YASKAWA

Low Harmonic Drive for HVAC Applications

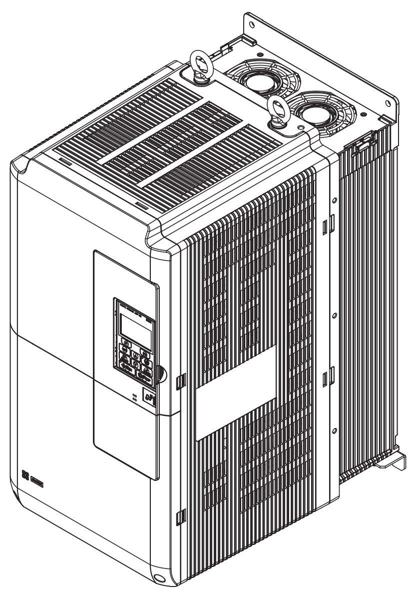
Z1000U HVAC MATRIX Drive

User Manual

Type: CIMR-ZU□

Models: 200 V Class: 7.5 to 75 kW (10 to 100 HP ND)
400 V Class: 5.5 to 260 kW (7.5 to 350 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.



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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.

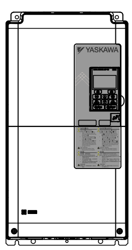
i.1 Preface

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 Z1000U-Series 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 Z1000U-series drives:

	Z1000U HVAC MATRIX Drive Quick Start Guide TOEPC71063611
	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 safety, and parameter settings. The most recent version of this manual is available for download on our documentation website, www.yaskawa.com.
	Z1000U HVAC MATRIX Drive User Manual TOEPC71063610
	This manual contains detailed information on fault diagnostics, parameter settings, and BACnet specifications. The most recent version of this manual is available for download on our documentation website, www.yaskawa.com.
	Z1000U HVAC MATRIX Drive Programming Manual SIEPC71063610
	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. The most recent version of this manual is available for download on our documentation website, www.yaskawa.com.

◆ Symbols

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

◆ Terms and Abbreviations

- **Drive:** Yaskawa Z1000U-Series Drive
- **Digital Operator:** Hand Off Auto (HOA) Keypad JVOP-183
- **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
- **PG:** Pulse Generator
- **r/min:** Revolutions per Minute
- **V/f:** V/f Control
- **OLV/PM:** Open Loop Vector Control for PM
- **PM motor:** Permanent Magnet Synchronous motor (an abbreviation for IPM motor or SPM motor)
- **IPM motor:** Interior Permanent Magnet Motor (e.g., Yaskawa SSR1 Series and SST4 Series motors)
- **SPM motor:** Surface mounted Permanent Magnet Motor (e.g., Yaskawa SMRA Series motors)

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- APOGEE® FLN is a registered trademark of Siemens Building Technologies, Inc.
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- MODBUS® is a registered trademark of Schneider Automation, Inc.
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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 Yaskawa or a Yaskawa representative and provide the manual number shown on the front cover. • If nameplate becomes worn or damaged, order a replacement from Yaskawa or a Yaskawa representative.

⚠ 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

Before servicing, disconnect all power to the equipment.

The output terminals remain charged even after the power supply is turned off. The charge indicator LED will extinguish when the control circuit DC voltage is below 50 Vdc. To prevent electric shock, wait for at least the time specified on the warning label, once all indicators are OFF, measure for unsafe voltages to confirm the drive is safe prior to servicing.

Failure to comply will result in death or serious injury.

⚠ 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.

Arc Flash Hazard

It is possible that there is more than one source of power for the equipment.

Obey the requirements for Electrical Safety in the Workplace and local codes for safe work procedures and applicable personal protective equipment (PPE).

Failure to obey can cause serious injury or death.

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.

Installation, maintenance, inspection, and service 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 4□0302 and larger, IEC/EN 61800-5-1:2007 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/EN 60755.

WARNING

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.

Do not use improper combustible materials.

Failure to comply could result in death or serious injury by fire. Attach the drive to metal or other noncombustible material.

Tighten all terminal screws to the specified tightening torque.

Loose electrical connections could result in death or serious injury by fire due to overheating of electrical connections.

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 maximum (200 V class), 480 Vac maximum (400 V class: 4E□□□□ and 4W□□□□), and 500 Vac maximum (400 V class: 4U□□□□ and 4P□□□□) when protected by branch circuit protection devices specified in this document.

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 or megger 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.

Check for short circuits or ground faults on the secondary side of fuses and GFCIs and check the wiring and the selection of peripheral devices. Remove the cause of the problem and then turn the power supply off and on again. If the cause cannot be identified, do not turn on the power supply or attempt to operate the equipment.

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 Yaskawa or a Yaskawa representative before restarting the drive or the peripheral devices if the cause cannot be identified.

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

Drive Rated Output Current

Make sure that the motor rated current is less than the rated output current for the drive.

When 2 Seconds is Required for Momentary Power Loss Ride-Thru Time

Use the units listed below when continuing drive operation after the power is restored even after a momentary loss of power of 2 seconds occurs:

- 200 V class Momentary Power Loss Ride-Thru unit: Model no. P0010
- 400 V class Momentary Power Loss Ride-Thru unit: Model no. P0020

Drive Start-Up Time

The drive requires 1.5 seconds to prepare for operation after the power is turned on. Be mindful of this delay when using an external reference input.

Note: 1.5 seconds is the required time when no optional devices are used with the drive. When using an optional communication device, the time required for the drive to be ready for operation will vary in accordance with the start up time of the communication card.

Selection of Power Supply Capacity

Use a power supply greater than the rated input capacity (kVA) of the drive. If the power supply is lower than the rated capacity of the drive, the device will be unable to run the application properly and will trigger a fault.

The rated input capacity of the drive, S_{CONV} (kVA), can be calculated by the following formula:

$$S_{CONV} = \sqrt{3} \times I_{in} \times V_{in} / 1000$$

(I_{in}: Rated input current [A], V_{in}: Applicable power supply voltage [V])

Connection to Power Supply

The total impedance of the power supply and wiring for the rated current of the drive is %Z = 10% or more. Power voltage distortion may occur when the impedance of the power supply is too large. When wiring over long distances, be sure to take preventative measures such as using thick cables or series wiring to lower the impedance of wiring. Also, tie the cables for three phases together at the power supply side (do not isolate the cable for each phase). If not, increased cable inductance will increase the voltage of the drive power supply terminal. Contact Yaskawa or a Yaskawa representative for details.

Grounding the Power Supply

Yaskawa recommends using a dedicated ground for the power supply, as the drive is designed to run with a 1:1 ratio relative to the power supply. Ground other devices as directed in the specifications for those devices. Take particular care when connecting sensitive electronic devices. Separate ground lines and install a noise filter to prevent problems from noise.

When Using a Generator as a Power Supply

Select the generator capacity approximately twice as large as the drive input power supply capacity. Set the deceleration time or load so that the regenerative power from the motor will be 10% or less of the generator capacity. For further information, contact Yaskawa or a Yaskawa representative.

When a Phase Advance Capacitor or Thyristor Controller is Provided for the Power Supply

Do not install a phase advancing capacitor to the drive.

For the phase advance capacitor that has already been installed on the same power supply system as the drive, switch to a phase-advanced capacitor with a series reactor to prevent oscillation with the drive.

Contact Yaskawa or a Yaskawa representative when a device generating voltage surge or voltage distortion such as DC motor drive thyristor controller or magnetic agitator is installed on the same power supply system.

Prevention Against EMC or High Frequency Leakage Current

Use units with built-in EMC filters that have the CE marking.

Use a zero-phase reactor as a noise filter when a device that will be affected by noise is near the drive.

Effects of Power Supply Distortion

Distortion of the power supply voltage increases the harmonics contents due to power supply harmonics entering the drive.

Starting Torque

The startup and acceleration characteristics of the motor are restricted to the drive overload current rating.

The overload rating for the drive determines the starting and accelerating characteristics of the motor. Expect lower torque than when running from line power. To achieve a higher starting torque, use a larger drive or a drive and motor with larger capacity.

Emergency Stop

During a drive fault condition, the output shuts off but the motor does not stop immediately. A mechanical brake may be required when it is necessary to stop the motor faster than the ability of the Fast Stop function of the drive.

Repetitive Starting/Stopping

Laundry machines, punching presses, and other applications with frequent starts and stops often approach 150% of their rated output current values. Heat stress generated from repetitive high current will shorten the life span of the IGBTs. The expected life span of the IGBTs is about 8 million start and stop cycles with a 4 kHz carrier frequency and a 150% peak current.

Run only one motor from each drive when using vector control. It is not possible to run more than one motor from one drive with vector control.

■ Carrier Frequency Derating

Reduce the rated output current of the drive when increasing the carrier frequency above the factory default setting. ***Refer to Rated Current Depending on Carrier Frequency on page 257*** for details.

■ Installation

Enclosure Panels

Keep the drive in a clean environment by installing the drive in an enclosure panel. 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 the Mechanical Installation section for more information on installation. Failure to comply may damage the drive due to improper cooling.*

■ Settings

Motor Code

When using a permanent magnet motor, set the proper motor code to parameter E5-01 before performing a trial run.

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.*

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 moment of inertia. 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. Use a larger drive and motor for faster acceleration and deceleration.

■ General Handling

Wiring Check

NOTICE: *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/EN 60755).

Select a Molded Case Circuit Breaker (MCCB) or GFCI with a rated current 1.5 to 2 times higher than the drive rated current to avoid nuisance trips caused by harmonics in the drive input current. ***Refer to Installing a Molded Case Circuit Breaker (MCCB) or Ground Fault Circuit Interrupter (GFCI) on page 246*** for more information.

Magnetic Contactor Installation

WARNING! *Fire Hazard. Shut off the drive with a magnetic contactor (MC) when a fault occurs in any external equipment such as braking resistors.* ***Refer to Installing a Magnetic Contactor at the Power Supply Side on page 247****. Failure to comply may cause resistor overheating, fire, and injury to personnel.*

NOTICE: *To get the full performance life out of the capacitor for the control power supply 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! *Electrical Shock Hazard. When a drive is running a PM motor, voltage continues to be generated at the motor terminals after the drive is shut off while the motor coasts to stop. Take the precautions described below to prevent shock and injury:*
· In applications where the machine can still rotate after the drive has fully stopped a load, install a switch to the drive output side to disconnect the motor and the drive.
· Do not allow an external force to rotate the motor beyond the maximum allowable speed or to rotate the motor when the drive has been shut off.
· Wait for at least the time specified on the warning label after opening the load switch on the output side before inspecting the drive or performing any maintenance.
· Do not open and close the load switch while the motor is running.
· If the motor is coasting, make sure the power to the drive is turned on and the drive output has completely stopped before closing the load switch.

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

All wire ends should 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

Low-Speed Range

The cooling fan of a standard motor should sufficiently cool the motor at the rated speed. As the self-cooling capability of such a motor decreases with the speed, applying full torque at low speed will possibly damage the motor. Reduce the load torque as the motor slows to prevent motor damage from overheat. *Figure i.1* shows the allowable load characteristics for a Yaskawa standard motor. Use a motor designed specifically for operation with a drive when 100% continuous torque is needed at low speeds.

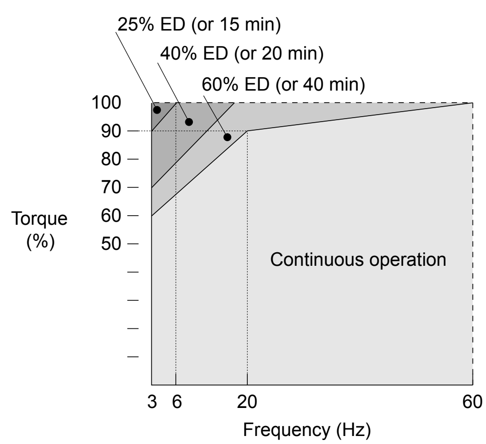


Figure i.1 Allowable Load Characteristics for a Yaskawa Motor

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. Selecting Closed Loop Vector control can help reduce motor oscillation.

- 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, install shock-absorbing rubber around the base of the motor and enable the Jump Frequency function to prevent continuous operation in the resonant frequency range.
- Mechanical resonance can occur with long motor shafts and in applications such as turbines, blowers, and fans with high inertia loads.

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.

Synchronous Motors

- Contact Yaskawa or a Yaskawa representative when planning to use a synchronous motor not endorsed by Yaskawa.
- Use a standard induction motor when running multiple synchronous motors simultaneously. A single drive does not have this capability.
- A synchronous motor may rotate slightly in the opposite direction of the Run command at start depending on parameter settings and rotor position.
- The amount of generated starting torque differs depending on the control mode and motor type. Set up the motor with the drive after verifying the starting torque, allowable load characteristics, impact load tolerance, and speed control range.

  Contact Yaskawa or a Yaskawa representative when planning to use a motor that does not fall within these specifications:
- In Open Loop Vector Control for PM motors, the allowable load inertia is approximately 50 times higher than the motor inertia.

  Contact Yaskawa or a Yaskawa representative for questions concerning applications with larger inertia.
- When using a holding brake in Open Loop Vector Control for PM motors, release the brake prior to starting the motor. Failure to set the proper timing can cause speed loss.
- Use the Speed Search function to restart a coasting motor rotating over 200 Hz while in V/f Control.

Specialized Motors

Multi-Pole Motor

The rated current of a multi-pole motor differs from that of a standard motor, so be sure to check the maximum current when selecting a drive. Always stop the motor before switching between the number of motor poles. The motor will coast to stop if a regenerative overvoltage (ov) fault occurs or if overcurrent (oC) protection is triggered.

Submersible Motor

The rated current of a submersible motor is greater than that of a standard motor, so select the drive 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.

When attaching an encoder to an explosion-proof motor, make sure the encoder is also explosion-proof. Use an insulating signal converter to connect the encoder signal lines to the speed feedback option card.

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 a high-frequency current to flow to the capacitors and can damage the capacitors. 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.

Motor with Brake

Take caution when using the drive to operate a motor with a built-in holding brake. If the brake is connected to the output side of the drive, it may not release at start due to low voltage levels, so be sure to install a separate power supply for the motor brake. Note that motors with built-in brakes tend to generate a fair amount of noise when running at low speeds.

■ 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 out 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***.

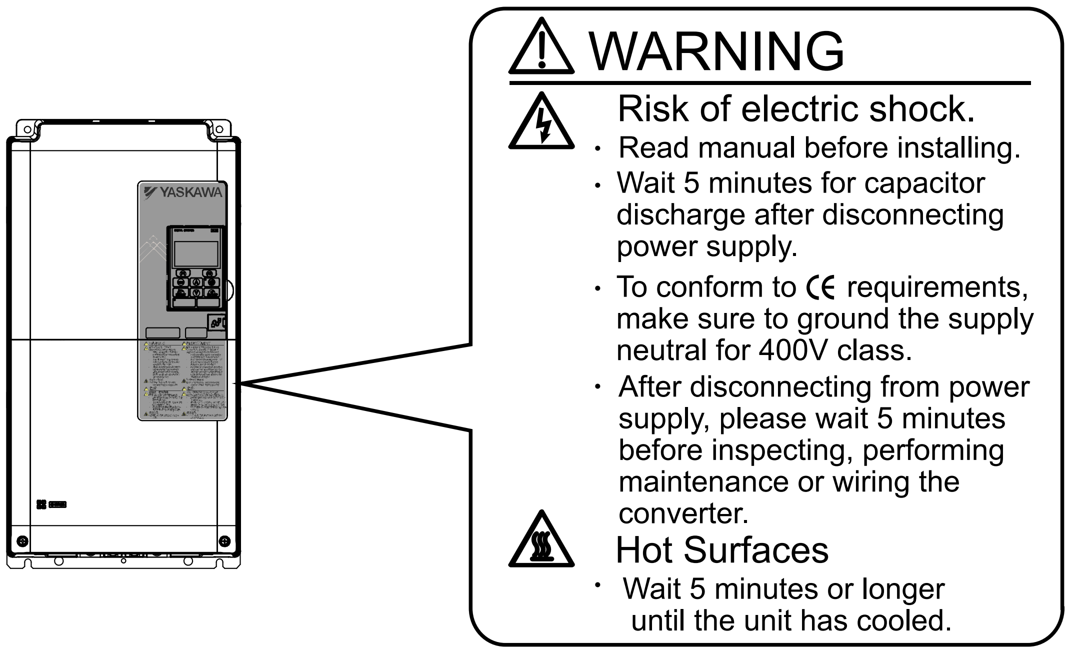


Figure i.2 Warning Information Example and Position

◆ Warranty Information

■ Warranty Period

This drive is warranted for 12 months from the date of delivery to the customer or 18 months from the date of shipment from the Yaskawa factory, whichever comes first.

■ Scope of Warranty

Inspections

Customers are responsible for periodic inspections of the drive. Upon request, a Yaskawa representative will inspect the drive for a fee. If the Yaskawa representative finds the drive to be defective due to Yaskawa workmanship or materials and the defect occurs during the warranty period, this inspection fee will be waived and the problem remedied free of charge.

Repairs

If a Yaskawa product is found to be defective due to Yaskawa workmanship or materials and the defect occurs during the warranty period, Yaskawa will provide a replacement, repair the defective product, and provide shipping to and from the site free of charge.

However, if the Yaskawa Authorized Service Center determines that the problem with the drive is not due to defective workmanship or materials, the customer will be responsible for the cost of any necessary repairs. Some problems that are outside the scope of this warranty are:

Problems due to improper maintenance or handling, carelessness, or other reasons where the customer is determined to be responsible.

Problems due to additions or modifications made to a Yaskawa product without Yaskawa's understanding.

Problems due to the use of a Yaskawa product under conditions that do not meet the recommended specifications.

Problems caused by natural disaster or fire.

After the free warranty period elapses.

Replenishment or replacement of consumables or expendables.

Defective products due to packaging or fumigation.

Other problems not due to defects in Yaskawa workmanship or materials.

Warranty service is only applicable within the country where the product was purchased. However, after-sales service is available for customers outside of the country where the product was purchased for a reasonable fee.

Contact your local Yaskawa representative for more information.

Exceptions

Any inconvenience to the customer or damage to non-Yaskawa products due to Yaskawa's defective products whether within or outside of the warranty period are NOT covered by warranty.

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 Section Safety

⚠ CAUTION

Do not carry the drive by the front cover or the terminal cover.
Failure to comply may cause the main body of the drive to fall, resulting in minor or moderate injury.

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.

A motor connected to a Z1000U may operate at a higher temperature than a utility-fed motor and the operating speed range may reduce motor cooling capacity.
Ensure that the motor is suitable for drive duty and/or the motor service factor is adequate to accommodate the additional heating with the intended operating conditions.

1.2 General Description

◆ Z1000U Model Selection

Refer to *Table 1.1* for drive selection.

Note: The models and capacities in shown here are based on standard settings and operation conditions. Higher carrier frequencies and higher ambient temperatures require derating.

Table 1.1 Z1000U Models

Three-Phase 200 V Class		Three-Phase 400 V Class	
Drive Model	**Rated Output Current (A)**	**Drive Model**	**Rated Output Current (A)**
2□0028	28	4□0011	11
2□0042	42	4□0014	14
2□0054	54	4□0021	21
2□0068	68	4□0027	27
2□0081	81	4□0034	34
2□0104	104	4□0040	40
2□0130	130	4□0052	52
2□0154	154	4□0065	65
2□0192	192	4□0077	77
2□0248	248	4□0096	96
–	–	4□0124	124
–	–	4□0156	156
–	–	4□0180	180
–	–	4□0216	216
–	–	4□0240	240
–	–	4□0302	302
–	–	4□0361	361
–	–	4□0414	414

◆ Control Mode Selection

Table 1.2 gives an overview of Z1000U control modes and their various features.

Table 1.2 Control Modes and Features

Motor Type		Induction Motors	Permanent Magnet Motors	Comments
Control Mode		**V/f**	**OLV/PM**	**–**
Parameter Setting		A1-02 = 0	A1-02 = 5	Default Setting is V/f control (A1-02 =0)
Basic Description		V/f control	Open Loop Vector control for PM motors	–
Type of Applications	**Motor Type**	IM	PM	–
	Multi Motor	YES	–	–
	Motor data unknown	YES	–	–
	High Speed Accuracy	–	YES	–

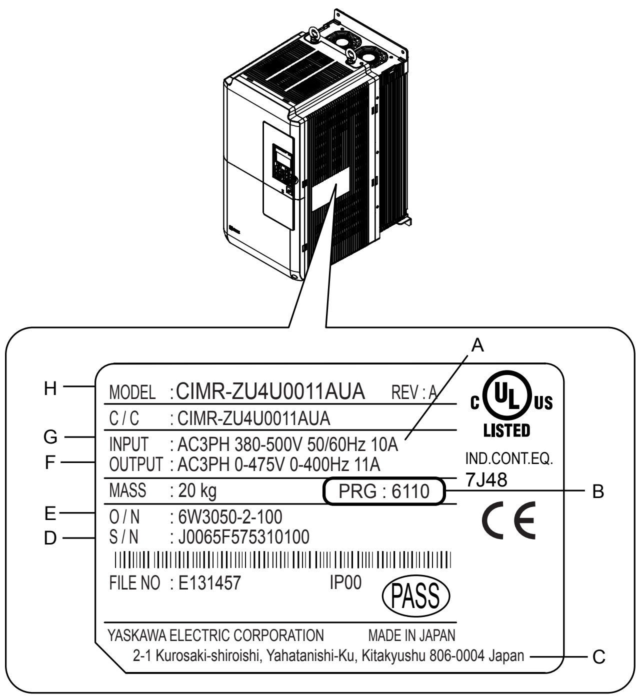
Motor Type		Induction Motors	Permanent Magnet Motors	Comments
Control Characteristics	Speed Control Range	1:40	1:20	May fluctuate with characteristics and motor temperature.
	Speed Accuracy	±2 to 3%	±0.2%	Speed deviation rate between speed reference value and motor speed (100% = rated speed, motor temperature 25 °C ±10 °C) when operating at normal status and when load is stable.
	Speed Response	3 Hz (approx.)	10 Hz	Max. frequency of a speed reference signal that the drive can follow may fluctuate with characteristics and motor temperature.
	Starting Torque	150% at 3 Hz	100% at 5% speed	Starting torque may fluctuate with characteristics and motor temperature.
Application-Specific	Auto-Tuning	• Energy Saving Tuning • Line to line resistance	• Stationary • Stator resistance	Automatically adjusts parameter settings that concern electrical characteristics of the motor.
	Speed Search	YES	YES	Bi-directional speed detection of a coasting motor to restart it without stopping.
	Energy-Saving Control	YES	–	Saves energy by always operating the motor at its maximum efficiency.
	Overexcitation Deceleration	YES	–	Provides fast deceleration without using a braking resistor.
	Commercial Power Switching Selection	YES	–	When the output frequency matches the power supply frequency (60 Hz), the PWM switching operation stops and switches to operation with a direct commercial power supply connection.

1.3 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 Yaskawa or a Yaskawa representative.

◆ Nameplate



A – Rated Output Current
B – Software version
C – Address <1>
D – Serial number
E – Lot number
F – Output specifications
G – Input specifications
H – AC drive model
Refer to *Figure 1.2* for details.

Figure 1.1 Drive Nameplate Information Example

<1> The address of the head office of Yaskawa Electric Corporation (responsible for product liability) is shown on the nameplate.

Receiving
1

◆ Model Number

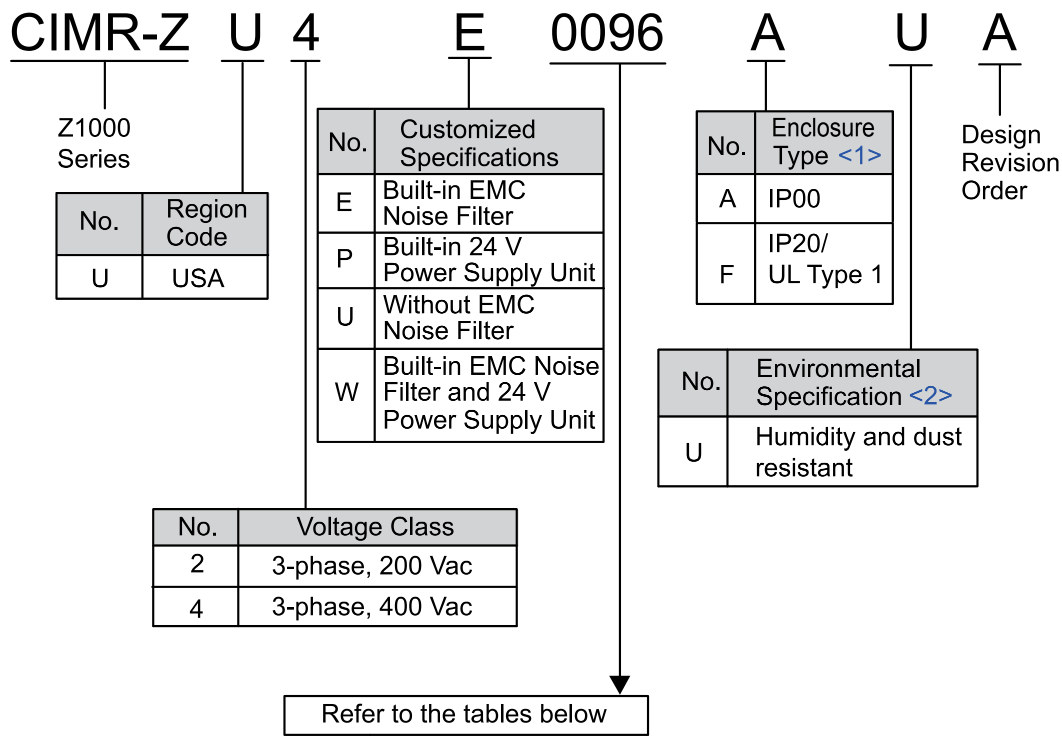


Figure 1.2 Drive Model Number Definition

<1> IP20/UL Type 1 enclosure drives require a UL Type 1 kit. Removing the top protective cover from an IP20/UL Type 1 enclosure drive may convert the drive to IP20 conformity.

<2> Drives with these specifications do not guarantee complete protection for the environmental conditions indicated.

■ Three-Phase 200 V Class

Table 1.3 Model Number and Specifications (200 V Class)

Drive Model	Reference Motor Capacity kW (HP)	Rated Output Current A	Drive Model	Reference Motor Capacity kW (HP)	Rated Output Current A
2□0028	7.5 (10)	28	2□0104	30 (40)	104
2□0042	11 (15)	42	2□0130	37 (50)	130
2□0054	15 (20)	54	2□0154	45 (60)	154
2□0068	18.5 (25)	68	2□0192	55 (75)	192
2□0081	22 (30)	81	2□0248	75 (100)	248

■ Three-Phase 400 V Class

Table 1.4 Model Number and Specifications (400 V Class)

Drive Model	Reference Motor Capacity kW (HP)	Rated Output Current A	Drive Model	Reference Motor Capacity kW (HP)	Rated Output Current A
4□0011	5.5 (7.5)	11	4□0096	55 (75)	96
4□0014	7.5 (10)	14	4□0124	75 (100)	124
4□0021	11 (15)	21	4□0156	90 (125)	156
4□0027	15 (20)	27	4□0180	110 (150)	180
4□0034	18.5 (25)	34	4□0216	132 (175)	216
4□0040	22 (30)	40	4□0240	150 (200)	240
4□0052	30 (40)	52	4□0302	185 (250)	302
4□0065	37 (50)	65	4□0361	220 (300)	361
4□0077	45 (60)	77	4□0414	260 (350)	414

1.4 Drive Models and Enclosure Types

Two types of enclosures are offered for Z1000U drives:

- IP00/Open Type enclosure models are designed for installation in an enclosure panel that serves to protect personnel from injury caused by accidentally touching live parts.
- IP20/UL Type 1 enclosure models mount to an indoor wall or in an enclosure panel.

Table 1.5 describes drive enclosures and models.

Table 1.5 Drive Models and Enclosure Types

Voltage Class	Enclosure Type	
	IP00/Open Type Enclosure Drive Model	IP20/UL Type 1 Enclosure <1> Drive Model
Three-Phase 200 V Class	2□0028A	2□0028F
	2□0042A	2□0042F
	2□0054A	2□0054F
	2□0068A	2□0068F
	2□0081A	2□0081F
	2□0104A	2□0104F
	2□0130A	2□0130F
	2□0154A	2□0154F
	2□0192A	2□0192F
	2□0248A	2□0248F
Three-Phase 400 V Class	4□0011A	4□0011F
	4□0014A	4□0014F
	4□0021A	4□0021F
	4□0027A	4□0027F
	4□0034A	4□0034F
	4□0040A	4□0040F
	4□0052A	4□0052F
	4□0065A	4□0065F
	4□0077A	4□0077F
	4□0096A	4□0096F
	4□0124A	4□0124F
	4□0156A	4□0156F
	4□0180A	4□0180F
	4□0216A	4□0216F
	4□0240A	4□0240F
	4□0302A	4□0302F
	4□0361A	4□0361F
	4□0414A	4□0414F

<1> Remove the top protective cover when installing an IP20/UL Type 1 enclosure drive in a cabinet.
Removing the top protective cover from an IP20/UL Type 1 enclosure drive voids UL Type 1 protection while retaining IP20 conformity.
Attaching a top protective cover and bottom cover to an IP00/Open Type enclosure drive will convert the drive to an IP20/UL Type 1 enclosure drive.

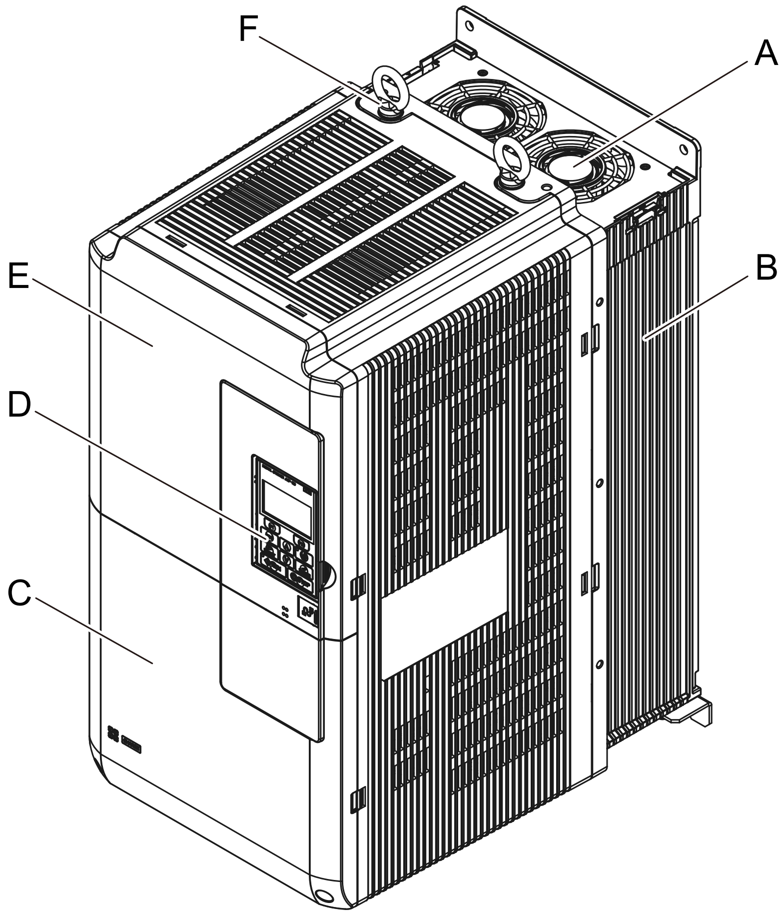
1.5 Component Names

This section gives an overview of the drive components described in this manual.

Note: *Refer to Using the HOA Keypad on page 103* for a description of the operator keypad.

◆ IP00/Open Type Enclosure

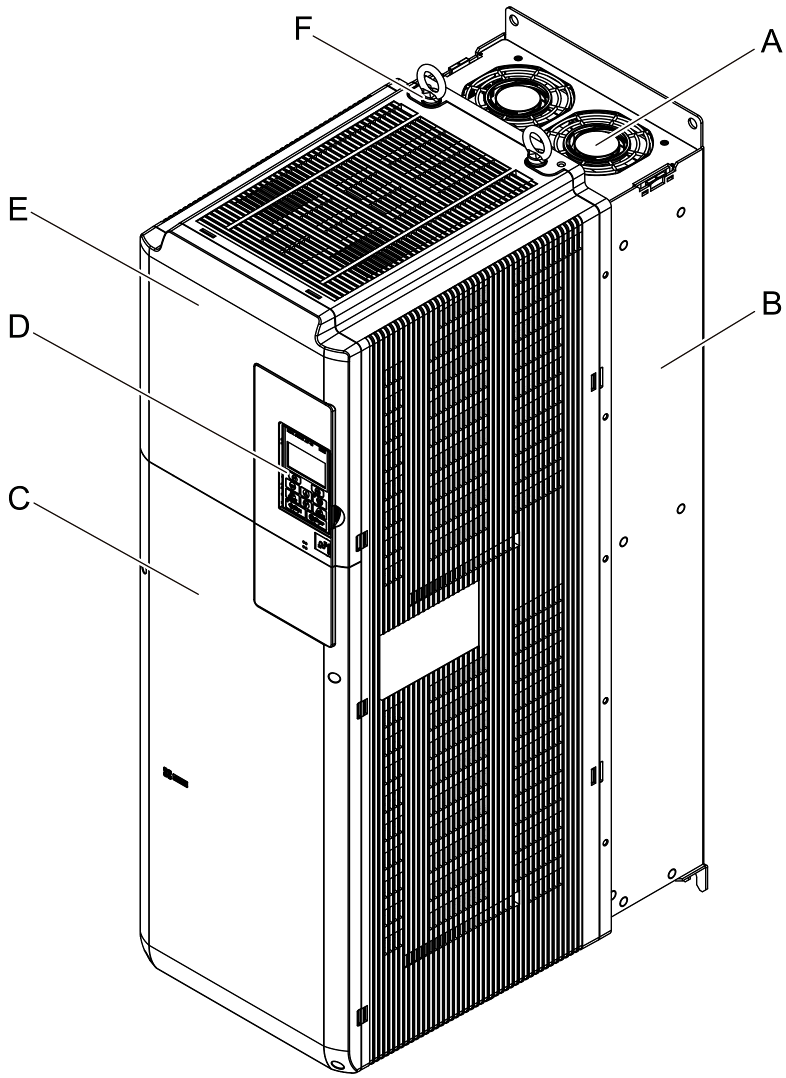
■ Three-Phase AC 200 V Class Models 2□0028A to 2□0081A Three-Phase AC 400 V Class Models 4□0011A to 4□0077A



A – Cooling fan
B – Heatsink
C – Terminal cover
D – Digital operator
E – Front cover
F – Eye bolt

Figure 1.3 IP00/Open Type Components (Drive Model 2□0028A)

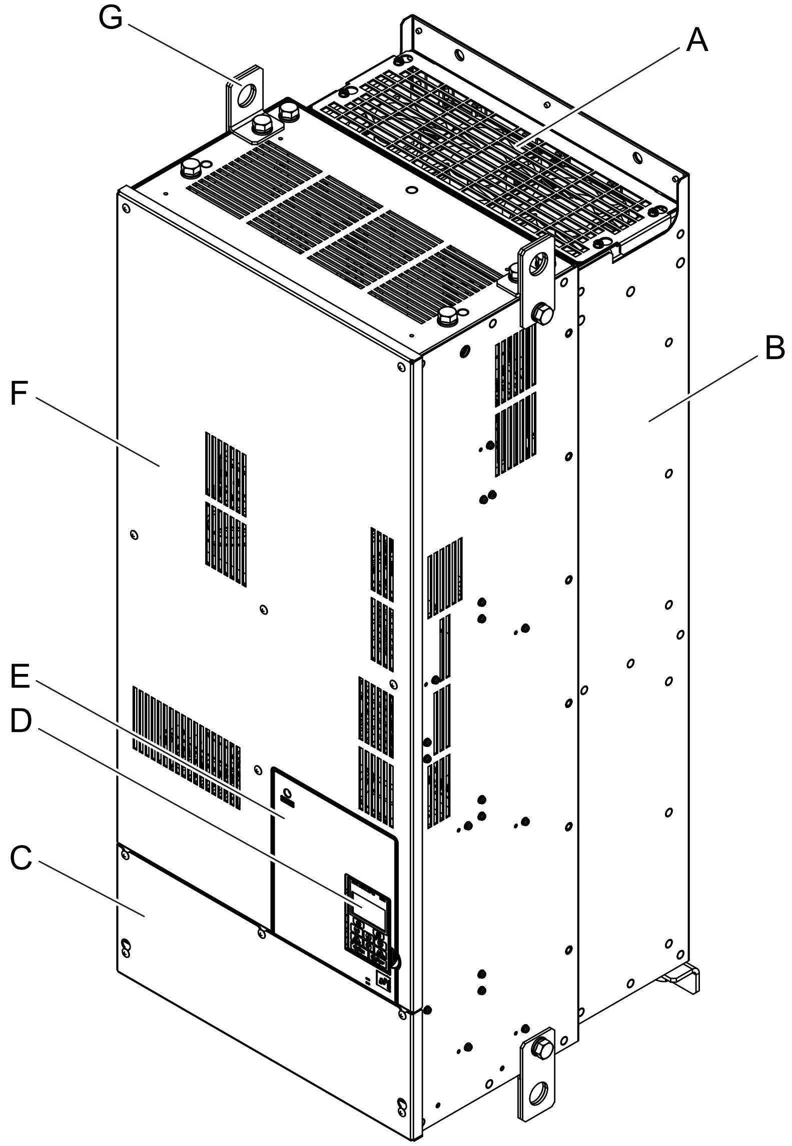
■ Three-Phase AC 200 V Class Models 2□0104A to 2□0130A
Three-Phase AC 400 V Class Models 4□0096A to 4□0124A



A – Cooling fan
B – Heatsink
C – Terminal cover
D – Digital operator
E – Front cover
F – Eye bolt

Figure 1.4 IP00/Open Type Components (Drive Model 2□0104A)

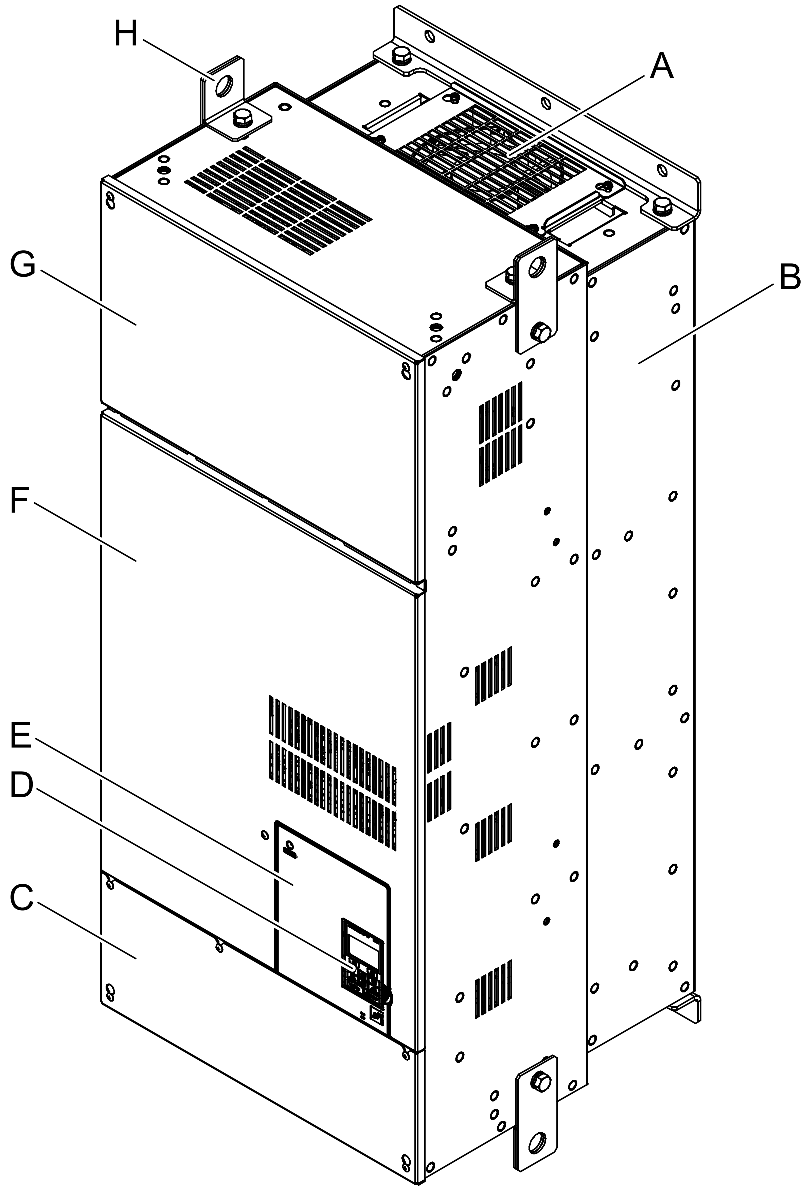
■ Three-Phase AC 200 V Class Models 2□0154A and 2□0192A Three-Phase AC 400 V Class Models 4□0156A and 4□0180A



A – Cooling fan
B – Heatsink
C – Terminal cover
D – Digital operator
E – Front cover
F – Drive cover
G – Hanging bracket

Figure 1.5 IP00/Open Type Components (Drive Model 2□0154A)

■ Three-Phase AC 200 V Class Model 2☐0248A Three-Phase AC 400 V Class Models 4☐0216A to 4☐0414A

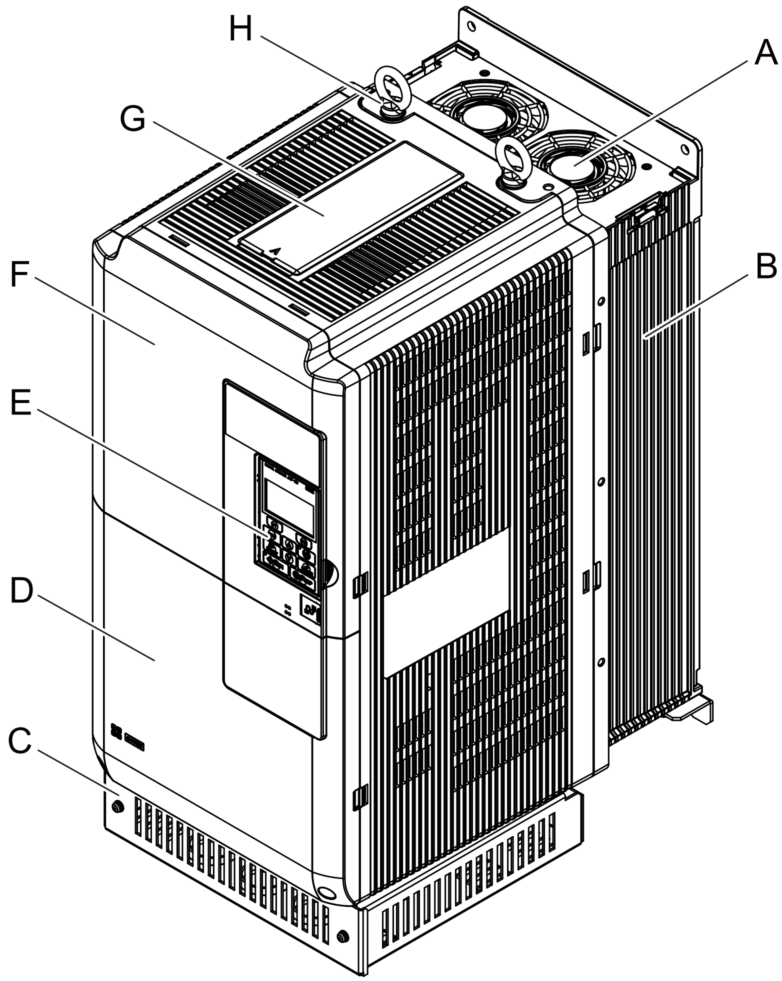


A – Cooling fan
B – Heatsink
C – Terminal cover
D – Digital operator
E – Front cover
F – Drive cover 2
G – Drive cover 1
H – Hanging bracket

Figure 1.6 IP00/Open Type Components (Drive Model 2☐0248A)

◆ IP20/UL Type 1 Enclosure

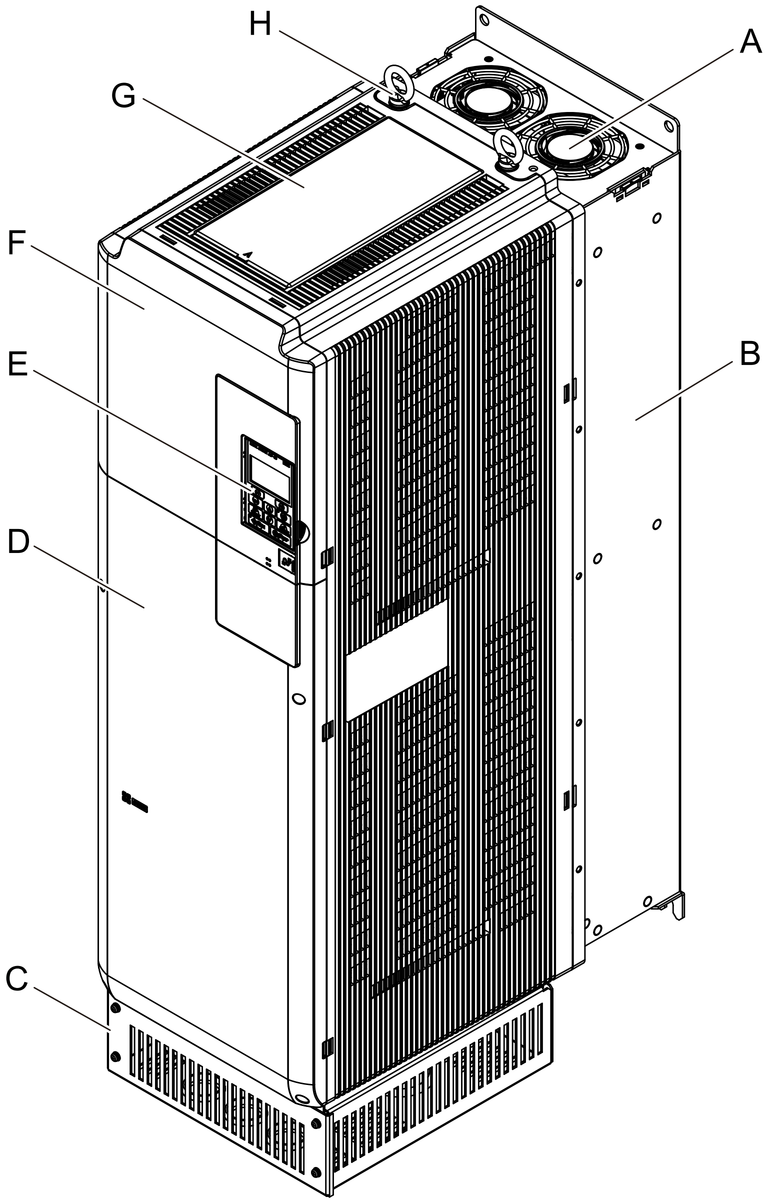
■ Three-Phase AC 200 V Class Models 2□0028F to 2□0081F
Three-Phase AC 400 V Class Models 4□0011F to 4□0077F



A – Cooling fan
B – Heatsink
C – Bottom cover
D – Terminal cover
E – Digital operator
F – Front cover
G – Top protective cover
H – Eye bolt

Figure 1.7 IP20/UL Type 1 Components (Drive Model 2□0028F)

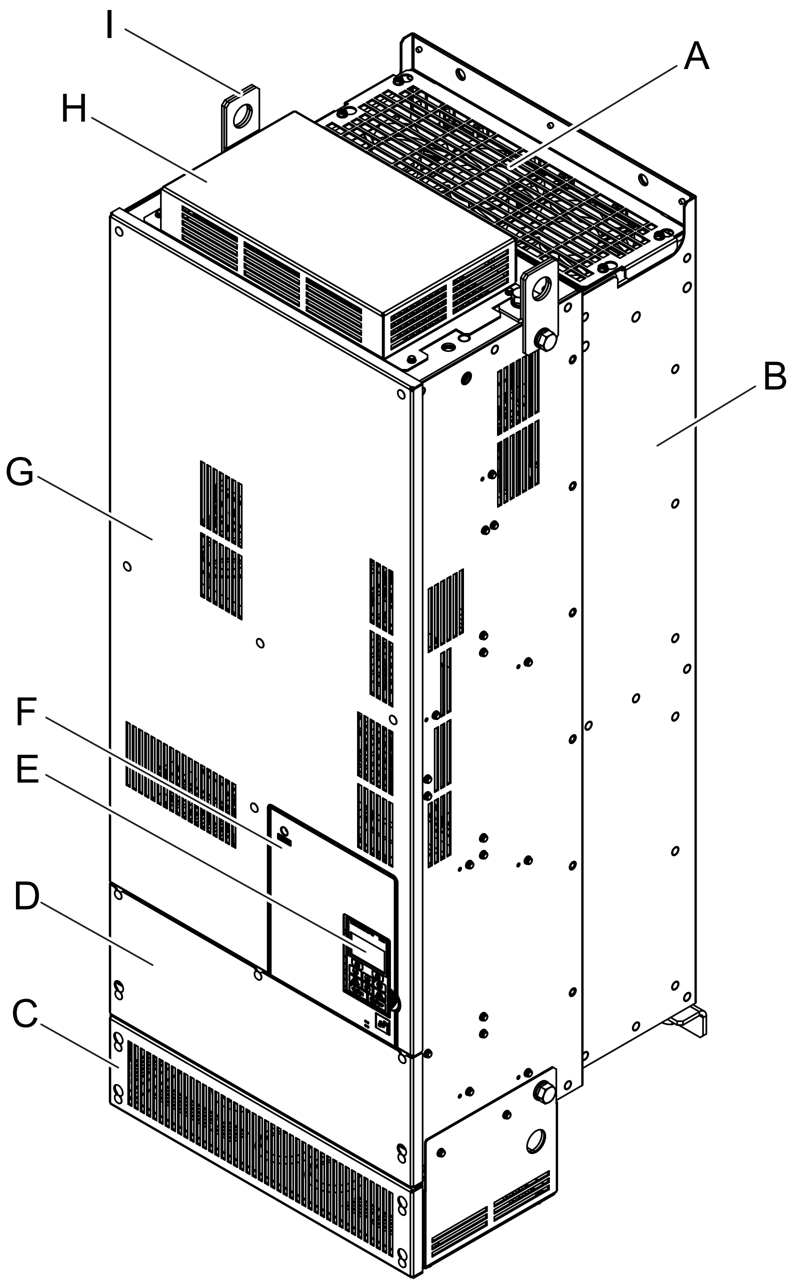
■ Three-Phase AC 200 V Class Models 2□0104F and 2□0130F Three-Phase AC 400 V Class Models 4□0096F and 4□0124F



A – Cooling fan
B – Heatsink
C – Bottom cover
D – Terminal cover
E – Digital operator
F – Front cover
G – Top protective cover
H – Eye bolt

Figure 1.8 IP20/UL Type 1 Components (Drive Model 2□0104F)

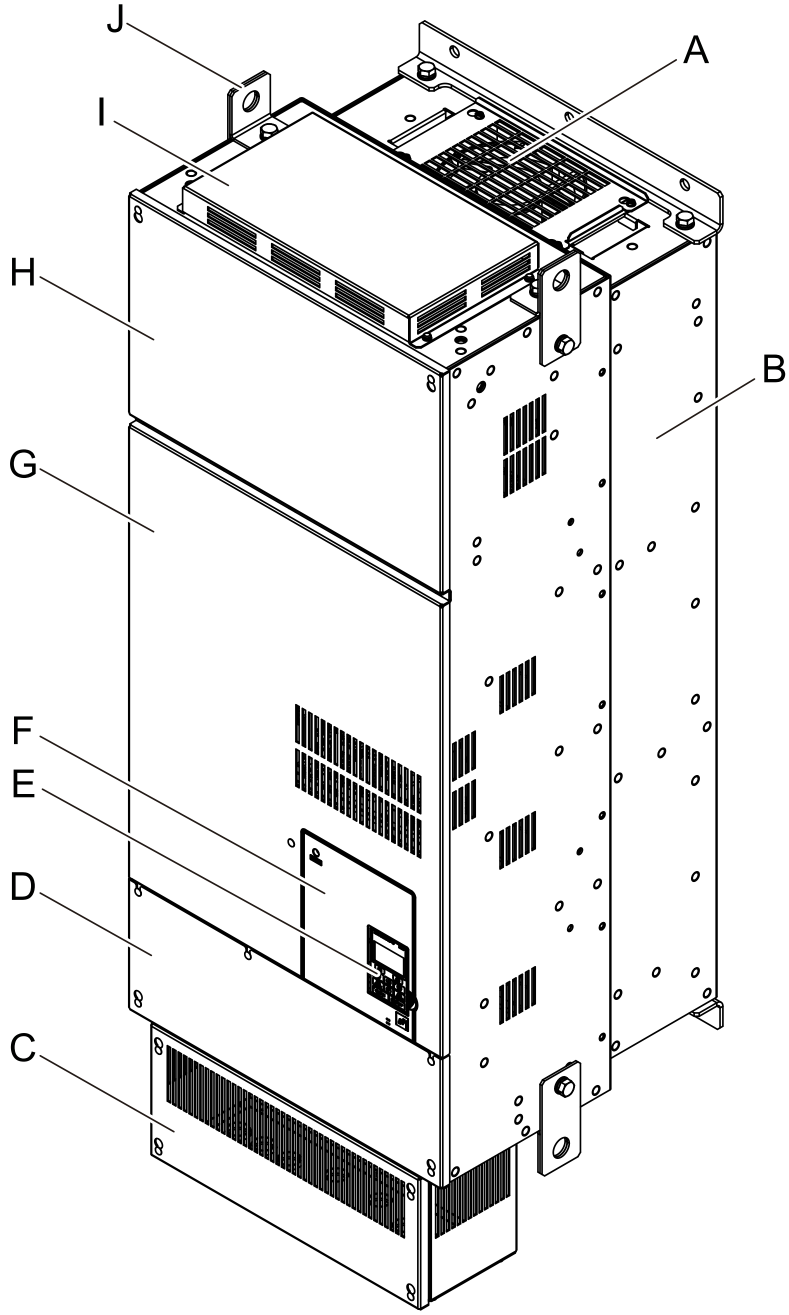
■ Three-Phase AC 200 V Class Models 2☐0154F and 2☐0192F Three-Phase AC 400 V Class Models 4☐0156F and 4☐0180F



A – Cooling fan
B – Heatsink
C – Bottom cover
D – Terminal cover
E – Digital operator
F – Front cover
G – Drive cover
H – Top protective cover
I – Hanging bracket

Figure 1.9 IP20/UL Type 1 Components (Drive Model 2☐0154F)

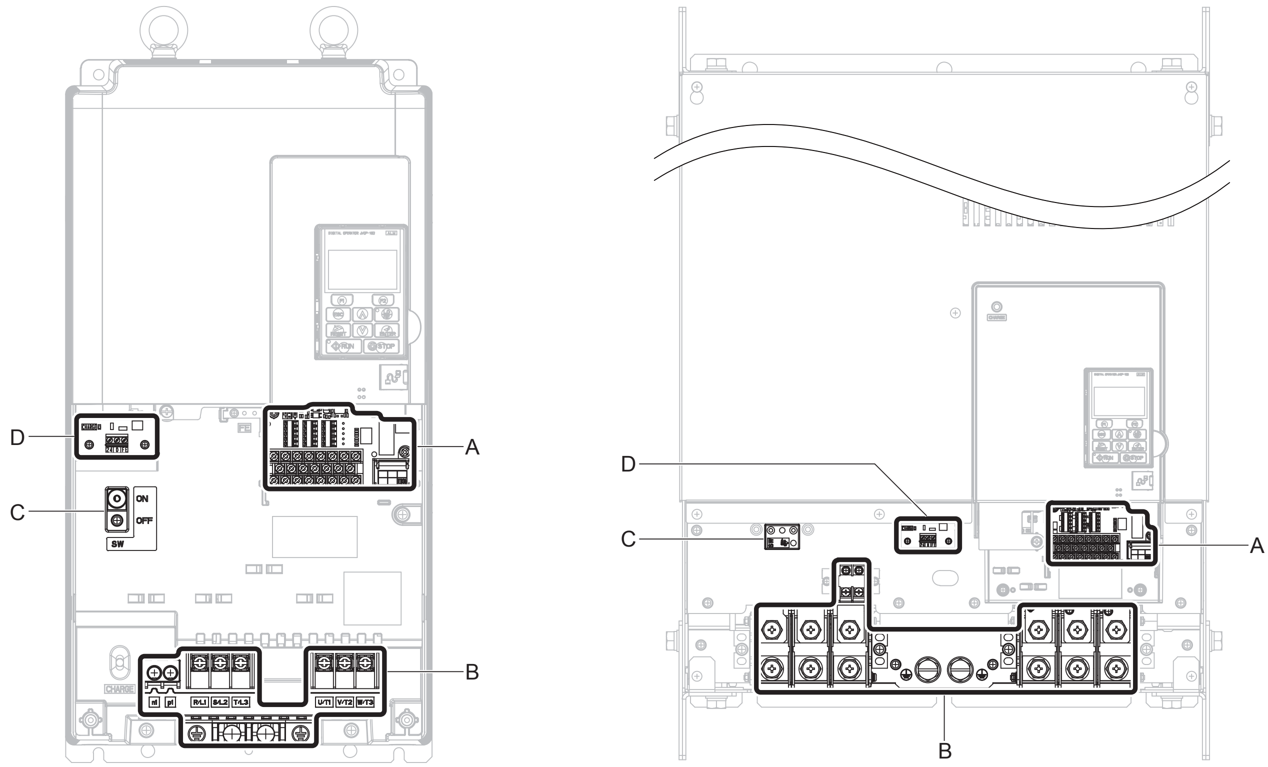
■ Three-Phase AC 200 V Class Model 2☐0248F
Three-Phase AC 400 V Class Models 4☐0216F to 4☐0414F



A – Cooling fan
B – Heatsink
C – Bottom cover
D – Terminal cover
E – Digital operator
F – Front cover
G – Drive cover 2
H – Drive cover 1
I – Top protective cover
J – Hanging bracket

Figure 1.10 IP20/UL Type 1 Components (Drive Model 2☐0248F)

◆ Front Views



A – Terminal board (*Refer to Control Circuit Wiring on page 79*)

B – Main circuit terminal (*Refer to Wiring the Main Circuit Terminal on page 78*)

C – EMC filter switch (Models ZU□E□□□□ and ZU□W□□□□)

D – 24 V control power supply unit (*Refer to 24 V Control Power Supply Unit Wiring on page 91*)

Figure 1.11 Front Views of Drives

2

Mechanical Installation

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

2.1 Section Safety

⚠ WARNING

Fire Hazard

Provide sufficient cooling when installing the drive inside an enclosed panel or cabinet.

Failure to comply could result in overheating and fire.

When multiple drives are placed inside the same enclosure panel, install proper cooling to ensure air entering the enclosure does not exceed 40 °C.

Crush Hazard

Use a dedicated lifter when transporting the drive by a lifter.

Failure to comply may result in serious injury or death from falling equipment.

Only use vertical suspension to temporarily lift the drive during installation to an enclosure panel. Do not use vertical suspension to transport the drive.

Failure to comply may result in serious injury or death from falling equipment.

Use screws to securely affix the drive front cover, terminal blocks, and other drive components prior to vertical suspension.

Failure to comply may result in serious injury or death from falling equipment.

Do not subject the drive to vibration or impact greater than 1.96 m/s^2 (0.2 G) while it is suspended by the cables.

Failure to comply may result in serious injury or death from falling equipment.

Do not attempt to flip the drive over or leave the drive unattended while it is suspended by the wires.

Failure to comply may result in serious injury or death from falling equipment.

⚠ CAUTION

Crush Hazard

Do not carry the drive by the front cover or the terminal cover.

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

NOTICE

Equipment Hazard

Prevent foreign matter such as metal shavings or wire clippings from falling into the drive during drive installation and project construction.

Failure to comply could result in damage to the drive. Place a temporary cover over the top during installation. Be sure to remove the temporary cover before start-up, as the cover will reduce ventilation and cause the unit to overheat.

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

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

Operating the motor in the low-speed range diminishes the cooling effects, increases motor temperature, and may lead to motor damage by overheating.

Reduce the motor torque in the low-speed range whenever using a standard blower cooled motor. If 100% torque is required continuously at low speed, consider using a special drive or vector-control motor. Select a motor that is compatible with the required load torque and operating speed range.

The speed range for continuous operation differs according to the lubrication method and motor manufacturer.

If the motor is to be operated at a speed higher than the rated speed, consult with the manufacturer.

Continuously operating an oil-lubricated motor in the low-speed range may result in burning.

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-rated motor with reinforced insulation.

Failure to comply could lead to motor winding failure.

Motor vibration may increase when operating a machine in variable-speed mode, if that machine previously operated at a constant speed.

Install vibration-proof rubber on the motor base or use the frequency jump function to skip a frequency resonating the machine.

The motor may require more acceleration torque with drive operation than with a commercial power supply.

Set a proper V/f pattern by checking the load torque characteristics of the machine to be used with the motor.

The rated input current of submersible motors is higher than the rated input current of standard motors.

Select an appropriate drive according to its rated output current. When the distance between the motor and drive is long, use a cable thick enough to connect the motor to the drive to prevent motor torque reduction.

The current rating differs for a motor with variable pole pitches differs from a standard motor.

Check the maximum current of the motor before selecting the drive capacity. Only switch motor poles when the motor is stopped. Switching between motor during run will trigger overcurrent protection circuitry or result in overvoltage from regeneration, and the motor will simply coast to stop.

When using an explosion-proof motor, it must be subject to an explosion-proof test in conjunction with the drive.

This is also applicable when an existing explosion-proof motor is to be operated with the drive. Since the drive itself is not explosion-proof, always install it in a safe place.

Never lift the drive up while the cover is removed.

This can damage the terminal board and other components.

2.2 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 optimum performance life.

Table 2.1 Drive Installation Environment

Environment	Conditions
Installation Area	Indoors
Ambient Temperature	IP00/Open Type enclosure: -10 °C to +50 °C (14 °F to 122 °F) IP20/UL Type 1 enclosure: -10 °C to +40 °C (14 °F to 104 °F) 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 °C to +60 °C (-4 °F to +104 °F)
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 (3281 ft.) or lower, up to 3000 m (9843 ft.) with derating
Vibration	10 to 20 Hz: 9.8 m/s^2 (2□0028 to 2□0248, 4□0011 to 4□0414) 20 to 55 Hz: 5.9 m/s^2 (2□0028 to 2□0081, 4□0011 to 4□0077) 20 to 55 Hz: 2.0 m/s^2 (2□0104 to 2□0248, 4□0096 to 4□0414)
Orientation	Install the drive vertically to maintain maximum cooling effects.

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

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 start-up, as the cover will reduce ventilation and cause overheat.*

◆ Installation Orientation and Spacing

NOTICE: *Install the drive upright as illustrated in **Figure 2.1**. Failure to comply may damage the drive due to improper cooling.*

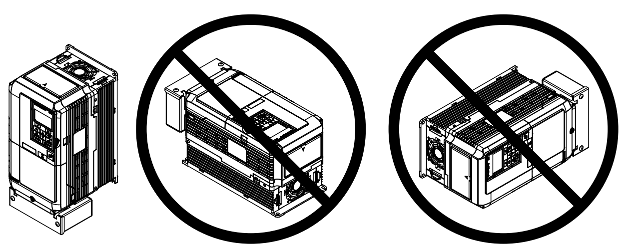
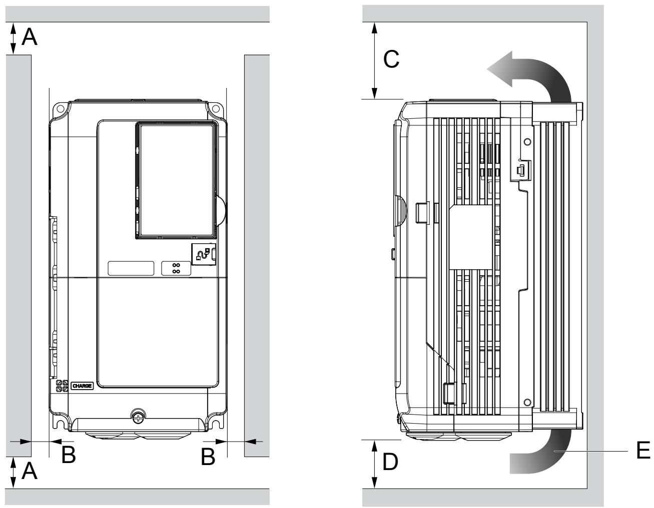


Figure 2.1 Correct Installation Orientation

NOTICE: *Install the drive upright as specified in the manual. Failure to comply may damage the drive due to improper cooling.*

■ Single Drive Installation

Figure 2.2 shows the installation distance required to maintain sufficient space for airflow and wiring.



A – 50 mm (1.97 in) minimum
B – 30 mm (1.18 in) minimum
C – 200 mm (7.87 in) minimum
D – 120 mm (4.72 in) minimum
E – Airflow direction

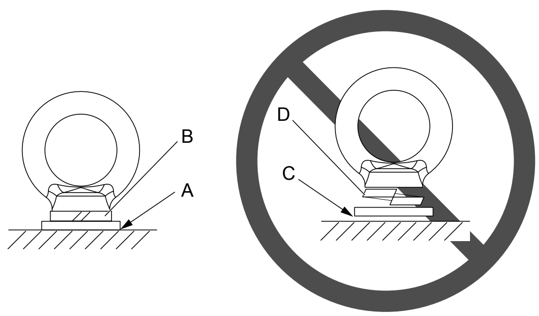
Figure 2.2 Correct Drive Installation Spacing

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

◆ Instructions on Installation Using the Eye Bolts and Hanging Brackets

Eye bolts and hanging brackets are used to install the drive or to temporarily lift the drive during drive replacement. Using the eye bolts and hanging brackets, the drive can be installed in an enclosure panel or on a wall. Do not leave the drive suspended by the wires in a horizontal or vertical position for long periods of time. Do not transport the drive over long distances. Read the following precautions and instructions before installing the drive.

WARNING! *Crush Hazard. Observe the following instructions and precautions. Failure to comply could result in serious injury or death from falling equipment.*
Only use vertical suspension to temporarily lift the drive during installation to an enclosure panel. Do not use vertical suspension to transport the drive.
Confirm that the spring washer is completely closed prior to lifting to prevent damage to the drive.
Use screws to securely affix the drive front cover, terminal blocks, and other drive components prior to vertical suspension.
Do not subject the drive to vibration or impact greater than 1.96 m/s^2 (0.2 G) while it is suspended by the wires.
Do not leave the drive unattended while it is suspended by the wires.
Do not attempt to flip the drive over while it is suspended by the wires.



A – No space between drive and washer
B – Spring washer fully closed
C – Space between drive and washer
D – Spring washer open

Figure 2.3 Spring Washer

■ Horizontal Suspension of Drive Models 2□0154 to 2□0248, 4□0156 to 4□0414

To make a wire hanger or frame for use when lifting the drive with a crane, lay the drive in a horizontal position and pass a wire through the hanging brackets.

NOTICE: *Use the hanging brackets on the top and hanging holes of the bottom cover when lifting drive models 2□0154F, 2□0192F, 4□0156F, and 4□0180F.*

2□0154A, 2□0192A, 2□0248,
4□0156A, 4□0180A, and 4□0216 to 4□0414

2□0154F, 2□0192F, 4□0156F, and 4□0180F

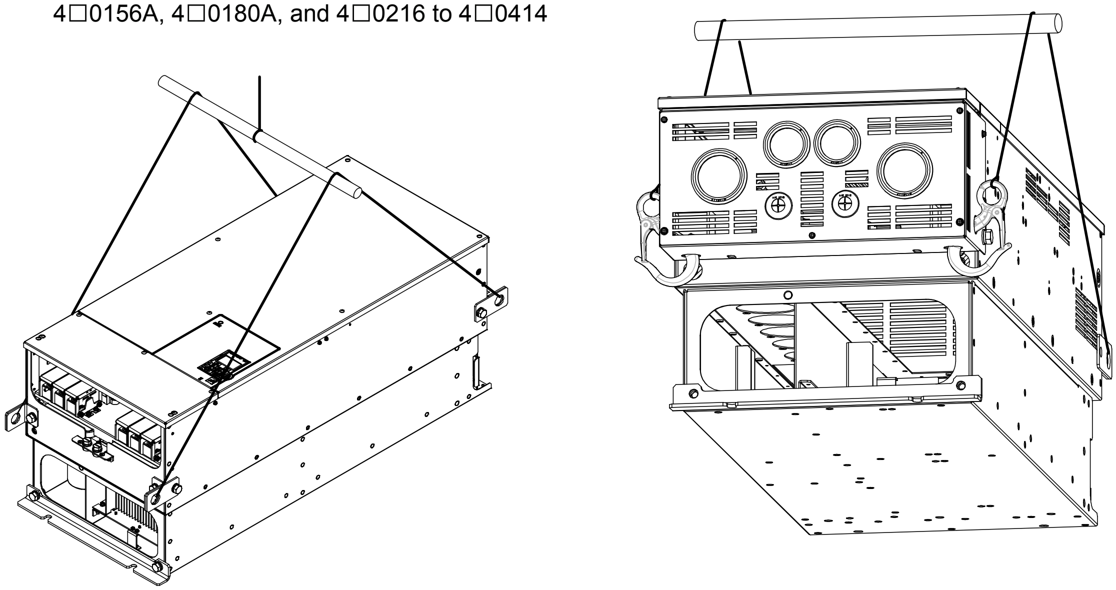


Figure 2.4 Horizontal Suspension of Drive Model 2□0154

■ Vertical Suspension of the Drive

Follow the procedure described below when suspending the drive with eye bolts or hanging brackets.

Drive Models 2□0028 to 2□0130 and 4□0011 to 4□0124

WARNING! *Crush Hazard. Use an adequate length of wire to ensure a 50° or wider suspension angle as illustrated in* ***Figure 2.5****. The maximum allowable load of the eye bolts cannot be guaranteed when the drive is suspended with the wires at angles less than 50°. Failure to comply may result in serious injury or death from falling equipment.*

1. Pass wire through the holes of the two eye bolts.

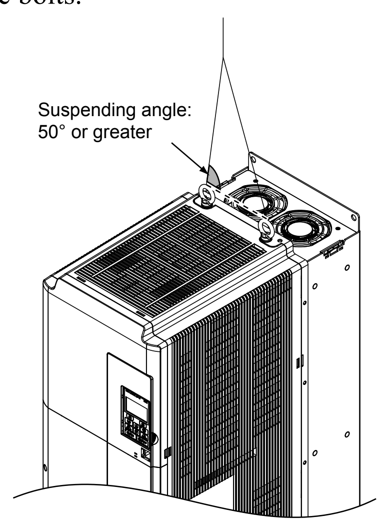


Figure 2.5 Suspension Using Wires and Eye Bolts

2. Gradually take up the slack in the wires and hoist the drive after the wires are stretched tight.
3. Lower the drive when ready to install in the enclosure panel. Stop lowering when near the floor, then slowly begin lowering the drive again until the drive is placed correctly.

Drive Models 2□0154 to 2□0248 and 4□0156 to 4□0414

WARNING! *Crush Hazard. Use an adequate length of wire to ensure a 50° or wider suspension angle as illustrated in* ***Figure 2.6****. The maximum allowable load of the eye bolts cannot be guaranteed when the drive is suspended with the wires at angles less than 50°. Failure to comply may result in serious injury or death from falling equipment.*

1. Remove the two hanging brackets from the drive lower side panels and bolt them on the top panel.

Note:
1. Tighten the hanging brackets with the specified tightening torque: M10: 18 to 23 N·m (159 to 204 in-lb), M12: 32 to 40 N·m (283 to 354 in-lb).
2. Four hanging brackets are attached to the top of IP20/UL Type 1 drives 2□0154F, 2□0192F, 4□0156F, and 4□0180F.

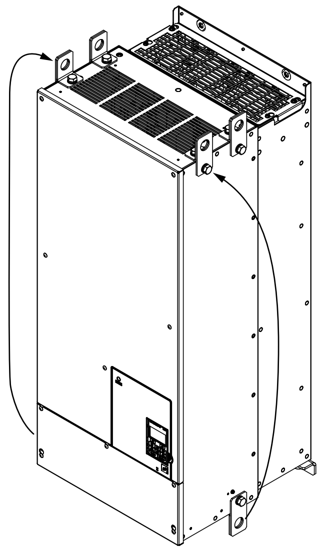


Figure 2.6 Location of Hanging Brackets (Drive Models 2□0154 to 2□0248 and 4□0156 to 4□0414)

2. Pass wire through the holes of all four hanging brackets.

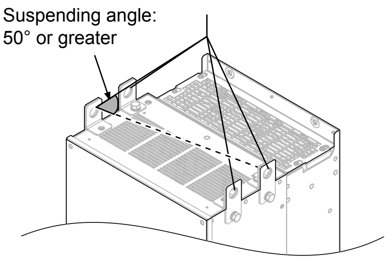


Figure 2.7 Drive Suspension Using Wires and Hanging Brackets (Drive Models 2□0154 to 2□0248 and 4□0156 to 4□0414)

3. Gradually take up the slack in the wires and hoist the drive after the wires are stretched tight.

4. Lower the drive when ready to install in the enclosure panel. Stop lowering the drive when it is near the floor, then slowly begin lowering the drive again until the drive is placed correctly.

◆ HOA Keypad Remote Usage

■ Remote Operation

The HOA keypad mounted on the drive can be removed and connected to the drive using a remote control 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 a remote control extension cable and an installation support set (depending on the installation type).

Note: *Refer to Peripheral Devices & Options on page 237* for information on remote control extension cables and installation support sets.

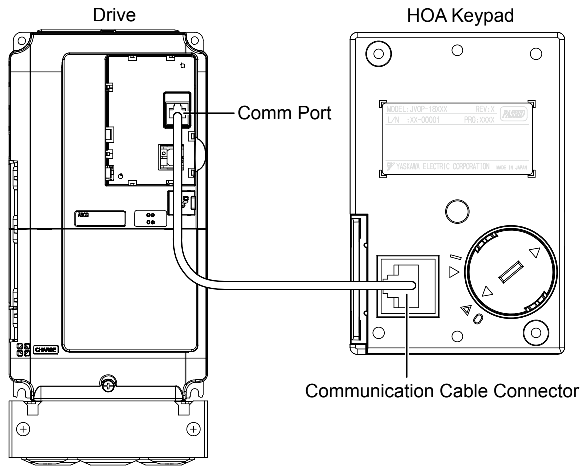


Figure 2.8 Communication Cable Connection

■ HOA Keypad Remote Installation

HOA Keypad Dimensions

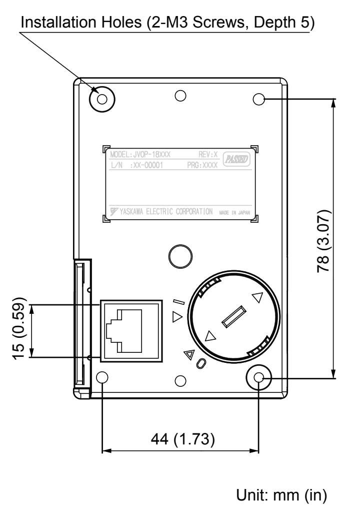


Figure 2.9 HOA Keypad Dimensions

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.*

External/Face-Mount

1. Cut an opening in the enclosure panel for the HOA keypad as shown in *Figure 2.10*.
2. Position the HOA keypad so the display faces outwards, and mount it to the enclosure panel as shown in *Figure 2.11*.

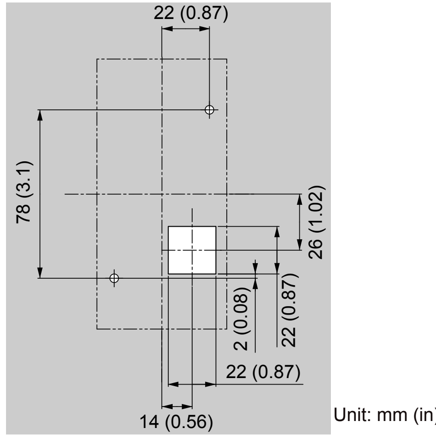


Figure 2.10 Panel Cut-Out Dimensions (External/Face-Mount Installation)

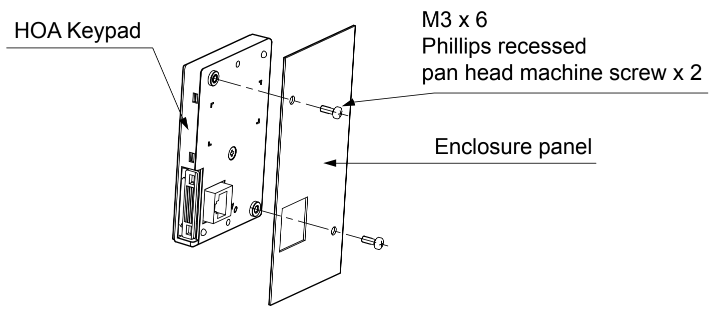


Figure 2.11 External/Face-Mount Installation

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 2.12* 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 2.13*.
2. Mount the HOA keypad to the installation support.
3. Mount the installation support set and HOA keypad to the enclosure panel.

