0 Hz Min.: 0.0 Max.: 400.0	167
P3-70 (11EF) RUN	Pump 4 Frequency Shutdown Level	P4 Shutdown Freq	Sets the level used for the multiplex pumping operation. Parameter is active only when P3-02 is set to 0 or 2. Parameter function is similar to P3-50, except for Pump 4 instead of Pump 2.	Default: 40.0 Hz Min.: 0.0 Max.: 400.0	168

No. (Addr. Hex)	Name	LCD Display	Description	Values	Page
P3-80 (11F9) RUN	Pump 5 Frequency Shutdown Level	P5 Shutdown Freq	Sets the level used for the multiplex pumping operation. Parameter is active only when P3-02 is set to 0 or 2. Parameter function is similar to P3-50, except for Pump 5 instead of Pump 2.	Default: 40.0 Hz Min.: 0.0 Max.: 400.0	–
P3-90 (1203) RUN	Pump 6 Frequency Shutdown Level	P6 Shutdown Freq	Sets the level used for the multiplex pumping operation. Parameter is active only when P3-02 is set to 0 or 2. Parameter function is similar to P3-50, except for Pump 6 instead of Pump 2.	Default: 40.0 Hz Min.: 0.0 Max.: 400.0	–

<1> Unit is determined by P1-02, Ssytem Units, setting.

◆ P4: Pump Advanced

No. (Addr. Hex)	Name	LCD Display	Description	Values	Page
P4-01 (0CFA) RUN	Pre-Charge Level	Pre-Charge Level	Runs the drive at the frequency set in P4-02. The drive will stop when one of the following conditions occurs: • The feedback level rises above the level set in P4-01 • The pre-charge time set in P4-03 expires • The low water digital input is deactivated (#8F)	Default: 0.0 PSI <1> Min.: 0.0 Max.: 6000.0	168
P4-02 (0CFB) RUN	Pre-Charge Frequency	Pre-Charge Freq.	Sets the frequency reference used when the Pre-Charge function is active.	Default: 0.0 Hz Min.: 0.0 Max.: [E1-04]	168
P4-03 (0CFC) RUN	Pre-Charge Time	Pre-Charge Time	Sets the maximum allowed Pre-Charge time. When P1-01 is set to 3 (MEMOBUS network), the function is active only on the first drive to run in the network. Setting this parameter to 0.0 disables the function.	Default: 0.0 min Min.: 0.0 Max.: 3600.0	168
P4-05 (0CFE) RUN	Pre-Charge Loss of Prime Level	Pre-Charge LOP	Detects loss of prime in the pump. When the measured quantity determined by P1-18 drops below this level for the time set in P1-20 and the output frequency is at the level set in P4-02, a “Loss of Prime” condition occurs. The drive responds to the “Loss of Prime” condition depending on the setting of P1-22, Loss of Prime Selection.	Default: 0.0 A <2> Min.: 0.0 Max.: 1000.0	–
P4-06 (0CFF) RUN	Pre-Charge Frequency 2	Pre-Charge Freq2	Sets the frequency reference used when the Pre-Charge function 2 is active. Setting this parameter to 0.0 disables the function.	Default: 0.0 Hz Min.: 0.0 Max.: [E1-04]	–
P4-07 (0D01) RUN	Pre-Charge Time 2	Pre-Charge Time2	Sets the time at which the drive will spend at the Pre-Charge frequency 2 speed during pre-charge. Setting this parameter to 0.0 disables the function.	Default: 0.0 min Min.: 0.0 Max.: 3600.0	–
P4-08 (0D01) RUN	Pre-Charge Loss of Prime Level 2	Pre-Charge LOP 2	Detects loss of prime in the pump. When the measured quantity determined by P1-18 drops below this level for the time set in P1-20 and the output frequency is at the level set in P4-06, a “Loss of Prime” condition occurs. The drive responds to the “Loss of Prime” condition depending on the setting of P1-22, Loss of Prime Selection.	Default: 0.0 A <2> Min.: 0.0 Max.: 1000.0	–
P4-10 (0D03) RUN	AUTO Mode Operator Run Power Down Storage	AMO PwDn-Storage 0: Disabled 1: Enabled	Stores the run status in AUTO Mode when operating from the HOA keypad (b1-02 = 0). 0: Disabled 1: Enabled	Default: 0 Range: 0, 1	168
P4-11 (0D04) RUN	Thrust Bearing Acceleration Time	Thrust Acc. Time	Sets the time at which the drive output frequency will ramp up to the reference frequency set in P4-12.	Default: 1.0 s Min.: 0.0 Max.: 600.0	–
P4-12 (0D05) RUN	Thrust Bearing Frequency	Thrust Freq.	The drive will accelerate to this frequency in the time set to P4-11. The drive will decelerate from the frequency in the time set to P4-13. **WARNING!** *Sudden Movement Hazard. If the drive is powered down while running, it will automatically initiate an internal Run command upon power-up.*	Default: 30.0 Hz Min.: 0.0 Max.: [E1-04]	168

No. (Addr. Hex)	Name	LCD Display	Description	Values	Page
P4-13 (0D06) RUN	Thrust Bearing Deceleration Time	Thrust Dec Time	Sets the amount of time it takes to bring the drive from the Thrust Frequency set in P4-12 to stop when Thrust Mode is active. When the Run command is removed while the drive is operating in Thrust Mode above the Thrust Frequency, the time set in this parameter is used when the frequency reference is at or below the thrust frequency.	Default: 5.0 s Min.: 0.0 Max.: 600.0	–
P4-17 (0D0A) RUN	Utility Start Delay	Utility Delay	Sets the amount of time that the drive will delay starting if a Run command is present at power-up. When P1-01, Pump Mode, is set to 3 (MEMOBUS network), the drive is unavailable to the network (Pump Off Network) when the function is active. Setting this parameter to 0.0 disables the function.	Default: 0.2 min Min.: 0.0 Max.: 1000.0	168
P4-21 (0D0E)	Low City Input Select	Low City In Sel 0: Normally Open 1: Normally Closed	Selects the type of pressure switch connected to the “Low City Press” digital input (H1-0□ = 73). 0: Normally open (closed indicates the Low City Pressure condition) 1: Normally closed (open indicates the Low City Pressure condition)	Default: 1 Range: 0, 1	–
P4-22 (0D0F) RUN	Low City On-Delay Time	Low City On Dly	Sets the amount of time a Low City Pressure condition needs to be present before the drive will stop.	Default: 10 s Min.: 1 Max.: 1000	–
P4-23 (0D10) RUN	Low City Off-Delay Time	Low City Off Dly	Sets the amount of time a Low City Pressure condition needs to be absent before the drive will restart.	Default: 5 s Min.: 0 Max.: 1000	–
P4-24 (0D11) RUN	Low City Alarm Text	Low City Alarm Txt 0: Low Cty Pressure 1: Low Suction Pres 2: Low Watr in Tank	Selects the alarm message that will be displayed when a Low City Pressure condition is detected. 0: Low city pressure 1: Low suction pressure 2: Low water in tank	Default: 0 Range: 0 to 2	–
P4-25 (0D12)	Remote Drive Disable Selection	Rem Drv Dis Sel 0: Normally Open 1: Normally Closed	Selects the type of pressure switch connected to the “Remote Drive Disable” digital input (H1-0□ = 95). 0: Normally open (closed indicates the Remote Drive Disable condition) 1: Normally closed (open indicates the Remote Drive Disable condition)	Default: 1 Range: 0, 1	–
P4-26 (0D13) RUN	Remote Drive Disable On-Delay	Drv Dis On-Delay	Sets the amount of time a Remote Drive Disable condition must be present before the drive will stop.	Default: 0 s Min.: 0 Max.: 1000	–
P4-27 (0D14) RUN	Remote Drive Disable Off-Delay	Drv Dis OffDelay	Sets the amount of time a Remote Drive Disable condition must be absent before the drive will run.	Default: 0 s Min.: 0 Max.: 1000	–
P4-31 (0D18) RUN	Lube Pump Delay Timer	Lube Pump Time	Sets the amount of time to delay the drive output and to energize the Lube Pump digital output (H2-□□ = 8B) before the drive is allowed to run. Setting this parameter to 0.0 disables the function.	Default: 0.0 s Min.: 0.0 Max.: 300.0	–

<1> Unit is determined by P1-02, Ssytem Units, setting.

<2> Unit text is set by P1-18, Prime Loss Detection Method.

◆ P5: Pump HAND Mode

No. (Addr. Hex)	Name	LCD Display	Description	Values	Page
P5-01 (0D2C) RUN	HAND Mode Ref Source	Hand Mode Ref. 0: Analog Input 1: Hand Ref 1 (OPR)	Sets the HAND Mode reference. 0: Analog input A1 (0-10 V) 1: P5-02 (HAND reference)	Default: 1 Range: 0, 1	–
P5-02 (0D2D) RUN	HAND Reference 1	HAND Reference 1	Sets the frequency reference used when HAND Mode is active and P5-01 is set to 1.	Default: 40.0 Hz Min.: 0 Max.: [E1-04]	169

No. (Addr. Hex)	Name	LCD Display	Description	Values	Page
P5-03 (0D2E)	HAND/AUTO During Run Selection	HAND/AUTO @ Run 0: Disabled 1: Enabled	Selects whether the drive will permit switching between HAND and AUTO Modes while running. 0: Disabled 1: Enabled	Default: 0 Range: 0, 1	–
P5-04 (0D2F)	HAND Key Function Selection	Oper HAND Key 0: Disabled 1: Enabled	Enables and disables the HAND key on the HOA keypad. 0: Disabled 1: Enabled	Default: 1 Range: 0, 1	169
P5-05 (0D30) RUN	HAND Reference 2	HAND Reference 2	Sets the frequency reference used when HAND Mode 2 is active.	Default: 0.0 Hz Min.: 0 Max.: [E1-04]	–
P5-06 (0D31) RUN	HAND Ref. 1 Loss of Prime Level	HandRef1 LOP Lvl	Detects loss of prime in the pump. When the measured quantity determined by P1-18 drops below this level for the time set in P1-20 and the output frequency is at the level set in P5-02, a “Loss of Prime” condition occurs. The drive responds to the “Loss of Prime” condition depending on the setting of P1-22, Loss of Prime Selection.	Default: 0.0 PSI <1> Min.: 0.0 Max.: 1000.0	–
P5-07 (0D32) RUN	HAND Ref. 2 Loss of Prime Level	HandRef2 LOP Lvl	Detects loss of prime in the pump. When the measured quantity determined by P1-18 drops below this level for the time set in P1-20 and the output frequency is at the level set in P5-05, a “Loss of Prime” condition occurs. The drive responds to the “Loss of Prime” condition depending on the setting of P1-22, Loss of Prime Selection.	Default: 0.0 PSI <1> Min.: 0.0 Max.: 1000.0	–
P5-09 (0D34)	HAND References Set via Motor Operated Pot Selection	HAND MOP Sel 0: Disabled 1: Enabled	Selects whether parameters P5-02 and P5-05 are changed via MOP from the home screen. 0: Disabled 1: Enabled	Default: 0 Range: 0, 1	–

<1> Unit text is set by P1-18, Prime Loss Detection Method.

◆ P6: Flow Meter Setup

No. (Addr. Hex)	Name	LCD Display	Description	Values	Page
P6-01 (0D5E)	Flow Meter Scaling	Flow Meter Scale	When an analog input is used for the flow rate, this parameter performs the following functions: • Enables and disables flow meter functions. This parameter must be set to a value greater than 0 to enable flow meter functions. • Sets the scaling for the “Flow Rate” analog input. • Sets the scaling for the “Flow Rate” analog output. • Sets the display scaling when “Flow Rate” is used as the PID feedback. When an pulse input is used for the flow rate, this parameter performs the following functions: • Enables and disables flow meter functions. Parameter must be set to a value greater than zero to enable flow meter functions. • Sets the scaling for the “Flow Rate” analog output. • Sets the display scaling when “Flow Rate” is used as the PID feedback.	Default: 0.0 GPM Min.: 0.0 Max.: 6000.0	–
P6-02 (0D5F) RUN	Turbine Input Scaling (Course)	Turbine Scale 1	Sets the scaling for the turbine in pulses per gallon. Pulses/Gallon = P6-02 + P6-03 This parameter is internally lower-limited to 0.0001 ppG.	Default: 1 ppG Min.: 0 Max.: 6000	–
P6-03 (0D60) RUN	Turbine Input Scaling (Fine)	Turbine Scale 2		Default: 0.0000 ppG Min.: 0.0000 Max.: 0.9999	–

Parameter List

B

B.11 P: Pump Parameters

No. (Addr. Hex)	Name	LCD Display	Description	Values	Page
P6-04 (0D61)	Water Flow Units	Water Flow Units 0: Gal/Min (GPM) 1: Gal/Hr (GPH) 2: Ft3/Min (CFM) 3: M3/Hr (CMH) 4: Acre-Ft/Yr (AFY)	Sets the display units for monitor U1-83, P2-02, P6-06, P6-17, P9-41, and P9-42. 0: U.S. Gallons / min (GPM) 1: U.S. Gallons / hr (GPH) 2: Cubic Feet / min (CFM) 3: Cubic Meters / hr (CMH) 4: Acre-Feet / yr (AFY)	Default: 0 Range: 0 to 4	–
P6-05 (0D62) RUN	Flow Accumulation Reset	Flow Accum Reset	Resets the accumulated flow and returns monitors U1-96 and U1-97 to 0. 0: No reset 7770: Reset accumulation All other settings have no effect. **Note:** After this parameter is changed, the setting will automatically return to "0".	Default: 0 Min.: 0 Max.: 65535	–
P6-06 (0D63) RUN	Low Flow Level	Low Flow Level	Sets the level below which the flow must fall for longer than the time set in P6-07 to trigger a Low Flow condition. Setting this parameter to 0.0 will disable the function.	Default: 0.0 GPM <1> Min.: 0.0 Max.: 6000.0	–
P6-07 (0D64) RUN	Low Flow Detection Delay Time When Already Running	Low Flow Tim Run	Sets the length of time that the flow rate must be below the level set in P6-06 to detect a Low Flow condition.	Default: 10 s Min.: 0 Max.: 6000	–
P6-08 (0D65) RUN	Low Flow Detection Wait Time at Start	Low Flow Time St	Sets the length of time that the drive will wait after coming out of a zero speed condition before activating Low Flow detection.	Default: 0.0 min Min.: 0.0 Max.: 3600.0	–
P6-09 (0D66)	Low Flow Select	Low Flow Sel 0: No Display 1: Alarm Only 2: Fault 3: Restart (P6-10)	Determines drive response when a Low Flow condition is detected. 0: No display 1: Alarm only 2: Fault 3: Auto-restart (time set by P6-10)	Default: 1 Range: 0 to 3	–
P6-10 (0D67)	Low Flow Auto-Restart Time	LowFlow Restart	Set the length of time that the drive will wait before attempting an auto-restart of the Low Flow fault. This parameter is effective only when P6-09 is set to 3.	Default: 3.0 min Min.: 0.1 Max.: 6000.0	–
P6-11 (0D68) RUN	Accumulation Level - Millions	AccumLvl*1000000	Sets the accumulated volume that will trigger the Accum Level alarm, Accum Level fault, or the Accum Level digital output. Accum Level is calculated using the following formula: Level = (P6-11 * 1000000) + (P6-12 * 1000) + P6-13 + P6-14)	Default: 0 gal <2> Min.: 0 Max.: 65535	–
P6-12 (0D69) RUN	Accumulation Level - Thousands	AccumLvl*1000		Default: 0 gal <2> Min.: 0 Max.: 999	–
P6-13 (0D6A) RUN	Accumulation Level - Ones	AccumLvl*1		Default: 0 gal <2> Min.: 0 Max.: 999	–
P6-14 (0D6B) RUN	Accumulation Level - Decimal	AccumLvl*0.0001		Default: 0.0000 gal <2> Min.: 0.0000 Max.: 0.9999	–
P6-15 (0D6C) RUN	Accumulation Behavior	Accum Behavior 0: No Display 1: Alarm Only 2: Fault 3: Fault-ResetAccum	Determines drive response when the accumulated volume reaches the P6-11 to P6-14 level. 0: No display 1: Alarm only 2: Fault 3: Fault - Auto flow accum reset	Default: 1 Range: 0 to 3	–
P6-16 (0D6D)	Flow Meter Accumulator Units Select	Accum Units 1: Gallons (gal) 2: Acre-Feet (A-F)	Selects whether the drive accumulates flow in gallons or acre-feet. 1: Gallons (gal) 2: Acre-feet **Note:** Changing this parameter resets the accumulated flow (U1-84 to U1-87) to zero.	Default: 1 Range: 1, 2	–
P6-17 (0D6E) RUN	High Flow Level	High Flow Level	Sets the level above which the flow must rise for the time set in P6-18 to trigger a High Flow condition.	Default: 0.0 GPM <1> Min.: 0.0 Max.: 6000.0	–

No. (Addr. Hex)	Name	LCD Display	Description	Values	Page
P6-18 (0D6F) RUN	High Flow Detection Delay Time	High Flow Time	Sets the length of time that the flow rate must be above the level set in P6-17 to detect a High Flow condition.	Default: 10 s Min.: 1 Max.: 6000	–
P6-19 (0D70)	High Flow Select	High Flow Sel 0: No Display 1: Alarm Only 2: Fault 3: Restart (L5-04)	Sets drive behavior when a High Flow condition is detected. 0: No display 1: Alarm only 2: Fault 3: Auto-restart (time set by L5-04)	Default: 1 Range: 0 to 3	–

<1> Unit text is set by P6-04, Water Flow Units.