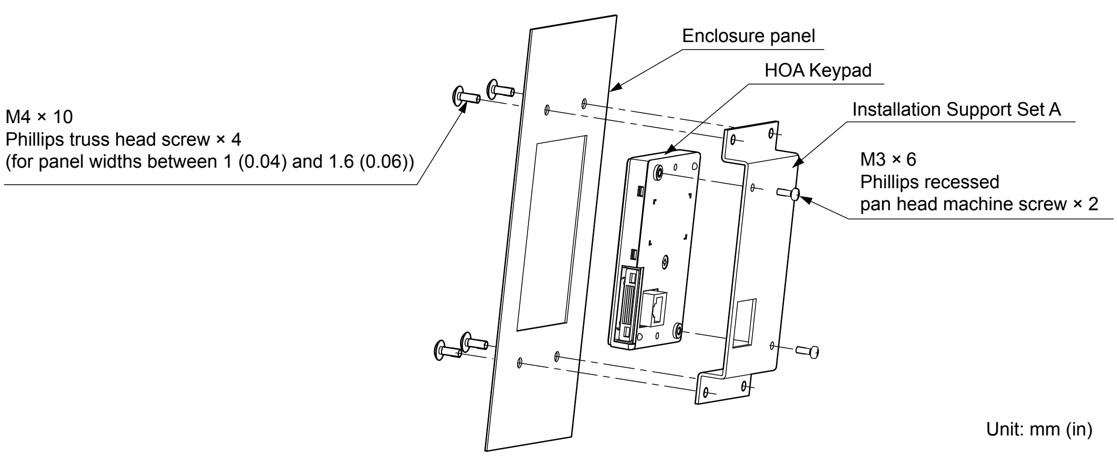
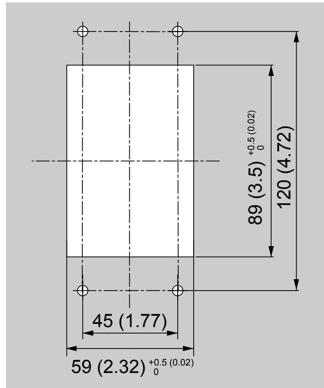


Figure 2.12 Internal/Flush Mount Installation

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 2.13 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	
IP00 Enclosure	2□0028A 2□0042A 2□0054A 2□0068A 2□0081A 2□0104A 2□0130A 2□0154A 2□0192A 2□0248A	4□0011A 4□0014A 4□0021A 4□0027A 4□0034A 4□0040A 4□0052A 4□0065A 4□0077A 4□0096A 4□0124A 4□0156A 4□0180A 4□0216A 4□0240A 4□0302A 4□0361A 4□0414A	*49*
IP20/UL Type 1 Enclosure	2□0028F 2□0042F 2□0054F 2□0068F 2□0081F 2□0104F 2□0130F 2□0154F 2□0192F 2□0248F	4□0011F 4□0014F 4□0021F 4□0027F 4□0034F 4□0040F 4□0052F 4□0065F 4□0077F 4□0096F 4□0124F 4□0156F 4□0180F 4□0216F 4□0240F 4□0302F 4□0361F 4□0414F	*51*

IP00 Enclosure Drives

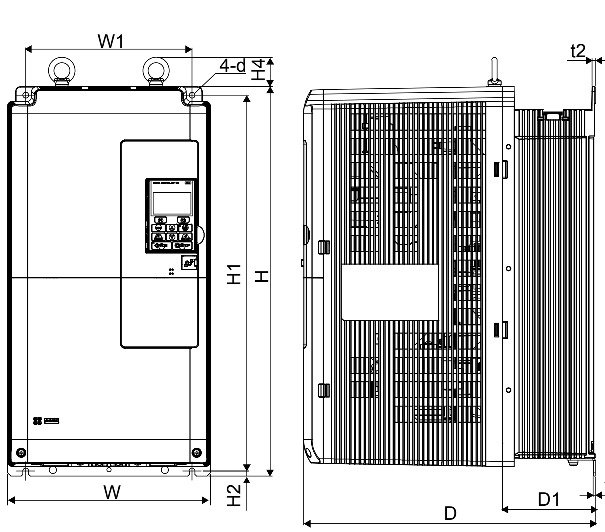


Figure 1

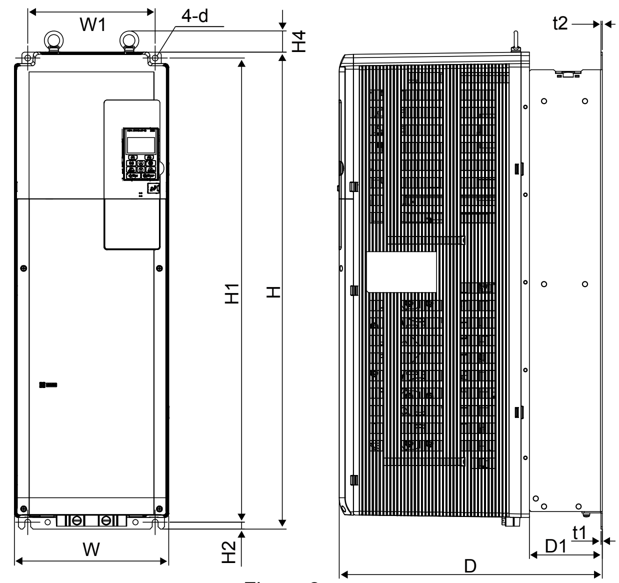


Figure 2

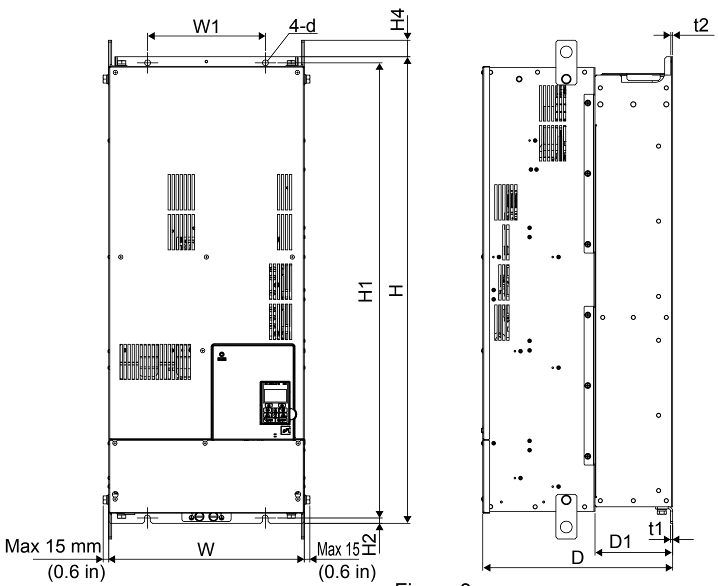


Figure 3

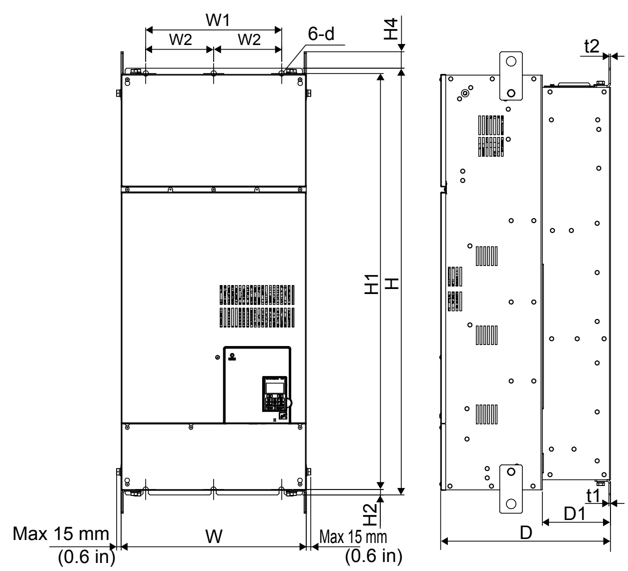


Figure 4

Table 2.4 Dimensions for IP00 Enclosure: 200 V Class

Drive Model	Figure	Dimensions mm (in)												Wt. kg (lb)	
		W	H	D	W1	W2	H1	H2	H4	D1	t1	t2	d	Models 2A□/ 2P□	Models 2E□/ 2W□
2□0028A	1	250 (9.84)	480 (18.89)	360 (14.17)	205 (8.07)	–	463 (18.22)	6.5 (0.25)	40 (1.58)	100 (3.93)	2.3 (0.10)	4 (0.16)	7 (0.28)	20 (44)	21 (46)
2□0042A	1	264 (10.39)	650 (25.60)	420 (16.53)	218 (8.58)	–	629 (24.73)	11.5 (0.45)	40 (1.58)	115.5 (4.54)	2.3 (0.10)	4 (0.16)	10 (0.40)	32 (71)	33 (73)
2□0054A															
2□0068A														35 (77)	36 (79)
2□0081A															
2□0104A	2	264 (10.39)	816 (32.12)	450 (17.71)	218 (8.58)	–	795 (31.29)	11.5 (0.45)	40 (1.58)	124.5 (4.90)	2.3 (0.10)	2.3 (0.10)	10 (0.40)	60 (132)	63 (139)
2□0130A															
2□0154A	3	415 (16.33)	900 (38.97)	403 (15.86)	250 (9.84)	–	966 (38.03)	11 (0.43)	40 (1.58)	165 (6.49)	4.5 (0.18)	3.9 (0.15)	12 (0.47)	110 (245)	115 (254)
2□0192A															
2□0248A	4	490 (19.29)	1132 (44.56)	450 (17.71)	360 (14.17)	180 (7.08)	1104 (43.46)	14.5 (0.57)	49 (1.92)	181 (7.12)	4.5 (0.18)	4.5 (0.18)	14 (0.55)	176 (388)	181 (399)

Table 2.5 Dimensions for IP00 Enclosure: 400 V Class

Drive Model	Figure	Dimensions mm (in)												Wt. kg (lb)	
		W	H	D	W1	W2	H1	H2	H4	D1	t1	t2	d	Models 4A□/ 4P□	Models 4E□/ 4W□
4□0011A	1	250 (9.84)	480 (18.89)	360 (14.17)	205 (8.07)	–	463 (18.22)	6.5 (0.25)	40 (1.58)	100 (3.93)	2.3 (0.10)	4 (0.16)	7 (0.28)	20 (44)	21 (46)
4□0014A															
4□0021A															
4□0027A															
4□0034A															
4□0040A		264 (10.39)	650 (25.60)	420 (16.53)	218 (8.58)	–	629 (24.73)	11.5 (0.45)	40 (1.57)	115.5 (4.54)	2.3 (0.10)	4 (0.16)	10 (0.40)	32 (71)	33 (73)
4□0052A															
4□0065A														35 (77)	36 (79)
4□0077A															
4□0096A	2	264 (10.39)	816 (32.12)	450 (17.71)	218 (8.58)	–	795 (31.29)	11.5 (0.45)	40 (1.57)	124.5 (4.90)	2.3 (0.10)	2.3 (0.10)	10 (0.28)	60 (132)	63 (139)
4□0124A															
4□0156A	3	415 (16.33)	990 (38.97)	403 (15.86)	250 (9.84)	–	966 (38.03)	11 (0.43)	40 (1.57)	165 (6.49)	4.5 (0.18)	3.9 (0.15)	12 (0.47)	110 (245)	115 (254)
4□0180A															
4□0216A	4	490 (19.29)	1132 (44.56)	450 (17.71)	360 (14.17)	180 (7.08)	1104 (43.46)	14.5 (0.57)	49 (1.92)	181 (7.12)	4.5 (0.18)	4.5 (0.18)	14 (0.55)	176 (388)	181 (399)
4□0240A															
4□0302A		695 (27.36)	1132 (44.56)	450 (17.71)	560 (22.04)	280 (11.02)	1102 (43.39)	14.5 (0.57)	65 (2.55)	178 (7.00)	4.5 (0.18)	4.5 (0.18)	14 (0.55)	259 (571)	267 (589)
4□0361A															
4□0414A															

IP20/UL Type 1 Enclosure Drives

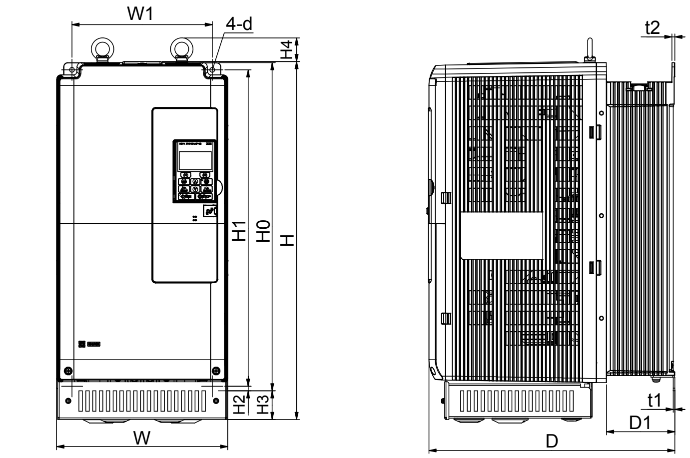


Figure 1

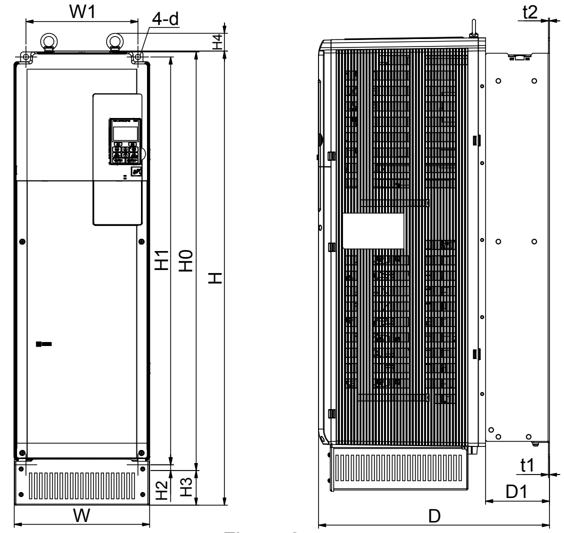


Figure 2

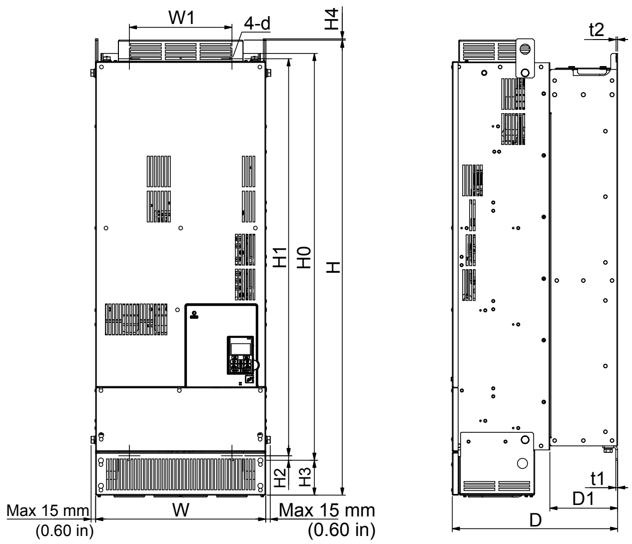


Figure 3

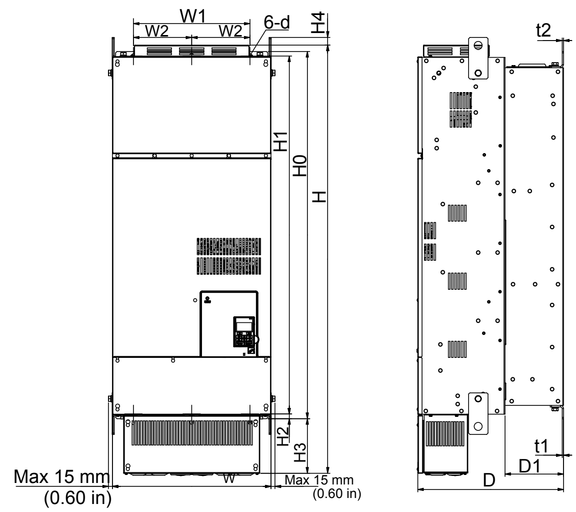


Figure 4

Table 2.6 Dimensions for IP20/UL Type 1 Enclosure: 200 V Class

Drive Model	Figure	Dimensions mm (in)														Wt. kg (lb)	
		W	H	D	W1	W2	H0	H1	H2	H3	H4	D1	t1	t2	d	Models 2A□/ 2P□	Models 2E□/ 2W□
2□0028F	1	250 (9.84)	524 (20.62)	360 (14.17)	205 (8.07)	–	480 (1890)	463 (18.22)	6.5 (0.25)	42 (1.65)	40 (1.58)	100 (3.93)	2.3 (0.10)	4 (0.16)	7 (0.28)	21.5 (47)	22.5 (50)
2□0042F	1	264 (10.39)	705 (27.75)	420 (16.53)	218 (8.58)	–	650 (25.59)	629 (24.73)	11.5 (0.45)	54 (2.12)	40 (1.58)	115.5 (4.54)	2.3 (0.10)	4 (0.16)	10 (0.40)	34 (75)	35 (77)
2□0054F																	
2□0068F																37 (82)	38 (84)
2□0081F																	
2□0104F	2	264 (10.39)	885 (34.84)	450 (17.71)	218 (8.58)	–	816 (32.12)	795 (31.29)	11.5 (0.45)	68 (2.67)	40 (1.58)	124.5 (4.90)	2.3 (0.10)	2.3 (0.10)	10 (0.40)	62 (137)	65 (143)
2□0130F																	
2□0154F	3	415 (16.33)	1107 (43.58)	403 (15.86)	250 (9.84)	–	990 (38.97)	966 (38.03)	11 (0.43)	85 (3.34)	8 (0.31)	165 (6.49)	4.5 (0.18)	3.9 (0.15)	12 (0.47)	113 (249)	118 (260)
2□0192F																	
2□0248F	4	490 (19.29)	1320 (51.96)	450 (17.71)	360 (14.17)	180 (7.08)	1132 (44.56)	1104 (43.46)	14.5 (0.57)	169 (6.65)	29 (1.14)	181 (7.12)	4.5 (0.18)	4.5 (0.18)	14 (0.55)	180 (397)	185 (408)

Table 2.7 Dimensions for IP20/UL Type 1 Enclosure: 400 V Class

<table>
<tr><th rowspan="2">Drive Model</th><th rowspan="2">Figure</th><th colspan="14">Dimensions mm (in)</th><th colspan="2">Wt. kg (lb)</th></tr>
<tr><th>W</th><th>H</th><th>D</th><th>W1</th><th>W2</th><th>H0</th><th>H1</th><th>H2</th><th>H3</th><th>H4</th><th>D1</th><th>t1</th><th>t2</th><th>d</th><th>Models 4A□/ 4P□</th><th>Models 4E□/ 4W□</th></tr>
<tr><td>4□0011F</td><td rowspan="9">1</td><td rowspan="5">250 (9.84)</td><td rowspan="5">524 (20.62)</td><td rowspan="5">360 (14.17)</td><td rowspan="5">205 (8.07)</td><td rowspan="5">–</td><td rowspan="5">480 (18.90)</td><td rowspan="5">463 (18.22)</td><td rowspan="5">6.5 (0.25)</td><td rowspan="5">42 (1.65)</td><td rowspan="5">40 (1.58)</td><td rowspan="5">100 (3.93)</td><td rowspan="5">2.3 (0.10)</td><td rowspan="5">4 (0.15)</td><td rowspan="5">7 (0.27)</td><td rowspan="5">21.5 (47)</td><td rowspan="5">22.5 (50)</td></tr>
<tr><td>4□0014F</td></tr>
<tr><td>4□0021F</td></tr>
<tr><td>4□0027F</td></tr>
<tr><td>4□0034F</td></tr>
<tr><td>4□0040F</td><td rowspan="4">264 (10.39)</td><td rowspan="4">705 (27.75)</td><td rowspan="4">420 (16.53)</td><td rowspan="4">218 (8.58)</td><td rowspan="4">–</td><td rowspan="4">650 (22.59)</td><td rowspan="4">629 (24.73)</td><td rowspan="4">11.5 (0.45)</td><td rowspan="4">54 (2.12)</td><td rowspan="4">40 (1.57)</td><td rowspan="4">115.5 (4.55)</td><td rowspan="4">2.3 (0.10)</td><td rowspan="4">4 (0.15)</td><td rowspan="4">10 (0.40)</td><td rowspan="2">34 (75)</td><td rowspan="2">35 (77)</td></tr>
<tr><td>4□0052F</td></tr>
<tr><td>4□0065F</td><td rowspan="2">37 (82)</td><td rowspan="2">38 (84)</td></tr>
<tr><td>4□0077F</td></tr>
<tr><td>4□0096F</td><td rowspan="2">2</td><td rowspan="2">264 (10.39)</td><td rowspan="2">885 (34.84)</td><td rowspan="2">450 (17.71)</td><td rowspan="2">218 (8.58)</td><td rowspan="2">–</td><td rowspan="2">816 (32.12)</td><td rowspan="2">795 (31.29)</td><td rowspan="2">11.5 (0.45)</td><td rowspan="2">68 (2.67)</td><td rowspan="2">40 (1.57)</td><td rowspan="2">124.5 (4.90)</td><td rowspan="2">2.3 (0.10)</td><td rowspan="2">2.3 (0.10)</td><td rowspan="2">10 (0.40)</td><td rowspan="2">62 (137)</td><td rowspan="2">65 (143)</td></tr>
<tr><td>4□0124F</td></tr>
<tr><td>4□0156F</td><td rowspan="2">3</td><td rowspan="2">415 (16.33)</td><td rowspan="2">1107 (43.58)</td><td rowspan="2">403 (15.86)</td><td rowspan="2">250 (9.84)</td><td rowspan="2">–</td><td rowspan="2">990 (38.97)</td><td rowspan="2">966 (38.03)</td><td rowspan="2">11 (0.43)</td><td rowspan="2">85 (3.34)</td><td rowspan="2">8 (0.31)</td><td rowspan="2">165 (6.49)</td><td rowspan="2">4.5 (0.18)</td><td rowspan="2">3.9 (0.15)</td><td rowspan="2">12 (0.47)</td><td rowspan="2">113 (249)</td><td rowspan="2">118 (260)</td></tr>
<tr><td>4□0180F</td></tr>
<tr><td>4□0216F</td><td rowspan="5">4</td><td rowspan="2">490 (19.29)</td><td rowspan="2">1320 (51.96)</td><td rowspan="2">450 (17.71)</td><td rowspan="2">360 (14.17)</td><td rowspan="2">180 (7.08)</td><td rowspan="2">1132 (44.56)</td><td rowspan="2">1104 (43.46)</td><td rowspan="2">14.5 (0.57)</td><td rowspan="2">169 (6.65)</td><td rowspan="2">29 (1.14)</td><td rowspan="2">181 (7.12)</td><td rowspan="2">4.5 (0.18)</td><td rowspan="2">4.5 (0.18)</td><td rowspan="2">14 (0.55)</td><td rowspan="2">180 (398)</td><td rowspan="2">185 (408)</td></tr>
<tr><td>4□0240F</td></tr>
<tr><td>4□0302F</td><td rowspan="3">695 (27.36)</td><td rowspan="3">1460 (57.48)</td><td rowspan="3">450 (17.71)</td><td rowspan="3">560 (22.05)</td><td rowspan="3">280 (11.02)</td><td rowspan="3">1132 (44.56)</td><td rowspan="3">1102 (43.39)</td><td rowspan="3">14.5 (0.57)</td><td rowspan="3">300 (11.81)</td><td rowspan="3">29 (1.14)</td><td rowspan="3">178 (7.00)</td><td rowspan="3">4.5 (0.18)</td><td rowspan="3">4.5 (0.18)</td><td rowspan="3">14 (0.55)</td><td rowspan="3">270 (595)</td><td rowspan="3">278 (613)</td></tr>
<tr><td>4□0361F</td></tr>
<tr><td>4□0414F</td></tr>
</table>

3

Electrical Installation

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

3.1 Section Safety

DANGER

Electrical Shock Hazard

Before servicing, disconnect all power to the equipment.

The capacitor for the control power supply remains charged even after the power supply is turned off. The charge indicator LED will extinguish when the control power supply voltage is below 50 Vdc. To prevent electric shock, wait for at least the time specified on the warning label, once all indicators are OFF, measure for unsafe voltages to confirm the drive is safe prior to servicing.

Failure to comply will result in death or serious injury.

WARNING

Arc Flash Hazard

It is possible that there is more than one source of power for the equipment.

Obey the requirements for Electrical Safety in the Workplace and local codes for safe work procedures and applicable personal protective equipment (PPE).

Failure to obey can cause serious injury or death.

Electrical Shock Hazard

Do not operate equipment with covers removed.

Failure to comply could result in death or serious injury.

The diagrams in this section may show drives without covers or safety shields to show details. Be sure to reinstall covers or shields before operating the drives and run the drives according to the instructions described in this manual.

Always 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/EN 60755.

Always ground the motor-side grounding terminal.

Improper equipment grounding could result in death or serious injury by contacting the motor case.

Do not perform work on the drive while wearing loose clothing, jewelry or without eye protection.

Failure to comply could result in death or serious injury.

Remove all metal objects such as watches and rings, secure loose clothing, and wear eye protection before beginning work on the drive.

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

Failure to comply could result in death or serious injury.

Do not allow unqualified personnel to perform work on the drive.

Failure to comply could result in death or serious injury.

Installation, maintenance, inspection, and service must be performed only by authorized personnel familiar installation, adjustment, and maintenance of drives.

Do not touch any terminals before the capacitors have fully discharged.

Failure to comply could result in death or serious injury.

Before wiring terminals, disconnect all power to the equipment. The capacitor for the control power supply 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

Fire Hazard

Tighten all terminal screws to the specified tightening torque.

Loose electrical connections could result in death or serious injury by fire due to overheating of electrical connections.

Do not use improper combustible materials.

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

Attach the drive to metal or other noncombustible material.

Do not use an improper voltage source.

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

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

⚠ CAUTION

Do not carry the drive by the front cover or the terminal cover.

Failure to comply may cause the main body of the drive to fall, resulting in minor or moderate injury.

NOTICE

Perform a final check of all sequence wiring and other connections prior to applying power.

Failure to comply may cause erroneous operation or damage to the drive.

Ensure there are no short circuits on the control terminals.

Failure to comply may damage the drive.

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.

Never connect or disconnect the motor from the drive while the drive is outputting voltage.

Improper equipment sequencing could result in damage to the drive.

Do not use unshielded cable for control wiring.

Failure to comply may cause electrical interference resulting in poor system performance. Use shielded, twisted-pair wires and ground the shield to the ground terminal of the drive.

Use ring terminals that comply with UL/cUL for all wire ends.

Failure to comply may damage the drive.

Use only the tools recommended by the terminal manufacturer for crimping.

Failure to comply may damage the drive.

Do not allow unqualified personnel to use the product.

Failure to comply may damage the drive.

Carefully review instruction manual when connecting, wiring, or replacing the drive.

Do not modify the drive circuitry.

Failure to comply may damage the drive and will void warranty.

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

NOTICE

Check all the wiring to ensure that all connections are correct after installing the drive and connecting any other devices.

Failure to comply may damage the drive.

Comply with proper wiring practices

The motor may run in reverse if the phase order is incorrect.

Connect motor input terminals U, V, and W to drive output terminals U/T1, V/T2, and W/T3. The phase order for the drive and motor should match.

3.2 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 HOA keypad without connecting digital I/O wiring.

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. When using a 3-Wire sequence, set the drive to 3-Wire sequence prior to wiring the control terminals and set parameter b1-17 to 0 so the drive will not accept a Run command at power up (default). If the drive is wired for a 3-Wire sequence but set up for a 2-Wire sequence (default), and parameter b1-17 is set to 1 so the drive accepts a Run command at power up, the motor will rotate in reverse direction at drive power up and may cause injury.*

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 A1-06 ≠ 0 will change the drive I/O terminal functions and may cause unexpected equipment operation. Failure to comply may cause death or serious injury.*

WARNING! *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.*

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 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: 4E□□□□ and 4W□□□□), and 500 Vac maximum (400 V class: 4U□□□□ and 4P□□□□) when protected by branch circuit protection devices specified in this document.*

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.*

NOTICE: *Route motor leads U/T1, V/T2, and W/T3 separate from all other leads to reduce possible interference related issues. Failure to comply may result in abnormal operation of drive and nearby equipment.*

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

NOTICE: *Create a sequence to shut off power on the power supply side by using a fault relay output as shown in the standard connection diagram, or create a sequence that prevents the motor shaft from being turned by an external force. If you continue to input power from a power supply with a large distortion or if an external force causes the motor shaft to continue turning even after an SoH (Snubber Discharge Resistor Overheat) occurs, the snubber resistor may break.*

NOTICE: *Do not connect more than one multi-function input to one terminal. Improper wiring may result in drive malfunction. Use an external power supply when sharing a terminal with more than one input. Do not use the built-in +24 V power supply.*

■ Drive Models 2□0028 to 2□0248 and 4□0011 to 4□0414

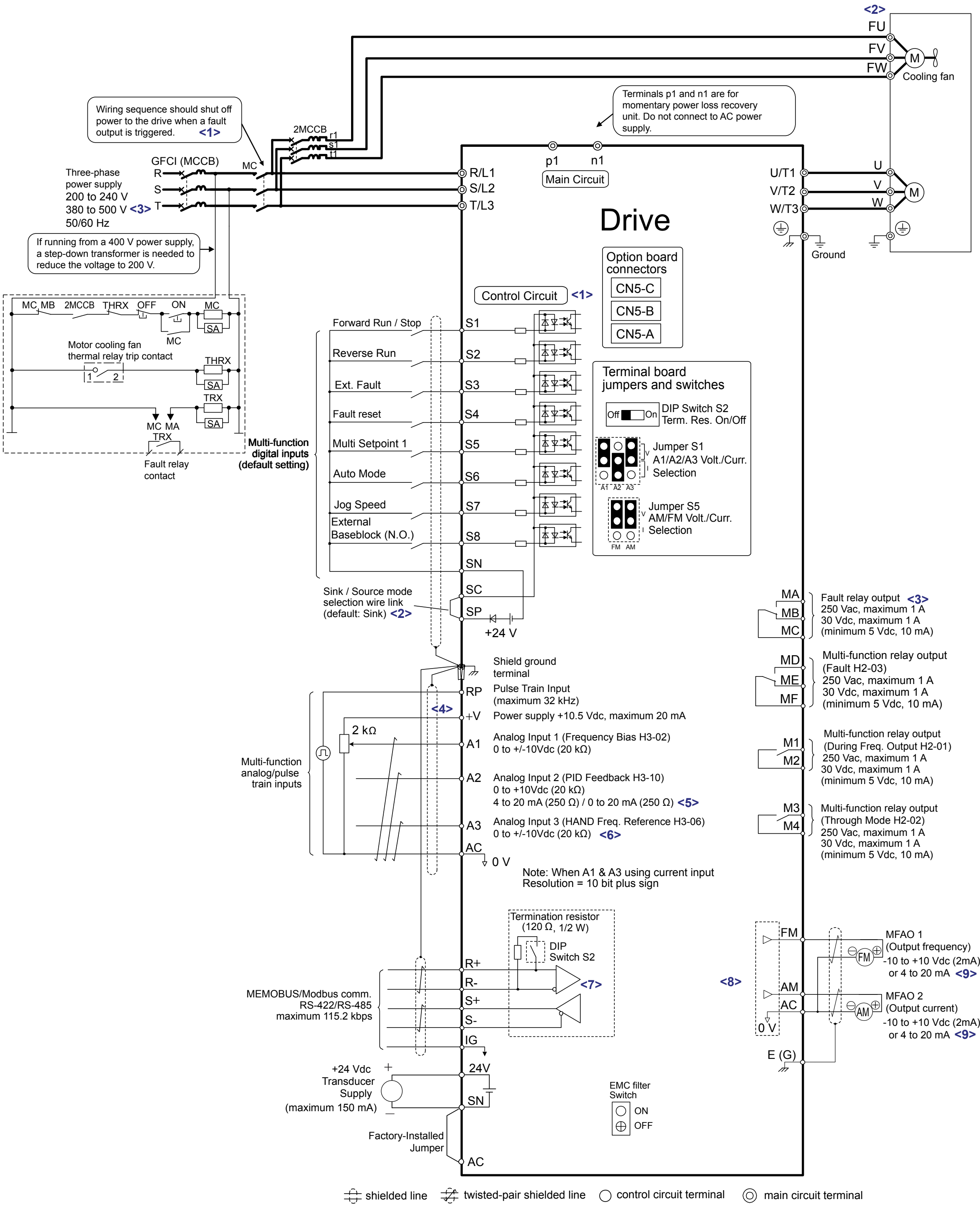


Figure 3.1 Drive Standard Connection Diagram (Example: Model 2□0028)

<1> When setting L5-02 to 1 to trigger a fault output whenever the fault restart function is activated, a sequence to interrupt power when a fault occurs will turn off power to the drive as the drive attempts to restart. The default setting for L5-02 is 0 (Fault output not active during restart attempt).

<2> Self-cooling motors do not require wiring that is necessary for motors using a cooling fan.

<3> Use a three-phase power supply with a voltage of 380 to 480 V for drive models 4□0011 to 4□0414 (built–in EMC filter).

<4> Supplying power to the control circuit separately from the main circuit requires 24 V power supply (option).

<5> 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. ***Refer to Control I/O Connections on page 85*** for details.

<6> Wire the fault relay output separately from the main circuit power supply and other power lines.

<7> The maximum output current capacity for the +V terminal on the control circuit is 20 mA. Never short terminals +V or AC, as it can cause erroneous operation or damage the drive.

<8> Set jumper S1 to select between a voltage or current input signal to terminal A2. The default setting is for current input.

<9> Set jumper S1 to select between a voltage or current input signal to terminal A1 and A3. The default setting is for current input.

<10> Set DIP switch S2 to the ON position to enable the termination resistor in the last drive in a MEMOBUS/Modbus network.

<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.

<12> 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.

3.3 Main Circuit Connection Diagram

Refer to *Figure 3.2* when wiring the main circuit of the drive.

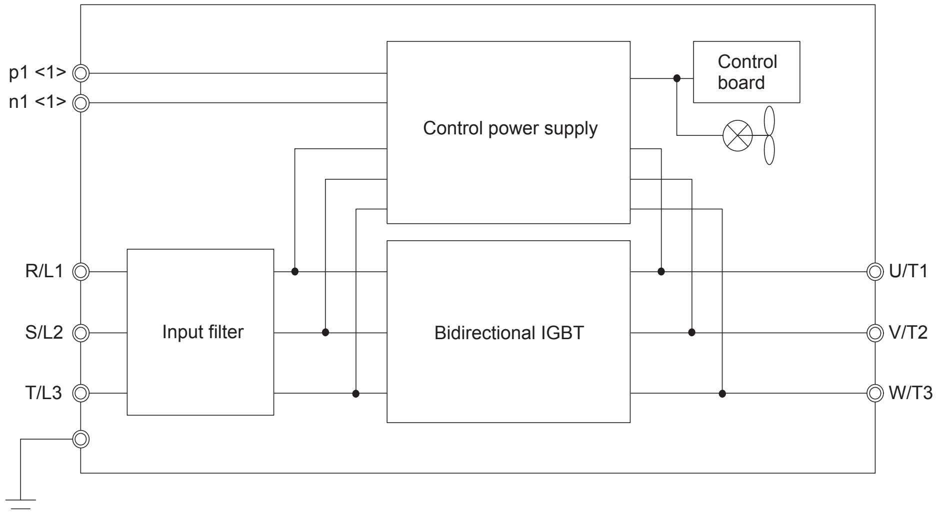


Figure 3.2 Connecting Main Circuit Terminals

<1> A Momentary Power Loss Recovery Unit can be connected as an option. Do not connect an AC power supply to these terminals.

3.4 Terminal Block Configuration

Figure 3.3 to *Figure 3.8* show the different main circuit terminal arrangements for the drive capacities. Use *Table 3.1* to determine the correct figure based on drive model.

Table 3.1 Terminal Block Configuration

Voltage Class	Drive Model	Figure
200 V Class	2□0028	*Figure 3.3*
	2□0042	*Figure 3.4*
	2□0054	
	2□0068	
	2□0081	
	2□0104	*Figure 3.5*
	2□0130	
	2□0154	*Figure 3.6*
	2□0192	
	2□0248	*Figure 3.7*
400 V Class	4□0011	*Figure 3.3*
	4□0014	
	4□0021	
	4□0027	
	4□0034	
	4□0040	*Figure 3.4*
	4□0052	
	4□0065	
	4□0077	
	4□0096	*Figure 3.5*
	4□0124	
	4□0156	*Figure 3.6*
	4□0180	
	4□0216	*Figure 3.7*
	4□0240	
	4□0302	*Figure 3.8*
	4□0361	
	4□0414	

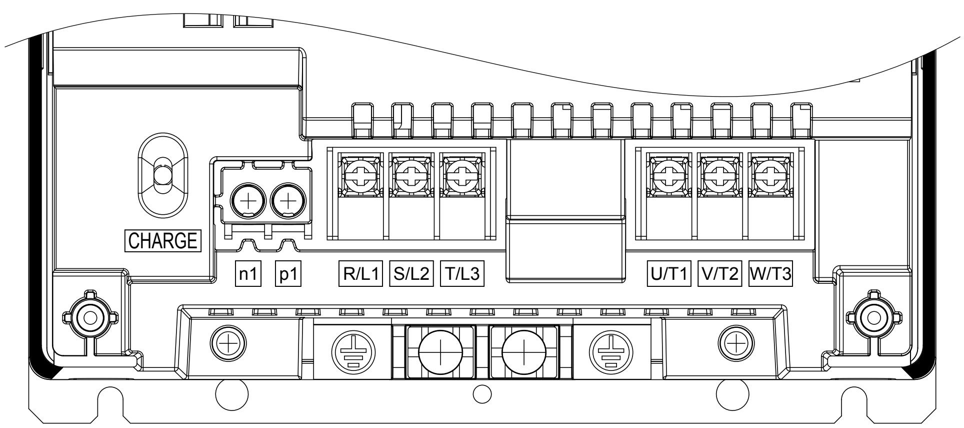


Figure 3.3 Main Circuit Terminal Configuration (Drive Models 2□0028 and 4□0011 to 4□0034)

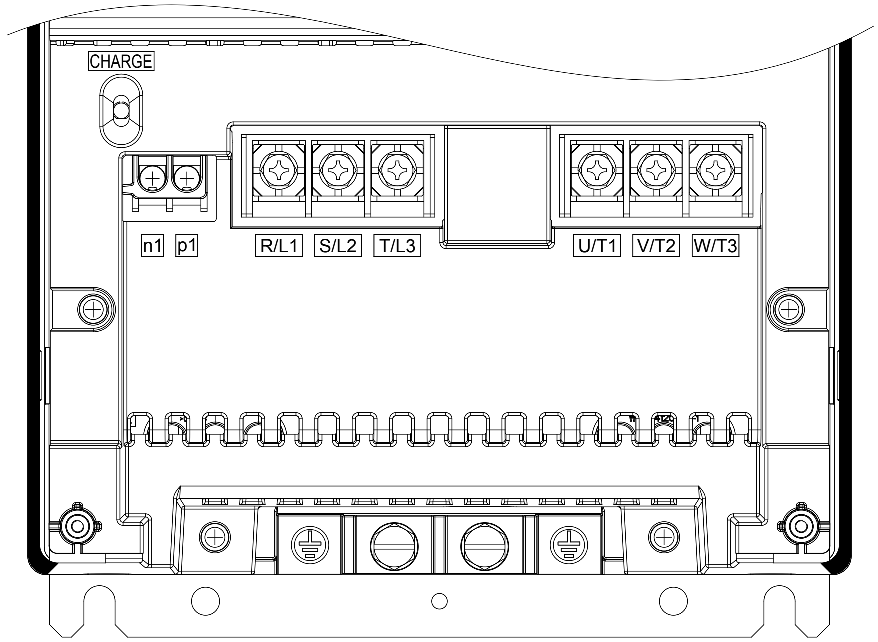


Figure 3.4 Main Circuit Terminal Configuration (Drive Models 2□0042 to 2□0081 and 4□0040 to 4□0077)

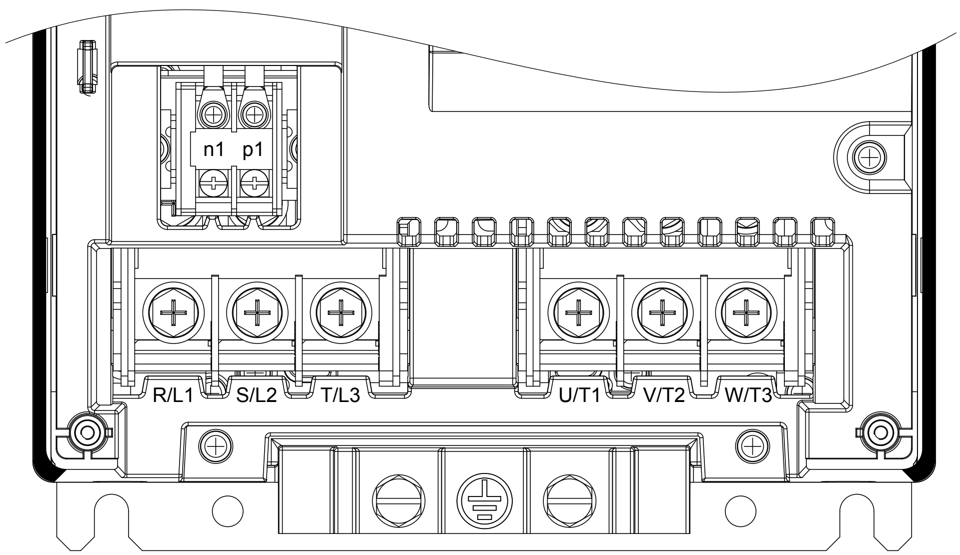


Figure 3.5 Main Circuit Terminal Configuration (Drive Models 2□0104, 2□0130, 4□0096, and 4□0124)

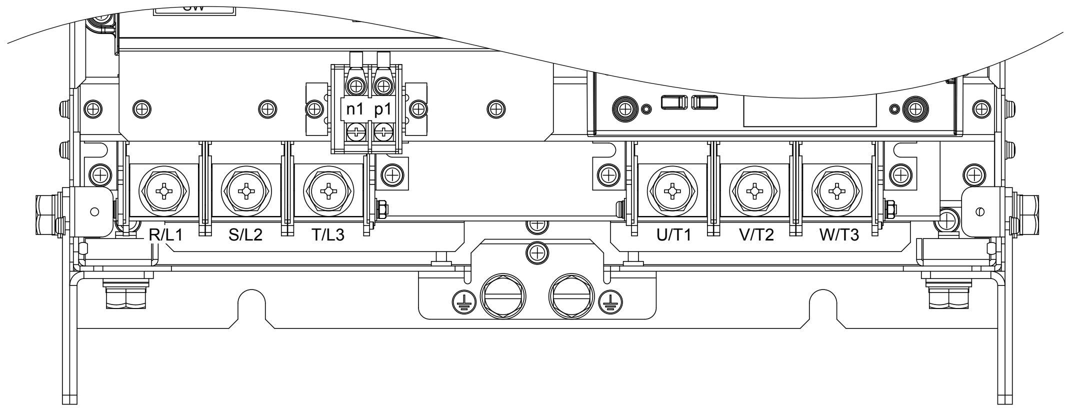


Figure 3.6 Main Circuit Terminal Configuration (Drive Models 2□0154, 2□0192, 4□0156, and 4□0180)

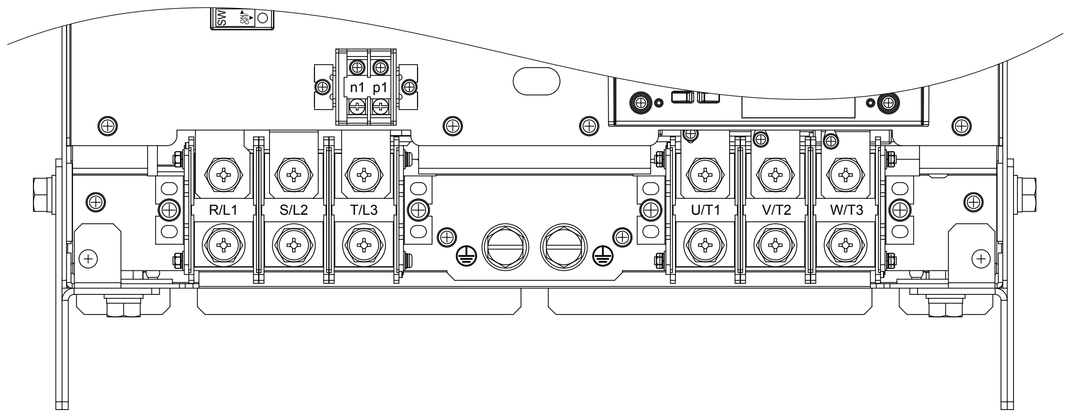


Figure 3.7 Main Circuit Terminal Configuration (Drive Models 2□0248, 4□0216, and 4□0240)

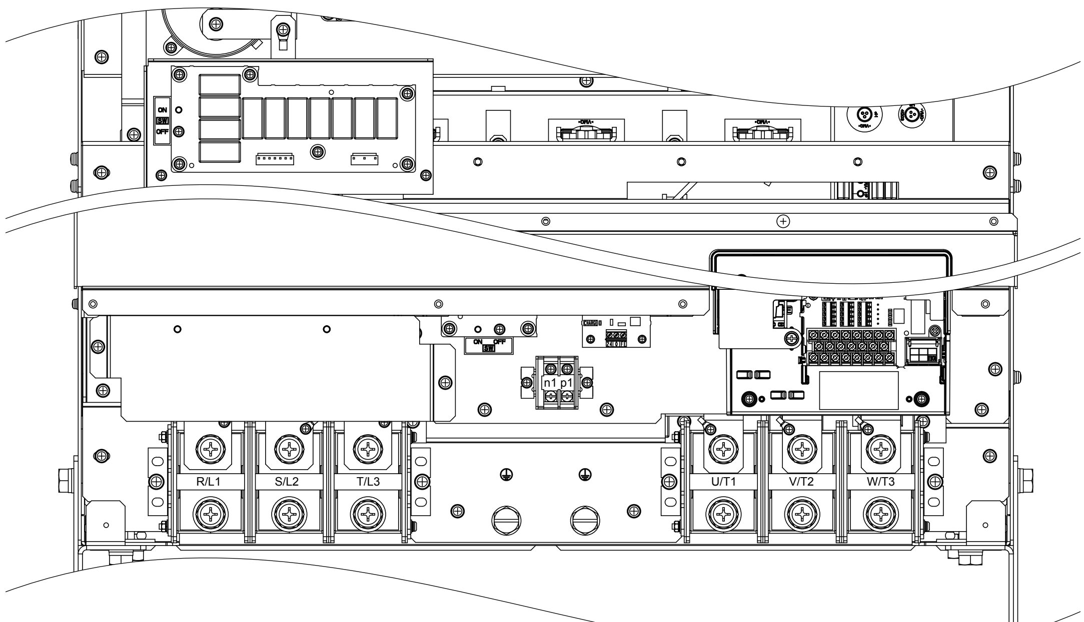


Figure 3.8 Main Circuit Terminal Configuration (Drive Models 4□0302 to 4□0414)

Electrical Installation

3

3.5 Terminal Cover

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

◆ Drive Models 2□0028 to 2□0130 and 4□0011 to 4□0124

■ Removing the Terminal Cover

1. Loosen the terminal cover screw.

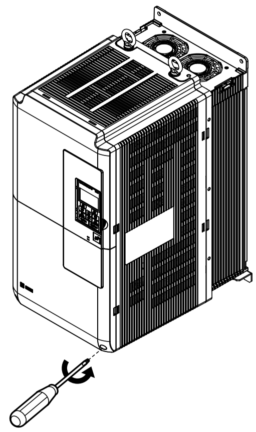


Figure 3.9 Removing the Terminal Cover

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

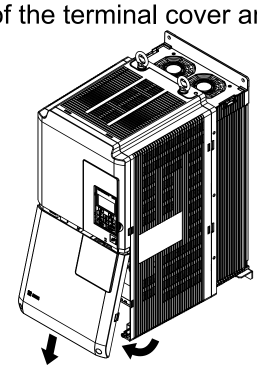


Figure 3.10 Removing the Terminal Cover

■ Reattaching the Terminal Cover

Power lines and signal wiring should pass through the opening provided. *Refer to Wiring the Main Circuit Terminal on page 78* and *Wiring the Control Circuit Terminal* on page *82* for details on wiring.

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

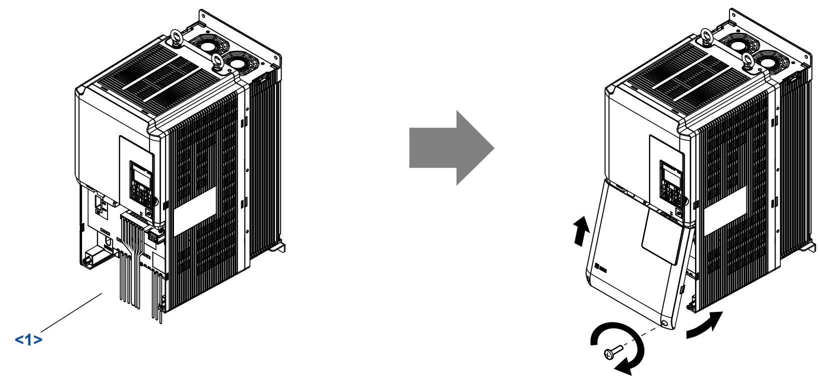


Figure 3.11 Reattaching the Terminal Cover

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

◆ Drive Models 2□0154 to 2□0248 and 4□0156 to 4□0414

■ Removing the Terminal Cover

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

   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.*

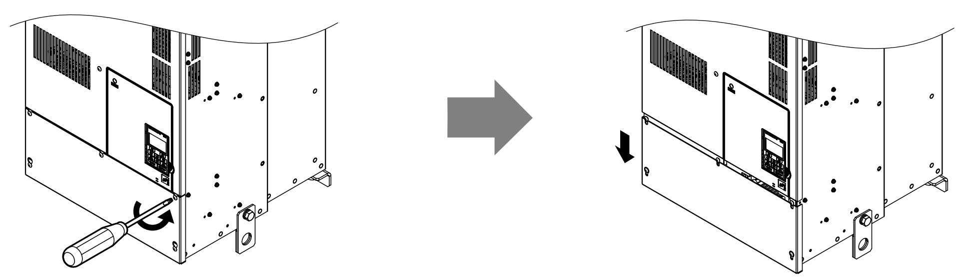


Figure 3.12   Removing the Terminal Cover

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

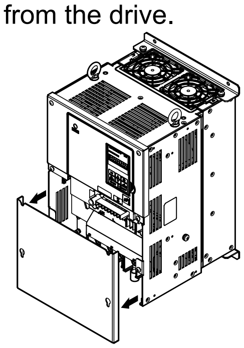


Figure 3.13 Removing the Terminal Cover

■ 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 78*** and ***Wiring the Control Circuit Terminal*** on page ***82*** for details on wiring.

Electrical Installation

3

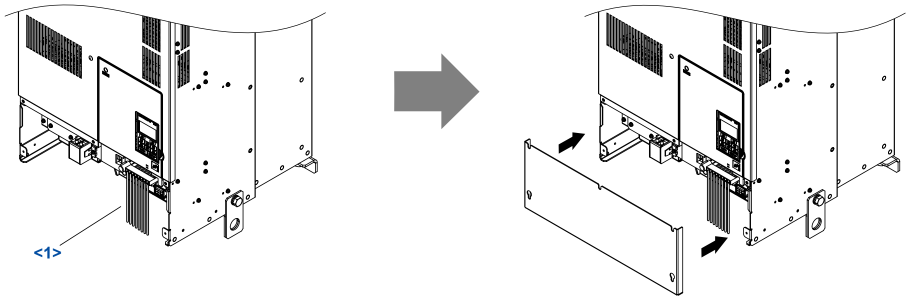


Figure 3.14 Reattaching the Terminal Cover

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

3.6 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 HOA keypad, pull the HOA keypad forward to remove it from the drive.

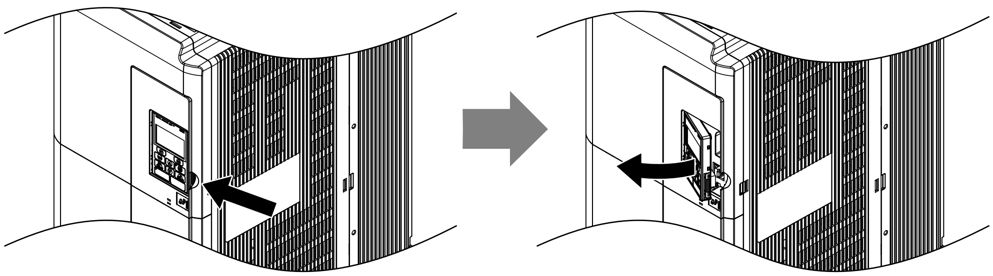


Figure 3.15 Removing the HOA Keypad

■ 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.

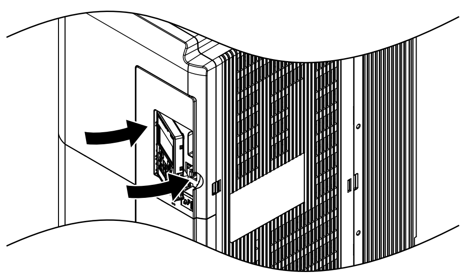


Figure 3.16 Reattaching the HOA Keypad

◆ Removing/Reattaching the Front Cover

■ Removing the Front Cover

Drive Models 2□0028 to 2□0130 and 4□0011 to 4□0124

After removing the terminal cover and the digital operator, loosen the screw that affixes 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.

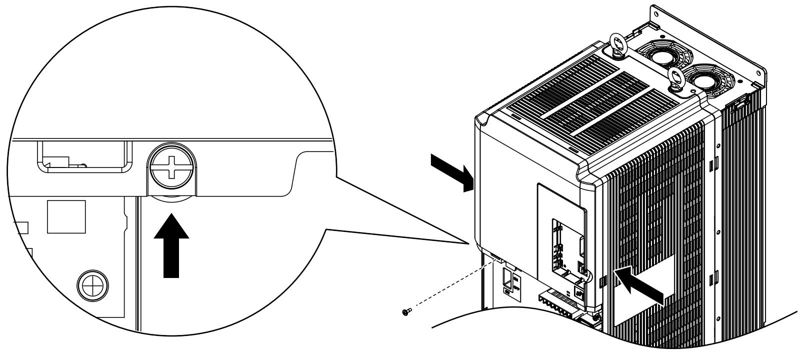


Figure 3.17 Remove the Front Cover (Drive Models 2□0028 to 2□0130 and 4□0011 to 4□0124)

Drive Models 2□0154 to 2□0248 and 4□0156 to 4□0414

1. Remove the terminal cover and the digital operator.
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.

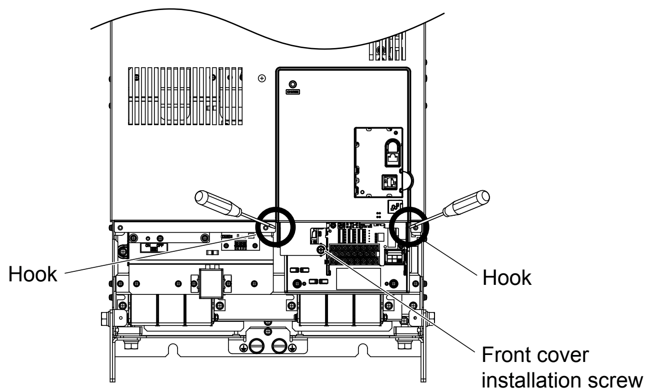


Figure 3.18 Remove the Front Cover (Drive Models 2□0154 to 2□0248 and 4□0156 to 4□0414)

4. Unhook the left side of the front cover then swing the left side towards you as shown in *Figure 3.19* until the cover comes off.

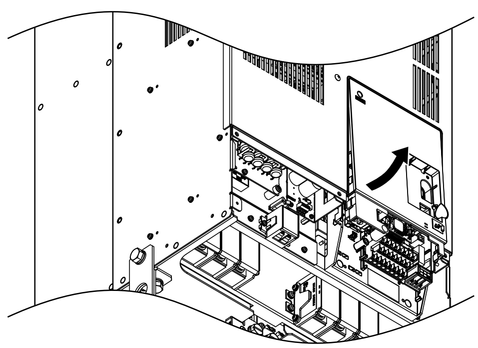


Figure 3.19 Remove the Front Cover (Drive Models 2□0154 to 2□0248 and 4□0156 to 4□0414)

■ Reattaching the Front Cover

Drive Models 2□0028 to 2□0130 and 4□0011 to 4□0124

Reverse the instructions given in *Remove the Front Cover (Drive Models 2□0028 to 2□0130 and 4□0011 to 4□0124)* on page ***68*** 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.

Drive Models 2□0154 to 2□0248 and 4□0156 to 4□0414

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

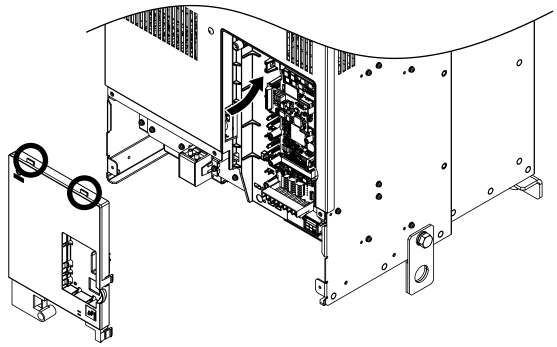


Figure 3.20 Reattach the Front Cover (Drive Models 2□0154 to 2□0248 and 4□0156 to 4□0414)

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

3.7 Top Protective Cover

Drive models with IP00 specifications become IP20/UL Type 1 after correctly installing a top protective cover and bottom conduit bracket. Do not attach the top protective cover when installing the drive in a control panel.

◆ Attaching the Top Protective Cover

Insert the small protruding hooks on the sides of the top protective cover into the provided mounting holes on the top of the drive. Pinch the hooks inward so that the they connect with the mounting holes and fasten the top protective cover back into place.

Note: Attaching the top protective cover and the bottom conduit bracket to an IP00 drive changes protection to IP20/UL Type 1.

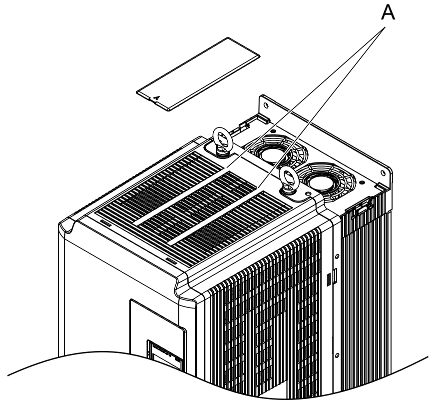


Figure 3.21 Reattaching the Protective Cover

◆ 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 *Figure 3.22* to free the cover from the drive.

Note: Removing the top protective cover from an IP20/UL Type 1 enclosure drive voids UL Type 1 protection while retaining IP20 conformity.

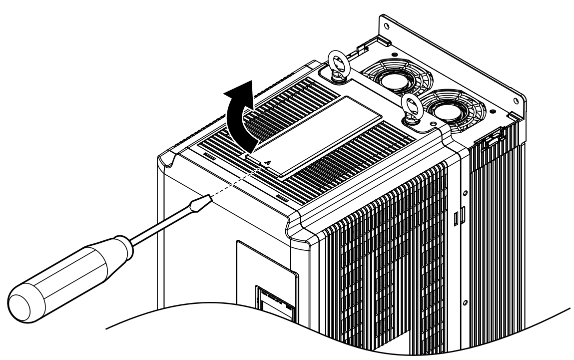


Figure 3.22 Removing the Top Protective Cover

3.8 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.*

◆ Main Circuit Terminal Functions

Table 3.2 Main Circuit Terminal Functions

Voltage Class	Three-Phase 200 V Class	Three-Phase 400 V Class	Function	Page
Drive Model	**2□0028 to 2□0248**	**4□0011 to 4□0414**		
Terminal	**Type**			
R/L1, S/L2, T/L3	Main circuit power supply input		Connects line power to the drive	*58*
U/T1, V/T2, W/T3	Drive output		Connects to the motor	
p1, n1	Momentary power loss recovery unit input		DC voltage terminals that connect to a momentary power loss recovery unit	
⏚	100 Ω or less	10 Ω or less	Grounding terminal	*78*

◆ 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.

■ Main Circuit Protective Cover

Close the protective cover after wiring the main circuit terminals on drive models 2□0028 to 2□0081 and 4□0011 to 4□0077.

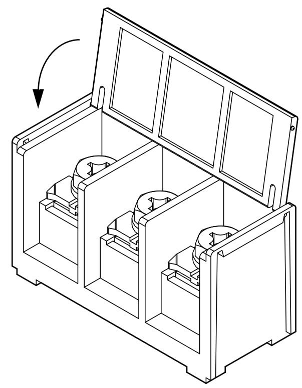
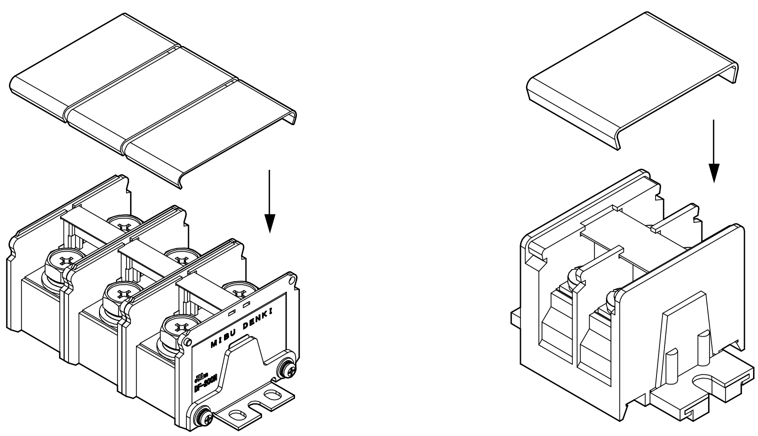


Figure 3.23 Main Circuit Protective Cover (Drive Models 2□0028 to 2□0081 and 4□0011 to 4□0077)

Attach the protective covers after wiring the main circuit terminals and p1, and n1 terminals on drive models 2□0104 to 2□0248 and 4□0096 to 4□0414.



A B

A – Main circuit terminal **B – Terminals p1 and n1**

Figure 3.24 Protective Cover Example (Drive Model 2□0104)

◆ Main Circuit 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: The recommended wires for the main circuit are 600 V, Class 2 vinyl-insulated copper wires with a continuous maximum operating temperature of 75 °C (167 °F). Assume these conditions:
- Ambient temperature: 40 °C (104 °F) maximum
- Wiring distance: 100 m (328 ft) maximum
- Normal Duty rated current value

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:

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

Refer to UL Standards Compliance on page 355 for information on UL compliance.

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 Drives

Table 3.3 Drive Wire Gauge and Torque Specifications (Three-Phase 200 V Class)

Drive Model	Terminal	For USA and Canada		For South America		Screw Size	Tightening Torque N·m (lb.in.)
		Recomm. Gauge mm^2 (AWG, kcmil)	Wire Range mm^2 (AWG, kcmil)	Recomm. Gauge mm^2 (AWG, kcmil)	Wire Range mm^2 (AWG, kcmil)		
2□0028	R/L1, S/L2, T/L3	10 (8)	6 to 10 (10 to 8)	4 (12)	2.5 to 10 (14 to 8)	M5	2.3 to 2.7 (20.4 to 23.9)
	U/T1, V/T2, W/T3	10 (8)	6 to 10 (10 to 8)	4 (12)	2.5 to 10 (14 to 8)	M5	
	⏚	10 (8)	6 to 16 (10 to 6)	6 (10)	6 to 16 (10 to 5)	M6	3.9 to 4.9 (34.7 to 43.4)
	p1, n1	2.5 (14)	2.5 to 4 (14 to 12)	2.5 (14)	2.5 to 4 (14 to 12)	M4	1 to 1.4 (8.9 to 12.4)
2□0042	R/L1, S/L2, T/L3	16 (6)	10 to 25 (8 to 3)	10 (8)	6 to 25 (10 to 3)	M6	4 to 6 (35.4 to 53.1)
	U/T1, V/T2, W/T3	16 (6)	10 to 25 (8 to 3)	10 (8)	6 to 25 (10 to 3)	M6	
	⏚	10 (8)	6 to 25 (10 to 3)	10 (8)	6 to 25 (10 to 3)	M8	8.8 to 10.8 (78.1 to 95.5)
	p1, n1	2.5 (14)	2.5 to 4 (14 to 12)	2.5 (14)	2.5 to 4 (14 to 12)	M4	1 to 1.4 (8.9 to 12.4)
2□0054	R/L1, S/L2, T/L3	25 (4)	16 to 25 (6 to 3)	16 (5)	10 to 25 (8 to 3)	M6	4 to 6 (35.4 to 53.1)
	U/T1, V/T2, W/T3	25 (4)	16 to 25 (6 to 3)	16 (5)	10 to 25 (8 to 3)	M6	
	⏚	16 (6)	10 to 25 (8 to 3)	10 (8)	10 to 25 (8 to 3)	M8	8.8 to 10.8 (78.1 to 95.5)
	p1, n1	2.5 (14)	2.5 to 4 (14 to 12)	2.5 (14)	2.5 to 4 (14 to 12)	M4	1 to 1.4 (8.9 to 12.4)
2□0068	R/L1, S/L2, T/L3	25 (4)	25 (4 to 3)	16 (5)	16 to 25 (5 to 3)	M6	4 to 6 (35.4 to 53.1)
	U/T1, V/T2, W/T3	25 (4)	25 (4 to 3)	16 (5)	16 to 25 (5 to 3)	M6	
	⏚	16 (6)	16 to 25 (6 to 3)	16 (5)	16 to 25 (5 to 3)	M8	8.8 to 10.8 (78.1 to 95.5)
	p1, n1	2.5 (14)	2.5 to 4 (14 to 12)	2.5 (14)	2.5 to 4 (14 to 12)	M4	1 to 1.4 (8.9 to 12.4)

Drive Model	Terminal	For USA and Canada: Recomm. Gauge mm² (AWG, kcmil)	For USA and Canada: Wire Range mm² (AWG, kcmil)	For South America: Recomm. Gauge mm² (AWG, kcmil)	For South America: Wire Range mm² (AWG, kcmil)	Screw Size	Tightening Torque N·m (lb.in.)
2□0081	R/L1, S/L2, T/L3	16 × 2 (6 × 2P)	16 to 25 × 2 (6 to 3 × 2P)	25 (3)	16 to 25 (5 to 3 × 2P)	M6	4 to 6 (35.4 to 53.1)
	U/T1, V/T2, W/T3	16 × 2 (6 × 2P)	16 to 25 × 2 (6 to 3 × 2P)	25 (3)	16 to 25 (5 to 3 × 2P)	M6	
	⏚	16 (6)	16 to 25 (6 to 3)	16 (5)	16 to 25 (5 to 3)	M8	8.8 to 10.8 (78.1 to 95.5)
	p1, n1	2.5 (14)	2.5 to 4 (14 to 12)	2.5 (14)	2.5 to 4 (14 to 12)	M4	1 to 1.4 (8.9 to 12.4)
2□0104	R/L1, S/L2, T/L3	35 (1)	16 to 50 × 2 (6 to 1/0 × 2P)	35 (1)	10 to 50 × 2P (8 to 1/0 × 2P)	M8	8 to 10 (70.8 to 88.5)
	U/T1, V/T2, W/T3	35 (1)	16 to 50 × 2 (6 to 1/0 × 2P)	35 (1)	10 to 50 × 2P (8 to 1/0 × 2P)	M8	
	⏚	25 (4)	25 to 35 (4 to 1)	25 (3)	10 to 35 (8 to 1)	M8	8.8 to 10.8 (78.1 to 95.5)
	p1, n1	2.5 (14)	2.5 to 4 (14 to 12)	2.5 (14)	2.5 to 4 (14 to 12)	M4	1.2 to 2.0 (10.4 to 17.4)
2□0130	R/L1, S/L2, T/L3	25 × 2 (4 × 2P)	16 to 50 × 2 (6 to 1/0 × 2P)	16 × 2P (5 × 2P)	10 to 50 × 2P (8 to 1/0 × 2P)	M8	8 to 10 (70.8 to 88.5)
	U/T1, V/T2, W/T3	25 × 2 (4 × 2P)	16 to 50 × 2 (6 to 1/0 × 2P)	16 × 2P (5 × 2P)	10 to 50 × 2P (8 to 1/0 × 2P)	M8	
	⏚	25 (4)	25 to 35 (4 to 1)	16 (5)	16 to 35 (5 to 1)	M8	8.8 to 10.8 (78.1 to 95.5)
	p1, n1	2.5 (14)	2.5 to 4 (14 to 12)	2.5 (14)	2.5 to 4 (14 to 12)	M4	1.2 to 2.0 (10.4 to 17.4)
2□0154	R/L1, S/L2, T/L3	25 × 2 (3 × 2P)	25 to 95 × 2 (4 to 4/0 × 2P)	25 × 2P (3 × 2P)	16 to 95 × 2P (5 to 4/0 × 2P)	M10	15 to 20 (130 to 173)
	U/T1, V/T2, W/T3	25 × 2 (3 × 2P)	25 to 95 × 2 (4 to 4/0 × 2P)	25 × 2P (3 × 2P)	16 to 95 × 2P (5 to 4/0 × 2P)	M10	
	⏚	25 (4)	25 to 70 (4 to 2/0)	25 (3)	25 to 70 (3 to 2/0)	M10	17.7 to 22.6 (156 to 200)
	p1, n1	2.5 (14)	2.5 to 4 (14 to 12)	2.5 (14)	2.5 to 4 (14 to 12)	M4	1.2 to 2.0 (10.4 to 17.4)
2□0192	R/L1, S/L2, T/L3	35 × 2 (1 × 2P)	25 to 95 × 2 (3 to 4/0 × 2P)	35 × 2P (1 × 2P)	25 to 95 × 2P (3 to 4/0 × 2P)	M10	15 to 20 (130 to 173)
	U/T1, V/T2, W/T3	35 × 2 (1 × 2P)	25 to 95 × 2 (3 to 4/0 × 2P)	35 × 2P (1 × 2P)	25 to 95 × 2P (3 to 4/0 × 2P)	M10	
	⏚	25 (3)	25 to 70 (4 to 2/0)	25 (3)	25 to 70 (3 to 2/0)	M10	17.7 to 22.6 (156 to 200)
	p1, n1	2.5 (14)	2.5 to 4 (14 to 12)	2.5 (14)	2.5 to 4 (14 to 12)	M4	1.2 to 2.0 (10.4 to 17.4)
2□0248	R/L1, S/L2, T/L3	70 × 2 (2/0 × 2P)	35 to 95 × 2 (1 to 4/0 × 2P)	50 × 2P (1/0 × 2P)	35 to 95 × 2P (1 to 4/0 × 2P)	M10	15 to 20 (130 to 173)
	U/T1, V/T2, W/T3	70 × 2 (2/0 × 2P)	35 to 95 × 2 (1 to 4/0 × 2P)	50 × 2P (1/0 × 2P)	35 to 95 × 2P (1 to 4/0 × 2P)	M10	
	⏚	25 (3)	25 to 95 (4 to 4/0)	35 (1)	25 to 95 (3 to 4/0)	M12	31.4 to 39.2 (278 to 347)
	p1, n1	2.5 (14)	2.5 to 4 (14 to 12)	2.5 (14)	2.5 to 4 (14 to 12)	M4	1.2 to 2.0 (10.4 to 17.4)

■ Three-Phase 400 V Class Drives

Table 3.4 Drive Wire Gauge and Torque Specifications (Three-Phase 400 V Class)

Drive Model	Terminal	For USA and Canada		For South America		Screw Size	Tightening Torque N·m (lb.in.)
		Recomm. Gauge mm^2 (AWG, kcmil)	Wire Range mm^2 (AWG, kcmil)	Recomm. Gauge mm^2 (AWG, kcmil)	Wire Range mm^2 (AWG, kcmil)		
4□0011	R/L1, S/L2, T/L3	2.5 (14)	2.5 to 10 (14 to 8)	2.5 (14)	2.5 to 10 (14 to 8)	M5	2.3 to 2.7 (20.4 to 23.9)
	U/T1, V/T2, W/T3	2.5 (14)	2.5 to 10 (14 to 8)	2.5 (14)	2.5 to 10 (14 to 8)	M5	
	⏚	6 (10)	4 to 16 (12 to 6)	2.5 (14)	2.5 to 16 (14 to 5)	M6	3.9 to 4.9 (34.7 to 43.4)
	p1, n1	2.5 (14)	2.5 to 4 (14 to 12)	2.5 (14)	2.5 to 4 (14 to 12)	M4	1 to 1.4 (8.9 to 12.4)
4□0014	R/L1, S/L2, T/L3	4 (12)	2.5 to 10 (14 to 8)	2.5 (14)	2.5 to 10 (14 to 8)	M5	2.3 to 2.7 (20.4 to 23.9)
	U/T1, V/T2, W/T3	4 (12)	2.5 to 10 (14 to 8)	2.5 (14)	2.5 to 10 (14 to 8)	M5	
	⏚	6 (10)	4 to 16 (12 to 6)	2.5 (14)	2.5 to 16 (14 to 5)	M6	3.9 to 4.9 (34.7 to 43.4)
	p1, n1	2.5 (14)	2.5 to 4 (14 to 12)	2.5 (14)	2.5 to 4 (14 to 12)	M4	1 to 1.4 (8.9 to 12.4)
4□0021	R/L1, S/L2, T/L3	6 (10)	4 to 10 (12 to 8)	2.5 (14)	2.5 to 10 (14 to 8)	M5	2.3 to 2.7 (20.4 to 23.9)
	U/T1, V/T2, W/T3	6 (10)	4 to 10 (12 to 8)	2.5 (14)	2.5 to 10 (14 to 8)	M5	
	⏚	6 (10)	4 to 16 (12 to 6)	2.5 (14)	2.5 to 16 (14 to 5)	M6	3.9 to 4.9 (34.7 to 43.4)
	p1, n1	2.5 (14)	2.5 to 4 (14 to 12)	2.5 (14)	2.5 to 4 (14 to 12)	M4	1 to 1.4 (8.9 to 12.4)
4□0027	R/L1, S/L2, T/L3	10 (8)	6 to 10 (10 to 8)	4 (12)	2.5 to 10 (14 to 8)	M5	2.3 to 2.7 (20.4 to 23.9)
	U/T1, V/T2, W/T3	10 (8)	6 to 10 (10 to 8)	4 (12)	2.5 to 10 (14 to 8)	M5	
	⏚	10 (8)	4 to 16 (12 to 6)	4 (12)	4 to 16 (12 to 5)	M6	3.9 to 4.9 (34.7 to 43.4)
	p1, n1	2.5 (14)	2.5 to 4 (14 to 12)	2.5 (14)	2.5 to 4 (14 to 12)	M4	1 to 1.4 (8.9 to 12.4)
4□0034	R/L1, S/L2, T/L3	10 (8)	10 (8)	6 (10)	4 to 10 (12 to 8)	M5	2.3 to 2.7 (20.4 to 23.9)
	U/T1, V/T2, W/T3	10 (8)	10 (8)	6 (10)	4 to 10 (12 to 8)	M5	
	⏚	10 (8)	6 to 16 (10 to 6)	6 (10)	6 to 16 (10 to 5)	M6	3.9 to 4.9 (34.7 to 43.4)
	p1, n1	2.5 (14)	2.5 to 4 (14 to 12)	2.5 (14)	2.5 to 4 (14 to 12)	M4	1 to 1.4 (8.9 to 12.4)
4□0040	R/L1, S/L2, T/L3	10 (8)	10 to 25 (8 to 3)	10 (8)	6 to 25 (10 to 3)	M6	4 to 6 (35.4 to 53.1)
	U/T1, V/T2, W/T3	10 (8)	10 to 25 (8 to 3)	10 (8)	6 to 25 (10 to 3)	M6	
	⏚	10 (8)	10 to 25 (10 to 3)	10 (8)	6 to 25 (10 to 3)	M8	8.8 to 10.8 (78.1 to 95.5)
	p1, n1	2.5 (14)	2.5 to 4 (14 to 12)	2.5 (14)	2.5 to 4 (14 to 12)	M4	1 to 1.4 (8.9 to 12.4)

Drive Model	Terminal	For USA and Canada: Recomm. Gauge mm^2 (AWG, kcmil)	For USA and Canada: Wire Range mm^2 (AWG, kcmil)	For South America: Recomm. Gauge mm^2 (AWG, kcmil)	For South America: Wire Range mm^2 (AWG, kcmil)	Screw Size	Tightening Torque N·m (lb.in.)
4□0052	R/L1, S/L2, T/L3	16 (6)	10 to 25 (8 to 3)	10 (8)	10 to 25 (8 to 3)	M6	4 to 6 (35.4 to 53.1)
	U/T1, V/T2, W/T3	16 (6)	10 to 25 (8 to 3)	10 (8)	10 to 25 (8 to 3)	M6	
	⏚	16 (6)	10 to 25 (8 to 3)	10 (8)	10 to 25 (8 to 3)	M8	8.8 to 10.8 (78.1 to 95.5)
	p1, n1	2.5 (14)	2.5 to 4 (14 to 12)	2.5 (14)	2.5 to 4 (14 to 12)	M4	1 to 1.4 (8.9 to 12.4)
4□0065	R/L1, S/L2, T/L3	25 (4)	16 to 25 (6 to 3)	16 (5)	10 to 25 (8 to 3)	M6	4 to 6 (35.4 to 53.1)
	U/T1, V/T2, W/T3	25 (4)	16 to 25 (6 to 3)	16 (5)	10 to 25 (8 to 3)	M6	
	⏚	16 (6)	16 to 25 (6 to 3)	16 (5)	16 to 25 (5 to 3)	M8	8.8 to 10.8 (78.1 to 95.5)
	p1, n1	2.5 (14)	2.5 to 4 (14 to 12)	2.5 (14)	2.5 to 4 (14 to 12)	M4	1 to 1.4 (8.9 to 12.4)
4□0077	R/L1, S/L2, T/L3	25 (3)	25 (4 to 3)	25 (3)	16 to 25 (5 to 3)	M6	4 to 6 (35.4 to 53.1)
	U/T1, V/T2, W/T3	25 (3)	25 (4 to 3)	25 (3)	16 to 25 (5 to 3)	M6	
	⏚	16 (6)	16 to 25 (6 to 3)	16 (5)	16 to 25 (5 to 3)	M8	8.8 to 10.8 (78.1 to 95.5)
	p1, n1	2.5 (14)	2.5 to 4 (14 to 12)	2.5 (14)	2.5 to 4 (14 to 12)	M4	1 to 1.4 (8.9 to 12.4)
4□0096	R/L1, S/L2, T/L3	35 (1)	10 to 50 (8 to 1/0 × 2P)	35 (1)	10 to 50 × 2P (8 to 1/0 × 2P)	M8	8 to 10 (70.8 to 88.5)
	U/T1, V/T2, W/T3	35 (1)	10 to 50 (8 to 1/0 × 2P)	35 (1)	10 to 50 × 2P (8 to 1/0 × 2P)	M8	
	⏚	25 (4)	25 to 35 (4 to 1)	25 (3)	10 to 35 (8 to 1)	M8	8.8 to 10.8 (78.1 to 95.5)
	p1, n1	2.5 (14)	2.5 to 4 (14 to 12)	2.5 (14)	2.5 to 4 (14 to 12)	M4	1.2 to 2.0 (10.4 to 17.4)
4□0124	R/L1, S/L2, T/L3	25 × 2 (4 × 2P)	16 to 50 × 2 (6 to 1/0 × 2P)	16 × 2P (5 × 2P)	10 to 50 × 2P (8 to 1/0 × 2P)	M8	8 to 10 (70.8 to 88.5)
	U/T1, V/T2, W/T3	25 × 2 (4 × 2P)	16 to 50 × 2 (6 to 1/0 × 2P)	16 × 2P (5 × 2P)	10 to 50 × 2P (8 to 1/0 × 2P)	M8	
	⏚	25 (4)	25 to 35 (4 to 1)	16 (5)	16 to 35 (5 to 1)	M8	8.8 to 10.8 (78.1 to 95.5)
	p1, n1	2.5 (14)	2.5 to 4 (14 to 12)	2.5 (14)	2.5 to 4 (14 to 12)	M4	1.2 to 2.0 (10.4 to 17.4)
4□0156	R/L1, S/L2, T/L3	25 × 2 (3 × 2P)	25 to 95 × 2 (4 to 4/0 × 2P)	25 × 2P (3 × 2P)	16 to 95 × 2P (5 to 4/0 × 2P)	M10	15 to 20 (130 to 173)
	U/T1, V/T2, W/T3	25 × 2 (3 × 2P)	25 to 95 × 2 (4 to 4/0 × 2P)	25 × 2P (3 × 2P)	16 to 95 × 2P (5 to 4/0 × 2P)	M10	
	⏚	25 (4)	25 to 70 (4 to 2/0)	25 (3)	25 to 70 (3 to 2/0)	M10	17.7 to 22.6 (156 to 200)
	p1, n1	2.5 (14)	2.5 to 4 (14 to 12)	2.5 (14)	2.5 to 4 (14 to 12)	M4	1.2 to 2.0 (10.4 to 17.4)
4□0180	R/L1, S/L2, T/L3	35 × 2 (2 × 2P)	25 to 95 × 2 (3 to 4/0 × 2P)	25 × 2P (3 × 2P)	25 to 95 × 2P (3 to 4/0 × 2P)	M10	15 to 20 (130 to 173)
	U/T1, V/T2, W/T3	35 × 2 (2 × 2P)	25 to 95 × 2 (3 to 4/0 × 2P)	25 × 2P (3 × 2P)	25 to 95 × 2P (3 to 4/0 × 2P)	M10	
	⏚	25 (3)	25 to 70 (4 to 2/0)	25 (3)	25 to 70 (3 to 2/0)	M10	17.7 to 22.6 (156 to 200)
	p1, n1	2.5 (14)	2.5 to 4 (14 to 12)	2.5 (14)	2.5 to 4 (14 to 12)	M4	1.2 to 2.0 (10.4 to 17.4)

Drive Model	Terminal	For USA and Canada: Recomm. Gauge mm² (AWG, kcmil)	For USA and Canada: Wire Range mm² (AWG, kcmil)	For South America: Recomm. Gauge mm² (AWG, kcmil)	For South America: Wire Range mm² (AWG, kcmil)	Screw Size	Tightening Torque N·m (lb.in.)
4□0216	R/L1, S/L2, T/L3	50 × 2 (1/0 × 2P)	35 to 95 × 2 (2 to 4/0 × 2P)	35 × 2P (1 × 2P)	25 to 95 × 2P (3 to 4/0 × 2P)	M10	15 to 20 (130 to 173)
	U/T1, V/T2, W/T3	50 × 2 (1/0 × 2P)	35 to 95 × 2 (2 to 4/0 × 2P)	35 × 2P (1 × 2P)	25 to 95 × 2P (3 to 4/0 × 2P)	M10	
	⏚	25 (3)	25 to 95 (4 to 4/0)	35 (1)	25 to 95 (3 to 4/0)	M12	31.4 to 39.2 (278 to 347)
	p1, n1	2.5 (14)	2.5 to 4 (14 to 12)	2.5 (14)	2.5 to 4 (14 to 12)	M4	1.2 to 2.0 (10.4 to 17.4)
4□0240	R/L1, S/L2, T/L3	50 × 2 (1/0 × 2P)	50 to 95 × 2 (1/0 to 4/0 × 2P)	50 × 2P (1/0 × 2P)	35 to 95 × 2P (1 to 4/0 × 2P)	M10	15 to 20 (130 to 173)
	U/T1, V/T2, W/T3	50 × 2 (1/0 × 2P)	50 to 95 × 2 (1/0 to 4/0 × 2P)	50 × 2P (1/0 × 2P)	35 to 95 × 2P (1 to 4/0 × 2P)	M10	
	⏚	35 (2)	35 to 95 (2 to 4/0)	50 (1/0)	35 to 95 (1 to 4/0)	M12	31.4 to 39.2 (278 to 347)
	p1, n1	2.5 (14)	2.5 to 4 (14 to 12)	2.5 (14)	2.5 to 4 (14 to 12)	M4	1.2 to 2.0 (10.4 to 17.4)
4□0302 <1>	R/L1, S/L2, T/L3	70 × 2 (3/0 × 2P)	50 to 95 × 2 (1/0 to 4/0 × 2P)	70 × 2P (3/0 × 2P)	50 to 95 × 2P (1/0 to 4/0 × 2P)	M10	15 to 20 (130 to 173)
	U/T1, V/T2, W/T3	70 × 2 (3/0 × 2P)	50 to 95 × 2 (1/0 to 4/0 × 2P)	70 × 2P (3/0 × 2P)	50 to 95 × 2P (1/0 to 4/0 × 2P)	M10	
	⏚	35 (1)	35 to 150 (1 to 300)	70 (3/0)	35 to 150 (1 to 300)	M12	31.4 to 39.2 (278 to 347)
	p1, n1	2.5 (14)	2.5 to 4 (14 to 12)	2.5 (14)	2.5 to 4 (14 to 12)	M4	1.2 to 2.0 (10.4 to 17.4)
4□0361 <1>	R/L1, S/L2, T/L3	95 × 2 (4/0 × 2P)	70 to 95 × 2 (3/0 to 4/0 × 2P)	95 × 2P (4/0 × 2P)	70 to 95 × 2P (3/0 to 4/0 × 2P)	M10	15 to 20 (130 to 173)
	U/T1, V/T2, W/T3	95 × 2 (4/0 × 2P)	70 to 95 × 2 (3/0 to 4/0 × 2P)	95 × 2P (4/0 × 2P)	70 to 95 × 2P (3/0 to 4/0 × 2P)	M10	
	⏚	50 (1/0)	50 to 150 (1/0 to 300)	95 (4/0)	70 to 150 (3/0 to 300)	M12	31.4 to 39.2 (278 to 347)
	p1, n1	2.5 (14)	2.5 to 4 (14 to 12)	2.5 (14)	2.5 to 4 (14 to 12)	M4	1.2 to 2.0 (10.4 to 17.4)
4□0414 <1>	R/L1, S/L2, T/L3	150 × 2 (300 × 2P)	95 to 150 × 2 (4/0 to 300 × 2P)	95 × 2P (4/0 × 2P)	95 to 150 × 2P (4/0 to 300 × 2P)	M12	25 to 35 (217 to 304)
	U/T1, V/T2, W/T3	150 × 2 (300 × 2P)	95 to 150 × 2 (4/0 to 300 × 2P)	95 × 2P (4/0 × 2P)	95 to 150 × 2P (4/0 to 300 × 2P)	M12	
	⏚	50 (1/0)	50 to 240 (1/0 to 400)	95 (4/0)	70 to 240 (3/0 to 400)	M12	31.4 to 39.2 (278 to 347)
	p1, n1	2.5 (14)	2.5 to 4 (14 to 12)	2.5 (14)	2.5 to 4 (14 to 12)	M4	1.2 to 2.0 (10.4 to 17.4)

<1> Take additional measures in accordance with IEC/EN 61800-5-1:2007 when wiring an EMC filter is installed. ***Refer to Internal EMC Filter Installation on page 352*** for details.

◆ Main Circuit Terminal and Motor Wiring

This section outlines the various steps, precautions, and checkpoints for wiring the main circuit terminals and motor 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: *Route motor leads U/T1, V/T2, and W/T3 separate from all other leads to reduce possible interference related issues. Failure to comply may result in abnormal operation of drive and nearby equipment.*

■ 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. *Refer to C6-02: Carrier Frequency Selection on page 128*.

Table 3.5 Cable Length Between Drive and Motor

Cable Length	50 m or less	Greater than 50 m
Carrier Frequency	10 kHz or less	4 kHz or less

Note:
1. When setting carrier frequency for drives running multiple motors, calculate cable length as the total wiring distance to all connected motors.
2. The maximum cable length when using OLV/PM (A1-02 = 5) is 100 m.

■ Ground Wiring

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

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). 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 3.25* when using multiple drives. Do not loop the ground wire.

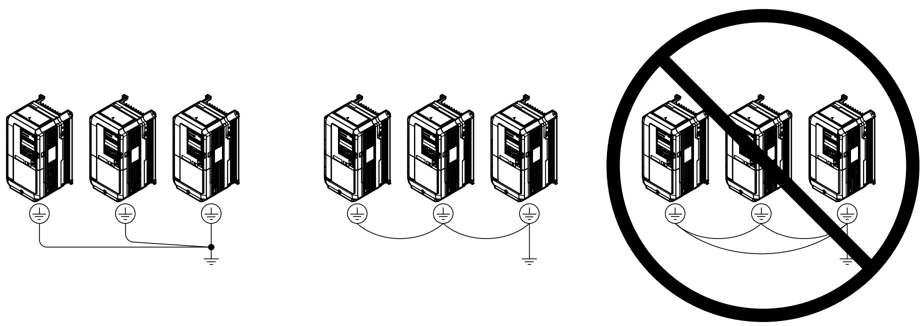


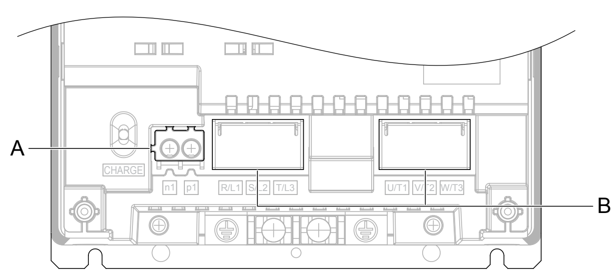
Figure 3.25 Multiple Drive Wiring

■ 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.

Drive Models 2□0028 to 2□0081 and 4□0011 to 4□0077 have a cover placed over terminals p1 and n1 prior to shipment to help prevent miswiring. Use wire cutters to cut away covers as needed for terminals.



A – Protective cover for terminals p1 and n1 **B – Main circuit protective cover**

Figure 3.26 Protective Cover

■ Main Circuit Connection Diagram

Refer to Main Circuit Connection Diagram on page 60 when wiring terminals on the main power circuit of the drive.

3.9 Control Circuit Wiring

◆ Control Circuit Connection Diagram

Refer to *Figure 3.1* on page *58* when wiring terminals on the drive control circuit.

◆ 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, MD to MF), multi-function analog inputs (A1 to A3), and multi-function analog monitor outputs (FM, AM). The default setting is listed next to each terminal in *Figure 3.1* on page *58*.

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. 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 for Digital Inputs on page 85.*	286
	S2	Multi-function input 2 (Closed: Reverse run, Open: Stop)		
	S3	Multi-function input 3 (External fault, N.O.)		
	S4	Multi-function input 4 (Fault reset)		
	S5	Multi-function input 5 (Multi-step speed reference 1)		
	S6	Multi-function input 6 (Multi-step speed reference 2)		
	S7	Multi-function input 7 (Jog reference)		
	S8	Multi-function input 8 (Baseblock command (N.O.))		
	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	85
	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.*	85
Analog Inputs	+V	Power supply for analog inputs	10.5 Vdc (max allowable current 20 mA)	123
	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.	123 170
	A2	Multi-function analog input 2 (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 H3-09.	123 123 171
	A3	Multi-function analog input 3 (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 H3-05.	123
	AC	Frequency reference common	0 V	123
	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	–
	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	290
	ME	N.C. Output		
	MF	Common (Speed agree)		
	M1	Multi-function digital output (During run)	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 (Zero speed)		
	M4			
Monitor Output	FM	Analog monitor output 1 (Output frequency)	-10 to +10 Vdc, or 0 to +10 Vdc	294
	AM	Analog monitor output 2 (Output current)		
	AC	Monitor common	0 V	–
External Power Supply	24V	External Power Supply	24 V (Max. 150 mA)	–

<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).

■ Serial Communication Terminals

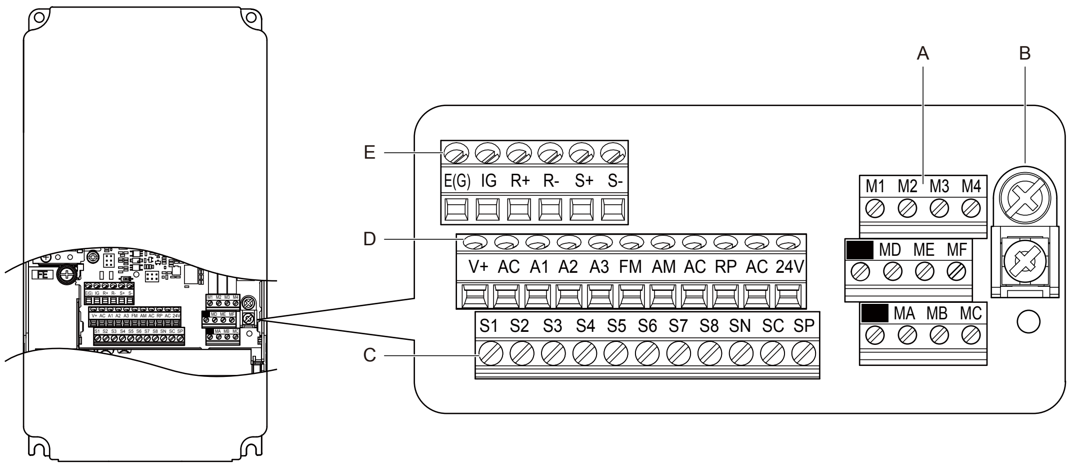
Table 3.8 Control Circuit Terminals: Serial Communications

Type	No.	Signal Name	Function (Signal Level)	
Serial Communication (APOGEE FLN, BACnet, MEMOBUS/ Modbus, or Metasys N2) <1>	R+	Communications input (+)	APOGEE FLN, BACnet, MEMOBUS/ Modbus, or Metasys N2 communication: Use an RS-422 or RS-485 cable to connect the drive.	• APOGEE FLN Comm. RS-422/ RS-485, 4.8 kbps • BACnet Comm. RS-485, max. 76.8 kbps • MEMOBUS/ Modbus Comm. RS-422/RS-485, max. 115.2 kbps • Metasys N2 Comm. RS-422/RS-485, 9.6 kbps
	R-	Communications input (-)		
	S+	Communications output (+)		
	S-	Communications output (-)		
	IG	Communications ground	0 V	
	FE	Option card ground	–	

<1> Enable the termination resistor in the last drive in an APOGEE FLN, BACnet, MEMOBUS/Modbus, or Metasys N2 network by setting DIP switch S2 to the ON position. *Refer to Control I/O Connections on page 85* for more information on the termination resistor.

◆ Terminal Configuration

The control circuit terminals should be arranged as shown in *Figure 3.27*.



A – Terminal Block (TB 2)
B – Terminal Block (TB 5)
C – Terminal Block (TB 1)
D – Terminal Block (TB 3)
E – Terminal Block (TB 4)

Figure 3.27 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.

Table 3.9 Wire Gauges

Terminal Block	Terminal	Screw Size	Tightening Torque N•m (lb. in)	Bare Wire Terminal		Ferrule-Type Terminal		Wire Type
				Recomm. wire size mm² (AWG)	Applicable wire size mm² (AWG)	Recomm. wire size mm² (AWG)	Applicable wire size mm² (AWG)	
TB1, TB2, TB3, TB4	IG, R+, R-, S+, S-, V+, AC, A1, A2, A3, FM, AM, AC, RP, AC, 24V, S1-S8, SN, SC, SP, M1, M2, M3, M4, MD, ME, MF, MA, MB, MC	M3	0.5 to 0.6 (4.4 to 5.3)	0.75 (18)	Stranded wire: 0.2 to 1.0 (24 to 17) Solid wire: 0.2 to 1.5 (24 to 16)	0.5 (20)	0.25 to 0.5 (24 to 20)	Shielded wire, etc.
	E(G)			1.0 (16)				
TB5	E(G)	M3.5	0.5 to 1.0 (4.4 to 8.9)	1.25 (12)	0.5 to 2 (20 to 14)	–	–	

■ 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.

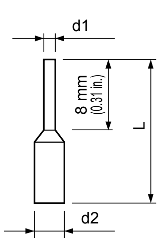


Figure 3.28 Ferrule Dimensions

Table 3.10 Ferrule Terminal Types and Sizes

Size mm² (AWG)	Type	L mm (in)	d1 mm (in)	d2 mm (in)	Manufacturer
0.25 (24)	AI 0.25-8YE	12.5 (0.49)	0.8 (0.03)	2.0 (0.08)	PHOENIX CONTACT
0.34 (22)	AI 0.34-8TQ	12.5 (0.49)	0.8 (0.03)	2.0 (0.08)	
0.5 (20)	AI 0.5-8WH AI 0.5-8OG	14.0 (0.55)	1.1 (0.04)	2.5 (0.10)	

◆ 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 and other high-power lines. Improper wiring practices could result in drive malfunction due to electrical interference.Main circuit terminals vary by drive model.* ***Refer to Main Circuit Terminal Functions on page 71*** *for details.*

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.*

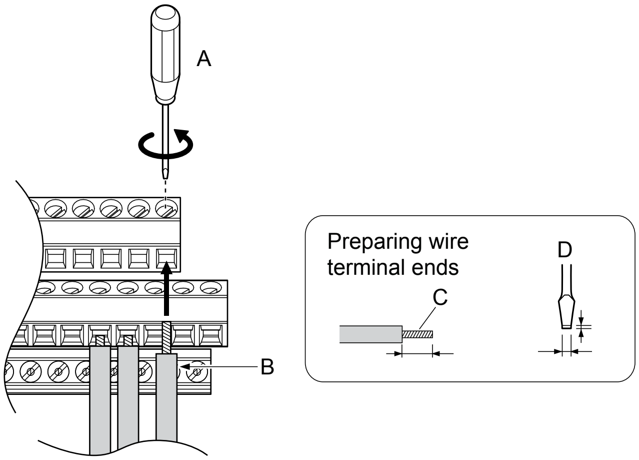
Wire the control circuit only after terminals have been properly grounded and main circuit wiring is complete. ***Refer to Terminal Board Wiring Guide on page 82*** for details. Prepare the ends of the control circuit wiring as shown in ***Figure 3.31***. ***Refer to Wire Gauges on page 81***.

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 82*** for details. Prepare the ends of the control circuit wiring as shown in ***Figure 3.31***. ***Refer to Wire Gauges on page 81***.

Connect control wires as shown in ***Figure 3.29*** and ***Figure 3.30***.



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 3.29 Terminal Board Wiring Guide

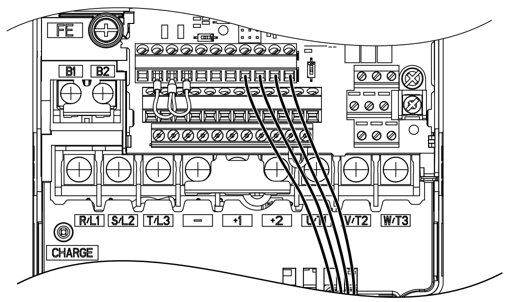
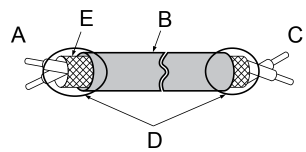


Figure 3.30 Terminal Board Location Inside the Drive



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

Figure 3.31 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.*

◆ Switches and Jumpers on the Terminal Board

The terminal board is equipped with several switches used to adapt the drive I/Os to the external control signals. *Figure 3.32* shows the location of these switches. *Refer to Control I/O Connections on page 85* for setting instructions.

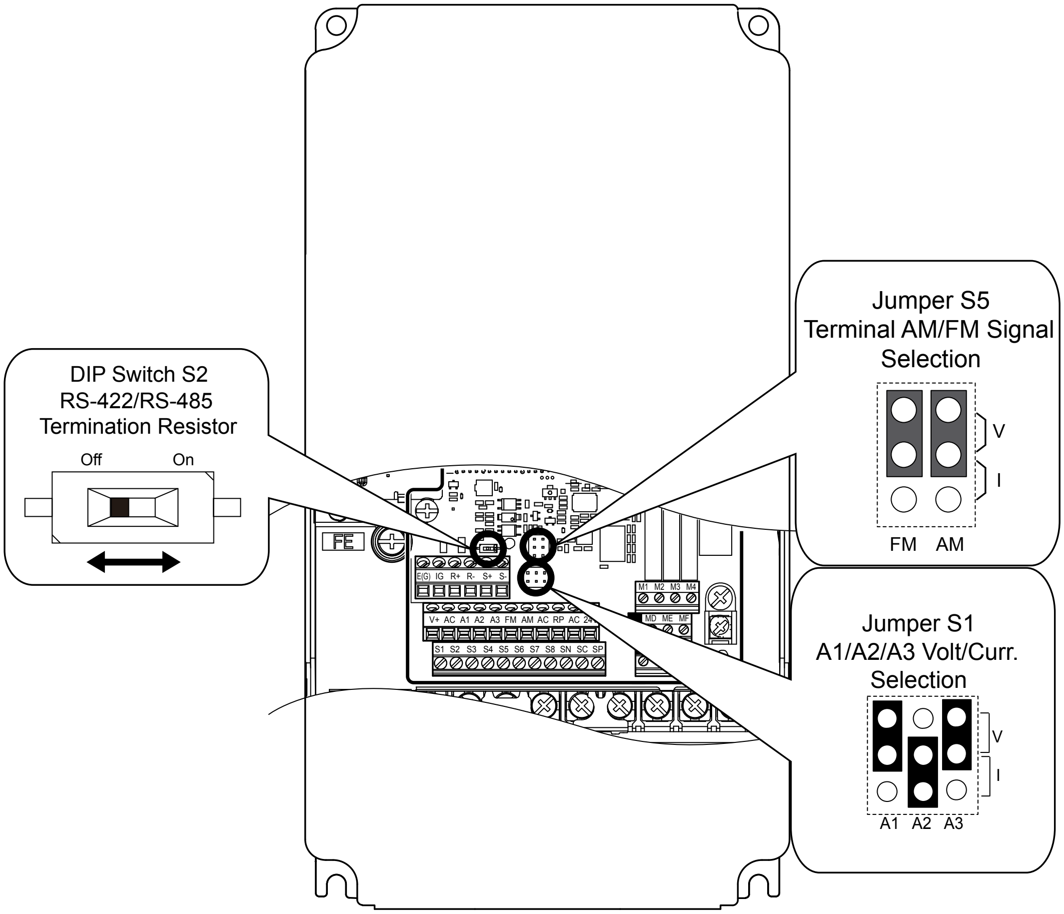


Figure 3.32 Locations of Jumpers and Switches on the Terminal Board

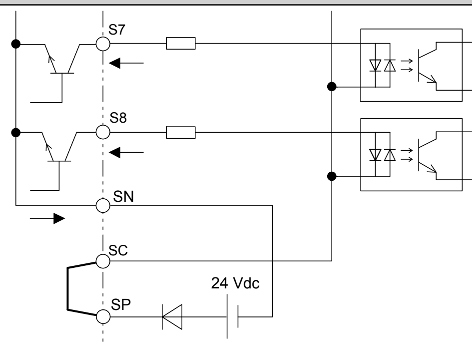
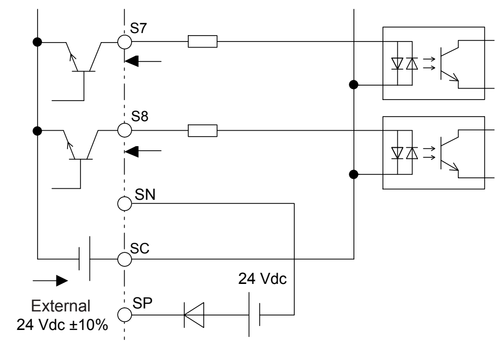
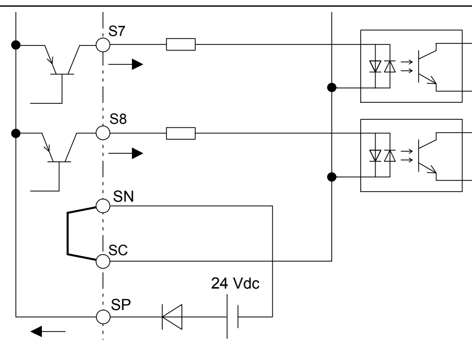
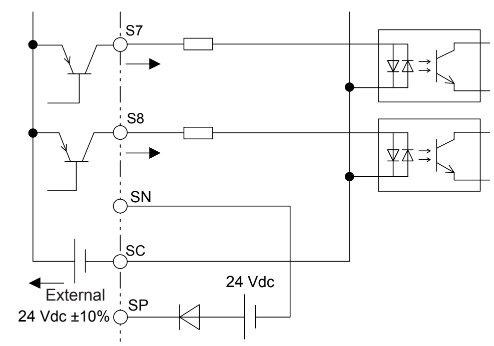
3.10 Control I/O Connections

◆ Sinking/Sourcing Mode 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

<table>
<tr><th>Mode</th><th>Drive Internal Power Supply (Terminals SN and SP)</th><th>External 24 Vdc Power Supply</th></tr>
<tr><td>Sinking Mode (NPN)</td><td>
</td><td>
</td></tr>
<tr><td>Sourcing Mode (PNP)</td><td>
</td><td>
</td></tr>
</table>

◆ 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.

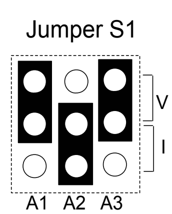


Figure 3.33 Terminal A2 Set to Current Input; A1 and A3 Set to Voltage Input

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)

Electrical Installation

3

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

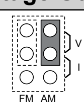
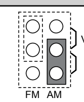
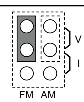
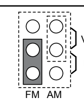
Terminal	Voltage Output	Current Output
Terminal AM		
Terminal FM		

Table 3.15 Parameter H4-07 and H4-08 Details

No.	Parameter Name	Description	Setting Range	Default Setting
H4-07	Terminal FM 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 AM signal level selection			

◆ MEMOBUS/Modbus Termination

This drive is equipped with a built-in termination resistor for the RS-422/RS-485 communication connector. DIP switch S2 enables or disabled the termination resistor as shown in *Table 3.16*. The OFF position is the default. The termination resistor should be placed to the ON position when the drive is the last in a series of slave drives. *Refer to Switches and Jumpers on the Terminal Board on page 84* to locate switch S2.

Table 3.16 MEMOBUS/Modbus Termination Switch S2 Settings

S2 Position	Description
ON	Internal termination resistor ON
OFF	Internal termination resistor OFF (default setting)

3.11 EMC Filter

◆ Enable the Internal EMC Filter

Drive models Z□□E□□□□/Z□□W□□□□ have a built-in EMC filter. Move the EMC filter screw to enable (ON) and disable (OFF) the EMC filter.

DANGER! *Electrical Shock Hazard. Do not touch SW screw while power is applied to the drive. Failure to comply will result in death or serious injury.*

WARNING! *Electrical Shock Hazard. Connect the ground cable correctly. Failure to comply may result in death or serious injury.*

NOTICE: *When disabling the internal EMC filter, move the screws from ON to OFF and then tighten to the specified torque. Completely removing the screws or tightening the screws to an incorrect torque may cause drive failure.*

NOTICE: *Prevent Drive Damage: Install the two EMC filter screws in the same position (ON and ONE, or OFF and OFF). Failure to comply may result in serious damage to the drive.*

NOTICE: *Prevent Drive Damage: Install the EMC filter screw in the OFF position. Installing the EMC filter screw disables the internal EMC filter in the network is grounded as follows. Failure to comply may result in serious damage to the drive.*

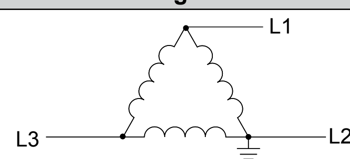
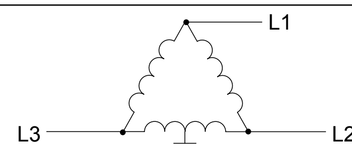
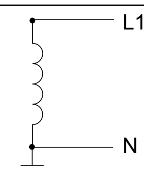
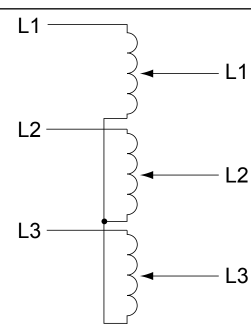
- Floating network
- High impedance grounded network
- Asymmetrically grounded network

Use size M4 internal EMC filter screws with 1.0 to 1.3 N • m tightening torque.

■ Asymmetrical Grounded Network

Table 3.17 shows asymmetrical grounded networks. Asymmetrical networks require first moving the SW screw to disconnect the internal ground connection. (Drives are shipped with the SW screw installed at the OFF position.)

Table 3.17 Asymmetrical Grounded Network

Characteristics	Diagram
Grounded at the corner of the delta	
Grounded at the middle of the side	
Single-phase, grounded at the end point	
Three-phase variable transformer without solidly grounded neutral	

■ Symmetrical Grounded Network

When EMC is a concern for drives with internal EMC filters and the network is grounded symmetrically, install the EMC filter screw to the ON position and enable the internal EMC filter.

Drives ship from the factory with EMC filter screws installed in the OFF position.

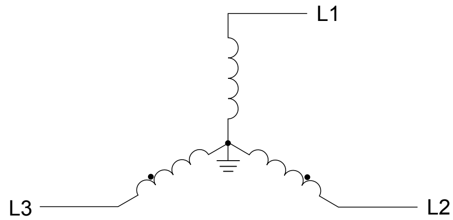
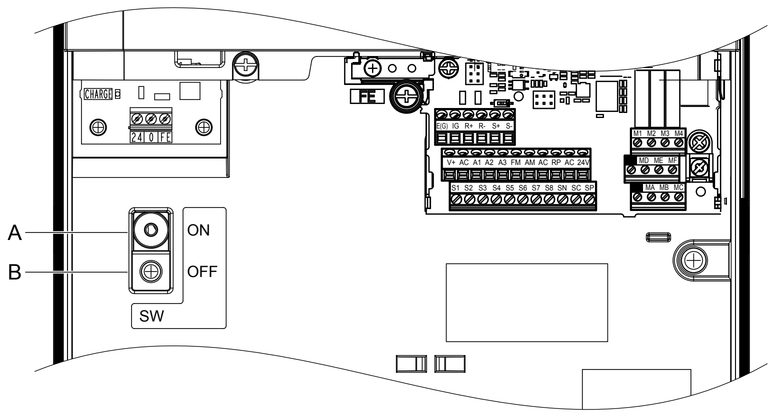


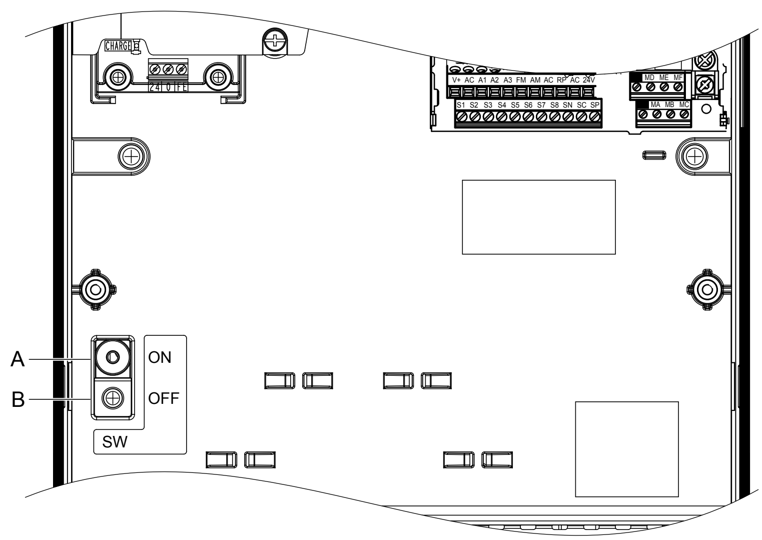
Figure 3.34 Symmetrical Grounded Network

■ EMC Filter Switch Location



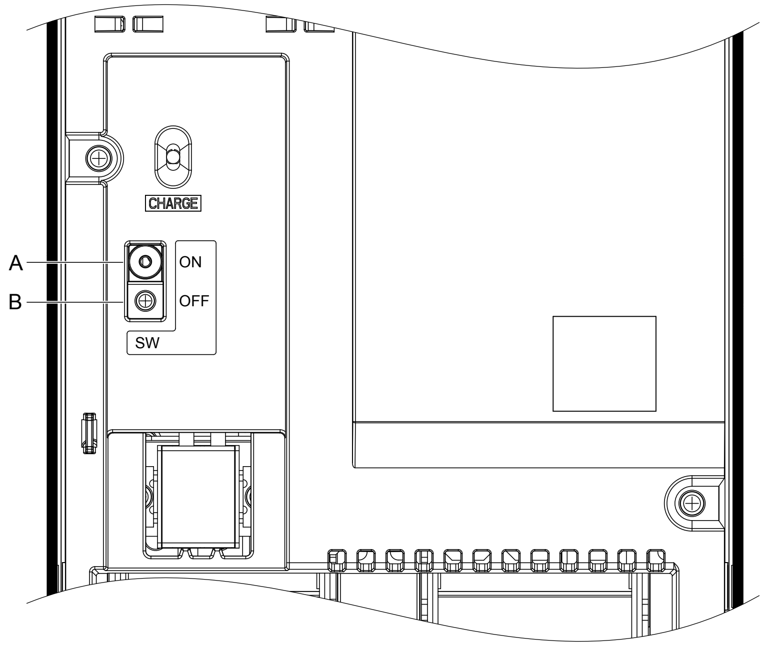
A – SW (ON) **B – Screw (OFF)**

Figure 3.35 EMC Filter Switch Location
(Drive Models 2E0028, 2W0028, 4E0011 to 4E0034, and 4W0011 to 4W0034)



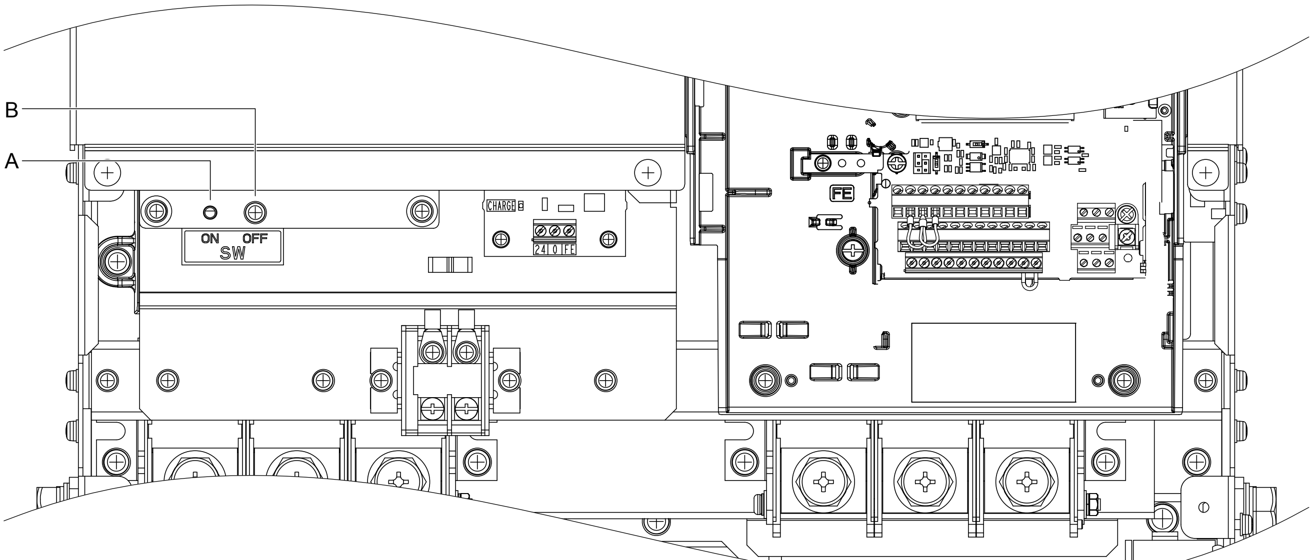
A – SW (ON) **B – Screw (OFF)**

Figure 3.36 EMC Filter Switch Location
(Drive Models 2E0042, 2W0042, 2E0054, 2W0054, 4E0040 to 4E0077, and 4W0040 to 4W0077)



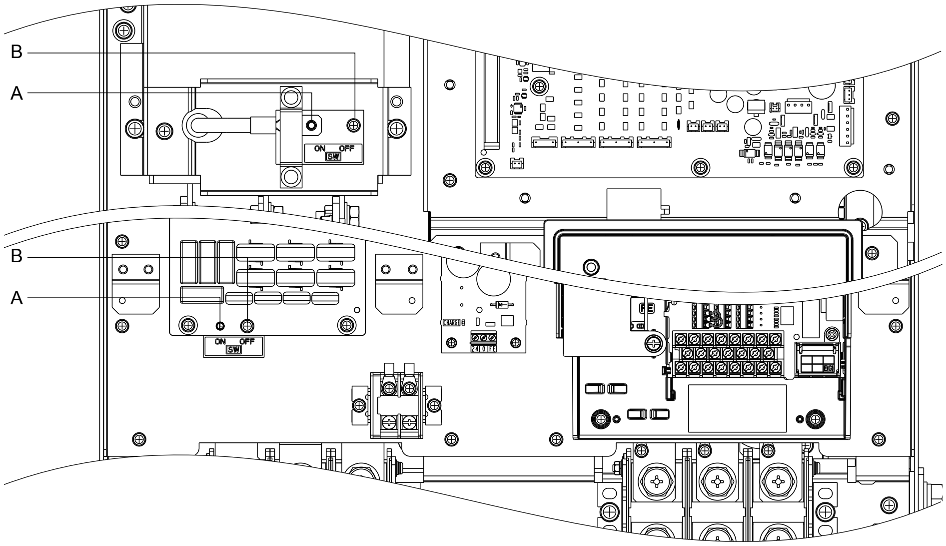
A – SW (ON) **B – Screw (OFF)**

Figure 3.37 EMC Filter Switch Location
(Drive Models 2E0104, 2W0104, 2E0130, 2W0130, 4E0096, 4W0096, 4E0124, and 4W0124)



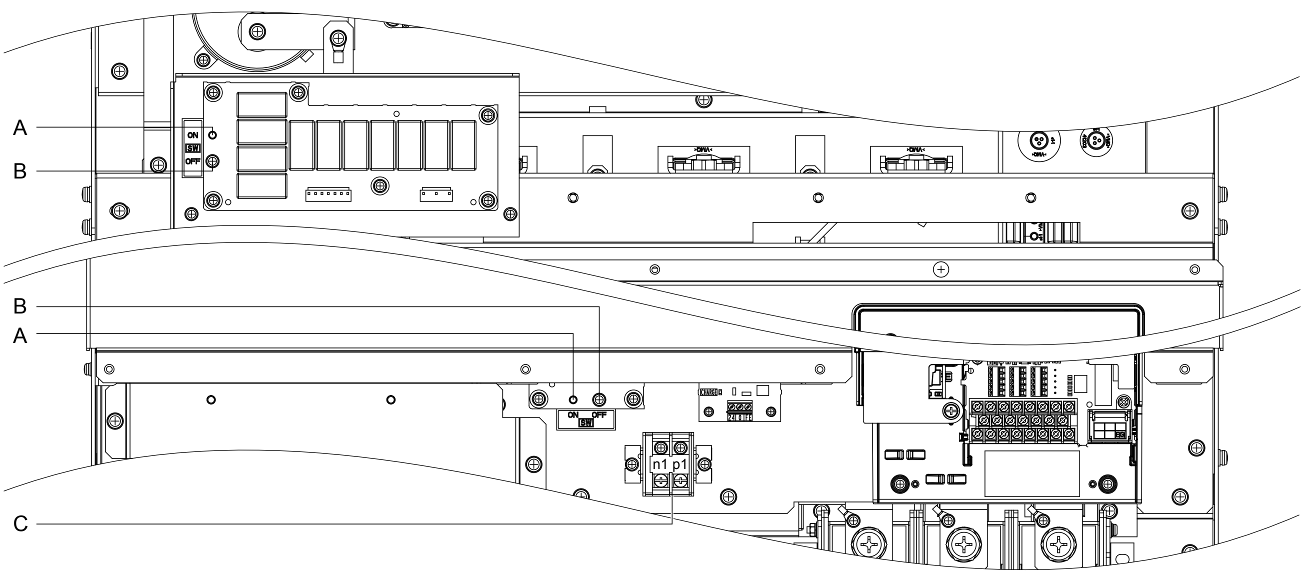
A – SW (ON) **B – Screw (OFF)**

Figure 3.38 EMC Filter Switch Location
(Drive Models 2E0154, 2W0154, 2E0192, 2W0192, 4E0156, 4W0156, 4E0180, and 4W0180)



A – SW (ON) B – Screw (OFF)

Figure 3.39 EMC Filter Switch Location
(Drive Models 2E0248, 2W0248, 4EU0216, 4W0216, 4E0240, and 4W0240)



A – SW (ON) C – Terminals p1 and n1
B – Screw (OFF)

Figure 3.40 EMC Filter Switch Location
(Drive Models 4E0302 to 4E0414 and 4W0302 to 4W0414)

3.12 24 V Control Power Supply Unit Wiring

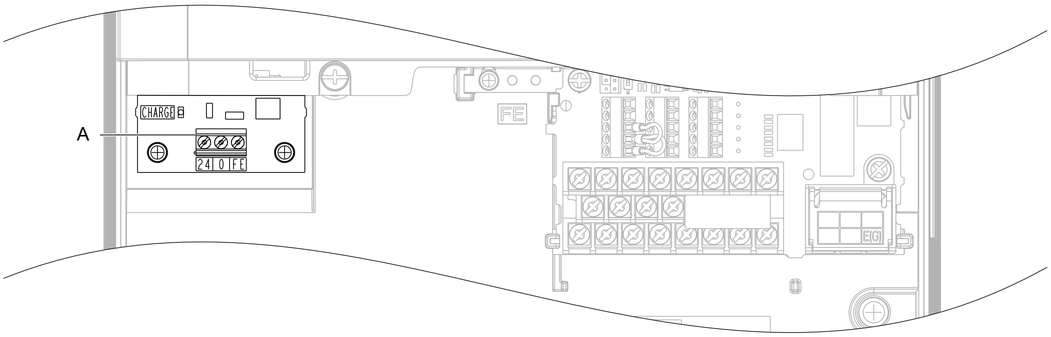
◆ 24 V Control Power Supply Unit

The 24 V Control Power Supply Unit maintains drive control circuit power in the event of a main power outage. As long as the control circuit has power, network communications and I/O data remain operational. The unit provides external power to the control circuit only, and does not provide power to the main circuit of the drive.

It is possible to read fault and parameter data in the drive via the operator or network communications when the drive switches to the 24 V Control Power Supply Unit as a back-up power supply.

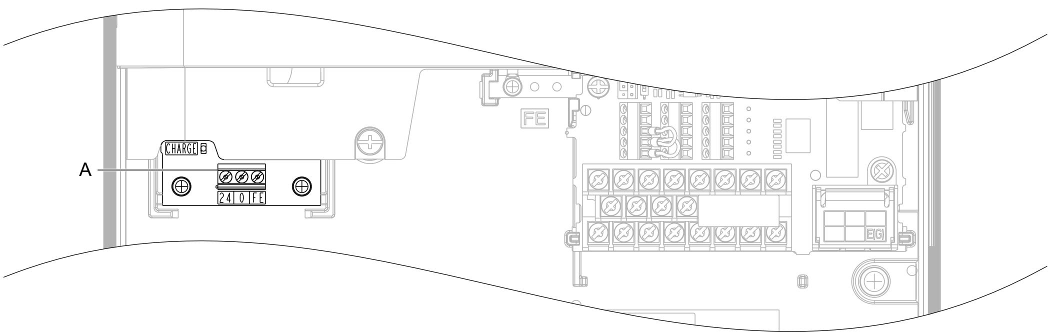
Note: Parameter settings cannot be changed without drive main circuit power regardless of whether the control circuit has enough power to operate.

◆ 24 V Control Power Supply Unit Location



A –Power Supply Terminal Block TB1

Figure 3.41 24 V Control Power Supply Unit Location
(Drive Models 2P0028, 2W0028, 4P0011 to 4P0034, and 4W0011 to 4W0034)



A –Power Supply Terminal Block TB1

Figure 3.42 24 V Control Power Supply Unit Location
(Drive Models 2P0042 to 2P0081, 2W0042 to 2W0081, 4P0040 to 4P0077, and 4W0040 to 4W0077)

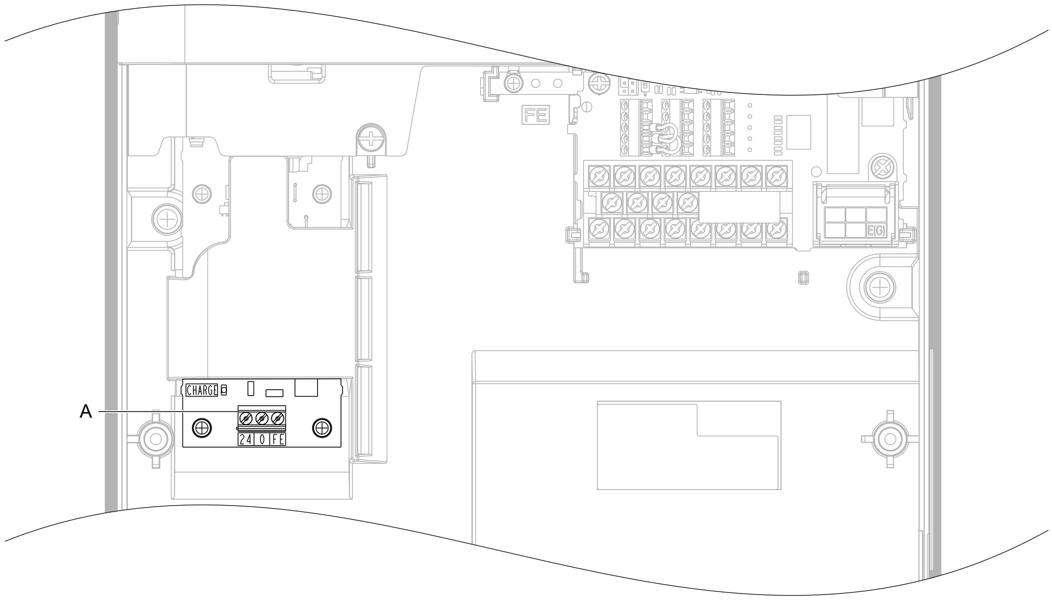
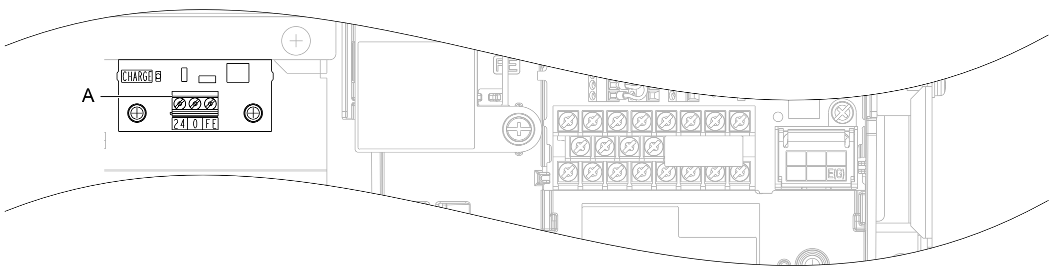
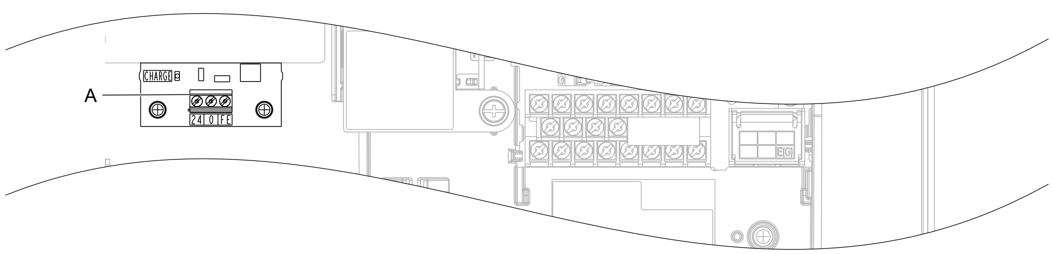


Figure 3.43 24 V Control Power Supply Unit Location
(Drive Models 2P0104, 2W0104, 2P0130, 2W0130, 4P0096, 4W0096, 4P0124, and 4W0124)



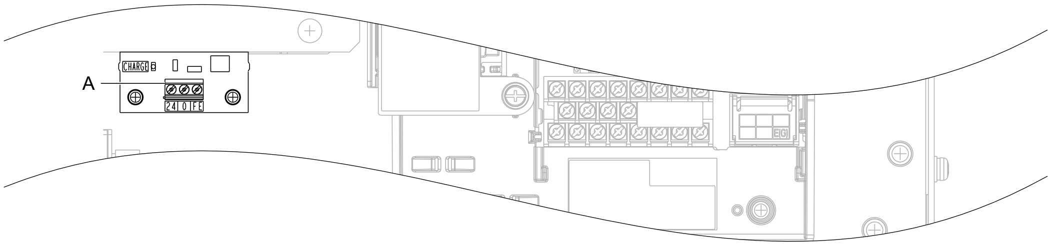
A –Power Supply Terminal Block TB1

Figure 3.44 24 V Control Power Supply Unit Location
(Drive Models 2P0154, 2W0154, 2P0192, 2W0192, 4P0156, 4W0156, 4P0180, and 4W0180)



A –Power Supply Terminal Block TB1

Figure 3.45 24 V Control Power Supply Unit Location
(Drive Models 2P0248, 2W0248, 4P0216, 4W0216, 4P0240, and 4W0240)



A –Power Supply Terminal Block TB1

Figure 3.46 24 V Control Power Supply Unit Location (Drive Models 4P0302 to 4P0414 and 4W0302 to 4W0414)

◆ Power Supply Terminal Block TB1 Wiring

■ Power Supply Terminal Block TB1 Wiring Procedure

1. Select an external power supply.

Two times the normal current will flow through the unit for approximately 0.5 seconds when the 24 V Control Power Supply Unit is first switched on. The unit requires at least 3 A to function properly.

WARNING! *Electrical Shock Hazard. Use a battery or a double-reinforced UL Class 2 power supply to provide power to the 24 V Control Power Supply Unit. Using a different type of power supply may result in death or serious injury by electrical shock or fire.*

NOTICE: *Do not install multiple 24 V Control Power Supply Units. Failure could cause erroneous operation or damage the drive.*

2. Use a flat-blade screwdriver to loosen the screws on the terminal block TB1, connect wiring to the 24, 0, and FE terminals as shown in ***Figure 3.47***, then tighten the terminal screws to hold wiring in place. Refer to ***Table 3.19*** to confirm that the proper tightening torque is applied to each terminal. Take particular precaution to ensure that each wire is properly connected and wire insulation is not accidentally pinched into electrical terminals.

NOTICE: *Properly connect an external 24 Vdc power source to terminal block TB1. Refer to **Table 3.19** for details. Improper wiring practices could damage the 24 V Control Power Supply Unit due to incorrect terminal connections.*

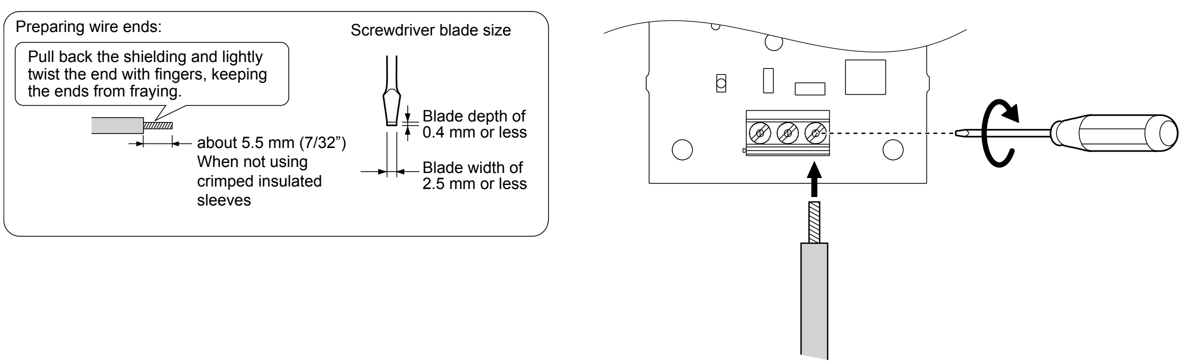


Figure 3.47 Wire the Option Plug

WARNING! *Fire Hazard. Tighten terminal screws to the specified tightening torque. Loose electrical connections could result in death or serious injury by fire due to overheating. Tightening screws beyond the specified tightening torque may cause erroneous operation, damage the terminal block, or cause a fire.*

NOTICE: *Heat shrink tubing or electrical tape may be required to ensure that cable shielding does not contact other wiring. Insufficient insulation may cause a short circuit and damage the drive.*

Electrical Installation

3

■ Tools Required for Installation

A straight-edge screwdriver (blade depth: 0.4 mm, width: 2.5 mm) is required to install the unit and wire the option terminal block.

Note: Tools required to prepare option cables for wiring are not listed in this manual.

■ Power Supply Terminal Block TB1 Functions

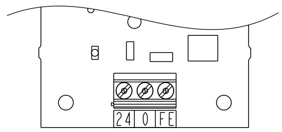


Figure 3.48 Power Supply Terminal Block TB1

Table 3.18 Power Supply Terminal Block TB1 Functions

Terminal	Function
24	+24 Vdc Input
0	0 V
FE	Ground

■ Wire Gauges and Tightening Torques

Table 3.19 Wire Gauges and Tightening Torques

Terminal	Screw Size	Tightening Torque N·m (in·lb)	Bare Cable		Crimp Terminals		Wire Type
			Recomm. Gauge mm^2 (AWG)	Applicable Gauges mm^2 (AWG)	Recomm. Gauge mm^2 (AWG)	Applicable Gauges mm^2 (AWG)	
24, 0, FE	M2	0.22 to 0.25 (1.95 to 2.21)	0.75 (18 AWG)	Stranded wire: 0.25 to 1.0 (24 to 17 AWG) Solid wire: 0.25 to 1.5 (24 to 16 AWG)	0.5 (20 AWG)	0.25 to 0.5 (24 to 20 AWG)	Shielded twisted pair, etc.

■ Ferrule-Type Wire Terminals

Yaskawa recommends using CRIMPFOX 6, a crimping tool manufactured by PHOENIX CONTACT, to prepare wire ends with insulated sleeves. See *Table 3.20* for dimensions.

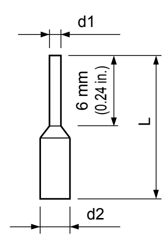


Figure 3.49 Ferrule Dimensions

Table 3.20 Ferrule Terminal Types and Sizes

Size mm^2 (AWG)	Type	L mm (in)	d1 mm (in)	d2 mm (in)	Manufacturer
0.25 (24)	AI 0.25-6YE AI 0.25-6BU	10.5 (0.41)	0.8 (0.03)	2.0 (0.08)	PHOENIX CONTACT
0.34 (22)	AI 0.34-6TQ	10.5 (0.41)	0.8 (0.03)	2.0 (0.08)	
0.5 (20)	AI 0.5-6WH	12 (0.47)	1.1 (0.04)	2.5 (0.10)	

■ Power Supply and the Control Circuit

Table 3.21 outlines the various conditions under which the option provides power to the control circuit.

Table 3.21 Power Supply and Control Circuit

Drive Main Circuit Input Power Supply	Power from 24 V Control Power Supply Unit	Control Circuit Operation in Drive	Drive Operation
ON	ON	Operating	Possible
ON	OFF		Possible
OFF	ON		Not possible
OFF	OFF	Stopping	Not possible

■ UL and CE Compliance

External Power Supply

Use a Class 2 power supply as defined by UL standards for the customer-supplied power supply connection to the 24 V Control Power Supply Unit.

◆ 24 V Control Power Supply Unit Specifications

Table 3.22 24 V Control Power Supply Unit Specifications

Item	Specifications
Input Operating Voltage	24 Vdc ± 20% (19.2 V to 28.8 V)
Input Current	1.9 A
Consumption Power	38 W
Compliance	UL <1> , CE

<1> Use a Class 2 power supply with a capacity of 24 V to comply with UL standards.

3.13 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 DriveWizard Industrial software can be used to monitor drive performance and manage parameter settings. Contact Yaskawa or a Yaskawa representative for more information on DriveWizard Industrial.

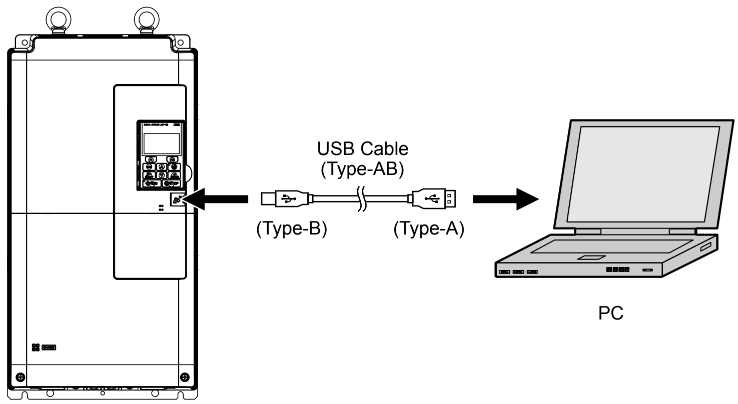


Figure 3.50 Connecting to a PC (USB)

3.14 External Interlock

Systems that may be affected during drive fault conditions should be interlocked with the drive fault output and ready signal.

◆ Operation Ready

When the “Operation Ready” signal has been set to one of the multi-function contact outputs, the output will close when the drive is ready to accept a Run command or is already running. Under the following conditions, the Operation Ready signal switches off and remains off during a fault even if a Run command is entered:

- when the power supply is shut off
- during a fault
- when there is problem with the control power supply
- when a parameter setting error renders the drive unable to run even when entering a Run command
- when a fault such as overvoltage or undervoltage is triggered as soon as the Run command is entered
- when the drive is in the Programming mode and will not accept a Run command.

■ Interlock Circuit Example

Two drives running a single application might interlock with the controller using the Drive Ready and Fault output signals as shown below. *Figure 3.51* illustrates how the application would not be able to run if either drive experiences a fault or is unable to supply a Drive Ready signal.

Terminal	Output Signal	Parameter Setting
MA, MB, MC	Fault	–
M1-M2	Drive Ready	H2-01 = 06

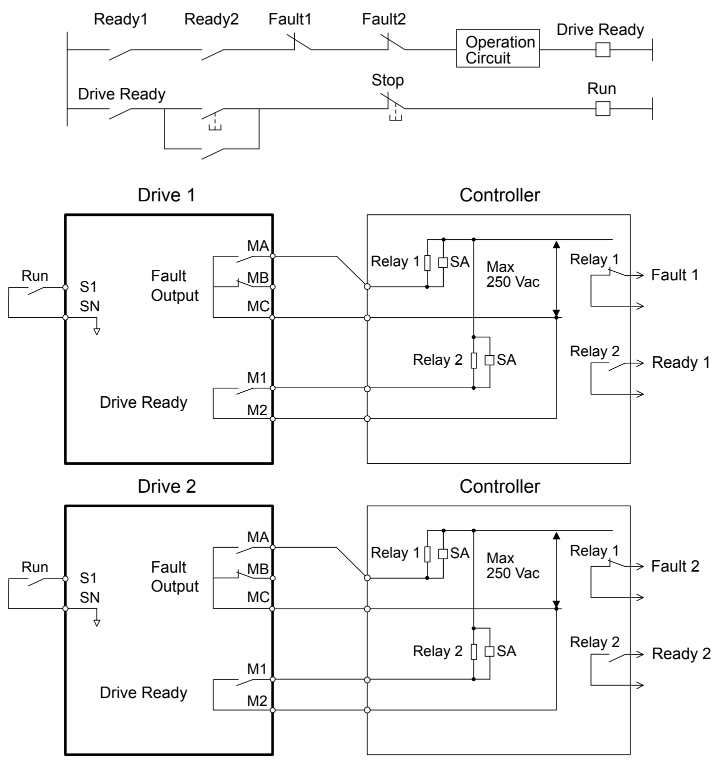
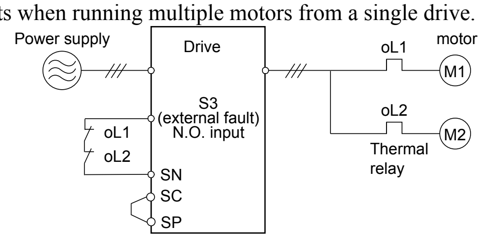


Figure 3.51 Interlock Circuit Example

Electrical Installation
3

3.15 Wiring Checklist

☑	No.	Item	Page(s)
		Drive, Peripherals, Option Cards	
☐	1	Check drive model number to ensure receipt of correct model.	*27*
☐	2	Make sure you have the correct noise filters and other peripheral devices.	–
☐	3	Check the option card model number.	–
		Installation Area and Physical Setup	
☐	4	Ensure that the area surrounding the drive complies with specifications.	*42*
		Power Supply Voltage, Output Voltage	
☐	5	The voltage from the power supply should be within the input voltage specification range of the drive.	–
☐	6	The voltage rating for the motor should match the drive output specifications.	*27*
☐	7	Verify that the drive is properly sized to run the motor.	
		Main Circuit Wiring	
☐	8	Confirm proper branch circuit protection as specified by national and local codes.	–
☐	9	Properly wire the power supply to drive terminals R/L1, S/L2, and T/L3.	*60*
☐	10	Properly wire the drive and motor together. The motor lines and drive output terminals U/T1, V/T2, and W/T3 should match in order to produce the desired phase order. If the phase order is incorrect, the drive will rotate in the opposite direction.	*77*
☐	11	Use 600 Vac vinyl-sheathed wire for the power supply and motor lines. Wire gauge recommendations based on using 75 °C (167 °F), 600 Vac vinyl-sheathed wire.	*73*
☐	12	Use the correct wire gauges for the main circuit. • 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} • If the cable between the drive and motor exceeds 50 m, adjust the carrier frequency set to C6-02 accordingly.	*73*
☐	13	Properly ground the drive.	*78*
☐	14	Tighten control circuit and grounding terminal screws.	*73*
☐	15	Set up overload protection circuits when running multiple motors from a single drive.  **Note:** Close MC1 – MCn before operating the drive. MC1 – MCn cannot be switched off during run.	–
☐	16	Verify that ground wiring for models 2E☐/2W☐/4E☐/4W☐ is correct before turning on the EMC filter switch.	*87*
☐	17	Verify phase advancing capacitors, input noise filters, or GFCIs are NOT installed on the output side of the drive.	–
		Control Circuit Wiring	
☐	18	Use twisted-pair line for all drive control circuit wiring.	*82*
☐	19	Ground the shields of shielded wiring to the GND ⏚ terminal.	*82*
☐	20	For 3-Wire sequence, set parameters for multi-function contact input terminals S1 to S8, and wire control circuits.	–
☐	21	Properly wire the option card.	*82*
☐	22	Check for any other wiring mistakes. Only use a multimeter to check wiring.	–
☐	23	Properly fasten drive control circuit terminal screws.	*73*
☐	24	Pick up all wire clippings.	–
☐	25	Ensure that no frayed wires on the terminal block are touching other terminals or connections.	–
☐	26	Properly separate control circuit wiring and main circuit wiring.	–
☐	27	Analog signal line wiring should not exceed 50 m.	–

☑	No.	Item	Page(s)
☐	28	Disconnect the internal EMC filter by moving the SW screw to the OFF position for floating, impedance grounded, or asymmetrically grounded networks.	87

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4

Start-Up Programming & Operation

This chapter explains HOA keypad functions and gives instructions on programming the drive for initial operation.

4.1 Section Safety

DANGER

Electrical Shock Hazard

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

Failure to comply will result in death or serious injury.

WARNING

Electrical Shock Hazard

Do not operate equipment with covers removed.

Failure to comply could result in death or serious injury.

The diagrams in this section may include drives without covers or safety shields to illustrate details. Be sure to reinstall covers or shields before operating the drives and run the drives according to the instructions described in this manual.

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

Failure to comply could result in death or serious injury.

Prepare a separate holding brake.

Wire the holding brake so when a fault occurs, it is activated by an external sequence and shuts the power off or triggers an emergency switch. Failure to comply could result in death or serious injury.

4.2 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

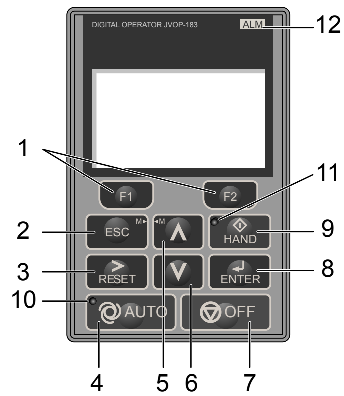


Figure 4.1 Keys and Displays on the HOA Keypad

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	Λ	Up Arrow Key	Scrolls up to display the next item, selects parameter numbers, and increments setting values.
6	V	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 AUTO LED and HAND LED Indications on page 105* for details.
11	HAND	HAND Light	Lit while the drive is in HAND mode. *Refer to AUTO LED and HAND LED Indications on page 105* for details.
12	ALM	ALM LED Light	Lit when the drive detects an alarm or error.

◆ LCD Display

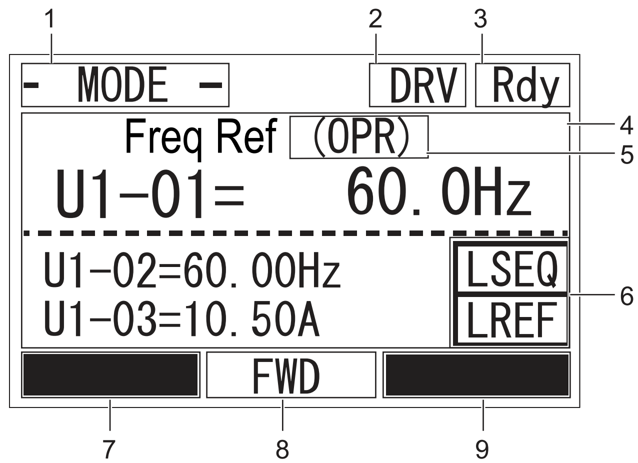


Figure 4.2 LCD Display

Table 4.1 Display and Contents

No.	Name	Display	Content
1	Operation Mode Menus	MODE	Displayed when in Mode Selection.
		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.
		AI	Displayed when the frequency reference is assigned to the Analog Input of the drive.
		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 an option card connected to the drive.
6	LO/RE Display <2>	RSEQ	Displayed when the run command is supplied from a remote source.
		LSEQ	Displayed when the run command is supplied from the operator keypad.
		RREF	Displayed when the frequency reference is supplied from a remote source.
		LREF	Displayed when the frequency reference is supplied from the operator keypad.
7	Function Key 1 (F1)	JOG	Pressing F1 runs the motor at the Jog frequency.
		HELP	Pressing F1 displays the Help menu.
		←	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.
8	FWD/REV	FWD	Indicates forward motor operation.
		REV	Indicates reverse motor operation.

No.	Name	Display	Content
9	Function Key 2 (F2)	FWD/REV	Pressing F2 switches between forward and reverse.
		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.
		DRV/BYP	The multi-function relay selected Drive/Bypass contact will be toggled.
		RUNBYP	The multi-function relay selected to RUN Bypass will be toggled.
		RLY	The multi-function relay selected to Relay operator control will be toggled.

<1> Displayed when in Frequency Reference Mode.

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

◆ ALARM (ALM) LED Displays

Table 4.2 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 4.3 AUTO LED and HAND LED Indications

AUTO LED	HAND LED	State
AUTO Off	HAND Off	OFF mode
AUTO Off	HAND On solid	HAND mode (Also during DC injection braking)
AUTO Off	HAND Long blink (50% duty)	HAND mode when the Frequency Reference is 0 and/or decelerating in HAND mode, or during PI Sleep or Snooze.
AUTO On solid	HAND Off	Running in AUTO mode (Also during DC injection braking)
AUTO Off	HAND Short blink (15% duty)	HAND mode, Ready, No Run command input. **Note:** Short Blink for Legacy Operation Mode (S5-04 = 0).
AUTO Off	HAND Double blink	HAND mode, cycle the Run command.
AUTO Long blink (50% duty)	HAND Off	Running in AUTO mode when the Frequency Reference is 0 and/or decelerating in AUTO mode, or during PI Sleep or Snooze.
AUTO Short blink (15% duty)	HAND Off	AUTO mode, Ready, No run command input.

AUTO LED	HAND LED	State
AUTO Double blink	HAND Off	AUTO mode, stopped by a Fast- Stop from a Multi-Function Digital Input.

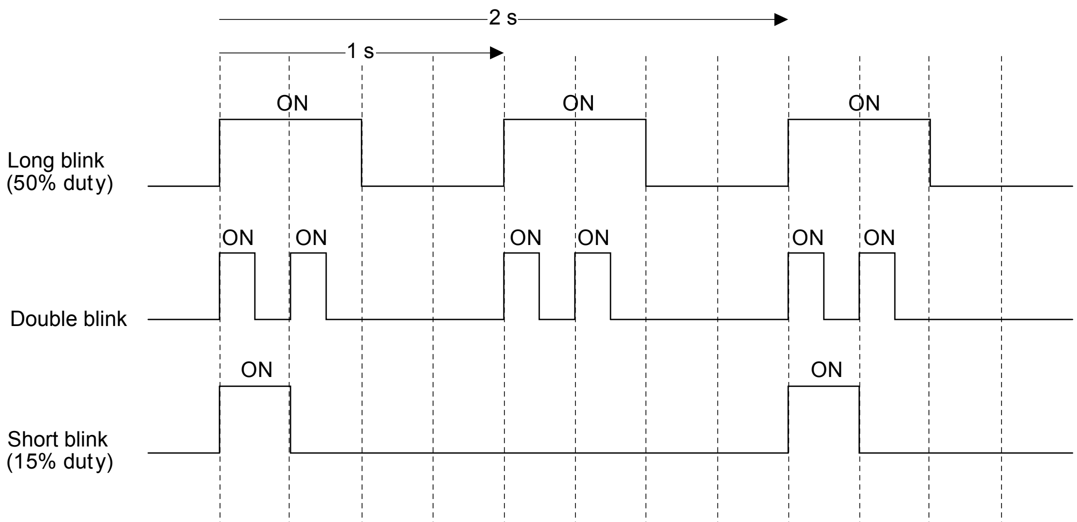


Figure 4.3 AUTO LED and HAND LED Timing Status

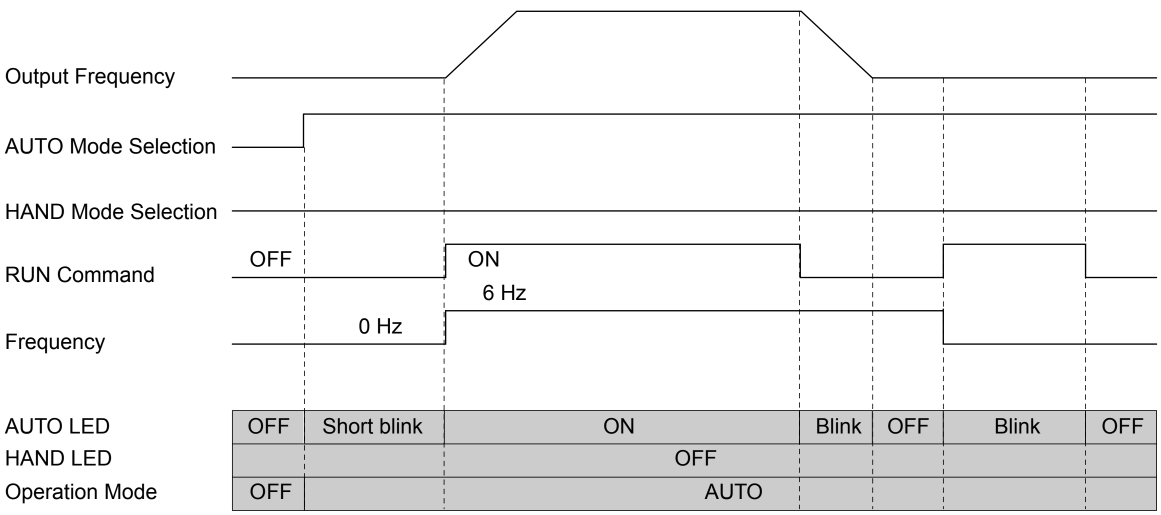


Figure 4.4 LEDs and Drive Operation in AUTO and HAND Modes

◆ Menu Structure for HOA Keypad

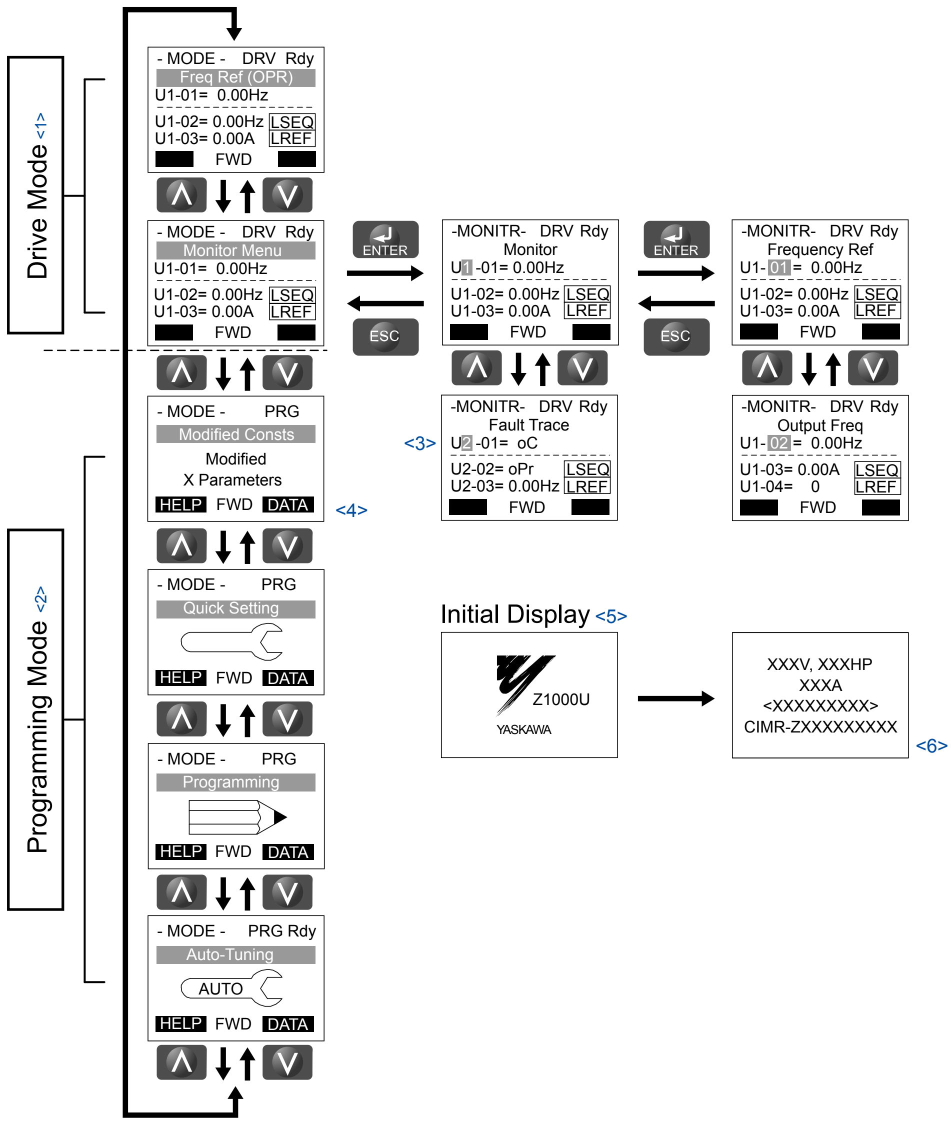


Figure 4.5 HOA Keypad Menu and Screen Structure

<1> Pressing AUTO or HAND will start the motor.
<2> Drive cannot operate motor.
<3> Flashing characters are shown with white letters on gray background. (Example: 0)
<4> “X” characters are used as examples in this manual. The HOA keypad will display the actual setting values.
<5> The Frequency Reference appears after the initial display that shows the product name.
<6> The information that appears on the display will vary depending on the drive.

4.3 The Drive, Programming, and Clock Adjustment Modes

The drive has a Drive Mode to operate the motor, a Programming Mode to edit parameter settings, and a Clock Adjustment Mode to adjust the Real Time Clock.

Drive Mode: In Drive Mode the user can operate the motor and observe U Monitor parameters. Parameter settings cannot be edited or changed when in Drive Mode.

Programming Mode: In Programming Mode the user can edit and verify parameter settings and perform Auto-Tuning. When the drive is in Programming Mode it will not accept a Run command unless b1-08 is set to 1.

Note:
1. If b1-08 is set to 0, the drive will only accept a Run command in Drive Mode. After editing parameters, the user must exit the Programming Mode and enter Drive Mode before operating the motor.
2. Set b1-08 to 1 to allow motor operation from the drive while in Programming Mode.

◆ Real-Time Clock (RTC)

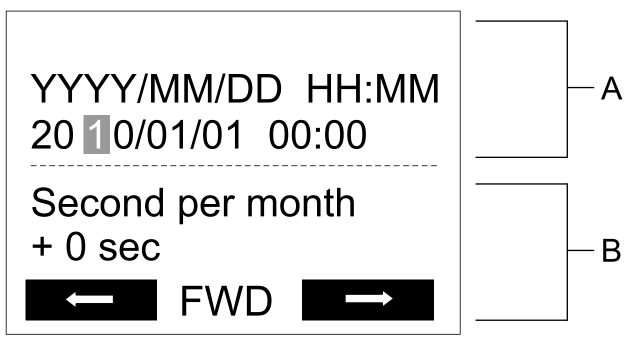
The drive has a Clock Adjustment Mode to set and adjust the Real-Time Clock.

Clock Adjustment Mode: When o4-17 is set to 1, the HOA keypad will show the Clock Adjustment display. In Clock Adjustment Mode, the user can adjust the Real-Time Clock. When the drive is in Clock Adjustment Mode, it will not accept a Run command.

◆ Clock Adjustment

The HOA keypad will display the Real Time Clock Adjustment Display in ***Figure 4.6*** when the drive is powered up for the first time. ***Refer to Manual Clock Adjustment Procedure by Setting o4-17 to 1 on page 109*** for the Real-Time Clock setting procedure.

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



A – Real Time Clock Setting Display **B – Gain/Loss Adjustment Display**

Figure 4.6 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.
Second per month	Set the gain or loss in seconds per month.

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:** 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.

Verifying the New Time Setting

After pressing ENTER , the display will indicate "Entry accepted" and the new time value will be saved to the Real-Time Clock (RTC).

If there is a problem with the entered time, the operator will indicate "Input error" and the screen will return to the time setting display.

Canceling the Input

Pressing the ESC key will display "Aborted" on the operator, and no value will be saved to the RTC. Pressing OFF will abort the setting process without any display, and no setting changes will be saved to the RTC.

Exiting from the Time Setting Screen Without Making Any Changes

If no changes are entered, the display will exit Real Time Clock Adjustment Display after a few seconds and no changes will be saved.

■ 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 HOA keypad battery replacement.

Table 4.4 illustrates how to set the Real-Time Clock at initial power-up of a new drive.

Table 4.4 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 time using the up and down arrow keys.	➡	ALM YYYY/MM/DD HH:MM 2010/01/01 00:00 Second per month + 0 sec
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.	➡	ALM Entry accepted
3	Initial display.	➡	- MODE - DRV Rdy Freq Ref (AI) U1-01= 0.00Hz U1-02= 0.00Hz LSEQ U1-03= 0.00 A LREF FWD

■ 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 4.5 illustrates how to set the Real-Time Clock manually.

Table 4.5 Manual Clock Adjustment Procedure by Setting o4-17 to 1

	Procedure		Display
1	The "Time Not Set" (TIM) display will appear if the Real-Time Clock data is not entered within 30 seconds of power-up on a new drive. ***Refer to Fault Displays, Causes, and Possible Solutions on page 201*** for more details on the TIM display.	➡	ALM - MODE - DRV TIM Time Not Set FWD RESET
2	Use the up and down arrow keys to scroll through display menu until the screen displays "Programming".	➡	ALM - MODE - PRG Programming HOME FWD

Procedure			Display
3	Press the ENTER key to enter select the parameter setting mode.	➡	ALM - PRMSET - PRG Initialization A1-00 = 0 Select Language HOME FWD DATA
4	Use the up and down arrow keys to scroll through display menu until parameter o4-17 appears.	➡	ALM - PRMSET - PRG Maintenance o4-17 = 0 Set time HOME FWD DATA
5	Press the ENTER key until “0” flashes.	➡	ALM - PRMSET - PRG Set time o4-17= 0 *0* - - “0” HOME FWD DATA
6	Press the up arrow key so that the display changes to “1”.	➡	ALM - PRMSET - PRG Set time o4-17= 1 *0* Set “0” HOME FWD DATA
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.	➡	ALM YYYY/MM/DD HH:MM 2010/01/01 00:00 Second per month + 0 sec ← →
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.	➡	ALM Entry accepted

■ Drive Mode Details

The following actions are possible in the Drive Mode:

- Run and stop the drive
- Monitor the operation status of the drive (frequency reference, output frequency, output current, output voltage, etc.)
- View information on an alarm
- View a history of alarms that have occurred

■ Programming Mode Details

The following actions are possible in the Programming Mode:

- **Parameter Setting Mode:** Access and edit all parameter settings.
- **Verify Menu:** View a list of parameters that have been changed from the default values.
- **Setup Group:** Access a list of commonly used parameters to simplify setup (*Refer to Simplified Setup Using the Setup Group on page 113*).
- **Auto-Tuning Mode:** Automatically calculate and set motor parameters to optimize drive performance.