<2> Unit text is set by P6-16, Flow Meter Accumulator Units Select.

◆ P7: Anti-Jam

No. (Addr. Hex)	Name	LCD Display	Description	Values	Page
P7-01 (0D90)	Anti-Jam Operation Selection	Anti-Jam Sel 0: Disabled 1: Enabled	Enables and disables the anti-jam function. 0: Disabled 1: Enabled	Default: 0 Range: 0, 1	–
P7-02 (0D91) RUN	Anti-Jam Cycle Count	AJ Cycle Count	Sets the maximum number of cycles that will be attempted before triggering and Anti-Jam fault.	Default: 1 Min.: 1 Max.: 100	–
P7-03 (0D92) RUN	Anti-Jam Detection Current Level	AJ Det I @Start	Sets the current level at start that will trigger the anti-jam function. Set as a percentage of the motor rated current.	Default: 120% Min.: 50 Max.: 200	–
P7-04 (0D93) RUN	Anti-Jam Detection Time at Start	AJ Det Tm@Start	Sets the length of time that current must rise above the level set in P7-03 to trigger the anti-jam function.	Default: 0.3 s Min.: 0.1 Max.: 2.0	–
P7-05 (0D94) RUN	Anti-Jam During Run Current	AJ Det I @Run	Sets the current level during run that will trigger the anti-jam function. Set as a percentage of motor rated current. Setting this parameter to 0 will disable anti-jam during run.	Default: 0% Min.: 0 Max.: 200	–
P7-06 (0D95) RUN	Anti-Jam During Run Time	AJ Det Tm @Run	Sets the length of time that the current must rise above the level set in P7-05 to trigger the anti-jam function. Restricted to simplex only.	Default: 0.3 s Min.: 0.1 Max.: 2.0	–
P7-07 (0D96) RUN	Anti-Jam Frequency Reference	AJ Freq Ref	Sets the maximum speed allowed when the anti-jam function is active.	Default: 25.00 Hz Min.: 0.00 Max.: 400.00	–
P7-08 (0D98) RUN	Anti-Jam Release Time	AJ Release Time	Sets the length of time that the current must fall below the level set in P7-03 to resume normal operation.	Default: 2.0 s Min.: 0.5 Max.: 10.0	–

◆ P9: Network Options

Parameters in this group are functional only when P1-01, Pump Mode, is set to 3 (MEMOBUS network).

No. (Addr. Hex)	Name	LCD Display	Description	Values	Page
P9-01 (0DF4)	Lead Drive Selection	Lead Drive Sel 0: Next Available 1: Lowest Runtime 2: Stop History	Specifies how the next lead drive is selected. 0: Next available 1: Lowest runtime 2: Stop history	Default: 1 Range: 0 to 2	–
P9-02 (0DF5)	Feedback Source	Feedback Source 0: Analog only 1: Ana->Net, No Alrm 2: Ana->Net, Alarm 3: Network only	Defines which signal to use for PI feedback when P1-01, Pump Mode, is set to 3 (MEMOBUS network). 0: Analog only 1: Ana->Net, No Alrm 2: Ana->Net, Alarm 3: Network only	Default: 0 Range: 0 to 3	–

B.11 P: Pump Parameters

No. (Addr. Hex)	Name	LCD Display	Description	Values	Page
P9-03 (0DF6) RUN	Alternation Time	Alternation Time	Specifies the time for a drive to request alternation. Setting this parameter to 0 disables the function.	Default: 24 H Min.: 0 Max.: 1000	–
P9-04 (0DF7)	Alternation Mode	Alternation Mode 0: FIFO Auto 1: FIFO Forced 2: LIFO 3: FIFO @ Sleep	Determines how alternation is performed. 0: FIFO auto 1: FIFO forced 2: LIFO 3: FIFO @sleep	Default: 0 Range: 0 to 3	–
P9-05 (0DF8)	Lag Drive Mode	Lag Drive Mode 0: Fixed Speed 2: Turn Off 3: Follow Lead Spd	Determines the functionality of the lag drives. 0: Fixed speed. The drive runs at the P9-06 setting after the time set in P9-07 expires. 2: Turn off. The drive stops running when it switches to a lag drive after the time set in P9-07 expires. 3: Follow Lead Speed. The drive will follow the speed of the current lead drive, applying P9-30 gain and P9-31 bias.	Default: 0 Range: 0, 2, 3	–
P9-06 (0DF9) RUN	Lag Fixed Speed	Lag Fixed Speed	Sets the speed at which the drive will run when the drive changes from a lead to a lag and the time set in P9-07 has expired.	Default: 55.0 Hz Min.: 0.0 Max.: 400.0	–
P9-07 (0DFA) RUN	Lag Fixed Speed Delay	Lag Fix Spd Dly	Specifies how long speed is latched before performing the function specified in P9-05 when the drive changes from a lead to a lag.	Default: 5 s Min.: 0 Max.: 1000	–
P9-08 (0DFB)	Add Pump Mode	Add Pump Mode 0: Output Frequency 1: Feedback 2: Feedback + Fout 3: Flow Meter	Selects the detection method for staging a new pump. 0: Output frequency 1: Feedback 2: Feedback + Fout 3. Flow meter	Default: 0 Range: 0 to 3	–
P9-09 (0DFC) RUN	Add Frequency Level	Add Freq Lvl	When P9-08 is set to 0, this parameter sets the level above which the output frequency needs to rise for the time set in P9-11 before the lead drive will send a request for a new lead drive via the iQPump MEMOBUS network. When P9-08 is set to 2 and the delta feedback (setpoint minus feedback) has exceeded the level set in P9-10 for the time set in P9-11, this parameter sets the level above which the output frequency needs to rise before the lead drive will send a request for a new lead drive via the iQPump MEMOBUS network.	Default: 59.5 Hz Min.: 0.0 Max.: 400.0	–
P9-10 (0DFD) RUN	Add Delta Level	Add Delta Lvl	When P9-08 is set to 1, this parameter sets the level above which the delta feedback (setpoint minus feedback) must rise for the time set in P9-11 before the lead drive will send a request for a new lead drive via the iQPump MEMOBUS network. When P9-08 is set to 2 and the output frequency has exceeded the level set in P9-09 for the time set in P9-11, this parameter sets the level above which the delta feedback (setpoint minus feedback) needs to rise before the lead drive will send a request for a new lead drive via the iQPump MEMOBUS network.	Default: 0.0 PSI <1> Min.: 0.0 Max.: 6000.0	–
P9-11 (0DFE) RUN	Add Delay Time	Add Dly Time	Sets the delay time before a new lead drive is added to the system.	Default: 10 s Min.: 0 Max.: 3600	–
P9-12 (0DFF)	Remove Pump Mode	Remove Pump Mode 0: Output Frequency 1: Feedback 2: Feedback + Fout 3: Flow Meter	Sets the detection method for de-staging to the previous lead pump. 0: Output frequency 1: Feedback 2: Feedback + Fout 3: Flow meter	Default: 0 Range: 0 to 3	–
P9-13 (0E00) RUN	Remove Frequency Level	Remove Freq Lvl	When P9-12 is set to 0, this parameter sets the level below which the output frequency must fall for the time set in P9-15 before the lead drive will send a request to be removed from the system via the iQPump MEMOBUS network. When P9-12 is set to 2 and the delta feedback (feedback minus setpoint) has exceeded the level set in P9-14 for the time set in P9-15, this parameter sets the level below which the output frequency must fall before the lead drive will request to be removed from the system via the iQPump MEMOBUS network.	Default: 40.0 Hz Min.: 0.0 Max.: 400.0	–

No. (Addr. Hex)	Name	LCD Display	Description	Values	Page
P9-14 (0E01) RUN	Remove Delta Level	Remove Delta Lvl	When P9-12 is set to 1, this parameter sets the level above which the delta feedback (feedback minus setpoint) must rise for the time set in P9-15 before the lead drive will request to be removed from the system via the iQPump MEMOBUS network. When P9-12 is set to 2 and the output frequency has exceeded the level set in P9-13 for the time set in P9-15, this parameter sets the level above which the delta feedback (feedback minus setpoint) frequency must rise before the lead drive will request to be removed from the system via the iQPump MEMOBUS network.	Default: 0.0 PSI <1> Min.: 0.0 Max.: 6000.0	–
P9-15 (0E02) RUN	Remove Delay Time	Remove Dly Time	Sets the delay time before the lead drive is removed from the system.	Default: 10 s Min.: 0 Max.: 3600	–
P9-16 (0E03) RUN	Stabilization Time	Stabilize Time	Sets the time used top stabilize the system when a pump is staged or de-staged. Lead/lag control and pump protection are suspended during this time.	Default: 3 s Min.: 0 Max.: 3600	–
P9-17 (0E04) RUN	Setpoint Modifier	Set-pt Modifier	Sets the value by which the system setpoint is incremented depending on the number of pumps that are running. Pump 1: Setpoint Pump 2: Setpoint + ((X-1) (P9-17))	Default: 0.0 PSI <1> Min.: -999.9 Max.: 999.9	–
P9-18 (0E05) RUN	High Feedback Quick De-Stage	High FB De-stage	Sets the feedback level that will trigger a quick de-stage. Set as a percentage of the P1-09 value. The quick de-stage ignores parameters P9-12 to P9-15 and uses an internal 2 second delay. Setting this parameter to 0.0 disables the feature.	Default: 97.0% Min.: 0.0 Max.: 100.0	–
P9-19 (0E06) RUN	Alternation Unit	Alternation Unit 0: Hours (H) 1: Minutes (min)	Sets the units used in P9-03. 0: Hours (H) 1: Minutes (min)	Default: 0 Range: 0, 1	–
P9-20 (0E07)	Allow Network Run	Allow Net Run 0: Always 1: First/Altrnation 2: First Only 3: Alternation Only	Specifies when a network Run command is allowed. 0: Always 1: First/alternation 2: First only 3: Alternation only	Default: 0 Range: 0 to 3	–
P9-21 (0E08) RUN	Run Priority	Run Priority	Sets the lead drive selection priority overriding the P9-01 selection. If multiple drives have the lowest P9-21 value, then P9-01 determines which drive becomes the lead.	Default: 8 Min.: 1 Max.: 16	–
P9-22 (0E09) RUN	System Fault Retry	System Flt Retry	Sets the number of times that the iQPump MEMOBUS network will allow automatic restarts of system faults. The drive uses L5-04, Fault Reset Interval Time, to determine when to attempt a system fault restart. Set this parameter to the same value for all drives on the network.	Default: 5 Min.: 0 Max.: 10	–
P9-23 (0E0A)	Maximum Number of Running Pumps	MaxPumps Running	Sets the maximum number of pumps that can run on the system.	Default: 8 Min.: 1 Max.: 8	–
P9-24 (0E0B) RUN	Lead Swap at Sleep	Lead Swap @Sleep	Sets the length of time for which the lead drive will be in Sleep Mode before this drive will request a swap when there is another drive available with a lower P9-21 setting. Setting this parameter to 0 will disable the function.	Default: 0 s Min.: 0 Max.: 7200	–
P9-25 (0E0C)	Highest Node Address	Highest Node Adr	Sets the highest possible node address in the MEMOBUS network. For optimal network performance, set the serial communication address H5-01 beginning with 01h consecutively up to the last drive and then set this parameter to that H5-01 address.	Default: 8 Min.: 2 Max.: 8	–
P9-26 (0E0D)	Master Time-out	Master Time-out	Sets the minimum amount of time that the slave drives will wait for a message from the master before performing the action set in P9-27.	Default: 4.0 s Min.: 1.0 Max.: 10.0	–

No. (Addr. Hex)	Name	LCD Display	Description	Values	Page
P9-27 (0E0E)	Network Recovery	Network Recovery 0: Automatic 1: Slave/Resume 2: Slave/Stop 3: Fault MSL	Determines the drive response when no messages are received from the master for the time set in P9-26. 0: Automatic. The drive will attempt to assume master functionality. 1: Slave/Resume. The drive will continue running when the master is lost and will wait for a master to come online. 2: Slave/Stop. The drive will stop running when the master is lost and will wait for a master to come online. 3: Fault MSL. Fault the drive with an MSL (Master Lost).	Default: 0 Range: 0 to 3	–
P9-28 (0E0F)	NETSCAN Alarm Time	NETSCAN AlrmTime	Sets the amount of time that the slave drives will wait for a message from the master before displaying a NETSCAN alarm.	Default: 2.0 s Min.: 1.0 Max.: 10.0	–
P9-29 (0E10) RUN	Net Start Delay	Net Start Delay	Sets the amount of time that the network will wait before selecting and starting the lead drive after the first drive on the network has been put on AUTO Mode.	Default: 2.0 s Min.: 0.0 Max.: 60.0	–
P9-30 (0E11) RUN	Lag Drive Speed Follower Gain	Lag Followr Gain	Sets the gain to be applied to the speed of the current lead drive when P9-05 is set to 3. The bias to be applied is set in P9-31.	Default: 100.0% Min.: 0.0 Max.: 300.0	–
P9-31 (0E12) RUN	Lag Drive Speed Follower Bias	Lag Followr Bias	Sets the bias to be applied to the speed of the current lead drive when P9-05 is set to 3. The gain to be applied is set in P9-30.	Default: 0.00 Hz Min.: -60.0 Max.: 60.0	–
P9-32 (0E13) RUN	Lag Follower Deceleration Time	Lag Followr Dcel	Sets the deceleration time when the P9-33 timer is running and the drive is running as Lag Drive Speed Follower (P9-05 is set to 3).	Default: 60.0 s Min.: 0.0 Max.: 1000.0	–
P9-33 (0E14) RUN	Lag Follower Deceleration Time Active Time	Lag Followr Dtim	Sets the time during which the deceleration time set in P9-32 is effective. The drive will use the standard deceleration rate when it expires. Setting this parameter to 0.0 disables the function.	Default: 0.0 s Min.: 0.0 Max.: 360.0	–
P9-34 (0E15) RUN	Low Feedback Quick De-Stage	Low FB De-stage	Sets the low feedback level that will trigger a quick de-stage. The quick de-stage ignores parameters P9-12 and P9-15 and only uses an internal 2 second delay. Setting this parameter to 0.0 disables the function.	Default: 0.0 PSI <1> Min.: 0.0 Max.: 6000.0	–
P9-40 (0E1B) RUN	Flow Rate Source	Flow Rate Source 0: Analog Only 3: Network Only	Defines the flow meter input source when P1-01, Pump Mode, is set to 3 (MEMOBUS network). 0: Analog 3: Network	Default: 0 Range: 0, 3	–
P9-41 (0E1C)	Add Flow Level	Add Flow Lvl	When P9-08 is set to 3 and the flow rate rises above this level multiplied by the number of pumps running for the time set in P9-11, the lead drive will request for a new lead drive through the iQpump MEMOBUS network.	Default: 0.0 GPM Min.: 0.0 Max.: 6000.0	–
P9-42 (0E1D)	Remove Flow Level	Remove Flow Lvl	When P9-12 is set to 3 and the flow rate falls below this level multiplied by the number of pumps running - 1 for the time set in P9-15, the lead drive will request to be removed from the system through the iQpump MEMOBUS network.	Default: 0.0 GPM Min.: 0.0 Max.: 6000.0	–
P9-50 (0E25)	Water Level/Suction Pressure Source	WL/SP Source 0: Analog only 1: Ana->Net, No Alrm 2: Ana->Net, Alarm 3: Network only	Sets the signal to use for Water Level Control (Q4-☐☐) or Suction Pressure Control (Q5-☐☐) when P1-01, Pump Mode, is set to 3 (MEMOBUS network). 0: Analog only 1: Ana->Net, No Alrm 2: Ana->Net, Alarm 3: Network only	Default: 0 Range: 0 to 3	–

No. (Addr. Hex)	Name	LCD Display	Description	Values	Page
P9-51 (0E26)	Low Water Level/ Suction Pressure Turn-Off Method	Low WL Turn-Off 0: Disabled 1: Enabled	Determines the MEMOBUS multiplex response to Water Level or Suction Pressure. 0: Disabled • Water level does not have an effect on Idle or Lag drives • Water level will not cause alternation 1: Enabled • A drive is considered offline when the Water Level/Suction Pressure is below the wake-up level set in Q4-06/Q5-06. • A Lag drive is removed when the Water Level/Suction Pressure is below the wake-up level set in Q4-06/Q5-06. • A Lead drive is alternated if in Level Control/Suction Pressure while the Water Level is below the septoint set in Q4-03/Q5-03.	Default: 0 Range: 0, 1	–
P9-60 (0E2F)	Geothermal Temperature Source	Geo Temp Source 0: Analog only 1: Ana->Net, No Alrm 2: Ana->Net, Alarm 3: Network only	0: Analog only 1: Ana->Net, No Alrm 2: Ana->Net, Alarm 3: Network only	Default: 0 Range: 0 to 3	–
P9-99 (0E56)	Network Compatibility Selection	Network Comp Sel 0: A-Ver: 30034 1: B-Ver: 30035/36 2: iQ SmartNetwork	Determines the communication compatibility for the iQPump MEMOBUS network. 0: A-Ver: 30034 1: B-Ver: 30035/36 2: iQ SmartNetwork	Default: 2 Range: 0 to 2	–

<1> Unit text is set by P1-18, Prime Loss Detection Method.