◆ Changing Parameter Settings or Values

This example explains changing C1-02, Deceleration Time 1, from 30.0 seconds to 20.0 seconds.

Step			Display/Result
1.	Turn on the power to the drive. The initial display appears.	➡	- MODE - DRV Rdy FREF (AI) U1-01= 0.00Hz U1-02= 0.00Hz RSEQ U1-03= 0.00A RREF JOG FWD
2.	Press ∧ or ∨ until the Parameter Setting Mode screen appears.	➡	- MODE - PRG Programming HELP FWD DATA
3.	Press ENTER to enter the parameter menu tree.	➡	-PRMSET- PRG Initialization A1-00= 0 Select Language ← FWD →
4.	Press ∧ or ∨ to select the C parameter group.	➡	-PRMSET- PRG Basic Setup C1-01= 30.0 sec Accel Time 1 ← FWD →
5.	Press ENTER two times.	➡	-PRMSET- PRG Accel/Decel C1-01= 30.0 sec Accel Time 1 ← FWD → ➡ -PRMSET- PRG Accel Time 1 C1-01= 30.0Sec (0.0~6000.0) "30.0 sec" ← FWD →
6.	Press ∧ or ∨ to select parameter C1-02.	➡	-PRMSET- PRG Decel Time 1 C1-02= 30.0Sec (0.0~6000.0) "30.0 sec" ← FWD →
7.	Press ENTER to view the current setting value. The leftmost digit flashes.	➡	-PRMSET- PRG Decel Time 1 C1-02= 0030.0Sec (0.0~6000.0) "30.0 sec" ← FWD →
8.	Press F1, F2, or RESET until the desired number is selected. "3" flashes.	➡	-PRMSET- PRG Decel Time 1 C1-02=0030.0Sec (0.0~6000.0) "30.0 sec" ← FWD →
9.	Press ∨ to enter 0020.0.	➡	-PRMSET- PRG Decel Time 1 C1-02=0020.0Sec (0.0~6000.0) "30.0 sec" ← FWD →
10.	Press ENTER to confirm the change.	➡	Entry Accepted
11.	The display automatically returns to the screen shown in Step 4.	➡	-PRMSET- PRG Decel Time 1 C1-02= 20.0Sec (0.0~6000.0) "30.0 sec" ← FWD →
12.	Press ESC as many times as necessary to return to the initial display.	➡	- MODE - DRV Rdy FREF (AI) U1-01= 0.00Hz U1-02= 0.00Hz RSEQ U1-03= 0.00A RREF JOG FWD

◆ Verifying Parameter Changes: Verify Menu

The Verify Menu lists edited parameters from the Programming Mode or as a result of Auto-Tuning. The Verify Menu helps determine which settings have been changed, and is particularly useful when replacing a drive. If no settings have been changed, the Verify Menu will read “None”. The Verify Menu also allows users to quickly access and re-edit any parameter settings that have been changed.

Note: The Verify Menu will not display parameters from the A1 group (except for A1-02) or E5-01 even if those parameters have been changed from their default settings.

The following example is a continuation of the steps above. Here, parameter C1-02 is accessed using the Verify Menu, and is changed again from 10.0 s to 20.0 s.

To check the list of edited parameters:

	Step		Display/Result
1.	Turn on the power to the drive. The initial display appears.	➡	- MODE - DRV Rdy FREF (AI) U1-01= 0.00Hz U1-02= 0.00Hz RSEQ U1-03= 0.00A RREF JOG FWD
2.	Press ∧ or ∨ until the display shows the top of the Verify Menu.	➡	- MODE - PRG Modified Consts Modified X Parameters HELP FWD DATA
3.	Press ENTER to enter the list of parameters that have been edited from their original default settings. If parameters other than C1-02 have been changed, use ∧ or ∨ to scroll until C1-02 appears.	➡	- VERIFY - PRG Rdy Accel Time 1 C1-02 = 20.0sec (0.0~6000.0) “10.0sec” Home FWD DATA
4.	Press ENTER. Press F1, F2, RESET, ∧ or ∨ to change the setting value.	➡	- VERIFY - PRG Rdy Accel Time 1 C1-01=0020.0sec (0.0~6000.0) “10.0sec” ← FWD →
5.	Press ENTER to confirm the change.	➡	Entry Accepted

◆ Simplified Setup Using the Setup Group

The Setup Group lists the basic parameters necessary to set up the drive for an application. This group expedites the startup process for an application by showing only the most important parameters for the application.

■ Using the Setup Group

Figure 4.7 illustrates how to enter and how to change parameters in the Setup Group.

The first display shown when entering the Setup Group is the Application Selection menu. Skipping this display will keep the current Setup Group parameter selection. The default setting for the Setup Group is a group of parameters most commonly use in general-purpose applications. Pressing the ENTER key from the Application Selection menu and selecting an Application Preset will change the Setup Group to parameters optimal for the application selected. ***Refer to Application Selection on page 120***.

In this example, the Setup Group is accessed to change b1-01 from 1 to 0. This changes the source of the frequency reference from the control circuit terminals to the HOA keypad.

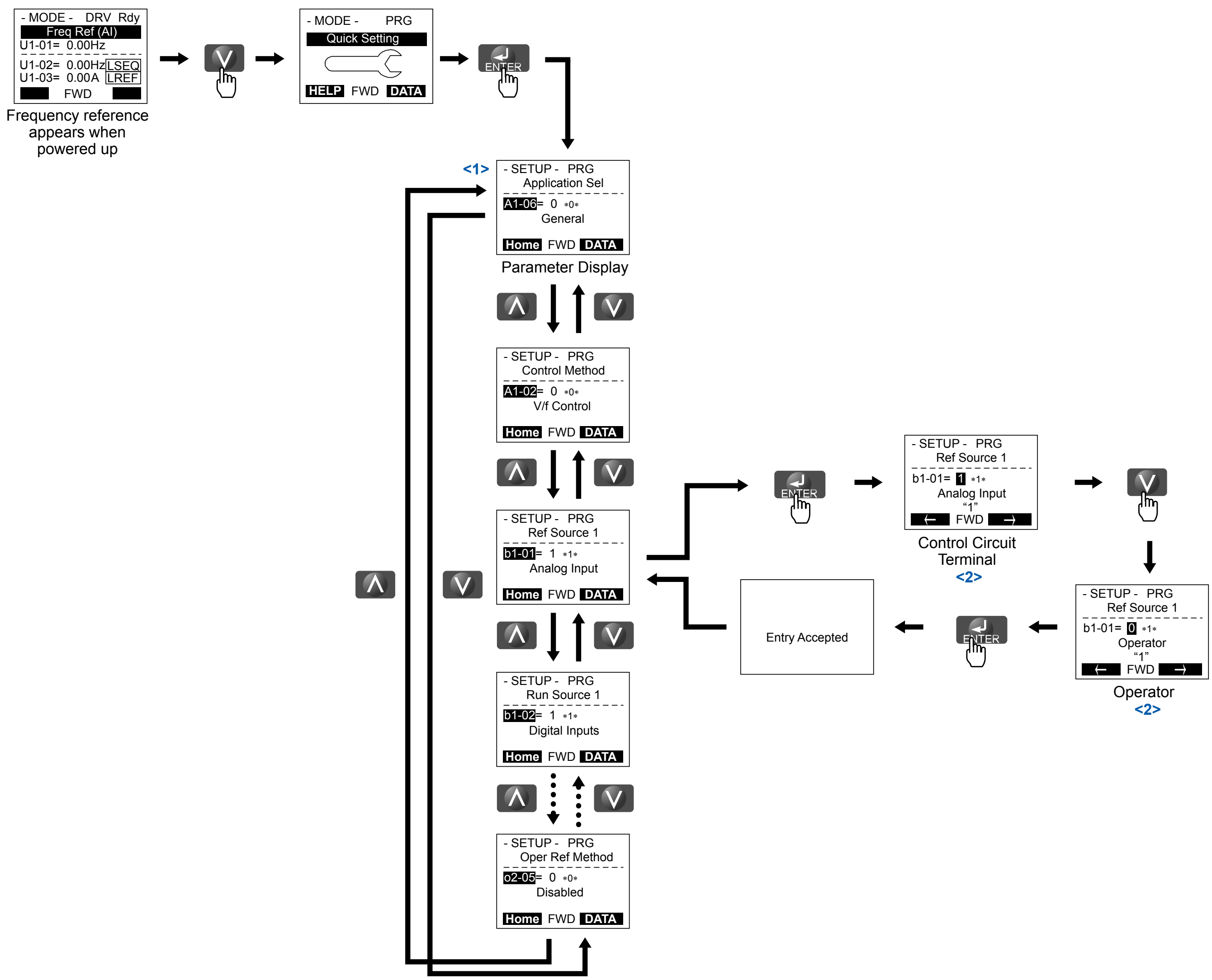


Figure 4.7 Setup Group Example

<1> Use the up and down arrow keys to scroll through the Setup Group. Press the ENTER key to view or change parameter settings.

<2> To return to the previous menu without saving changes, press the ESC key.

■ Setup Group Parameters

Table 4.6 lists the parameters available by default in the Setup Group. Selecting an Application Preset in parameter A1-06 or from the Application Selection Menu of the Setup Group automatically changes the parameters selected for the Setup Group. *Refer to Application Selection on page 120* for more information.

Use the Programming Mode to access parameters not displayed in the Setup Group.

Table 4.6 Setup Group Parameters

Parameter	Name	Parameter	Name
A1-02	Control Method Selection	H3-03	Terminal A1 Gain Setting
b1-01	Frequency Reference Selection 1	H3-04	Terminal A1 Bias Setting
b1-02	Run Command Selection 1	H3-11	Terminal A2 Gain Setting
b1-03	Stopping Method Selection	H3-12	Terminal A2 Bias Setting
C1-01	Acceleration Time 1	L2-01	Momentary Power Loss Operation Selection
C1-02	Deceleration Time 1	L2-02	Momentary Power Loss Ride-Thru Time
C6-02	Carrier Frequency Selection	L4-05	Frequency Reference Loss Detection Selection
d2-01	Frequency Reference Upper Limit	L4-06	Frequency Reference at Reference Loss
d2-02	Frequency Reference Lower Limit	L5-01	Number of Auto Restart Attempts
E1-01	Input Voltage Setting	L5-03	Fault Reset Interval Time
E1-04	Maximum Output Frequency	L6-01	Torque Detection Selection 1
E1-05	Maximum Voltage	L6-02	Torque Detection Level 1
E1-06	Base Frequency	L6-03	Torque Detection Time 1
E2-01	Motor Rated Current	o2-03	User Parameter Default Value
E2-11	Motor Rated Power	o2-05	Frequency Reference Setting Method Selection
F6-01	Communications Error Operation Selection		

Note:
1. Parameter availability depends on the control mode set in A1-02; some parameters listed in *Table 4.6* may not be accessible in all control modes.
2. Parameters listed in *Table 4.6* are set in alphanumeric order as User Parameters in A2-01 to A2-32.

4.4 Start-Up Flowcharts

These flowcharts summarize steps required to start the drive. Use the flowcharts to determine the most appropriate start-up method for a given application. The charts are quick references to help familiarize the user with start-up procedures.

Note: *Refer to Application Selection on page 120* to set up the drive using one of the Application Presets.

Flowchart	Subchart	Objective	Page
A	–	Basic start-up procedure and motor tuning	116
–	A-1	Simple motor setup using V/f mode	117
	A-2	Setting up the drive to run a permanent magnet (PM) motor	118

◆ Flowchart A: Basic Start-Up and Motor Tuning

Flowchart A in ***Figure 4.8*** describes a basic start-up sequence that varies slightly depending on the application. Use the drive default parameter settings in simple applications that do not require high precision.

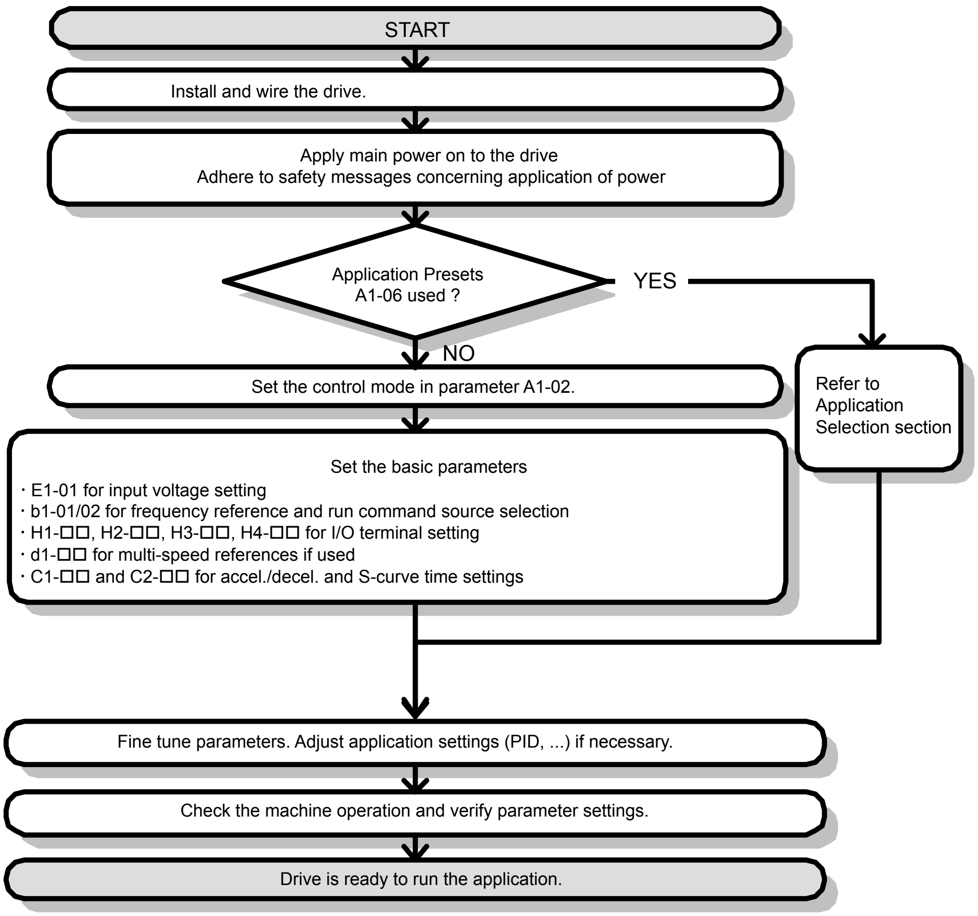


Figure 4.8 Basic Start-Up

◆ Subchart A-1: Simple Motor Setup Using V/f Control

Flowchart A-1 in ***Figure 4.9*** describes simple motor setup for V/f Control. V/f Control is suited for more basic applications such as fans and pumps. This procedure illustrates Energy Savings and Speed Estimation Speed Search.

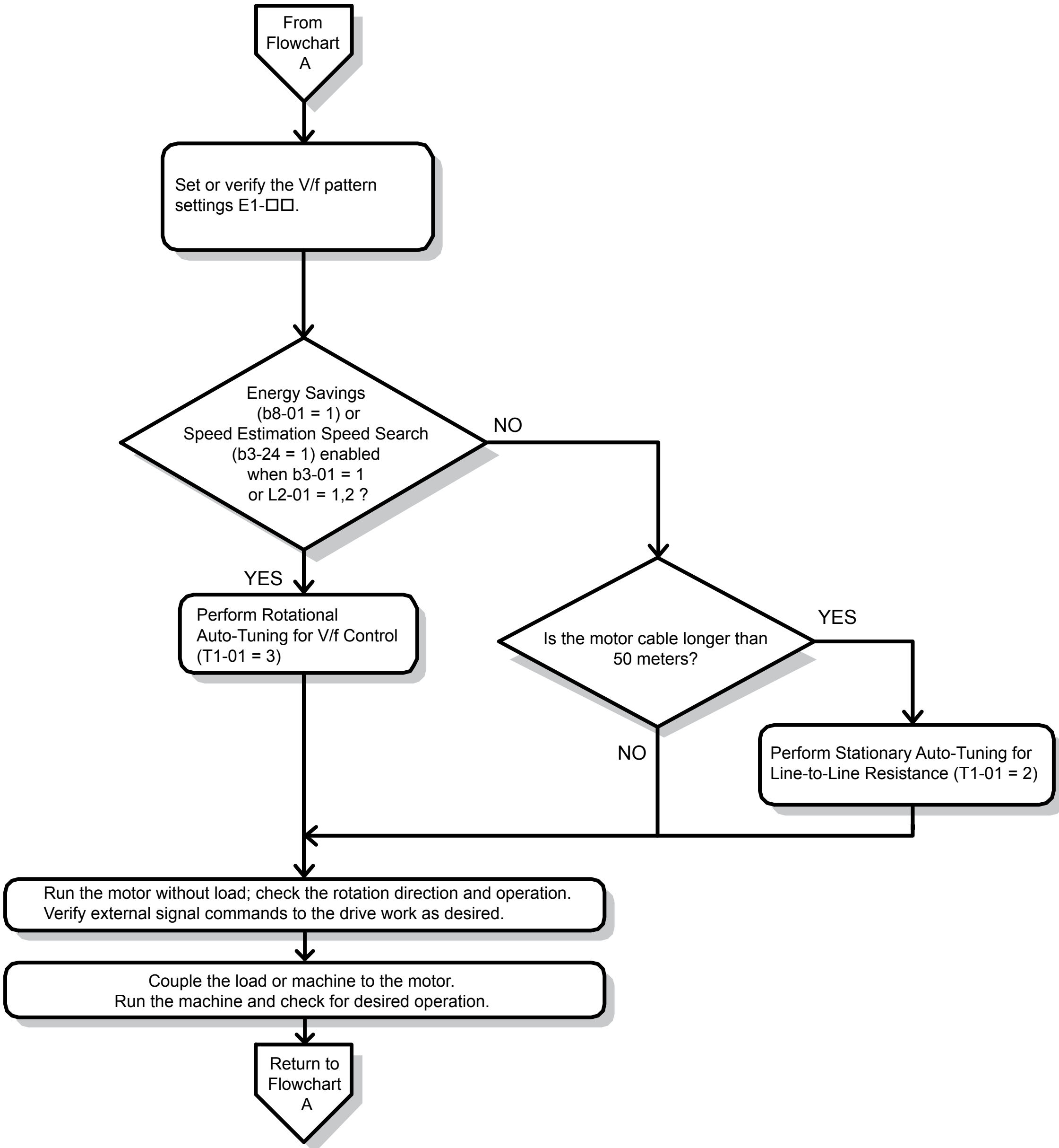


Figure 4.9 Simple Motor Setup with Energy Savings or Speed Search

◆ Subchart A-2: Operation with Permanent Magnet Motors

Flowchart A-2 in *Figure 4.10* describes the setup procedure for running a PM motor in Open Loop Vector Control. PM motors can be used for more energy-efficient operation in reduced or variable torque applications.

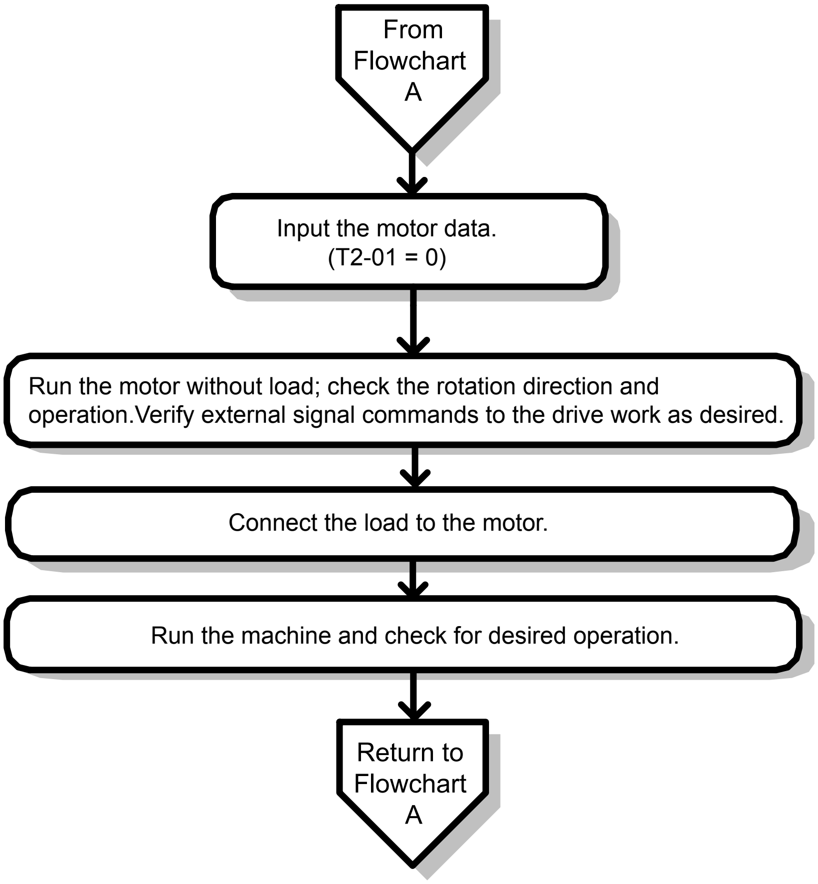


Figure 4.10 Operation with Permanent Magnet Motors

4.5 Powering Up the Drive

◆ Powering Up the Drive and Operation Status Display

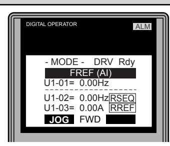
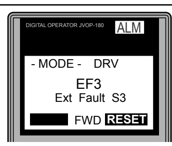
■ Powering Up the Drive

Review the following checklist before turning the power on.

Item to Check	Description
Power supply voltage	200 V class: Three-phase 200 to 240 Vac 50/60 Hz 400 V class: Models 4U□□□□ and 4P□□□□: Three-phase 380 to 500 Vac 50/60 Hz 400 V class: Models 4E□□□□and 4W□□□□: Three-phase 380 to 480 Vac 50/60 Hz
	Properly wire the power supply input terminals (R/L1, S/L2, T/L3).
	Check for proper grounding of drive and motor. Use a power supply with a capacity that is equal to or greater than drive capacity.
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.

■ Status Display

When the power supply to the drive is turned on, the HOA keypad lights will appear as follows:

Status	Name	Description
Normal Operation		The data display area displays the frequency reference. “Rdy” is displayed..
Fault	 External fault (example)	Data displayed varies by the type of fault. ***Refer to Fault Displays, Causes, and Possible Solutions on page 201*** for more information. “ALM” is displayed.

4.6 Application Selection

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

An Application Preset can either be selected from the Application Selection display in the Setup Group (***Refer to Using the Setup Group on page 113***) or in parameter A1-06. The following presets can be selected:

Note: An Application Preset can only be selected if all drive parameters are on at their original default settings. It may be necessary to initialize the drive by setting A1-03 to "2220" or "3330" prior to selecting an Application Preset.

WARNING! *Confirm the drive I/O signals and external sequence before performing a test run. Setting parameter A1-06 may change the I/O terminal function automatically from the default setting. Failure to comply may result in death or serious injury.*

No.	Parameter Name	Setting Range	Default
A1-06	Application Presets	0: Standard 1: Fan 2: Fan with PID Control 3: Return Fan with PID Control 4: Cooling Tower Fan 5: Cooling Tower Fan with PID Control 6: Pump (Secondary) 7: Pump with PID Control	0

◆ HVAC Application Parameters

In addition, the application parameters most likely to be changed for fan and pump applications are assigned to the group of User Parameters, A2-01 through A2-32. User Parameters provide quicker access to by eliminating the need to scroll through multiple menus.

Table 4.7 User Parameters (A2-01 to A2-32)

No.	Parameter Name
b1-03	Stopping Method Selection
b1-04	Reverse Operation Selection
b2-09	Motor Pre-Heat Current 2
b5-01	PID Function Setting
b5-03	Integral Time Setting (I)
b5-08	PID Primary Delay Time Constant
b5-09	PID Output Level Selection
b5-13	PID Feedback Low Detection Level
b5-14	PID Feedback Low Detection Time
b5-15	PID Sleep Function Start Level
b5-16	PID Sleep Delay Time
C1-01	Acceleration Time 1
d2-03	Master Speed Reference Lower Limit
H1-07	Multi-Function Digital Input Terminal S7 Function Selection
H3-01	Terminal A1 Signal Level Selection
H3-02	Terminal A1 Function Selection
H3-10	Terminal A2 Function Selection
L5-01	Number of Auto Restart Attempts
L6-01	Stall Prevention Selection during Deceleration
o1-06	User Monitor Selection Mode
o1-07	Second Line Monitor Selection
o1-08	Third Line Monitor Selection

◆ Setting 1: Fan Application

Table 4.8 Fan: Parameter Settings

No.	Name	Default Setting
b1-03	Stopping Method Selection	1: Coast to Stop
b1-04	Reverse Operation Selection	1: Reverse operation disabled
C1-01	Acceleration Time 1	60 s
L5-01	Number of Auto Restart Attempts	10
L6-01	Torque Detection Selection 1	5: UL3 at speed agree (Alarm)

◆ Setting 2: Fan with PI Control Application

Table 4.9 Fan with PI Control: Parameter Settings

No.	Parameter Name	Default Setting
b1-03	Stopping Method Selection	1: Coast to Stop
b1-04	Reverse Operation Selection	1: Reverse operation disabled
b5-01	PI Function Setting	1: Output frequency = PI output 1
b5-03	Integral Time Setting (I)	30 s
b5-08	PI Primary Delay Time Constant	2 s
b5-13	PI Feedback Low Detection Level	2%
b5-14	PI Feedback Low Detection Time	25 s
C1-01	Acceleration Time 1	60 s
L5-01	Number of Auto Restart Attempts	10
L6-01	Stall Prevention Selection during Deceleration	5: UL3 at speed agree (Alarm)

◆ Setting 3: Return Fan with PI Control Application

Table 4.10 Return Fan with PI Control: Parameter Settings

No.	Parameter Name	Default Setting
b1-03	Stopping Method Selection	1: Coast to Stop
b1-04	Reverse Operation Selection	1: Reverse operation disabled
b5-01	PI Function Setting	1: Output frequency = PI output 1
b5-03	Integral Time Setting (I)	30 s
b5-08	PI Primary Delay Time Constant	2 s
b5-13	PI Feedback Low Detection Level	2%
b5-14	PI Feedback Low Detection Time	25 s
C1-01	Acceleration Time 1	60 s
H3-01	Terminal A1 Signal Level Selection	2: 4 to 20 mA
H3-02	Terminal A1 Function Selection	B: PI feedback
H3-10	Terminal A2 Function Selection	16: Differential PI feedback
L5-01	Number of Auto Restart Attempts	10
L6-01	Stall Prevention Selection during Deceleration	5: UL3 at speed agree (Alarm)
o1-07	Second Line Monitor Selection	505: PI Differential Feedback

◆ Setting 4: Cooling Tower Fan Application

Table 4.11 Cooling Tower Fan: Parameter Settings

No.	Parameter Name	Default Setting
b1-03	Stopping Method Selection	1: Coast to Stop
b1-04	Reverse Operation Selection	0: Reverse operation enabled
b2-09	Motor Pre-Heat Current 2	10%
C1-01	Acceleration Time 1	60 s
d2-03	Master Speed Reference Lower Limit	30%
H1-07	Multi-Function Digital Input Terminal S7 Function Selection	60: Motor Pre-Heat 1
L5-01	Number of Auto Restart Attempts	10
L6-01	Stall Prevention Selection during Deceleration	5: UL3 at speed agree (Alarm)

◆ Setting 5: Cooling Tower Fan with PI Control Application

Table 4.12 Cooling Tower Fan with PI Control: Parameter Settings

No.	Parameter Name	Default Setting
b1-03	Stopping Method Selection	1: Coast to Stop
b1-04	Reverse Operation Selection	0: Reverse operation enabled
b2-09	Motor Pre-Heat Current 2	10%
b5-01	PI Function Setting	1: Output frequency = PI output 1
b5-03	Integral Time Setting (I)	30 s
b5-08	PI Primary Delay Time Constant	2 s
b5-09	PI Output Level Selection	1: Reverse Output
b5-13	PI Feedback Low Detection Level	2%
b5-14	PI Feedback Low Detection Time	25 s
b5-15	PI Sleep Function Start Level	10.8 Hz
b5-16	PI Sleep Delay Time	25.5 s
C1-01	Acceleration Time 1	60 s
d2-03	Master Speed Reference Lower Limit	30%
H1-07	Multi-Function Digital Input Terminal S7 Function Selection	60: Motor Pre-Heat 1
L5-01	Number of Auto Restart Attempts	10
L6-01	Stall Prevention Selection during Deceleration	5: UL3 at speed agree (Alarm)

◆ Setting 6: Pump (Secondary) Application

Table 4.13 Pump (Secondary): Parameter Settings

No.	Parameter Name	Default Setting
b1-04	Reverse Operation Selection	1: Reverse operation disabled
C1-01	Acceleration Time 1	20 s
d2-03	Master Speed Reference Lower Limit	20%
L5-01	Number of Auto Restart Attempts	10
L6-01	Stall Prevention Selection during Deceleration	5: UL3 at speed agree (Alarm)

◆ Setting 7: Pump with PI Control Application

Table 4.14 Pump with PI Control: Parameter Settings

No.	Parameter Name	Default Setting
b1-04	Reverse Operation Selection	1: Reverse operation disabled
b5-01	PI Function Setting	1: Enabled (PI output becomes output frequency reference)
b5-03	Integral Time Setting (I)	15 s
b5-08	PI Primary Delay Time Constant	10.0 s
b5-13	PI Feedback Low Detection Level	2%
b5-14	PI Feedback Low Detection Time	25 s
b5-15	PI Sleep Function Start Level	72%
b5-16	PI Sleep Delay Time	25.5 s
C1-01	Acceleration Time 1	20 s
d2-03	Master Speed Reference Lower Limit	20%
L5-01	Number of Auto Restart Attempts	10
L6-01	Stall Prevention Selection during Deceleration	5: UL3 at speed agree (Alarm)

4.7 Basic Drive Setup Adjustments

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 261* for a complete listing of drive parameters if more information is required for parameters not listed in this section or in *4.12 Advanced Drive Setup Adjustments*.

■ A1-02: Control Method Selection

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

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

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

Setting 0: V/f Control for Induction Motors

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

Setting 5: Open Loop Vector Control for PM

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

■ b1-01: Frequency Reference Selection for AUTO Mode

Selects the frequency reference source 1.

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

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

Setting 0: HOA Keypad

Using this setting, the frequency reference can be input using the HOA keypad.

Setting 1: Terminals (analog input terminals)

Using this setting, an analog frequency reference can be entered as a voltage or current signal from terminals A1, A2, or A3.

Voltage Input

Voltage input can be used at any of the three analog input terminals. Make the settings as described in *Table 4.15* for the input used.

Table 4.15 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	–
	-10 to +10 Vdc	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.
	-10 to +10 Vdc	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”.
	-10 to +10 Vdc	H3-05 = 1				

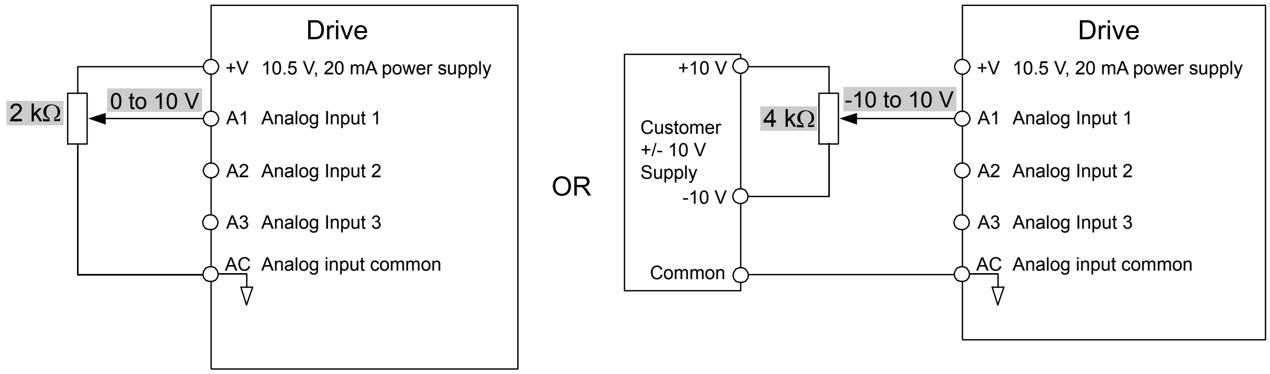


Figure 4.11 Setting the Frequency Reference as a Voltage Signal at Terminal A1

Current Input

Input terminals, A1, A2, and A3 can accept a current input signal. Refer to ***Table 4.16*** for an example to set terminal A2 for current input.

Table 4.16 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				

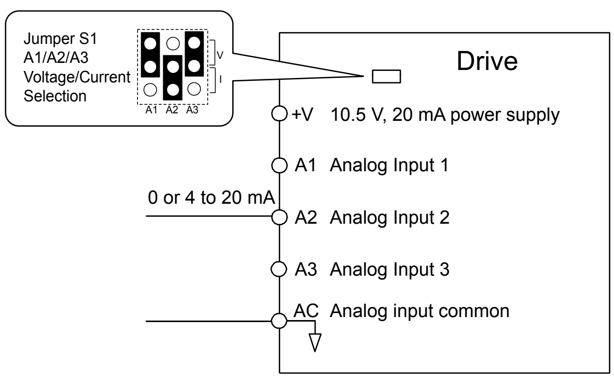


Figure 4.12 Setting the Frequency Reference as a Current Signal to Terminal A2

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. ***Refer to Multi-Step Speed Selection on page 165*** for details on using this function.

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

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

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 operation error will be displayed on the digital operator and the drive will not run.

■ b1-02: Run Command Selection for AUTO Mode

Determines the Run command selection for AUTO mode.

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

Setting 1: Control Circuit Terminal

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

- 2-Wire sequence 1:

  Two inputs (FWD/Stop-REV/Stop). Set A1-03 to 2220 to initialize the drive and preset terminals S1 and S2 to these functions. This is the default setting of the drive.
- 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.

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

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

Setting 3: Option Card

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

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

■ b1-03: Stopping Method Selection

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

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

Setting 0: Ramp to Stop

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

When the output frequency falls below the level set in parameter b2-01, the drive will start DC injection or Zero Speed Control depending on the selected control mode.

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.

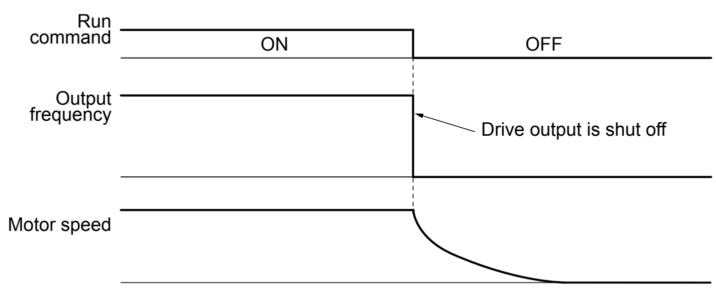


Figure 4.13 Coast to Stop

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 on page 265*) or Speed Search (*Refer to b3: Speed Search on page 265*) to restart the motor before it has completely stopped.

Setting 2: DC Injection Braking to Stop

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

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

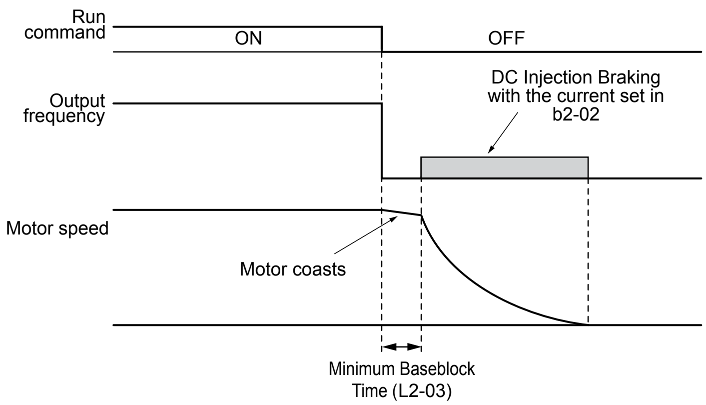


Figure 4.14 DC Injection Braking to Stop

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:

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

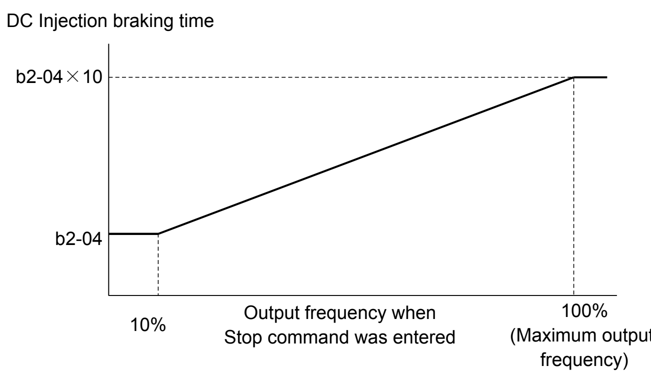


Figure 4.15 DC Injection Braking Time Depending on Output Frequency

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

Setting 3: Coast with Timer

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

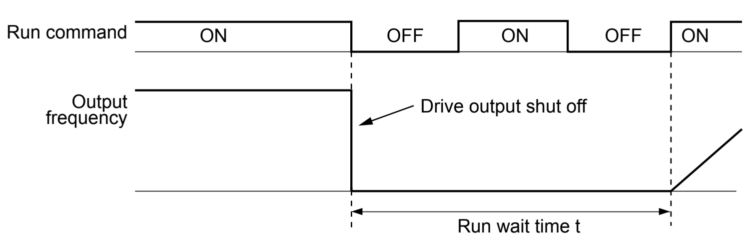


Figure 4.16 Coast with Timer

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

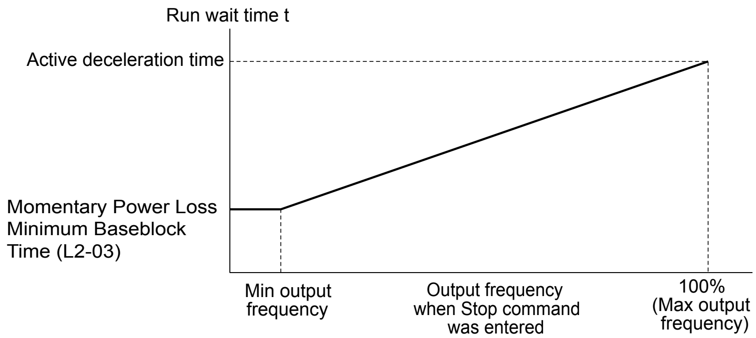


Figure 4.17 Run Wait Time Depending on Output Frequency

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

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

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

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

Switching Acceleration Times by Digital Input

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

Table 4.17 Accel/Decel Time Selection by Digital Input

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

Figure 4.18 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).

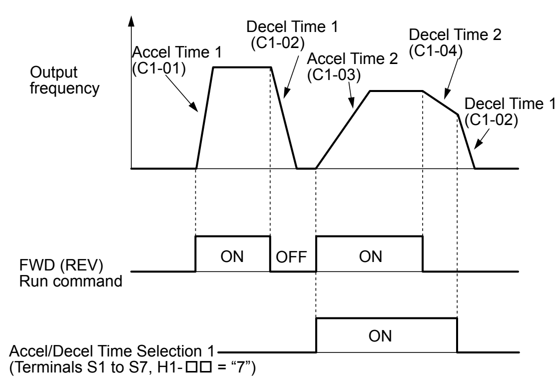


Figure 4.18 Timing Diagram of Accel/Decel Time Change

Switching Accel/Decel Times by a Frequency Level

The drive can switch between different acceleration and deceleration times automatically. The drive will switch from accel/decel time 2 in C1-03 and C1-04 to the default accel/decel time in C1-01 and C1-02 when the output frequency exceeds the frequency level set in parameter C1-11. When the frequency falls below this level, the accel/decel times are switched back. *Figure 4.19* shows an operation example.

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

$$\text{C1-03} = \frac{(\text{accel time from 0 Hz to C1-11}) \times (\text{E1-04})}{\text{C1-11}}$$

$$\text{C1-01} = \frac{(\text{accel time between C1-11 and E1-04}) \times (\text{E1-04})}{(\text{E1-04} - \text{C1-11})}$$

$$\text{C1-02} = \frac{(\text{decel time between E1-04 and C1-11}) \times (\text{E1-04})}{(\text{E1-04} - \text{C1-11})}$$

$$\text{C1-04} = \frac{(\text{decel time from C1-11 to 0 Hz}) \times (\text{E1-04})}{\text{C1-11}}$$

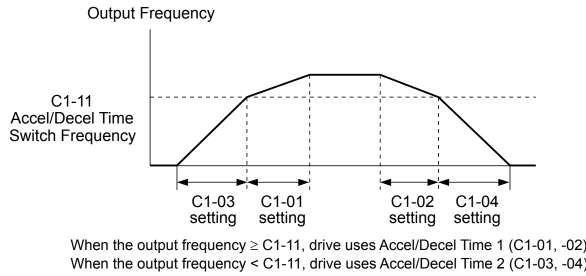


Figure 4.19 Accel/Decel Time Switching Frequency

■ C6-02: Carrier Frequency Selection

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

Note: Increasing the carrier frequency above the default value automatically lowers the drive current rating. *Refer to Rated Current Depending on Carrier Frequency on page 257*.

No.	Parameter Name	Setting Range	Default
C6-02	Carrier Frequency Selection	1 to 4, F	Determined by A1-02 and o2-04.

Setting 1: 4.0 kHz

Setting 2: 6.0 kHz

Setting 3: 8.0 kHz

Setting 4: 10.0 kHz

Setting F: User defined (C6-03 to C6-05)

Guidelines for Carrier Frequency Parameter Setup

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

<1> The carrier frequency may need to be lowered if the motor cable is too long. Refer to *Table 4.18*.

Table 4.18 Wiring Distance and Carrier Frequency

Wiring Distance	Up to 50 m	Greater than 50 m
Recommended setting value for C6-02	1 to 4 (up to 10 kHz)	1 (up to 4 kHz)

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

■ d2-01: Frequency Reference Upper Limit

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

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

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

■ d2-02: Frequency Reference Lower Limit

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

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

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

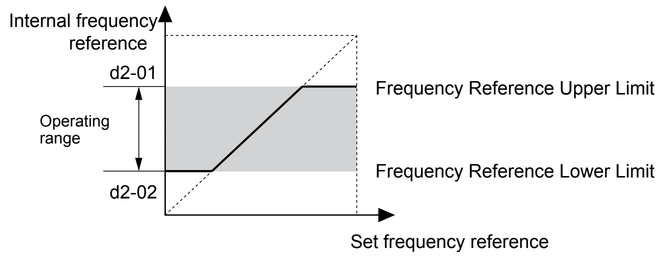


Figure 4.20 Frequency Reference: Upper and Lower Limits

■ V/f Pattern Settings E1-04 to E1-13

If E1-03 is set to a preset V/f pattern (i.e., a value other than F), the user can monitor the V/f pattern in parameters E1-04 through E1-13. To create a new V/f pattern, set E1-03 to F. ***Refer to V/f Pattern on page 130*** for an example custom V/f pattern.

Note: Certain E1-□□ parameters might not be visible depending on the control mode. ***Refer to Parameter List on page 261*** for details.

No.	Parameter Name	Setting Range	Default
E1-04	Maximum Output Frequency	40.0 to 400.0 Hz <1>	<2> <3>
E1-05	Maximum Voltage	0.0 to 255.0 V <4>	<2> <5>
E1-06	Base Frequency	0.0 to [E1-04] <1>	<2> <3> <5>
E1-07	Middle Output Frequency	0.0 to [E1-04]	<2>
E1-08	Middle Output Frequency Voltage	0.0 to 255.0 V <4>	<2>
E1-09	Minimum Output Frequency	0.0 to [E1-04] <1>	<2> <3> <5>
E1-10	Minimum Output Frequency Voltage	0.0 to 255.0 V <4>	<2>
E1-11 <6>	Middle Output Frequency 2	0.0 to [E1-04]	0.0 Hz
E1-12 <6>	Middle Output Frequency Voltage 2	0.0 to 255.0 V <4>	0.0 V <7>
E1-13 <8>	Base Voltage	0.0 to 255.0 V <4>	0.0 V <7>

<1> Default setting is determined by E5-01 in OLV/PM. When E5-01 is set to FFFFH, the setting range for E1-04 and E1-06 is 10.0 to 400.0 Hz and the setting range for E1-09 is 0.0 to 400.0 Hz.

<2> Default setting is dependent on parameters A1-02, Control Mode Selection, and o2-04, and Drive Model Selection.

<3> When using PM motors, the default setting is determined by the motor code set to E5-01.

<4> Values shown are specific to 200 V class drives. Double the value for 400 V class drives.

<5> Default setting is determined by parameter A1-02, Control Mode Selection.

<6> Parameter ignored when E1-11 (Motor 1 Mid Output Frequency 2) and E1-12 (Motor 1 Mid Output Frequency Voltage 2) are set to 0.0.

<7> The drive changes these settings when Auto-Tuning is performed.

<8> When Auto-Tuning is performed, E1-13 and E1-05 will be set to the same value.

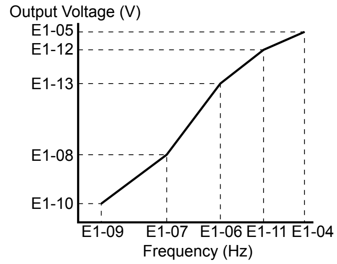


Figure 4.21 V/f Pattern

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

■ E2-01: 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 150% of the drive rated current <1>	Determined by o2-04

<1> Display is in the following units:
2□0028, 2□0042, and 4□0011 to 4□0027: 0.01 A units
2□0054 to 2□0248 and 4□0034 to 4□0414: 0.1 A units

Note: Setting E2-01 ≤ E2-03 will trigger an oPE02 error. Set E2-03 correctly to prevent this error.

■ E2-11: Motor Rated Power

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

No.	Parameter Name	Setting Range	Default
E2-11	Motor Rated Power	0.00 to 650.00 kW	Determined by o2-04

■ E5-01: Motor Code Selection (for PM Motors)

When using Yaskawa motors, set the motor code for the PM motor being used. The drive automatically sets several parameters to appropriate values depending on the motor code.

Setting parameter E5-01 to FFFF allows the motor data to be manually set using the E5-□□ parameters.

No.	Parameter Name	Setting Range	Default
E5-01	Motor Code Selection (for PM Motors)	0000 to FFFF	Determined by A1-02 and o2-04

Note:
1. E5-□□ parameters are not reset when the drive is initialized using parameter A1-03.
2. When E5-01 is set to a value other than FFFF, the drive will not initialize using parameter A1-03
3. Changing E5-01 to FFFF from value other than FFFF will not change the values of parameters E5-02 through E5-24.
4. Set E5-01 to FFFF when using a motor other than a Yaskawa SMRA, SSR1, or SST4 series.
5. Default settings is Yaskawa SSR1 Series (1750 r/min)
6. Selection may vary depending on the motor code entered to E5-01.
7. If an alarm or hunting occurs despite using a motor code, enter the value indicated on the nameplate.

Figure 4.22 explains the motor code setting.

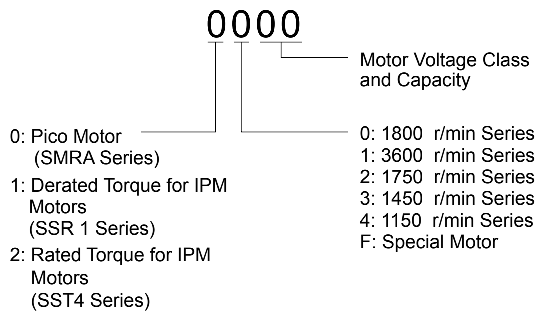


Figure 4.22 PM Motor Code

■ E5-02: Motor Rated Power (for PM Motors)

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

No.	Parameter Name	Setting Range	Default
E5-02	Motor Rated Power (for PM Motors)	0.10 to 650.00 kW	Determined by E5-01

■ E5-03: Motor Rated Current (for PM Motors)

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

No.	Parameter Name	Setting Range	Default
E5-03	Motor Rated Current (for PM Motors)	10 to 150% of drive rated current <1>	Determined by E5-01

<1> Display is in the following units:
2□0028, 2□0042, and 4□0011 to 4□0027: 0.01 A units
2□0054 to 2□0248 and 4□0034 to 4□0414: 0.1 A units

■ E5-04: Number of Motor Poles (for PM Motors)

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

No.	Parameter Name	Setting Range	Default
E5-04	Number of Motor Poles (for PM Motors)	2 to 48	Determined by E5-01

■ E5-05: Motor Stator Resistance (r1) (for PM Motors)

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

No.	Parameter Name	Setting Range	Default
E5-05	Motor Stator Resistance (for PM Motors)	0.000 to 65.000 Ω	Determined by E5-01

■ E5-06: Motor d-Axis Inductance (Ld) (for PM Motors)

Sets the d-Axis inductance in 0.01 mH units.

No.	Parameter Name	Setting Range	Default
E5-06	Motor d-Axis Inductance (for PM Motors)	0.00 to 300.00 mH	Determined by E5-01

■ E5-07: Motor q-Axis Inductance (Lq) (for PM Motors)

Sets the q-Axis inductance in 0.01 mH units.

No.	Parameter Name	Setting Range	Default
E5-07	Motor q-Axis Inductance (for PM Motors)	0.00 to 600.00 mH	Determined by E5-01

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

Sets the induced peak voltage per phase in units of 0.1 mV/(rad/s) [electrical angle]. Set this parameter when using an IPM motor with derated torque (SSR1 series or equivalent) or an IPM motor with constant torque (SST4 series or equivalent).

Set the voltage constant with E5-09 or E5-24 when E5-01 is set to FFFF. This parameter is set during Auto-Tuning for PM motors.

No.	Parameter Name	Setting Range	Default
E5-09	Motor Induction Voltage Constant 1 (for PM Motors)	0.0 to 2000.0 mV/(rad/s)	Determined by E5-01

Note: Set E5-24 to 0 when setting E5-09. However, setting both E5-09 and E5-24 to 0 will trigger an alarm. An alarm will also be triggered if neither E5-09 nor E5-24 are set to 0. When E5-01 is set to FFFF, then E5-09 = 0.0.

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

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

When E5-01 is set to FFFF, use either E5-09 or E5-24 for setting the voltage constant. This parameter is set during Parameter Auto-Tuning for PM motors.

No.	Parameter Name	Setting Range	Default
E5-24	Motor Induction Voltage Constant 2 (for PM Motors)	0.0 to 6500.0 mV/(r/min)	Determined by E5-01

Note: Set E5-24 to 0.0 when setting E5-09. However, setting both E5-09 and E5-24 to 0.0 will trigger an alarm. An alarm will also be triggered if neither E5-09 nor E5-24 are set to 0.0. When E5-01 is set to FFFF, then E5-09 should be set to 0.0.

■ H2-06: Power Consumption Output Unit Selection

When one of the multi-function terminals is set to power consumption pulse output (H2-01, H2-02, or H2-03 = 39) or regenerated power pulse output (H2-01, H2-02, or H2-03 = 3A), parameter H2-06 determines the units for the output signal.

This output function provides a watt hour meter or a PLC input by a 200 ms pulse signal. H2-06 determines the frequency that pulses are issued to keep track of the kWh for the drive.

No.	Parameter Name	Setting Range	Default
H2-06	Power Consumption Output Unit Selection	0 to 4 <1>	1

<1> Setting range is 1 to 4 in drive software versions PRG: 6113 and earlier.

Setting 0: 0.1 kWh Units

Setting 1: 1 kWh Units

Setting 2: 10 kWh Units

Setting 3: 100 kWh Units

Setting 4: 1000 kWh Units

Note:
1. A regenerated power pulse output does not subtract from the total watt hours while power is applied. A power consumption output does not subtract from the total watt hours during regeneration.
2. The drive keeps track of the watt hours as long as the control circuit has power. The value is reset when the power supply is shut off.

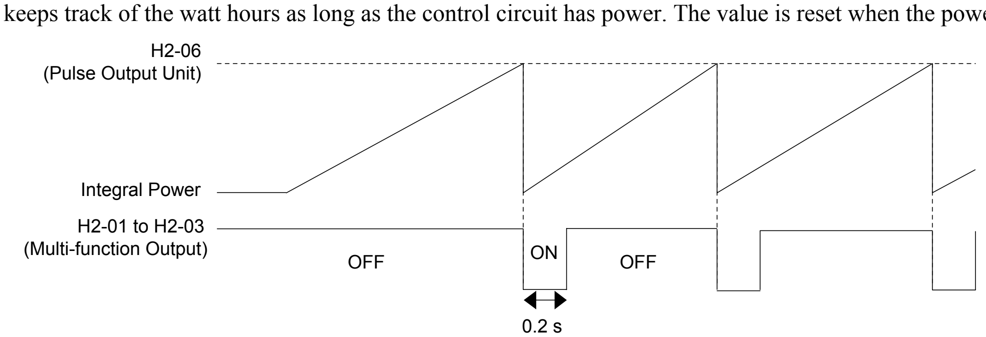


Figure 4.23 Watt Hour Output Example

■ H3-03, H3-04: Terminal A1 Gain and Bias Settings

Parameter H3-03 sets the level of the selected input value that is equal to 10 Vdc (20 mA) input at terminal A1 (gain).

Parameter H3-04 sets the level of the selected input value that is equal to 0 V (4 mA, 0 mA) input at terminal A1 (bias).

Use both parameters to adjust the characteristics of the analog input signal to terminal A1.

No.	Name	Setting Range	Default
H3-03	Terminal A1 Gain Setting	-999.9 to 999.9%	100.0%
H3-04	Terminal A1 Bias Setting	-999.9 to 999.9%	0.0%

Setting Examples

- Gain H3-03 = 200%, bias H3-04 = 0, terminal A1 as frequency reference input (H3-02 = 0):

  A 10 Vdc input is equivalent to a 200% frequency reference and 5 Vdc is equivalent to a 100% frequency reference. Since the drive output is limited by the maximum frequency parameter (E1-04), the frequency reference will be equal to E1-04 above 5 Vdc.

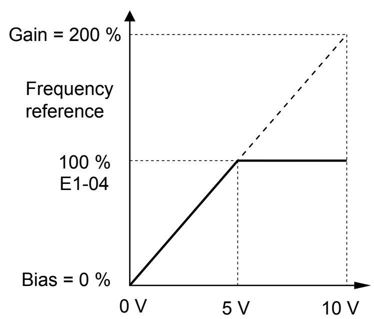


Figure 4.24 Frequency Reference Setting by Analog Input with Increased Gain

- Gain H3-03 = 100%, bias H3-04 = -25%, terminal A1 as frequency reference input:

  An input of 0 Vdc will be equivalent to a -25% frequency reference.

  When parameter H3-01 = 0, the frequency reference is 0% between 0 and 2 Vdc input.

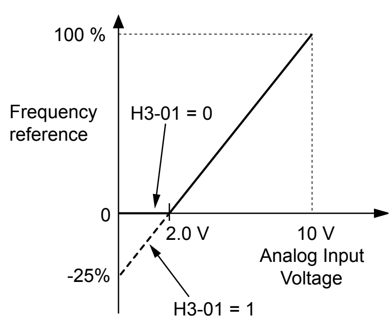


Figure 4.25 Frequency Reference Setting by Analog Input with Negative Bias

■ 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%

■ L2-01: Momentary Power Loss Operation Selection

When a momentary power loss occurs, the drive can automatically return to the operation it was performing prior to the power loss based on certain conditions.

No.	Name	Setting Range	Default
L2-01	Momentary Power Loss Operation Selection	0 to 2	0

Setting 0: Disabled

If a momentary power loss occurs, a power supply frequency fault (Fdv) is detected and the drive output is turned OFF. The motor coasts to stop.

Setting 1: Recover within L2-02

When a momentary power loss occurs, the drive output will be shut off. If the power returns within the time set to parameter L2-02, the drive will perform Speed Search and attempt to resume operation. If power is not restored within this time, then an Fdv fault is triggered and the drive will stop.

Setting 2: Recover as long as CPU Has Power

When a momentary power loss occurs, the drive output will be shut off. If the power returns and the drive control circuit has power, the drive will attempt to perform Speed Search and resume the operation. This will not trigger an Fdv fault.

Notes on Settings 1 and 2:

- “Uv” flashes on the operator while the drive attempts to recover from a momentary power loss. A fault signal is not output at this time.
- When using a magnetic contactor between the motor and the drive, keep the magnetic contactor closed while the drive attempts to restart with Speed Search.

■ L2-02: Momentary Power Loss Ride-Thru Time

Sets the length of time that the drive will wait if the control circuit voltage is less than the detection level of the Uv1 after a momentary power loss before the drive detects a control circuit undervoltage fault (Uv1). This function is applicable when L2-01 = 1 (Recover within L2-02). After a power loss, if all of these conditions are satisfied, the drive detects a Uv1 fault, shuts off the output, and the motor coasts to stop:

- The control circuit voltage is less than the detection level of Uv1.
- The time set in L2-02 is expired.
- The drive does not detect a control power supply voltage fault (Uv2). Depending on use conditions, if the time set in L2-02 is long, the drive can detect Uv2 before it detects Uv1. If this is a problem, decrease the time set in L2-02 to prevent Uv2.

Note:
1. The length of time that the drive can recover after a power loss changes when drive capacity changes.
2. The upper limit of the possible momentary power loss Ride-Thru time changes when drive capacity changes.

No.	Name	Setting Range	Default
L2-02	Momentary Power Loss Ride-Thru Time	0.0 to 2.5 s	0.5 s

■ L4-05: Frequency Reference Loss Detection Selection

The drive can detect a loss of an analog frequency reference from input A1, A2, or A3. Frequency reference loss is detected when the frequency reference drops below 10% of the reference or below 5% of the maximum output frequency within 400 ms.

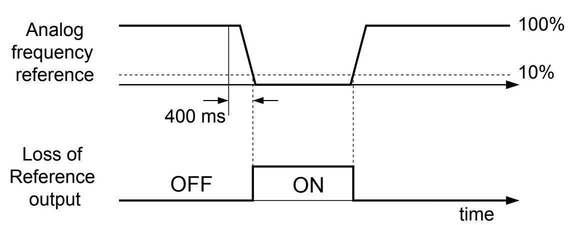


Figure 4.26 Loss of Reference Function

Set H2-01 or H2-02 to C for a digital output to trigger when frequency reference loss occurs.

Parameter L4-05 selects the operation when a frequency reference loss is detected.

No.	Name	Setting Range	Default
L4-05	Frequency Reference Loss Detection Selection	0, 1	1

Setting 0: Stop. Drive stops when the frequency reference is lost.

Setting 1: Run. Drive continues operation according to the setting of L4-06.

The drive will continue operation at the percent of the previous frequency value set to parameter L4-06. When the external frequency reference value is restored, the operation is continued with the frequency reference.

■ L4-06: Frequency Reference at Reference Loss

Sets the frequency reference level at which the drive runs when L4-05 = 1 and when detecting a reference loss. The value is set as a percentage of the frequency reference before the loss was detected.

No.	Name	Setting Range	Default
L4-06	Frequency Reference at Reference Loss	0.0 to 100.0%	80.0%

■ L5-01: Number of Auto Restart Attempts

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

Parameter L5-05 determines the method of incrementing the restart counter. When the counter reaches the number set to L5-01, the operation stops and the fault must be manually cleared and reset.

The restart counter is incremented at each restart attempt, regardless of whether the attempt was successful. When the counter reaches the number set to L5-01, the operation stops and the fault must be manually cleared and reset.

The number of fault restarts is reset to zero when:

- The drive operates normally for 10 minutes following a fault restart.
- A fault is cleared manually after protective functions are triggered.
- The power supply is cycled.

No.	Name	Setting Range	Default
L5-01	Number of Auto Restart Attempts	0 to 10 Times	0 Times

■ L5-03: Time to Continue Making Fault Restarts (enabled only when L5-05 = 0)

Although the drive will continue to execute fault restarts, this parameter will cause a fault if a fault restart cannot occur after the time set to L5-03 passes.

All major faults will cause the drive to stop. For some faults it is possible to configure the drive to attempt a restart automatically. After the fault occurs, the drive baseblocks for L2-03 seconds. After the baseblock is removed, the drive checks if a fault condition still exists. If no fault condition exists, the drive will attempt to restart the motor. If the restart is successful, the drive performs a Speed Search (Regardless of the status of b3-01 "Speed Search Selection") from the set speed command and the Auto Restart Attempts count is increased by one. Even if the restart fails, the restart count is increased by one as long as the drive attempted to rotate the motor. The restart count will not be incremented if the restart is not attempted due to a continuing fault condition, (i.e., an ov fault). The drive waits L5-03 seconds before attempting another restart.

No.	Name	Setting Range	Default
L5-03	Time to Continue Making Fault Restarts	0.1 to 600.0 s	180.0 s

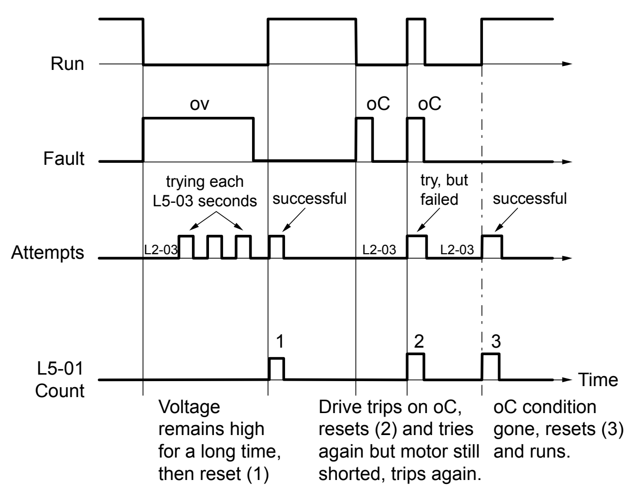


Figure 4.27 Automatic Restart Timing Diagram

The auto restart count is reset back to 0 if any of the following occur:
- No further faults for 10 minutes after the last retry.
- The drive power is turned off (the drive must be without power long enough to let control power dissipate).
- The RESET key is pushed after the last reset attempt.

The setting of parameter L5-02 determines whether the fault output (MA-MB) will be closed during an auto restart attempt.

The setting of L5-02 can be important when using the drive with other equipment.

The following faults will allow the Auto Restart function to initiate:
- oC (Overcurrent)
- LF (Output Phase Loss)
- PF (Input Phase Loss)
- oL1 (Motor Overload)
- oL3 (Overtorque Detection 1)
- oL2 (Drive Overload)
- ov (Overvoltage)
- GF (Ground Fault)
- Uv1 (Undervoltage)
- oH1 (Heatsink Overheat)

In order for auto restart after a Uv1 fault, Momentary Power Loss Ride-thru must be enabled (L2-01= 1: “Power Loss Ridethru Time”). Setting H2-01, H2-02 or H2-03 to 1E configures a digital output as “Restart Enabled” to signal if an impending auto restart is possible.

■ L6-01: Torque Detection Selection 1

The torque detection function is triggered when the current or torque exceed the levels set to L6-02 for longer than the time set to L6-03. L6-01 selects the conditions for detection and the operation that follows.

No.	Name	Setting Range	Default
L6-01	Torque Detection Selection 1	0 to 12	0

Setting 0: Disabled

Setting 1: oL3 at Speed Agree (Alarm)

Overtorque detection is active only when the output speed is equal to the frequency reference (i.e., no detection during acceleration and deceleration). The operation continues after detecting overtorque and triggering an oL3 alarm.

Setting 2: oL3 at Run (Alarm)

Overtorque detection works as long as the Run command is active. The operation continues after detecting overtorque and triggering an oL3 alarm.

Setting 3: oL3 at Speed Agree (Fault)

Overtorque detection is active only when the output speed is equal to the frequency reference (i.e., no detection during acceleration and deceleration). The operation stops and triggers an oL3 fault.

Setting 4: oL3 at Run (Fault)

Overtorque detection works as long as a Run command is active. The operation stops and triggers an oL3 fault.

Setting 5: UL3 at Speed Agree (Alarm)

Undertorque detection is active only when the output speed is equal to the frequency reference (i.e., no detection during acceleration and deceleration). The operation continues after detecting overtorque and triggering a UL3 alarm.

Setting 6: UL3 at Run (Alarm)

Undertorque detection works as long as the Run command is active. The operation continues after detecting overtorque and triggering a UL3 alarm.

Setting 7: UL3 at Speed Agree (Fault)

Undertorque detection is active only when the output speed is equal to the frequency reference (i.e., no detection during acceleration and deceleration). The operation stops and triggers a UL3 fault.

Setting 8: UL3 at Run (Fault)

Undertorque detection works as long as a Run command is active. The operation stops and triggers a UL3 fault.

Setting 9: UL6 at Speed Agree (Alarm)

Motor Underload detection is active only when the output speed is equal to the frequency reference (i.e., no detection during acceleration and deceleration). The operation continues after detection and triggers a UL6 alarm.

Setting 10: UL6 at Run (Alarm)

Motor Underload detection works as long as the Run command is active. The operation continues after detection and triggers a UL6 alarm.

Setting 11: UL6 at Speed Agree (Fault)

Motor Underload detection is active only when the output speed is equal to the frequency reference (i.e., no detection during acceleration and deceleration). The operation stops and triggers a UL6 fault.

Setting 12: UL6 at Run (Fault)

Motor Underload detection works as long as a Run command is active. The operation stops and triggers a UL6 fault.

■ L6-02: Torque Detection Level 1

Sets the detection levels for torque detection function 1 as a percentage of the drive rated output current.

No.	Name	Setting Range	Default
L6-02	Torque Detection Level 1	0 to 300%	15%

Note: The torque detection level 1 (L6-02) can also be supplied by an analog input terminal set to H3-☐☐ = 7. Here, the analog value has priority and the setting in L6-02 is disregarded.

■ L6-03: Torque Detection Time 1

Determines the time required to trigger an alarm or fault after exceeding the level in L6-02.

No.	Name	Setting Range	Default
L6-03	Torque Detection Time 1	0.0 to 10.0 s	10.0 s

■ o2-03: User Parameter Default Value

After completely setting up drive parameters, save the values as user-set defaults with parameter o2-03. After saving the values, parameter A1-03 (Initialize Parameters) will offer the choice of "1110: User Initialize". Selecting 1110 resets all parameters to the user-set default values. ***Refer to A1-03: Initialize Parameters on page 152*** for details on drive initialization.

No.	Name	Setting Range	Default
o2-03	User Parameter Default Value	0 to 2	0

Setting 0: No Change (Awaiting Command)

Setting 1: Set User Initialize Values

The current parameter settings are saved as user-set default for a later User Initialization. Setting o2-03 to 1 and pressing the ENTER key saves the values and returns the display to 0.

Setting 2: Clear User Initialize Values

All user-set defaults for “User Initialize” are cleared. Setting o2-03 to 2 and pressing the ENTER key erases the values and returns the display to 0.

■ o2-05: Frequency Reference Setting Method Selection

Determines if the ENTER key must be pressed after changing the frequency reference using the HOA keypad while in Drive Mode.

No.	Name	Setting Range	Default
o2-05	Frequency Reference Setting Method Selection	0, 1	0

Setting 0: ENTER Key Required

The ENTER key must be pressed every time the frequency reference is changed using the HOA keypad for the drive to accept the change.

Setting 1: ENTER Key not Required

The output frequency changes immediately when the reference is changed by the up or down arrow keys on the HOA keypad. The ENTER key does not need to be pressed. The frequency reference (Fref) is saved to memory after remaining unchanged for 5 seconds.

4.8 Auto-Tuning

◆ Types of Auto-Tuning

The drive offers different types of Auto-Tuning for induction motors and permanent magnet motors. The type of Auto-Tuning used differs further based on the control mode and other operating conditions. Refer to the tables below to select the type of Auto-Tuning that bests suits the application. *Refer to Start-Up Flowcharts on page 115* for directions on executing Auto-Tuning.

Note: The drive will only show Auto-Tuning parameters that are valid for the control mode that has been set in A1-02. If the control mode is for an induction motor, the Auto-Tuning parameters for PM motors will not be available.

■ Auto-Tuning for Induction Motors

This feature automatically sets the V/f pattern and motor parameters E1-□□ and E2-□□ for an induction motor.

Table 4.19 Types of Auto-Tuning for Induction Motors

Type	Setting	Application Conditions and Benefits	Control Mode
			V/f
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. • 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
Rotational Auto-Tuning for V/f Control Energy Saving	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

Table 4.20 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. Also refer to page *117* for details on Auto-Tuning processes and selections.

Table 4.20 Auto-Tuning Input Data

Input Value	Input Parameter	Unit	Tuning Type (T1-01)	
			2 Stationary Auto-Tuning for Line-to-Line Resistance	3 Rotational Auto-Tuning for V/f Control Energy Saving
Motor rated power	T1-02	kW	YES	YES
Motor rated voltage	T1-03	Vac	–	YES
Motor rated current	T1-04	A	YES	YES
Motor rated frequency	T1-05	Hz	–	YES
Number of motor poles	T1-06	–	–	YES
Motor rated Speed	T1-07	r/min	–	YES
Motor iron loss	T1-11	W	–	YES

Auto-Tuning for Permanent Magnet Motors

Automatically sets the V/f pattern and motor parameters E1-☐☐ and E5-☐☐ when a PM motor is used.

Table 4.21 Types of Auto-Tuning for Permanent Magnet Motors

Type	Setting	Application Conditions and Benefits	Control Mode
			OLV/PM
PM Motor Parameter Settings	T2-01 = 0	• Motor does not rotate during Auto-Tuning. • Motor data similar to *Table 4.22* are available from test report or motor nameplate.	YES
PM Stationary Auto-Tuning	T2-01 = 1	• A motor test report listing motor data is not available. • Drive automatically calculates and sets motor parameters.	YES
PM Stationary Auto-Tuning for Stator Resistance	T2-01 = 2	• Useful to tune the drive when the motor data were set up manually or by motor code and the cable is longer than 50 m. • Should also be performed if the cable length has changed after prior tuning.	YES
PM Rotational Auto-Tuning	T2-01 = 14	• A motor test report listing motor data is not available. • Motor can be decoupled from the load and rotate freely while Auto-Tuning is performed. Drive automatically calculates and sets motor parameters. • PM Rotational Auto-Tuning gives more accurate results than Stationary Auto-Tuning.	YES

Table 4.22 lists the data that must be entered for Auto-Tuning. Make sure the 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. Also refer to page *118* for details on the Auto-Tuning process and selection.

Table 4.22 Auto-Tuning Input Data

Input Value	Input Parameter	Unit	Tuning Type (T2-01)
			0 Motor Parameter Settings
Control Mode	**A1-02**	**–**	**5**
Motor Code (Hex.)	**T2-02**	**–**	<1>
Motor Type	T2-03	–	–
Motor Rated Power	T2-04	kW	YES
Motor Rated Voltage	T2-05	Vac	YES
Motor Rated Current	T2-06	A	YES
Motor Rated Frequency	T2-07	Hz	YES
Number of Motor Poles	T2-08	–	YES
Stator Single-phase Resistance	T2-10	Ω	YES
d-Axis Inductance	T2-11	mH	YES
q-Axis Inductance	T2-12	mH	YES
Induced Voltage Constant Unit Selection <2>	T2-13	mVs/rad (elec.)	YES
Voltage Constant <2> <3>	T2-14	mVmin (mech.)	YES
Tuning Pull-in Current	T2-15	A	–

<1> Input the motor code when using a Yaskawa motor. Select “FFFF” when using a motor from another manufacturer.

<2> It is only necessary to input either T2-13 or T2-14. Select one and leave the other empty.

<3> Dependent upon T2-13 setting.

◆ Before Auto-Tuning the Drive

Check the items below before Auto-Tuning the drive.

Basic Auto-Tuning Preparations

- Auto-Tuning requires the user to input data from the motor nameplate or motor test report. Make sure this data is available before Auto-Tuning the drive.

- For best performance, the drive input supply voltage must be at least equal to or greater than the motor rated voltage.

Note: Better performance is possible when using a motor with a base voltage that is lower than the input supply voltage (20 V for 200 V class models and 40 V for 400 V class models). This is particularly important when operating the motor above 90% of base speed, where high torque precision is required.

- To cancel Auto-Tuning, press the OFF key on the HOA keypad.
- When using a motor contactor, make sure it is closed throughout the Auto-Tuning process.

Table 4.23 Auto-Tuning Input Data

Motor Type	Auto-Tuning Type	Digital Input	Digital Output
Induction Motor	Stationary Auto-Tuning for Line-to-Line Resistance	Digital input functions are disabled.	Maintains the status at the start of Auto-Tuning
	Rotational Auto-Tuning for V/f Control		Functions the same as during normal operation.
PM Motor	PM Motor Parameter Settings		Digital output functions are disabled.
	PM Stationary Auto-Tuning		Maintains the status at the start of Auto-Tuning.
	PM Stationary Auto-Tuning for Stator Resistance		
	PM Rotational Auto-Tuning		Functions the same as during normal operation.

■ Notes on Rotational Auto-Tuning

- Decouple the load from the motor to achieve optimal performance from Rotational Auto-Tuning. Rotational Auto-Tuning is best suited for applications requiring high performance over a wide speed range.
- If it is not possible to decouple the motor and load, reduce the load so it is less than 30% of the rated load. Performing Rotational Auto-Tuning with a higher load will set motor parameters incorrectly, and can cause irregular motor rotation.
- Ensure the motor-mounted brake is fully released, if installed.
- Connected machinery should be allowed to rotate the motor.

■ Notes on Stationary Auto-Tuning

Stationary Auto-Tuning modes analyze motor characteristics by injecting current into the motor for approximately one minute.

WARNING! *Electrical Shock Hazard. When executing stationary Auto-Tuning, voltage is applied to the motor before the motor rotates. Do not touch the motor until Auto-Tuning is completed. Failure to comply may result in injury or death from electrical shock.*

WARNING! *Sudden Movement Hazard. If installed, do not release the mechanical brake during Stationary Auto-Tuning. Inadvertent brake release may cause damage to equipment or injury to personnel. Ensure that the mechanical brake release circuit is not controlled by the drive multi-function digital outputs.*

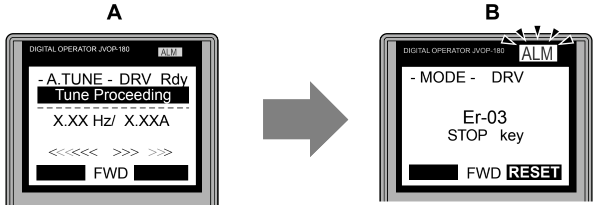
Stationary Auto-Tuning for Line-to-Line Resistance

- Perform when entering motor data manually while using motor cables longer than 50 m.
- If the motor cables have been replaced with cables more than 50 m long after Auto-Tuning has already been performed, use Stationary Auto-Tuning for line-to-line resistance.

◆ 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 4.28 Auto-Tuning Aborted Display

◆ Auto-Tuning Operation Example

The following example demonstrates Rotational Auto-Tuning for V/f.

■ Selecting the Type of Auto-Tuning

Step			Display/Result
1.	Turn on the power to the drive. The initial display appears.	➡	- MODE - DRV Rdy Freq Ref (AI) U1-01= 0.00Hz U1-02= 0.00Hz LSEQ U1-03= 0.00 A LREF FWD
2.	Press ∧ or ∨ until the Auto-Tuning display appears.	➡	- MODE - PRG Auto-Tuning AUTO HELP FWD DATA
3.	Press ENTER to display T1-01 and the current setting (0: Rotational Auto-Tuning).	➡	- A.TUNE - PRG Rdy Tuning Mode Sel T1-01= 2 *2* Line-to-Line ESC FWD DATA
4.	Press ENTER. The T1-01 setting flashes and can now be changed.	➡	- A.TUNE - PRG Rdy Tuning Mode Sel T1-01= 2 *2* Line-to-Line "0" ← FWD →
5.	The setting is already 0 (Rotational Auto-Tuning). Do not change the setting. Press ENTER.	➡	Entry Accepted
6.	The display automatically returns to the display shown in Step 3.	➡	- A.TUNE - PRG Rdy Tuning Mode Sel T1-01= 3 *3* V/f Engy Sav Tun 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. The value set for E2-11 prior to turning on the power is displayed for T1-02.	➡	- A.TUNE - PRG Rdy Mtr Rated Power T1-02= 0.75kW (0.00 ~ 650.00) "0.75kW" ESC FWD DATA
2.	The setting value of T1-02 flashes when ENTER is pressed. The setting can be changed.	➡	- 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

Step			Display/Result
6.	Repeat Steps 1 through 5 to set the following parameters: • T1-03, Motor Rated Voltage • T1-04, Motor Rated Current • T1-05, Motor Base Frequency • T1-06, Number of Motor Poles • T1-07, Motor Base Frequency	➡	- A.TUNE - PRG Rated Voltage T1-03= 200.0VAC (0.0 ~ 255.0) “200.0VAC” ESC FWD DATA ⋮ - A.TUNE - PRG Mtr Rated Slip T1-10= X.XX Hz (0.00 ~ 20.00) “X.XX Hz” ESC FWD DATA

Note: **1.** For details on each setting, *Refer to T1: Parameter Settings during Induction Motor Auto-Tuning on page 143*.
2. 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.	➡	- A.TUNE - DRV Rdy Auto-Tuning 0.00 Hz/ 0.00A Tuning Ready ? Press HAND key ESC FWD
2.	Press HAND 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.	➡	- A.TUNE - DRV Rdy Tune Proceeding X.XX Hz/ X.XXA <<<<< >>> >>> FWD
3.	Auto-Tuning finishes in approximately one to two minutes.	➡	- MODE - DRV End Tune Successful FWD RESET

◆ T1: Parameter Settings during Induction Motor Auto-Tuning

The T1-□□ parameters set the Auto-Tuning input data for induction motor tuning.

Note: For motors operating in the field weakening range, first perform the Auto-Tuning with the base data. After Auto-Tuning is complete, change E1-04, Maximum Output Frequency, to the desired value.

■ T1-01: Auto-Tuning Mode Selection

Sets the type of Auto-Tuning to be used. *Refer to Auto-Tuning for Induction Motors on page 139* for details on the different types of Auto-Tuning.

No.	Name	Setting Range	Default
T1-01	Auto-Tuning Mode Selection	2, 3	2

Setting 2: Stationary Auto-Tuning for Line-to-Line Resistance

Setting 3: Rotational Auto-Tuning for V/f Control Energy Saving

■ T1-02: Motor Rated Power

Sets the motor rated power according to the motor nameplate value.

Note: Use the following formula to convert HP to kW: kW = HP x 0.746.