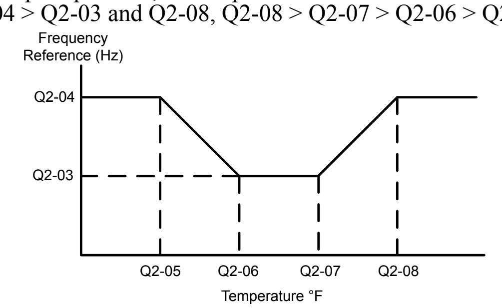
B.12 Q: PID Controller Parameters

◆ Q1: Preset Setpoint

No. (Addr. Hex)	Name	LCD Display	Description	Values	Page
Q1-01 (0E58) RUN	PID Controller Setpoint 1	Setpoint 1	Sets the PID Setpoint when b1-01 is set to 0.	Default: 0.0 Min.: 0.0 Max.: 6000.0 <1>	169
Q1-02 (0E59) RUN	PID Controller Setpoint 2	Setpoint 2	Sets the PID Setpoint when the “Multi Setpoint 1” multi-function digital input is closed.	Default: 0.0 Min.: 0.0 Max.: 6000.0 <1>	–
Q1-03 (0E59) RUN	PID Controller Setpoint 3	Setpoint 3	Sets the PID Setpoint when the “Multi Setpoint 2” multi-function digital input is closed.	Default: 0.0 Min.: 0.0 Max.: 6000.0 <1>	–
Q1-04 (0E59) RUN	PID Controller Setpoint 4	Setpoint 4	Sets the PID Setpoint when the “Multi Setpoint 1” and “Multi Setpoint 2” multi-function digital inputs are closed.	Default: 0.0 Min.: 0.0 Max.: 6000.0 <1>	–
Q1-09 (0E60)	PID Setpoint Set via Motor Operated Pot	Setpoint MOP 0: Disabled 1: Enabled	Selects whether parameters Q1-01 to Q1-04 are changed via MOP from the home screen. 0: Disabled 1: Enabled	Default: 0 Range: 0, 1	–

<1> Unit text is set by P1-02, System Units. Scaling is set by P1-03, Feedback Device Scaling.

◆ Q2: Geothermal Mode Setup

No. (Addr. Hex)	Name	LCD Display	Description	Values	Page
Q2-01 (0E8A)	Minimum Geothermal Temperature Input	MinGeothrm Scale	Sets the temperature that corresponds to a 0 V (or 4 mA) analog input.	Default: 0.0 °F Min.: -110.0 Max.: 320.0	–
Q2-02 (0E8B)	Maximum Geothermal Temperature Input	MaxGeothrm Scale	Sets the temperature that corresponds to a 10 V (or 20 mA) analog input.	Default: 120.0 °F Min.: -110.0 Max.: 320.0	–
Q2-03 (0E8C) RUN	Minimum Geothermal Speed	MinGeothrm Speed	Sets the frequency reference characteristics based on the set temperature points and the corresponding frequency. For proper operation, set the parameters as follows: Q2-04 > Q2-03 and Q2-08, Q2-08 > Q2-07 > Q2-06 > Q2-05 	Default: 40.0 Hz Min.: 0.0 Max.: 400.0	–
Q2-04 (0E8D) RUN	Maximum Geothermal Speed	MaxGeothrm Speed		Default: 60.0 Hz Min.: 0.0 Max.: 400.0	–
Q2-05 (0E8E) RUN	Low Temperature to Run at Maximum Geothermal Speed	Low Temp @ Max		Default: 55.0 °F Min.: -110.0 Max.: 320.0	–
Q2-06 (0E8F) RUN	Low Temperature to Run at Minimum Geothermal Speed	Low Temp @ Min		Default: 65.0 °F Min.: -110.0 Max.: 320.0	–
Q2-07 (0E90) RUN	High Temperature to Run at Minimum Geothermal Speed	High Temp @ Min		Default: 75.0 °F Min.: -110.0 Max.: 320.0	–
Q2-08 (0E91) RUN	High Temperature to Run at Maximum Geothermal Speed	High Temp @ Max		Default: 85.0 °F Min.: -110.0 Max.: 320.0	–
Q2-09 (0E92)	Geothermal Temperature Loss Detection	Geotherm Loss Det 0: Disabled 1: Alarm Only 2: Fault	Selects the drive response when the signal from Terminal A2 falls below 3 mA or rises above 21 mA. This parameter is only effective when H3-0□ = 2 (4 to 20 mA) and H3-0□ = 21 (Geothermal Temperature). 0: Disabled 1: Alarm 2: Fault	Default: 1 Range: 0 to 2	–

No. (Addr. Hex)	Name	LCD Display	Description	Values	Page
Q2-10 (0E93) RUN	Geothermal Sleep Delay Time	Geotherm Slp Dly	Set the length of time that the drive must be running at the speed set in Q2-03, Minimum Geothermal Speed, before going to sleep.	Default: 30 s Min.: 0 Max.: 3600	–
Q2-11 (0E94)	Geothermal Temperature Delta Wake Level	Geotherm Wake Lvl	Sets the geothermal temperature that will wake up the drive. The drive will wake up when one of the following conditions is true: Temperature > Q2-07 + Q2-11 OR Temperature < Q2-06 - Q2-11 Setting this parameter to 0.0 will disable Geothermal Sleep Mode.	Default: 0.0 °F Min.: 0.0 Max.: 50.00	–
Q2-12 (0E95) RUN	Geothermal Sleep Wake-Up Delay Time	Geotherm Wake Dly	Sets the length of time that the setting of Q2-11, Geothermal Temperature Delta Wake Level, must be met to wake up the drive.	Default: 5 s Min.: 0 Max.: 3600	–

◆ Q3: Output Current Limit

No. (Addr. Hex)	Name	LCD Display	Description	Values	Page
Q3-01 (0EBC)	Output Current Limit Select	Current Lim Sel 0: Disabled 1: Enabled	Enables and disables the output current regulator. 0: Disabled 1: Enabled	Default: 0 Range: 0, 1	–
Q3-02 (0EBD)	Current Limit	Current Limit	Sets the current limit. Value is internally limited to 300% of the drive rated current, n9-01.	Default: 0.0 A Min.: 0.0 Max.: 1000.0	–
Q3-10 (0EC5)	Single Phase Foldback Selection	1-Phase Foldback 0: Disabled 1: Enabled	Enables and disables the single phase ripple regulator. 0: Disabled 1: Enabled	Default: 1 Range: 0, 1	–
Q3-11 (0EC6)	Ripple Regulator Setpoint	Ripple Reg S.P.	Set as a percentage of the maximum amount of ripple allowed before triggering an input phase loss fault.	Default: 95.0% Min.: 0.0 Max.: 200.0	–

◆ Q4: Water Level Control

No. (Addr. Hex)	Name	LCD Display	Description	Values	Page
Q4-01 (0EEE)	Water Level Selection	Water Level Sel 0: Disabled 1: Enabled	Enables and disables the water level control. 0: Disabled 1: Enabled	Default: 0 Range: 0, 1	–
Q4-02 (0EEF) RUN	Water Level Scaling	Water Lvl Scale	Sets the full scale (20 mA) output of the pressure transducer that is connected to the analog input terminal programmed for “WaterLvl/Suction” (H3-☐☐ = 23). **Note:** 1 PSI = 2.308 feet of water	Default: 100 PSI Min.: 5 Max.: 500	–
Q4-03 (0EF0) RUN	Water Level Setpoint	Water Lvl Setpnt	Sets the amount of water above the sensor to which the drive will attempt to regulate.	Default: 20.0 ft Min.: 0.0 Max.: 1200.0	–
Q4-04 (0EF1) RUN	Minimum Water Level	Min Water Level	Sets the level below which the amount of water must drop for the time set in Q4-05 to put the drive to sleep.	Default: 10.0 ft Min.: 0.0 Max.: 1200.0	–
Q4-05 (0EF2) RUN	Water Level Sleep Delay Time	WL Sleep Dly Tm	Sets the length of time that the drive will delay after the water level drops below the level set in Q4-04 before going to sleep.	Default: 5 s Min.: 0 Max.: 3600	–
Q4-06 (0EF3) RUN	Wake-Up Water Level	Wake-Up Level	Sets the level above which the water needs to rise for more than the time set in Q4-07 for the drive to wake up after being put to sleep via parameter Q4-04, Minimum Water Level.	Default: 30.0 ft Min.: 0.0 Max.: 1200.0	–
Q4-07 (0EF4)	Water Level Control Sleep Wake-Up Time	WL Wake-up Time	Sets the length of time that the water level set in Q4-06 must be met for the drive to wake up after being put to sleep via parameter Q4-04, Minimum Water Level.	Default: 1 s Min.: 0 Max.: 3600	–

No. (Addr. Hex)	Name	LCD Display	Description	Values	Page
Q4-08 (0EF5) RUN	Level Control Minimum Speed	Level Min Spd	Sets the minimum speed at which the drive will run when the drive is controlling the water level. When the drive is controlling pressure or if this parameter is set less than P1-06 and P4-12, parameters P1-06 and P4-12 will be used as the minimum speed.	Default: 0.00 Hz Min.: 0.00 Max.: 400.00	–
Q4-09 (0EF6) RUN	Low Level Detection Level	Low Level Detect	Sets the level below which the water level must drop for the time set in Q4-10 to trigger the drive response set in Q4-11. Setting this parameter to 0.0 will disable the function.	Default: 0.0 ft Min.: 0.0 Max.: 1200.0	–
Q4-10 (0EF7) RUN	Low Level Detection Time Delay	Low Lvl Det Tm	Sets the length of time that the water level must fall below the level set in Q4-09 to trigger the drive response set in Q4-11.	Default: 0.0 <1> Min.: 0.0 Max.: 300.0	–
Q4-11 (0EF8)	Low Level Behavior	Low Lvl Behavior 0: No Display 1: Alarm Only 2: Fault 3: Restart (Q4-12)	Selects drive response when the water level drops below the level set in Q4-09 for the time set in Q4-10. 0: No display (digital output only) 1: Alarm only 2: Fault 3: Restart (time set by Q4-12)	Default: 1 Range: 0 to 3	–
Q4-12 (0EF9) RUN	Water Level Control Auto-Restart Time	WtrLvl Restart	Sets the length of time that the drive will wait before attempting an auto-restart of the Low Water Level fault. This parameter is effective only when Q4-11 is set to 3 and L5-01 is set to a value greater than 0.	Default: 5.0 min Min.: 0.1 Max.: 6000.0	–
Q4-13 (0EFA) RUN	Level Control Proportional Gain	Lvl Ctrl P Gain	Sets the proportional gain for the water level control.	Default: 2.00 Min.: 0.00 Max.: 25.00	–
Q4-14 (0EFB) RUN	Level Control Integral Time	Lvl Ctrl I Time	Sets the integral time for the water level control. Setting this parameter to 0.0 disables the water level control integrator.	Default: 5.0 s Min.: 0.0 Max.: 360.0	–
Q4-15 (0EFC)	Low Water Level Detection Time Unit	Low Lvl Det Unit 0: Minutes (min) 1: Seconds (sec)	Determines the time unit for Q4-10, Low Level Detection Time Delay. 0: Minutes (min) 1: Seconds (sec)	Default: 0 Range: 0, 1	–
Q4-16 (0EFD)	Water Level Analog Input Wire-Break Detection	WL Wire Break 0: No Display 1: Alarm Only 2: Fault	Sets the behavior when the analog input selected for water level feedback is programmed to receive a 4-20 mA signal and the signal is lost. 0: No display 1: Alarm only 2: Fault (no retry, coast to stop)	Default: 2 Range: 0 to 2	–

<1> Units are determined by Q4-15, Low Water Level Detection Time Unit, setting.