No.	Name	Setting Range	Default
T1-02	Motor Rated Power	0.00 to 650.00 kW	Determined by o2-04

■ T1-03: Motor Rated Voltage

Sets the motor rated voltage according to the motor nameplate value. Enter the voltage base speed when the motor operates above base speed. Enter the voltage needed to operate the motor under no-load conditions at rated speed to T1-03.

No.	Name	Setting Range	Default
T1-03	Motor Rated Voltage	0.0 to 255.0 V <1>	200.0 V <1>

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

■ T1-04: Motor Rated Current

Sets the motor rated current according to the motor nameplate value. Enter the current at the motor base speed.

No.	Name	Setting Range	Default
T1-04	Motor Rated Current	10.0 to 150.0% of drive rated current	Determined by o2-04

■ T1-05: Motor Base Frequency

Sets the motor rated frequency according to the motor nameplate value. If a motor with an extended speed range is used or the motor is used in the field weakening area, enter the maximum frequency to E1-04 after Auto-Tuning is complete.

No.	Name	Setting Range	Default
T1-05	Motor Base Frequency	0.0 to 400.0 Hz	60.0 Hz

■ T1-06: Number of Motor Poles

Sets the number of motor poles according to the motor nameplate value.

No.	Name	Setting Range	Default
T1-06	Number of Motor Poles	2 to 48	4

■ T1-07: Motor Base Speed

Sets the motor rated speed according to the motor nameplate value. Enter the speed at base frequency when using a motor with an extended speed range or if using the motor in the field weakening area.

No.	Name	Setting Range	Default
T1-07	Motor Base Speed	0 to 24000 r/min	1750 r/min

■ T1-11: Motor Iron Loss

Provides iron loss information to determine the Energy Saving coefficient. T1-11 will first display the value for the motor iron loss that the drive automatically calculated when the motor capacity was entered to T1-02. Enter the motor iron loss value listed to T1-11 if the motor test report is available.

No.	Name	Setting Range	Default
T1-11	Motor Iron Loss	0 to 65535 W	Determined by E2-11

■ T1-12: T1 Tuning Start

Set T1-12 to 0 to start IM Auto-Tuning.

No.	Name	Setting Range	Default
T1-12	T1 Tuning Start	0	–

◆ T2: Parameter Settings during PM Motor Auto-Tuning

The T2-☐☐ parameters are used to set the Auto-Tuning input data for PM motor tuning.

T2-01: PM Motor Auto-Tuning Mode Selection

No.	Name	Setting Range	Default
T2-01	PM Motor Auto-Tuning Mode Selection	0 to 2; 14	0

Setting 0: PM Motor Parameter Settings

Setting 1: PM Stationary Auto-Tuning

Setting 2: PM Stationary Auto-Tuning for Stator Resistance

Setting 14: PM Rotational Auto-Tuning

T2-02: PM Motor Code Selection

If the drive is operating a Yaskawa PM motor from the SMRA, SSR1, or SST4 series, enter the motor code in T2-02 to automatically set parameters T2-03 through T2-09. Use the motor nameplate or motor test report values to set parameters T2-10 to T2-14. If the drive is operating a specialized motor or a motor designed by a manufacturer other than Yaskawa, set T2-02 to FFFF and enter the data from the motor nameplate or the motor test report as prompted.

Only the designated PM motor codes may be entered. The PM motor codes accepted by the drive will differ depending on the selected control mode.

No.	Name	Setting Range	Default
T2-02	PM Motor Code Selection	0000 to FFFF	Determined by o2-04

T2-03: PM Motor Type

Selects the type of PM motor the drive will operate.

No.	Name	Setting Range	Default
T2-03	PM Motor Type	0, 1	1

Setting 0: IPM motor

Setting 1: SPM motor

T2-04: PM Motor Rated Power

Specifies the motor rated power in kilowatts.

No.	Name	Setting Range	Default
T2-04	PM Motor Rated Power	0.00 to 650.00 kW	Determined by o2-04

T2-05: PM Motor Rated Voltage

Sets the motor rated voltage.

No.	Name	Setting Range	Default
T2-05	PM Motor Rated Voltage	0.0 to 255.0 V <1>	200.0 V <1>

<1> Value shown is specific to 200 V class drives. Double value for 400 V class drives.

T2-06: PM Motor Rated Current

Enter the motor rated current in amps.

No.	Name	Setting Range	Default
T2-06	PM Motor Rated Current	0.0% to 300.0% of the drive rated current.	Determined by o2-04

T2-07: PM Motor Base Frequency

Enter the motor base frequency in Hz.

Note: T2-07 will be displayed when in OLV/PM.

No.	Name	Setting Range	Default
T2-07	PM Motor Base Frequency	0.0 to 400.0 Hz	87.5 Hz

■ T2-08: Number of PM Motor Poles

Enter the number of motor poles.

No.	Name	Setting Range	Default
T2-08	Number of PM Motor Poles	2 to 48	6

■ T2-10: PM Motor Stator Resistance

Enter the motor stator resistance per motor phase.

No.	Name	Setting Range	Default
T2-10	PM Motor Stator Resistance	0.000 to 65.000 Ω	Determined by T2-02

■ T2-11: PM Motor d-Axis Inductance

Enter the d-Axis inductance per motor phase.

No.	Name	Setting Range	Default
T2-11	PM Motor d-Axis Inductance	0.00 to 600.00 mH	Determined by T2-02

■ T2-12: PM Motor q-Axis Inductance

Enter the q-Axis inductance per motor phase.

No.	Name	Setting Range	Default
T2-12	PM Motor q-Axis Inductance	0.00 to 600.00 mH	Determined by T2-02

■ T2-13: Induced Voltage Constant Unit Selection

Selects the units used for setting the induced voltage coefficient.

No.	Name	Setting Range	Default
T2-13	Induced Voltage Constant Unit Selection	0, 1	1

Setting 0: mV (r/min)

Setting 1: mV (rad/sec)

Note: If T2-13 is set to 0, then the drive will use E5-24 (Motor Induction Voltage Constant 2), and will automatically set E5-09 (Motor Induction Voltage Constant 1 (Ke)) to 0.0. If T2-13 is set to 1, then the drive will use E5-09 and will automatically set E5-25 to 0.0.

■ T2-14: PM Motor Induced Voltage Constant (Ke)

Enter the motor induced voltage constant (Ke).

No.	Name	Setting Range	Default
T2-14	PM Motor Induced Voltage Constant (Ke)	0.0 to 2000.0	Determined by T2-02

■ T2-15: Pull-In Current Level for PM Motor Tuning

Sets the amount of pull-in current. Set as a percentage of the motor rated current.

No.	Name	Setting Range	Default
T2-15	Pull-In Current Level for PM Motor Tuning	0 to 120%	30%

4.9 No-Load Operation Test Run

◆ 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.

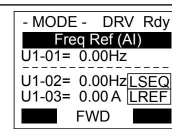
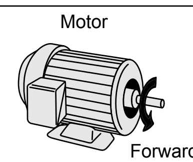
■ During Operation

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 HAND 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 OFF to stop the motor. The HAND light is OFF and the motor coasts to stop.	➡	

4.10 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. ***Refer to Motor Performance Fine-Tuning on page 194*** for details.

4.11 Verifying Parameter Settings and Backing Up Changes

Use the Verify Menu to check all changes to parameter settings. ***Refer to Verifying Parameter Changes: Verify Menu on page 112***.

It is convenient to check all changes to parameters then save the verified parameters as User parameters.

Change the access level or set a password to the drive to prevent accidental modification of parameter settings.

◆ Backing Up Parameter Values: o2-03

Setting o2-03 to 1 saves all parameter settings before resetting o2-03 to 0. The drive can now recall all the saved parameters by performing a User Initialization (A1-03 = 1110).

No.	Parameter Name	Description	Setting Range	Default Setting
o2-03	User Parameter Default Values	Lets the user create a set of default settings for a User Initialization. 0: Saved/Not Set 1: Set Defaults - Saves current parameter settings as the default values for a User Initialization. 2: Clear All - Clears the currently saved user settings. After saving the user parameter set value, the items of 1110 (User Initialization) are displayed in A1-03 (User Parameter Default Value).	0 to 2	0
A1-03	Initialize Parameters	Selects a method to initialize the parameters. 0: No Initialize 1110: User Initialization (The user must first program and store desired settings using parameter o2-03) 2220: 2-Wire Initialization (parameter initialized prior to shipment) 3330: 3-Wire Initialization 3410: HVAC Initialization 3420: OEM Bypass Initialization	0 to 3420	0

◆ Parameter Access Level: A1-01

Setting the Access Level for “Operation only” (A1-01 = 0) allows the user to access parameters A1-□□ and U□-□□ only. Other parameters are not displayed.

Setting the Access Level for “User Parameters” (A1-01 = 1) allows the user to access only the parameters that have been previously saved as User Parameters. This is helpful when displaying only the relevant parameters for a specific application.

No.	Parameter Name	Description	Setting Range	Default
A1-01	Access Level Selection	Selects which parameters are accessible via the HOA keypad. 0: Operation only. A1-01, A1-04, and A1-06 can be set and monitored, and U□-□□parameters can also be viewed. 1: User Parameters. Only parameters A1-00, A1-01, and A1-04, and A2-01 to A2-32 in Setup Mode can be set and monitored. 2: Advanced Access Level. All parameters can be set and monitored.	0 to 2	2
A2-01 to A2-32	User Parameters 1 to 32 <1>	Parameters selected by the user are saved as User Parameters, including changed parameters and parameters specifically selected for quick access. If parameter A2-33 is set to 1, changed parameters will be listed between A2-17 and A2-32. Parameters A2-01 through A2-16 must be manually selected by the user. If A2-33 is set to 0, recently viewed parameters will not be saved to the group of User Parameters. A2-□□ parameters are now available for manual programming.	b1-01 to o□-□□	–
A2-33	User Parameter Automatic Selection <1>	0: Parameters A2-01 through A2-32 are reserved for the user to create a group of User Parameters. 1: Save history of recently viewed parameters. Recently edited parameters will be saved to A2-17 through A2-32 for quick access. The most recently changed parameter is saved to A2-17. The second most recently changed parameter is saved to A2-18, etc.	0, 1	1

<1> When User Parameters are set to parameters A2-17 and higher, all parameters after the last listed parameter will be listed. Example: When User Parameters are listed from A2-01 to A2-20, the next parameter A2-21 and higher will be listed.

◆ Password Settings: A1-04, A1-05

The user can set a password in parameter A1-05 to restrict access to the drive. The password must be entered to A1-04 to unlock parameter access (i.e., parameter setting A1-04 must match the value programmed into A1-05). The following parameters cannot be viewed or edited until the value entered to A1-04 correctly matches the value set to A1-05: A1-01, A1-02, A1-03, A1-06, and A2-01 through A2-32.

Note: Parameter A1-05 is hidden from view. To display A1-05, access parameter A1-04 and press OFF and ∧ simultaneously.

◆ Copy Function

Parameter settings can be copied to another drive to simplify parameter restoration or multiple drive setup. The drive supports the following copy options:

- **HOA Keypad (standard in all models)**

  The HOA keypad used to operate the drive supports copying, importing, and verifying parameter settings.

- **USB Copy Unit and CopyUnitManager**

  The copy unit is an external option connected to the drive to copy parameter settings from one drive and save those settings to another drive. Refer to the manual supplied with the USB Copy Unit for instructions.

  The CopyUnitManager is a PC software tool. It allows the user to load parameter settings from the Copy Unit onto a PC, or from the PC onto a Copy Unit. This is useful when managing parameters for various drives or applications. Refer to the manual supplied with the CopyUnitManager for instructions.

4.12 Advanced Drive Setup Adjustments

This section explains advanced settings and parameters that may be required for drive operation. ***Refer to Parameter List on page 261*** for a complete listing of drive parameters if more information is required for parameters not listed in this section or in ***4.7 Basic Drive Setup Adjustments***.

■ A1-00: Language Selection

Selects the display language for the HOA keypad.

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

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

Setting 0: English

Setting 1: Japanese

Setting 3: French

Setting 5: Spanish

Setting 6: Portuguese

■ A1-01: Access Level Selection

Allows or restricts access to drive parameters.

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

Setting 0: Operation Only

A1-01, A1-04, and Drive Mode can be accessed and set. All U monitor parameters can be accessed. Parameters that are set in A2-01 to A2-32 can be accessed in Setup Mode. Verify Mode, Setup Mode, and Auto-Tuning Mode cannot be accessed.

Setting 1: User Parameters

A1-00, A1-01, A1-04, and Drive Mode can be accessed and set. All U monitor parameters can be accessed. Parameters that are set in A2-01 through A2-32 can be accessed in Setup Mode. Verify Mode and Auto-Tuning Mode cannot be accessed.

Setting 2: Advanced Access Level (A)

All parameters can be viewed and edited.

Notes on Parameter Access

- If the drive parameters are password protected by A1-04 and A1-05, parameters A1-01 through A1-03, A1-06, and A2-01 through A2-32 cannot be modified.
- If a digital input terminal programmed for “Program lockout” (H1-□□ = 1B) is enabled, parameter values cannot be modified, even if A1-01 is set to 1 or 2.
- If parameters are changed via serial communication, it will not be possible to edit or change parameter settings with the HOA keypad until an Enter command is issued to the drive from the serial communication.

■ A1-03: Initialize Parameters

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

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

Setting 0: No Initialize

Setting 1110: User Initialize

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

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

Setting 2220: 2-Wire Initialization

Resets parameters except parameters listed in ***Table 4.24*** 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.

Setting 3410: HVAC Initialization

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

H1-03: b1 (Customer Safeties)

H1-04: b2 (BAS Interlock)

H1-05: AF (Emergency Override Forward Run)

H2-03: b2 (BAS Interlock Relay Contact)

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

Setting 3420: OEM Bypass Initialization

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

H1-03: A7 (BP Customer Safeties)

H1-04: A6 (BP BAS Interlock)

H1-05: A4 (Emergency Override)

H1-06: AE (BP Bypass Run)

H2-01: A4 (BP Drive Relay)

H2-02: A5 (BP Bypass Relay)

H2-03: A6 (BP BAS Interlock)

o1-16: 2 (Drive/Bypass)

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

Notes on Parameter Initialization

The parameters shown in ***Table 4.24*** will not be reset when the drive is initialized by setting A1-03 = 2220 or 3330. Although the control mode in A1-02 is not reset when A1-03 is set to 2220 or 3330, it may change when an application preset is selected.

Table 4.24 Parameters Not Changed by Drive Initialization

No.	Parameter Name
A1-00	Language Selection
A1-02	Control Method Selection
E1-03	V/f Pattern Selection
F6-08	Communication Parameter Reset
L8-35	Installation Selection

No.	Parameter Name
o2-04	Drive Model Selection

■ A1-06: Application Preset

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

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

■ b1-04: Reverse Operation Selection

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

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

Setting 0: Reverse Enabled

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

Setting 1: Reverse Disabled

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

■ b1-14: Phase Order Selection

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

Switching motor phases will reverse the direction of the motor.

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

Setting 0: Standard

Setting 1: Switch Phase Order

The direction of the motor is reversed.

■ b1-17: Run Command at Power Up

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

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

Setting 0: Disregarded

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

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

Setting 1: Allowed

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

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

■ b2-01: Zero Speed Level (DC Injection Braking Start Frequency)

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

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

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

V/f and OLV/PM (A1-02 = 0, 5)

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

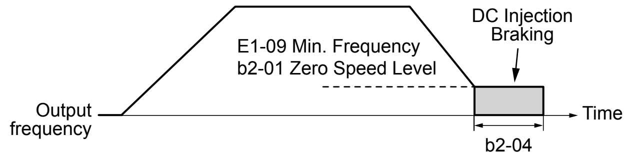


Figure 4.29 DC Injection Braking at Stop for V/f

Note: If b2-01 is set to a smaller value than E1-09 (Minimum Output Frequency), then DC Injection Braking will begin when the frequency falls to the E1-09 value.

■ b2-02: DC Injection Braking Current

Sets the DC Injection Braking current as a percentage of the drive rated current.

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

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

■ b2-03: DC Injection Braking Time at Start

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

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

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

■ b3-01: Speed Search Selection at Start

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

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

Setting 0: Disabled

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

Setting 1: Enabled

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

■ b3-03: Speed Search Deceleration Time

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

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

■ b3-04: V/f Gain during Speed Search (Speed Estimation Type)

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

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

■ b3-05: Speed Search Delay Time

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

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

■ b3-06: Output Current 1 during Speed Search (Speed Estimation Type)

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

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

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

■ b3-10: Speed Search Detection Compensation Gain (Speed Estimation Type)

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

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

■ b3-14: Bi-Directional Speed Search Selection (Speed Estimation Type)

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

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

Setting 0: Disabled

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

Setting 1: Enabled

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

■ b3-17: Speed Search Restart Current Level (Speed Estimation Type)

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

No.	Name	Setting Range	Default
b3-17	Speed Search Restart Current Level	0 to 200%	150%

■ b3-18: Speed Search Restart Detection Time (Speed Estimation Type)

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

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

■ b3-19: Number of Speed Search Restarts (Speed Estimation Type)

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

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

■ b3-24: Speed Search Method Selection

Sets the Speed Search method.

In V/f control mode, set this parameter to 2 (Current Detection Type Speed Search 2) when b3-50 is 0.1 or longer.

No.	Parameter Name	Setting Range	Default
b3-24	Speed Search Method Selection	1, 2	Determined by A1-02 and o2-04

Setting 1: Speed Estimation

Setting 2: Current Detection 2

Note: Enable or disable Speed Search at start with b3-01 and Speed Search after momentary power loss with L2-01.

■ b3-25: Speed Search Wait Time

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

No.	Name	Setting Range	Default
b3-25	Speed Search Wait Time	0.0 to 30.0 s	0.5 s

■ b3-27: Start Speed Search Select

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

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

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

Setting 1: Triggered when an External Baseblock Is Released

■ b5-01: PID Function Setting

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

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

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

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

■ b5-02: Proportional Gain Setting (P)

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

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

■ b5-03: Integral Time Setting (I)

Sets the time constant used to calculate the integral of the 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

■ b5-04: Integral Limit Setting

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

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

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

■ b5-05: Derivative Time (D)

Sets the time the drive predicts the PID input/PID feedback signal based on the derivative of the PID input/PID feedback. Longer time settings improve the response but can cause instability, while shorter time settings reduce the overshoot but reduce controller responsiveness. D control is disabled by setting b5-05 to zero seconds.

No.	Name	Setting Range	Default
b5-05	Derivative Time (D)	0.00 to 10.00 s	0.00 s

■ b5-06: PID Output Limit

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

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

■ b5-07: PID Offset Adjustment

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

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

■ b5-08: PID Primary Delay Time Constant

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

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

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

■ b5-09: 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).

■ b5-10: PID Output Gain Setting

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

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

■ b5-11: PID Output Reverse Selection

Determines whether a negative PID output reverses the direction of drive operation. This parameter has no effect when the PID function trims the frequency reference (b5-01 = 3 or 4) and the PID output will not be limited (same as b5-11 = 1).

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

Setting 0: Reverse Disabled

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

Setting 1: Reverse Enabled

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

■ b5-12: PID Feedback Loss Detection Selection

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

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

Setting 0: Multi-Function Digital Outputs Only

Multi-function digital outputs set for “PID feedback low” (H2-☐☐ = 3E) will be triggered if the PID feedback value is below the detection level set to b5-13 for the time set to b5-14 or longer. Multi-function digital outputs set for “PID feedback high” (H2-☐☐ = 3F) will be triggered if the PID feedback value is beyond the detection level set to b5-36 for longer than the time set to b5-37. Neither a fault nor an alarm is displayed on the digital operator and the drive will continue operation. The multi-function digital outputs reset when the feedback value leaves the loss detection range.

Setting 1: Feedback Loss Alarm

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

Setting 2: Feedback Loss Fault

If the PID feedback value falls below the level set to b5-13 for longer than the time set to b5-14, a “FbL - Feedback Low” fault will be displayed. If the PID feedback value exceeds the level set to b5-36 for longer than the time set to b5-37, a “FbH - Feedback High” fault will be displayed. Both events trigger a fault output (H2-☐☐ = E) and cause the drive to stop the motor.

Setting 3: Digital Output Only, even if PID Is Disabled by Digital Input

Same as b5-12 = 0. Detection remains active when PID is disabled by a digital input (H1-☐☐ = 19).

Setting 4: Feedback Loss Alarm, even if PID Is Disabled by Digital Input

Same as b5-12 = 1. Detection remains active when PID is disabled by a digital input (H1-☐☐ = 19).

Setting 5: Feedback Loss fault, even if PID Is Disabled by Digital Input

Same as b5-12 = 2. Detection remains active when PID is disabled by a digital input (H1-☐☐ = 19).

■ b5-13: PID Feedback Low Detection Level

Sets the PID feedback detection low level as a percentage of E1-04 (Maximum Output Frequency). The PID feedback must fall below this level for longer than the time set to b5-14 before feedback loss is detected.

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

■ b5-14: PID Feedback Low Detection Time

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

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

■ b5-15: PID Sleep Function Start Level

Sets the level that triggers PID Sleep.

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

No.	Name	Setting Range	Default
b5-15	PID Sleep Function Start Level	0.0 to 400.0 Hz	0.0 Hz

■ b5-16: PID Sleep Delay Time

Sets the delay time to activate or deactivate the PID Sleep function.

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

■ b5-17: PID Accel/Decel Time

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

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

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

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

■ b5-18: PID Setpoint Selection

Enables or disables parameter b5-19 for PID setpoint.

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

Setting 0: Disabled

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

Setting 1: Enabled

Parameter b5-19 is used as PID setpoint.

■ b5-19: PID Setpoint Value

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

No.	Name	Setting Range	Default
b5-19	PID Setpoint Value	0.00 to 100.00%	0.00%

■ b5-20: PID Setpoint Scaling

Determines the units for the PID Setpoint Value (b5-19) and monitors U5-01 and U5-04. The units for setting and display can be changed with b5-20.

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

Setting 0: 0.01 Hz

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

Setting 1: 0.01% (100.00%: Maximum PID Feedback)

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

Setting 2: r/min (Set the Motor Poles)

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

Setting 3: User Defined (Determined by b5-38 and b5-39)

Parameters b5-38 and b5-39 determine the units and resolution used to display the values the setpoint in b5-19, and PID monitors U1-01 and U1-04.

■ b5-21: PID Sleep Input Source

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

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

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

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

Setting 0: PID Setpoint

Setting 1: SFS Input

Setting 2: Snooze

■ b5-22: PID Snooze Level

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

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

■ b5-23: PID Snooze Delay Time

Sets the PID Snooze function delay time in seconds.

No.	Parameter Name	Setting Range	Default
b5-23	PID Snooze Delay Time	0 to 2600 s	0 s

■ b5-24: PID Snooze Deactivation Level

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

No.	Parameter Name	Setting Range	Default
b5-24	PID Snooze Deactivation Level	0 to 100%	0%

■ b5-25: PID Setpoint Boost Setting

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

No.	Parameter Name	Setting Range	Default
b5-25	PID Setpoint Boost Setting	0 to 100%	0%

■ b5-26: PID Maximum Boost Time

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

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

■ b5-27: PID Snooze Feedback Level

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

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

Sets as a percentage of maximum frequency.

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

■ b5-28: PID Feedback Function Selection

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

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

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

0: Disabled

1: Square Root

■ b5-29: PID Square Root Gain

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

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

■ b5-30: PID Feedback Offset

Sets PID feedback Offset as a percentage of maximum frequency.

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

■ b5-34: PID Output Lower Limit

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

No.	Name	Setting Range	Default
b5-34	PID Output Lower Limit	-100.0 to 100.0%	0.00%

■ b5-35: PID Input Limit

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

No.	Name	Setting Range	Default
b5-35	PID Input Limit	0.0 to 1000.0%	1000.0%

■ b5-36: PID Feedback High Detection Level

Sets the excessive PID feedback detection high level as a percentage of E1-04 (Maximum Output Frequency). The PID feedback must exceed this level for longer than the time set to b5-37 before feedback loss is detected.

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

■ b5-37: PID Feedback High Detection Time

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

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

■ 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

Setting 0: No Decimal Places

Setting 1: One Decimal Place

Setting 2: Two Decimal Places

Setting 3: Three Decimal Places

■ b5-40: Frequency Reference Monitor Content During PID

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

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

Setting 0: Frequency Reference after PID

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

Setting 1: Frequency Reference

Monitor U1-01 displays the frequency reference value.

■ b5-41: PID Unit Selection

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

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

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

■ b5-42: PID Output Monitor Calculation Method

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

Setting 0: Linear

The monitor displays PID output.

Setting 1: Square Root

The monitor displays square root PID output.

Setting 2: Quadratic

The monitor displays 1/(PID output)^2

Setting 3: Cubic

The monitor displays 1/(PID output)^3

■ b5-43/b5-44: PID Output 2 Monitor Max Upper/Lower 4 Digits

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

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

■ b5-45: PID Output 2 Monitor Minimum

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

No.	Name	Setting Range	Default
b5-45	PID Output 2 Monitor Minimum	0 to 999.9	999.9

■ b5-46: PID Setpoint Monitor Unit Selection

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

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

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

■ b5-47: PID Output Reverse Selection 2

Determines whether a negative PID output reverses the direction of drive operation. When the PID function is used to trim the frequency reference (b5-01 = 3 or 4), this parameter has no effect and the PID output will not be limited (same as b5-11 = 1).

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

Setting 0: Reverse Disabled

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

Setting 1: Reverse Enabled

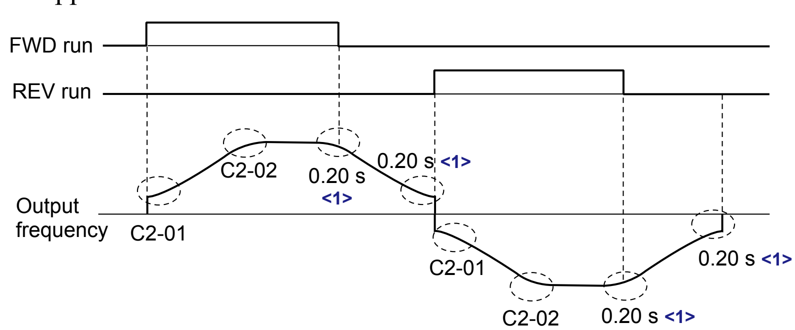
Negative PID output will cause the drive to run in the opposite direction.

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

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

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

Figure 4.30 illustrates S-curve application.



<1> S-Curve characteristic at Decel Start/End is fixed to 0.20 s.

Figure 4.30 S-Curve Timing Diagram - FWD/REV Operation

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

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

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

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

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

No.	Parameter Name	Setting Range	Default
C6-03	Carrier Frequency Upper Limit	4.0 to 10.0 kHz <1>	Determined by C6-02 and o2-04
C6-04	Carrier Frequency Lower Limit (V/f Control only)	4.0 to 10.0 kHz <1>	
C6-05	Carrier Frequency Proportional Gain (V/f Control only)	0 to 99 <1>	

<1> Available only when C6-02 is set to F.

The upper limit of the carrier frequency varies by the drive model. *Refer to Rated Current Depending on Carrier Frequency on page 257* for details.

Setting a Fixed User-Defined Carrier Frequency

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

Setting a Variable Carrier Frequency (V/f Control)

In V/f Control, the carrier frequency can be set up to change linearly with the output frequency by setting the upper and lower limits for the carrier frequency and the carrier frequency proportional gain (C6-03, C6-04, C6-05) as shown in *Figure 4.31*.

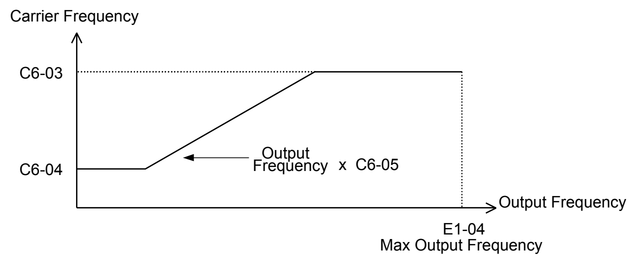


Figure 4.31 Carrier Frequency Changes Relative to Output Frequency

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

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

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

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

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

No.	Parameter Name	Setting Range	Default
d1-01 to d1-04	Frequency Reference 1 to 4	0.00 to 400.00 Hz <1> <2>	0.00 Hz <2>
d1-16	Frequency Reference 16	0.00 to 400.00 Hz <1> <2>	0.00 Hz <2>
d1-17	Jog Frequency Reference	0.00 to 400.00 Hz <1> <2>	6.00 Hz <2>

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

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

Multi-Step Speed Selection

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

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

- The first frequency reference (Multi-Speed 1) comes from the source specified in b1-01. When using an analog input terminal to supply the frequency reference, assign the frequency reference source to the control terminals (b1-01 = 1).

- When an analog input is set to “Auxiliary frequency 1” (H3-02 or H2-06 = 2), the value set to this input will be used as the Multi-Step Speed 2 instead of the value set to parameter d1-02. If no analog inputs are set for “Auxiliary frequency 1”, then d1-02 becomes the reference for Multi-Step Speed 2.

Select the different speed references as shown in *Table 4.25*. *Figure 4.32* illustrates the multi-step speed selection.

Table 4.25 Multi-Step Speed Reference and Terminal Switch Combinations

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

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

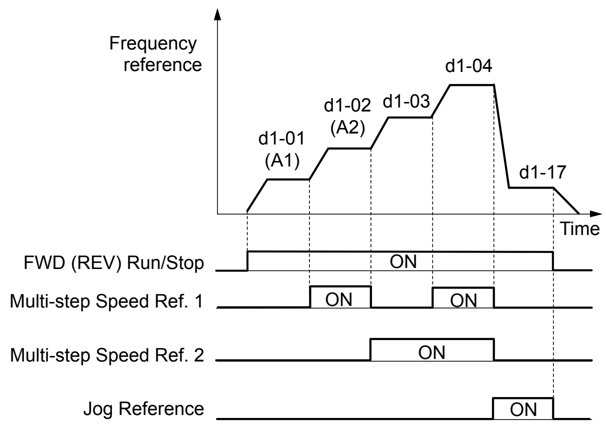


Figure 4.32 Preset Reference Timing Diagram

■ d2-03: Master Speed Reference Lower Limit

Sets a lower limit as a percentage of the maximum output frequency that will only affect a frequency reference entered from the analog input terminals (A1, A2, or A3) as the master speed reference. This is unlike parameter d2-02, which affects all frequency references regardless of their source.

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

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

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

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

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

No.	Parameter Name	Setting Range	Default
d3-01	Jump Frequency 1	0.0 to 400.0 Hz	0.0 Hz
d3-02	Jump Frequency 2	0.0 to 400.0 Hz	0.0 Hz
d3-03	Jump Frequency 3	0.0 to 400.0 Hz	0.0 Hz
d3-04	Jump Frequency Width	0.0 to 20.0 Hz	1.0 Hz

Figure 4.33 shows the relationship between the Jump Frequency and the frequency reference.

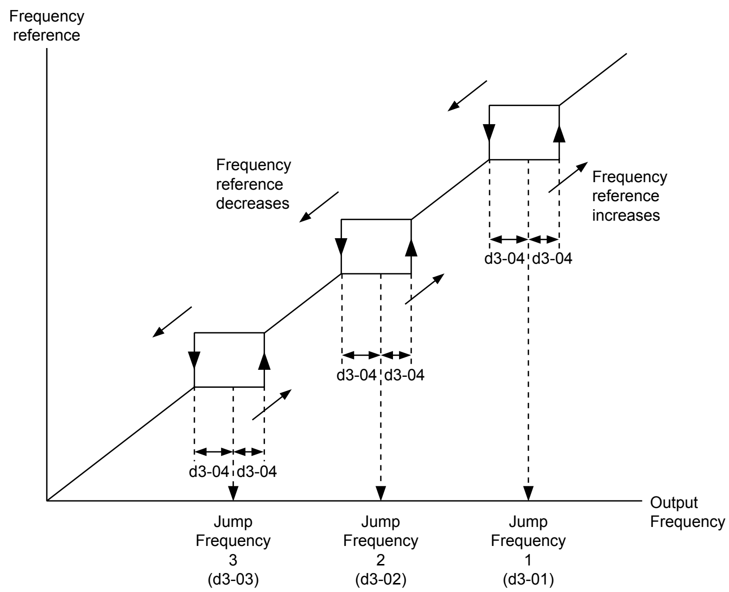


Figure 4.33 Jump Frequency Operation

Note:
1. The drive will use the active accel/decel time to pass through the specified dead band range, but will not allow continuous operation in that range.
2. When setting more than one Jump Frequency, make sure that the parameters do not overlap.

■ E1-03: V/f Pattern Selection

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

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

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

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

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

Choose the V/f pattern that best meets the application demands from *Table 4.26*. These settings are available only in V/f Control modes. Set the correct value to E1-03. Parameters E1-04 to E1-13 can only be monitored, not changed.

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

Table 4.26 Predefined V/f Patterns

Setting	Specification	Characteristic	Application
0	50 Hz	Constant torque	For general purpose applications. Torque remains constant regardless of changes to speed.
1	60 Hz		
2	60 Hz (with 50 Hz base)		
3	72 Hz (with 60 Hz base)		
4	50 Hz, Variable torque 1	Variable torque	For fans, pumps, and other applications where the required torque changes as a function of the speed.
5	50 Hz, Variable torque 2		
6	60 Hz, Variable torque 1		
7	60 Hz, Variable torque 2		
8	50 Hz, mid starting torque	High starting torque	Select high starting torque when: • Wiring between the drive and motor exceeds 150 m. • A large amount of starting torque is required.
9	50 Hz, high starting torque		
A	60 Hz, mid starting torque		
B	60 Hz, high starting torque		

Setting	Specification	Characteristic	Application
C	90 Hz (with 60 Hz base)	Constant output	Output voltage is constant when operating at greater than 60 Hz.
D	120 Hz (with 60 Hz base)		
E	180 Hz (with 60 Hz base)		
F <1>	60 Hz	Constant torque	For general purpose applications. Torque remains constant regardless of changes to speed.

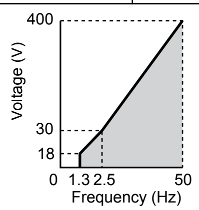
<1> Setting F enables a custom V/f pattern by changing parameters E1-04 to E1-13. When the drive is shipped, the default values for parameters E1-04 to E1-13 are the same as those of setting 1.

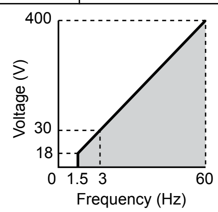
The following tables show details on predefined V/f patterns.

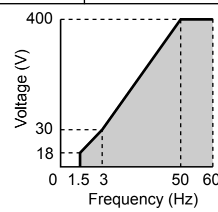
Predefined V/f Patterns for Models 4□0011 and 4□0014

Table 4.27 Constant Torque Characteristics, Settings 0 to 3

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







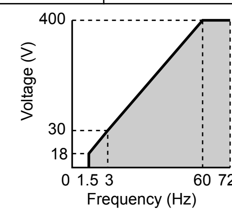
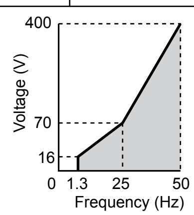
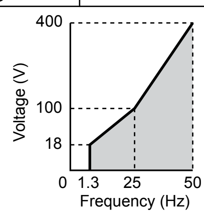
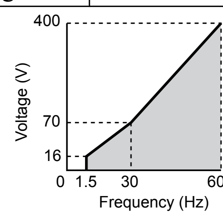


Table 4.28 Derated Torque Characteristics, Settings 4 to 7

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







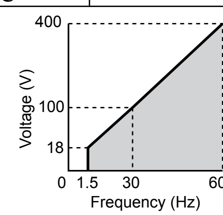
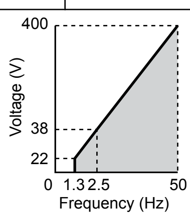
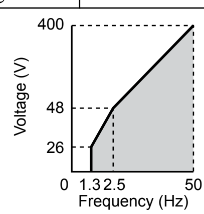
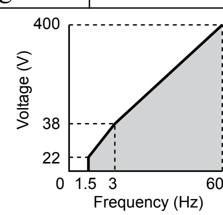


Table 4.29 High Starting Torque, Settings 8 to B

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







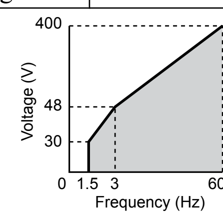
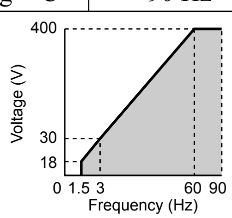
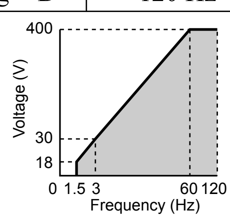
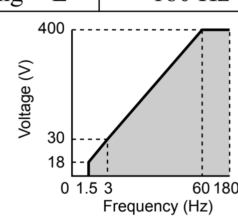


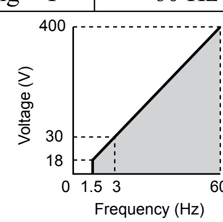
Table 4.30 Rated Output Operation, Settings C to F

Setting = C	90 Hz	Setting = D	120 Hz	Setting = E	180 Hz	Setting = F	60 Hz









Predefined V/f Patterns for Models 2□0028 to 2□0192 and 4□0021 to 4□0124

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

Table 4.31 Rated Torque Characteristics, Settings 0 to 3

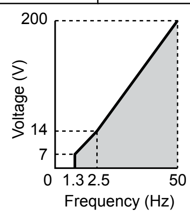
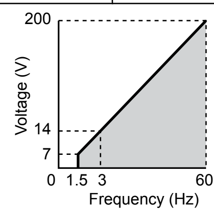
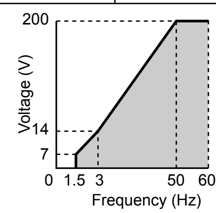
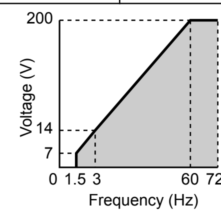
<table>
<tr><td>Setting = 0</td><td>50 Hz</td><td>Setting = 1</td><td>60 Hz</td><td>Setting = 2</td><td>60 Hz</td><td>Setting = 3</td><td>72 Hz</td></tr>
<tr>
<td colspan="2"></td>
<td colspan="2"></td>
<td colspan="2"></td>
<td colspan="2"></td>
</tr>
</table>

Table 4.32 Derated Torque Characteristics, Settings 4 to 7

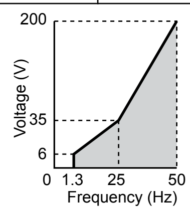
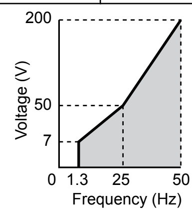
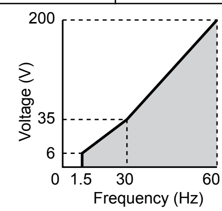
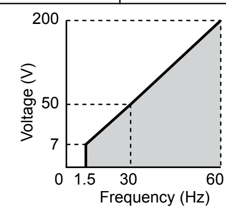
<table>
<tr><td>Setting = 4</td><td>50 Hz</td><td>Setting = 5</td><td>50 Hz</td><td>Setting = 6</td><td>60 Hz</td><td>Setting = 7</td><td>60 Hz</td></tr>
<tr>
<td colspan="2"></td>
<td colspan="2"></td>
<td colspan="2"></td>
<td colspan="2"></td>
</tr>
</table>

Table 4.33 High Starting Torque, Settings 8 to B

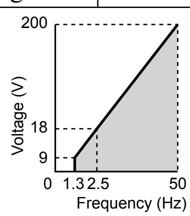
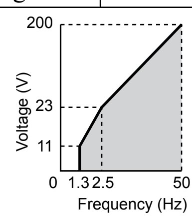
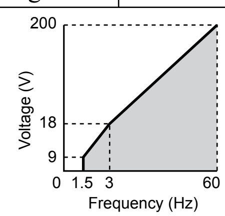
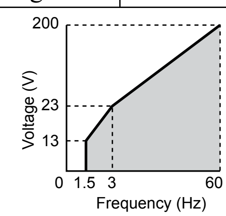
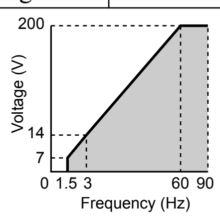
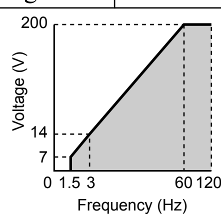
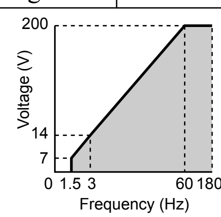
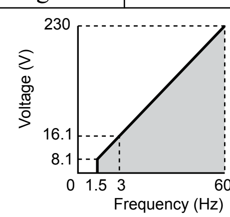
<table>
<tr><td>Setting = 8</td><td>50 Hz</td><td>Setting = 9</td><td>50 Hz</td><td>Setting = A</td><td>60 Hz</td><td>Setting = B</td><td>60 Hz</td></tr>
<tr>
<td colspan="2"></td>
<td colspan="2"></td>
<td colspan="2"></td>
<td colspan="2"></td>
</tr>
</table>

Table 4.34 Constant Output, Settings C to F

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

Predefined V/f Patterns for Models 2□0216 and 4□0156 to 4□0414

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

Table 4.35 Rated Torque Characteristics, Settings 0 to 3

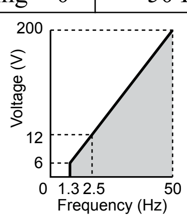
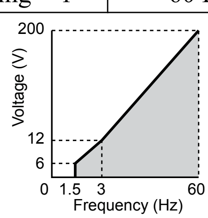
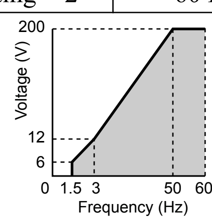
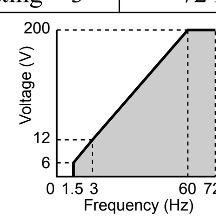
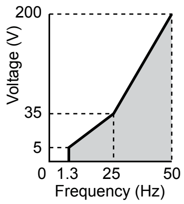
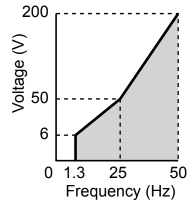
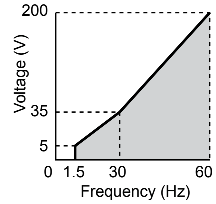
<table>
<tr><td>Setting = 0</td><td>50 Hz</td><td>Setting = 1</td><td>60 Hz</td><td>Setting = 2</td><td>60 Hz</td><td>Setting = 3</td><td>72 Hz</td></tr>
<tr>
<td colspan="2"></td>
<td colspan="2"></td>
<td colspan="2"></td>
<td colspan="2"></td>
</tr>
</table>

Table 4.36 Derated Torque Characteristics, Settings 4 to 7

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







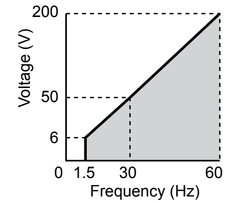
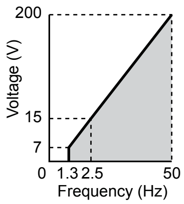
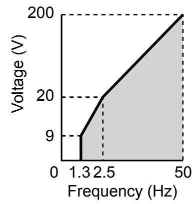
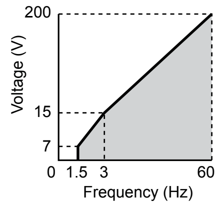


Table 4.37 High Starting Torque, Settings 8 to B

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







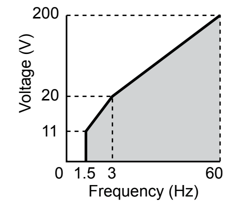
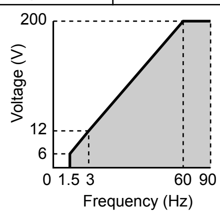
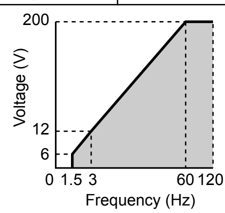
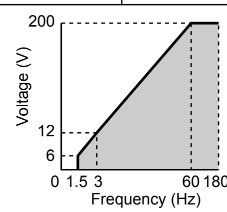


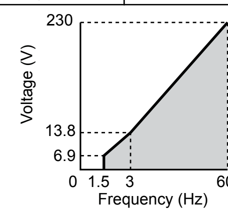
Table 4.38 Constant Output, Settings C to F

Setting = C	90 Hz	Setting = D	120 Hz	Setting = E	180 Hz	Setting = F	60 Hz









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

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

■ H3-01: Terminal A1 Signal Level Selection

Selects the input signal level for analog input A1. Set jumper S1 on the terminal board accordingly for voltage input or current input.

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

Setting 0: 0 to 10 V with Zero Limit

The input level is 0 to 10 Vdc with zero limit. The minimum input level is limited to 0%, so that a negative input signal due to gain and bias settings will be read as 0%.

Setting 1: 0 to 10 V without Zero Limit

The input level is 0 to 10 Vdc without zero limit. If the resulting voltage is negative after being adjusted by gain and bias settings, then the motor will rotate in reverse.

Setting 2: 4 to 20 mA Current Input

The input level is 4 to 20 mA. Negative input values by negative bias or gain settings are limited to 0%.

Setting 3: 0 to 20 mA Current Input

The input level is 0 to 20 mA. Negative input values by negative bias or gain settings are limited to 0%.

■ H3-02: Terminal A1 Function Selection

Selects the input signal level for analog input A1. *Refer to Multi-Function Analog Input Terminal Settings on page 172* for instructions on adjusting the signal level.

No.	Name	Setting Range	Default
H3-02	Terminal A1 Function Selection	0 to 26	0

■ H3-05: Terminal A3 Signal Level Selection

Selects the input signal level for analog input A3. *Refer to Multi-Function Analog Input Terminal Settings on page 172* for a list of functions and descriptions.

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 V with Zero Limit on page 170*.

Setting 1: -10 to 10 Vdc

The input level is -10 to 10 Vdc. See the explanation provided for H3-01. *Refer to Setting 1: 0 to 10 V without Zero Limit on page 170*.

Setting 2: 4 to 20 mA Current Input

The input level is 4 to 20 mA. Negative input values by negative bias or gain settings will be limited to 0%.

Setting 3: 0 to 20 mA Current Input

The input level is 0 to 20 mA. Negative input values by negative bias or gain settings will be limited to 0%.

■ H3-06: Terminal A3 Function Selection

Determines the function assigned to analog input terminal A3. *Refer to Multi-Function Analog Input Terminal Settings on page 172* for a list of functions and descriptions.

No.	Name	Setting Range	Default
H3-06	Terminal A3 Function Selection	0 to 26	2

■ H3-09: Terminal A2 Signal Level Selection

Selects the input signal level for analog input A2. Set Jumper S1 on the terminal board accordingly for a voltage input or current input.

No.	Name	Setting Range	Default
H3-09	Terminal A2 Signal Level Selection	0 to 3	2

Setting 0: 0 to 10 V with Zero Limit

The input level is 0 to 10 Vdc. Negative input values will be limited to 0. *Refer to Setting 0: 0 to 10 V with Zero Limit on page 170*.

Setting 1: 0 to 10 V without Zero Limit

The input level is 0 to 10 Vdc. Negative input values will be accepted. *Refer to Setting 1: 0 to 10 V without Zero Limit on page 170*.

Setting 2: 4 to 20 mA Current Input

The input level is 4 to 20 mA. Negative input values by negative bias or gain settings will be limited to 0%.

Setting 3: 0 to 20 mA Current Input

The input level is 0 to 20 mA. Negative input values by negative bias or gain settings will be limited to 0%.

■ H3-10: Terminal A2 Function Selection

Determines the function assigned to analog input terminal A2. *Refer to Multi-Function Analog Input Terminal Settings on page 172* for a list of functions and descriptions.

No.	Name	Setting Range	Default
H3-10	Terminal A2 Function Selection	0 to 26	<1>

<1> Default is 0 when b5-01 is set to 0.
Default is B when b5-01 is set to 1 or 3.

■ Multi-Function Analog Input Terminal Settings

See *Table 4.39* for information on how H3-02, H3-10, and H3-06 determine functions for terminals A1, A2, and A3.

Note: The scaling of all input functions depends on the gain and bias settings for the analog inputs. Set these to appropriate values when selecting and adjusting analog input functions.

Table 4.39 Multi-Function Analog Input Terminal Settings

Setting	Function	Page	Setting	Function	Page
0	Frequency Bias	*172*	9	Output Frequency Lower Limit Level	–
1	Frequency Gain	*172*	B	PID Feedback	*172*
2	Auxiliary Frequency Reference 1	*172*	C	PID Setpoint	*172*
3	Auxiliary Frequency Reference 2	*172*	D	Frequency Bias	*172*
4	Output Voltage Bias	–	E	Motor Temperature (PTC Input)	*172*
5	Accel/Decel Time Gain	–	F	Through Mode	*172*
6	DC Injection Braking Current	–	16	Differential PID Feedback	*173*
7	Overtorque/Undertorque Detection Level	–	25	Secondary PI Setpoint	*173*
8	Stall Prevention Level During Run	–	26	Secondary PI Feedback	*173*

Setting 0: Frequency Bias

The input value of an analog input set to this function will be added to the analog frequency reference value. When the frequency reference is supplied by a different source other than the analog inputs, this function will have no effect. Use this setting also when only one of the analog inputs is used to supply the frequency reference.

By default, analog inputs A1 and A2 are set for this function. Simultaneously using A1 and A2 increases the frequency reference by the total of all inputs.

Example: If the analog frequency reference from analog input terminal A1 is 50% and a bias of 20% is applied by analog input terminal A2, the resulting frequency reference will be 70% of the maximum output frequency.

Setting 1: Frequency Gain

The input value of an analog input set to this function will be multiplied with the analog frequency reference value.

Example: If the analog frequency reference from analog input terminal A1 is 80% and a gain of 50% is applied from analog input terminal A2, the resulting frequency reference will be 40% of the maximum output frequency.

Setting 2: Auxiliary Reference 1

Sets the auxiliary frequency reference 1 when multi-step speed operation is selected. ***Refer to Multi-Step Speed Selection on page 165*** for details.

Setting 3: Auxiliary Reference 2

Sets the auxiliary frequency reference 2 when multi-step speed operation is selected. ***Refer to Multi-Step Speed Selection on page 165*** for details.

Setting B: PID Feedback

Supplies the PID feedback value. This setting requires PID operation to be enabled in b5-01.

Setting C: PID Setpoint

Supplies the PID setpoint value and makes the frequency reference selected in parameter b1-01 no longer the PID setpoint. PID operation to be enabled in b5-01 to use this setting.

Setting D: Frequency Bias

The input value of an analog input set to this function will be added to the frequency reference. This function can be used with any frequency reference source.

Setting E: Motor Temperature

In addition to motor overload fault detection oL1, it is possible to use a PTC (Positive Temperature Coefficient) thermistor for motor insulation protection.

Setting F: Through Mode

When set to F, an input does not affect any drive function, but the input level can still be read out by a PLC via APOGEE FLN, BACnet, MEMOBUS/Modbus, or Metasys N2 communications.

Setting 16: Differential PID Feedback

If an analog value is set for this function, the PID controller is set for differential feedback. The difference of the PID feedback input value and the differential feedback input value builds the feedback value used to calculate the PID input.

Setting 25: Secondary PI Setpoint

10 V = S3-02 (Maximum Output Frequency).

Setting 26: Secondary PI Feedback

10 V = S3-02 (Maximum Output Frequency).

■ H5-01: Drive Slave Address

Sets the drive slave address used for communications.

Note: Cycle power for the setting to take effect.

No.	Name	Setting Range	Default
H5-01	Drive Slave Address	0 to FFH	1FH

Each slave drive must be assigned a unique slave address for serial communications to work. Slave addresses do not need to be assigned in sequential order, but no two drives may share the same address.

■ H5-02: Communication Speed Selection

Sets the communications speed for APOGEE FLN, BACnet, MEMOBUS/Modbus, and Metasys N2.

Note:
1. Cycle power for the setting to take effect.
2. When Metasys N2 communications are selected (H5-08 = 1), selecting a baud rate other than 9600 bps will trigger an oPE29 error.
3. When APOGEE FLN (P1) communications are selected (H5-08 = 2), selecting a baud rate other than 4800 bps will trigger an oPE29 error.
4. When BACnet communications are selected (H5-08 = 3), selecting 115200 bps (Setting 8) will trigger an oPE29 error.

No.	Name	Setting Range	Default
H5-02	Communication Speed Selection	0 to 8	<1>

<1> Default depends on H5-08 setting:
H5-08 = 0, MEMOBUS/Modbus; default: 3
H5-08 = 1, N2 (Metasys); default: 3
H5-08 = 2, P1 (APOGEE FLN); default: 2
H5-08 = 3, BACnet; default: 3

H5-02	Communication Speed	H5-02	Communication Speed
0 <1>	1200 bps	5 <1>	38400 bps
1 <1>	2400 bps	6 <1>	57600 bps
2	4800 bps	7 <1>	76800 bps
3 <1>	9600 bps	8 <1> <2>	115200 bps
4 <1>	19200 bps		

<1> Not available when H5-08 is set to 2 P1 (APOGEE FLN).

<2> Not available when H5-08 is set to 0 (MEMOBUS/Modbus) or 1 (Metasys N2).

■ H5-03: Communication Parity Selection

Sets the parity used for communications.

Note: Cycle power for the setting to take effect.

No.	Name	Setting Range	Default
H5-03	Communication Parity Selection	0 to 2	0

Setting 0: No parity

Setting 1: Even parity

Setting 2: Odd parity

■ H5-04: Stopping Method after Communication Error

Selects the stopping method after a communications error (CE) has occurred.

No.	Name	Setting Range	Default
H5-04	Stopping Method after CE	0 to 4	3

Setting 0: Ramp to Stop

Uses the deceleration time currently enabled.

Setting 1: Coast to Stop

Setting 2: Fast Stop

Setting 3: Alarm Only - Operation Continues

Setting 4: Run at d1-04

■ H5-05: Communication Fault Detection Selection

Enables or disables the CE detection for communications.

No.	Name	Setting Range	Default
H5-05	Communication Fault Detection Selection	0 or 1	1

Setting 0: Disabled

No communication error detection. The drive continues operation.

Setting 1: Enabled

If the drive does not receive data from the master for longer than the time set to H5-09, then a CE fault will be triggered and the drive will operate as determined by parameter H5-04.

■ H5-06: Drive Transmit Wait Time

Sets the time the drive waits after receiving data from a master until responding data.

Note: Cycle power for the setting to take effect.

No.	Name	Setting Range	Default
H5-06	Drive Transmit Wait Time	5 to 65 ms	5 ms

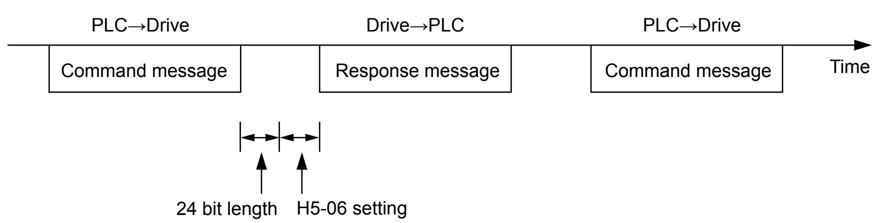


Figure 4.34 Drive Transmit Wait Time Setting

■ H5-07: RTS Control Selection

Enables or disables RTS control.

Note: Cycle power for the setting to take effect.

No.	Name	Setting Range	Default
H5-07	RTS Control Selection	0 or 1	1

Setting 0: Disabled. RTS is always on.

Use this setting with point-to-point RS-422 communications.

Setting 1: Enabled. RTS switches while sending.

Use this setting with RS-485 communications or when using multi-drop RS-422 communications.

■ H5-08: Communications Protocol Selection

Selects the communications protocol.

No.	Name	Setting Range	Default
H5-08	Communications Protocol Selection	0 to 3	0

Setting 0: MEMOBUS/Modbus

Setting 1: N2 (Metasys)

Setting 2: P1 (APOGEE FLN)

Setting 3: BACnet

■ H5-09: Communications Fault Detection Time

Sets the time the communications must be lost before the drive triggers a CE fault.

No.	Name	Setting Range	Default
H5-09	Communications Fault Detection Time	0.0 to 10.0 s	2.0 s

■ H5-10: Unit Selection for MEMOBUS/Modbus Register 0025H

Sets the unit for the output voltage monitor value in MEMOBUS/Modbus register 0025H.

No.	Name	Setting Range	Default
H5-10	Unit Selection for MEMOBUS/Modbus Register 0025H	0 or 1	0

Setting 0: 0.1 V units

Setting 1: 1 V units

■ H5-11: Communications Enter Function Selection

Selects whether an Enter command is necessary to change parameter values via MEMOBUS/Modbus communications. ***Refer to Enter Command on page 343***.

No.	Name	Setting Range	Default
H5-11	Communications Enter Function Selection	0 or 1	0

Setting 0: Enter command necessary

Parameter changes become effective after an Enter command. An Enter command must only be sent after the last parameter change, not for each single parameter.

Setting 1: Enter command not necessary

Parameter value changes become effective immediately without the need to send an Enter command.

■ H5-12: Run Command Method Selection

Selects the type of sequence used when the Run command source is set to network communications (b1-02 = 2).

When BACnet protocol is selected (H5-08 = 3), then the value entered for H5-12 will be ignored and the logic will be handled as though “0” was entered (FWD/Stop, REV/Stop method).

No.	Name	Setting Range	Default
H5-12	Run Command Method Selection	0 or 1	0

Setting 0: FWD/Stop, REV/Stop

Setting bit 0 will start and stop the drive in the forward direction. Setting bit 1 will start and stop the drive in reverse.

Setting 1: Run/Stop, FWD/REV

Setting bit 0 will start and stop the drive. Setting bit 1 changes the direction.

■ L5-02: Auto Restart Fault Output Operation Selection

Determines if a fault output is triggered (H2-☐☐ = E) when the drive attempts to restart.

No.	Name	Setting Range	Default
L5-02	Auto Restart Fault Output Operation Selection	0, 1	0

Setting 0: No Fault Output

Setting 1: Fault Output Is Set

■ L5-04: Fault Reset Interval Time

Determines the amount of time to wait between restart attempts when parameter L5-05 is set to 1.

No.	Name	Setting Range	Default
L5-04	Fault Reset Interval Time	0.5 to 600.0 s	10.0 s

■ L5-05: Fault Reset Operation Selection

No.	Name	Setting Range	Default
L5-05	Fault Reset Operation Selection	0, 1	1

Setting 0: Count Successful Restarts

The drive will continuously attempt to restart. If it restarts successfully, the restart counter is increased. This operation is repeated each time a fault occurs until the counter reaches the value set to L5-01.

Setting 1: Count Restart Attempts

The drive will attempt to restart using the time interval set to parameter L5-04. A record is kept of the number of attempts to restart to the drive, regardless of whether those attempts were successful. When the number of attempted restarts exceeds the value set to L5-01, the drive stops attempting to restart.

■ L6-13: Motor Underload Protection Selection

Sets Motor Underload Protection (UL6) based on motor load and determines whether the level of L6-02 refers to fbase or fmax.

Selects the operation of underload detection UL6. Underload is detected when the output current falls below the underload detection level defined by L6-14 and L2-02.

No.	Name	Setting Range	Default
L6-13	Motor Underload Protection Selection	0, 1	0

Setting 0: Enabled (Base Frequency)

Setting 1: Enabled (Max Frequency)

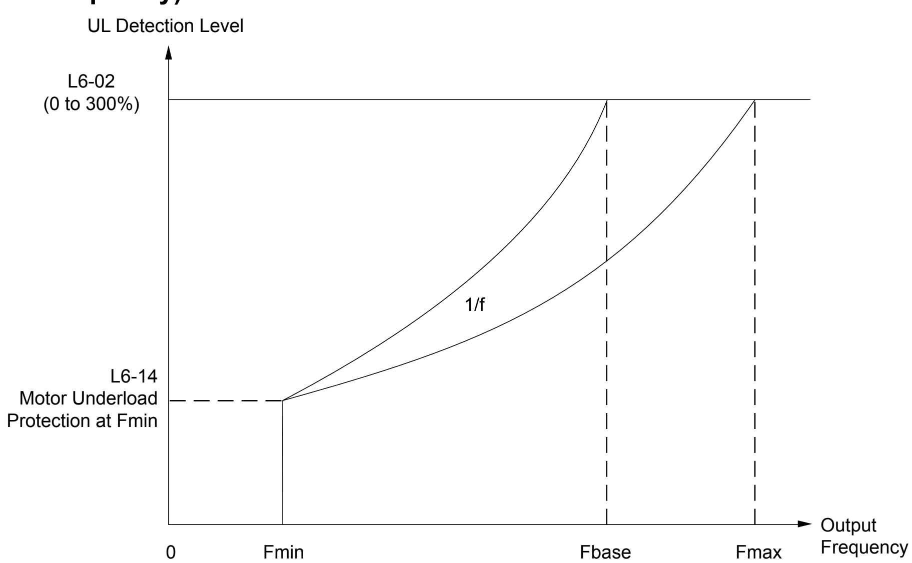


Figure 4.35 Motor Underload Protection

■ L6-14: Motor Underload Protection Level at Minimum Frequency

Sets the UL6 detection level at minimum frequency by percentage of drive rated current

No.	Name	Setting Range	Default
L6-14	Motor Underload Protection Level at Minimum Frequency	0 to 300%	15%

■ L8-02: Overheat Alarm Level

Sets the overheat alarm (oH) detection level.

The drive outputs an alarm when the heatsink temperature exceeds the overheat alarm level. If the drive is set to continue operation after this alarm occurs (L8-03 = 4) and the temperature reaches the overheat fault level, the drive will trigger an oH1 fault and stop operation.

When an output terminal is set for the oH pre-alarm (H2-□□ = 20), the switch will close when the heatsink temperature rises above L8-02.

No.	Name	Setting Range	Default
L8-02	Overheat Alarm Level	50 to 150 °C	Determined by o2-04

■ L8-03: Overheat Pre-Alarm Operation Selection

Sets the operation when an overheat pre-alarm is detected.

Note: Change L8-03 setting only when necessary.

No.	Name	Setting Range	Default
L8-03	Overheat Pre-Alarm Operation Selection	0 to 4	4

Setting 0: Ramp to Stop

If an overheat alarm occurs, the drive decelerates to stop using the currently selected deceleration time. If a digital output is programmed for “fault” (H2-□□ = E), this output will be triggered.

Setting 1: Coast to Stop

If an overheat alarm occurs, the drive switches off the output and the motor coasts to stop. If a digital output is programmed for “fault” (H2-□□ = E), this output will be triggered.

Setting 2: Fast Stop

If an overheat alarm occurs, the drive decelerates to stop using the Fast Stop time (C1-09). If a digital output is programmed for “fault” (H2-□□ = E), this output will be triggered.

Setting 3: Alarm Only

If an overheat alarm occurs, an alarm is output and the drive continues operation.

Setting 4: Operation with Reduced Speed

If an overheat alarm occurs, the operation continues with the speed reduced to the level set to parameter L8-19. If the oH alarm is still present after 10 s, the speed is reduced again. The amount of speed reduction depends on how often the alarm repeats. If the oH alarm disappears while the drive is operating at a reduced speed, the drive will switch to the previous speed in 10 s increments until reaching base frequency. *Figure 4.36* explains the operation with reduced speed during an oH alarm. A digital output programmed for 4D is switched when the oH alarm is still active after ten reduction cycles.

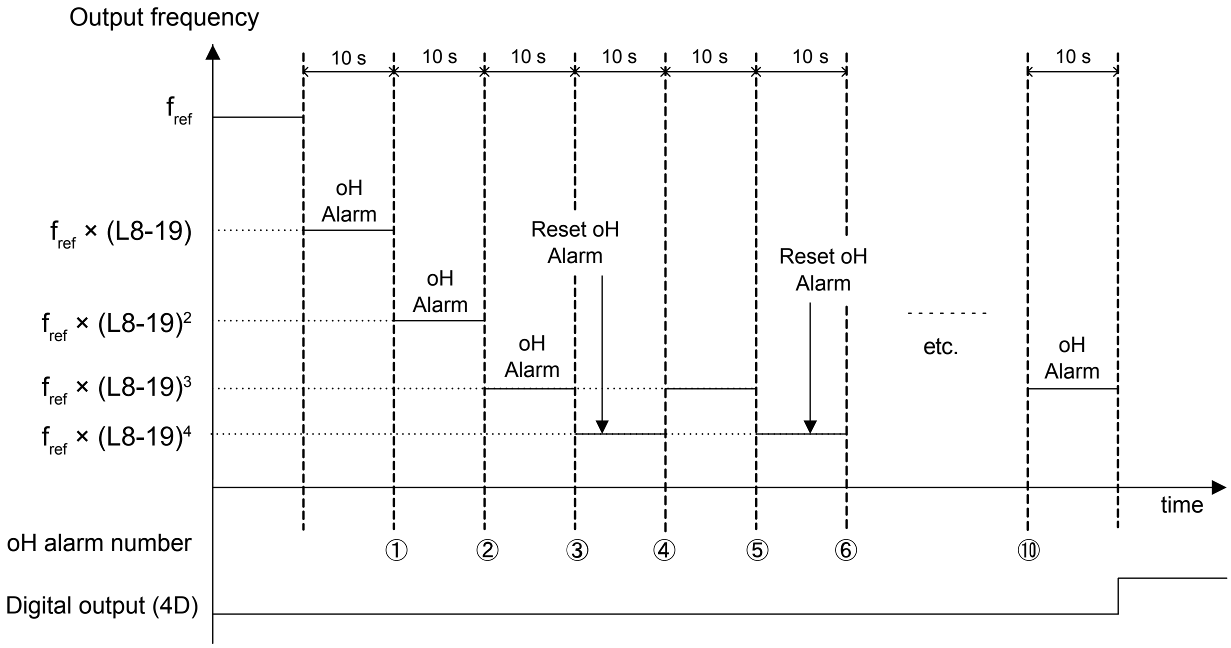


Figure 4.36 Output Frequency Reduction During Overheat Alarm

■ L8-06: Input Phase Loss Detection Level

Sets the Input Phase Loss Detection (PF) Level.

Triggers PF fault when there is an imbalance larger than the value set to L8-06 in the drive input power voltage.

Detection Level = 100% = Voltage Class × $\sqrt{2}$

No.	Name	Setting Range	Default
L8-06	Input Phase Loss Detection Level	0.0 to 50.0%	Determined by o2-04

■ L8-07: Output Phase Loss Protection Selection

Enables or disables the output phase loss detection.

Note:
1. Output phase loss detection can mistakenly be triggered if the motor rated current is very small compared to the drive rating. Disable this parameter in such cases.
2. Output phase loss detection is not possible when the drive is running a PM motor with light load.

No.	Name	Setting Range	Default
L8-07	Output Phase Loss Protection Selection	0 to 2	1

Setting 0: Disabled

Setting 1: Fault when One Phase Is Lost

An output phase loss fault (LF) is triggered when the output current for any phase U, V, or W drops to 5% or less of the drive rated current.

When using a PM motor, this is applicable when the output current is 30% or higher of the drive rated current.

When using an IM motor, this is applicable when the output current is 5% or higher of the drive rated current.

Setting 2: Fault when Two Phases Are Lost

An output phase loss fault (LF) is triggered when the output current for phases U, V, and W all drop to 5% or less of the drive rated current.

The output shuts off and the motor coasts to stop.

■ L8-09: Output Ground Fault Detection Selection

Enables or disables the output ground fault detection.

No.	Name	Setting Range	Default
L8-09	Output Ground Fault Detection Selection	0, 1	Determined by o2-04

Setting 0: Disabled

Ground faults are not detected.

Setting 1: Enabled

A ground fault (GF) is triggered when high leakage current or a ground short circuit occurs in one or two output phases.

■ L8-10: Heatsink Cooling Fan Operation Selection

Selects the heatsink cooling fan operation.

No.	Name	Setting Range	Default
L8-10	Heatsink Cooling Fan Operation Selection	0, 1	0

Setting 0: Run with Timer

The fan is switched on when a Run command is active and switched off with the delay set to parameter L8-11 after releasing the Run command. This setting extends the fan lifetime.

Setting 1: Run Always

The fan runs when power is supplied to the drive.

■ L8-11: Heatsink Cooling Fan Off-Delay Time

Sets the cooling fan switch off-delay time if parameter L8-10 is set to 0.

No.	Name	Setting Range	Default
L8-11	Heatsink Cooling Fan Off-Delay Time	0 to 300 s	60 s

■ L8-12: Ambient Temperature Setting

Automatically adapts the drive rated current to safe values when used with parameter L8-35. This eliminates the need to reduce the drive rated current when the temperature where the drive is mounted is above the specified values.

No.	Name	Setting Range	Default
L8-12	Ambient Temperature Setting	-10 to +50 °C	40 °C

■ L8-15: oL2 Characteristics Selection at Low Speeds

Selects whether the drive overload capability (oL fault detection level) is reduced at low speeds to prevent premature output transistor failures. Set this parameter to 0 (Protection disabled at low speed) when protection is activated for an oL2 fault for a light load at low speed.

Note:
1. Contact Yaskawa before using the drive for applications for which the setting is 0 (disabled).
2. Do not set this parameter to 0 (disabled) in V/f or OLV control.
3. Do not set this parameter to 0 (disabled) in models 4□0302 to 4□0414.

No.	Name	Setting Range	Default
L8-15	oL2 Characteristics Selection at Low Speed	0, 1	1

Setting 0: oL2 (Drive Overload) Characteristics Disabled at Low Speed

The overload protection level is not reduced. Frequently operating the drive with high output current at low speed can lead to premature drive faults.

Setting 1: oL2 (Drive Overload) Characteristics Enabled at Low Speed

The overload protection level (oL2 fault detection level) is automatically reduced at speeds below 6 Hz. At zero speed, the overload is derated by 50%.

■ L8-18: Software Current Limit Selection

Enables and disables the Software Current Limit (CLA) protection function to prevent main circuit transistor failures caused by high current.

Note: Do not change this setting unless absolutely necessary.

No.	Name	Setting Range	Default
L8-18	Software Current Limit Selection	0, 1	Determined by A1-02

Setting 0: Software CLA Disabled

The drive may trip on an oC fault if the load is too heavy or the acceleration is too short.

Setting 1: Software CLA Enabled

When the Software CLA current level is reached, the drive reduces the output voltage to reduce the current. Normal operation continues when the current level drops below the Software CLA level.

■ L8-19: Frequency Reduction Rate during Overheat Pre-Alarm

Specifies the output frequency reduction when L8-03 is set to 4 and an oH alarm is present. Set as a factor of the maximum output frequency.

No.	Name	Setting Range	Default
L8-19	Frequency Reduction Rate During Overheat Pre-Alarm	10.0 to 100.0%	20.0%

■ L8-27: Overcurrent Detection Gain

Adjusts the overcurrent detection level in OLV/PM control mode. A setting of 100% is equal to the motor rated current. When the drive rated current is considerably higher than the motor rated current, use this parameter to decrease the overcurrent level and prevent motor demagnetization from high current.

Overcurrent detection uses the lower value between the overcurrent level for the drive and the motor rated current multiplied by L8-27.

Note: The drive detects the lowest overcurrent from the overcurrent level of the drive, the setting value of this parameter, and the overcurrent level determined from the motor rated current.

No.	Name	Setting Range	Default
L8-27	Overcurrent Detection Gain	0.0 to 400.0%	300.0%

■ L8-29: Current Unbalance Detection (LF2)

Enables and disables output current unbalance detection in OLV/PM. Current unbalance can heat a PM motor and demagnetize the magnets. The current unbalance detection function monitors output current and triggers the LF2 fault to prevent such motor damage.

No.	Name	Setting Range	Default
L8-29	Current Unbalance Detection (LF2)	0, 2	2

Setting 0: Disabled

Motor protection with LF2 is disabled.

Setting 2: Current Det Type

LF2 fault is triggered when an output current imbalance is detected. Drive output shuts off and the motor coasts to stop.

■ L8-32: Cooling Fan Failure Selection

Determines drive operation when a FAn fault occurs.

No.	Name	Setting Range	Default
L8-32	Cooling Fan Failure Selection	0 to 2	1

Setting 0: Ramp to Stop

The drive stops the motor using the deceleration time 1 set in parameter C1-02.

Setting 1: Coast to Stop

The drive output is switched off and the motor coasts to a stop.

Setting 2: Fast Stop

The drive stops the motor using the Fast stop time set in parameter C1-09.

■ L8-35: Installation Method Selection

Selects the type of installation for the drive and changes the drive overload (oL2) limits accordingly.

Note:
1. Initialization does not reset this parameter.
2. The value is preset to the appropriate value when the drive is shipped. Change the value only when mounting a standard drive with the heatsink outside the cabinet.

No.	Name	Setting Range	Default
L8-35	Installation Method Selection	0, 2, 3	Determined by o2-04

Setting 0: IP00/Open-Chassis Enclosure

For an Open Type enclosure drive installed with at a minimum of 30 mm space to the next drive or a cabinet wall.

Setting 2: IP20/UL Type 1 Enclosure

For drives compliant with IP20/UL Type 1 enclosure specifications.

Setting 3: External Heatsink Installation

For a standard drive mounted with the heatsink outside the cabinet or enclosure panel.

■ L8-38: Carrier Frequency Reduction Selection

Selects the operation of the carrier frequency reduction function. Reduces the carrier frequency when the output current exceeds a certain level. This temporarily increases the overload capability (oL2 detection), allowing the drive to run through transient load peaks without tripping.

No.	Name	Setting Range	Default
L8-38	Carrier Frequency Reduction Selection	0 to 2	Determined by A1-02 and o2-04

Setting 0: Disabled

No carrier frequency reduction at high current.

Setting 1: Enabled for Output Frequencies below 6 Hz

The carrier frequency is reduced at speeds below 6 Hz when the current exceeds 100% of the drive rated current. The drive returns to the normal carrier frequency when the current falls below 88% or the output frequency exceeds 7 Hz.

Setting 2: Enabled for Entire Frequency Range

The carrier frequency is reduced at the following speeds:
- Below 6 Hz when the current exceeds 100% of the drive rated current.
- Above 7 Hz when the current exceeds 112% of the drive rated current.

The drive uses the delay time set in parameter L8-40 and a hysteresis of 12% when switching the carrier frequency back to the set value.

■ L8-40: Carrier Frequency Reduction Off-Delay Time

Sets a hold time before returning to the original carrier frequency setting after the carrier frequency has been temporarily derated as determined by L8-38. The carrier frequency reduction function is disabled when this value is 0.00 s.

No.	Name	Setting Range	Default
L8-40	Carrier Frequency Reduction Off-Delay Time	0.00 to 2.00 s	0.50 s

■ L8-41: High Current Alarm Selection

Triggers a high current alarm (HCA) when the output current exceeds 150% of the drive rated current.

No.	Name	Setting Range	Default
L8-41	High Current Alarm Selection	0, 1	0

Setting 0: Disabled

No alarm is detected.

Setting 1: Enabled

An alarm is triggered when the output current exceeds 150% of the drive rated current. A digital output set for an alarm

(H2-☐☐ = 10) will close.

■ L9-12: SoH Alarm Selection during bb

Sets the SoH (Snubber Discharge Resistor Overheat) alarm to output a fault or a minor fault during baseblock (bb). There is normally no need to change this parameter from the default value.

Note: This parameter is available in drive software versions PRG: 6113 and later.

No.	Name	Setting Range	Default
L9-12	SoH Alarm Selection during bb	0, 1	0

Setting 0: Outputs a Fault for an SoH Alarm during Baseblock (bb)

Setting 1: Outputs a Minor Fault for an SoH Alarm during Baseblock (bb)

■ n8-63: Output Voltage Limit Proportional Gain (for PM Motors)

Stabilizes constant output.

There is normally no need to change this parameter from the default value.

Note:
1. This parameter is only available in OLV/PM.
2. This parameter is available in drive software versions PRG: 6114 and later.

No.	Name	Setting Range	Default
n8-63	Output Voltage Limit Proportional Gain (for PM Motors)	0.00 to 100.00	1.00

■ n8-64: Output Voltage Limit Integral Time (for PM Motors)

There is normally no need to change this parameter from the default value.

Note:
1. This parameter is only available in OLV/PM.
2. This parameter is available in drive software versions PRG: 6114 and later.

No.	Name	Setting Range	Default
n8-63	Output Voltage Limit Integral Time (for PM Motors)	0.000 to 5.000 s	0.040 s

■ n8-66: Output Voltage Limit Output Filter Time Constant (for PM Motors)

There is normally no need to change this parameter from the default value.

Note:
1. This parameter is only available in OLV/PM.
2. This parameter is available in drive software versions PRG: 6114 and later.

No.	Name	Setting Range	Default
n8-66	Output Voltage Limit Output Filter Time Constant (for PM Motors)	0.000 to 5.000 s	0.001 s

■ o1-01: Drive Mode Unit Monitor Selection

When o1-02 is set to 5, any U monitors can be displayed. This parameter will select the monitors. Pressing the up arrow key will display the following data: frequency reference → rotational direction → output frequency → output current → o1-01 selection.

Parameter o1-01 selects the content of the last monitor in this sequence. This is done by entering the “1☐☐” part of “U1-☐☐”. Certain monitors are not available in some control modes. There is no effect like this on an LCD operator.

No.	Name	Setting Range	Default
o1-01	Drive Mode Unit Monitor Selection	104 to 914 U1-04 (Control Mode) to U9-14 (Power Monitor) <1>	106 (U1-06)

<1> U2-☐☐ and U3-☐☐ parameters cannot be selected.

■ o1-02: User Monitor Selection after Power Up

Selects which monitor parameter is displayed upon power up by entering the 1- ☐☐ part of U1-☐☐. Certain monitors are not available in some control modes.

No.	Name	Setting Range	Default
o1-02	User Monitor Selection after Power Up	1 to 5	<1>

<1> Default is 1 when b5-01 is set to 0.
Default is 3 when b5-01 is set to 1 or 3.

Setting 1: Frequency Reference (U1-01)

Setting 2: Motor Direction

Setting 3: Output Frequency (U1-02)

Setting 4: Output Current (U1-03)

Setting 5: User Monitor

The monitor value selected by o1-01 will be displayed.

■ o1-03: HOA Keypad Display Selection

Sets the units used to display the frequency reference and output frequency. Set o1-03 to 3 for user-set units before setting parameters o1-10 and o1-11.

No.	Name	Setting Range	Default
o1-03	HOA Keypad Display Selection	0 to 3	0

Setting 0: 0.01 Hz Units

Setting 1: 0.01% Units (100% = Max Output Frequency)

Setting 2: r/min Units (Calculated by the Max Output Frequency and the Number of Motor Poles)

Setting 3: User-set Units (Use o1-10, o1-11)

Set the value used for the maximum frequency reference to o1-10. Set the placement of the decimal point in this number to o1-11.

For example, to have the maximum output frequency displayed as “100.00”, set o1-10 = 1000 and o1-11 = 2 (i.e., 1000 with 2 decimal points).

Note: **1.** Parameter o1-03 allows the programmer to change the units used in the following parameters and monitors:
U1-01: frequency reference
U1-02: output frequency
U1-16: output frequency after softstarter (accel/decel ramp generator)
d1-01 to d1-17: frequency references

2. Setting o1-03 to 2 requires entering the number of motor poles to E2-04 and E5-04.

■ o1-06: User Monitor Selection Mode

Normally the monitors shown directly below the active monitor are the next two sequential monitors. If o1-06 (User Monitor Selection Mode) is set to 1: “3 Mon Selectable”, those two monitors are locked as specified by parameters o1-07 and o1-08 and will not change as the top parameter is scrolled with the Up/Down Arrow keys.