◆ Q5: Suction Pressure Control

No. (Addr. Hex)	Name	LCD Display	Description	Values	Page
Q5-01 (0F20)	Suction Pressure Select	Suction Pres Sel 0: Disabled 1: Suction Pressure 2: Vacuum ("Hg)	Sets the method of operation for the Suction Control / Vacuum Control function. 0: Disabled 1: Suction pressure (PSI) 2: Vacuum ("Hg)	Default: 0 Range: 0 to 2	–
Q5-02 (0F21) RUN	Suction Transducer Scaling	Suction Scaling	Sets the full scale (20 mA) output of the pressure transducer that is connected to the analog input terminal programmed for “WaterLvl/Suction” (H3-0□ = 23).	Default: 100.0 <1> Min.: 5.0 Max.: 1200.0	–
Q5-03 (0F22) RUN	Suction Pressure Setpoint	Suction Setpoint	Sets the amount of suction pressure to which the drive will attempt to regulate.	Default: 20.0 <1> Min.: 0.0 Max.: 1200.0	169
Q5-04 (0F23) RUN	Minimum Suction Pressure	Min Suction Pres	Sets the level below which the suction pressure must fall for longer than the Q5-05 time to put the drive to sleep and turn off all lag pumps.	Default: 10.0 <1> Min.: 0.0 Max.: 1200.0	–

No. (Addr. Hex)	Name	LCD Display	Description	Values	Page
Q5-05 (0F24) RUN	Suction Pressure Sleep Delay Time	SP Sleep Dly Tm	Sets the length of time that the drive will delay after suction pressure drops below the level set in Q5-04 before going to sleep.	Default: 5 s Min.: 0 Max.: 3600	–
Q5-06 (0F25) RUN	Wake-Up Suction Pressure	Wake-Up Pres	Sets the level above which the suction pressure must rise for the time set in Q5-07 for the drive to wake up when it has been put to sleep via parameter Q5-04, Minimum Suction Pressure.	Default: 30.0 <1> Min.: 0.0 Max.: 1200.0	169
Q5-07 (0F26)	Suction Pressure Sleep Wake-Up Time	SP Wake-up Time	Sets the length of time for which the pressure must rise above the level set in Q5-06 to wake up the drive when it has been put to sleep via parameter Q5-04, Minimum Suction Pressure.	Default: 1 s Min.: 0 Max.: 3600	–
Q5-08 (0F27) RUN	Suction Pressure Control Minimum Speed	Suction Min Spd	Sets the minimum speed at which the drive will run when the drive is controlling suction pressure. When the drive is controlling outlet pressure or this parameter is set lower than P1-06 and P4-12, parameters P1-06 and P4-12 will be used as the minimum speed.	Default: 0.00 Hz Min.: 0.00 Max.: 400.00	–
Q5-09 (0F28) RUN	Low Suction Pressure Detection Level	Low Pres Detect	Sets the level below which the suction pressure must fall for the time set in Q5-10 to trigger a drive response according to Q5-11, Low Suction Pressure Behavior Select. Setting this parameter to 0.0 will disable the function.	Default: 0.0 <1> Min.: 0.0 Max.: 1200.0	169
Q5-10 (0F29) RUN	Low Suction Pressure Detection Time	Low Pres Det Tm	Sets the length of time that the suction pressure must fall below the level set in Q5-09 to trigger a drive response according to Q5-11, Low Suction Pressure Behavior Select. Time unit is defined by Q5-18.	Default: 0.1 <2> Min.: 0.0 Max.: 300.0	170
Q5-11 (0F2A)	Low Suction Pressure Behavior Select	Low Pressure Sel 0: No Display 1: Alarm Only 2: Fault 3: Restart (Q5-15)	Determines drive response when the suction pressure drops below the level set in Q5-09 for longer than the time set in Q5-10. 0: No display (digital output only) 1: Alarm only 2: Fault 3: Auto-restart (time set by Q5-15)	Default: 1 Range: 0 to 3	170
Q5-12 (0F2B) RUN	High Suction Pressure Detection Level	Hi Pres Detect	Sets the level above which the suction pressure must rise for the time set in Q5-13 to trigger a drive response according to Q5-14. Setting this parameter to 0.0 disables the function.	Default: 0.0 <1> Min.: 0.0 Max.: 1200.0	–
Q5-13 (0F2C) RUN	High Suction Pressure Detection Time	Hi Pres Det Tm	Sets the length of time that the suction pressure must rise above the level set in Q5-12 to trigger a drive response according to Q5-14. Time unit is defined by Q5-18.	Default: 0.1 <2> Min.: 0.0 Max.: 300.0	–
Q5-14 (0F2D)	High Suction Pressure Behavior Select	Hi Pressure Sel 0: No Display 1: Alarm Only 2: Fault 3: Restart (Q5-15)	Determines drive response when the suction pressure rises above the level set in Q5-12 for longer than the time set in Q5-13. 0: No display 1: Alarm only 2: Fault 3: Auto-restart (time set by Q5-15)	Default: 1 Range: 0 to 3	–
Q5-15 (0F2E)	Suction Pressure Auto-Restart Time	Suction Restart	Sets the length of time that the drive will wait before attempting an auto-restart of the Low Suction or High Suction fault. Parameter is only effective when Q5-11 is set to 3 or Q5-14 is set to 3 and L5-01 is greater than 0.	Default: 5.0 min Min.: 0.1 Max.: 6000.0	–
Q5-16 (0F2F) RUN	Suction Control Proportional Gain	Suction P Gain	Sets the proportional gain for the suction pressure control.	Default: 2.00 Min.: 0.00 Max.: 25.00	170
Q5-17 (0F30) RUN	Suction Control Integral Time	Suction I Time	Sets the integral time for the suction pressure control. Setting this parameter to 0.0 disables the suction pressure control integrator.	Default: 5.0 s Min.: 0.0 Max.: 360.0	170
Q5-18 (0F31)	Suction Pressure Detection Time Unit	SuctionPresUnit 0: Minutes (min) 1: Seconds (sec)	Sets the time unit for Q5-10 and Q5-13. 0: Minutes (min) 1: Seconds (sec)	Default: 0 Range: 0, 1	–
Q5-19 (0F32)	Suction Pressure Analog Input Wire-Break Detection	SP Wire Break 0: No Display 1: Alarm Only 2: Fault	Sets the behavior when the analog input selected for suction pressure feedback is programmed to receive a 4 to 20 mA signal and the signal is lost. 0: Disabled 1: Alarm only 2: Fault (no retry, coast to stop)	Default: 2 Range: 0 to 2	–

<1> Units are determined by Q5-01, Suction Pressure Select, setting.

<2> Units are determined by Q5-18, Suction Pressure Detection Time Unit, setting.

B.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	V/f 0: Disabled 1: Enabled	Default: 0 Range: 0, 1	–
S1-02 (3201)	Voltage Reduction Rate	Volt Reduce Amt	V/f 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	–
S1-03 (3202)	Voltage Restoration Level	V Reduce On Lvl	V/f 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	–
S1-04 (3203)	Voltage Restoration Complete Level	V Reduce Off Lvl	V/f 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	–
S1-05 (3204)	Voltage Restoration Sensitivity Time Constant	Sensitivity Time	V/f Sets the level of sensitivity of the output torque and LPF time constants 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	–
S1-06 (3205)	Voltage Restoration Time Constant at Impact	Impact Load Time	V/f Sets the voltage restoration time constant if an impact load is added.	Default: 0.050 s Min.: 0.000 Max.: 1.000	–

◆ S2: Programmable Run 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 <1>	–
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 <1>	–
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	–
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	–

No. (Addr. Hex)	Name	LCD Display	Description	Values	Page
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 7: Pulse Input 8: Set by b1-01	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 7: Pulse input 8: Set by b1-01	Default: 8 Range: 0 to 8	–
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 <1>	–
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 <1>	–
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	–
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 timer 2 is active. 0: Digital output only 1: Run 2: Run - PI disable	Default: 0 Range: 0 to 2	–
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 7: Pulse Input 8: Set by b1-01	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 7: Pulse input 8: Set by b1-01	Default: 8 Range: 0 to 8	–
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 <1>	–
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 <1>	–
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	–
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	–

No. (Addr. Hex)	Name	LCD Display	Description	Values	Page
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 7: Pulse Input 8: Set by b1-01	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 7: Pulse input 8: Set by b1-01	Default: 8 Range: 0 to 8	–
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 <1>	–
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 <1>	–
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	–
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	–
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 7: Pulse Input 8: Set by b1-01	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 7: Pulse input 8: Set by b1-01	Default: 8 Range: 0 to 8	–

<1> Setting the sequence timer start time to a higher value than the sequence timer stop time disables that sequence timer.

◆ 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	Determines when the secondary PI controller is enabled. 0: Disabled 1: Always 2: Drive running 3: Motor running **Note:** Setting 3 does not run the motor at zero speed, baseblock, or in DC injection.	Default: 0 Range: 0 to 3	–
S3-02 (321B) RUN	Secondary PI User Display	PI2 UsrDspMaxVal	Sets the scale value of 100% PI input.	Default: 10000 Min.: 0 Max.: 60000	–

No. (Addr. Hex)	Name	LCD Display	Description	Values	Page
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)	Sets the decimal place display for secondary PI units. 0: No decimal places 1: One decimal place 2: Two decimal places 3: Three decimal places	Default: 2 Range: 0 to 3	–
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	–
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>	–
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	–
S3-07 (3220) RUN	Secondary PI Integral Time Setting	PI2 I Time	Sets the integral time for the secondary PI controller. A setting of 0.0 s disables integral control.	Default: 1.0 s Min.: 0.0 Max.: 360.0	–
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	–
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	–
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	–
S3-11 (3224) RUN	Secondary PI Output Level Selection	PI2 Out Lvl Sel 0: Direct Acting 1: Inverse Acting	Sets the secondary PI controller output direction. 0: Normal Output (direct acting) 1: Inverse Output (inverse acting)	Default: 0 Range: 0, 1	–
S3-12 (3225) RUN	Secondary PI Disable Mode	PI2 Disable Mode 0: No output 1: Lower Limit (S3-10) 2: Setpoint	Selects the secondary PI controller output when disabled. 0: No output (0%) 1: Lower Limit (S3-10) 2: Setpoint	Default: 0 Range: 0 to 2	–
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>	–
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	–
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>	–
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	–

No. (Addr. Hex)	Name	LCD Display	Description	Values	Page
S3-17 (322A) RUN	Secondary PI Feedback Detection Selection	PI2 FB Det Sel 0: PI2 Enabled 1: Always	Selects when secondary PI controller low and high feedback detection are active. 0: Secondary PI enabled 1: Always	Default: 0 Range: 0, 1	–

<1> Unit is determined by S3-04.

<2> Upper limit is S3-02, decimal placeholder is determined by S3-03.

◆ S6: 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	–
S6-02 (3237)	Emergency Override Reference Selection	E OverrideRefSel 0: Use S6-01 Ref 1: Use Freq Ref	Selects the emergency override speed source. 0: Use S6-01 Reference 1: Use Frequency Reference	Default: 0 Range: 0, 1	–
S6-07 (323C)	Output Phase Loss Level for Dynamic Noise Control	DNC Outp Ph Loss	Reduces the output phase loss level when Dynamic Noise Control is active.	Default: 100.0% Min.: 10.0 Max.: 100.0	–

B.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 (0701)	Auto-Tuning Mode Selection	Tuning Mode Sel 0: Standard Tuning 1: Tune-No Rotate1 2: Term Resistance 3: V/f Engy Sav Tun 4: Tune-No Rotate2	0: Standard 1: Tune-No Rotate1 2: Stationary Auto-Tuning for Line-to-Line Resistance 3: Rotational Auto-Tuning for V/f Control Energy Saving 4: Tune-No Rotate2	Default: <1> Range: 0 to 4	–
T1-02 (0702)	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	–
T1-03 (0703)	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>	–
T1-04 (0704)	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	–
T1-05 (0705)	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.: 400.0	–
T1-06 (0706)	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	–
T1-07 (0707)	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.: 24000	–
T1-09 (0709)	Motor No-Load Current (Stationary Auto-Tuning)	Motor No-Load Current	OLV Sets the no-load current for the motor. After setting the motor capacity to T1-02 and the motor rated current to T1-04, this parameter will automatically display the no-load current for a standard 4-pole Yaskawa motor. Enter the no-load current as indicated on the motor test report.	Default: – Min.: 0 A Max.: T1-04	–
T1-10 (070A)	Motor Rated Slip (Stationary Auto-Tuning)	Motor Rated Slip	OLV Sets the motor rated slip. After setting the motor capacity to T1-02, this parameter will automatically display the motor slip for a standard 4-pole Yaskawa motor. Enter the motor slip as indicated on the motor test report.	Default: – Min.: 0.00 Hz Max.: 20.00 Hz	–
T1-11 (070B)	Motor Iron Loss	Mtr Iron Loss(W)	V/f 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	–

<1> Default depends on parameter A1-02, Control Mode Selection.
Setting 0 (V/f): Default is 2.
Setting 2 (OLV): Default is 0

<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. Multiply the value by 2.875 for 600 V class drives.

<4> Default setting value differs depending on the motor code value and motor parameter settings.

B.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 (0040)	Frequency Reference	Frequency Ref	Monitors the frequency reference. Display units are determined by o1-03.	10 V: Max frequency	0.01 Hz
U1-02 (0041)	Output Frequency	Output Freq	Displays the output frequency. Display units are determined by o1-03.	10 V: Max frequency	0.01 Hz
U1-03 (0042)	Output Current	Output Current	Displays the output current.	10 V: Drive rated current	<1> <2>
U1-04 (0043)	Control Method	Control Method	0: V/f Control 2: OLV Control	No signal output available	–
U1-05 (0044)	Motor Speed	Motor Speed	OLV Displays the motor speed feedback. Display units are determined by o1-03.	10 V: Max frequency	0.01 Hz
U1-06 (0045)	Output Voltage Reference	Output Voltage	Displays the output voltage.	10 V: 200 Vrms <3>	0.1 Vac
U1-07 (0046)	DC Bus Voltage	DC Bus Voltage	Displays the DC bus voltage.	10 V: 400 V <3>	1 Vdc
U1-08 (0047)	Output Power	Output kWatts	Displays the output power (this value is calculated internally).	10 V: Drive capacity (motor capacity) kW	<4>
U1-09 (0048)	Torque Reference	Torque Reference	OLV Monitors the internal torque reference.	10 V: Motor rated torque	0.1%
U1-10 (0049)	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) 1 Digital input 8 (terminal S8 enabled)	No signal output available	–
U1-11 (004A)	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 MD-ME-MF) 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 (004B)	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 (004E)	Terminal A1 Input Level	Term A1 Level	Displays the signal level to analog input terminal A1.	10 V: 100%	0.1%
U1-14 (004F)	Terminal A2 Input Level	Term A2 Level	Displays the signal level to analog input terminal A2.	10 V: 100%	0.1%
U1-15 (0050)	Terminal A3 Input Level	Term A3 Level	Displays the signal level to analog input terminal A3.	10 V: 100%	0.1%
U1-16 (0053)	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 (0061)	oPE Fault Parameter	OPE Error Code	Displays the parameter number that caused the oPE02 operation error.	No signal output available	–
U1-19 (0066)	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	–
U1-24 (007D)	Input Pulse Monitor	Term RP Inp Freq	Displays the frequency to pulse train input terminal RP.	Determined by H6-02	1 Hz
U1-25 (004D)	Software Number (Flash)	CPU 1 SW Number	FLASH ID	No signal output available	–
U1-26 (005B)	Software No. (ROM)	CPU 2 SW Number	ROM ID	No signal output available	–
U1-75 (0851)	Time-Hour/Minute	Time Hr Min HHMM	Displays the current time (Hours and Minutes).	No signal output available	–
U1-76 (0852)	Date – Year	Date Year	Displays the current year.	No signal output available	–
U1-77 (0853)	Date – Month/Day	Date Mo Day MMDD	Displays the current date (Month and Date).	No signal output available	–
U1-78 (0854)	Date – Week Day	Date Week	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	–
U1-80 (0B9B)	Geothermal Temperature Input	Geothermal Temp	Displays the geothermal temperature input after the gain and bias have been applied. This temperature is used by the Geothermal Function to determine the proper frequency at which to run the drive. This monitor is internally limited to -999.9 °F to +999.9 °F.	No signal output available	0.1 °F

No. (Addr. Hex)	Name	LCD Display	Description	Analog Output Level	Unit
U1-83 (0B9E)	Flow Rate	Flow Rate	Displays the flow rate based on the pulse input frequency or the analog voltage (flow rate input) and parameters P6-01 and P6-04. A 2-second first order filter will be applied to this monitor.	Full scale: P6-01 setting	dep. on P6-04
U1-84 (0B9F)	Accumulation Level - Millions	Volume * 1000000	Displays the recorded volume from the flow meter (pulse input or analog voltage). Total volume is calculated as follows: Total Volume = (U1-84 * 1000000) + (U1-85 * 1000) + U1-86 + U1-87	No signal output available	dep. on P6-16
U1-85 (0BA0)	Accumulation Level - Thousands	Volume * 1000			
U1-86 (0BA1)	Accumulation Level - Ones	Volume * 1			
U1-87 (0BA2)	Accumulation Level - Decimal	Volume * 0.0001			
U1-90 (0BA5)	Pump Setpoint	Pump Setpoint	Displays the PID Setpoint.	No signal output available	dep. on P1-02
U1-91 (0BA6)	Pump Feedback	Pump Feedback	Displays the PID Feedback.	No signal output available	dep. on P1-02
U1-92 (0BA7)	Pump Status	Pump Status	Displays Pump Running Status. U1-92=00000000 1 Drive 1 Pump 2 1 Pump 3 1 Pump 4 1 Pump 5 1 Pump 6 0 Not used 0 Not used	No signal output available	–
U1-93 (0BA8)	Total Setpoint Compensation	Total SP Comp.	Displays the total absolute Setpoint Compensation.	No signal output available	dep. on P1-02
U1-94 (0BA9)	Motor Speed	Motor Speed	Displays the absolute value of the output frequency (U1-02) converted to RPM.	No signal output available	1 RPM
U1-97 (0BAC)	Water Level	Water Level	Displays the amount of water above the water level sensor.	Full scale: 10 V = Q4-02	0.1 ft.
U1-98 (0BAD)	Suction Pressure	Suction Pressure	Displays the amount of suction pressure.	Full scale: 10 V = Q5-02	0.1 PSI or ”Hg
U1-99 (0BAE)	Anti-No-Flow Timer	ANF Timer	The Anti-No-Flow reduces the output frequency when this value reaches the P2-24 setting.	No signal output available	0.1 s

<1> The number of decimal places in the parameter value depends on the drive model and the ND selection. 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. Multiply the value by 2.875 for 600 V class drives.

<4> The display resolution depends on the ND selection. 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 (0080)	Current Fault	Current Fault	Displays the current fault.	No signal output available	–
U2-02 (0081)	Previous Fault	Last Fault	Displays the previous fault.	No signal output available	–
U2-03 (0082)	Frequency Reference at Previous Fault	Frequency Ref	Displays the frequency reference at the previous fault.	No signal output available	0.01 Hz

No. (Addr. Hex)	Name	LCD Display	Description	Analog Output Level	Unit
U2-04 (0083)	Output Frequency at Previous Fault	Output Freq	Displays the output frequency at the previous fault.	No signal output available	0.01 Hz
U2-05 (0084)	Output Current at Previous Fault	Output Current	Displays the output current at the previous fault.	No signal output available	<1> <2>
U2-07 (0086)	Output Voltage at Previous Fault	Output Voltage	Displays the output voltage at the previous fault.	No signal output available	0.1 Vac
U2-08 (0087)	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 (0088)	Output Power at Previous Fault	Output kWatts	Displays the output power at the previous fault.	No signal output available	0.1 kW
U2-10 (0089)	Torque Reference at Previous Fault	Torque Reference	OLV Displays the torque reference at the previous fault.	No signal output available	0.1%
U2-11 (008A)	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 (008B)	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 (008C)	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 (008D)	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 (07E0)	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 (07E1)	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 (07E2)	Motor d-Axis Current at Previous Fault	Motor Id Current	OLV Displays the d-axis current for the motor at the previous fault.	No signal output available	0.10%
U2-20 (008E)	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> The number of decimal places in the parameter value depends on the drive model and the ND selection. 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 (0800 to 0803))	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 (0804 to 0809)	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	–

No. (Addr. Hex)	Name	LCD Display	Description	Analog Output Level	Unit
U3-11 to U3-14 (94 to 97 (080A to 080D))	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
U3-15 to U3-20 (080E to 0813)	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 sixth most 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 seventh most 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	–

No. (Addr. Hex)	Name	LCD Display	Description	Analog Output Level	Unit
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	–
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 (004C)	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 (0075)	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 (0067)	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 (007E)	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. Replace the fan when this monitor reaches 90%.	No signal output available	1%
U4-05 (007C)	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. Replace the capacitor when this monitor reaches 90%.	No signal output available	1%
U4-06 (07D6)	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. Replace the soft charge bypass relay when this monitor reaches 90%.	No signal output available	1%
U4-07 (07D7)	IGBT Maintenance	IGBT Life Mon	Displays IGBT usage time as a percentage of the expected performance life. Parameter o4-09 can be used to reset this monitor. Replace the IGBT when this monitor reaches 90%.	No signal output available	1%
U4-08 (0068)	Heatsink Temperature	Heatsink Temp	Displays the heatsink temperature.	10 V: 100 °C	1 °C
U4-09 (005E)	LED Check	LED Oper Check	Lights all segments of the LED to verify that the display is working properly. Press the ENTER key to turn the LEDs on and press ESC to turn the LEDs off.	No signal output available	–

No. (Addr. Hex)	Name	LCD Display	Description	Analog Output Level	Unit
U4-10 (005C)	kWh, Lower 4 Digits	kWh Lower 4 dig	Monitors the drive output power usage (or consumption). 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 (005D)	kWh, Upper 5 Digits	kWh Upper 5 dig		No signal output available	1 MWh
U4-13 (07CF)	Peak Hold Current	Current PeakHold	Displays the highest current value that occurred during run.	No signal output available	0.01 A <1>
U4-14 (07D0)	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 (07D8)	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%
U4-18 (07DA)	Frequency Reference Source Selection	Reference Source	Displays the source for the frequency reference as XY-nn. **X: indicates which reference is used:** 1 = Reference 1 (b1-01) **Y-nn: indicates the reference source** 0-01 = Digital operator 1-01 = Analog (terminal A1) 1-02 = Analog (terminal A2) 1-03 = Analog (terminal A3) 2-02 to 17 = Multi-step speed (d1-02 to 17) 3-01 = MEMOBUS/Modbus communications 4-01 = Communication option card 5-01 = Pulse input	No signal output available	–
U4-19 (07DB)	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 (07DC)	Option Frequency Reference	Option Freq Ref	Displays the frequency reference input by an option card (decimal).	No signal output available	–
U4-21 (07DD)	Run Command Source Selection	Run Cmd Source	Displays the source for the Run command as XY-nn. **X: Indicates which Run source is used:** 1 = Reference 1 (b1-02) **Y: Input power supply data** 0 = Digital operator 1 = External terminals 3 = MEMOBUS/Modbus communications 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, digital operator) 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 (07DE)	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 (07DF)	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	–
U4-32 (07FB)	Motor Temperature (NTC)	Motor Temperature (NTC)	Displays the motor temperature (NTC). U4-32 will display "20 °C" when a multi-function analog input is not set for motor thermistor input (H1-□□ = 17H). Monitor is only present when a digital input is programmed for 17 (Thermistor Input).	200 °C	1 °C

<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: PID Monitors

No. (Addr. Hex)	Name	LCD Display	Description	Analog Output Level	Unit
U5-01 (0057)	PID Feedback 1	PID Feedback 1	Displays the PID feedback value.	10 V: 100%	0.01% <1>
U5-02 (0063)	PID Input	PID Input	Displays the amount of PID input (deviation between PID setpoint and feedback).	10 V: 100%	0.01%
U5-03 (0064)	PID Output	PID Output	Displays PID control output.	10 V: 100%	0.01%
U5-04 (0065)	PID Setpoint	PID Setpoint	Displays the PID setpoint.	10 V: 100%	0.01% <1>
U5-05 (07D2)	PID Differential Feedback	PID Feedback 2	Displays the 2nd PID feedback value if differential feedback is used (H3-□□ = 16).	10 V: 100%	0.01%
U5-06 (07D3)	PID 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%
U5-14 (086B)	PI Output 2 Upper 4 Digits	PI Output2 U4	Displays the custom PI output. U5-14 shows the upper 4 digits while U5-15 shows the lower 4 digits. Monitors are scaled by b5-43 and b5-44.	No signal output available	1 <2>
U5-15 (086C)	PI Output 2 Lower 4 Digits	PI Output2 L4	Displays the custom PI output. U5-14 shows the upper 4 digits while U5-15 shows the lower 4 digits. Monitors are scaled by b5-43 and b5-44.	No signal output available	0.01 <2>
U5-17 (086E)	PI2 Setpoint	PI2 Setpoint	Displays the secondary PI setpoint.	Dependent upon S3-02	<3>
U5-18 (086F)	PI2 Feedback	PI2 Feedback	Displays the secondary PI feedback value.	Dependent upon S3-02	<3>
U5-19 (0870)	PI2 Input	PI2 Input	Displays the secondary PI input (deviation between PI target and feedback).	Dependent upon S3-02	<3>
U5-20 (0871)	PI2 Output	PI2 Output	Displays the secondary PI control output.	Dependent upon S3-02	<3>
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)	Date Week 000W	Date Week 0: Sunday 1: Monday 2: Tuesday 3: Wednesday 4: Thursday 5: Friday 6: Saturday	Displays the current date of the week. 0: Sunday 1: Monday 2: Tuesday 3: Wednesday 4: Thursday 5: Friday 6: Saturday	No signal output available	1
U5-99 (1599)	AUTO Setpoint	Auto Setpoint	Displays the PID Setpoint commanded by the source when the drive is in AUTO Mode.	No signal output available	0.01% <1>

<1> Unit, range and resolution is determined by b5-20, b5-38, b5-39, and b5-46

<2> Unit is determined by b5-41

<3> Unit is determined by S3-04.

◆ U6: Operation Status Monitors

No. (Addr. Hex)	Name	LCD Display	Description	Analog Output Level	Unit
U6-01 (0051)	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 (0052)	Motor Excitation Current (Id)	Mot EXC Current	OLV 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 (0059)	Output Voltage Reference (Vq)	Voltage Ref (Vq)	OLV Output voltage reference (Vq) for the q-Axis.	10 V: 200 Vrms <1>	0.1 Vac
U6-06 (005A)	Output Voltage Reference (Vd)	Voltage Ref (Vd)	OLV Output voltage reference (Vd) for the d-Axis.	10 V: 200 Vrms <1>	0.1 Vac
U6-07 (005F)	q-Axis ACR Output	ACR(q) Output	OLV Displays the output value for current control relative to motor secondary current (q-Axis).	10 V: 200 Vrms <1>	0.1%
U6-08 (0060)	d-Axis ACR Output	ACR(d) Output	OLV Displays the output value for current control relative to motor secondary current (d-Axis).	110 V: 200 Vrms <1>	0.1%

<1> Values shown are specific to 200 V class drives. Double the values for 400 V class drives. Multiply the values by 2.875 for 600 V class drives.

Note: Fault histories are not kept when CPF00, CPF01, CPF06, CPF24, oFA00, oFb00, oFC00, Uv1, Uv2, or Uv3 occur.

◆ U7: CASE Monitors

No. (Addr. Hex)	Name	LCD Display	Description	Analog Output Level	Unit
U7-01 (0051)	CASE Software Number	CASE Software #	Displays the CASE software version number.	No signal output available	–

◆ U9: Operation Status Monitors

No. (Addr. Hex)	Name	LCD Display	Description	Analog Output Level	Unit
U9-01 (1901)	Network PI Feedback	Net PI Feedback	Displays the network PI feedback recognized by the iQpump MEMOBUS network.	No signal output available	Dep. on P1-02
U9-02 (1902)	Network Activity	iQ Net Activity	Displays network traffic. A fluctuating number from 0 to 10000 denotes activity, while a relatively constant 0 denotes no activity.	No signal output available	<1>
U9-03 (1903)	Time to Alternate	Time to Alternate	Displays the time remaining before a drive requests the alternation mode set in P9-04.	No signal output available	min
U9-04 (1904)	Running Queue Number	Running Queue No	Displays the position in the iQPump MEMOBUS Multiplex running queue.	No signal output available	–

<1> Unit changes based on network status.
<->: Drive cannot communicate to other drives
<+>: Drive is a node on a network
<M>: Drive is the master on an iQpump network.

Appendix: C

Standards Compliance

This appendix explains the guidelines and criteria for maintaining CE and UL standards.

C.1 European Standards

Figure C.1 CE Mark

The CE mark indicates compliance with European safety and environmental regulations. It is required for engaging in business and commerce in Europe.

European standards include the Machinery Directive for machine manufacturers, the Low Voltage Directive for electronics manufacturers, and the EMC guidelines for controlling noise.

This drive displays the CE mark based on the EMC guidelines and the Low Voltage Directive.

- **Low Voltage Directive:** 2006/95/EC
- **EMC Guidelines:** 2004/108/EC

Devices used in combination with this drive must also be CE certified and display the CE mark. When using drives displaying the CE mark in combination with other devices, it is ultimately the responsibility of the user to ensure compliance with CE standards. After setting up the device, verify that conditions meet European standards.

Note: 600 V class drives (models 5□□□□□□) are not compliant with European Standards.

◆ CE Low Voltage Directive Compliance

This drive has been tested according to European standard IEC61800-5-1, and it fully complies with the Low Voltage Directive.

To comply with the Low Voltage Directive, be sure to meet the following conditions when combining this drive with other devices:

■ Area of Use

Do not use drives in areas with pollution higher than severity 2 and overvoltage category 3 in accordance with IEC664.

■ Factory Recommended Branch Circuit Protection

Yaskawa recommends installing one of the following types of branch circuit protection to maintain compliance with UL508C. Semiconductor protective type fuses are preferred. Alternate branch circuit protection devices are also listed in *Table C.1*.

NOTICE: *If a fuse is blown or a Ground Fault Circuit Interrupter (GFCI) is tripped, check the wiring and the selection of peripheral devices to identify the cause. Contact Yaskawa before restarting the drive or the peripheral devices if the cause cannot be identified.*

Table C.1 Factory Recommended Drive Branch Circuit Protection

Drive Model	Fuse Type	
	Manufacturer: Bussmann	
	Model	Fuse Ampere Rating (A)
Three-Phase 200 V Class		
2A0004	FWH-70B	70
2A0006	FWH-70B	70
2A0008	FWH-70B	70
2A0010	FWH-70B	70
2A0012	FWH-70B	70
2A0018	FWH-90B	90
2A0021	FWH-90B	90
2A0030	FWH-100B	100
2A0040	FWH-200B	200
2A0056	FWH-200B	200
2A0069	FWH-200B	200
2A0081	FWH-300A	300
2A0110	FWH-300A	300
2A0138	FWH-350A	350

Drive Model	Fuse Type	
	Manufacturer: Bussmann	
	Model	Fuse Ampere Rating (A)
2A0169	FWH-400A	400
2A0211	FWH-400A	400
2A0250	FWH-600A	600
2A0312	FWH-700A	700
2A0360	FWH-800A	800
2A0415	FWH-1000A	1000
Three-Phase 400 V Class		
4A0002	FWH-40B	40
4A0004	FWH-50B	50
4A0005	FWH-70B	70
4A0007	FWH-70B	70
4A0009	FWH-90B	90
4A0011	FWH-90B	90
4A0018	FWH-80B	80
4A0023	FWH-100B	100
4A0031	FWH-125B	125
4A0038	FWH-200B	200
4A0044	FWH-250A	250
4A0058	FWH-250A	250
4A0072	FWH-250A	250
4A0088	FWH-250A	250
4A0103	FWH-250A	250
4A0139	FWH-350A	350
4A0165	FWH-400A	400
4A0208	FWH-500A	500
4A0250	FWH-600A	600
4A0296	FWH-700A	700
4A0362	FWH-800A	800
4A0414	FWH-800A	800
4A0515	FWH-1000A	1000
4A0675	FWH-1200A	1200
Three-Phase 600 V Class		
5A0003 <1>	FWP-50B	50
5A0004 <1>	FWP-50B	50
5A0006 <1>	FWP-60B	60
5A0009 <1>	FWP-60B	60
5A0011 <1>	FWP-70B	70
5A0017 <1>	FWP-100B	100
5A0022 <1>	FWP-100B	100
5A0027 <1>	FWP-125A	125
5A0032 <1>	FWP-125A	125
5A0041 <1>	FWP-175A	175
5A0052 <1>	FWP-175A	175
5A0062 <1>	FWP-250A	250
5A0077 <1>	FWP-250A	250
5A0099 <1>	FWP-250A	250

Drive Model	Fuse Type	
	Manufacturer: Bussmann	
	Model	Fuse Ampere Rating (A)
5A0125 <1>	FWP-350A	350
5A0145 <1>	FWP-350A	350
5A0192 <1>	FWP-600A	600
5A0242 <1>	FWP-600A	600

<1> 600 V class drives are not compliant with European Standards.

■ Guarding Against Harmful Materials

When installing IP00/Open Type enclosure drives, use an enclosure that prevents foreign material from entering the drive from above or below.

■ Grounding

The drive is designed to be used in T-N (grounded neutral point) networks. If installing the drive in other types of grounded systems, contact your Yaskawa representative for instructions.

◆ EMC Guidelines Compliance

This drive is tested according to European standards EN61800-3: 2004.

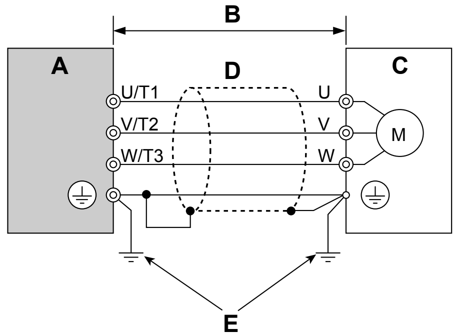
■ EMC Filter Installation

The following conditions must be met to ensure continued compliance with guidelines. *Refer to EMC Filters on page 341* for EMC filter selection.

Installation Method

Verify the following installation conditions to ensure that other devices and machinery used in combination with this drive also comply with EMC guidelines.

1. Install an EMC noise filter to the input side specified by Yaskawa for compliance with European standards.
2. Place the drive and EMC noise filter in the same enclosure.
3. Use braided shield cable for the drive and motor wiring, or run the wiring through a metal conduit.
4. Keep wiring as short as possible. Ground the shield on both the drive side and the motor side.