No.	Name	Setting Range	Default
o1-06	User Monitor Selection Mode	0, 1	<1>

<1> Default is 0 when b5-01 is set to 0.
Default is 1 when b5-01 is set to 1 or 3.

Setting 0: 3 Monitor Sequential (Displays the Next 2 Sequential Monitors)

Setting 1: 3 Monitor Selectable (o1-07, and o1-08 Selected Monitor Is Shown)

■ o1-07: Second Line Monitor Selection

Selects which monitor will be displayed in the second line. The monitor parameter number is entered into the spaces provided: U□-□□.

For example, set “403” to display monitor parameter U4-03.

No.	Name	Setting Range	Default
o1-07	Second Line Monitor Selection	101 to 699	<1>

<1> Default is 102 when b5-01 is set to 0.
Default is 504 when b5-01 is set to 1 or 3.

■ o1-08: Third Line Monitor Selection

Selects which monitor will be displayed in the third line. The monitor parameter number is entered into the spaces provided: U□-□□.

For example, set “403” to display monitor parameter U4-03.

No.	Name	Setting Range	Default
o1-08	Third Line Monitor Selection	101 to 699	<1>

<1> Default is 102 when b5-01 is set to 0.
Default is 501 when b5-01 is set to 1 or 3.

■ o1-09: Frequency Reference Display Units

Sets unit display for the frequency reference parameters and frequency related monitors when o1-03 = 3.

No.	Name	Setting Range	Default
o1-09	Frequency Reference Display Units	0 to 16	16

Setting 0: Inch of Water (“WC)

Setting 1: Pounds per Square Inch (PSI)

Setting 2: Gallons per Minute (GPM)

Setting 3: Degrees Fahrenheit (F)

Setting 4: Cubic Feet per Minute (CFM)

Setting 5: Cubic Meters per Hour (CMH)

Setting 6: Liters per Hour (LPH)

Setting 7: Liters per Second (LPS)

Setting 8: Bar (Bar)

Setting 9: Pascals (Pa)

Setting 10: Degrees Celsius (C)

Setting 11: Meters (Mtr)

Setting 12: Ft (Feet)

Setting 13: Liters per Minute (LPM)

Setting 14: Cubic Meters per Minute (CMM) No unit

Setting 15: Custom Units (Determined by o1-12)

Setting 16: None

■ o1-10: User-Set Display Units Maximum Value

Determines the display value that is equal to the maximum output frequency.

No.	Name	Setting Range	Default
o1-10	User-Set Display Units Maximum Value	1 to 60000	Determined by o1-03

■ o1-11: User-Set Display Units Decimal Display

Determines how many decimal points should be used to set and display the frequency reference.

No.	Name	Setting Range	Default
o1-11	User-Set Display Units Decimal Display	0 to 3	Determined by o1-03

Setting 0: No Decimal Point

Setting 1: One Decimal Point

Setting 2: Two Decimal Points

Setting 3: Three Decimal Points

■ o1-13 to o1-15: Frequency Reference and Frequency Related Monitor Custom Units 1 to 3

Sets the customer specified unit display for the frequency reference parameters and frequency related monitors when o1-03 is set to 3 and o1-09 is set to 15 as custom units.

The custom units consist of three characters selected from o1-13 to o1-15. Each character is selected by ASCII code from 30Hex to 7AHex.

No.	Name	Setting Range	Default
o1-13	Frequency Reference and Frequency Related Monitor Custom Units 1	30H to 7AH	41H
o1-14	Frequency Reference and Frequency Related Monitor Custom Units 2		
o1-15	Frequency Reference and Frequency Related Monitor Custom Units 3		

■ o1-16, o1-17: F1/F2 Key Function Selection

The HOA Keypad multi-function keys F1 and F2 can be set for different HVAC specific functions. Selects the functions of the F1/F2 keys and the LCD display text above the F1/F2 keys.

Note: Parameters o1-16 and o1-17 cannot be set to the same value (except for setting 0).

No.	Name	Setting Range	Default
o1-16	F1 Key Function Selection	0 to 4	0
o1-17	F2 Key Function Selection		0

Setting 0: Standard

Setting 1: Monitor

Setting 2: Drive/Bypass (DRV/BYP)

Setting 3: Bypass Run (RUN BYP)

Setting 4: Toggle Relay Output (RLY)

■ o1-18, o1-19: User-Defined Parameter Upper/Lower

Allows the user to set values that can be used as reference information.

No.	Name	Setting Range	Default
o1-18	User-Defined Parameter Upper	0 to 999	0
o1-19	User-Defined Parameter Lower		

■ o2-02: OFF Key Function Selection

Determines if the OFF key on the HOA keypad will stop drive operation when the drive is controlled from a remote source (i.e., not from HOA keypad).

Note: The keypad OFF key is not functional when the drive is in Emergency Override.

No.	Name	Setting Range	Default
o2-02	OFF Key Function Selection	0, 1	1

Setting 0: Disabled

Setting 1: Enabled

The OFF key will terminate drive operation even if the Run command source is not assigned to the HOA keypad. Cycle the Run command to restart the drive if the drive has been stopped by pressing the OFF key.

■ o2-04: Drive Model Selection

Set this parameter when replacing the control board or the terminal board.

NOTICE: *Drive performance will suffer and protective functions will not operate properly if the correct drive capacity is not set to o2-04.*

No.	Name	Setting Range	Default
o2-04	Drive Model Selection	-	Determined by drive capacity

Note: Change o2-04 setting only when necessary.

■ o2-06: Operation Selection when HOA Keypad is Disconnected

Determines whether the drive will stop when the remote control extension cable of the HOA keypad is removed in HAND mode or when b1-02 or b1-16 is set to 0. When the operator is reconnected, the display will indicate that it was disconnected.

No.	Name	Setting Range	Default
o2-06	Operation Selection when HOA Keypad is Disconnected	0, 1	1

Setting 0: Continue Operation

The operation continues.

Setting 1: Trigger a Fault

The operation stops and triggers an oPr fault. The motor coasts to stop.

■ o2-07: Motor Direction at Power Up when Using Operator

Determines the direction the motor will rotate after the drive is powered up and the Run command is given from the HOA keypad.

Note: This parameter is effective only when the Run command is set to be given from the HOA keypad (b1-02 = 0).

No.	Name	Setting Range	Default
o2-07	Motor Direction at Power Up when Using Operator	0, 1	0

Setting 0: Forward

Setting 1: Reverse

■ o3-01: Copy Function Selection

Instructs the drive to Read, Write, or Verify parameter settings.

No.	Name	Setting Range	Default
o3-01	Copy Function Selection	0 to 3	0

Setting 0: Copy Select (No Function)

Setting 1: INV --> OP READ

Copies all parameters from the drive to the HOA keypad.

Note: The copy protection for the HOA keypad is enabled by default. Set o3-01 to 1 to unlock copy protection.

Setting 2: OP --> INV WRITE

Copies all parameters from the HOA keypad to the drive.

Setting 3: OP<-->INV VERIFY

Compares the parameters in the drive with the parameter settings saved on the HOA keypad for matches.

■ o3-02: Copy Allowed Selection

Allows and restricts the use of the Copy function.

No.	Name	Setting Range	Default
o3-02	Copy Allowed Selection	0, 1	0

Setting 0: Disabled

Setting 1: Enabled

■ o4-01: Cumulative Operation Time Setting

Sets the cumulative operation time of the drive. The user can also manually set this parameter to begin keeping track of operation time from some desired value. Total operation time can be viewed in monitor U4-01.

Note: The value in o4-01 is set in 10 h units. For example, a setting of 30 will set the cumulative operation time counter to 300 h. 300 h will also be displayed in monitor U4-01.

No.	Name	Setting Range	Default
o4-01	Cumulative Operation Time Setting	0 to 9999 h	0 h

■ o4-02: Cumulative Operation Time Selection

Selects the conditions for how the drive keeps track of its total operation time. This time log can be viewed in monitor U4-01.

No.	Name	Setting Range	Default
o4-02	Cumulative Operation Time Selection	0, 1	1

Setting 0: Power on Time

The drive logs the time it is connected to a power supply, regardless of whether the motor is running.

Setting 1: Run Time

The drive logs the time that the output is active including when the Run command is active (even if the motor is not rotating) and when there is voltage output.

■ o4-03: Cooling Fan Operation Time Setting

Sets the value for how long the cooling fan has been operating. This value can be viewed in monitor U4-03. Parameter o4-03 also sets the base value used for the cooling fan maintenance, which is displayed in U4-04. Reset this parameter to 0 after replacing the cooling fan.

Note:
1. The value in o4-03 increases after every 10 hours of use. A setting of 30 will set the cooling fan operation time counter to 300 h. “300” will be displayed in monitor U4-03.
2. The cooling fan may require maintenance at an earlier date in harsher environments.

No.	Name	Setting Range	Default
o4-03	Cooling Fan Operation Time Setting	0 to 9999 h	0 h

■ o4-05: Capacitor Maintenance Setting

Starts estimates for capacitor maintenance times from this setting value. This value should be reset to 0 when the capacitors have been replaced.

Note: The actual maintenance time will depend on the environment where the drive is used.

No.	Name	Setting Range	Default
o4-05	Capacitor Maintenance Setting	0 to 150%	0%

■ o4-07: DC Bus Pre-Charge Relay Maintenance Setting

Starts estimates for soft charge bypass relay maintenance times from this setting value. This value should be reset to 0 when the bypass relay has been replaced.

Note: The actual maintenance time will depend on the environment where the drive is used.

No.	Name	Setting Range	Default
o4-07	DC Bus Pre-charge Relay Maintenance Setting	0 to 150%	0%

■ o4-11: U2, U3 Initialization

Resets the fault trace and fault history monitors (U2-□□ and U3-□□).

Note: Initializing the drive using A1-03 does not reset these monitors.

No.	Name	Setting Range	Default
o4-11	U2, U3 Initialization	0, 1	0

Setting 0: No Action

The drive keeps the previously saved record concerning fault trace and fault history.

Setting 1: Reset Fault Data

Resets the data for the U2-□□ and U3-□□ monitors. Setting o4-11 to 1 and pressing the ENTER key erases fault data and returns the display to 0.

■ o4-12: kWh Monitor Initialization

Manually resets kWh monitors U4-10, U4-11, and U9-□□. Initializing the drive or cycling the power will not reset these monitors.

No.	Name	Setting Range	Default
o4-12	kWh Monitor Initialization	0, 1	0

Setting 0: No Action

The kWh data are maintained.

Setting 1: Reset kWh Data

Resets the kWh counter. The monitors U4-10, U4-11, and U9-□□ will display “0” after they are initialized. Setting o4-12 to 1 and pressing the ENTER erases kWh data and returns the display to 0.

■ o4-13: Number of Run Commands Counter Initialization

Resets the Run command counter displayed in U4-02. Initializing the drive or cycling the power does not reset this monitor.

No.	Name	Setting Range	Default
o4-13	Number of Run Commands Counter Initialization	0, 1	0

Setting 0: No Action

The Run command data are kept.

Setting 1: Number of Run Commands Counter

Resets the Run command counter. The monitor U4-02 will show 0. Setting o4-13 to 1 and pressing the ENTER key erases the counter value and returns the display to 0.

■ o4-17: Set/Reset Real Time Clock

The time setting screen will appear.

No.	Name	Setting Range	Default
o4-17	Set/Reset Real Time Clock	0 to 2	0

Setting 0: — —

No Setting

Setting 1: Set

The HOA keypad shows the Clock Adjustment display. In Clock Adjustment Mode the user can adjust the Real Time Clock.

Setting 2: Reset

The Real-Time Clock data is cleared. A TIM fault will occur until o4-17 is set to 1 to set the Real Time Clock.

■ T1-01: Auto-Tuning Mode Selection

Sets the type of Auto-Tuning to be used. ***Refer to Auto-Tuning for Induction Motors on page 139*** for details on the different types of Auto-Tuning.

No.	Name	Setting Range	Default
T1-01	Auto-Tuning Mode Selection	2, 3	2

Setting 2: Stationary Auto-Tuning for Line-to-Line Resistance

Setting 3: Rotational Auto-Tuning for V/f Control Energy Saving

■ T1-02: Motor Rated Power

Sets the motor rated power according to the motor nameplate value.

Note: Use the following formula to convert HP to kW: kW = HP x 0.746.

No.	Name	Setting Range	Default
T1-02	Motor Rated Power	0.00 to 650.00 kW	Determined by o2-04

■ T1-03: Motor Rated Voltage

Sets the motor rated voltage according to the motor nameplate value. Enter the voltage base speed when the motor operates above base speed. Enter the voltage needed to operate the motor under no-load conditions at rated speed to T1-03.

No.	Name	Setting Range	Default
T1-03	Motor Rated Voltage	0.0 to 255.0 V <1>	200.0 V <1>

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

■ T1-04: Motor Rated Current

Sets the motor rated current according to the motor nameplate value. Enter the current at the motor base speed.

No.	Name	Setting Range	Default
T1-04	Motor Rated Current	10.0 to 150.0% of drive rated current	Determined by o2-04

■ T1-05: Motor Base Frequency

Sets the motor rated frequency according to the motor nameplate value. If a motor with an extended speed range is used or the motor is used in the field weakening area, enter the maximum frequency to E1-04 after Auto-Tuning is complete.

No.	Name	Setting Range	Default
T1-05	Motor Base Frequency	0.0 to 400.0 Hz	60.0 Hz

■ T1-06: Number of Motor Poles

Sets the number of motor poles according to the motor nameplate value.

No.	Name	Setting Range	Default
T1-06	Number of Motor Poles	2 to 48	4

■ T1-07: Motor Base Speed

Sets the motor rated speed according to the motor nameplate value. Enter the speed at base frequency when using a motor with an extended speed range or if using the motor in the field weakening area.

No.	Name	Setting Range	Default
T1-07	Motor Base Speed	0 to 24000 r/min	1750 r/min

■ T1-11: Motor Iron Loss

Provides iron loss information to determine the Energy Saving coefficient. T1-11 will first display the value for the motor iron loss that the drive automatically calculated when the motor capacity was entered to T1-02. Enter the motor iron loss value listed to T1-11 if the motor test report is available.

No.	Name	Setting Range	Default
T1-11	Motor Iron Loss	0 to 65535 W	Determined by E2-11

■ T1-12: T1 Tuning Start

Set T1-12 to 0 to start IM Auto-Tuning.

No.	Name	Setting Range	Default
T1-12	T1 Tuning Start	0	–

◆ U1: Operation Status Monitors

Status monitors display drive status data such as output frequency and output current. *Refer to U1: Operation Status Monitors on page 317* for a complete list of U1-□□ monitors and descriptions.

◆ U2: Fault Trace

Use these monitor parameters to view the status of various drive aspects when a fault occurs.

This information is helpful for determining the cause of a fault. *Refer to U2: Fault Trace on page 319* for a complete list of U2-□□ monitors and descriptions.

U2-□□ monitors are not reset when the drive is initialized. *Refer to o4-11: U2, U3 Initialization on page 187* for instructions on how to reset these monitor values.

Note: Fault histories are not kept when CPF00, CPF01, CPF06, CPF24, oFA00, oFb00, oFC00, Uv1, Uv2, or Uv3 occur.

◆ U3: Fault History

These parameters display faults that have occurred during operation as well as the drive operation time when those faults occurred. *Refer to U3: Fault History on page 320* for a complete list of U3-□□ monitors and descriptions.

U3-□□ monitors are not reset when the drive is initialized. *Refer to o4-11: U2, U3 Initialization on page 187* for instructions on how to reset these monitor values.

Note: Fault histories are not kept when CPF00, CPF01, CPF06, CPF24, oFA00, oFb00, oFC00, Uv1, Uv2, or Uv3 occur.

◆ U4: Maintenance Monitors

Maintenance monitors show:

- Runtime data of the drive and cooling fans and number of Run commands issued
- Maintenance data and replacement information for various drive components
- kWh data
- Highest peak current that has occurred and output frequency at the time the peak current occurred
- Motor overload status information
- Detailed information about the present Run command and frequency reference source selection

Refer to U4: Maintenance Monitors on page 322 for a complete list of U4-□□ monitors and descriptions.

◆ U5: PID Monitors

These monitors display various aspects of PID control.

Refer to U5: PID Monitors on page 323 for a complete list of U5-□□ monitors and descriptions.

◆ U6: Operation Status Monitors

These monitors display reference data for the output voltage and vector control and the offset value added to the frequency reference by the frequency offset function.

Refer to U6: Operation Status Monitors on page 324 for a complete list of U6-□□ monitors and descriptions.

◆ U9: Power Monitors

The total consumed power and regenerated power are displayed for these parameters. *Refer to U9: Power Monitors on page 325* for a complete list of U9-□□ monitors and descriptions.

5

Troubleshooting

This chapter provides descriptions of the drive faults, alarms, errors, related displays, and guidance for troubleshooting. This chapter can also serve as a reference guide for tuning the drive during a trial run.

5.1 Section Safety

⚠ DANGER

Electrical Shock Hazard

Before servicing, disconnect all power to the equipment.

The capacitor for the control power supply remains charged even after the power supply is turned off. The charge indicator LED will extinguish when the control power supply voltage is below 50 Vdc. To prevent electric shock, wait for at least the time specified on the warning label, once all indicators are OFF, measure for unsafe voltages to confirm the drive is safe prior to servicing.

Failure to comply will result in death or serious injury.

⚠ WARNING

Arc Flash Hazard

It is possible that there is more than one source of power for equipment.

Obey the requirements for Electrical Safety in the Workplace and local codes for safe work procedures and applicable personal protective equipment (PPE).

Failure to obey can cause serious injury or death.

Electrical Shock Hazard

Do not operate equipment with covers removed.

Failure to comply could result in death or serious injury.

The diagrams in this section may illustrate drives without covers or safety shields to display details. Be sure to reinstall covers or shields before operating the drives and run the drives according to the instructions described in this manual.

Always ground the motor-side grounding terminal.

Improper equipment grounding could result in death or serious injury by contacting the motor case.

Do not touch terminals before the drive has fully discharged.

Failure to comply could result in death or serious injury.

Before servicing, disconnect all power to the equipment. The capacitor for the control power supply remains charged even after the power supply is turned off. The charge indicator LED will extinguish when the control power supply 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.

After blowing a fuse or tripping a GFCI, do not attempt to restart the drive or operate peripheral devices until five minutes pass and CHARGE lamp is OFF.

Failure to comply could result in death, serious injury, and damage to the drive.

Check wiring and peripheral device ratings to identify the cause of trips.

Contact Yaskawa or a Yaskawa representative if the cause cannot be identified.

Do not allow unqualified personnel to perform work on the drive.

Failure to comply could result in death or serious injury.

Installation, maintenance, inspection, and service must be performed only by authorized personnel familiar installation, adjustment, and maintenance of drives.

Do not perform work on the drive while wearing loose clothing, jewelry, or without eye protection.

Failure to comply could result in death or serious injury.

Remove all metal objects such as watches and rings, secure loose clothing and wear eye protection before beginning work on the drive.

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

Failure to comply could result in death or serious injury.

⚠ WARNING

Fire Hazard

Tighten all terminal screws to the specified tightening torque.

Loose electrical connections could result in death or serious injury by fire due to overheating of electrical connections.

Do not use an improper voltage source.

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

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

Do not use improper combustible materials.

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

Attach the drive to metal or other noncombustible material.

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.

Never connect or disconnect the motor from the drive while the drive is outputting voltage.

Improper equipment sequencing could result in damage to the drive.

Do not use unshielded cable for control wiring.

Failure to comply may cause electrical interference resulting in poor system performance. Use shielded twisted-pair wires and ground the shield to the ground terminal of the drive.

Do not allow unqualified personnel to use the product.

Failure to comply could result in damage to the drive.

Installation, maintenance, inspection, and service must be performed only by authorized personnel familiar installation, adjustment, and maintenance of drives.

Do not modify the drive circuitry.

Failure to comply could result in damage to the drive and will void warranty.

Yaskawa is not responsible for modification of the product made by the user.

Check all the wiring after installing the drive and connecting other devices to ensure that all connections are correct.

Failure to comply could result in damage to the drive.

5.2 Motor Performance Fine-Tuning

This section offers helpful information for counteracting oscillation, hunting, and other problems that occur while performing a trial run. Refer to the appropriate control method in this section.

Note: This section describes commonly edited parameters that may be set incorrectly. Consult Yaskawa for more information on detailed settings and for fine-tuning the drive.

◆ Fine-Tuning V/f Control

Table 5.1 Parameters for Fine-Tuning Performance in V/f

Problem	Parameter No.	Corrective Action	Default	Suggested Setting
Motor hunting and oscillation at speeds between 10 and 40 Hz	Hunting Prevention Gain (n1-02)	• Reduce the setting if insufficient motor torque relative to the size of the load causes hunting. • Increase the setting when motor hunting and oscillation occur with a light load. • Reduce the setting if hunting occurs when using a motor with a relatively low inductance, such as a high-frequency motor or a motor with a larger frame size.	1.00	0.10 to 2.00
• Motor noise • Motor hunting and oscillation at speeds up to 40 Hz	Carrier Frequency Selection (C6-02)	• Increase the carrier frequency If the motor noise is too loud. • Lower the carrier frequency when motor hunting and oscillation occur at speeds up to 40 Hz. • The default setting for the carrier frequency depends on the drive capacity (o2-04).	1 (4 kHz) <1>	1 to 4; F
• Poor torque or speed response • Motor hunting and oscillation	Torque Compensation Primary Delay Time (C4-02)	• Reduce the setting if motor torque and speed response are too slow. • Increase the setting if motor hunting and oscillation occur.	Depends on o2-04, Drive Model Selection	100 to 1000 ms
• Poor motor torque at speeds below 10 Hz • Motor hunting and oscillation	Torque Compensation Gain (C4-01)	• Increase the setting if motor torque is insufficient at speeds below 10 Hz. • Reduce the setting if motor hunting and oscillation with a relatively light load.	1.00	0.50 to 1.50
• Poor motor torque at low speeds • Motor instability at motor start	Mid Output Voltage A (E1-08) Minimum Output Voltage (E1-10)	• Increase the setting if motor torque is insufficient at speeds below 10 Hz. • Reduce the setting If motor instability occurs at motor start.	E1-08: 15.0 V E1-10: 9.0 V <2>	Default setting ±5 V

<1> Default setting value is dependent on parameters A1-02, Control Method Selection, and o2-04, Drive Model Selection.

<2> Changing the control method in A1-02 or selecting a different V/f pattern in E1-03 will change the default setting.

◆ Fine-Tuning Open Loop Vector Control for PM Motors

Table 5.2 Parameters for Fine-Tuning Performance in OLV/PM

Problem	Parameter No.	Corrective Action	Default	Suggested Setting
Undesirable motor performance	Motor parameters (E1-□□, E5-□□)	• Check the settings for base and maximum frequency in the E1-□□ parameters. • Check E5-□□ parameters and set motor data correctly. Do not enter line-to-line data where single-phase data is required, and vice versa. • Perform Auto-Tuning.	-	-
Poor motor torque and speed response	Load Inertia Ratio (n8-55)	Adjust parameter n8-55 to meet the load inertia ratio of the machine.	0	Close to the actual load inertia ratio
	Speed Feedback Detection Gain (n8-45)	Increase the speed feedback detection gain (n8-45).	0.80	Increase in increments of 0.05
	Torque Compensation (C4-01)	Enable torque compensation. **Note:** Setting this value too high can cause overcompensation and motor oscillation.	0.00	1.00
Oscillation at start or the motor stalls	Pull-In Current during Accel/Decel (n8-51)	Increase the pull-in current in n8-51	50%	Increase in steps of 5%
	DC Injection Braking Current (b2-02), DC Injection Time at Start (b2-03)	Use DC Injection Braking at start to align the rotor. This may cause a short reverse rotation at start.	b2-02 = 50% b2-03 = 0.00 s	b2-03 = 0.5 s Increase b2-02 if needed
	Load Inertia Ratio (n8-55)	Increase the load inertia ratio. **Note:** Setting this value too high can cause overcompensation and motor oscillation.	0	Close to the actual load inertia ratio
Stalling or oscillation occur when load is applied during constant speed	Pull-In Current Compensation Time Constant (n8-47)	Reduce n8-47 if hunting occurs during constant speed	5.0 s	Reduce in increments of 0.2 s
	Pull-In Current (n8-48)	Increase the pull-in current in n8-48.	30%	Increase in increments of 5%
	Load Inertia Ratio (n8-55)	Increase the load inertia ratio.	0	Close to the actual load inertia ratio
Hunting or oscillation occur	Speed feedback Detection Gain (n8-45)	Reduce the speed feedback detection gain in n8-45.	0.80	Increase in increments 0.05
STo fault trips when the load is not excessively high	Induced Voltage Constant (E5-09 or E5-24)	• Check and adjust the induced voltage constant. • Check the motor nameplate and the data sheet or contact the motor manufacturer.	Depends on drive capacity	Refer to the motor data sheet or the nameplate.
Stalling or STo occurs at high speed as the output voltage becomes saturated	Output Voltage Limit (n8-62)	Set the value of the input voltage to parameter n8-62	200 Vac (200 V class) 400 Vac (400 V class)	Set equal to input voltage
Oscillation at constant output when U6-02 displays -10% or more.	Output Voltage Limit Proportional Gain (for PM Motors) (n8-63)	Decrease the output voltage limit proportional gain (n8-63). **Note:** The speed response will be slow if the setting is too low.	1.00	0.10 to 1.00 Decrease in decrements of 0.1

◆ Parameters to Minimize Motor Hunting and Oscillation

In addition to the parameters discussed on pages *194* and *195*, parameters in *Table 5.3* indirectly affect motor hunting and oscillation.

Table 5.3 Parameters that Affect Control Performance in Applications

Name (Parameter No.)	Application
Accel/Decel Time (C1-01 through C1-11)	Adjusting accel and decel times will affect the torque presented to the motor during acceleration or deceleration.
S-Curve Characteristics (C2-01 and C2-02)	Prevents shock at the beginning and end of acceleration and deceleration.
Jump Frequency (d3-01 through d3-04)	Skips over the resonant frequencies of connected machinery.
Analog Filter Time Constant (H3-13)	Prevents fluctuation in the analog input signal due to noise.
Stall Prevention (L3-01 through L3-06)	• Prevents motor speed loss and overvoltage when the load is too heavy or during sudden acceleration/deceleration. • Adjustment is not normally necessary because Stall Prevention is enabled as a default.

5.3 Drive Alarms, Faults, and Errors

◆ 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 103*.

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

Table 5.4 contains descriptions of the various types of alarms, faults, and errors that may occur while operating the drive.

Table 5.4 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 227*.
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.

◆ Alarm and Error Displays

■ Faults

Table 5.5 gives an overview of possible fault codes. Conditions such as overvoltages can trip faults and alarms. It is important to distinguish between faults and alarms to determine the proper corrective actions.

When the drive detects a fault, the ALM indicator LED lights, the fault code appears on the HOA keypad, and the fault contact MA-MB-MC triggers. An alarm is present if the ALM LED blinks and the fault code on the HOA keypad flashes. ***Refer to Minor Faults and Alarms on page 199*** for a list of alarm codes.

Table 5.5 Fault Displays

HOA Keypad Display	Name	Page
Aov	Power Supply Overvoltage	201
AUv	Power Supply Undervoltage	201
bAT	HOA Keypad Battery Low	201
bUS	Option Communication Error	201
CE	MEMOBUS/Modbus Communication Error	201
CoF	Current Offset Fault	202
CPF00 to CPF03, CPF07, CPF08, CPF11 to CPF14, CPF16 to CPF24 CPF26 to CPF35 CPF40 to CPF45 <1> <2>	Control Circuit Error	202
CPF06	Control Circuit Error	202
CPF25	Terminal Board Not Connected	202
doH	Damping Resistor Overheat	202
EF0	Option Card External Fault	202
EF1 to EF8	External Fault (input terminal S1 to S8)	202
Err	EEPROM Write Error	203
FAn	Fan Fault	203
FbH	Excessive PID Feedback	203
FbL	PID Feedback Loss	204
Fdv	Power Supply Frequency Fault	204
GF	Ground Fault	204
LF	Output Phase Loss	204
LF2	Current Imbalance	205
nSE	Node Setup Error	205
oC	Overcurrent	205
oFA00 <3>	Option Card Connection Error at Option Port CN5-A	206
oFA01	Option Card Fault at Option Port CN5-A	206
oFA03 to oFA06	Option Card Error Occurred at Option Port CN5-A	206
oFA10, oFA11	Option Card Error (CN5-A)	206
oFA12 to oFA17	Option Card Connection Error (CN5-A)	206
oFA30 to oFA43	Comm Option Card Connection Error (CN5-A)	206

HOA Keypad Display	Name	Page
oFb00	Option Card Fault at Option Port CN5-B	206
oFb01	Option Card Fault at Option Port CN5-B	206
oFb02	Option Card Fault at Option Port CN5-B	206
oFb03, oFb11	Option Card Error Occurred at Option Port CN5-B	207
oFb12 to oFb17	Option Card Error Occurred at Option Port CN5-B	207
oFC00	Option Card Connection Error at Option Port CN5-C	207
oFC01	Option Card Fault at Option Port CN5-C	207
oFC02	Option Card Fault at Option Port CN5-C	207
oFC03, oFC11	Option Card Error Occurred at Option Port CN5-C	207
oFC12 to oFC17	Option Card Error Occurred at Option Port CN5-C	207
oFC50 to oFC55	Option Card Error Occurred at Option Port CN5-C	207
oH	Heatsink Overheat	207
oH1	Overheat 1 (Heatsink Overheat)	208
oH3	Motor Overheat Alarm (PTC input)	208
oH4	Motor Overheat Fault (PTC input)	208
oL1	Motor Overload	208
oL2	Drive Overload	209
oL3	Overtorque Detection 1	209
oL4	Overtorque Detection 2	209
oL5	Mechanical Weakening Detection 1	209
oPr	External Digital Operator Connection Fault	209
ov	Control Circuit Overvoltage	209
SCF	Safety Circuit Fault	209
SEr	Too Many Speed Search Restarts	209
SoH	Snubber Discharge Resistor Overheat	209
SrC	Phase Order Detection Fault	209
Srr	Internal Resistance Fault	210
STo	Pull-Out Detection	210
SvE	Zero Servo Fault	210
TdE	Time Data Error	210
TIM	Time Not Set	210
UL3	Undertorque Detection 1	210
UL5	Mechanical Weakening Detection 2	210
Uv1 <3>	Control Circuit Undervoltage Fault	211

HOA Keypad Display	Name	Page
Uv2 <3>	Control Power Supply Voltage Fault	211
Uv3 <3>	Undervoltage 3 (Soft-Charge Bypass Circuit Fault)	211

<1> Displayed as CPF00 when occurring at drive power up. When one of the faults occurs after successfully starting the drive, the display will show CPF01.

<2> Displayed as CPF20 when occurring at drive power up. When one of the faults occurs after successfully starting the drive, the display will show CPF21.

<3> Fault histories are not kept when CPF00, CPF01, CPF06, CPF24, Fdv, oFA00, oFb00, oFC00, Uv1, Uv2, or Uv3 occur.

■ Minor Faults and Alarms

Refer to *Table 5.6* for an overview of possible alarm codes. Conditions such as overvoltages can trip faults and alarms. It is important to distinguish between faults and alarms to determine the proper corrective actions.

When the drive detects an alarm, the ALM indicator LED blinks and the alarm code display flashes. Most alarms trigger a digital output programmed for alarm output (H2-☐☐ = 10). A fault (not an alarm) is present if the ALM LED lights without blinking. *Refer to Faults on page 198* for information on fault codes.

Table 5.6 Minor Fault and Alarm Displays

HOA Keypad Display	Name	Minor Fault Output (H2-☐☐ = 10)	Page
AEr	Station Address Setting Error (CC-Link, CANopen, MECHATROLINK)	YES	212
AUv	Power Supply Undervoltage	YES	201
bb	Baseblock	No output <2>	212
bUS	Option Card Communications Error	YES	212
CALL	Serial Communication Transmission Error	YES	212
CE	MEMOBUS/Modbus Communication Error	YES	213
CrST	Cannot Reset	YES	213
dnE	Drive Disabled	YES	213
doH	Damping Resistor Overheat	–	202
EF	Forward/Reverse Run Command Input Error	YES	213
EF0	Option Card External Fault	YES	214
EF1 to EF8	External Fault (input terminal S1 to S8)	YES	214
FbH	Excessive PID Feedback	YES	214
FbL	PID Feedback Loss	YES	214
Fdv	Power Supply Frequency Fault	–	204
HCA	Current Alarm	YES	215
LT-1	Cooling Fan Maintenance Time	No output <1>	215
LT-2	Capacitor Maintenance Time	No output <1>	215
LT-3	Soft Charge Bypass Relay Maintenance Time	No output <1>	215
oH	Heatsink Overheat	YES	215
oH2	Heatsink Overheat Warning	YES	216
oH3	Motor Overheat	YES	216
oL3	Overtorque 1	YES	216
ov	Control Circuit Overvoltage	YES	216
PASS	MEMOBUS/Modbus Test Mode Complete	No output	216
SE	MEMOBUS/Modbus Test Mode Fault	YES	217
SrC	Phase Order Detection Fault	–	209
UL3	Undertorque Detection 1	YES	217
Uv	Control Circuit Undervoltge	YES	217
WrUn	Waiting for Run	YES	217

<1> Output when H2-☐☐ = 2F.

<2> Baseblock alarm “bb” will not activate a digital output programmed for minor fault H2-0☐= 10. Set H2-0☐ = 8 or 1B to activate a digital otuput for “bb”.

■ Operation Errors

Table 5.7 Operation Error Displays

HOA Keypad Display	Name	Page
oPE01	Unit Capacity Setting Fault	218
oPE02	Parameter Range Setting Error	218
oPE03	Multi-Function Input Selection Error	218
oPE05	Initialization Required	219
oPE07	Multi-Function Analog Input Selection Error	219
oPE08	Parameter Selection Error	219
oPE09	PID Control Selection Fault	219
oPE10	V/f Data Setting Error	220
oPE11	Carrier Frequency Setting Error	220
oPE16	Energy Saving Constants Error	220
oPE27	BP Program Error	220
oPE28	Sequence Timer Error	220

HOA Keypad Display	Name	Page
oPE30	Incorrect Input Voltage Adjustment	220

Auto-Tuning Errors

Table 5.8 Auto-Tuning Error Displays

HOA Keypad Display	Name	Page
End3	Rated Current Setting Alarm (displayed after Auto-Tuning is complete)	222
End4	Adjusted Slip Calculation Error	222
End5	Resistance Tuning Error	222
End7	No-Load Current Alarm	222
Er-01	Motor Data Error	222
Er-02	Minor Fault	223
Er-03	OFF Button Input	223
Er-04	Line-to-Line Resistance Error	223
Er-05	No-Load Current Error	223
Er-08	Rated Slip Error	223
Er-09	Acceleration Error	223
Er-12	Current Detection Error	223

Errors and Displays When Using the Copy Function

Table 5.9 Copy Errors

HOA Keypad Display	Name	Page
CoPy	Writing parameter settings (flashing)	224
CPEr	Control mode mismatch	224
CPyE	Error writing data	224
CSEr	Copy unit error	224
dFPS	Drive model mismatch	224
End	Task complete	224
iFEr	Communication error	225
ndAT	Model, voltage class, capacity mismatch	225
rdEr	Error reading data	225
rEAd	Reading parameter settings (flashing)	225
vAEr	Voltage class, capacity mismatch	225
vFyE	Parameter setting mismatch	225
vrFy	Comparing parameter settings (flashing)	225

5.4 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 5.10 Detailed Fault Displays, Causes, and Possible Solutions

HOA Keypad Display	Fault Name
Aov	Power Supply Overvoltage
	The input power supply voltage became equal to or higher than the Input Power Supply Overvoltage Detection Level. 200 V Class: Approximately 277 Vrms 400 V Class: Approximately 630 Vrms

HOA Keypad Display	Fault Name
AUv	Power Supply Undervoltage
	The input power supply voltage became equal to or lower than the Input Power Supply Undervoltage Detection Level (L2-21). 200 V Class: Approximately 150 Vrms 400 V Class: Approximately 300 Vrms

HOA Keypad Display	Fault Name
bAT	HOA Keypad Battery Voltage Low
Cause	**Possible Solution**
The HOA keypad battery is low	Replace the HOA keypad battery.

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.
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.

HOA Keypad Display	Fault Name
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.

HOA Keypad Display	Fault Name
CoF	Current Offset Fault
Cause	**Possible Solution**
The drive tried to adjust the current offset value beyond the allowable range. This is due to residual induction current in the motor (e.g., during sudden deceleration or when coasting) when the drive attempted to start the motor.	• Create a motor restart sequence that allows enough time for residual induction voltage to dissipate. • Enable Speed Search at start (b3-01 = 1). Use the multi-function terminals to execute External Speed Search 1 and 2 (H1-□□ = 61 or 62). **Note:** When using a PM motor, External Speed Searches 1 and 2 perform the same operation.
The current sensor in the drive 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
CPF00 to CPF03, CPF07, CPF08, CPF11 to CPF14, CPF16 to CPF24 CPF26 to CPF35 CPF40 to CPF45	Control Circuit Error

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 using parameter A1-03.

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
doH	Damping Resistor Overheat
	The temperature of the built-in damping resistor exceeded the set value.

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	External Fault (input terminal S1)
	External fault at multi-function input terminal S1.
EF2	External Fault (input terminal S2)
	External fault at multi-function input terminal S2.

HOA Keypad Display	Fault Name
EF3	External Fault (input terminal S3)
	External fault at multi-function input terminal S3.
EF4	External Fault (input terminal S4)
	External fault at multi-function input terminal S4.
EF5	External Fault (input terminal S5)
	External fault at multi-function input terminal S5.
EF6	External Fault (input terminal S6)
	External fault at multi-function input terminal S6.
EF7	External Fault (input terminal S7)
	External fault at multi-function input terminal S7.
EF8	External Fault (input terminal S8)
	External fault at multi-function input terminal S8.
Cause	**Possible Solution**
An external device tripped an alarm function	• Properly connect the signal lines to the terminals assigned for external fault detection (H1-□□ = 20 to 2F). • Reconnect the signal line.
Multi-function contact input setting is incorrect	• Check for unused terminals set for H1-□□ = 20 to 2F (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 HOA keypad. • 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
FbH	Excessive PI Feedback
	PI feedback input is greater than the level set to b5-36 for longer than the time set to b5-37. Set b5-12 to 2 or 5 to enable fault detection.
Cause	**Possible Solution**
Parameters are set inappropriately	Check b5-36 and b5-37 settings.
Incorrect PI feedback wiring	Correct the wiring.

HOA Keypad Display	Fault Name
There is a problem with the feedback sensor	• Check the sensor on the control side. • Replace the sensor if damaged.

HOA Keypad Display	Fault Name
FbL	PI Feedback Loss
	This fault occurs when PI feedback loss detection is programmed to trigger a fault (b5-12 = 2) and the PI feedback level is below the detection level set to b5-13 for longer than the time set to b5-14.
Cause	**Possible Solution**
Parameters are set inappropriately	Check b5-13 and b5-14 settings.
Incorrect PI feedback wiring	Correct the wiring.
There is a problem with the feedback sensor	• Check the sensor on the control side. • Replace the sensor if damaged.

HOA Keypad Display	Fault Name
Fdv	Power Supply Frequency Fault
	The input power supply frequency exceeded the allowable frequency fluctuation.

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	• The set value exceeds the allowable setting range while the drive automatically adjusts the current offset. This only happens when attempting to restart a PM motor that is coasting to 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. **Note:** Speed Searches 1 and 2 are the same when using OLV/PM.
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
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 Main Circuit Wire Gauges and Tightening Torque on page 73*** 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
LF2	Output Current Imbalance
	One or more of the phases in the output current are lost.
Cause	**Possible Solution**
Phase loss has occurred on the output side of the drive	• Check for faulty wiring or poor connections on the output side of the drive. • Correct the wiring.
Terminal wires are loose on the output side of the drive	Apply the tightening torque specified in this manual to fasten the terminals. ***Refer to Main Circuit Wire Gauges and Tightening Torque on page 73*** for details.
The output circuit 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.
Motor impedance or motor phases are uneven	• Measure the line-to-line resistance for each motor phase. Ensure all values match. • Replace the motor.

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 and C1-03) • Increase the S-curve characteristics (C2-01 and C2-02) • 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).

HOA Keypad Display	Fault Name
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 motor control method and motor do not match	• Check the control mode. • For IM motors, set A1-02 to 0. • For PM motors, set A1-02 to 5.
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.

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 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
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.

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, 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
oFb03 to oFb11 oFb12 to oFb17	Option card error occurred at Option Port CN5-B
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 oFC12 to oFC17	Option Card Error Occurred at Option Port CN5-C
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. The default value for L8-02 is determined by drive capacity (o2-04).
Cause	**Possible Solution**

HOA Keypad Display	Fault Name
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).
External 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. Overheat level is determined by drive capacity (o2-04).
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
oH3	Motor Overheat Alarm (PTC Input)
	• The motor overheat signal to analog input terminals A1 or A2 exceeded the alarm detection level. • Detection requires setting multi-function analog inputs H3-02 or H3-10 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	Fault Name
oH4	Motor Overheat Fault (PTC Input)
	• The motor overheat signal to analog input terminal A1 or A2 exceeded the fault detection level. • Detection requires setting multi-function analog inputs H3-02 or H3-10 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	Fault Name
oL1	Motor Overload
	The electronic motor overload protection tripped

HOA Keypad Display	Fault Name
oL2	Overload
	The thermal sensor of the drive triggered overload protection.

HOA Keypad Display	Fault Name
oL3	Overtorque Detection 1
	The current has exceeded the value set for Torque Detection Level 1 (L6-02) for longer than the allowable time (L6-03).

HOA Keypad Display	Fault Name
oL4	Overtorque Detection 2
	The current has exceeded the value set for Torque Detection Level 2 (L6-05) for longer than the allowable time (L6-06).

HOA Keypad Display	Fault Name
oL5	Mechanical Weakening Detection 1
	Overtorque occurred, matching the conditions specified in L6-08.

HOA Keypad Display	Fault Name
oPr	HOA Keypad Connection Fault
	The HOA keypad has been disconnected from the drive. 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 keypad (b1-02 = 0 and OFF mode has been selected).
Cause	**Possible Solution**
External operator is not properly connected to the drive	• Check the connection between the operator and the drive. • Replace the cable if damaged. • Turn off the drive input power and disconnect the operator. Reconnect the operator and reapply drive input power.

HOA Keypad Display	Fault Name
ov	Control Circuit Overvoltage
	Voltage in the control circuit has exceeded the overvoltage level. • For 200 V class drives: approximately 450 V • For 400 V class drives: approximately 900 V

HOA Keypad Display	Fault Name
SCF	Safety Circuit Fault
	Safety Circuit Fault is detected.

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).
The motor is coasting in the opposite direction of the Run command	Set b3-14 to 1 to enable Bi-Directional Speed Search.

Digital Operator Display	Fault Name
SoH	Snubber Discharge Resistor Overheat

Digital Operator Display	Fault Name
SrC	Phase Order Detection Fault
	The phase rotation direction for the input power supply changed.

Digital Operator Display	Fault Name
Srr	Internal Resistance Fault
	An operation failure occurred in the snubber discharge resistor circuit.

HOA Keypad Display	Fault Name
STo	Motor Pull Out or Step Out Detection
	Motor pull out or step out has occurred. Motor has exceeded its pull-out torque.
Cause	**Possible Solution**
Load is too heavy	• Increase the load inertia for PM motor (n8-55). • Increase the pull-in current during accel/decel (n8-51). • Reduce the load. • Increase the motor or drive capacity.
Load inertia is too heavy	Increase the load inertia for PM motor (n8-55).
Acceleration and deceleration times are too short	• Increase the acceleration and deceleration times (C1-01 to C1-04). • Increase the S-curve acceleration and deceleration times (C2-01).
Speed response is too slow	Increase the load inertia for PM motor (n8-55).

HOA Keypad Display	Fault Name
SvE	Zero Servo Fault
	Position deviation during zero servo.

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. Contact Yaskawa or your nearest sales representative for instructions on replacing the HOA keypad.
A communication error has occurred with the Real-Clock Time function of the HOA keypad	

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 • 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 the time for the HOA keypad. Parameter o4-17 = 1. The drive will display the "TIM" alarm (Time Not Set) whenever 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 HOA keypad. For instructions on replacing the HOA keypad, contact Yaskawa or your nearest sales representative.

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
UL5	Mechanical Weakening Detection 2
	The operation conditions matched the conditions set to L6-08.
Cause	**Possible Solution**

HOA Keypad Display	Fault Name
Undertorque was detected and matched the conditions for mechanical loss detection set to L6-08	Check the load side for any problems.

HOA Keypad Display	Fault Name
Uv1	Control Circuit Undervoltage Fault
	Voltage in the control circuit fell below the detection level: • For 200 V class drives: approximately 175 V • For 400 V class drives: approximately 350 V
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 Main Circuit Wire Gauges and Tightening Torque on page 73* 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**
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 Relay Fault)
	The soft-charge bypass relay failed.
Cause	**Possible Solution**
The relay or contactor on the soft-charge bypass circuit is damaged	• Cycle power to the drive. • If the problem continues, replace the entire drive. Contact Yaskawa or your nearest sales representative. • Check monitor U4-06 for the performance life of the soft-charge bypass. • Replace the entire drive if U4-06 exceeds 90%. Contact Yaskawa or your nearest sales representative.

5.5 Alarm Detection

◆ Alarm Codes, Causes, and Possible Solutions

Alarms are drive protection functions that do not necessarily cause the drive to stop. Once the cause of an alarm is removed, 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-3 (triggered only if H2-□□ = 2F).

Table 5.11 Alarm Codes, Causes, and Possible Solutions

HOA Keypad Display	Minor Fault Name
AEr	Station Address Setting Error (CC-Link, CANopen, MECHATROLINK)
	Option card node address is outside of the acceptable setting range.
Cause	**Possible Solutions**
Station number is set outside the possible setting range.	• Set parameter F6-10 to the proper value when using a CC-Link option. • Set parameter F6-35 to the proper value when using a CANopen option.

HOA Keypad Display	Minor Fault Name
AUv	Power Supply Undervoltage
	The input power supply voltage became equal to or lower than the Input Power Supply Undervoltage Detection Level (L2-21). 200 V Class: Approximately 150 Vrms 400 V Class: Approximately 300 Vrms

HOA Keypad Display	Minor Fault Name
bb	Baseblock
	Drive output interrupted as indicated by an external baseblock signal.
Cause	**Possible Solutions**
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
bUS	Option Communication Error
	• The connection was lost after initial communication was established. • Assign a Run command frequency reference to the option.
Cause	**Possible Solutions**
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.

HOA Keypad Display	Minor Fault Name
CALL	Serial Communication Transmission Error
	Communication has not yet been established.
Cause	**Possible Solutions**

HOA Keypad Display	Minor Fault Name
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 Solutions**
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.
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 Solutions**
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 Solutions**
"Drive Enable" is set to a multi-function contact input (H1-☐☐ = 6A) and that signal was switched off	Check the operation sequence.

HOA Keypad Display	Minor Fault Name
doH	Damping Resistor Overheat
	The temperature of the built-in damping resistor exceeded the set value.

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 Solutions**
Sequence error	Check the forward and reverse command sequence and correct the problem. **Note:** When minor fault EF detected, motor ramps to stop.

Troubleshooting

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HOA Keypad Display	Minor Fault Name
EF0	Option Card External Fault
	An external fault condition is present.
Cause	**Possible Solutions**
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	External Fault (Input Terminal S1)
	External fault at multi-function input terminal S1.
EF2	External fault (input terminal S2)
	External fault at multi-function input terminal S2.
EF3	External fault (input terminal S3)
	External fault at multi-function input terminal S3.
EF4	External fault (input terminal S4)
	External fault at multi-function input terminal S4.
EF5	External fault (input terminal S5)
	External fault at multi-function input terminal S5.
EF6	External fault (input terminal S6)
	External fault at multi-function input terminal S6.
EF7	External fault (input terminal S7)
	External fault at multi-function input terminal S7.
EF8	External 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-□□ = 20 to 2F). • Reconnect the signal line.
Multi-function contact inputs are set incorrectly	• Check if the unused terminals have been set for H1-□□ = 20 to 2F (External Fault). • Change the terminal settings.

HOA Keypad Display	Minor Fault Name
FbH	Excessive PI Feedback
	The PI feedback input is higher than the level set to b5-36 for longer than the time set to b5-37, and b5-12 is set to 1 or 4.
Cause	**Possible Solutions**
Parameter settings for b5-36 and b5-37 are incorrect	Check parameters b5-36 and b5-37.
PI feedback wiring is faulty	Correct the wiring.
Feedback sensor has malfunctioned	Check the sensor and replace it if damaged.
Feedback input circuit is damaged	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
FbL	PI Feedback Loss
	The PI feedback input is lower than the level set to b5-13 for longer than the time set to b5-14, and b5-12 is set to 1 or 4.
Cause	**Possible Solutions**
Parameter settings for b5-13 and b5-14 are incorrect	Check parameters b5-13 and b5-14.
PI feedback wiring is faulty	Correct the wiring.
Feedback sensor has malfunctioned	Check the sensor and replace it if damaged.

HOA Keypad Display	Minor Fault Name
Feedback input circuit is damaged	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
Fdv	Power Supply Frequency Fault
	The input power supply frequency exceeded the allowable frequency fluctuation.

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 to 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
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 Solutions**
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 Solutions**
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 Solutions**
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
oH	Heatsink Overheat
	The temperature of the heatsink exceeded the overheat pre-alarm level set to L8-02 (90-100 °C). Default value for L8-02 is determined by drive capacity (o2-04).
Cause	**Possible Solutions**

HOA Keypad Display	Minor Fault Name
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 42*** 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 S7 (H1-☐☐= B).
Cause	**Possible Solutions**
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 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 C1-08). • 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	Minor Fault Name
oL3	Overtorque 1
	Drive output current was greater than L6-02 for longer than the time set to L6-03.
Cause	**Possible Solutions**
Inappropriate parameter settings	Check parameters L6-02 and L6-03.
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.

HOA Keypad Display	Minor Fault Name
ov	Control Circuit Overvoltage
	Voltage in the control circuit has exceeded the trip point. • For 200 V class drives: approximately 450 V • For 400 V class drives: approximately 900 V

HOA Keypad Display	Minor Fault Name
PASS	MEMOBUS/Modbus Comm. Test Mode Complete
Cause	**Possible Solutions**

HOA Keypad Display	Minor Fault Name
MEMOBUS/Modbus test has finished normally	This verifies that the test was successful.

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 Solutions**
A digital input set to 67H (MEMOBUS/Modbus test) was closed while the drive was running	Stop the drive and run the test again.

Digital Operator Display	Minor Fault Name
SrC	Phase Order Detection Fault
	The phase rotation direction for the input power supply changed.

HOA Keypad Display	Minor Fault Name
UL3	Undertorque Detection 1
	Drive output current less than L6-02 for longer than L6-03 time.
Cause	**Possible Solutions**
Inappropriate parameter settings	Check parameters L6-02 and L6-03.
Load has dropped or decreased significantly	Check for broken parts in the transmission system.

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.
Cause	**Possible Solutions**
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 Main Circuit Wire Gauges and Tightening Torque on page 73***.
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
	A Run command has been issued and the drive is waiting to begin running the motor.
Cause	**Possible Solutions**
After a Run command has been entered, the drive must wait for the time set to b1-11 to pass before it can begin to operate the motor	This is not an error.

5.6 Operator Programming Errors

◆ Operator Programming Error Codes, Causes, and Possible Solutions

A 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 5.12* for the appropriate action. When an oPE appears on the HOA keypad display, press the ENTER button to view U1-18 and see which parameter is causing the oPE.

Table 5.12 oPE Codes, Causes, and Possible Solutions

HOA Keypad Display	Error Name
oPE01	Unit Capacity Setting Fault
	Unit 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 H1-07.
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.
• 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) • 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 PI control (b5-01) are enabled simultaneously	Set b5-01 to 0 to disable control PI 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) • FWD Run Command (or REV) and FWD/REV Run Command (2-wire) (40, 41 vs. 42, 43) • Drive Enable (60 vs. 6A)	• Check if contradictory settings have simultaneously been assigned to the multi-function input terminals. • Correct setting errors.

HOA Keypad Display	Error Name
One of the following settings was entered while H1-☐☐ = 2 (External Reference 1/2): • 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
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	

HOA Keypad Display	Error Name
oPE07	Multi-Function Analog Input Selection Error
	A contradictory setting is assigned to multi-function analog inputs H3-02 or H3-10 and PI 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 or H3-10)	Change the settings to H3-02 and H3-10 so that functions no longer conflict. **Note:** Both 0 (Frequency Reference Bias) and F (Not Used) can be set to H3-02 and H3-10 simultaneously.
The following simultaneous contradictory settings: H3-02 or H3-10 = C (PI Target Value) while b5-18 = 1 (enables b5-19 as the target PI value)	Disable one of the PI selections.

HOA Keypad Display	Error Name
oPE08	Parameter Selection Error
	A function has been set that cannot be used in the motor control method selected.
Cause	**Possible Solutions**
In OLV/PM, parameters E5-02 to E5-07 are set to 0	When using a special-purpose motor, set E5-☐☐ in accordance with the test report provided.
The following settings have occurred in OLV/PM: • E5-03 does not equal 0 • E5-09 and E5-24 are both equal to 0, or neither equals 0	• Set E5-09 or E5-24 to the correct value, and set the other to 0. • Set the motor rated current for PM to 0 (E5-03).
Note: Use U1-18 to find parameters that are set outside the specified setting range. When multiple errors occur simultaneously, other errors are given precedence over oPE08.	

HOA Keypad Display	Error Name
oPE09	PI Control Selection Fault
	PI control function selection is incorrect. Requires that PI control is enabled (b5-01 = 1 or 3).
Cause	**Possible Solutions**
The following simultaneous contradictory settings have occurred: • b5-15 is not set to 0.0 (PI 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, enabling PI 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.

HOA Keypad Display	Error Name
b5-01 is set to 3, enabling PI 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: E1-04 ≥ E1-06 E1-06 ≥ E1-07 E1-07 ≥ E1-09 or E1-09 ≥ E1-11
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
oPE16	Energy Saving Constants Error
Cause	**Possible Solutions**
The following contradictory settings are true: A1-02 = 0, S1-01 =1, and b8-01 = 1	Correct the parameter settings.

HOA Keypad Display	Error Name
oPE27	BP Program Error
	Bypass mode is not correctly configured.
Cause	**Possible Solutions**
If digital inputs A4, A5, or A7 or digital outputs A4 or A5 are programmed, then all must be programmed	Correct the parameter settings.
Digital inputs A4, A5, or A7 and digital outputs A4 or A5 are programmed and one of the following conditions is true: • H1-0□ = 0 (3-Wire Sequence) • L5-01 > 0 and S4-01 = 1 (Auto Transfer of Fault) • H1-□□≤ A6 and H2-□□ = A6 • H1-□□ = A6 and H2-□□≤ A6	

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
oPE30	Incorrect Input Voltage Adjustment
	The input voltage offset adjustment has not been performed.

HOA Keypad Display	Error Name
Cause	**Possible Solutions**
• o2-04, Drive Model Selection, setting changed. • ERPROM failed for the input voltage offset.	Contact Yaskawa or your nearest sales representative for information on clearing the error.

5.7 Auto-Tuning Fault Detection

Auto-Tuning faults in this section are displayed on the digital operator and will cause the motor to coast to a stop. Auto-Tuning faults do not trigger a multi-function digital output set for fault or alarm output.

An End□ error on the digital operator display indicates Auto-Tuning has successfully completed with discrepancies in the calculations. Restart Auto-Tuning after fixing the cause of the End□ error.

The drive may be used in the application if no cause can be identified despite the existence of an End□ error.

An Er□ error indicates that Auto-Tuning has not completed successfully. Check for the cause of the error using the tables in this section, and perform Auto-Tuning again after fixing the cause.

◆ Auto-Tuning Codes, Causes, and Possible Solutions

Table 5.13 Auto-Tuning Codes, Causes, and Possible Solutions

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.

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
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	• Make sure motor data entered to T1-□□ match motor nameplate information. • 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.
Base frequency and motor rated speed (T1-05 and T1-07) do not match	• Correct the settings of parameters T1-05 and T1-07. • Check that the correct number of poles were entered to T1-06.

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 restart Auto-Tuning.

HOA Keypad Display	Error Name
Er-03	OFF Button Input
Cause	**Possible Solutions**
Auto-Tuning canceled by pressing the OFF 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 motor data entered to T1-□□ match motor nameplate information. • 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 motor data entered to T1-□□ match motor nameplate information. • 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.

HOA Keypad Display	Error Name
Er-08	Rated Slip Error
Cause	**Possible Solutions**
Motor data entered during Auto-Tuning was incorrect	• Make sure motor data entered to T1-□□ match motor nameplate information. • 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.

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.

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.

5.8 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 HOA keypad will indicate the task being performed. When an error occurs, a code appears on the HOA 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. Press any key on the HOA keypad to clear an error; the error display will disappear.

Table 5.14 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 5.14 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	Error
CPEr	Control Mode Mismatch
Cause	**Possible Solutions**
Control mode of the parameters to be loaded onto the drive and the control mode set to the drive do not match.	• Verify the control mode for the parameters to be loaded onto the drive and the control mode on drive to which those parameters will be written. • Set the same control mode using parameter A1-02 and retry.

HOA Keypad Display	Error
CPyE	Error Writing Data
Cause	**Possible Solutions**
Failed writing parameters	Attempt to write parameters again.

HOA Keypad Display	Error
CSEr	Copy Unit Error
Cause	**Possible Solutions**
Hardware fault	Replace the operator or the USB Copy Unit.

HOA Keypad Display	Error
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	Error
iFEr	Communication Error
Cause	**Possible Solutions**
A communication error occurred between the drive and the operator 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	Error
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 operator.

HOA Keypad Display	Error
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	Error
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	Error
vFyE	Parameter settings in the drive and those saved to the copy function are not the same
Cause	**Possible Solutions**
Indicates that the 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.

5.9 Diagnosing and Resetting Faults

When a fault occurs and the drive stops, follow the instructions below to remove whatever conditions triggered the fault, then restart the drive.

Note: An oC/SC fault will be displayed in the event of an IGBT failure. It may not be possible to reset this fault until the IGBT problem is corrected.

◆ Fault Occurs Simultaneously with Power Loss

WARNING! *Electrical Shock Hazard. Ensure there are no short circuits between the main circuit terminals (R/L1, S/L2, and T/L3) or between the ground and main circuit terminals before restarting the drive. Do not immediately operate peripheral devices if a fuse is blown or a GFCI has tripped. Failure to comply may result in serious injury or death and will cause damage to equipment.*

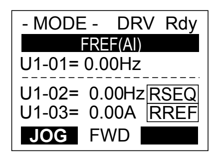
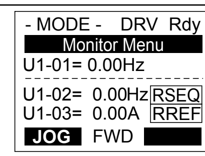
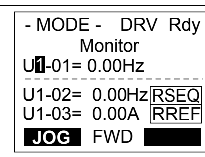
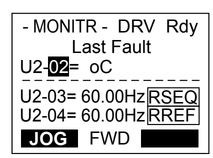
1. Turn on the drive input power.
2. Use monitor parameters U2-□□ to display data on the operating status of the drive just before the fault occurred.
3. Remove the cause of the fault and reset.

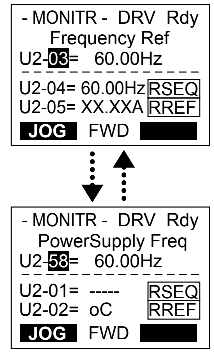
Note:
1. To find out what faults were triggered, check the fault history in U2-02. Information on drive status when the fault occurred such as the frequency, current, and voltage can be found in U2-03 through U2-58. ***Refer to Viewing Fault Trace Data After Fault on page 226*** for information on how to view fault data.
2. When the fault continues to be displayed after cycling power, remove the cause of the fault and reset.

◆ If the Drive Still has Power After a Fault Occurs

1. Look at the HOA keypad for information on the fault that occurred.
2. ***Refer to Fault Displays, Causes, and Possible Solutions on page 201***.
3. Reset the fault. ***Refer to Fault Reset Methods on page 227***.

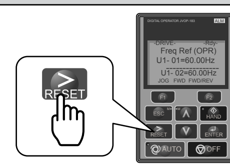
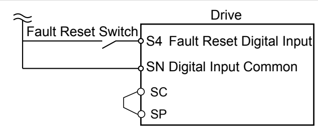
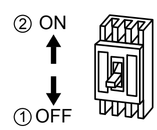
◆ Viewing Fault Trace Data After Fault

	Step		Display/Result
1.	Turn on the drive input power. The first screen displays.	→	
2.	Press (∧) to display the monitor menu screen.	→	
3.	Press (ENTER) to display the monitor mode screen.	→	
4.	Press (∧) and (> RESET) to scroll to monitor U2-02. The fault code shown in U2-02 is the fault that occurred most recently. In this example, the most recent fault is “oC” (overcurrent).	→	

Step			Display/Result
5.	Press [up key] to view drive status information when fault occurred. Parameter U2-58 helps determine the cause of a fault. Parameters to be monitored differ depending on the control mode.	➡	

◆ 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 when the error code is displayed.	
Resetting via Fault Reset Digital Input S4	Close then open the fault signal digital input via terminal S4. S4 is set for “Fault Reset” as default (H1-04 = 14).	
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.		

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.

5.10 Troubleshooting without Fault Display

This section describes troubleshooting problems that do not trip an alarm or fault.

The following symptoms indicate that the drive is not set correctly for proper performance with the motor. ***Refer to Motor Performance Fine-Tuning on page 194*** for guidance on troubleshooting.

- Motor hunting and oscillation
- Poor motor torque
- Poor speed precision
- Poor motor torque and speed response
- Motor noise

◆ Common Problems

◆ Cannot Change Parameter Settings

Cause	Possible Solutions
The drive is running the motor (i.e., the Run command is present).	• Stop the drive and switch over to the Programming Mode. • Most parameters cannot be edited during run.
The Access Level is set to restrict access to parameter settings.	• Set the Access Level to allow parameters to be edited (A1-01 = 2).
The operator is not in the Parameter Setup Mode (the screen will display "PAr").	• See what mode the operator is currently set for. • Parameters cannot be edited when in the Setup Mode ("STUP"). Switch modes so that "PAr" appears on the screen. ***Refer to The Drive, Programming, and Clock Adjustment Modes on page 108***.
A multi-function contact input terminal is set to allow or restrict parameter editing (H1-01 through H1-08 = 1B).	• When the terminal is open, parameters cannot be edited. • Turn on the multi-function contact input set to 1B.

Cause	Possible Solutions
The wrong password was entered.	• If the password entered to A1-04 does not match the password saved to A1-05, then drive settings cannot be changed. • Reset the password. If you cannot remember the password: • Scroll to A1-04. Press STOP and ∧ simultaneously. Parameter A1-05 will appear. • Set a new password to parameter A1-05.
Undervoltage was detected.	• Check the drive input power voltage by looking at the control circuit voltage (U1-07). • Check all main circuit wiring.

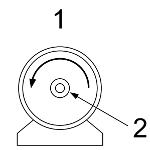
◆ Motor Does Not Rotate Properly after Pressing AUTO Button or after Entering External Run Command

■ Motor Does Not Rotate

Cause	Possible Solutions
The drive is not in the Drive Mode.	• Check if the DRV light on the HOA keypad is lit. • Enter the Drive Mode to begin operating the motor. ***Refer to The Drive, Programming, and Clock Adjustment Modes on page 108***.
The HAND button was pressed.	Stop the drive and check if the correct frequency reference source is selected. If the operator keypad shall be the source, the HAND button LED must be on. If the source is REMOTE, it must be off. Press the HAND button to solve the problem.
Auto-Tuning has just completed.	• When Auto-Tuning completes, the drive is switched back to the Programming Mode. The Run command will not be accepted unless the drive is in the Drive Mode. • Use the HOA keypad to enter the Drive Mode. ***Refer to The Drive, Programming, and Clock Adjustment Modes on page 108***.
A Fast Stop was executed and has not yet been reset.	Reset the Fast Stop command.
Settings are incorrect for the source that provides the Run command.	Check parameter b1-02 (Run Command Selection). Set b1-02 so that it corresponds with the correct Run command source. 0: HOA keypad 1: Control circuit terminal (default setting) 2: MEMOBUS/Modbus communications 3: Option card
There is faulty wiring in the control circuit terminals.	• Check the wiring for the control terminal. • Correct wiring mistakes. • Check the input terminal status monitor (U1-10).
The drive has been set to accept the frequency reference from the incorrect source.	Check parameter b1-01 (Frequency Reference Selection 1). Set b1-01 to the correct source of the frequency reference. 0: HOA keypad 1: Control circuit terminal (default setting) 2: MEMOBUS/Modbus communications 3: Option card
The terminal set to accept the main speed reference is set to the incorrect voltage and/or current.	Check parameter H3-01 for the correct signal level selection when setting the frequency reference at terminal A1. Check parameter H3-08 when using terminals A2 or A3. ***Refer to Terminals A1, A2, and A3 Input Signal Selection on page 85*** for details.
Selection for the sink/source mode and the internal/external power supply is incorrect.	Check wire jumper connection between terminals SC and SP. ***Refer to Sinking/Sourcing Mode for Digital Inputs on page 85***.
Frequency reference is too low.	• Check the frequency reference monitor (U1-01). • Increase the frequency by changing the maximum output frequency (E1-09).
Multi-function analog input is set up to accept gain for the frequency reference, but no voltage (current) has been provided.	• Check the multi-function analog input settings. • Check if analog input A1, A2, or A3 is set for frequency reference gain (H3-02, H3-10, H3-06 = 1). If so, check if the correct signal is applied to the terminal. The gain and the frequency reference will be 0 if no signal is applied to the gain input. • Check if H3-02, H3-10, and H3-06 have been set to the proper values. • Check if the analog input value has been set properly. (U1-13 to U1-15)
The OFF button was pressed when the drive was started from a REMOTE source.	• Pressing the OFF button will decelerate the drive to stop. • Switch off the Run command and then re-enter a new Run command. • Set o2-02 to 0 to disable the OFF button.
Motor starting torque is too low.	***Refer to Motor Performance Fine-Tuning on page 194***.

Cause	Possible Solutions
Frequency reference value is too low or the drive does not accept the value entered.	Enter a value that is above the minimum output frequency determined by E1-09.
The sequence Start/Stop sequence is set up incorrectly.	• If the drive is supposed to be set up for a 2-wire sequence, then ensure parameters H1-03 through H1-08 are not set to 0. • If the drive is supposed to be set up for a 3-wire sequence, then one of the parameters H1-03 through H1-08 must be set to 0. Terminal S1 will become the Start, terminal S2 will become the Stop input.

■ Motor Rotates in the Opposite Direction from the Run Command

Cause	Possible Solutions
Phase wiring between the drive and motor is incorrect.	• Check the motor wiring. • Switch two motor cables (U, V, and W) to reverse motor direction. • Connect drive output terminals U/T1, V/T2, and W/T3 in the right order to match motor terminals U, V, and W. • Change the setting of parameter b1-14.
The forward direction for the motor is set up incorrectly.	Typically, forward is designated as being counterclockwise when looking from the motor shaft (see figure below).  1. Forward Rotating Motor (looking down the motor shaft) 2. Motor Shaft
The motor is running at almost 0 Hz and the Speed Search estimated the speed to be in the opposite direction.	• Disable bi-directional search (b3-14 = 0) so that Speed Search is performed only in the specified direction.

Note: Check the motor specifications for the forward and reverse directions. The motor specifications will vary depending on the manufacturer of the motor.

■ Motor Rotates in One Direction Only

Cause	Possible Solutions
The drive prohibits reverse rotation.	• Check parameter b1-04. • Set parameter b1-04 to 0 to allow the motor to rotate in reverse.
A Reverse run signal has not been entered, although 3-Wire sequence is selected.	• Make sure that one of the input terminals S3 to S8 used for the 3-Wire sequence has been set for reverse.

◆ Motor is Too Hot

Cause	Possible Solutions
The load is too heavy.	If the load is too heavy for the motor, the motor will overheat as it exceeds its rated torque value for an extended period of time. Keep in mind that the motor also has a short-term overload rating in addition to the possible solutions provided below: • Reduce the load. • Increase the acceleration and deceleration times. • Check the values set for the motor protection (L1-01, L1-02) as well as the motor rated current (E2-01). • Increase motor capacity.
The air around the motor is too hot.	• Check the ambient temperature. • Cool the area until it is within the specified temperature range.
The drive is operating in a vector control mode but Auto-Tuning has not yet been performed.	• Perform Auto-Tuning. • Calculate the motor value and reset the motor parameters. • Change the motor control method to V/f Control (A1-02 = 0).

Cause	Possible Solutions
Insufficient voltage insulation between motor phases.	When the motor cable is long, high voltage surges occur between the motor coils and drive switching. Normally, surges can reach up to three times the drive input power supply voltage. • Use a motor with a voltage tolerance higher than the maximum voltage surge. • Use an inverter-duty motor rated for use with AC drives when using the motor on drives rated higher than 200 V class.
The motor fan has stopped or is clogged.	Check the motor fan.
The carrier frequency is too low.	Increase the carrier frequency to lower the current harmonic distortion and lower the motor temperature.

◆ Drive Does Not Allow Selection of the Desired Auto-Tuning Mode

Cause	Possible Solutions
The desired Auto-Tuning mode is not available for the selected control mode.	• Check if the desired tuning mode is available for the selected control mode. ***Refer to Auto-Tuning on page 139***. • Change the motor control method by setting A1-02.

◆ oPE02 Error Occurs When Lowering the Motor Rated Current Setting

Cause	Possible Solutions
Motor rated current and the motor no-load current setting in the drive are incorrect.	• The user is trying to set the motor rated current in E2-01 to a value lower than the no-load current set in E2-03. • Make sure that value set in E2-01 is higher than E2-03. • If it is necessary to set E2-01 lower than E2-03, first lower the value set to E2-03, then change the setting in E2-01 as needed.

◆ Motor Stalls during Acceleration or Acceleration Time is Too Long

Cause	Possible Solutions
Torque limit has been reached or current suppression keeps the drive from accelerating.	Take the following steps to resolve the problem: • Reduce the load. • Increase motor capacity. **Note:** Although the drive has a Stall Prevention function and a Torque Compensation Limit function, accelerating too quickly or trying to drive an excessively large load can exceed the capabilities of the motor.
Load is too heavy.	
Torque limit is not set properly.	Check the torque limit setting.
Frequency reference is too low.	• Check the maximum output frequency (E1-04). • Increase E1-04 if it is set too low.
	Check U1-01 for proper frequency reference.
	Check if a frequency reference signal switch has been set to one of the multi-function input terminals.
	Check for low gain level set to terminals A1, A2, or A3 (H3-03, H3-11, H3-07).
Load is too heavy.	• Reduce the load so that the output current remains within the motor rated current. • In extruder and mixer applications, the load will sometimes increase as the temperature drops.
	• Increase the acceleration time. • Check if the mechanical brake is fully releasing as it should.
Acceleration time has been set too long.	Check if the acceleration time parameters have been set too long (C1-01, C1-03, C1-05, C1-07).
Motor characteristics and drive parameter settings are incompatible with one another.	• Set the correct V/f pattern so that it matches the characteristics of the motor being used. • Check the V/f pattern set to E1-03. • Execute Rotational Auto-Tuning.
Although the drive is operating in Open Loop Vector motor control method, Auto-Tuning has not been performed.	• Perform Auto-Tuning. • Calculate motor data and reset motor parameters. • Switch to V/f Control (A1-02 = 0).

Cause	Possible Solutions
Incorrect frequency reference setting.	• Check the multi-function analog input settings. Multi-function analog input terminal A1, A2, or A3 is set for frequency gain (H3-02, H3-10, or H3-06 is set to "1"), but there is no voltage or current input provided. • Make sure H3-02, H3-10, and H3-06 are set to the proper values. • See if the analog input value is set to the right value (U1-13 to U1-15).
The Stall Prevention level during acceleration and deceleration set too low.	• Check the Stall Prevention level during acceleration (L3-02). • If L3-02 is set too low, acceleration may be taking too long. • Increase L3-02.
The Stall Prevention level during run has been set too low.	• Check the Stall Prevention level during run (L3-06). • If L3-06 is set too low, speed will drop as the drive outputs torque. • Increase the setting value.
Drive reached the limitations of the V/f motor control method.	• The motor cable may be long enough (over 50 m) to require Auto-Tuning for line-to-line resistance. • Be aware that V/f Control is comparatively limited when it comes to producing torque at low speeds. • Consider switching to Open Loop Vector Control.

◆ Drive Frequency Reference Differs from the Controller Frequency Reference Command

Cause	Possible Solutions
The analog input gain and bias for the frequency reference input are set to incorrect values.	• Check the gain and bias settings for the analog inputs that are used to set the frequency reference. Check parameters H3-03 and H3-04 for input A1, check parameters H3-11, and H3-12 for input A2, and check parameters H3-07 and H3-08 for input A3. • Set these parameters to the appropriate values.
A frequency bias signal is being entered via analog input terminals A1 to A3.	• If more than one of multi-function analog inputs A1 to A3 is set for frequency reference bias (H3-02, H3-10, or H3-06 is set to "0"), then the sum of all signals builds the frequency reference. • Make sure that H3-02, H3-10, and H3-06 are set appropriately. • Check the input level set for terminals A1 to A3 (U1-13 to U1-15).
PID control is enabled, and the drive is consequently adjusting the output frequency to match the PID setpoint. The drive will only accelerate to the maximum output frequency set in E1-04 while PID control is active.	If PID control is not necessary for the application, disable it by setting b5-01 to 0.

◆ Excessive Motor Oscillation and Erratic Rotation

Cause	Possible Solutions
Poor balance between motor phases.	Check drive input power voltage to ensure that it provides stable power.
Hunting prevention function is disabled.	Set n1-01 to 1 to enable Hunting Prevention.

◆ Deceleration Takes Longer than Expected

Cause	Possible Solutions
L3-04 is set incorrectly.	Check the Stall Prevention level during deceleration (L3-04).
The deceleration time is set too long.	Set deceleration to more appropriate time (C1-02 and C1-04).
Insufficient motor torque.	• Assuming parameter settings are normal and that no overvoltage occurs when there is insufficient torque, it is likely that the demand on the motor has exceeded the motor capacity. • Use a larger motor.
Load exceeded the internal torque limit determined by the drive rated current.	Switch to a larger capacity drive.

◆ Noise From Drive or Motor Cables When the Drive is Powered On

Cause	Possible Solutions
Relay switching in the drive generates excessive noise.	• Lower the carrier frequency (C6-02). • Install a noise filter on the input side of drive input power. • Install a noise filter on the output side of the drive. • Place the wiring inside a metal conduit to shield it from switching noise. • Ground the drive and motor properly. • Separate the main circuit wiring and the control lines. • Make sure wires and the motor have been properly grounded.

◆ Ground Fault Circuit Interrupter (GFCI) Trips During Run

Cause	Possible Solutions
Excessive leakage current trips GFCI.	• Check the wiring and rating of peripheral devices. • Increase the GFCI sensitivity or use GFCI with a higher threshold. • Lower the carrier frequency (C6-02). • Reduce the length of the cable used between the drive and the motor. • Disable the internal EMC filter.

◆ Connected Machinery Vibrates When Motor Rotates

■ Unexpected Noise from Connected Machinery

Cause	Possible Solutions
The carrier frequency is at the resonant frequency of the connected machinery.	Adjust the carrier frequency using parameters C6-02 through C6-05.
The drive output frequency is the same as the resonant frequency of the connected machinery.	• Adjust the parameters used for the Jump Frequency function (d3-01 through d3-04) to skip the problem-causing bandwidth. • Place the motor on a rubber pad to reduce vibration.

■ Oscillation or Hunting

Cause	Possible Solutions
Insufficient tuning.	Perform Auto-Tuning. *Refer to Motor Performance Fine-Tuning on page 194*.
Gain is too low when using PID control.	Refer to the Programming Manual for details.
The frequency reference is assigned to an external source and the signal is noisy.	• Ensure that noise is not affecting the signal lines. • Separate main circuit wiring and control circuit wiring. • Use twisted-pair cables or shielded wiring for the control circuit. • Increase the analog input time filter constant (H3-13).
The cable between the drive and motor is too long.	• Perform Auto-Tuning. • Reduce the length of the cable.

◆ PID Output Fault

Cause	Possible Solutions
No PID feedback input.	• Check the multi-function analog input terminal settings. • Set multi-function analog input terminal A1, A2, or A3 for PID feedback (H3-02, H3-10, or H3-06 = B). • A signal input to the terminal selection for PID feedback is needed. • Check the connection of the feedback signal. • Check the various PID-related parameter settings. • No PID feedback input to the terminal causes the value detected to be 0, causing a PID fault and the drive to operate at max frequency.
The level of detection and the target value do not correspond with each other.	• PID control keeps the difference between target and detection values at 0. Set the input level for the values relative to one another. • Use analog input gains H3-03, H3-07, and H3-11 to adjust PID target and feedback signal scaling.

Cause	Possible Solutions
Reverse drive output frequency and speed detection. When output frequency rises, the sensor detects a speed decrease.	Set PID output for reverse characteristics (b5-09 = 1).
Adjustment made to PID parameter settings are insufficient.	*Refer to b5: PID Control on page 267* for details.

◆ Motor Rotates after the Drive Output is Shut Off (Motor Rotates During DC Injection Braking)

Cause	Possible Solutions
DC Injection Braking is set too low and the drive cannot decelerate properly.	• Adjust the DC Injection braking settings. • Increase the current level for DC Injection Braking Current (b2-02). • Increase the DC Injection Braking time at stop (b2-04).
The stopping method is set so that the drive coasts to stop.	Set b1-03 (Stopping Method Selection) to 0 or 2.

◆ Output Frequency is Not as High as Frequency Reference

Cause	Possible Solutions
Frequency reference is set within the range of the Jump Frequency.	• Adjust the parameters used for the Jump Frequency function (d3-01, d3-02, d3-03). • Enabling the Jump Frequency prevents the drive from outputting the frequencies specified in the Jump range.
Upper limit for the frequency reference has been exceeded.	• Set the maximum output frequency and the upper limit for the frequency reference to more appropriate values (E1-04, d2-01). • The following calculation yields the upper value for the output frequency: E1-04 x d2-01 / 100
Large load triggered Stall Prevention function during acceleration.	• Reduce the load. • Adjust the Stall Prevention level during acceleration (L3-02).

◆ Sound from Motor

Cause	Possible Solutions
Exceeded 110% of the rated output current of the drive while operating at low speeds.	• If the output current rises too high at low speeds, the carrier frequency is automatically reduced and causes a whining or buzzing sound. • If the sound is coming from the motor, disable carrier frequency derating (L8-38 = 0). • Disabling the automatic carrier frequency derating increases the chances of an overload fault (oL2). Switch to a larger capacity motor if oL2 faults occur too frequently.

◆ Unstable Motor Speed when Using PM

Cause	Possible Solutions
Drive is attempting to operate the motor beyond the speed control range listed in the specifications.	Check the speed control range and adjust the speed accordingly.
Drive is attempting to operate the motor at 5% or less of the speed reference value.	Use an alternative motor.
Motor hunting occurs.	*Refer to Motor Performance Fine-Tuning on page 194* for details.
Hunting occurs at start.	Increase the S-curve time at the start of acceleration (C2-01).
Too much current is flowing through the drive.	• Use alternative motor if the drive is attempting to operate the motor at 5% or less of the speed reference value. • For special-purpose motors, enter the correct data to all E5 parameters according to the test report provided for the motor.