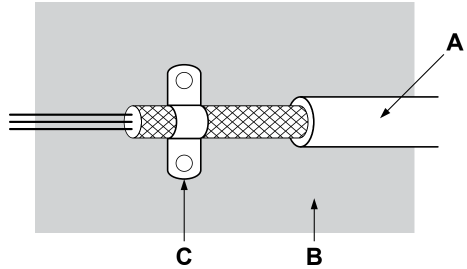


A – Drive
B – 10 m max cable length between drive and motor
C – Motor
D – Metal conduit
E – Ground wire should be as short as possible.

Figure C.2 Installation Method

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

WARNING! *Electrical Shock Hazard. Because the leakage current exceeds 3.5 mA in models 4A0414 to 4A1200, 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 mm² (Cu) or 16 mm² (Al) must be used. Failure to comply may result in death or serious injury.*

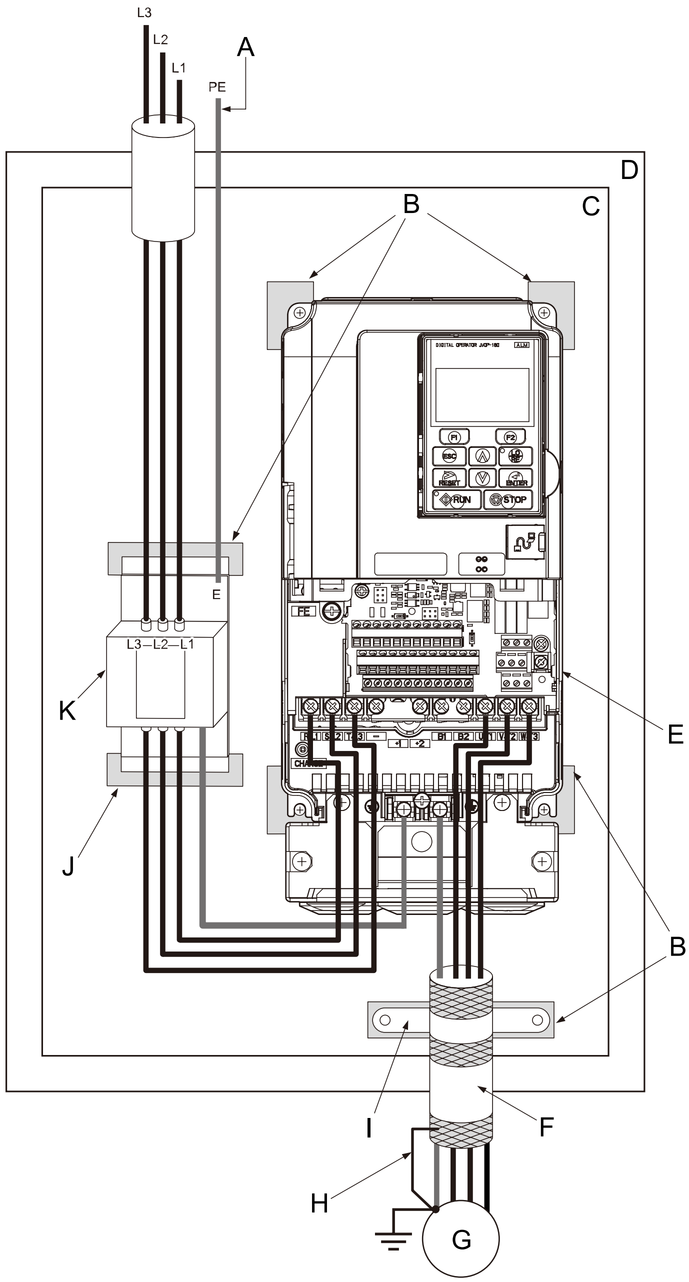


A – Braided shield cable
B – Metal panel
C – Cable clamp (conductive)

Figure C.3 Ground Area

6. Connect a DC link choke to minimize harmonic distortion. *Refer to DC Link Chokes for EN 61000-3-2 Compliance on page 342*.

Three-Phase 200 V / 400 V Class



A – Make sure the ground wire is grounded
B – Grounding surface (remove any paint or sealant)
C – Metal plate
D – Enclosure panel
E – Drive
F – Motor cable (braided shield cable, max. 10 m)
G – Motor
H – Cable shield ground
I – Cable clamp
J – Ground plate (scrape off any visible paint)
K – EMC noise filter

Figure C.4 EMC Filter and Drive Installation for CE Compliance (Three-Phase 200 V / 400 V Class)

■ EMC Filters

Install the drive with the EMC filters listed in ***Table C.2*** to comply with the EN61800-3 requirements.

Table C.2 EN61800-3 Filters

Drive Model	Filter Data (Manufacturer: Schaffner)					
	Type	Rated Current (A)	Weight (lb)	Dimensions [W x D x H] (in)	Y x X (in)	Figure
Three-Phase 200 V Class						
2A0004	FS5972-10-07	10	2.6	5.6 × 1.8 × 13.0	4.5 × 12.3	1
2A0006						
2A0008						
2A0010	FS5972-18-07	18	2.9	5.6 × 1.8 × 13.0	4.5 × 12.3	
2A0012						
2A0018	FS5972-35-07	35	4.6	8.1 × 2.0 × 14.0	6.9 × 13.2	
2A0021						
2A0030						
2A0040	FS5972-60-07	60	8.8	9.3 × 2.6 × 16.1	8.1 × 15.4	
2A0056						
2A0069	FS5972-100-35	100	7.5	3.5 × 5.9 × 13.0	2.6 × 10.0	2
2A0081						
2A0110	FS5972-170-40	170	13.2	4.7 × 6.7 × 17.8	4.0 × 14.4	
2A0138						
2A0169	FS5972-250-37	250	25.8	5.1 × 9.5 × 24.0	3.5 × 19.6	
2A0211						
2A0250	FS5972-410-99	410	23.1	10.2 × 4.5 × 15.2	9.3 × 4.7	3
2A0312						
2A0360	FS5972-600-99	600	24.3	10.2 × 5.3 × 15.2	9.3 × 4.7	
2A0415						
Three-Phase 400 V Class						
4A0002	FS5972-10-07	10	2.7	5.6 × 1.8 × 13.0	4.5 × 12.3	1
4A0004						
4A0005						
4A0007						
4A0009	FS5972-18-07	18	2.9	5.6 × 1.8 × 13.0	4.5 × 12.3	
4A0011						
4A0018	FS5972-35-07	35	4.6	8.1 × 2.0 × 14.0	6.9 × 13.2	
4A0023						
4A0031						
4A0038	FS5972-60-07	60	8.8	9.3 × 2.6 × 16.1	8.0 × 15.4	
4A0044						
4A0058						
4A0072	FS5972-100-35	100	16.5	3.5 × 5.9 × 13.0	2.6 × 10.0	2
4A0088						
4A0103	FS5972-170-35	170	10.4	4.7 × 6.7 × 17.8	4.0 × 14.4	
4A0139						
4A0165						
4A0208	FS5972-250-37	250	25.8	5.1 × 9.5 × 24.0	3.5 × 19.6	
4A0250	FS5972-410-99	410	23.1	10.2 × 4.5 × 15.2	9.3 × 4.7	3
4A0296						
4A0362						
4A0414	FS5972-600-99	600	24.3	10.2 × 5.3 × 15.2	9.3 × 4.7	
4A0515						
4A0675	FS5972-800-99	800	69.4	11.8 × 6.3 × 28.2	10.8 × 8.3	

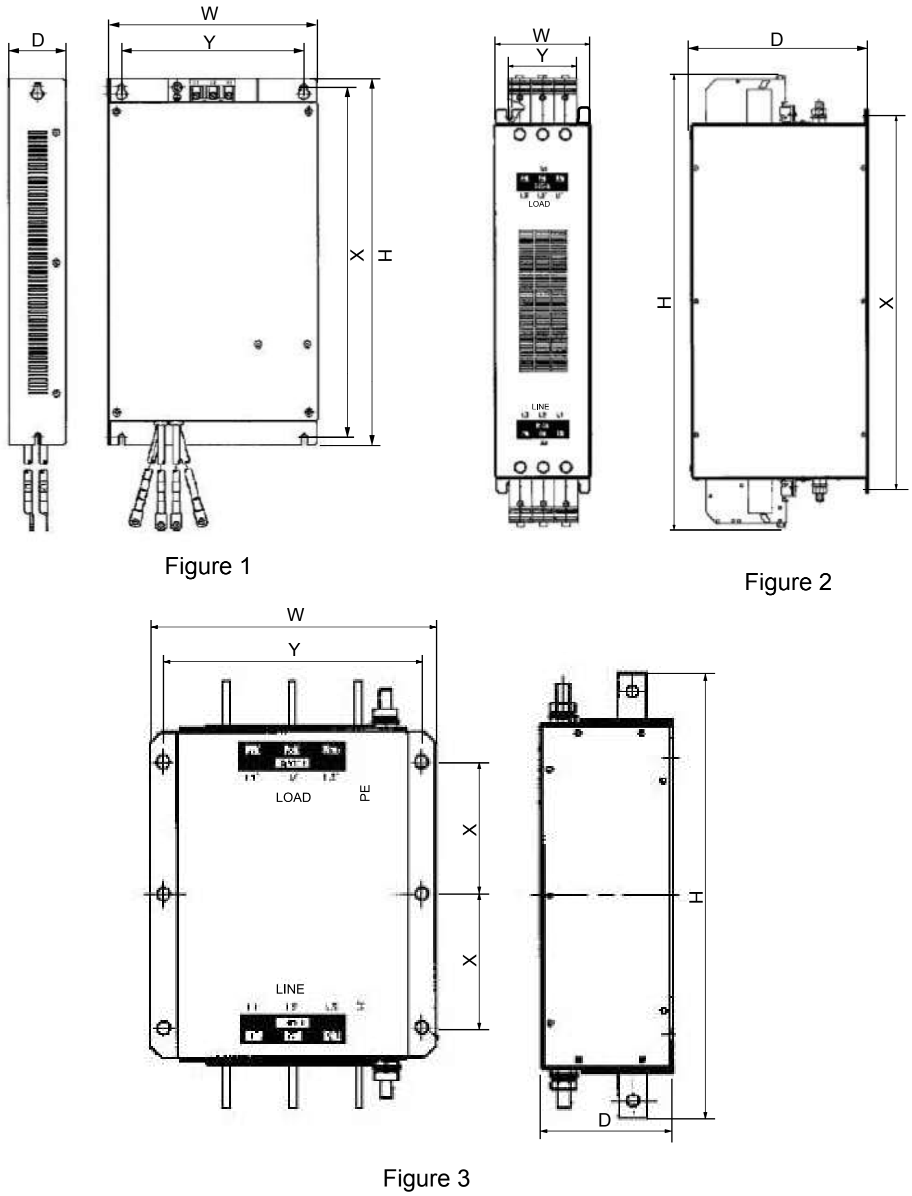


Figure C.5 EMC Filter Dimensions

■ DC Link Chokes for EN 61000-3-2 Compliance

Table C.3 DC Link Chokes for Harmonic Reduction

Drive Model	DC Link Chokes	
	Model	Rating
200 V Three-Phase Units		
2A0004	UZDA-B	5.4 A 8 mH
2A0006		
400 V Three-Phase Units		
4A0002	UZDA-B	3.2 A 28 mH
4A0004		

Note: DC link chokes are not required for other models to comply with EMC.

C.2 UL and CSA Standards

◆ UL Standards Compliance

The UL/cUL mark applies to products in the United States and Canada. It indicates that UL has performed product testing and evaluation, and determined that their stringent standards for product safety have been met. For a product to receive UL certification, all components inside that product must also receive UL certification.

Figure C.6 UL/cUL Mark

This drive is tested in accordance with UL standard UL508C and complies with UL requirements. The conditions described below must be met to maintain compliance when using this drive in combination with other equipment:

■ Installation Area

Do not install the drive to an area greater than pollution degree 2 (UL standard).

■ Main Circuit Terminal Wiring

Yaskawa recommends using closed-loop crimp terminals on all drive models. To maintain UL/cUL approval, UL-Listed closed-loop crimp terminals are specifically required when wiring the drive main circuit terminals on models 2A0110 to 2A0415, 4A0058 to 4A0675, and 5A0041 to 5A0242. Use only the tools recommended by the terminal manufacturer for crimping. ***Refer to Closed-Loop Crimp Terminal Size on page 343*** for closed-loop crimp terminal recommendations.

Closed-Loop Crimp Terminal Recommendations

Yaskawa recommends crimp terminals made by JST and Tokyo DIP (or equivalent) for the insulation cap. ***Table C.4*** matches the wire gauges and terminal screw sizes with Yaskawa-recommended crimp terminals, tools, and insulation caps. Refer to the appropriate Wire Gauge and Torque Specifications table for the wire gauge and screw size for your drive model. Place orders with a Yaskawa representative or the Yaskawa sales department.

The closed-loop crimp terminal sizes and values listed in ***Table C.4*** are Yaskawa recommendations.

Wire gauge values shown in ***bold italic*** are the recommended values. Refer to local codes for proper selections.

Table C.4 Closed-Loop Crimp Terminal Size

<table>
<tr><th rowspan="2">Drive Model</th><th colspan="2">Wire Gauge (AWG, kcmil)</th><th rowspan="2">Screw Size</th><th rowspan="2">Crimp Terminal Model Number</th><th colspan="2">Tool</th><th rowspan="2">Insulation Cap Model No.</th><th rowspan="2">Code <1></th></tr>
<tr><th>R/L1, S/L2, T/L3</th><th>U/T1, V/T2, W/T3</th><th>Machine No.</th><th>Die Jaw</th></tr>
<tr><td colspan="9">200 V Class</td></tr>
<tr><td rowspan="3">2A0004
2A0006
2A0008
2A0010</td><td colspan="2">***14***</td><td rowspan="3">M4</td><td>R2-4</td><td rowspan="3">YA-4</td><td rowspan="3">AD-900</td><td>TP-003</td><td>100-054-028</td></tr>
<tr><td colspan="2">12</td><td rowspan="2">R5.5-4</td><td rowspan="2">TP-005</td><td rowspan="2">100-054-029</td></tr>
<tr><td colspan="2">10</td></tr>
<tr><td rowspan="3">2A0012</td><td>14</td><td>***14***</td><td rowspan="3">M4</td><td>R2-4</td><td rowspan="3">YA-4</td><td rowspan="3">AD-900</td><td>TP-003</td><td>100-054-028</td></tr>
<tr><td>***12***</td><td>12</td><td rowspan="2">R5.5-4</td><td rowspan="2">TP-005</td><td rowspan="2">100-054-029</td></tr>
<tr><td colspan="2">10</td></tr>
<tr><td rowspan="3">2A0018</td><td>–</td><td>14</td><td rowspan="3">M4</td><td>R2-4</td><td rowspan="3">YA-4</td><td rowspan="3">AD-900</td><td>TP-003</td><td>100-054-028</td></tr>
<tr><td colspan="2">12</td><td rowspan="2">R5.5-4</td><td rowspan="2">TP-005</td><td rowspan="2">100-054-029</td></tr>
<tr><td colspan="2">***10***</td></tr>
<tr><td rowspan="2">2A0021</td><td colspan="2">12</td><td rowspan="2">M4</td><td rowspan="2">R5.5-4</td><td rowspan="2">YA-4</td><td rowspan="2">AD-900</td><td rowspan="2">TP-005</td><td rowspan="2">100-054-029</td></tr>
<tr><td colspan="2">***10***</td></tr>
<tr><td rowspan="3">2A0030</td><td colspan="2">10</td><td rowspan="3">M4</td><td>R5.5-4</td><td rowspan="3">YA-4</td><td>AD-900</td><td>TP-005</td><td>100-054-029</td></tr>
<tr><td colspan="2">***8***</td><td>8-4</td><td>AD-901</td><td>TP-008</td><td>100-054-031</td></tr>
<tr><td colspan="2">6</td><td>14-NK4</td><td>AD-902</td><td>TP-014</td><td>100-054-033</td></tr>
</table>