◆ Motor Does Not Restart after Power Loss

Cause	Possible Solutions
The Run command was not issued again when power was restored.	• Check the sequence and wiring that has been set up to enter the Run command. • A relay should be set up to make sure the Run command remains enabled throughout any power loss.
The relay that is supposed to maintain the Run command has been switched off.	Check wiring and circuitry for the relay intended to keep the Run command enabled.

◆ The Safety Controller Does Not Recognize Safe Disable Monitor Output Signals (Terminals DM+ and DM-)

Cause	Possible Solutions
There is faulty wiring in the Safe Disable monitor output terminals.	• Check the Safe Disable monitor output terminal wiring. • Correct any wiring mistakes.

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6

Peripheral Devices & Options

This chapter explains the installation of peripheral devices and options available for the drive.

6.1 Section Safety

DANGER

Electrical Shock Hazard

Before servicing, disconnect all power to the equipment.

The capacitor for the control power supply remains charged even after the power supply is turned off. The charge indicator LED will extinguish when the DC bus voltage is below 50 Vdc. To prevent electric shock, wait for at least the time specified on the warning label, once all indicators are OFF, measure for unsafe voltages to confirm the drive is safe prior to servicing.

Failure to comply will result in death or serious injury.

WARNING

Electrical Shock Hazard

Do not operate equipment with covers removed.

Failure to comply could result in death or serious injury.

The diagrams in this section may show drives without covers or safety shields to show details. Be sure to reinstall covers or shields before operating the drives and run the drives according to the instructions described in this manual.

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

Failure to comply could result in death or serious injury.

Do not allow unqualified personnel to perform work on the drive.

Failure to comply could result in death or serious injury.

Installation, maintenance, inspection, and service must be performed only by authorized personnel familiar installation, adjustment, and maintenance of drives.

Do not perform work on the drive while wearing loose clothing, jewelry or without eye protection.

Failure to comply could result in death or serious injury.

Remove all metal objects such as watches and rings, secure loose clothing and wear eye protection before beginning work on the drive.

Always ground the motor-side grounding terminal.

Improper equipment grounding could result in death or serious injury by contacting the motor case.

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

Failure to comply could result in death or serious injury.

Do not use damaged wires, place excessive stress on wiring, or damage the wire insulation.

Failure to comply could result in death or serious injury.

Fire Hazard

Tighten all terminal screws to the specified tightening torque.

Loose electrical connections could result in death or serious injury by fire due to overheating of electrical connections.

Do not use an improper voltage source.

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

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

Do not use improper combustible materials.

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

Attach the drive to metal or other noncombustible material.

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.

Never connect or disconnect the motor from the drive while the drive is outputting voltage.

Improper equipment sequencing could result in damage to the drive.

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 or 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.

Do not operate damaged equipment.

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

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

Do not use unshielded wire for control wiring.

Failure to comply may cause electrical interference resulting in poor system performance. Use shielded twisted-pair wires and ground the shield to the ground terminal of the drive.

Properly connect all pins and connectors.

Failure to comply may prevent proper operation and possibly damage equipment.

Check all the wiring to ensure that all connections are correct after installing the option and connecting any other devices.

Failure to comply could result in damage to the option.

6.2 Drive Options and Peripheral Devices

Table 6.1 lists the names of the various peripheral devices, accessories, and options available for Yaskawa drives. Contact Yaskawa or your Yaskawa agent to order these peripheral devices.

- **Peripheral Device Selection**: Refer to the Yaskawa catalog for selection and part numbers.
- **Peripheral Device Installation**: Refer to the corresponding option manual for installation instructions.

Table 6.1 Available Peripheral Devices

Option	Model Number	Description
Input/Output Option Cards		
Analog Input	AI-A3	• Allows high precision, high resolution analog reference input • Input channels: 3 • Voltage input: -10 to 10 Vdc (20 kΩ), 13-bit signed • Current input: 4 to 20 mA or 0 to 20 mA (250 Ω), 12-bit
Analog Monitor	AO-A3	• Provides extra multi-function analog output terminals • Output channels: 2 • Output voltage: -10 to 10 V, 11-bit (signed)
Digital Input	DI-A3	• Sets the frequency reference by digital inputs • Input channels: 18 (including SET signal and SIGN signal) • Input signal type: BCD 16-bit (4-digit), 12-bit (3-digit), 8-bit (2-digit) • Input signal: 24 Vdc, 8 mA
Digital Output	DO-A3	• Provides extra insulated multi-function digital outputs • Photocoupler relays: 6 (48 V, up to 50 mA) • Contact relays: 2 (250 Vac/up to 1 A, 30 Vdc/up to 1 A)
Communication Option Cards		
EtherNet/IP	SI-EN3	Connects to an EtherNet/IP network.
Modbus TCP/IP	SI-EM3	Connects to a Modbus TCP/IP network.
PROFINET	SI-EP3	Connects to a PROFINET network.
LonWorks	SI-W3	Connects to a LonWorks network.
DeviceNet	SI-N3	Connects to a DeviceNet network
PROFIBUS-DP	SI-P3	Connects to a PROFIBUS-DP network.
MECHATROLINK-II	SI-T3	Connects to a MECHATROLINK-II network.
MECHATROLINK-III	SI-ET3	Connects to a MECHATROLINK-III network.
BACnet	SI-B3	Connects to a BACnet MS/TP network.
EtherCAT	SI-ES3	Connects to an EtherCAT network.
CC-Link <1>	SI-C3	Connects to a CC-Link network.
CANopen <1>	SI-S3	Connects to a CANopen network.
BACnet/IP	JOHB-SMP3	Connects to a BACnet/IP network.
Interface Options		
Remote Control Extension Cable	UWR000051, 1 m cable UWR000052, 2 m cable	RJ-45, 8-pin straight through, UTP CAT5e, extension cable (1 m or 2 m) to connect the digital operator for remote operation.
USB Copy Unit	JVOP-181	• Allows the user to copy and verify parameter settings between drives. • Functions as an adapter to connect the drive to a USB port on a PC.
Mechanical Options		
Attachment for External Heatsink	EZZ022706	Installation kit for mounting the drive with the heatsink outside of the panel.
UL Type 1 Kit	EZZ022745	Parts to make the drive conform to IP20/UL Type 1 enclosure requirements.
UL Type 1, 4, 12 Blank Keypad Kit	UUX0000526	Provides digital operator functionality on an enclosure designed for IP20/UL Type 1, 3R, 4, 4X, 12, or IP□6 environment. This keypad has a blank label on the front.
UL Type 1, 4, 12 Yaskawa Logo Keypad Kit	UUX0000527	Provides digital operator functionality on an enclosure designed for IP20/UL Type 1, 3R, 4, 4X, 12, or IP□6 environment. This keypad has a Yaksawa brand label on the front.

<1> Limited support. Contact a Yaskawa representative or the nearest Yaskawa sales office for assistance.

6.3 Connecting Peripheral Devices

Figure 6.1 illustrates how to configure the drive and motor to operate with various peripheral devices.

Refer to the specific manual for the devices shown below for more detailed installation instructions.

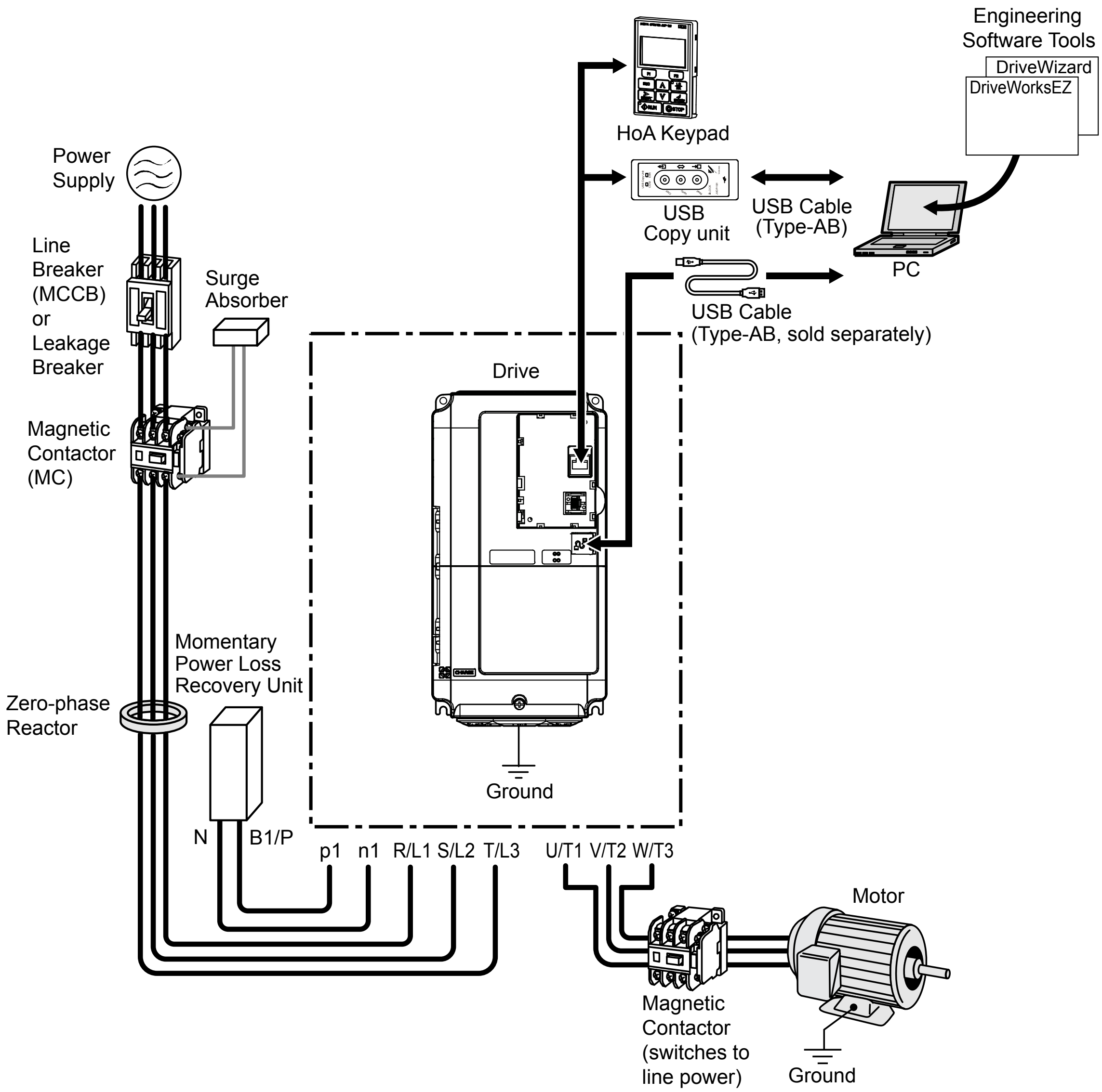


Figure 6.1 Connecting Peripheral Devices

Note: If the drive is set to trigger a fault output when the fault restart function is activated (L5-02 = 1), then a sequence to interrupt power when a fault occurs will turn off the power to the drive while the drive attempts to restart. The default setting for L5-02 is 0 (fault output active during restart).

NOTICE: *Damage to Equipment. Do not connect an Ethernet cable to the RJ-45 keypad port of the drive. Damage to your PC port may occur if you directly connect an Ethernet cable from the RJ-45 port on the drive to your PC port. Contact Yaskawa for specific methods of connecting to your drive using your PC.*

6.4 Option Installation

This section provides instructions on installing the options in *Table 6.2*.

◆ Prior to Installing the Option

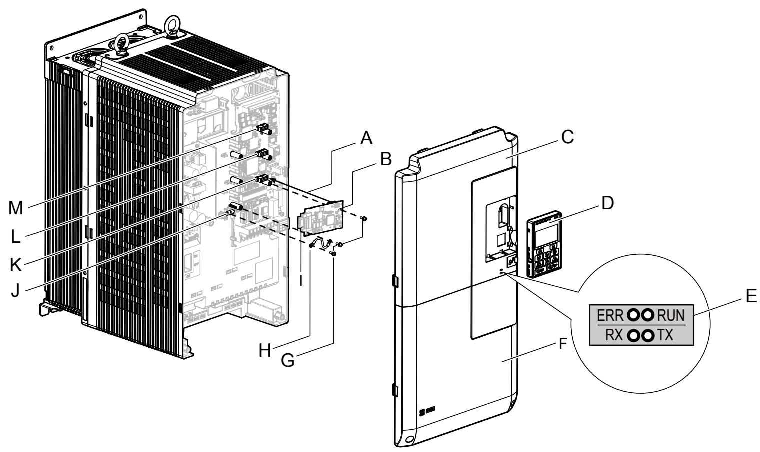
Prior to installing the option, wire the drive, make necessary connections to the drive terminals, and verify that the drive functions normally without the option installed.

Table 6.2 below lists the number of options that can be connected to the drive and the drive ports for connecting those options.

Table 6.2 Option Installation

Option	Port/Connector	Number of Options Possible
AO-A3, DO-A3	CN5-A, B, C	1
SI-B3, SI-C3, SI-EN3, SI-EM3, SI-EP3, SI-ES3, JOHB-SMP3 SI-ET3, SI-N3, SI-P3, SI-S3, SI-T3, SI-W3, AI-A3, DI-A3	CN5-A	1

Figure 6.2 shows an exploded view of the drive with the option and related components for reference.



A – Insertion point for CN5
B – Option card
C – Front cover
D – HOA keypad
E – LED label
F – Terminal cover
G – Included screws
H – Ground wire
I – Option modular connector
J – Drive grounding terminal (FE)
K – Connector CN5-A
L – Connector CN5-B
M – Connector CN5-C

Figure 6.2 Drive Components with Option

◆ Installing the Option

Refer to the instructions below to install the option.

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 capacitor for the control power supply remains charged even after the power supply is turned off. The charge indicator LED will extinguish when the control power supply voltage is below 50 Vdc. To prevent electric shock, wait at least five minutes after all indicators are off and measure the control circuit DC voltage level to confirm safe level.*

WARNING! *Electrical Shock Hazard. Do not allow unqualified personnel to perform work on the drive. 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 and Option Cards.*

NOTICE: *Damage to Equipment. Observe proper electrostatic discharge procedures (ESD) when handling the option card, drive, and circuit boards. Failure to comply may result in ESD damage to circuitry.*

NOTICE: *Damage to Equipment. Tighten all terminal screws to the specified tightening torque. Failure to comply may cause the application to operate incorrectly or damage the drive.*

1. Shut off power to the drive, wait the appropriate amount of time for voltage to dissipate, then remove the HOA keypad (E) and front covers (D, F). Front cover removal varies by model.

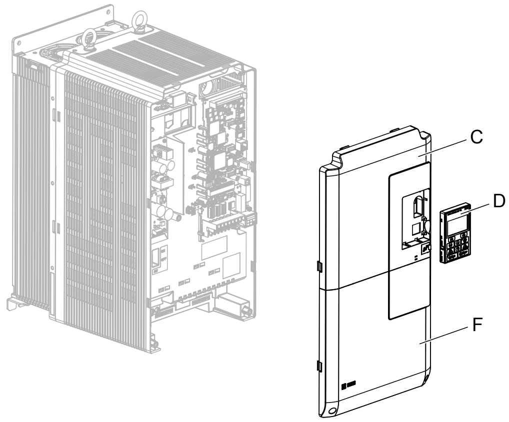


Figure 6.3 Remove the Front Covers and HOA Keypad

2. With the front covers and HOA keypad removed, apply the LED label (E) in the appropriate position on the unit top front cover (C).

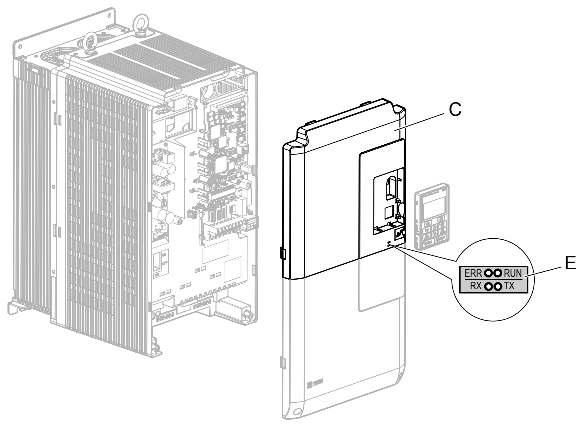


Figure 6.4 Apply the LED Label

3. Insert the option (B) into the **CN5-A** connector (K) located on the drive and fasten it using one of the included screws (G). Refer to ***Table 6.2*** for more information.

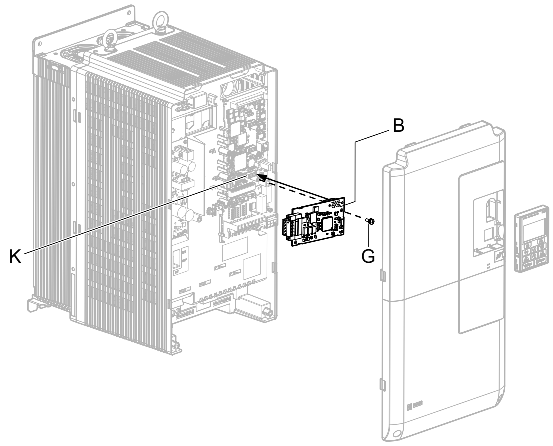


Figure 6.5 Insert the Option

4. Connect the ground wire (H) to the ground terminal (J) using one of the remaining provided screws (G). Connect the other end of the ground wire (H) to the remaining ground terminal and installation hole on the option (B) using the last remaining provided screw (G) and tighten both screws to 0.5 to 0.6 N m or (4.4 to 5.3 in lbs).

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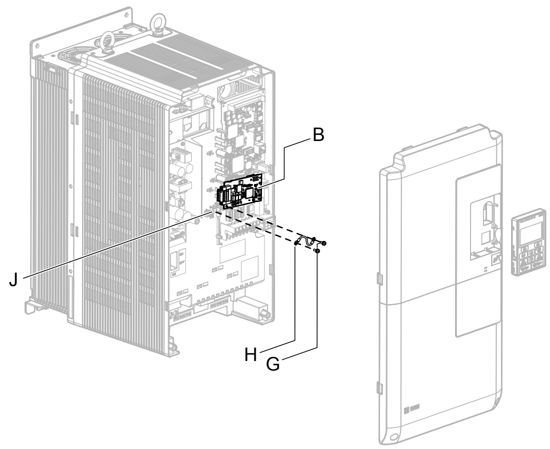


Figure 6.6 Connect the Ground Wire

Note:
1. The option package includes two ground wires. Use the longer wire when plugging the option into connector CN5-C on the drive side. Use the shorter wire when plugging the option into connector CN5-B. Refer to the Option Installation manual for more information.
2. There are two screw holes on the drive for use as ground terminals (H). When connecting three options, two ground wires will need to share the same drive ground terminal.

Replacing the Drive Covers and HOA Keypad and Checking for Proper Motor Rotation

1. Route the communication wiring inside the enclosure as shown in ***Figure 6.7***.

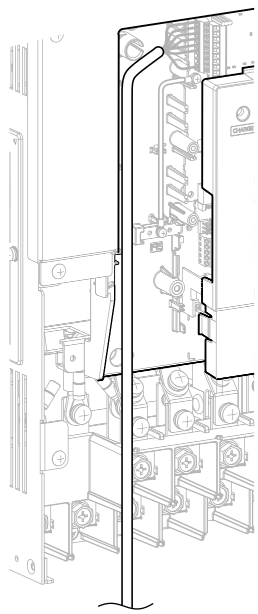


Figure 6.7 Wire Routing Examples

2. Replace and secure the front covers of the drive (C, F) and replace the HOA keypad (D).

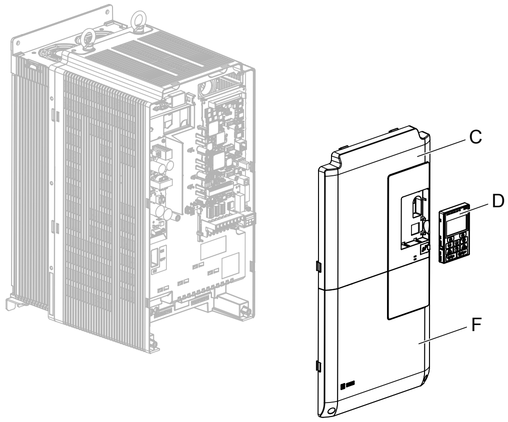


Figure 6.8 Replace the Front Covers and HOA Keypad

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.

6.5 Installing Peripheral Devices

This section describes the proper steps and precautions to take when installing or connecting various peripheral devices to the drive.

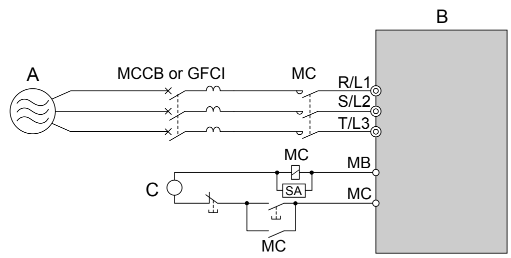
NOTICE: *Use a class 2 power supply when connecting to the control terminals. Improper application of peripheral devices could result in drive performance degradation due to improper power supply. Refer to NEC Article 725 Class 1, Class 2, and Class 3 Remote-Control, Signaling, and Power Limited Circuits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

◆ Installing a Molded Case Circuit Breaker (MCCB) or Ground Fault Circuit Interrupter (GFCI)

Install an MCCB or GFCI for line protection between the power supply and the main circuit power supply input terminals R/L1, S/L2, and T/L3. This protects the main circuit and devices wired to the main circuit while also providing overload protection.

Consider the following when selecting and installing an MCCB or GFCI:

- Use an MCCB or GFCI to keep the drive from faulting out instead of using overheat protection (110% for one minute at the rated output current).
- If several drives are connected to one MCCB or GFCI that is shared with other equipment, use a sequence that shuts the power OFF when errors are output by using magnetic contactor (MC) as shown in *Figure 6.9*.



A – Power supply
B – Drive
C – Control power supply

Figure 6.9 Power Supply Interrupt Wiring (Example)

WARNING! *Electrical Shock Hazard. Disconnect the MCCB (or GFCI) and MC before wiring terminals. Failure to comply may result in serious injury or death.*

■ Application Precautions when Installing a GFCI

Drive outputs generate high-frequency leakage current as a result of high-speed switching. Install a GFCI on the input side of the drive to switch off potentially harmful leakage current.

Factors in determining leakage current:

- Size of the AC drive
- AC drive carrier frequency
- Motor cable type and length
- EMI/RFI filter

If the GFCI trips spuriously, consider changing these items or use a GFCI with a higher trip level.

Note: Choose a GFCI designed specifically for an AC drive. The operation time should be at least 0.1 s with sensitivity amperage of at least 200 mA per drive. The output waveform of the drive and built-in EMC filter may cause an increase in leakage current. This may in turn cause the leakage breaker to malfunction. Increase the sensitivity amperage or lower the carrier frequency to correct the problem.

◆ Installing a Magnetic Contactor at the Power Supply Side

Install a magnetic contactor (MC) to the drive input for the purposes explained below.

■ Disconnecting the Power Supply

Shut off the drive with an MC when a fault occurs in external equipment.

NOTICE: *Do not connect electromagnetic switches or MCs to the output motor circuits without proper sequencing. Improper sequencing of output motor circuits could result in damage to the drive.*

NOTICE: *Install an MC on the input side of the drive when the drive should not automatically restart after power loss. To get the full performance life out of the capacitor for the control power supply 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.*

NOTICE: *Use a magnetic contactor (MC) to ensure that power to the drive can be completely shut off when necessary. The MC should be wired so that it opens when a fault output terminal is triggered.*

Note:
1. Install an MC to the drive input side to prevent the drive from restarting automatically when power is restored after momentary power loss.
2. Set up a delay that prevents the MC from opening prematurely to continue operating the drive through a momentary power loss.

◆ Connecting a Surge Absorber

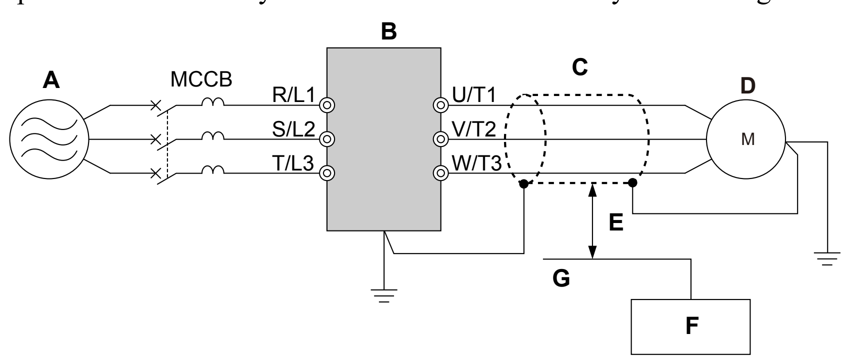
A surge absorber suppresses surge voltage generated from switching an inductive load near the drive. Inductive loads include magnetic contactors, relays, valves, solenoids, and brakes. Always use a surge absorber or diode when operating with an inductive load.

WARNING! *Fire Hazard. Due to surge absorber short circuit on drive output terminals U/T1, V/T2, and W/T3, do not connect surge absorbers to the drive output power terminals. Failure to comply may result in serious injury or death by fire or flying debris.*

◆ Reducing Noise

■ Preventing Induced Noise

Use shielded cables or zero phase reactors and lay the cables at least 30 cm away from the signal line to prevent induced noise.



A – Power supply
B – Drive
C – Shielded motor cable
D – Motor
E – Separate at least 30 cm
F – Controller
G – Signal line

Figure 6.10 Preventing Induced Noise

■ Reducing Noise Using Internal EMC Filter Models

Models ZU□E□□□□ and ZU□W□□□□ contain a built-in EMC filter. These drives comply with EMC guidelines IEC/EN 61800-3 2nd Environment Category C2. Use switches on the drive to enable the EMC filters. ***Refer to Enable the Internal EMC Filter on page 87*** for details.

◆ Attachment for External Heatsink Mounting

An external attachment can be used to project the heatsink outside of an enclosure to ensure that there is sufficient air circulation around the heatsink.

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◆ Internal EMC Filter Model Installation

Internal EMC filter models (ZU□E□□□□ and ZU□W□□□□) are tested according to IEC/EN 61800-3 2nd Environment Category C2 and comply with the EMC guidelines. *Refer to Enable the Internal EMC Filter on page 87* for details about EMC filter selection and installation.

◆ Installing a Motor Thermal Overload (oL) Relay on the Drive Output

Motor thermal overload relays protect the motor by disconnecting power lines to the motor due to a motor overload condition.

Install a motor thermal overload relay between the drive and motor:

- When operating multiple motors on a single AC drive.
- When using a power line bypass to operate the motor directly from the power line.

It is not necessary to install a motor thermal overload relay when operating a single motor from a single AC drive. The AC drive has UL recognized electronic motor overload protection built into the drive software.

Note:
1. Disable the motor protection function (L1-01 = 0) when using an external motor thermal overload relay.
2. Create a sequence to produce an external fault (coast to a stop) when triggered.

■ General Precautions when Using Thermal Overload Relays

Consider the following application precautions when using motor thermal overload relays on the output of AC drives to prevent nuisance trips or overheat of the motor at low speeds:

- Low speed motor operation
- Use of multiple motors on a single AC drive
- Motor cable length
- Nuisance tripping resulting from high AC drive carrier frequency

Low Speed Operation and Motor Thermal oL Relays

Generally, thermal relays are applied on general-purpose motors. When general-purpose motors are driven by AC drives, the motor current is approximately 5% to 10% greater than if driven by a commercial power supply. In addition, the cooling capacity of a motor with a shaft-driven fan decreases when operating at low speeds. Even if the load current is within the motor rated value, motor overheating may occur. A thermal relay cannot effectively protect the motor due to the reduction of cooling at low speeds. For this reason, apply the UL recognized electronic thermal overload protection function built into the drive whenever possible.

Using a Single Drive to Operate Multiple Motors

Set parameter L1-01 to 0 to disable thermal overload protection for the drive.

Note: The UL recognized electronic thermal overload function cannot be applied when operating multiple motors with a single drive.

Long Motor Cables

When a high carrier frequency and long motor cables are used, nuisance tripping of the thermal relay may occur due to increased leakage current. To avoid this, reduce the carrier frequency or increase the tripping level of the thermal overload relay.

Nuisance Tripping Due to a High AC Drive Carrier Frequency

Current waveforms generated by high carrier frequency drives tend to increase the temperature in overload relays. It may be necessary to increase the trip level setting when encountering nuisance triggering of the relay.

WARNING! *Fire Hazard. Confirm an actual motor overload condition is not present prior to increasing the thermal oL trip setting. Check local electrical codes before making adjustments to motor thermal overload settings. Failure to comply could result in death or serious injury.*

Appendix: A

Specifications

A.1 Power Ratings

◆ Three-Phase 200 V Class Drive Models 2□0028 to 2□0081

Table A.1 Power Ratings (Three-Phase 200 V Class)

Item		Specification				
Drive Model		2□0028	2□0042	2□0054	2□0068	2□0081
Maximum Applicable Motor Capacity kW (HP) <1>		7.5 (10)	11 (15)	15 (20)	18.5 (25)	22 (30)
Input/Output Rating	Rated Input Current (A) <2>	25	38	49	62	74
	Rated Input Capacity (kVA) <3>	12	17	22	28	34
	Rated Output Current (A) <4> <5>	28	42	54	68	81
	Overload Tolerance	120% of rated output current for 60 s (Derating may be required for applications that start and stop frequently)				
	Carrier Frequency	4 kHz (User adjustable up to 10 kHz. Derating may be required.)				
	Maximum Output Voltage (V)	Proportional to input voltage <6>				
	Maximum Output Frequency (Hz)	400 Hz (User-adjustable)				
Power Supply	Rated Voltage Rated Frequency	Three-phase 200 to 240 Vac 50/60 Hz				
	Allowable Voltage Fluctuation	-15 to 10%				
	Allowable Frequency Fluctuation	±3% (Frequency fluctuation rate: 1 Hz/100 ms or less)				
	Allowable Phase Power Supply Voltage Unbalance	2% or less				
Harmonic Current Distortion <6>		5% or less (IEEE519 compliant)				
Input Power Factor		0.98 or more (During rated operation)				

<1> The motor capacity (HP) refers to an NEC 4-pole motor. The rated output current of the drive 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 input capacity is calculated with a power line voltage of 240 V × 1.1.

<4> The rated output current of the drive should be equal to or greater than the motor rated current.

<5> Carrier frequency is set to 4 kHz. Current derating is required to raise the carrier frequency.

<6> If the harmonic current distortion should be 5% or less and the maximum output voltage = [input voltage] × 0.87: Change C7-60, Output Voltage Limit Mode Selection, from the default setting.

◆ Three-Phase 200 V Class Drive Models 2□0104 to 2□0248

Table A.2 Power Ratings (Three-Phase 200 V Class) Continued

Item		Specification				
Drive Model		2□0104	2□0130	2□0154	2□0192	2□0248
Maximum Applicable Motor Capacity kW (HP) <1>		30 (40)	37 (50)	45 (60)	55 (75)	75 (100)
Input/Output Rating	Rated Input Current (A) <2>	95	118	140	175	226
	Rated Input Capacity (kVA) <3>	43	54	64	80	103
	Rated Output Current (A) <4> <5>	104	130	154	192	248
	Overload Tolerance	120% of rated output current for 60 s (Derating may be required for applications that start and stop frequently)				
	Carrier Frequency	4 kHz (User adjustable up to 8 kHz. Derating may be required.)				
	Maximum Output Voltage (V)	Proportional to input voltage <6>				
	Maximum Output Frequency (Hz)	400 Hz (User-adjustable)				
Power Supply	Rated Voltage Rated Frequency	Three-phase 200 to 240 Vac 50/60 Hz				
	Allowable Voltage Fluctuation	-15 to 10%				
	Allowable Frequency Fluctuation	±3% (Frequency fluctuation rate: 1 Hz/100 ms or less)				
	Allowable Phase Power Supply Voltage Unbalance	2% or less				
Harmonic Current Distortion <6>		5% or less (IEEE519 compliant)				
Input Power Factor		0.98 or more (During rated operation)				

<1> The motor capacity (HP) refers to an NEC 4-pole motor. The rated output current of the drive 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 input capacity is calculated with a power line voltage of 240 V × 1.1.

<4> The rated output current of the drive should be equal to or greater than the motor rated current.

<5> Carrier frequency is set to 4 kHz. Current derating is required to raise the carrier frequency.

<6> If the harmonic current distortion should be 5% or less and the maximum output voltage = [input voltage] × 0.87: Change C7-60, Output Voltage Limit Mode Selection, from the default setting.

◆ Three-Phase 400 V Class Drive Models 4□0011 to 4□0077

Table A.3 Power Ratings (Three-Phase 400 V Class)

Item		Specification								
Drive Model		4□0011	4□0014	4□0021	4□0027	4□0034	4□0040	4□0052	4□0065	4□0077
Maximum Applicable Motor Capacity kW (HP) <1>		5.5 (7.5)	7.5 (10)	11 (15)	15 (20)	18.5 (25)	22 (30)	30 (40)	37 (50)	45 (60)
Input/ Output Rating	Rated Input Current (A) <2>	10	13	19	25	31	36	47	59	70
	Rated Input Capacity (kVA) <3>	9	12	17	22	28	33	43	54	64
	Rated Output Current (A) <4> <5>	11	14	21	27	34	40	52	65	77
	Overload Tolerance	120% of rated output current for 60 s (Derating may be required for applications that start and stop frequently)								
	Carrier Frequency	4 kHz (User adjustable up to 8 kHz. Derating may be required.)								
	Maximum Output Voltage (V)	Proportional to input voltage <6>								
	Maximum Output Frequency (Hz)	400 Hz (User-adjustable)								
Power Supply	Rated Voltage Rated Frequency	Three-phase 4U□□□□ and 4P□□□□ 380 to 500 Vac 50/60 Hz Three-phase 4E□□□□ and 4W□□□□ 380 to 480 Vac 50/60 Hz								
	Allowable Voltage Fluctuation	-15 to 10%								
	Allowable Frequency Fluctuation	±3% (Frequency fluctuation rate: 1 Hz/100 ms or less)								
	Allowable Phase Power Supply Voltage Unbalance	2% or less								
Harmonic Current Distortion <6>		5% or less (IEEE519 compliant)								
Input Power Factor		0.98 or more (During rated operation)								

<1> The motor capacity (HP) refers to an NEC 4-pole motor. The rated output current of the drive 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 input capacity is calculated with a power line voltage of 480 V × 1.1.

<4> The rated output current of the drive should be equal to or greater than the motor rated current.

<5> Carrier frequency is set to 4 kHz. Current derating is required to raise the carrier frequency.

<6> If the harmonic current distortion should be 5% or less and the maximum output voltage = [input voltage] × 0.87: Change C7-60, Output Voltage Limit Mode Selection, from the default setting.

◆ Three-Phase 400 V Class Drive Models 4□0096 to 4□0414

Table A.4 Power Ratings (Three-Phase 400 V Class) Continued

Item		Specification								
Drive Model		4□0096	4□0124	4□0156	4□0180	4□0216	4□0240	4□0302	4□0361	4□0414
Maximum Applicable Motor Capacity kW (HP) <1>		55 (75)	75 (100)	90 (125)	110 (150)	132 (175)	150 (200)	185 (250)	220 (300)	260 (350)
Input/ Output Rating	Rated Input Current (A) <2>	87	113	142	164	197	218	275	329	377
	Rated Input Capacity (kVA) <3>	80	103	130	150	180	200	251	300	344
	Rated Output Current (A) <4> <5>	96	124	156	180	216	240	302	361	414
	Overload Tolerance	120% of rated output current for 60 s (Derating may be required for applications that start and stop frequently)								
	Carrier Frequency	4 kHz (User adjustable up to 8 kHz. Derating may be required.)		4 kHz (User adjustable up to 6 kHz. Derating may be required.)		4 kHz				
	Maximum Output Voltage (V)	Proportional to input voltage <6>								
	Maximum Output Frequency (Hz)	400 Hz (User-adjustable)								
Power Supply	Rated Voltage Rated Frequency	Three-phase 4U□□□□ and 4P□□□□ 380 to 500 Vac 50/60 Hz Three-phase 4E□□□□ and 4W□□□□ 380 to 480 Vac 50/60 Hz								
	Allowable Voltage Fluctuation	-15 to 10%								
	Allowable Frequency Fluctuation	±3% (Frequency fluctuation rate: 1 Hz/100 ms or less)								
	Allowable Phase Power Supply Voltage Unbalance	2% or less								
Harmonic Current Distortion <6>		5% or less (IEEE519 compliant)								
Input Power Factor		0.98 or more (During rated operation)								

<1> The motor capacity (HP) refers to an NEC 4-pole motor. The rated output current of the drive 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 input capacity is calculated with a power line voltage of 480 V × 1.1.

<4> The rated output current of the drive should be equal to or greater than the motor rated current.

<5> Carrier frequency is set to 4 kHz. Current derating is required to raise the carrier frequency.

<6> If the harmonic current distortion should be 5% or less and the maximum output voltage = [input voltage] × 0.87: Change C7-60, Output Voltage Limit Mode Selection, from the default setting.

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 for PM (OLV/PM)
	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) (14 °F to 104 °F) Analog input: within ±0.1% of the max output frequency (25 °C ±10 °C) (77 °F ±50 °F)
	Frequency Setting Resolution	Digital inputs: 0.01 Hz Analog inputs: 1/2048 of the maximum output frequency setting (11 bit plus sign)
	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)
	Starting Torque	V/f: 150% at 3 Hz OLV/PM: 100% at 3 Hz <1>
	Speed Control Range	V/f: 1:40 OLV/PM: 1:20
	Speed Control Accuracy	V/f: ±0.2 to 3% (25 °C ±10 °C) (77 °F ±50 °F) OLV/PM: ±0.2% (25 °C ±10 °C) (77 °F ±50 °F) <2>
	Speed Response	OLV/PM: 10 Hz (25 °C ±10 °C) (77 °F ±50 °F)
	Accel/Decel Time	0.0 to 6000.0 s (4 selectable combinations of independent acceleration and deceleration settings)
	Braking Torque	Same value as overload tolerance in motoring or regeneration.
	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, 4 Step Speed (max), Accel/Decel Switch, S-curve Accel/decel, 3-Wire Sequence, Auto-Tuning (Stationary for Line-to-Line Resistance, Rotational for V/f Control), Cooling Fan on/off Switch, Slip Compensation, Torque Compensation, Frequency Jump, Upper/lower Limits for Frequency Reference, DC Injection Braking at Start and Stop, Overexcitation Braking, PID Control (with sleep function), Energy Saving Control, APOGEE FLN Comm. (RS-422/RS-485 4.8 kbps), BACnet Comm. (RS-485 max. 76.8 kbps), MEMOBUS/Modbus Comm. (RS-422/RS-485 max, 115.2 kbps), Metasys N2 Comm. (RS-422/RS-485 9.6 kbps), Fault Restart, Application Presets, Overexcitation Deceleration, Sequence Timer Operation, Secondary PI Control, Bypass Operation, HOA Keypad, Dynamic Noise Control
Protection Functions	Power Supply Regeneration	Available
	Motor Protection	Electronic thermal overload relay
	Momentary Overcurrent Protection	Drive stops when output current reaches about 200% of the rated current
	Overload Protection	Drive stops after 60 s at 150% of rated output current <3>
	Overvoltage Protection	200 V class: Stops when input voltage exceeds approx. 315 V 400 V class: Stops when input voltage exceeds approx. 630 V
	Undervoltage Protection	200 V class: Stops when input voltage falls below approx. 150 V 400 V class: Stops when input voltage falls below approx. 300 V
	Momentary Motor Power Ride-Thru During Utility Power Loss	2 ms or longer at full load <4>
	Momentary Control Power Ride-Thru During Utility Power Loss	Typically 2 seconds or longer <5>
	Stall Prevention	Stall Prevention is available during acceleration, deceleration, and during run.
	Ground Protection	Electronic circuit protection <6>
	Charge LED of Capacitor for Control Power Supply	Remains lit until control power supply voltage falls below 50 V

Item		Specification
Environment	Area of Use	Indoors
	Ambient Temperature	IP20/UL Type 1 enclosure: -10 °C to +40 °C (14 °F to 104 °F) IP00 enclosure: -10 °C to +50 °C (14 °F to 122 °F)
	Humidity	95 RH% or less (no condensation)
	Storage Temperature	-20 °C to +60 °C (-4 °F to +104 °F) (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 (2□0028 to 2□0248 and 4□0011 to 4□0414) 20 to 55 Hz: 5.9 m/s^2 (2□0028 to 2□0081 and 4□0011 to 4□0077) 20 to 55 Hz: 2.0 m/s^2 (2□0104 to 2□0248 and 4□0096 to 4□0414)
Standards		• UL 61800-5-1 • IEC/EN 61800-3, IEC/EN 61800-5-1:2007
Protection Design		IP00/Open Type enclosure <7>, IP20/UL Type 1 enclosure

<1> Current derating is required. Select control modes in accordance with drive capacity.

<2> 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.

<3> Overload protection may be triggered when operating with 150% of the rated output current if the output frequency is less than 6 Hz.

<4> Momentary motor power ride-thru during utility power loss designates the time the drive is able to maintain control over a motor operating at full load after utility power is lost. Actual specifications may vary depending on motor characteristics.

<5> An auxiliary Momentary Power Loss Ride-Thru Unit is required if the application needs to maintain control power long after a 2 second momentary power loss.

<6> Ground protection is triggered when a ground short circuit occurs while the drive is running. The 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.

<7> An IP20/UL Type 1 enclosure drive requires a UL Type 1 kit.

A.3 Drive Watt Loss Data

◆ Drive Models 2□0028 to 2□0248

Table A.5 Watt Loss 200 V Class Three-Phase Models

Drive Model	Rated Amps (A)	Heatsink Loss (W)	Interior Unit Loss (W)	Total Loss (W)
2□0028	28	659	103	762
2□0042	42	854	168	1022
2□0054	54	1037	195	1232
2□0068	68	1295	225	1520
2□0081	81	1420	238	1658
2□0104	104	1696	282	1978
2□0130	130	2157	341	2498
2□0154	154	2441	366	2807
2□0192	192	3064	447	3511
2□0248	248	3785	578	4363

◆ Drive Models 4□0011 to 4□0414

Table A.6 Watt Loss 400 V Class Three-Phase Models

Drive Model	Rated Amps (A)	Heatsink Loss (W)	Interior Unit Loss (W)	Total Loss (W)
4□0011	11	452	80	532
4□0014	14	459	79	538
4□0021	21	641	105	746
4□0027	27	675	106	781
4□0034	34	798	124	922
4□0040	40	877	174	1051
4□0052	52	1109	209	1318
4□0065	65	1369	240	1609
4□0077	77	1479	251	1730
4□0096	96	1715	290	2005
4□0124	124	2256	362	2618
4□0156	156	2857	421	3278
4□0180	180	3316	482	3798
4□0216	216	3720	587	4307
4□0240	240	3897	600	4497
4□0302	302	5202	857	6059
4□0361	361	5434	863	6297
4□0414	414	6444	1012	7456

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.

◆ Rated Current Depending on Carrier Frequency

The tables below show the drive output current depending on the carrier frequency settings.

Use the data in the following tables to linearly calculate output current values for carrier frequencies not listed.

Table A.7 Three-Phase 200 V Class Carrier Frequency and Current Derating

Drive Model	Setting Range	Rated Current [A]			
		4 kHz	6 kHz	8 kHz	10 kHz
2□0028	4 to 10 kHz	28	25	22	20
2□0042	4 to 10 kHz	42	38	34	29
2□0054	4 to 10 kHz	54	49	43	38
2□0068	4 to 10 kHz	68	61	54	48
2□0081	4 to 10 kHz	81	73	65	57
2□0104	4 to 8 kHz	104	94	83	—
2□0130	4 to 8 kHz	130	117	104	—
2□0154	4 to 6 kHz	154	139	—	—
2□0192	4 to 6 kHz	192	173	—	—
2□0248	4 kHz	248	—	—	—

Table A.8 Three-Phase 400 V Class Carrier Frequency and Current Derating

Drive Model	Setting Range	Rated Current [A]			
		4 kHz	6 kHz	8 kHz	10 kHz
4□0011	4 to 10 kHz	11	9.9	8.8	7.7
4□0014	4 to 10 kHz	14	13	11	9.8
4□0021	4 to 10 kHz	21	19	17	15
4□0027	4 to 10 kHz	27	24	22	19
4□0034	4 to 10 kHz	34	31	27	24
4□0040	4 to 10 kHz	40	36	32	28
4□0052	4 to 10 kHz	52	47	42	36
4□0065	4 to 10 kHz	65	59	52	46
4□0077	4 to 10 kHz	77	69	62	54
4□0096	4 to 8 kHz	96	86	77	—
4□0124	4 to 8 kHz	124	112	99	—
4□0156	4 to 6 kHz	156	140	—	—
4□0180	4 to 6 kHz	180	162	—	—
4□0216	4 kHz	216	—	—	—
4□0240	4 kHz	240	—	—	—
4□0302	4 kHz	302	—	—	—
4□0361	4 kHz	361	—	—	—
4□0414	4 kHz	414	—	—	—

◆ Carrier Frequency Derating

Derate the drive according to *Figure A.1* as the carrier frequency increases above the factory default setting.

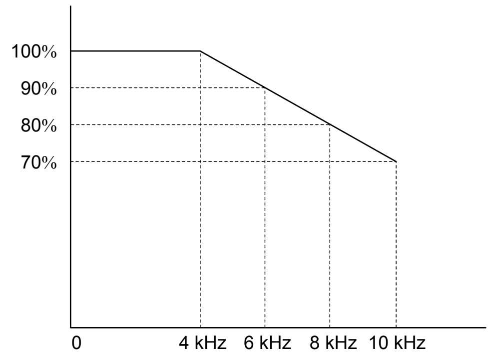

Figure A.1 Carrier Frequency Derating

◆ Temperature Derating

To ensure the maximum performance life, the drive output current must be derated as shown in *Figure A.2* when the drive is installed in areas with high ambient temperature. Set parameters L8-12 and L8-35 according to the installation conditions to ensure reliable drive overload protection.

■ Parameter Settings

No.	Name	Description	Range	Default
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 2: IP20/UL Type 1 Enclosure 3: External Heatsink Installation	0, 2, 3	Det. by o2-04

Setting 0: IP00/Open-Chassis Enclosure

Drive operation between -10 °C and +50 °C allows 100% continuous current without derating.

Setting 2: IP20/UL 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.

Setting 3: External Heatsink Installation

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.

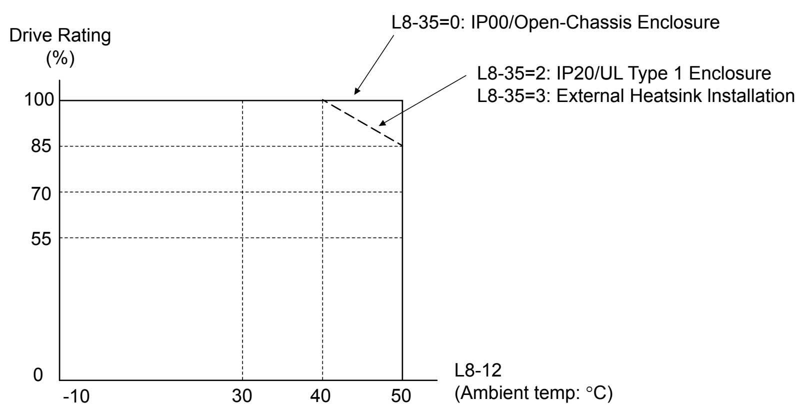

Figure A.2 Ambient Temperature and Installation Method Derating

◆ 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 1% 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 Understanding Parameter Descriptions

◆ Control Modes, Symbols, and Terms

The table below lists terms and symbols used in this section to indicate parameter availability and control.

Table B.1 Symbols and Icons Used in Parameter Descriptions

Symbol	Description
OLV/PM	Parameter is ONLY available when operating the drive with Open Loop Vector for PM motors.
RUN	Parameter can be changed during run.

B.2 A: Initialization Parameters

The A parameter group creates the operating environment for the drive. This includes the parameter Access Level, Motor Control Method, Password, User Parameters and more.

◆ A1: Initialization

No. (Addr. Hex)	Name	LCD Display	Description	Values	Page
A1-00 (0100) RUN <1>	Language Selection	Select Language 0: English 1: ニホンゴ (Japanese) 3: Françcais 5: Español 6: Português	0: English 1: Japanese 3: French 5: Spanish 6: Portuguese	Default: 0 Range: 0 to 6	151
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 a set of parameters selected by the user, A2-01 to A2-32) 2: Advanced Access (access to view and set all parameters)	Default: 2 Range: 0 to 2	151
A1-02 (0102) <1>	Control Method Selection	Control Method 0: V/F Control 5: PM OpenLoop Vect	0: V/f Control 5: Open Loop Vector Control for PM	Default: 0 Range: 0, 5	123
A1-03 (0103)	Initialize Parameters	Init Parameters 0: No Initialize 1110: User Initialize 2220: 2-Wire Initial 3330: 3-Wire Initial 3410: SELVAL HVAC Initialize 3420: SELVAL OEM Bypass Init	0: No initialization 1110: User Initialize (parameter values must be stored using parameter o2-03) 2220: 2-Wire Initialization 3330: 3-Wire Initialization 3410: HVAC Initialization 3420: OEM Bypass Initialization	Default: 0 Range: 0 to 3420	152
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, A1-06, and A2-01 through A2-32 cannot be changed.	Default: 0000 Min.: 0000 Max.: 9999	–
A1-05 (0105)	Password Setting	Select Password	When the value set into A1-04 does not match the value set into A1-05, parameters A1-01 through A1-03, A1-06, and A2-01 through A2-32 cannot be changed.	Default: 0000 Min.: 0000 Max.: 9999	–
A1-06 (0127)	Application Preset	Application Sel 0: General 1: Fan General 2: Fan PID 3: Fan ReturnAir/PID 4: Cooling Tower 5: CoolingTower/PID 6: Pump Secondary 7: Pump PID	0: Standard 1: Fan 2: Fan with PID Control 3: Return Fan with PID Control 4: Cooling Tower Fan 5: Cooling Tower Fan with PID Control 6: Pump (Secondary) 7: Pump with PID Control	Default: 0 Range: 0 to 7	153

<1> Parameter setting value is not reset to the default value when the drive is initialized.

<2> Default setting value is dependent on the Application Preset selected with parameter A1-06.

◆ A2: User Parameters

No. (Addr. Hex)	Name	LCD Display	Description	Values	Page
A2-01 to A2-32 (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> <2> Range: A1-00 to S6-07	–
A2-33 (0126)	User Parameter Automatic Selection	User Parms Sel 0: Disabled 1: Enabled	0: Parameters A2-01 to A2-32 are reserved for the user to create a list of User Parameters. 1: Save history of recently viewed parameters. Recently edited parameters will be saved to A2-17 through A2-32 for quicker access.	Default: 1 <3> Range: 0, 1	–

<1> Default setting value is dependent on the Application Preset selected with parameter A1-06.

<2> This setting is the default setting of the Setup Group parameters. Refer to TOEPC71063610 User Manual Section 4 for details.

<3> Default setting value is determined by parameter A1-06. Default is 0 when A1-06 = 0, and 1 when A1-06 ≠ 0.

B.3 b: Application

Application parameters configure the source of the Run command, DC Injection Braking, Speed Search, timer functions, PID control, Energy Savings, and a variety of other application-related settings.

◆ b1: Operation Mode Selection

No. (Addr. Hex)	Name	LCD Display	Description	Values	Page
b1-01 (0180)	Frequency Reference Selection for AUTO mode	Ref Source 1 0: Operator 1: Analog Input 2: Serial Com 3: Option PCB	0: HOA keypad 1: Terminals (Analog Input Terminals) 2: Serial communications (APOGEE FLN, BACnet, MEMOBUS/Modbus, or Metasys N2) 3: Option card	Default: 1 Range: 0 to 3	123
b1-02 (0181)	Run Command Selection for AUTO mode	Run Source 1 1: Digital Inputs 2: Communication 3: Option PCB	1: Control Circuit Terminal 2: Serial communications (APOGEE FLN, BACnet, MEMOBUS/Modbus, or Metasys N2) 3: Option card	Default: 1 Range: 1 to 3	124
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	125
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	153
b1-06 (0185)	Digital Input Reading	Cntl Input Scans 0: 1 Scan 1: 2 Scans	0: Input status is read once and processed immediately (for quicker response) 1: Input is read twice and processed only if the status is the same in both readings (robust against noisy signals)	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 2: Prohibit entering Programming Mode during Run	Default: 0 Range: 0 to 2	–
b1-11 (01DF)	Drive Delay Time Setting	Run Delay Time	After a Run command is entered, the drive output waits until this delay time has passed before starting.	Default: 0 s Min.: 0 Max.: 600	–
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	153
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	153
b1-24 (0B2C)	Commercial Power Operation Switching Selection	CommerclPwrSwSel 0: Disabled 1: Enabled	0: Disabled 1: Enabled	Default: 0 Range: 0, 1	–
b1-25 (0B2D)	Commercial Power Supply Operation Cancellation Level	Freq Deviate Lvl	Sets the judgement value of the hysteresis comparator in the judgment section for the commercial power switching function in increments of 0.1 Hz.	Default: 1.0 Hz Min.: 0.4 Max.: 6.0	–
b1-26 (0B2E)	Commercial Power Supply Operation Switching Level	Freq Accept Lvl		Default: 0.2 Hz Min.: 3.0 Max.: 6.0	–

◆ b2: DC Injection 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: <1> Min.: 0.0 Hz Max.: 10.0 Hz	153
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	154
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	154
b2-04 (018C)	DC Injection Braking Time at Stop	DCInj Time@Stop	Sets DC Injection Braking time at stop.	Default: 0.00 s Min.: 0.00 Max.: 10.00	–
b2-09 (01E1)	Motor Pre-Heat Current 2	Preheat Current	Determines the percentage of motor rated output current used for the motor pre-heat function.	Default: 5% Min.: 0 Max.: 100	–

<1> Default setting is determined by parameter A1-02, Control Method Selection.

◆ b3: Speed Search

No. (Addr Hex.)	Name	LCD Display	Description	Values	Page
b3-01 (0191)	Speed Search Selection at Start	SpdSrch at Start 0: Disabled 1: Enabled	0: Disabled 1: Enabled	Default: 0 Range: 0, 1	154
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	154
b3-04 (0194)	V/f Gain during Speed Search (Speed Estimation Type)	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%	155
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 (Speed Estimation Type)	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	155
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 (output current during Speed Search is automatically limited by the drive rated current). Increase this setting value in increments of 0.1 if the drive fails to perform Speed Estimation.	Default: 1.0 Min.: 0.0 Max.: 5.0	–
b3-08 (198)	Current Control Gain during Speed Search (Speed Estimation Type)	Srch ACR P Gain	Sets the proportional gain for the current controller during Speed Search.	Default: <1> <2> Min.: 0.00 Max.: 6.00	–
b3-09 (0199)	Current Control Integral Time during Speed Search (Speed Estimation Type)	Srch ACR I Time	Sets the Integral Time for the current controller during Speed Search.	Default: <2> Min.: 0.0 ms Max.: 1000.0 ms	–
b3-10 (019A)	Speed Search Detection Compensation Gain (Speed Estimation Type)	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	155
b3-11 (19B)	Speed Search Method Switching Level (Speed Estimation Type)	Srch Mthd Sw Lvl	Uses the amount of voltage remaining in the motor to automatically switch the search method within the type of speed measurement. (200 V class at 100% = 200 V; 400 V class at 100% = 400 V)	Default: 5.0% Min.: 0.5 Max.: 100.0	–

No. (Addr Hex.)	Name	LCD Display	Description	Values	Page
b3-12 (019C)	Minimum Current Detection Level during Speed Search	Srch I Deadband	Sets the minimum current detection level during Speed Search. Increase this setting value in increments of 0.1 if the drive fails to perform Speed Estimation.	Default: <1> Min.: 2.0 Max.: 10.0	–
b3-14 (019E)	Bi-Directional Speed Search Selection (Speed Estimation Type)	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	155
b3-17 (01F0)	Speed Search Restart Current Level (Speed Estimation Type)	SrchRestart Lvl	Sets the Speed Search restart current level as a percentage of the drive rated current.	Default: 150% Min.: 0 Max.: 200	155
b3-18 (01F1)	Speed Search Restart Detection Time (Speed Estimation Type)	SrchRestart Time	Sets the time to detect Speed Search restart.	Default: 0.10 s Min.: 0.00 Max.: 1.00	155
b3-19 (01F2)	Number of Speed Search Restarts (Speed Estimation Type)	Num of SrchRestr	Sets the number of times the drive can attempt to restart when performing Speed Search.	Default: 3 Min.: 0 Max.: 10	156
b3-24 (01C0)	Speed Search Method Selection	SpdSrch Method 1: Speed Estimation 2: CurrentDetection2	1: Speed Estimation 2: Current Detection 2	Default: <3> Range: 1, 2	–
b3-25 (01C8)	Speed Search Wait Time (Speed Estimation Type)	SpdSrch WaitTime	Sets the time the drive must wait between each Speed Search restart attempt.	Default: 0.5 s Min.: 0.0 Max.: 300.0	156
b3-27 (01C9)	Start Speed Search Select	SPD Search By AI 0: start from 0 1: start SPD	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	–
b3-29 (077C)	Speed Search Induced Voltage Level	SpdSrch Ind Vlvl	OLV/PM Performs Speed Search when the motor induced voltage exceeds the set level. There is normally no need to change this parameter from the default value, but if changes are necessary, try lowering this value in small increments. When set too low, the drive will not perform Speed Search.	Default: 10% Min.: 0 Max.: 10	–
b3-31 (0BC0)	Speed Search Operation Current Level 1 (Current Detection 1)	Search (I2) Lvl1	Set the current level to use to limit the output current during a Speed Search.	Default: 1.50 Min.: 1.50 Max.: 3.50	–
b3-32 (0BC1)	Speed Search Operation Current Level 2 (Current Detection 2)	Search (I2) Lvl2	Set the current level at which to end the Speed Search for Current Detection Type Speed Search 2.	Default: 1.20 Min.: 0.00 Max.: 1.49	–
b3-33 (0B3F)	Speed Search Selection when Run Command is Given during Uv	SpdSrch Start UV 0: Disabled 1: Enabled	Activates and deactivates Speed Search at start in accordance with whether a Run command was issued during an undervoltage (Uv) condition. Function is active when a momentary power loss (L2-01 = 1 or 2), Speed Search at start (b3-01 = 1), and coasting to a stop (b1-03 = 1) are enabled. 0: Disabled 1: Enabled	Default: 0 Range: 0, 1	–
b3-50 (0BC7)	Backspin Search Direction Judgment Time 1	Bkspin Srch Time1	Adjusts the direction of Speed Search to allow for backspin.	Default: 0.0 s Min.: 0.0 Max.: 10.0	–
b3-51 (0BC8)	Backspin Search Direction Judgment Time 2	Bkspin Srch Time2		Default: 0.0 s Min.: 0.0 Max.: 10.0	–
b3-52 (0BC9)	Backspin Search Deceleration Time 1	BkspinSrchDecel1	Sets the search frequency deceleration rate when searching from the direction command when the momentary power loss time is shorter than the time set in b3-50.	Default: 2.0 s Min.: 0.0 Max.: 10.0	–
b3-53 (0BCA)	Backspin Search Deceleration Time 2	BkspinSrchDecel2	Sets the search frequency deceleration rate for a Speed Search from the opposite direction of the direction command when the momentary power loss time is equal to or longer than the time set in b3-51.	Default: 2.0 s Min.: 0.0 Max.: 10.0	–
b3-59 (1B44)	PM Speed Search DC Injection Braking Time at Low Speed	Srch DCInj Time	OLV/PM Sets the DC Injection Braking time at low speed PM motor Speed Search.	Default: 1.00 s Min.: 0.50 Max.: 10.00	–

<1> Default setting is dependent on parameter o2-04, Drive Model Selection.

<2> Default setting is determined by parameter A1-02, Control Method Selection.
<3> Default setting is determined by parameters A1-02, Control Method Selection, and 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	–
b4-03 (0B30)	H2-01 ON Delay Time	H2-01 ON Delay	Sets the length of the delay time for contact outputs to open or close for the related functions set in H2-□□.	Default: 0 ms Min.: 0 Max.: 65000	–
b4-04 (0B31)	H2-01 OFF Delay Time	H2-01 OFF Delay			
b4-05 (0B32)	H2-02 ON Delay Time	H2-02 ON Delay			
b4-06 (0B33)	H2-02 OFF Delay Time	H2-02 OFF Delay			
b4-07 (0B34)	H2-03 ON Delay Time	H2-03 ON Delay			
b4-08 (0B35)	H2-03 OFF Delay Time	H2-03 OFF Delay			

◆ 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 3: Fref+PID D=Fdbk	0: Disabled 1: Enabled (PID output becomes output frequency reference) 3: Enabled (PID output added to frequency reference)	Default: 0 Range: 0, 1, 3	*156*
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	*156*
b5-03 (01A7) RUN	Integral Time Setting (I)	PID I Time	Sets the integral time for the PID controller.	Default: 0.5 s Min.: 0.0 Max.: 360.0	*157*
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	*157*
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	*157*
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	*157*
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	*157*
b5-09 (01AD)	PID Output Level Selection	Output Level Sel 0: Normal Character 1: Rev Character	0: Normal output (direct acting) 1: Reverse output (reverse acting)	Default: 0 Range: 0, 1	*157*

No. (Addr. Hex)	Name	LCD Display	Description	Values	Page
b5-10 (01AE)	PID Output Gain Setting	Output Gain	Sets the gain applied to the PID output.	Default: 1.00 Min.: 0.00 Max.: 25.00	158
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	158
b5-12 (01B0)	PID Feedback Loss Detection Selection	Fb loss Det Sel 0: Disabled 1: Alarm @ PID Enbl 2: Fault @ PID Enbl 3: DO Only@PID Enbl 4: Alarm – Always 5: Fault – Alwaysl	0: Digital Output Only (Remains active when PID is disabled by digital input) 1: Alarm output, drive continues operation (Remains active when PID is disabled by digital input) 2: Fault output, drive output is shut off (Remains active when PID is disabled by digital input) 3: Digital output only. No detection when PID is disabled by digital input. 4: Alarm detection. No detection when PID is disabled by digital input. 5: Fault detection. No detection when PID is disabled by digital input.	Default: 0 Range: 0 to 5	158
b5-13 (01B1)	PID Feedback Loss Detection Level	Fb loss Det Lvl	Sets the PID feedback loss detection level as a percentage of the maximum output frequency.	Default: 0% Min.: 0 Max.: 100	158
b5-14 (01B2)	PID Feedback Loss Detection Time	Fb loss Det Time	Sets a delay time for PID feedback loss.	Default: 1.0 s Min.: 0.0 Max.: 25.5	159
b5-15 (01B3)	PID Sleep Function Start Level	PID Sleep Level	Sets the frequency level that triggers the sleep/snooze function.	Default: 0.0 Hz Min.: 0.0 Max.: 400.0	159
b5-16 (01B4)	PID Sleep Delay Time	PID Sleep Time	Sets a delay time before the sleep/snooze function is triggered.	Default: 0.0 s Min.: 0.0 Max.: 25.5	159
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	159
b5-18 (01DC)	PID Setpoint Selection	PID Setpoint Sel 0: Disabled 1: Enabled	0: Disabled 1: Enabled	Default: 0 Range: 0, 1	159
b5-19 (01DD) RUN	PID Setpoint Value	PID Setpoint	Sets the PID target value when b5-18 = 1. Set as a percentage of the maximum output frequency.	Default: 0.00% Min.: 0.00 Max.: 100.00 <1>	159
b5-20 (01E2)	PID Setpoint Scaling	PID Disp Scaling 0: 0.01Hz units 1: 0.01% units 2: r/min 3: User Units	0: 0.01 Hz units 1: 0.01% units (100% = max output frequency) 2: r/min (number of motor poles must entered) 3: User-set (set scaling to b5-38 and b5-39)	Default: 1 Range: 0 to 3	159
b5-21 (01E3)	PID Sleep Input Source	PID Sleep Ref 0: PID Setpoint 1: Frequency Ref 2: Snooze Func	Input source selection for Sleep Function mode. 0: PID Setpoint 1: SFS Input 2: Snooze	Default: 1 Range: 0 to 2	160
b5-22 (01E4)	PID Snooze Level	Snooze Level	Sets the PID Snooze Function start level as a percentage of the maximum frequency.	Default: 0% Min.: 0 Max.: 100	160
b5-23 (01E5)	PID Snooze Delay Time	Snooze DelayTime	Sets the PID Snooze Function delay time in seconds.	Default: 0s Min.: 0 Max.: 2600	160
b5-24 (01E6)	PID Snooze Deactivation Level	SnoozeRestartLvl	When the PID feedback level drops below this level, the drive returns to normal operation. Set as a percentage of the maximum frequency.	Default: 0% Min.: 0 Max.: 100	160
b5-25 (01E7)	PID Setpoint Boost Setting	SetpointBoostLvl	Temporarily increases the PID setpoint to create an overshoot of the intended PID setpoint.	Default: 0% Min.: 0 Max.: 100	160

No. (Addr. Hex)	Name	LCD Display	Description	Values	Page
b5-26 (01E8)	PID Maximum Boost Time	SetpointBoostTim	Sets the maximum boost time when PID feedback does not reach boost level. The Snooze Function starts when the PID feedback exceeds the boost setting level or when the boost time expires.	Default: 0s Min.: 0 Max.: 2600	160
b5-27 (01E9)	PID Snooze Feedback Level	Snooze Reset Lvl	Sets the PID feedback level above which Snooze mode is activated. Set as a percentage of the maximum frequency.	Default: 60% Min.: 0 Max.: 100	161
b5-28 (01EA)	PID Feedback Function Selection	PID FdbkSqrt Sel 0: Disabled 1: Enabled	0: Disabled 1: Square root	Default: 0 Range: 0, 1	161
b5-29 (01EB)	PID Square Root Gain	PID FdbkSqrtGain	A multiplier applied to the square root of the feedback.	Default: 0.00 Min.: 0.00 Max.: 2.00	161
b5-30 (01EC)	PID Feedback Offset	PID Fdbk Offset	PID feedback offset set as a percentage of the maximum frequency.	Default: 0.00 Min.: 0.00 Max.: 100.00	161
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: 0.0% Min.: -100.0 Max.: 100.0	161
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	161
b5-36 (01A1)	PID Feedback High Detection Level	Fb High Det Lvl	Sets the PID feedback high detection level as a percentage of the maximum output frequency.	Default: 100% Min.: 0 Max.: 100	161
b5-37 (01A2)	PID Feedback High Detection Time	Fb High Dly Time	Sets the PID feedback high level detection delay time.	Default: 1.0 s Min.: 0.0 Max.: 25.5	162
b5-38 (01FE)	PID Setpoint User Display	PID UsrDspMaxVal	Sets the display value of U5-01 and U5-04 when the maximum frequency is output.	Default: <2> Min.: 1 Max.: 60000	162
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: <2> Range: 0 to 3	162
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	162
b5-41 (0160)	PID Unit Selection	PID Mon Unit Sel 0: WC 1: PSI 2: GPM 3: °F 4: CFM 5: CMH 6: LPH 7: LPS 8: Bar 9: Pa 10: °C 11: Mtr 12: Ft 13: LPM 14: CMM	0: WC (Inch of water) 1: PSI (Pounds per square inch) 2: GPM (Gallons per minute) 3: F (Degrees Fahrenheit) 4: CFM (Cubic feet per minute) 5: CMH (Cubic meters per hour) 6: LPH (Liters per hour) 7: LPS (Liters per second) 8: Bar (Bar) 9: Pa (Pascal) 10: C (Degrees Celsius) 11: Mtr (Meters) 12: Ft (Feet) 13: LPM (Liters per minute) 14: CMM (Cubic meters per minute)	Default: 0 Range: 0 to 14	162
b5-42 (0161) RUN	PID Output Monitor Calculation Method	PID Out 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) 3: Cubic - the monitor displays 1/(PID output)	Default: 0 Range: 0 to 3	163

No. (Addr. Hex)	Name	LCD Display	Description	Values	Page
b5-43 (0162) RUN	PID Output 2 Monitor Max Upper 4 Digits	PID Out MonMax U4	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	*163*
b5-44 (0163) RUN	PID Output 2 Monitor Max Lower 4 Digits	PID Out MonMax L4	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	*163*
b5-45 (0164) RUN	PID Output 2 Monitor Minimum	PID Out 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	*163*
b5-46 (0165)	PID Setpoint Monitor Unit Selection	PID Mon Unit Sel 0: WC 1: PSI 2: GPM 3: °F 4: CFM 5: CMH 6: LPH 7: LPS 8: bar 9: Pa 10: °C 11: Mtr 12: Ft 13: LPM 14: CMM	0: WC (Inch of water) 1: PSI (Pounds per square inch) 2: GPM (Gallons per minute) 3: F (Degrees Fahrenheit) 4: CFM (Cubic feet per minute) 5: CMH (Cubic meters per hour) 6: LPH (Liters per hour) 7: LPS (Liters per second) 8: Bar (Bar) 9: Pa (Pascal) 10: C (Degrees Celsius) 11: Mtr (Meters) 12: Ft (Feet) 13: LPM (Liters per minute) 14: CMM (Cubic meters per minute)	Default: 0 Range: 0 to 14	*163*
b5-47 (017D)	Reverse Operation Selection 2 by PID Output	Output Rev Sel2 0: 0 limit 1: Reverse	Reverse operation selection when b5-01 = 3 0: Reverse Disabled 1: Reverse Enabled	Default: 1 Range: 0, 1	*164*

<1> Internally limited to the value of b5-38. Changing b5-20, b5-38, and b5-39 will not automatically update the value of this parameter.

<2> Default setting is dependent on parameter b5-20, PID Setpoint Scaling.

◆ 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: <1> Range: 0, 1	–
b8-04 (01CF)	Energy Saving Coefficient Value	Energy Save COEF	Determines the level of maximum motor efficiency. Setting range is 0.0 to 2000.0 for drives 3.7 kW and smaller.	Default: <2> <3> Min.: 0.00 Max.: 655.00	–
b8-05 (01D0)	Power Detection Filter Time	kW Filter Time	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	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 determined by parameter A1-02, Control Method Selection.

<2> Default setting is determined by parameters A1-02, Control Method Selection, and o2-04, Drive Model Selection.

<3> Parameter value changes automatically if E2-11 is manually changed or changed by Auto-Tuning.

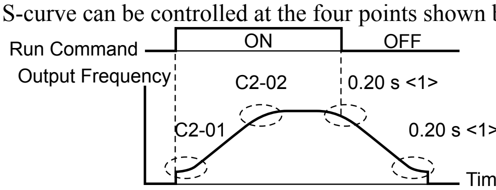
B.4 C: Tuning

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: 30.0 s Min.: 0.1 Max.: 6000.0	127
C1-02 (0201) RUN	Deceleration Time 1	Decel Time 1	Sets the time to decelerate from maximum frequency to 0.		127
C1-03 (0202) RUN	Acceleration Time 2	Accel Time 2	Sets the time to accelerate from 0 to maximum frequency.	Default: 30.0 s Min.: 0.1 Max.: 6000.0	127
C1-04 (0203) RUN	Deceleration Time 2	Decel Time 2	Sets the time to decelerate from maximum frequency to 0.		127
C1-09 (0208)	Fast Stop Time	Fast Stop Time	Sets the time for the Fast Stop function.	Default: 10.0 s Min.: 0.1 Max.: 6000.0	–
C1-11 (020A)	Accel/Decel Time Switching Frequency	Acc/Dec SW Freq	Sets the frequency to switch between accel/decel time settings. Setting units are determined by parameter A1-02, Control Method Selection.	Default: 0.0 Hz Min.: 0.0 Max.: 400.0	–

◆ 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: <1> Min.: 0.00 s Max.: 10.00 s	164
C2-02 (020C)	S-Curve Characteristic at Accel End	SCrv Acc @ End		Default: 0.20 s Min.: 0.00 Max.: 10.00	164

<1> Default setting is determined by parameter A1-02, Control Method Selection.

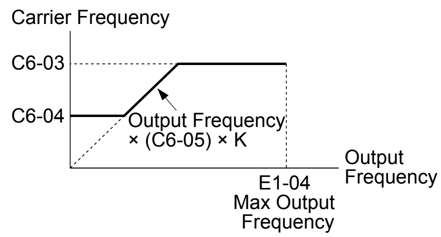
◆ C4: Torque Compensation

No. (Addr. Hex)	Name	LCD Display	Description	Values	Page
C4-01 (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> 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: <2> Min.: 0 ms Max.: 60000 ms	–

<1> Default setting is determined by parameter A1-02, Control Method Selection.

<2> Default setting is determined by parameters A1-02, Control Method Selection, and o2-04, Drive Model Selection.

◆ C6: Carrier Frequency

No. (Addr. Hex)	Name	LCD Display	Description	Values	Page
C6-02 (0224)	Carrier Frequency Selection	CarrierFreq Sel 1: Fc=4.0 kHz 2: Fc=6.0 kHz 3: Fc=8.0 kHz 4: Fc=10.0 kHz F: Program	1: 4.0 kHz 2: 6.0 kHz 3: 8.0 kHz 4: 10.0 kHz F: User-defined (determined by C6-03 through C6-05)	Default: <1> Range: 1 to 4; F	128
C6-03 (0225)	Carrier Frequency Upper Limit	CarrierFreq Max	Determines the upper and lower limits for the carrier frequency. 	Default: <2> Min.: 4.0 kHz Max.: 10.0 kHz	165
C6-04 (0226)	Carrier Frequency Lower Limit	CarrierFreq Min		Default: <2> Min.: 4.0 kHz Max.: 10.0 kHz	165
C6-05 (0227)	Carrier Frequency Proportional Gain	CarrierFreq Gain		Default: <2> Min.: 0 Max.: 99	165
C6-09 (022B)	Carrier Frequency during Rotational Auto-Tuning	Carrier in tune 0: Fc = 5kHz 1: Fc = C6-03	OLV/PM 0: Carrier Frequency = 4 kHz. 1: Setting value for C6-03.	Default: 0 Range: 0, 1	–

<1> Default setting value is dependent on parameters A1-02, Control Method Selection and o2-04, Drive Model Selection.

<2> Default setting value is dependent on parameter C6-02, Carrier Frequency Selection and o2-04, Drive Model Selection.

◆ C7: Voltage Adjustment

No. (Addr. Hex)	Name	LCD Display	Description	Values	Page
C7-43 (112A)	Input Voltage Offset Adjustment	InputVolt Offset	Adjusts the offset for the input voltage circuit when the control board is replaced. 0000: Standard 0002: Offset adjustment not required	Default: 0000 Range: 0000 to 9999	–
C7-56 (1107)	Power Factor Control Selection	PF Control Sel 0: PF Ctrl Disabled 1: PF Ctrl Enabled	0: Power factor control disabled 1: Power factor control enabled	Default: 0 Range: 0, 1	–
C7-60 (0B1C)	Output Voltage Limit Mode Selection	V Out Limit Sel 0: Limit Harmonics 1: Improve PF	0: Harmonic suppression priority mode 1: High output voltage mode	Default: 1 Range: 0, 1	–

B.5 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>	165
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>	165
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>	165
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>	165
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>	165
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>	165

<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	128
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	129
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	166

◆ 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. Setting 0.0 disables this function. Parameters must be set so that d3-01 ≥ d3-02 ≥ d3-03.	Default: 0.0 Hz Min.: 0.0 Max.: 400.0	*166*
d3-02 (0295)	Jump Frequency 2	Jump Freq 2	Eliminates problems with resonant vibration of the motor/ machine by avoiding continuous operation in predefined frequency ranges. The drive accelerates and decelerates the motor through the prohibited frequency ranges. Setting 0.0 disables this function. Parameters must be set so that d3-01 ≥ d3-02 ≥ d3-03.	Default: 0.0 Hz Min.: 0.0 Max.: 400.0	*166*
d3-03 (0296)	Jump Frequency 3	Jump Freq 3	Eliminates problems with resonant vibration of the motor/ machine by avoiding continuous operation in predefined frequency ranges. The drive accelerates and decelerates the motor through the prohibited frequency ranges. Setting 0.0 disables this function. Parameters must be set so that d3-01 ≥ d3-02 ≥ d3-03.	Default: 0.0 Hz Min.: 0.0 Max.: 400.0	*166*
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	*166*

◆ d4: Frequency Reference Hold 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	–
d4-10 (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	–

◆ d6: Field Weakening

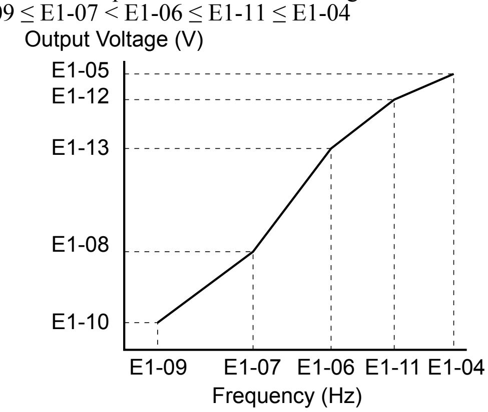
No. (Addr. Hex)	Name	LCD Display	Description	Values	Page
d6-01 (02A0)	Field Weakening Level	Field-Weak Lvl	Sets the drive output voltage for the Field Weakening function as a percentage of the maximum output voltage. Enabled when a multi-function input is set for Field Weakening (H1-□□ = 63).	Default: 80% Min.: 0 Max.: 100	–
d6-02 (02A1)	Field Weakening Frequency Limit	Field-Weak Freq	Sets the lower limit of the frequency range where Field Weakening control is valid. The Field Weakening command is valid only at frequencies above this setting and only when the output frequency matches the frequency reference (speed agree).	Default: 0.0 Hz Min.: 0.0 Max.: 400.0	–

◆ d7: Offset Frequency

No. (Addr. Hex)	Name	LCD Display	Description	Setting	Page
d7-01 (02B2) RUN	Offset Frequency 1	Offset Freq 1	Added to the frequency reference when the digital input “Frequency offset 1” (H1-□□ = 44) is switched on.	Default: 0.0% Min.: -100.0 Max.: 100.0	–
d7-02 (02B3) RUN	Offset Frequency 2	Offset Freq 2	Added to the frequency reference when the digital input “Frequency offset 2” (H1-□□ = 45) is switched on.	Default: 0.0% Min.: -100.0 Max.: 100.0	–
d7-03 (02B4) RUN	Offset Frequency 3	Offset Freq 3	Added to the frequency reference when the digital input “Frequency offset 3” (H1-□□ = 46) is switched on.	Default: 0.0% Min.: -100.0 Max.: 100.0	–

B.6 E: Motor Parameters

◆ E1: V/f Pattern for Motor 1

No. (Addr. Hex)	Name	LCD Display	Description	Values	Page
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 <1> Range: 0 to 9; A to F	167
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  **Note:** E1-07, E1-08, and E1-10 to E1-13 are not available in OLV/PM control mode.	Default: <2> <8> Min.: 40.0 Hz Max.: 400.0 Hz <3>	129
E1-05 (0304) <7>	Maximum Voltage	Max Voltage		Default: <2> <4> Min.: 0.0 V Max.: 255.0 V <5>	129
E1-06 (0305)	Base Frequency	Base Frequency		Default: <2> <4> <8> Min.: 0.0 Hz Max.: E1-04 <3>	129
E1-07 (0306)	Middle Output Frequency	Mid Frequency A		Default: <2> Min.: 0.0 Hz Max.: E1-04	129
E1-08 (0307)	Middle Output Frequency Voltage	Mid Voltage A		Default: <2> Min.: 0.0 V Max.: 255.0 V <5>	129
E1-09 (0308)	Minimum Output Frequency	Min Frequency		Default: <2> <4> <8> Min.: 0.0 Hz Max.: E1-04 <3>	129
E1-10 (0309)	Minimum Output Frequency Voltage	Min Voltage		Default: <2> Min.: 0.0 V Max.: 255.0 V <5>	129
E1-11 (030A) <6>	Middle Output Frequency 2	Mid Frequency B		Default: 0.0 Hz Min.: 0.0 Max.: E1-04	129
E1-12 (030B) <6> <9>	Middle Output Frequency Voltage 2	Mid Voltage B		Default: 0.0 V Min.: 0.0 Max.: 255.0 <5>	129
E1-13 (030C) <7> <9>	Base Voltage	Base Voltage		Default: 0.0 V Min.: 0.0 Max.: 255.0 <5>	129

<1> Parameter setting value is not reset to the default value when the drive is initialized.