<table>
<tr><th rowspan="2">Drive Model</th><th colspan="2">Wire Gauge (AWG, kcmil)</th><th rowspan="2">Screw Size</th><th rowspan="2">Crimp Terminal Model Number</th><th colspan="2">Tool</th><th rowspan="2">Insulation Cap Model No.</th><th rowspan="2">Code <1></th></tr>
<tr><th>R/L1, S/L2, T/L3</th><th>U/T1, V/T2, W/T3</th><th>Machine No.</th><th>Die Jaw</th></tr>
<tr><td rowspan="2">2A0040</td><td>8</td><td>***8***</td><td rowspan="2">M4</td><td>8-4</td><td rowspan="2">YA-4</td><td>AD-901</td><td>TP-008</td><td>100-054-031</td></tr>
<tr><td>***6***</td><td>6</td><td>14-NK4</td><td>AD-902</td><td>TP-014</td><td>100-054-033</td></tr>
<tr><td rowspan="2">2A0056</td><td colspan="2">6</td><td rowspan="2">M6</td><td>R14-6</td><td rowspan="2">YA-5</td><td>AD-952</td><td>TP-014</td><td>100-051-261</td></tr>
<tr><td colspan="2">***4***</td><td>R22-6</td><td>AD-953</td><td>TP-022</td><td>100-051-262</td></tr>
<tr><td rowspan="2">2A0069</td><td colspan="2">4</td><td rowspan="2">M8</td><td>R22-8</td><td rowspan="2">YA-5</td><td>AD-953</td><td>TP-022</td><td>100-051-263</td></tr>
<tr><td colspan="2">***3***</td><td>R38-8</td><td>AD-954</td><td>TP-038</td><td>100-051-264</td></tr>
<tr><td rowspan="2">2A0081</td><td colspan="2">3</td><td rowspan="2">M8</td><td rowspan="2">R38-8</td><td rowspan="2">YA-5</td><td rowspan="2">AD-954</td><td rowspan="2">TP-038</td><td rowspan="2">100-051-264</td></tr>
<tr><td colspan="2">***2***</td></tr>
<tr><td rowspan="4">2A0110</td><td colspan="2">3</td><td rowspan="4">M8</td><td rowspan="3">R38-8</td><td rowspan="3">YA-5</td><td rowspan="3">AD-954</td><td rowspan="3">TP-038</td><td rowspan="3">100-051-264</td></tr>
<tr><td colspan="2">2</td></tr>
<tr><td colspan="2">1</td></tr>
<tr><td colspan="2">***1/0***</td><td>R60-8</td><td>YA-5</td><td>AD-955</td><td>TP-060</td><td>100-051-265</td></tr>
<tr><td rowspan="3">2A0138</td><td colspan="2">1</td><td rowspan="3">M10</td><td>R38-10</td><td rowspan="3">YF-1
YET-300-1</td><td rowspan="2">TD-321,
TD-311</td><td rowspan="2">TP-060</td><td>100-061-114</td></tr>
<tr><td colspan="2">1/0</td><td>R60-10</td><td>100-051-266</td></tr>
<tr><td colspan="2">***2/0***</td><td>70-10</td><td>TD-323,
TD-312</td><td>TP-080</td><td>100-054-036</td></tr>
<tr><td rowspan="3">2A0169</td><td>2/0</td><td>–</td><td rowspan="3">M10</td><td>70-10</td><td rowspan="3">YF-1
YET-300-1</td><td rowspan="2">TD-323,
TD-312</td><td rowspan="2">TP-080</td><td>100-054-036</td></tr>
<tr><td colspan="2">3/0</td><td>80-10</td><td>100-051-267</td></tr>
<tr><td colspan="2">***4/0***</td><td>R100-10</td><td>TD-324,
TD-312</td><td>TP-100</td><td>100-051-269</td></tr>
<tr><td rowspan="2">2A0211</td><td colspan="2">***1/0 × 2P***</td><td rowspan="2">M10</td><td>R60-10</td><td rowspan="2">YF-1
YET-300-1</td><td>TD-321,
TD-311</td><td>TP-060</td><td>100-051-266</td></tr>
<tr><td colspan="2">2/0 × 2P</td><td>70-10</td><td>TD-323,
TD-312</td><td>TP-080</td><td>100-054-036</td></tr>
<tr><td rowspan="5">2A0250</td><td colspan="2">***3/0 × 2P***</td><td rowspan="5">M12</td><td>80-L12</td><td rowspan="5">YF-1
YET-300-1</td><td>TD-323,
TD-312</td><td>TP-080</td><td>100-051-558</td></tr>
<tr><td colspan="2">4/0 × 2P</td><td>100-L12</td><td>TD-324,
TD-312</td><td>TP-100</td><td>100-051-560</td></tr>
<tr><td>–</td><td>250 × 2P</td><td>150-L12</td><td rowspan="3">TD-325,
TD-313</td><td>TP-150</td><td>100-051-562</td></tr>
<tr><td>250</td><td>–</td><td rowspan="2">R150-12</td><td rowspan="2">TP-150</td><td rowspan="2">100-051-273</td></tr>
<tr><td colspan="2">300</td></tr>
<tr><td rowspan="4">2A0312</td><td>3/0 × 2P</td><td>***3/0 × 2P***</td><td rowspan="4">M12</td><td>80-L12</td><td rowspan="4">YF-1
YET-300-1</td><td>TD-323,
TD-312</td><td>TP-080</td><td>100-051-558</td></tr>
<tr><td>***4/0 × 2P***</td><td>4/0 × 2P</td><td>100-L12</td><td>TD-324,
TD-312</td><td>TP-100</td><td>100-051-560</td></tr>
<tr><td colspan="2">250 × 2P</td><td rowspan="2">150-L12</td><td rowspan="2">TD-325,
TD-313</td><td rowspan="2">TP-150</td><td rowspan="2">100-051-562</td></tr>
<tr><td colspan="2">300 × 2P</td></tr>
<tr><td rowspan="7">2A0360</td><td>4/0 × 2P</td><td>***4/0 × 2P***</td><td rowspan="7">M12</td><td>100-L12</td><td rowspan="7">YF-1
YET-300-1</td><td>TD-324,
TD-312</td><td>TP-100</td><td>100-051-560</td></tr>
<tr><td>***250 × 2P***</td><td>250 × 2P</td><td rowspan="2">150-L12</td><td rowspan="2">TD-325,
TD-313</td><td rowspan="2">TP-150</td><td rowspan="2">100-051-562</td></tr>
<tr><td colspan="2">300 × 2P</td></tr>
<tr><td colspan="2">350 × 2P</td><td>180-L12</td><td rowspan="2">TD-327,
TD-314</td><td rowspan="2">TP-200</td><td>100-066-688</td></tr>
<tr><td colspan="2">400 × 2P</td><td>200-L12</td><td>100-051-564</td></tr>
<tr><td colspan="2">500 × 2P</td><td rowspan="2">325-12</td><td rowspan="2">TD-328,
TD-315</td><td rowspan="2">TP-325</td><td rowspan="2">100-051-277</td></tr>
<tr><td>600</td><td>600 × 2P</td></tr>
<tr><td rowspan="6">2A0415</td><td>250 × 2P</td><td>–</td><td rowspan="6">M12</td><td rowspan="2">150-L12</td><td rowspan="6">YF-1
YET-300-1</td><td rowspan="2">TD-325,
TD-313</td><td rowspan="2">TP-150</td><td rowspan="2">100-051-562</td></tr>
<tr><td>300 × 2P</td><td>***300 × 2P***</td></tr>
<tr><td>***350 × 2P***</td><td>350 × 2P</td><td>180-L12</td><td rowspan="2">TD-327,
TD-314</td><td rowspan="2">TP-200</td><td>100-066-688</td></tr>
<tr><td colspan="2">400 × 2P</td><td>200-L12</td><td>100-051-564</td></tr>
<tr><td colspan="2">500 × 2P</td><td rowspan="2">325-12</td><td rowspan="2">TD-328,
TD-315</td><td rowspan="2">TP-325</td><td rowspan="2">100-051-277</td></tr>
<tr><td colspan="2">600 × 2P</td></tr>
</table>

<table>
<tr><th rowspan="2">Drive Model</th><th colspan="2">Wire Gauge (AWG, kcmil)</th><th rowspan="2">Screw Size</th><th rowspan="2">Crimp Terminal Model Number</th><th colspan="2">Tool</th><th rowspan="2">Insulation Cap Model No.</th><th rowspan="2">Code <1></th></tr>
<tr><th>R/L1, S/L2, T/L3</th><th>U/T1, V/T2, W/T3</th><th>Machine No.</th><th>Die Jaw</th></tr>
<tr><th colspan="9">400 V Class</th></tr>
<tr><td rowspan="3">4A0002
4A0004
4A0005
4A0007
4A0009</td><td colspan="2">***14***</td><td rowspan="3">M4</td><td>R2-4</td><td rowspan="3">YA-4</td><td rowspan="3">AD-900</td><td>TP-003</td><td>100-054-028</td></tr>
<tr><td colspan="2">12</td><td rowspan="2">R5.5-4</td><td rowspan="2">TP-005</td><td rowspan="2">100-054-029</td></tr>
<tr><td colspan="2">10</td></tr>
<tr><td rowspan="3">4A0011</td><td>14</td><td>***14***</td><td rowspan="3">M4</td><td>R2-4</td><td rowspan="3">YA-4</td><td rowspan="3">AD-900</td><td>TP-003</td><td>100-054-028</td></tr>
<tr><td>***12***</td><td>12</td><td rowspan="2">R5.5-4</td><td rowspan="2">TP-005</td><td rowspan="2">100-054-029</td></tr>
<tr><td colspan="2">10</td></tr>
<tr><td rowspan="4">4A0018</td><td colspan="2">12</td><td rowspan="4">M4</td><td rowspan="2">R5.5-4</td><td rowspan="4">YA-4</td><td rowspan="2">AD-900</td><td rowspan="2">TP-005</td><td rowspan="2">100-054-029</td></tr>
<tr><td colspan="2">***10***</td></tr>
<tr><td colspan="2">8</td><td>8-4</td><td>AD-901</td><td>TP-008</td><td>100-054-031</td></tr>
<tr><td colspan="2">6</td><td>14-NK4</td><td>AD-902</td><td>TP-014</td><td>100-054-033</td></tr>
<tr><td rowspan="3">4A0023</td><td colspan="2">**10**</td><td rowspan="3">M4</td><td>R5.5-4</td><td rowspan="3">YA-4</td><td>AD-900</td><td>TP-005</td><td>100-054-029</td></tr>
<tr><td colspan="2">8</td><td>8-4</td><td>AD-901</td><td>TP-008</td><td>100-054-031</td></tr>
<tr><td colspan="2">6</td><td>14-NK4</td><td>AD-902</td><td>TP-014</td><td>100-054-033</td></tr>
<tr><td rowspan="3">4A0031</td><td>–</td><td>10</td><td rowspan="3">M5</td><td>R5.5-5</td><td rowspan="3">YA-4</td><td>AD-900</td><td>TP-005</td><td>100-054-030</td></tr>
<tr><td colspan="2">***8***</td><td>R8-5</td><td>AD-901</td><td>TP-008</td><td>100-054-032</td></tr>
<tr><td colspan="2">6</td><td>R14-5</td><td>AD-902</td><td>TP-014</td><td>100-054-034</td></tr>
<tr><td rowspan="2">4A0038</td><td>8</td><td>***8***</td><td rowspan="2">M5</td><td>R8-5</td><td rowspan="2">YA-4</td><td>AD-901</td><td>TP-008</td><td>100-054-032</td></tr>
<tr><td>***6***</td><td>6</td><td>R14-5</td><td>AD-902</td><td>TP-014</td><td>100-054-034</td></tr>
<tr><td rowspan="2">4A0044</td><td colspan="2">***6***</td><td rowspan="2">M6</td><td>R14-6</td><td rowspan="2">YA-5</td><td>AD-952</td><td>TP-014</td><td>100-051-261</td></tr>
<tr><td colspan="2">4</td><td>R22-6</td><td>AD-953</td><td>TP-022</td><td>100-051-262</td></tr>
<tr><td rowspan="2">4A0058</td><td colspan="2">6</td><td rowspan="2">M8</td><td>R14-8</td><td rowspan="2">YA-5</td><td>AD-952</td><td>TP-014</td><td>100-054-035</td></tr>
<tr><td colspan="2">**4**</td><td>R22-8</td><td>AD-953</td><td>TP-022</td><td>100-051-263</td></tr>
<tr><td rowspan="2">4A0072</td><td colspan="2">4</td><td rowspan="2">M8</td><td>R22-8</td><td rowspan="2">YA-5</td><td>AD-953</td><td>TP-022</td><td>100-051-263</td></tr>
<tr><td colspan="2">***3***</td><td>R38-8</td><td>AD-954</td><td>TP-038</td><td>100-051-264</td></tr>
<tr><td rowspan="4">4A0088</td><td colspan="2">3</td><td rowspan="4">M8</td><td rowspan="3">R38-8</td><td rowspan="4">YA-5</td><td rowspan="3">AD-954</td><td rowspan="3">TP-038</td><td rowspan="3">100-051-264</td></tr>
<tr><td colspan="2">***2***</td></tr>
<tr><td colspan="2">1</td></tr>
<tr><td colspan="2">1/0</td><td>R60-8</td><td>AD-955</td><td>TP-060</td><td>100-051-265</td></tr>
<tr><td rowspan="3">4A0103</td><td colspan="2">2</td><td rowspan="3">M8</td><td rowspan="2">R38-8</td><td rowspan="3">YA-5</td><td rowspan="2">AD-954</td><td rowspan="2">TP-038</td><td rowspan="2">100-051-264</td></tr>
<tr><td>1</td><td>***1***</td></tr>
<tr><td>***1/0***</td><td>1/0</td><td>R60-8</td><td>AD-955</td><td>TP-060</td><td>100-051-265</td></tr>
<tr><td rowspan="4">4A0139</td><td colspan="2">1/0</td><td rowspan="4">M10</td><td>R60-10</td><td rowspan="4">YF-1
YET-300-1</td><td>TD-321,
TD-311</td><td>TP-060</td><td>100-051-266</td></tr>
<tr><td>2/0</td><td>***2/0***</td><td>70-10</td><td rowspan="2">TD-323,
TD-312</td><td rowspan="2">TP-080</td><td>100-054-036</td></tr>
<tr><td>***3/0***</td><td>3/0</td><td>80-10</td><td>100-051-267</td></tr>
<tr><td colspan="2">4/0</td><td>R100-10</td><td>TD-324,
TD-312</td><td>TP-100</td><td>100-051-269</td></tr>
<tr><td rowspan="2">4A0165</td><td colspan="2">3/0</td><td rowspan="2">M10</td><td>80-10</td><td rowspan="2">YF-1
YET-300-1</td><td>TD-323,
TD-312</td><td>TP-080</td><td>100-051-267</td></tr>
<tr><td colspan="2">***4/0***</td><td>R100-10</td><td>TD-324,
TD-312</td><td>TP-100</td><td>100-051-269</td></tr>
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<tr><td colspan="2">4/0</td><td>R100-10</td><td>TD-228,
TD-214</td><td>TP-100</td><td>100-051-269</td></tr>
<tr><td colspan="2">250</td><td rowspan="2">R150-10</td><td rowspan="2">TD-229,
TD-215</td><td rowspan="2">TP-150</td><td rowspan="2">100-051-272</td></tr>
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<table>
<tr><th rowspan="2">Drive Model</th><th colspan="2">Wire Gauge (AWG, kcmil)</th><th rowspan="2">Screw Size</th><th rowspan="2">Crimp Terminal Model Number</th><th colspan="2">Tool</th><th rowspan="2">Insulation Cap Model No.</th><th rowspan="2">Code <1></th></tr>
<tr><th>R/L1, S/L2, T/L3</th><th>U/T1, V/T2, W/T3</th><th>Machine No.</th><th>Die Jaw</th></tr>
<tr><td rowspan="9">4A0250</td><td>1 × 2P</td><td>–</td><td rowspan="9">M10</td><td>38-L10</td><td rowspan="5">YF-1
YET-150-1</td><td>TD-224,
TD-212</td><td>TP-038</td><td>100-051-556</td></tr>
<tr><td colspan="2">3/0 × 2P</td><td>80-L10</td><td>TD-227,
TD-214</td><td>TP-080</td><td>100-051-557</td></tr>
<tr><td colspan="2">4/0 × 2P</td><td>100-L10</td><td>TD-228,
TD-214</td><td>TP-100</td><td>100-051-559</td></tr>
<tr><td colspan="2">250 × 2P</td><td>150-L10</td><td rowspan="2">TD-229,
TD-215</td><td>TP-150</td><td>100-051-561</td></tr>
<tr><td colspan="2">300</td><td>R150-10</td><td>TP-150</td><td>100-051-272</td></tr>
<tr><td colspan="2">350</td><td>180-10</td><td rowspan="4">YF-1
YET-300-1</td><td rowspan="2">TD-327,
TD-314</td><td rowspan="2">TP-200</td><td>100-066-687</td></tr>
<tr><td colspan="2">400</td><td>200-10</td><td>100-051-563</td></tr>
<tr><td colspan="2">500</td><td rowspan="2">325-10</td><td rowspan="2">TD-328,
TD-315</td><td rowspan="2">TP-325</td><td rowspan="2">100-051-565</td></tr>
<tr><td colspan="2">600</td></tr>
<tr><td rowspan="9">4A0296</td><td colspan="2">3/0 × 2P</td><td rowspan="9">M12</td><td>80-L12</td><td rowspan="9">YF-1
YET-300-1</td><td>TD-323,
TD-312</td><td>TP-080</td><td>100-051-558</td></tr>
<tr><td colspan="2">4/0 × 2P</td><td>100-L12</td><td>TD-324,
TD-312</td><td>TP-100</td><td>100-051-560</td></tr>
<tr><td colspan="2">250 × 2P</td><td rowspan="2">150-L12</td><td rowspan="2">TD-325,
TD-313</td><td rowspan="2">TP-150</td><td rowspan="2">100-051-562</td></tr>
<tr><td colspan="2">300 × 2P</td></tr>
<tr><td>–</td><td>350 × 2P</td><td>180-L12</td><td rowspan="3">TD-327,
TD-314</td><td rowspan="3">TP-200</td><td>100-066-688</td></tr>
<tr><td>350</td><td>–</td><td>180-12</td><td>100-066-689</td></tr>
<tr><td colspan="2">400</td><td>R200-12</td><td>100-051-275</td></tr>
<tr><td colspan="2">500</td><td rowspan="2">325-12</td><td rowspan="2">TD-328,
TD-315</td><td rowspan="2">TP-325</td><td rowspan="2">100-051-277</td></tr>
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YET-300-1</td><td>TD-324,
TD-312</td><td>TP-100</td><td>100-051-560</td></tr>
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TD-313</td><td rowspan="2">TP-150</td><td rowspan="2">100-051-562</td></tr>
<tr><td colspan="2">300 × 4P</td></tr>
</table>

<1> Codes refer to a set of three crimp terminals and three insulation caps. Prepare input and output wiring using two sets for each connection.
Example 1: Models with 300 kcmil for both input and output require one set for input terminals and one set for output terminals, so the user should order two sets of [100-051-272].
Example 2: Models with 4/0 AWG × 2P for both input and output require two sets for input terminals and two sets for output terminals, so the user should order four sets of [100-051-560].

Note: Use crimp insulated terminals or insulated shrink tubing for wiring connections. Wires should have a continuous maximum allowable temperature of 75 °C 600 Vac UL-approved vinyl-sheathed insulation.

Input Fuse Installation

Yaskawa recommends installing one of the following types of branch circuit protection to maintain compliance with UL508C. Semiconductor protective type fuses are preferred. Alternate branch circuit protection devices are also listed in *Table C.5*.

Table C.5 Factory Recommended AC Drive Branch Circuit Protection (Normal Duty)

Drive Model	Nominal Output Power HP	AC Drive Input Amps	MCCB Rating Amps <1>	Time Delay Fuse Rating Amps <2>	Non-time Delay Fuse Rating Amps <3>	Bussman Semi-conductor Fuse Rating (Fuse Ampere) <4>
200 V Class						
2A0004	0.75	3.9	15	6.25	10	FWH-70B (70)
2A0006	1 - 1.5	7.3	15	12	20	FWH-70B (70)
2A0008	2	8.8	15	15	25	FWH-70B (70)
2A0010	3	10.8	20	17.5	30	FWH-70B (70)
2A0012	3	13.9	25	20	40	FWH-70B (70)
2A0018	5	18.5	35	30	50	FWH-90B(90)
2A0021	7.5	24	45	40	70	FWH-90B(90)
2A0030	10	37	60	60	110	FWH-100B (100)
2A0040	15	52	100	90	150	FWH-200B (200)
2A0056	20	68	125	110	200	FWH-200B (200)
2A0069	25	80	150	125	225	FWH-200B (200)
2A0081	30	96	175	150	275	FWH-300A (300)
2A0110	40	111	200	175	300	FWH-300A (300)
2A0138	50	136	250	225	400	FWH-350A (350)
2A0169	60	164	300	250	450	FWH-400A (400)
2A0211	75	200	400	350	600	FWH-400A (400)
2A0250	100	271	500	450	800	FWH-600A (600)
2A0312	125	324	600	500	800	FWH-700A (700)
2A0360	150	394	700	600	1000 <5>	FWH-800A (800)
2A0415	175	471	900	800	1400 <5>	FWH-1000A (1000)
400 V Class						
4A0002	1	2.1	15	3.5	6	FWH-40B (40)
4A0004	2	4.3	15	7.5	12	FWH-50B (50)
4A0005	3	5.9	15	10	17.5	FWH-70B (70)
4A0007	3	8.1	15	12	20	FWH-70B (70)
4A0009	5	9.4	15	15	25	FWH-90B (90)
4A0011	7.5	14	25	20	40	FWH-90B (90)
4A0018	10	20	40	35	60	FWH-80B (80)
4A0023	15	24	45	40	70	FWH-100B (100)
4A0031	20	38	75	60	110	FWH-125B (125)
4A0038	25	44	75	75	125	FWH-200B (200)
4A0044	30	52	100	90	150	FWH-250A (250)
4A0058	40	58	100	100	150	FWH-250A (250)
4A0072	50	71	125	110	200	FWH-250A (250)
4A0088	60	86	150	150	250	FWH-250A (250)
4A0103	75	105	200	175	300	FWH-250A (250)
4A0139	100	142	250	225	400	FWH-350A (350)
4A0165	125	170	300	250	500	FWH-400A (400)
4A0208	150	207	400	350	600	FWH-500A (500)
4A0250	200	248	450	400	700	FWH-600A (600)
4A0296	250	300	600	500	800	FWH-700A (700)
4A0362	300	346	600	600	1000 <5>	FWH-800A (800)

Drive Model	Nominal Output Power HP	AC Drive Input Amps	MCCB Rating Amps <1>	Time Delay Fuse Rating Amps <2>	Non-time Delay Fuse Rating Amps <3>	Bussman Semi-conductor Fuse Rating (Fuse Ampere) <4>
4A0414	350	410	800	700	1200 <5>	FWH-800A (800)
4A0515	400 - 450	465	900	800	1350 <5>	FWH-1000A (1000)
4A0675	500 - 600	657	1200	1100 <5>	1800 <5>	FWH-1200A (1200)
600 V Class						
5A0003	2	3.6	15	6.25	10	FWP-50B (50)
5A0004	3	5.1	15	8	15	FWP-50B (50)
5A0006	5	8.3	15	12	20	FWP-60B (60)
5A0009	7.5	12	20	20	35	FWP-60B (60)
5A0011	10	16	30	25	45	FWP-70B (70)
5A0017	15	23	40	40	60	FWP-100B (100)
5A0022	20	31	60	50	90	FWP-100B (100)
5A0027	25	38	75	60	110	FWP-125A (125)
5A0032	30	45	75	75	125	FWP-125A (125)
5A0041	40	44	75	75	125	FWP-175A (175)
5A0052	50	54	100	90	150	FWP-175A (175)
5A0062	60	66	125	110	175	FWP-250A (250)
5A0077	75	80	150	125	225	FWP-250A (250)
5A0099	100	108	175	175	300	FWP-250A (250)
5A0125	125	129	225	225	350	FWP-350A (350)
5A0145	150	158	300	275	450	FWP-350A (350)
5A0192	200	228	400	350	600	FWP-600A (600)
5A0242	250	263	500	450	700	FWP-600A (600)

<1> Maximum MCCB Rating is 15 A, or 200 % of drive input current rating, whichever is larger. MCCB voltage rating must be 600 VAC or greater.

<2> Maximum Time Delay fuse is 175% of drive input current rating. This covers any Class CC, J or T class fuse.

<3> Maximum Non-time Delay fuse is 300% of drive input current rating. This covers any CC, J or T class fuse.

<4> When using semiconductor fuses, Bussman FWH and FWP are required for UL compliance. Select FWH for 200 V Class and 400 V Class models and FWP fuses for 600 V models.

<5> Class L fuse is also approved for this rating.

■ Low Voltage Wiring for Control Circuit Terminals

Wire low voltage wires with NEC Class 1 circuit conductors. Refer to national state or local codes for wiring. The external power supply shall be a UL listed Class 2 power supply source or equivalent only.

Table C.6 Control Circuit Terminal Power Supply

Input / Output	Terminal Signal	Power Supply Specifications
Digital inputs	S1 to S8, SC	Use the internal LVLC power supply of the drive. Use class 2 for external power supply.
Analog inputs / outputs	+V, A1, A2, A3, AC, AM, FM	Use the internal LVLC power supply of the drive. Use class 2 for external power supply.

■ Drive Short Circuit Rating

The drive is suitable for use on a circuit capable of delivering not more than 100,000 RMS symmetrical Amperes, 240 Vac maximum (200 V Class), 480 Vac maximum (400 V Class), and 600 Vac maximum (600 V Class) when protected by Bussmann Type FWH or FWP fuses as specified in *Factory Recommended Branch Circuit Protection* on page *336*.

◆ CSA Standards Compliance

Figure C.7 CSA Mark

■ CSA for Industrial Control Equipment

The drive is CSA-certified as Industrial Control Equipment Class 3211.

Specifically, the drive is certified to: CAN/CSA C22.2 No. 04-04 and CAN/CSA C22.2 No.14-05.

◆ Drive Motor Overload Protection

Set parameter E2-01 (motor rated current) to the appropriate value to enable motor overload protection. The internal motor overload protection is UL listed and in accordance with the NEC and CEC.

■ E2-01: Motor Rated Current

Setting Range: Model-dependent

Default Setting: Model-dependent

Parameter E2-01 protects the motor when parameter L1-01 is not set to 0. The default for L1-01 is 1, which enables protection for standard induction motors.

If Auto-Tuning has been performed successfully, the motor data entered to T1-04 is automatically written to parameter E2-01. If Auto-Tuning has not been performed, manually enter the correct motor rated current to parameter E2-01.

■ L1-01: Motor Overload Protection Selection

The drive has an electronic overload protection function (oL1) based on time, output current, and output frequency that protects the motor from overheating. The electronic thermal overload function is UL-recognized, so it does not require an external thermal relay for single motor operation.

This parameter selects the motor overload curve used according to the type of motor applied.

Table C.7 Overload Protection Settings

Setting	Description	
0	Disabled	Disabled the internal motor overload protection of the drive.
1	Standard fan-cooled motor (60 Hz default)	Selects protection characteristics for a standard self-cooled motor with limited cooling capabilities when running below the rated speed. The motor overload detection level (oL1) is automatically reduced when running below the motor rated speed.
2	Drive duty motor with a speed range of 1:10	Selects protection characteristics for a motor with self-cooling capability within a speed range of 10:1. The motor overload detection level (oL1) is automatically reduced when running below 1/10 of the motor rated speed.
3	Vector motor with a speed range of 1:100	Selects protection characteristics for a motor capable of cooling itself at any speed including zero speed (externally cooled motor). The motor overload detection level (oL1) is constant over the entire speed range.
6	Standard fan-cooled motor (50 Hz)	Selects protection characteristics for a standard self-cooled motor with limited cooling capabilities when running below the rated speed. The motor overload detection level (oL1) is automatically reduced when running below the motor rated speed.

When connecting the drive to more than one motor for simultaneous operation, disable the electronic overload protection (L1-01 = 0) and wire each motor with its own motor thermal overload relay.

Enable motor overload protection (L1-01 ≠ 0) when connecting the drive to a single motor, unless another motor overload preventing device is installed. The drive electronic thermal overload function causes an oL1 fault, which shuts off the output of the drive and prevents additional overheating of the motor. The motor temperature is continually calculated while the drive is powered up.

■ L1-02: Motor Overload Protection Time

Setting Range: 0.1 to 5.0 min

Factory Default: 1.0 min

Parameter L1-02 determines how long the motor is allowed to operate before the oL1 fault occurs when the drive is running a hot motor at 60 Hz and at 150% of the full load amp rating (E2-01) of the motor. Adjusting the value of L1-02 can shift the set of oL1 curves up the y axis of the diagram below, but will not change the shape of the curves.

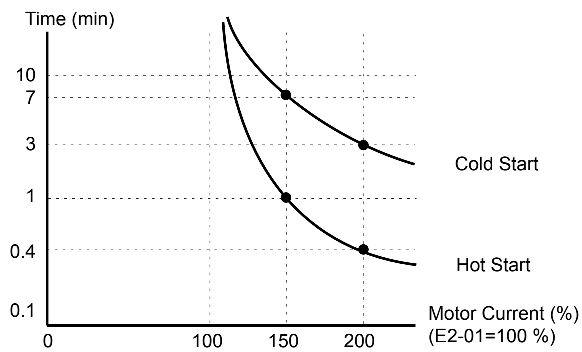


Figure C.8 Motor Overload Protection Time

◆ Precautionary Notes on External Heatsink (IP00/Open Type Enclosure)

When mounting the drive heatsink out the back of an enclosure, UL compliance requires covering exposed capacitors in the main circuit to prevent injury to surrounding personnel.

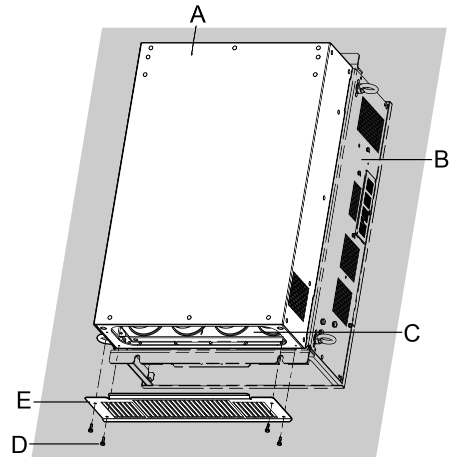
The portion of the external heatsink that projects out can be protected with the enclosure or with the appropriate capacitor cover after completing drive installation. The drive models listed in ***Table C.8*** require additional protection by means of a capacitor cover. Order capacitor covers from a Yaskawa representative or directly from the Yaskawa sales department.

Refer to ***Figure C.9*** for a detailed description of the capacitor cover parts.

Table C.8 Capacitor Cover

Drive Model	Code Number	Model
2A0110	100-061-273	ECAT31875-11
2A0138	100-061-274	ECAT31876-11
2A0169	100-061-275	ECAT31877-11
2A0211		
2A0250	100-061-277	ECAT31726-11
2A0312		
2A0360	100-061-278	ECAT31698-11
2A0415		
4A0058	100-061-273	ECAT31875-11
4A0072	100-061-274	ECAT31876-11
4A0088	100-061-276	ECAT31878-11
4A0103		
4A0139	100-061-275	ECAT31877-11
4A0165		
4A0208	100-061-277	ECAT31726-11
4A0250	100-061-278	ECAT31698-11
4A0296		
4A0362		
4A0414	100-061-279	ECAT31740-11
4A0515	100-061-280	ECAT31746-11
4A0675		
5A0041	100-061-274	ECAT31876-11
5A0052		
5A0062	100-061-275	ECAT31877-11
5A0077		
5A0099		
5A0125	100-061-277	ECAT31726-11
5A0145		
5A0192	100-061-278	ECAT31698-11
5A0242		

<1> Requires two sets.



A – Drive (outside panel)
B – Drive (inside panel)
C – Opening to capacitors
D – Installation screws
E – Capacitor cover

Figure C.9 Capacitor Cover

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Revision History

The revision dates and the numbers of the revised manuals appear on the bottom of the back cover.

Date of Publication	Revision Number	Section	Revised Content
November 2012	-	-	First Edition. This manual supports drive software version PRG: 8550.

iQpump1000 AC Drive
Intelligent Pump Controller
Quick Start Guide

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