<2> Default setting is dependent on parameters A1-02, Control Mode Selection and o2-04, Drive Model Selection.

<3> Default setting is determined by E5-01 in OLV/PM.
When E5-01 is set to FFFFH, the setting range for E1-04 and E1-06 is 10.0 to 400.0 Hz and the setting range for E1-09 is 0.0 to 400.0 Hz.

<4> Default setting is dependent on parameter A1-02, Control Mode Selection.
<5> Values shown are specific to 200 V class drives. Double the value for 400 V class drives.
<6> Parameter ignored when E1-11 (Motor 1 Mid Output Frequency 2) and E1-12 (Motor 1 Mid Output Frequency Voltage 2) are set to 0.0.
<7> When Auto-Tuning is performed, E1-13 and E1-05 will be set to the same value.
<8> When using PM motors, the default setting is determined by the motor code set to E5-01.
<9> The drive changes these settings when Auto-Tuning is performed.

◆ E2: Motor 1 Parameters

No. (Addr. Hex)	Name	LCD Display	Description	Values	Page
E2-01 (030E)	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.: 150% of drive rated current <2>	130
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.: 0.00 A Max.: E2-01 <2>	–
E2-04 (0311)	Number of Motor Poles	Number of Poles	Sets the number of motor poles. Automatically set during Auto-Tuning.	Default: 4 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	–
E2-10 (0317)	Motor Iron Loss for Torque Compensation	Motor Iron Loss	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> Display is in the following units:
2□0028, 2□0042, and 4□0011 to 4□0027: 0.01 A units
2□0054 to 2□0248 and 4□0034 to 4□0414: 0.1 A units

◆ E5: PM Motor Settings

No. (Addr. Hex)	Name	LCD Display	Description	Values	Page
E5-01 (0329) <1>	Motor Code Selection (for PM Motors)	PM Mtr Code Sel	OLV/PM Enter the Yaskawa motor code for the PM motor being used. Various motor parameters are automatically set based on the value of this parameter. Settings that were changed manually will be overwritten by the defaults of the selected motor code. **Note:** 1. Set to FFFF when using a non-Yaskawa PM motor or a special motor. 2. If an alarm or hunting occurs despite using a motor code, enter the value indicated on the nameplate.	Default: <2> Min.: 0000 Max.: FFFF <4>	130
E5-02 (032A) <1>	Motor Rated Power (for PM Motors)	PM Mtr Capacity	OLV/PM Sets the rated capacity of the motor.	Default: <3> Min.: 0.10 kW Max.: 650.00 kW	131

No. (Addr. Hex)	Name	LCD Display	Description	Values	Page
E5-03 (032B) <1>	Motor Rated Current (for PM Motors)	PM Mtr Rated FLA	OLV/PM Sets the motor rated current.	Default: <3> Min: 10% of drive rated current Max: 150% of drive rated current <5>	131
E5-04 (032C) <1>	Number of Motor Poles (for PM Motors)	PM Motor Poles	OLV/PM Sets the number of motor poles.	Default: <3> Min.: 2 Max.: 48	131
E5-05 (032D) <1>	Motor Stator Resistance (for PM Motors)	PM Mtr Arm Ohms	OLV/PM Set the resistance for each motor phase.	Default: <3> Min.: 0.000 Ω Max.: 65.000 Ω	131
E5-06 (032E) <1>	Motor d-Axis Inductance (for PM Motors)	PM Mtr d Induct	OLV/PM Sets the d-Axis inductance for the PM motor.	Default: <3> Min.: 0.00 mH Max.: 300.00 mH	131
E5-07 (032F) <1>	Motor q-Axis Inductance (for PM Motors)	PM Mtr q Induct	OLV/PM Sets the q-Axis inductance for the PM motor.	Default: <3> Min.: 0.00 mH Max.: 600.00 mH	131
E5-09 (0331) <1>	Motor Induction Voltage Constant 1 (for PM Motors)	PM Mtr Ind V 1	OLV/PM Sets the induced peak voltage per phase in units of 0.1 mV/(rad/s) [electrical angle]. Set this parameter when using an IPM motor with variable torque. Set E5-24 to 0 when setting this parameter.	Default: <3> Min.: 0.0 mV/(rad/s) Max.: 2000.0 mV/(rad/s)	132
E5-24 (0353) <1>	Motor Induction Voltage Constant 2 (for PM Motors)	PM Mtr Ind V 2	OLV/PM Sets the induced phase-to-phase rms voltage in units of 0.1 mV/(r/min) [mechanical angle].	Default: <3> Min.: 0.0 mV/(r/min) Max.: 6500.0 mV/(r/min)	132

<1> Setting value is not reset to the default when drive is initialized.

<2> Default setting is determined by parameters A1-02, Control Method Selection, and o2-04, Drive Model Selection.

<3> Default setting is dependent on parameter E5-01, Motor Code Selection.

<4> Selection may vary depending on the motor code entered to E5-01.

<5> Display is in the following units:
2□0028, 2□0042, and 4□0011 to 4□0027: 0.01 A units
2□0054 to 2□0248 and 4□0034 to 4□0414: 0.1 A units

B.7 F: Option Settings

◆ F2: Analog Input Card Settings (AI-A3)

No. (Addr. Hex)	Name	LCD Display	Description	Values	Page
F2-01 (038F)	Analog Input Option Card Operation Selection	AI Function Sel 0: 3ch Individual 1: 3ch Addition	0: Option card input terminals V1, V2, and V3 replace drive input terminals A1, A2, and A3. 1: Input signals to terminals V1, V2, and V3 are added together to create the frequency reference.	Default: 0 Range: 0, 1	–
F2-02 (0368) RUN	Analog Input Option Card Gain	AI Input Gain	Sets the gain for the input signal to the analog card.	Default: 100.0% Min.: -999.9 Max.: 999.9	–
F2-03 (0369) RUN	Analog Input Option Card Bias	AI Input Bias	Sets the bias for the input signal to the analog card.	Default: 0.0% Min.: -999.9 Max.: 999.9	–

◆ F3: Digital Input Card Settings (DI-A3)

No. (Addr. Hex)	Name	LCD Display	Description	Values	Page
F3-01 (0390)	Digital Input Option Card Input Selection	DI Function Sel 0: BCD 1% 1: BCD 0.1% 2: BCD 0.01% 3: BCD 1 Hz 4: BCD 0.1 Hz 5: BCD 0.01 Hz 6: BCD(5DG) 0.01 Hz 7: Binary	0: BCD, 1% units 1: BCD, 0.1% units 2: BCD, 0.01% units 3: BCD, 1 Hz units 4: BCD, 0.1 Hz units 5: BCD, 0.01 Hz units 6: BCD customized setting (5-digit), 0.02 Hz units 7: Binary input The unit and the setting range are determined by F3-03. F3-03 = 0: 255/100% (-255 to +255) F3-03 = 1: 40961/100% (-4095 to +4095) F3-03 = 2: 30000/100% (-33000 to +33000) When the digital operator units are set to be displayed in Hz or user-set units (o1-03 = 2 or 3), the units for F3-01 are determined by parameter o1-03.	Default: 0 Range: 0 to 7	–
F3-03 (03B9)	Digital Input Option DI-A3 Data Length Selection	Data length Sel 0: 8bit 1: 12bit 2: 16bit	0: 8 bit 1: 12 bit 2: 16 bit	Default: 2 Range: 0 to 2	–

◆ F4: Analog Monitor Card Settings (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	–

No. (Addr. Hex)	Name	LCD Display	Description	Values	Page
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 Settings (DO-A3)

No. (Addr. Hex)	Name	LCD Display	Description	Values	Page
F5-01 (0399)	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.	Default: 0 Range: 0 to 1B6	–
F5-02 (039A)	Terminal P2-PC Output Selection	DO Ch2 Select		Default: 1 Range: 0 to 1B6	–
F5-03 (039B)	Terminal P3-PC Output Selection	DO Ch3 Select		Default: 2 Range: 0 to 1B6	–
F5-04 (039C)	Terminal P4-PC Output Selection	DO Ch4 Select		Default: 4 Range: 0 to 1B6	–
F5-05 (039D)	Terminal P5-PC Output Selection	DO Ch5 Select		Default: 6 Range: 0 to 1B6	–
F5-06 (039E)	Terminal P6-PC Output Selection	DO Ch6 Select		Default: 37 Range: 0 to 1B6	–
F5-07 (039F)	Terminal M1-M2 Output Selection	DO Ch7 Select		Default: F Range: 0 to 1B6	–
F5-08 (03A0)	Terminal M3-M4 Output Selection	DO Ch8 Select		Default: F Range: 0 to 1B6	–
F5-09 (03A1)	DO-A3 Output Mode Selection	DO Function Sel	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 Settings

Parameters F6-01 through F6-03, F6-07, and F6-08 are used for BACnet/IP, EtherNet/IP, Modbus TCP/IP, and LONWORKS options. F7 parameters are used for the BACnet/IP, EtherNet/IP, and Modbus TCP/IP options.

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 4: Alarm (d1-04) 5: Alm – Ramp Stop	0: Ramp to stop. Decelerate to stop using the deceleration time in C1-02. 1: Coast to stop. 2: Fast Stop. Decelerate to stop using the deceleration time in C1-09. 3: Alarm only. <1> 4: Alarm only. Continue operation using the frequency reference set in d1-04. <1> 5: Alarm. Ramp to stop.	Default: 1 Range: 0 to 5	–
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	–

No. (Addr. Hex)	Name	LCD Display	Description	Values	Page
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. <1>	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 (same as F7) 1: Multi-step reference enabled (same as V7)	Default: 0 Range: 0, 1	–
F6-08 (036A) <3>	Reset Communication Parameters	Com Prm Init Sel 0: No Init Com Prms 1: Init Com Prms	0: Communication-related parameters (F6-□□) are not reset when the drive is initialized using A1-03. 1: Reset all communication-related parameters (F6-□□) when the drive is initialized using A1-03.	Default: 0 Range: 0, 1	–
F6-10 (03B6)	CC-Link Node Address	CC-Link Node Add	Sets the node address if a CC-Link option is installed.	Default: 0 Min.: 0 Max.: 64	–
F6-11 (03B7)	CC-Link Communication Speed	CC-Link Baud 0: 156 kbps 1: 625 kbps 2: 2.5 Mbps 3: 5 Mbps 4: 10 Mbps	0: 156 Kbps 1: 625 Kbps 2: 2.5 Mbps 3: 5 Mbps 4: 10 Mbps	Default: 0 Range: 0 to 4	–
F6-14 (03BB)	CC-Link bUS Error Auto Reset	Bus Err Auto Rst 0: Disabled 1: Enabled	0: Disabled 1: Enabled	Default: 0 Range: 0, 1	–
F6-20 (036B)	MECHATROLINK Station Address	Station Address	Sets the station address when the MECHATROLINK option has been installed.	Default: 21 Min.: 20 <2> Max.: 3F <2>	–
F6-21 (036C)	MECHATROLINK Frame Size	Frame length	MECHATROLINK-II (SI-T3) 0: 32-byte 1: 17-byte MECHATROLINK-III (SI-ET3) 0: 64-byte 1: 32-byte	Default: 0 Range: 0, 1	–
F6-22 (036D)	MECHATROLINK Link Speed	Link Speed 0: 10MHz 1: 4MHz	0: 10 Mbps 1: 4 Mbps	Default: 0 Range: 0, 1	–
F6-23 (036E)	MECHATROLINK Monitor Selection (E)	Mon E register	Sets the MECHATROLINK monitor (E).	Default: 0 Min.: 0 Max.: FFFF	–
F6-24 (036F)	MECHATROLINK Monitor Selection (F)	Mon F register	Sets the MECHATROLINK monitor (F).	Default: 0 Min.: 0 Max.: FFFF	–
F6-25 (03C9)	Operation Selection at MECHATROLINK Watchdog Timer Error (E5)	SI-T WDTErr Sel 0: Ramp to Stop 1: Coast to Stop 2: Fast-Stop 3: Alarm Only	0: Ramp to stop. Decelerate using the deceleration time in C1-02. 1: Coast to stop 2: Fast stop. Decelerate using the deceleration time in C1-09. 3: Alarm only	Default: 1 Range: 0 to 3	–
F6-26 (03CA)	MECHATROLINK bUS Errors Detected	Num of SI-T BUS	Sets the number of option communication errors (bUS).	Default: 2 Min.: 2 Max.: 10	–
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	–

No. (Addr. Hex)	Name	LCD Display	Description	Values	Page
F6-35 (03D0)	CANopen Node ID Selection	CO Node Address	Sets the node address.	Default: 0 Min.: 0 Max.: 126	–
F6-36 (03D1)	CANopen Communication Speed	CO Baud Rate 0: Auto Detect 1: 10 kbps 2: 20 kbps 3: 50 kbps 4: 125 kbps 5: 250 kbps 6: 500 kbps 7: 800 kbps 8: 1Mbps	0: Auto-detection 1: 10 kbps 2: 20 kbps 3: 50 kbps 4: 125 kbps 5: 250 kbps 6: 500 kbps 7: 800 kbps 8: 1 Mbps	Default: 6 Range: 0 to 8	–
F6-40 (03D5)	CompoNet Node Address	CN Node Adress	Reserved.	–	–
F6-41 (03D6)	CompoNet Communication Speed	CN Baud Rate	Reserved.	–	–
F6-45 (02FB)	BACnet Node Address	BAC Node Address	Sets BACnet physical node address.	Default: 1 Min.: 0 Max.: 127	–
F6-46 (02FC)	BACnet Baud Rate	BAC 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 1: 2400 2: 4800 3: 9600 4: 19200 5: 38400 6: 57600 7: 76800 8: 115200	Default: 3 Range: 0 to 8	–
F6-47 (02FD)	Rx to Tx Wait Time	Rx to Tx Wait T	Sets the wait time between receiving and sending for BACnet MS/TP.	Default: 5 ms Min.: 5 Max.: 65	–
F6-48 (02FE)	BACnet Device Object Identifier 0	BAC Dev Obj Id 0	Sets the least significant word for BACnet/IP when using the JOHB-SMP3 option and BACnet MS/TP when using the SI-B3 option.	Default: 0 Min.: 0 Max.: FFFF	–
F6-49 (02FF)	BACnet Device Object Identifier 1	BAC Dev Obj Id 1	Sets the most significant word for BACnet/IP when using the JOHB-SMP3 option and BACnet MS/TP when using the SI-B3 option.	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	–
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	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	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	Speed Scale	Sets the scaling factor for the speed monitor in DeviceNet.	Default: 0 Min.: -15 Max.: 15	–

No. (Addr. Hex)	Name	LCD Display	Description	Values	Page
F6-57 (03D8)	DeviceNet Current Scaling	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	Torque Scale	Sets the scaling factor for the torque monitor in DeviceNet.	Default: 0 Min.: -15 Max.: 15	–
F6-59 (03DA)	DeviceNet Power Scaling	Power Scale	Sets the scaling factor for the power monitor in DeviceNet.	Default: 0 Min.: -15 Max.: 15	–
F6-60 (03DB)	DeviceNet Voltage Scaling	Voltage Scale	Sets the scaling factor for the voltage monitor in DeviceNet.	Default: 0 Min.: -15 Max.: 15	–
F6-61 (03DC)	DeviceNet Time Scaling	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)	Reserved	–	Reserved for Dynamic I/O Assembly Parameters.	–	–
F6-72 (03DE)	PowerLink Node Address	PowerLink NodeID	Reserved.	–	–
F7-01 (03E5) <4> <5> <6>	IP Address 1	IP Address 1	Sets the most significant octet of network static IP address.	Default: 192 Min.: 0 Max.: 255	–
F7-02 (03E6) <4> <5> <6>	IP Address 2	IP Address 2	Sets the second most significant octet of network static IP address.	Default: 168 Min.: 0 Max.: 255	–
F7-03 (03E7) <4> <5> <6>	IP Address 3	IP Address 3	Sets the third most significant octet of network static IP address.	Default: 1 Min.: 0 Max.: 255	–
F7-04 (03E8) <4> <5> <6>	IP Address 4	IP Address 4	Sets the fourth most significant octet of network static IP address.	Default: 20 Min.: 0 Max.: 255	–
F7-05 (03E9) <6>	Subnet Mask 1	Subnet Mask 1	Sets the most significant octet of network static Subnet Mask.	Default: 255 Min.: 0 Max.: 255	–
F7-06 (03EA) <6>	Subnet Mask 2	Subnet Mask 2	Sets the second most significant octet of network static Subnet Mask.	Default: 255 Min.: 0 Max.: 255	–
F7-07 (03EB) <6>	Subnet Mask 3	Subnet Mask 3	Sets the third most significant octet of network static Subnet Mask.	Default: 255 Min.: 0 Max.: 255	–
F7-08 (03EC) <6>	Subnet Mask 4	Subnet Mask 4	Sets the fourth most significant octet of network static Subnet Mask.	Default: 0 Min.: 0 Max.: 255	–
F7-09 (03ED) <6>	Gateway Address 1	Gateway IP Add 1	Sets the most significant octet of network Gateway address.	Default: 192 Min.: 0 Max.: 255	–
F7-10 (03EE) <6>	Gateway Address 2	Gateway IP Add 2	Sets the second most significant octet of network Gateway address.	Default: 168 Min.: 0 Max.: 255	–

No. (Addr. Hex)	Name	LCD Display	Description	Values	Page
F7-11 (03EF) <6>	Gateway Address 3	Gateway IP Add 3	Sets the third most significant octet of network Gateway address.	Default: 1 Min.: 0 Max.: 255	–
F7-12 (03E0) <6>	Gateway Address 4	Gateway IP Add 4	Sets the fourth most significant octet of network Gateway address.	Default: 1 Min.: 0 Max.: 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 <5> <6> 1: BOOTP 2: DHCP	Default: 2 Range: 0 to 2	–
F7-14 (03F2)	Duplex Mode Selection	Duplex Select 0: Half/Half 1: Auto/Auto 2: Full/Full	Selects duplex mode setting. 0: Half duplex forced <7> 1: Auto-negotiate duplex mode and communication speed 2: Full duplex forced <7>	Default: 1 Range: 0 to 2	–
F7-15 (03F3) <7>	Communication Speed Selection	Baud Rate 10: 10/10 Mbps 100: 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 in tenths of a second for communication loss detection. Example: Setting this parameter to 100 represents 10.0 seconds. Setting this parameter to 0 disables the connection timeout.	Default: 0.0 s Min.: 0.0 Max.: 30.0	–
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	–
F7-50 (1BC1) <8>	BACnet/IP Port	BACnet/IP Port	Sets the UDP port on which the drive will receive incoming BACnet/IP messages.	Default: 47808 Min.: 1024 Max.: 65535	–
F7-51 (1BE9) <8>	BBMD Foreign Register Addr 1	BBMD IP Addr 1	Sets first octet of the IP Address of the BBMD device to which this unit will register as a foreign device.	Default: 0 Min.: 0 Max.: 255	–
F7-52 (1BEA) <8>	BBMD Foreign Register Addr 2	BBMD IP Addr 2	Sets second octet of the IP Address of the BBMD device to which this unit will register as a foreign device.	Default: 0 Min.: 0 Max.: 255	–

No. (Addr. Hex)	Name	LCD Display	Description	Values	Page
F7-53 (1BEB) <8>	BBMD Foreign Register Addr 3	BBMD IP Addr 3	Sets third octet of the IP Address of the BBMD device to which this unit will register as a foreign device.	Default: 0 Min.: 0 Max.: 255	–
F7-54 (1BEC) <8>	BBMD Foreign Register Addr 4	BBMD IP Addr 4	Sets fourth octet of the IP Address of the BBMD device to which this unit will register as a foreign device.	Default: 0 Min.: 0 Max.: 255	–
F7-55 (1BED) <8>	BBMD Foreign Register Port #	BBMD Port #	Sets the UDP port of the BBMD device to which this unit will register.	Default: 47808 Min.: 1024 Max.: 65535	–
F7-56 (1BEE) <8>	BBMD Foreign Register Time	BBMD Register Tm	Sets the time interval in which this unit will repeat BBMD foreign registration.	Default: 3600 Min.: 0 Max.: 65535	–
F7-57 (1BEF) <8>	BACnet/IP bUS Timeout Value	B/IP bUS Flt Tim	Sets the length of time that this unit will wait after it receives Run command or frequency reference command before it will detect a bUS fault.	Default: 3600 Min.: 0 Max.: 65535	–

<1> When using this setting, be sure to take safety measures, such as installing an emergency stop switch. The drive will continue to operate when a fault is detected.

<2> Values shown are for the MECHATROLINK-II option (SI-T3). Values for MECHATROLINK-III option (SI-ET3) are:
Min: 03
Max.: EF

<3> Parameter setting value is not reset to the default value when the drive is initialized.

<4> Cycle power for setting changes to take effect.

<5> When setting F7-13 to 0, all IP addresses (F7-01 to F7-04) must be unique.

<6> When setting F7-13 to 0, also set parameters F7-01 to F7-12.

<7> When F7-14 is set to 0 or 2, be sure to also set F7-15.

<8> Available in drive software versions PRG: 6117 and later.

B.8 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 286 to 289 for descriptions of setting values. **Note:** Set unused terminals to F.	Default: 40 (F) <1> Min.: 1 Max.: B2	–
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 286 to 289 for descriptions of setting values. **Note:** Set unused terminals to F.	Default: 41 (F) <1> Min.: 1 Max.: B2	–
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 286 to 289 for descriptions of setting values. **Note:** Set unused terminals to F.	Default: 24 Min.: 0 Max.: B2	–
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 286 to 289 for descriptions of setting values. **Note:** Set unused terminals to F.	Default: 14 Min.: 0 Max.: B2	–
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 286 to 289 for descriptions of setting values. **Note:** Set unused terminals to F.	Default: 3 (0) <1> Min.: 0 Max.: B2	–
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 286 to 289 for descriptions of setting values. **Note:** Set unused terminals to F.	Default: 4 (3) <1> Min.: 0 Max.: B2	–
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 286 to 289 for descriptions of setting values. **Note:** Set unused terminals to F.	Default: 6 (4) <1> Min.: 0 Max.: B2	–
H1-08 (0405)	Multi-Function Digital Input Terminal S8 Function Selection	Term S8 Func Sel	Assigns a function to the multi-function digital inputs. Refer to pages 286 to 289 for descriptions of setting values. **Note:** Set unused terminals to F.	Default: 8 Min.: 0 Max.: B2	–

<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.	–
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.	–

H1 Multi-Function Digital Input Selections				
H1-□□ Setting	Function	LCD Display	Description	Page
B	Drive overheat alarm (oH2)	OH2 Alarm Signal	Closed: Closes when an oH2 alarm occurs. An external device has triggered an oH2 alarm. Sets Drive Overheat Pre-alarm Multi-Function Digital Output 20H.	–
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 it can be used as digital input for the controller to which the drive is connected.	–
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	–
1B	Program lockout	Program Lockout	Open: Parameters cannot be edited (except for U1-01 if the reference source is assigned to the HOA keypad). Closed: Parameters can be edited and saved.	–
1E	Reference sample hold	Ref Sample Hold	Closed: Samples the analog frequency reference and operates the drive at that speed.	–
20 to 2F	External fault	External fault 20: NO/Always Det, Ramp to Stop 21: NC/Always Det, Ramp to Stop 22: NO/During RUN, Ramp to Stop 23: N.C., During run, ramp to stop 24: NO/ Always Det, Coast to Stop 25: NC/Always Det, Coast to Stop 26: NO/During RUN, Coast to Stop 27: NC/During RUN, Coast to Stop 28: NO/Always Det, Fast-Stop 29: NC/Always Det, Fast-Stop 2A: NO/During RUN, Fast-Stop 2B: NC/During RUN, Fast- Stop 2C: NO/Always Det, Alarm Only 2D: NC/Always Det, Alarm Only 2E: NO/ During RUN, Alarm Only 2F: NC/During RUN, Alarm Only	20: N.O., Always detected, ramp to stop 21: N.C., Always detected, ramp to stop 22: N.O., During run, ramp to stop 23: N.C., During run, ramp to stop 24: N.O., Always detected, coast to stop 25: N.C., Always detected, coast to stop 26: N.O., During run, coast to stop 27: N.C., During run, coast to stop 28: N.O., Always detected, Fast Stop 29: N.C., Always detected, Fast Stop 2A: N.O., During run, Fast Stop 2B: N.C., During run, Fast Stop 2C: N.O., Always detected, alarm only (continue running) 2D: N.C., Always detected, alarm only (continue running) 2E: N.O., During run, alarm only (continue running) 2F: N.C., During run, alarm only (continue running)	–
30	PID integral reset	PID Intgrl Reset	Closed: Resets the PID control integral value.	–

H1 Multi-Function Digital Input Selections				
H1-□□ Setting	**Function**	**LCD Display**	**Description**	**Page**
31	PID integral hold	PID Intgrl Hold	Open: Performs integral operation. Closed: Maintains the current PID control integral value.	–
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.	–
44	Offset frequency 1	Offset Freq 1	Closed: Adds d7-01 to the frequency reference.	–
45	Offset frequency 2	Offset Freq 2	Closed: Adds d7-02 to the frequency reference.	–
46	Offset frequency 3	Offset Freq 3	Closed: Adds d7-03 to the frequency reference.	–
47	Node setup	CanOpenNID Setup	Closed: Node setup for SI-S3 enabled.	–
50	Motor Pre-Heat 2	Motor Preheat 2	Closed: Triggers Motor Pre-Heat 2.	–
51	Sequence Timer Disable	SeqTimer Disable	Closed: Drive ignores sequence timers and runs normally.	–
52	Sequence Timer Cancel	SeqTimer Cancel	Closed: Sequence Timer Cancel .	–
60	Motor pre-heat 1	DCInj Activate	Closed: Triggers Motor pre-heat 1.	–
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.	–
67	Communications test mode	Comm Test Mode	Tests the MEMOBUS/Modbus RS-422/RS-485 interface. Displays “PASS” if the test completes successfully.	–
69	Jog 2	Jog 2	Cause the drive to ramp to the jog frequency (d1-17).	–
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.	–
6D	AUTO mode select	AUTO Mode Sel	Legacy Operation Mode (S5-04 = 0) • Open: HAND reference is selected (based on S5-01) • Closed: AUTO reference is selected (based on b1-01) Normal Operation Mode (S5-04 ≠ 0) **Note:** The drive will always be in AUTO mode at power up when S5-04 is set to 1. • Open: Drive is in OFF or HAND mode. • Closed: Drive is in AUTO mode (when HAND mode select input is open)	–
6E	HAND mode select	HAND Mode Se	Legacy Operation Mode (S5-04 = 0) • Open: AUTO reference is selected (based on b1-01) • Closed: HAND reference is selected (based on S5-01) Normal Operation Mode (S5-04 ≠ 0) **Note:** The drive will always be in AUTO mode at power up when S5-04 is set to 1. • Open: Drive is in OFF or AUTO mode. • Closed: Drive is in HAND mode. (when AUTO mode select input is open)	–

H1 Multi-Function Digital Input Selections				
H1-□□ Setting	**Function**	**LCD Display**	**Description**	**Page**
70	Drive Enable2	Drive Enable 2	Prevents the Drive from executing a Run command until the Drive Enable2 input is closed. When the Drive Enable2 input is open and a Run command is closed, the drive LCD will display “dnE”. The drive will run when the Run and Drive Enable2 inputs are both closed. If the Drive Enable2 input is opened while the drive is running, the drive will stop using the method set by parameter b1-03.	–
A4	BP Customer Safeties	BP Emg Override	Closed: Indicates that customer safeties are in place.	–
A5	BP Drive/Bypass Select	BP Drv/Bypss Sel	Open: Bypass mode. Closed: Drive mode.	–
A6	BP BAS Interlock Input	BP BAS Interlock	Closed: Indicates that the dampers are open	–
A7	BP Customer Safeties	BP Cust Safeties	Closed: Indicates that customer safeties are in place.	–
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 PID 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 PID 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 PID controller (b5-□□).	–
AE	BP Bypass Run	BP Bypass Run	Closed: Commands a Run (via closing the BP Bypass Relay multi-function output) when in Bypass mode.	–
AF	Emergency Override Forward Run	EmergOverrideFWD	Closed: Emergency Override Forward Run	–
B0	Emergency Override Reverse Run	EmergOverrideREV	Closed: Emergency Override Reverse Run	–
B1	Customer Safeties	CustomerSafeties	The functionality is identical to Drive Enable 2 (H1-□□ = 70), except for the following characteristics: • The stopping method is forced to Coast to Stop when the input is open • The drive will display a “SAFE” alarm if the input is open when a Run command is present. It will not display “dnE”. Open: Customer Safeties are open. Drive will not run. Stopping method is Coast to Stop. Closed: Customer Safeties are in place.	–
B2	BAS Interlock	BAS Interlock	Open: Damper interlock is not closed. Drive output is shut off (baseblocked). The drive displays an "inTLK" message if a Run command is present. It will not display "dnE". Closed: Damper interlock is closed. Drive operates normally. **Note:** The state of the BAS Interlock multi-function input has no effect on the Emergency Override multi-function inputs (H1-□□ = AF, B0). The Emergency Override command is accepted when the BAS Interlock digital input is open or closed.	–

◆ 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 290 to 292 for descriptions of setting values.	Default: 0 Range: 0 to 1B6	–
H2-02 (040C)	Terminal M3-M4 function selection (relay)	M3/M4 Func Sel		Default: 1 Range: 0 to 1B6	–
H2-03 (040D)	Terminal MD-ME-MF function selection (relay)	MD/ME/MF FuncSel		Default: 2 Range: 0 to 1B6	–
H2-06 (0437)	Power Consumption Output Unit Selection	Pwr Mon Unit Sel	Sets the units for the output signal when Power Consumption Pulse Output or Regenerated Power Pulse Output are selected as the digital output (H2-01, H2-02, or H2-03 = 39 or 3A). 0: 0.1 kWh units <1> 1: 1 kWh units 2: 10 kWh units 3: 100 kWh units 4: 1000 kWh units	Default: 1 Range: 0 to 4	–
H2-07 (0B3A)	MEMOBUS Register 1 Address Select	MFDO Regs1 Addr	Sets the addresses of the MEMOBUS/Modbus registers from which data will be sent to contact outputs 62 and 162.	Default: 1 Range: 1 to 1FFFH	–
H2-08 (0B3B)	MEMOBUS Register 1 Bit Select	MFDO Regs1 Bit	Sets the bits for the MEMOBUS/Modbus registers from which data will be sent to contact outputs 62 and 162.	Default: 0 Range: 0 to FFFFH	–
H2-09 (0B3C)	MEMOBUS Register 2 Address Select	MFDO Regs2 Addr	Sets the addresses of the MEMOBUS/Modbus registers from which data will be sent to contact outputs 63 and 163.	Default: 1 Range: 1 to 1FFFH	–
H2-10 (0B3D)	MEMOBUS Register 2 Bit Select	MFDO Regs2 Bit	Sets the bits for the MEMOBUS/Modbus registers from which data will be sent to contact outputs 63 and 163.	Default: 0 Range: 0 to FFFFH	–

<1> Available in drive software versions PRG: 6113 and later.

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	During Power Supply Voltage Fault	Power Supply Err	Closed: One of the following faults will occur: AUv (Power Supply Undervoltage), Uv (Undervoltage). or Fdv (Power Supply Frequency Fault).	–
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). Closed: HOA keypad 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). Closed: HOA keypad 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.	–
E	Fault	Fault	Closed: Fault occurred.	–

H2 Multi-Function Digital Output Settings				
H2-□□ Setting	Function	LCD Display	Description	Page
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.	–
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.	–
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: The heatsink temperature exceeds the L8-02 level (while L8-03 = 3, 4), or an external device has triggered an oH2 alarm via multi-function input H1-□□ = BH.	–
2F	Maintenance period	Maintenance	Closed: Cooling fan, capacitor for the control power supply, or the soft charge bypass relay may require maintenance.	–
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	Power consumption pulse output	Energy Pulse Out	Outputs a pulse to indicate the power consumed. Output units are determined by H2-06. Outputs a pulse every 200 ms to indicate the kWh count.	–
3A	Regenerated power pulse output	RegEn Pulse Out	Outputs a pulse to indicate the regenerated power. Output units are determined by H2-06. Outputs a pule every 200 ms to indicate kWh count.	–
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.	–
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. An oH pre-alarm is present after 10 output frequency reduction cycles have passed (L8-03 = 4).	–
50	Waiting for run	Waiting for Run	Closed: Delay executing any run command until the time set to b1-11 has expired.	–
51	Sequence timer 1 active	SeqTimer Disable	Closed: Sequence timer 1 is active.	–
52	Sequence timer 2 active	SeqTimer Cancel	Closed: Sequence timer 2 is active.	–
53	Sequence timer 3 active	Sequence timer 3	Closed: Sequence timer 3 is active.	–
54	Sequence timer 4 active	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	–
62	MEMOBUS Register 1 (Selected with H2-07 and H2-08)	Memobus Regs1	The contact output is closed when any of the bits specified by H2-08 for the MEMOBUS/Modbus register address set in H2-07 turn on.	–
63	MEMOBUS Register 2 (Selected with H2-09 and H2-10)	Memobus Regs2	The contact output is closed when any of the bits specified by H2-10 for the MEMOBUS/Modbus register address set in H2-09 turn on.	–
64	During Commercial Power Operation	CommerclPwr Mode	Closed: Operating on commercial power.	–
AF	BP Drive Relay Contact	BP Drive Relay	Closed: Line voltage is being supplied to the dive, and the motor is being run via the drive.	–

H2 Multi-Function Digital Output Settings				
H2-□□ Setting	Function	LCD Display	Description	Page
B0	BP Bypass Relay Contact	BP Bypass Relay	Closed: Line voltage is being supplied directly to the motor.	–
B1	BP BAS Interlock Relay Contact	BP BAS Interlock	Closed: Actuation signal for options dampers.	–
B2	BAS Interlock Relay Contact	BAS Interlock	A Run command is active or voltage is output. Actuation signal for damper.	–
B3	Secondary PI Feedback Low	PI2 Feedback Low	Closed: PI2 feedback level is too low.	–
B4	Secondary PI Feedback High	PI2 FeedbackHigh	Closed: The PI2 feedback level is too high.	–
B5	Relay Operator Control	PI2 Disable N.C.	Closed: F1 (F2) key toggle relay output.	–
B6	Drive overheat alarm 2	OH Alarm 2	Closed: An external device triggered an overheat warning in the drive.	–
100 to 1B6	Function 0 to B6 with inverse output Note: A prefix of "!" is added to represent inverse functions on the LCD keypad display. Example: "!Zero speed"	–	Inverts the output switching of the multi-function output functions. Set the last two digits of 1□□ to reverse the output signal of that specific function.	–

◆ 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 with zero limit 1: 0 to 10 V without zero limit 2: 4-20 mA 3: 0-20 mA **Note:** Use jumper switch S1 to set input terminal A1 for current or voltage.	Default: 0 Range: 0 to 3	*170*
H3-02 (0434)	Terminal A1 Function Selection	Term A1 FuncSel	Sets the function of terminal A1.	Default: 0 Range: 0 to 26	*170*
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	*132*
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	*132*
H3-05 (0413)	Terminal A3 Signal Level Selection	Term A3 Signal 0: 0-10V (LowLim=0) 1: 0-10V, (BipolRef) 2: 4-20mA 3: 0-20mA	0: 0 to 10 V 1: -10 to 10 V 2: 4 to 20 mA 3: 0 to 20 mA **Note:** Use jumper switch S1 to set input terminal A3 for current or voltage input signal.	Default: 0 Range: 0 to 3	*171*
H3-06 (0414)	Terminal A3 Function Selection	Terminal A3 Sel	Sets the function of terminal A3.	Default: 2 Range: 0 to 26	*171*
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	–
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	–
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 with zero limit 1: 0 to 10 V without zero limit 2: 4 to 20 mA 3: 0 to 20 mA **Note:** Use jumper switch S1 to set input terminal A2 for current or voltage input signal.	Default: 2 Range: 0 to 3	*171*

No. (Addr. Hex)	Name	LCD Display	Description	Values	Page
H3-10 (0418)	Terminal A2 Function Selection	Term A2 FuncSel	Sets the function of terminal A2.	Default: <1> Range: 0 to 26	171
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	133
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	133
H3-13 (041B)	Analog Input Filter Time Constant	A1/A2 Filter T	Sets a primary delay filter time constant for terminals A1 and A2. Used for noise filtering.	Default: 0.03 s Min.: 0.00 Max.: 2.00	–
H3-14 (041C)	Analog Input Terminal Enable Selection	A1/A2/A3 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 or disabled when a digital input programmed for “Analog input enable” (H1-☐☐ = C) is activated. The terminals not set as the target are not influenced by input signals. 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	TerminalA1Offset	Adds an offset when the analog signal to terminal A1 is at 0 V.	Default: 0 Min.: -500 Max.: 500	–
H3-17 (02F1)	Terminal A2 Offset	TerminalA2Offset	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	TerminalA3Offset	Adds an offset when the analog signal to terminal A3 is at 0 V.	Default: 0 Min.: -500 Max.: 500	–

<1> Default is 0 when b5-01 is set to 0.
Default is B when b5-01 is set to 1 or 3.

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)	172
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%.	172
2	Auxiliary frequency reference 1 (used as a Multi-Step Speed 2)	Aux Reference1	10 V = E1-04 (maximum output frequency)	172
3	Auxiliary frequency reference 2 (3rd step analog)	Aux Reference2	10 V = E1-04 (maximum output frequency)	172
4	Output voltage bias	Voltage Bias	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) 10 V = Motor rated torque (OLV/PM)	–
8	Stall Prevention level during run	Stall Prev Level	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%	172
C	PID setpoint	PID Set Point	10 V = 100%	172

H3 Multi-Function Analog Input Settings				
H3-□□ Setting	Function	LCD Display	Description	Page
D	Frequency bias	Freq Ref Bias 2	10 V = E1-04 (maximum output frequency)	172
E	Motor temperature (PTC input)	Motor PTC	10 V = 100%	–
F	Through mode	Not Used	Set this value when using the terminal in the pass-through mode.	–
16	Differential PID feedback	PID Feedback 2	10 V = 100%	–
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)	–

◆ 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 655	–
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	–
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	–
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 655	–
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	–
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	–
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 20 mA	Default: 0 Range: 0 to 2	–
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	–

◆ H5: MEMOBUS/Modbus Serial Communication

No. (Addr. Hex)	Name	LCD Display	Description	Values	Page
H5-01 (0425) <1>	Drive Slave Address	Serial Comm Adr	Selects drive station slave number (address) for MEMOBUS/ Modbus terminals R+, R-, S+, S-. **Note:** Cycle power for the setting to take effect.	Default: 1F (Hex) Min.: 0 Max.: FF	173
H5-02 (426)	Communication Speed Selection	Serial Baud Rate 0: 1200 bps 1: 2400 bps 2: 4800 bps 3: 9600 bps 4: 19.2 kbps 5: 38.4 kbps 6: 57.6 kbps 7: 76.8 kbps 8: 115.2 kbps	0: 1200 bps 1: 2400 bps 2: 4800 bps 3: 9600 bps 4: 19200 bps 5: 38400 bps 6: 57600 bps 7: 76800 bps 8: 115200 bps **Note:** Cycle power for the setting to take effect.	Default: 3 Range: 0 to 8	173
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 **Note:** Cycle power for the setting to take effect.	Default: 0 Range: 0 to 2	173
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 4: Alarm(d1-04)	0: Ramp to stop 1: Coast to stop 2: Fast Stop 3: Alarm only 4: Run at d1-04	Default: 3 Range: 0 to 4	174
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	174
H5-06 (042A)	Drive Transmit Wait Time	Transmit WaitTIM	Set the wait time between receiving and sending data. **Note:** Cycle power for the setting to take effect.	Default: 5 ms Min.: 5 Max.: 65	174
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. **Note:** Cycle power for the setting to take effect.	Default: 1 Range: 0, 1	174
H5-08 (062D)	Communication Protocol Selection	Protocol Select 0: MEMOBUS 1: N2 2: P1 3: BACnet	Selects the communication protocol. 0: MEMOBUS/Modbus 1: N2 (Metasys) 2: P1 (APOGEE FLN) 3: BACnet	Default: 0 Range: 0 to 3	174
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	175
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	175
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 (same as V7).	Default: 0 Range: 0, 1	175
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	175
H5-14 (310D)	BAC Dev Obj ID 0	BAC Dev Obj Id 0	BACnet device object ID	Default: 1 Range: 0 to FFFF	–
H5-15 (310E)	BAC Dev Obj ID 1	BAC Dev Obj Id 1	BACnet device object ID	Default: 0 Range: 0 to 3F	–

No. (Addr. Hex)	Name	LCD Display	Description	Values	Page
H5-17 (11A1)	Operation Selection when Unable to Write into EEPROM	Busy Enter Sel 0: No ROM Enter 1: RAM Enter	Selects operation when an attempt is made to write data into EEPROM via MEMOBUS/Modbus communications and writing into EEPROM is not possible. There is normally no need to change this parameter from the default value 0: Cannot write into EEPROM 1: Write in RAM only	Default: 0 Range: 0, 1	–
H5-18 (11A2)	Filter Time Constant for Motor Speed Monitoring	MtrSpd Monitor T	Sets the filter time constant for monitoring the motor speed from MEMOBUS/Modbus communications and communication options. Applicable MEMOBUS/Modbus registers are: 3EH, 3FH, 44H, ACH, and ADH	Default: 0 ms Min.: 0 Max.: 100	–

<1> If this parameter is set to 0, the drive will be unable to respond to MEMOBUS/Modbus commands.

B.9 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 4: PM Motor	0: Disabled 1: General purpose motor (standard fan cooled) 4: PM motor with variable torque The drive may not be able to provide protection when using multiple motors, even if overload is enabled in L1-01. Set L1-01 to 0 and install separate thermal relays to each motor.	Default: <1> Range: 0, 1, 4	–
L1-02 (0481)	Motor Overload Protection Time	MOL Time Const	Sets the motor thermal overload protection (oL1) time.	Default: 1.0 min Min.: 1.0 Max.: 5.0	–
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 or H3-10 = E) exceeds the alarm level. 0: Ramp to stop 1: Coast to stop 2: Fast Stop (decelerate to stop using the deceleration time in C1-09) 3: Alarm only ("oH3" will flash)	Default: 3 Range: 0 to 3	–
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, or H3-10 = E) exceeds the oH4 fault level. 0: Ramp to stop 1: Coast to stop 2: Fast Stop (decelerate to stop using the deceleration time in C1-09)	Default: 1 Range: 0 to 2	–
L1-05 (0484)	Motor Temperature Input Filter Time (PTC input)	Mtr Temp Filter	Adjusts the filter for the motor temperature analog input (H3-02, or H3-10 = E).	Default: 0.20 s Min.: 0.00 Max.: 10.00	–
L1-08 (1103)	oL1 Current Level	oL1 Current Lvl	Sets the reference current for motor thermal overload detection for the motor in amperes.	Default: <3> Min.: 10% of drive rated current Max.: 150% of drive rated current <4>	–
L1-13 (046D)	Continuous Electrothermal Operation Selection	Mtr OL Mem Sel 0: Disabled 1: Enabled 2: Enabled(RTC)	0: Disabled 1: Enabled 2: Enable using Real Time Clock	Default: 1 Range: 0 to 2	–

<1> Default setting is determined by parameter A1-02, Control Method Selection.

<3> Default setting is determined by parameter o2-04, Drive Model Selection.

<4> Display is in the following units:
2☐0028, 2☐0042, and 4☐0011 to 4☐0027: 0.01 A units
2☐0054 to 2☐0248 and 4☐0034 to 4☐0414: 0.1 A units

◆ 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	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. Fdv is not detected.	Default: 0 Range: 0 to 2	133
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.	Default: 0.5 s Min.: 0.0 Max.: 2.5	134
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	–
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	–
L2-07 (048B)	Momentary Power Loss Voltage Recovery 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 <2>	–
L2-13 (04CD)	Input Power Frequency Fault Detection Gain	FDV Detect Gain	Set the gain to use to detect power supply frequency fault (Fdv).	Default: 1.0 Min.: 0.1 Max.: 2.0	–
L2-21 (04D5)	Low Input Voltage Detection Level	AVV Detect evel	Set the level at which to detect a low input voltage.	Default: 150 V Min.: 100 V <3> Max.: 230 V <3>	–
L2-27 (04F7)	Power Supply Frequency Fault Detection Width	FDV Detect Width	Sets the frequency width to use to detect power supply frequency fault (Fdv).	Default: 6.0 Hz Min.: 3.0 Hz Max.: 20.0 Hz	–

<1> Default setting is dependent on parameter o2-04, Drive Model Selection.

<2> 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.

<3> Values shown are specific to 200 V class drives. Double the value for 400 V class drives.

◆ L3: Stall Prevention

No. (Addr. Hex)	Name	LCD Display	Description	Values	Page
L3-01 (048F)	Stall Prevention Selection during Acceleration	StallP Accel Sel 0: Disabled 1: General purpose 3: iLim Mode	0: Disabled. 1: General purpose. Acceleration is paused as long as the current is above the L3-02 setting. 3: Enabled (Current Limit). The acceleration rate is automatically adjusted while limiting the output current at the setting value of the stall prevention level (L3-02).	Default: 1 Range: 0, 1, 3 <1>	–
L3-02 (0490)	Stall Prevention Level during Acceleration	StallP Accel Lvl	Used when L3-01 = 1 or 3. 100% is equal to the drive rated current.	Default: <2> Min.: 0% Max.: 150% <2>	–
L3-03 (0491)	Stall Prevention Limit during Acceleration	StallPAccDecLim	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	–
L3-04 (0492)	Stall Prevention Selection during Deceleration	StallP Decel Sel 0: Disabled 1: General purpose 4: High Flux Brake 6: iLim Mode	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. 4: Overexcitation Deceleration. Decelerates while increasing the motor flux 6: Enable (Current Limit). The deceleration rate is automatically adjusted while limiting the regeneration current at the setting value of the stall prevention level (L3-14).	Default: 1 Range: 0, 1, 4, 6 <1>	–

No. (Addr. Hex)	Name	LCD Display	Description	Values	Page
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: 1 Range: 0 to 2	–
L3-06 (0494)	Stall Prevention Level during Run	StallP Run Level	Enabled when L3-05 is set to 1 or 2. 100% is equal to the drive rated current.	Default: <2> Min.: 30% Max.: 150% <2>	–
L3-14 (04E9)	Stall Prevention Level during Deceleration	StallP Decel Lvl	Used when L3-04 = 1. 100% is equal to the drive rated current.	Default: 120% Min.: 80 Max.: 120 <2>	–
L3-22 (04F9)	Deceleration Time at Stall Prevention during Acceleration	PM Acc Stall P T	Sets the deceleration time used for Stall Prevention during acceleration in OLV/PM.	Default: 0.0 s Min.: 0.0 Max.: 6000	–
L3-23 (04FD)	Automatic Reduction Selection for Stall Prevention during Run	CHP Stall P Sel 0: Lv1 set in L3-06 1: Autom. Reduction	0: Sets the Stall Prevention level set in L3-04 that is used throughout the entire frequency range. 1: Automatic Stall Prevention level reduction in the constant output range. The lower limit value is 40% of L3-06.	Default: 0 Range: 0, 1	–
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	–
L3-36 (11D0)	Vibration Suppression Gain during Acceleration (with Current Limit)	ILim Acc Gain	Increase the setting value if oscillation occurs in the output current during acceleration.	Default: 10.0 Min.: 0.0 Max.: 100.0	–
L3-39 (11D3)	Current-limited Integral Time Constant during Acceleration	ILim Acc I Time	Sets the time constant for acceleration rate adjustment for current-limited acceleration.	Default: 100.0 ms Min.: 1.0 Max.: 1000.0	–
L3-40 (11D6)	Current-limited Maximum S-curve Selection during Acceleration	ILimAcc S-Curve 0: Disable 1: Enable	0: Disable 1: Enable	Default: 0 Range: 0, 1	–
L3-41 (11D7)	Vibration Suppression Gain during Deceleration (with Current Limit)	ILim Dec Gain	Increase the setting value if oscillation occurs in the output current during deceleration.	Default: 10.0 Min.: 1.0 Max.: 100.0	–
L3-44 (11D8)	Current-limited Integral Time Constant during Deceleration	ILim Dec I Time	Sets the time constant for deceleration rate adjustment for current-limited deceleration.	Default: 100.0 ms Min.: 1.0 Max.: 1000.0	–
L3-45 (11D9)	Current-limited Maximum S-curve Selection during Deceleration	ILimDec S-Curve 0: Disable 1: Enable	0: Disable 1: Enable Available when L3-04 = 6.	Default: 0 Range: 0, 1	–

<1> The setting range is 0, 1 in OLV/PM control mode.

<2> Upper limit is dependent on parameter L8-38, Frequency Reduction Selection.

◆ L4: Speed Detection

No. (Addr. Hex)	Name	LCD Display	Description	Values	Page
L4-01 (0499)	Speed Agreement Detection Level	Spd Agree Level	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	Sets the hysteresis or allowable margin for speed detection.	Default: 2.0 Hz Min.: 0.0 Max.: 20.0	–
L4-03 (049B)	Speed Agreement Detection Level (+/-)	Spd Agree Lvl+-	Sets the frequency detection level for digital output functions H2-□□ = 13, 14, 15, 16.	Default: 0.0 Hz Min.: -400.0 Max.: 400.0	–

No. (Addr. Hex)	Name	LCD Display	Description	Values	Page
L4-04 (049C)	Speed Agreement Detection Width (+/-)	Spd Agree Wdth+-	Sets the hysteresis or allowable margin for speed detection.	Default: 2.0 kHz 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 continues operation according to the setting of L4-06.	Default: 1 Range: 0, 1	134
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	135
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, oL1, oL2, oL3, STo, Uv1.	Default: 0 Min.: 0 Max.: 10	135
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	175
L5-03 (04A0)	Time to Continue Making Fault Restarts	Max Restart Time	Enabled only when L5-05 is set to 0. Causes a fault if a fault restart cannot occur after the set time passes.	Default: 180.0 s Min.: 0.1 Max.: 600.0	135
L5-04 (046C)	Fault Reset Interval Time	Flt Reset Wait T	Sets the amount of time to wait between performing fault restarts.	Default: 10.0 s Min.: 0.5 Max.: 600.0	176
L5-05 (0467)	Fault Reset Operation Selection	Fault Reset Sel 0: Continuous 1: Use L5-04 Time	0: Continuously attempt to restart while incrementing restart counter only at a successful restart (same as F7 and G7). 1: Attempt to restart with the interval time set in L5-04 and increment the restart counter with each attempt (same as V7).	Default: 1 Range: 0, 1	176

◆ 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 at speed agree (alarm) 10: UL6 at run (alarm) 11: UL6 at speed agree (fault) 12: UL6 at run (fault)	Default: 0 Range: 0 to 12	136
L6-02 (04A2)	Torque Detection Level 1	Torq Det 1 Lvl	Sets the overtorque and undertorque detection level.	Default: 15% Min.: 0 Max.: 300	137

No. (Addr. Hex)	Name	LCD Display	Description	Values	Page
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	137
L6-13 (062E)	Motor Underload Protection Selection	Underload Select 0: Base Freq Enable 1: Max Freq Enable	Sets the motor underload protection (UL□) based on motor load. 0: Overtorque/undertorque detection enabled 1: Base frequency motor load enabled	Default: 0 Range: 0, 1	136
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	136

◆ L8: Drive Protection

No. (Addr. Hex)	Name	LCD Display	Description	Values	Page
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	177
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: 4 Range: 0 to 4	177
L8-06 (04B2)	Input Phase Detection Level	Inp Ph Loss Lvl	When ripple is observed in the DC bus, expansion of the input bias is calculated. This value becomes the input phase if the difference between the maximum and minimum values of the ripple is greater than the value set to L8-06. Detection Level = 100% = Voltage class x $\sqrt{2}$	Default: <1> Min.: 0.0% Max.: 50.0%	178
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	178
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	178
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	179
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: 60 s Min.: 0 Max.: 300	179
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	179
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 reduced to 70% at 0 Hz.	Default: 1 Range: 0, 1	179
L8-18 (04BE)	Software Current Limit Selection	Soft CLA Sel 0: Disabled 1: Enabled	0: Disabled 1: Enabled	Default: <2> Range: 0, 1	179
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: 20.0% Min.: 10.0 Max.: 100.0	180
L8-27 (04DD)	Overcurrent Detection Gain	OC Level	Sets the gain for overcurrent detection as a percentage of the motor rated current. Overcurrent is detected using the lower value between the overcurrent level of the drive or the value set to L8-27.	Default: 300.0% Min.: 0.0 Max.: 400.0	180

No. (Addr. Hex)	Name	LCD Display	Description	Values	Page
L8-29 (04DF)	Current Unbalance Detection (LF2)	LF2 Flt Det Sel 0: Disabled 2: Current Det Type	OLV/PM 0: Disabled 2: Enabled (current detection)	Default: 2 Range: 0, 2	–
L8-32 (04E2)	Main Contactor and Cooling Fan Power Supply Failure Selection	FAN Fault Sel 0: Ramp to stop 1: Coast to stop 2: Fast-Stop	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)	Default: 1 Range: 0 to 2	180
L8-35 (04EC)	Installation Method Selection	Installation Sel 0: IP00/OpenChassis 2: IP20/Nema Type 1 3: Finless/Fin Ext	0: IP00/Open-Chassis enclosure 2: IP20/UL Type 1 enclosure 3: External heatsink installation	Default: <1> <3> <4> Range: 0, 2, 3	181
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: <5> Range: 0 to 2	181
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: 0.50 s Min.: 0.00 Max.: 2.00	181
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	181
L8-97 (3104)	Carrier Frequency Reduction Selection during oH Pre-Alarm	FC Sel dur OHAlm 0: Disabled 1: Enabled	Carrier frequency reduction protection selection. It is reduced to the carrier frequency at oH pre-alarm. 0: Disabled 1: Enabled	Default: 0 Range: 0, 1	–

<1> Default setting is dependent on parameter o2-04, Drive Model Selection.

<2> Default setting value is determined by the drive software version.
PRG: 6113: 0
PRG: 6114 and later: Default setting is dependent on parameter A1-02, Control Method Selection.

<3> Parameter setting value is not reset to the default value when the drive is initialized.

<4> Default setting is determined by parameter o2-04, Drive Model Selection.

<5> Default setting is dependent on parameters A1-02, Control Method Selection, and o2-04, Drive Model Selection.

◆ L9: Drive Protection 2

No. (Addr. Hex)	Name	LCD Display	Description	Values	Page
L9-03 (0819)	Carrier Frequency Reduction Level Selection	Fc ReductLvl Sel 0: Disabled 1: Enabled	Selects the level to start the reduction of the frequency or to clear the current frequency level for the automatic reduction of the carrier frequency. There is normally no need to change this parameter from the default value. 0: Reduces the carrier frequency based on the drive rated current that is not derated. 1: Reduces the carrier frequency based on the drive rated current that is derated by the carrier frequency and the temperature selected for C6-02.	Default: 0 Range: 0, 1	–
L9-12 (0B28) <1>	SoH Alarm Selection during bb	SoH ALM Sel 0: Fault 1: Alarm	Sets the SoH (Snubber Discharge Resistor Overheat) alarm to output a fault or a minor fault during baseblock (bb). 0: Output a fault for an SoH alarm during baseblock (bb). 1: Output a minor fault for an SoH alarm during baseblock (bb).	Default: 0 Range: 0, 1	182

<1> Available in drive software versions PRG: 6113 and later.

B.10 n: Special Adjustment

The n parameters adjust more advanced performance characteristics such as Hunting Prevention, speed feedback detection, High Slip Braking, and Online Tuning for motor line-to-line resistance.

◆ n1: Hunting Prevention

No. (Addr. Hex)	Name	LCD Display	Description	Values	Page
n1-01 (0580)	Hunting Prevention Selection	Hunt Prev Select 0: Disabled 1: Enabled	0: Disabled 1: Enabled	Default: 1 Range: 0, 1	–
n1-02 (0581)	Hunting Prevention Gain Setting	Hunt Prev Gain	If the motor vibrates while lightly loaded, increase the gain by 0.1 until vibration ceases. If the motor stalls, decrease the gain by 0.1 until the stalling ceases.	Default: 1.00 Min.: 0.00 Max.: 2.50	–
n1-03 (0582)	Hunting Prevention Time Constant	Hunt Prev Time	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	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.

◆ n3: Overexcitation Braking

No. (Addr. Hex)	Name	LCD Display	Description	Values	Page
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.: 2.00	–

◆ n8: PM Motor Control Tuning

No. (Addr. Hex)	Name	LCD Display	Description	Values	Page
n8-45 (0538)	Speed Feedback Detection Control Gain	PM Spd Fdbk Gain	OLV/PM Increase this setting if hunting occurs. Decrease to lower the response.	Default: 0.80 Min.: 0.00 Max.: 10.00	–
n8-47 (053A)	Pull-In Current Compensation Time Constant	PM Pull-in I Tc	OLV/PM Sets the time constant to make the pull-in current reference and actual current value agree. Decrease the value if the motor begins to oscillate, and increase the value if it takes too long for the current reference to equal the output current.	Default: 5.0 s Min.: 0.0 Max.: 100.0	–
n8-48 (053B)	Pull-In Current	PM No-load Curr	OLV/PM Defines the d-Axis current reference during no-load operation at a constant speed. Set as a percentage of the motor rated current. Increase this setting if hunting occurs while running at constant speed.	Default: 30% Min.: 20 Max.: 200	–
n8-49 (053C)	d-Axis Current for High Efficiency Control	EnergySav ID Lvl	OLV/PM Sets the d-Axis current reference when running a high load at constant speed. Set as a percentage of the motor rated current.	Default: <1> Min.: -200.0% Max.: 0.0%	–
n8-51 (053E)	Acceleration/ Deceleration Pull-In Current	PM Pull-in I@Acc	OLV/PM Sets the d-Axis current reference during acceleration/ deceleration as a percentage of the motor rated current. Set to a high value when more starting torque is needed.	Default: 50% Min.: 0 Max.: 200	–
n8-54 (056D)	Voltage Error Compensation Time Constant	PM V Error CompT	OLV/PM Adjusts the value when hunting occurs at low speed. If hunting occurs with sudden load changes, increase n8-54 in increments of 0.1. Reduce this setting if oscillation occurs at start.	Default: 1.00 s Min.: 0.00 Max.: 10.00	–

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No. (Addr. Hex)	Name	LCD Display	Description	Values	Page
n8-55 (056E)	Load Inertia	PMLoad wk2 Ratio 0: Less than 1:10 1: 1:10 to 1:30 2: 1:30 to 1:50 3: More than 1:50	OLV/PM Sets the ratio between motor and machine inertia. 0: Lower than 1:10 1: Between 1:10 to 1:30 2: Between 1:30 to 1:50 3: Higher than 1:50	Default: 0 Min.: 0 Max.: 3	–
n8-62 (057D)	Output Voltage Limit	PM Vout Limit	OLV/PM Prevents output voltage saturation. Should be set just below the voltage provided by the input power supply.	Default: 200.0 V <2> Min.: 0.0 Max.: 230.0 <2>	–
n8-63 (057E) <3>	Output Voltage Limit Proportional Gain (for PM Motors)	PM Vout P Gain	OLV/PM Stabilizes constant output. There is normally no need to change this parameter from the default value.	Default: 1.00 Min.: 0.00 Max.: 100.00	–
n8-64 (057F) <3>	Output Voltage Limit Integral Time (for PM Motors)	PM Vout I Time	OLV/PM There is normally no need to change this parameter from the default value.	Default: 0.040 s Min.: 0.000 Max.: 5.000	–
n8-66 (0235) <3>	Output Voltage Limit Output Filter Time Constant (for PM Motors)	VlimFilterTime	OLV/PM There is normally no need to change this parameter from the default value.	Default: 0.001 s Min.: 0.000 Max.: 5.000	–

<1> Default setting is dependent on parameter o2-04, Drive Model Selection.

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

<3> Available in drive software versions PRG: 6114 and later.

B.11 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 Range: 104 to 914	182
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 Monitor	Default: <1> Range: 1 to 5	182
o1-03 (0502)	HOA Keypad 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 or E5-04) 3: User-selected units (set by o1-10 and o1-11)	Default: 0 Range: 0 to 3	183
o1-05 (0504) RUN	LCD Contrast Control	LCD Contrast	Sets the contrast of the LCD operator.	Default: 3 Min.: 0 Max.: 5	–
o1-06 (0517)	User Monitor Selection Mode	Monitor Mode Sel 0: 3 Mon Sequential 1: 3 Mon Selectable	0: 3 Monitor Sequential (Displays the next two sequential monitors) 1: 3 Monitor Selectable (o1-07 and o1-08 selected monitor are shown)	Default: <2> Range: 0, 1	183
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.	Default: <3> Range: 101 to 699	183
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.	Default: <4> Range: 101 to 699	183
o1-09 (051C)	Frequency Reference Display Units	Fref Disp Unit 0: WC 1: PSI 2: GPM 3: °F 4: CFM 5: CMH 6: LPH 7: LPS 8: Bar 9: Pa 10: °C 11: Mtr 12: Ft 13: LPM 14: CMM 15: Custom unit 16: No Unit	Sets unit display for the frequency reference parameters and frequency related monitors when o1-03 > 40. 0: WC (Inch of water) 1: PSI (Pounds per square inch) 2: GPM (Gallons per minute) 3: F (Degrees Fahrenheit) 4: CFM (Cubic feet per minute) 5: CMH (Cubic meters per hour) 6: LPH (Liters per hour) 7: LPS (Liters per second) 8: Bar (Bar) 9: Pa (Pascal) 10: C (Degrees Celsius) 11: Mtr (Meters) 12: Ft (Feet) 13: LPM (Liters per minute) 14: CMM (Cubic meters per minute) 15: Custom units (Determined by o1-12) 16: None	Default: 16 Range: 0 to 16	183
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: <5> Range: 1 to 60000	184
o1-11 (0521)	User-Set Display Units Decimal Display	UserDisp Dec		Default: <5> Range: 0 to 3	184
o1-13 (3105)	Frequency Reference and Frequency Related Monitor Custom Units 1	Fref Cust Unit 1	Sets the customer-specified unit display for the frequency reference parameters and frequency related monitors when o1-03 = 3 and o1-09 = 15 as custom units.	Default: 41 Range: 30 to 7A	184

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No. (Addr. Hex)	Name	LCD Display	Description	Values	Page
o1-14 (3106)	Frequency Reference and Frequency Related Monitor Custom Units 2	Fref Cust Unit 2	Sets the customer-specified unit display for the frequency reference parameters and frequency related monitors when o1-03 = 3 and o1-09 = 15 as custom units	Default: 41 Range: 30 to 7A	184
o1-15 (3107)	Frequency Reference and Frequency Related Monitor Custom Units 3	Fref Cust Unit 3	Sets the customer-specified unit display for the frequency reference parameters and frequency related monitors when o1-03 = 3 and o1-09 = 15 as custom units	Default: 41 Range: 30 to 7A	184
o1-16 (3108)	F1 Key Function Selection	F1 Key Func Sel 0: Standard 1: Mon 2: DRV/BYP 3: RUN BYP 4: RLY	Selects the function of the F1 key and the LCD display text above the F1 key. 0: Standard 1: Monitor 2: Drive/Bypass (DRV/BYP) 3: Bypass Run Command (RUN BYP) 4: Toggle Relay Output (RLY)	Default: 0 Range: 0 to 4	184
o1-17 (3109)	F2 Key Function Selection	F2 Key Func Sel 0: Standard 1: Mon 2: DRV/BYP 3: RUN BYP 4: RLY	Selects the function of the F1 key and the LCD display text above the F1 key. 0: Standard 1: Monitor 2: Drive/Bypass (DRV/BYP) 3: Bypass Run Command (RUN BYP) 4: Toggle Relay Output (RLY)	Default: 0 Range: 0 to 4	184
o1-18 (310A)	User Defined Parameter Upper	Userdefined par1	Allows the user to set values that can be used as reference information.	Default: 0 Range: 0 to 999	184
o1-19 (310B)	User Defined Parameter Lower	Userdefined par2	Allows the user to set values that can be used as reference information.	Default: 0 Range: 0 to 999	184

<1> Default is 1 when b5-01 is set to 0.
Default is 3 when b5-01 is set to 1 or 3.

<2> Default is 0 when b5-01 is set to 0.
Default is 1 when b5-01 is set to 1 or 3.

<3> Default is 102 when b5-01 is set to 0.
Default is 504 when b5-01 is set to 1 or 3.

<4> Default is 102 when b5-01 is set to 0.
Default is 501 when b5-01 is set to 1 or 3.

<5> Default setting is dependent on parameter o1-03, HOA Keypad Display Selection.

◆ o2: HOA Keypad Functions

No. (Addr. Hex)	Name	LCD Display	Description	Values	Page
o2-02 (0506)	OFF Key Function Selection	Oper STOP Key 0: Disabled 1: Enabled	0: Disabled. OFF key is disabled in REMOTE operation. 1: Enabled. OFF key is always enabled.	Default: 1 Range: 0, 1	185
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	137
o2-04 (0508)	Drive Model Selection	Inverter Model #	Enter the drive model. Setting required only if installing a new control board.	Default: Determined by drive capacity	185
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	137
o2-06 (050A)	Operation Selection when HOA Keypad is Disconnected	Oper Discon Det 0: Disabled 1: Enabled	0: The drive continues operating if the HOA keypad is disconnected. 1: An oPr fault is triggered and the motor coasts to stop.	Default: 1 Range: 0, 1	185
o2-07 (0527)	Motor Direction at Power Up when Using Operator	For/RevSel@PwrUp 0: Forward 1: Reverse	0: Forward 1: Reverse This parameter requires assigning drive operation to the HOA keypad.	Default: 0 Range: 0, 1	186

No. (Addr. Hex)	Name	LCD Display	Description	Values	Page
o2-19 (061F)	Selection of Parameter Write during Uv	ParameterSet Sel 0: Disabled 1: Enabled	Determines whether parameter settings can be changed during a control circuit undervoltage condition. To be used with 24 V Power Supply Unit Built-in model. 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 HOA keypad. 2: Copy parameters from the digital operator, writing them to the drive. 3: Verify parameter settings on the drive to check if they match the data saved on the HOA keypad.	Default: 0 Range: 0 to 3	186
o3-02 (0516)	Copy Allowed Selection	Read Allowable 0: Disabled 1: Enabled	0: Read operation prohibited 1: Read operation allowed	Default: 0 Range: 0, 1	186

◆ 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 h Min.: 0 Max.: 9999	186
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	186
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 h Min.: 0 Max.: 9999	187
o4-05 (051D)	Capacitor Maintenance Setting	BusCap Maint Set	Starts estimates for capacitor maintenance times from this setting value. See U4-05 to check when the capacitors may need to be replaced.	Default: 0% Min.: 0 Max.: 150	187
o4-07 (0523)	DC Bus Pre-Charge Relay Maintenance Setting	ChrgCircMaintSet	Starts estimates for soft charge bypass relay maintenance times from this setting value. See U4-06 to check when the bypass relay may need to be replaced.	Default: 0% Min.: 0 Max.: 150	187
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	187
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	187
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	188
o4-17 (3100)	Set/Reset Real Time Clock	Set Time 0: — — 1: Set 2: Reset	Sets the current date and time for the Real Time Clock. 0: — — No Setting 1: Real Time Clock Set 2: Real Time Clock Reset	Default: 0 Range: 0 to 2	188
o4-19 (113A)	Power Unit Price	Energy Price/kWh	Sets the price per 1 kWh to calculate the power rate displayed for total consumed power (U9-07 to U9-10) and total regenerated power (U9-11 to U9-14).	Default: 000.00 Min.: 000.00 Max.: 650.00	–

B.12 S: Special Application

◆ S1: Dynamic Noise Control Function

No. (Addr. Hex)	Name	LCD Display	Description	Values	Page
S1-01 (3200)	Dynamic Audible Noise Control Function Selection	Dyn Noise Ctrl 0: Disabled 1: Enabled	Reduces audible noise by decreasing the output voltage in variable torque applications with light loads. 0: Disabled 1: Enabled	Default: 1 Range: 0, 1	–
S1-02 (3201)	Voltage Reduction Rate	Volt Reduce Amt	Sets the rate at which the output voltage will be reduced as a percentage of the V/f pattern when operating with no load.	Default: 50.0% Min.: 50.0 Max.: 100.0	–
S1-03 (3202)	Voltage Restoration Level	V Reduce On Lvl	Sets the level when the drive should start restoring the voltage as a percentage of the drive rated torque.	Default: 20.0% Min.: 0.0 Max.: 90.0	–
S1-04 (3203)	Voltage Restoration Complete Level	V Reduce Off Lvl	Sets the level at which voltage restoration for the V/f pattern is complete as a percentage of the drive rated torque. If the output torque rises above the value of S1-04, then the voltage will be controlled in a manner specified by the V/f pattern setting.	Default: 50.0% Min.: S1-03 + 10.0 Max.: 100.0	–
S1-05 (3204)	Voltage Restoration Sensitivity Time Constant	Sensitivity Time	Sets the level of sensitivity of the output torque and LPF time constant for the voltage reduction rate. The level of sensitivity can be adjusted in accordance with the load response.	Default: 1.000 s Min.: 0.000 Max.: 3.000	–
S1-06 (3205)	Voltage Restoration Time Constant at Impact	Impact Load Time	Sets the voltage restoration time constant if an impact load is added.	Default: 0.050 s Min.: 0.000 Max.: 1.000	–

◆ S2: Sequence Timers

No. (Addr. Hex)	Name	LCD Display	Description	Values	Page
S2-01 (3206)	Sequence Timer 1 Start Time	Tmr 1 Start Time	Sets the start time for timer 1. The value must be set less than or equal to S2-02.	Default: 00:00 Min.: 00:00 Max.: 24:00	–
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	–
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 - PID Disable	Sets the action that occurs when sequence timers 1 is active. 0: Digital output only 1: Run 2: Run - PID disable	Default: 0 Range: 0 to 2	–
S2-05 (320A)	Sequence Timer 1 Reference Source	Tmr 1 Ref Source 0: Operator (d1-01) 1: Operator (d1-02) 2: Operator (d1-03) 3: Operator (d1-04) 4: Terminals 5: Serial com 6: Option PCB	Selects the frequency reference source used for running the drive when sequence timer 1 is active (only applicable when S2-04 is set to 1 or 2). 0: Operator (d1-01) 1: Operator (d1-02) 2: Operator (d1-03) 3: Operator (d1-04) 4: Terminals 5: Serial communication 6: Option card	Default: 0 Range: 0 to 6	–

No. (Addr. Hex)	Name	LCD Display	Description	Values	Page
S2-06 (320B)	Sequence Timer 2 Start Time	Tmr 2 Start Time	Sets the start time for timer 2. The value must be set less than or equal to S2-07.	Default: 00:00 Min.: 00:00 Max.: 24:00	–
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	–
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 - PID Disable	Sets the action that occurs when sequence timers 2 is active. 0: Digital output only 1: Run 2: Run - PID 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	Selects the frequency reference source used for running the drive when sequence timer 2 is active (only applicable when S2-09 is set to 1 or 2). 0: Operator (d1-01) 1: Operator (d1-02) 2: Operator (d1-03) 3: Operator (d1-04) 4: Terminals 5: Serial communication 6: Option card	Default: 0 Range: 0 to 6	–
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	–
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	–
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 - PID Disable	Sets the action that occurs when sequence timer 3 is active. 0: Digital output only 1: Run 2: Run - PID disable	Default: 0 Range: 0 to 2	–
S2-15 (3214)	Sequence Timer 3 Reference Source	Tmr 3 Ref Source 0: Operator (d1-01) 1: Operator (d1-02) 2: Operator (d1-03) 3: Operator (d1-04) 4: Terminals 5: Serial com 6: Option PCB	Selects the frequency reference source used for running the drive when sequence timer 3 is active (only applicable when S2-14 is set to 1 or 2). 0: Operator (d1-01) 1: Operator (d1-02) 2: Operator (d1-03) 3: Operator (d1-04) 4: Terminals 5: Serial communication 6: Option card	Default: 0 Range: 0 to 6	–
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	–

No. (Addr. Hex)	Name	LCD Display	Description	Values	Page
S2-17 (3216)	Sequence Timer 4 Stop Time	Tmr 4 Stop Time	Sets the stop time for timer 4. The value must be set greater than or equal to S2-16.	Default: 00:00 Min.: 00:00 Max.: 24:00	–
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 - PID Disable	Sets the action that occurs when sequence timer 4 is active. 0: Digital output only 1: Run 2: Run - PID 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	Selects the frequency reference source used for running the drive when sequence timer 4 is active (only applicable when S2-19 is set to 1 or 2). 0: Operator (d1-01) 1: Operator (d1-02) 2: Operator (d1-03) 3: Operator (d1-04) 4: Terminals 5: Serial communication 6: Option card	Default: 0 Range: 0 to 6	–

◆ S3: Secondary PI (PI2) Control

No. (Addr. Hex)	Name	LCD Display	Description	Values	Page
S3-01 (321A) RUN	Secondary PI Enable Selection	PI2 Enable Sel 0: Disabled 1: Always 2: Drive running 3: Motor running	0: Secondary PI disabled 1: Always 2: Drive running 3: Motor running	Default: 0 Range: 0 to 3	–
S3-02 (321B) RUN	Secondary PI User Display	PI2 UsrDspMaxVal	Sets the scale value of 100% PI input.	Default: 10000 Min.: 0 Max.: 60000	–
S3-03 (321C) RUN	Secondary PI Display Digits	PI2 UsrDspDigits 0: No Dec (XXXXX) 1: 1 Dec (XXXX.X) 2. 2 Dec (XXX.XX) 3: 3 Dec (XX.XXX)	0: No decimal places 1: One decimal place 2: Two decimal places 3: Three decimal places	Default: 2 Range: 0 to 3	–
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	–

No. (Addr. Hex)	Name	LCD Display	Description	Values	Page
S3-05 (321E) RUN	Secondary PI Setpoint Value	PI2 Setpoint	Sets the secondary PI controller target value	Default: 0.00 <1> Min.: 0.00 Max.: 600.00 <2>	–
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 0.0s 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: Normal Character 1: Rev Character	0: Normal Output (direct acting) 1: Reverse Output (reverse 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	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	–
S3-17 (322A) RUN	Secondary PI Feedback Detection Selection	PI2 FB Det Sel 0: PI2 Enabled 1: Always	0: Secondary PI enabled 1: Always	Default: 0 Range: 0, 1	–

<1> Unit is determined by S3-04.

<2> Upper limit is S3-02, decimal placeholder is determined by S3-03.

Parameter List

B

◆ S4: Bypass Operation

No. (Addr. Hex)	Name	LCD Display	Description	Values	Page
S4-01 (322B) RUN	BP Auto Transfer on Fault Enable	BP Fault Trnsfer 0: Disabled 1: Enabled	0: No transfer after fault 1: Transfer to bypass after fault	Default: 1 Range: 0, 1	–
S4-02 (322C) RUN	Secondary PI User Display	BP Enrgy Sav Lvl	Delta used to determine when to switch into Energy Save Bypass. This allows for lower frequency output values to also trigger Energy Save Bypass functionality.	Default: 0 Hz Min.: 0 Max.: 20	–
S4-03 (322D) RUN	BP Energy Save Bypass Timer	BP Enrgy Sav TMR	Sets the time in seconds that the drive should run at the specified speed before entering Energy Save Bypass mode.	Default: 60 s Min.: 10 Max.: 60000	–
S4-04 (322E) RUN	BP Energy Save Bypass Speed Increase	BP Enrgy Sav Inc	Sets the value in Hz that the drive will increase the output frequency above E1-04 before performing an Energy Save transfer to bypass.	Default: 6 Hz Min.: 0 Max.: 10	–

◆ S5: HOA Keypad Parameters

No. (Addr. Hex)	Name	LCD Display	Description	Values	Page
S5-01 (322F)	HAND Frequency Reference Selection	HAND Fref Source 0: Operator 1: Terminals 2: d1-16 3: S5-05 4: Set by b1-01	0: HOA keypad 1: Terminals 2: d1-16 3: S5-05 4: Determined by b1-01	Default: 0 Range: 0 to 4	–
S5-02 (3230)	HAND/AUTO During Run Selection	HAND/AUTO @Run 0: Disabled 1: Enabled	0: Disabled 1: Enabled	Default: 1 Range: 0, 1	–
S5-03 (3231) RUN	HAND Mode PI Selection	HAND Mode PI Sel 0: Disabled 1: Enabled	0: Disabled 1: Enabled	Default: 1 Range: 0, 1	–
S5-04 (3232)	HAND Mode Behavior Selection	HAND BehaviorSel 0: Legacy 1: Normal 2: Normal w/ Memory	0: Legacy operation mode 1: Normal operation mode 2: Normal with memory **Note:** The drive will always be in AUTO mode at power up with S5-04 = 1.	Default: 1 Range: 0 to 2	–
S5-05 (3233) RUN	HAND Frequency Reference 1	HAND Freq Ref 2	Sets the frequency reference used in HAND mode when S5-01 is set to 2.	Default: 0.00 Hz Min.: 0.00 Max.: E1-04	–
S5-07 (3235)	HAND Key Function Selection (HOA Keypad)	Oper HAND Key 0: Disabled 1: Enabled	Determines whether the HAND key on the HOA keypad will be enabled for switching between HAND and AUTO. 0: Disabled 1: Enabled	Default: 1 Range: 0, 1	–

◆ S6: Z1000U 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.: E1-04	–
S6-02 (3237)	Emergency Override Reference Selection	E OverrideRefSel 0: Use S6-01 Ref 1: Use AUTO Ref	Selects the frequency reference source for the Emergency Override function (H1-□□= AF or B0). 0: Use S6-01 Reference 1: Use AUTO Reference	Default: 0 Range: 0, 1	–

No. (Addr. Hex)	Name	LCD Display	Description	Values	Page
S6-07 (323C)	Output Phase Loss Detection Level for Dynamic Audible Noise Control	Outp Ph Loss Lv1	Sets the output phase loss detection level for Dynamic Audible Noise Control. Decrease the setting in steps of 10% when output phase loss is detected erroneously. This setting rarely needs to be changed.	Default: 100.0% Min.: 10.0 Max.: 100.0	–

B.13 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) <1>	Auto-Tuning Mode Selection	Tuning Mode Sel 2: Term Resistance 3: On-DelayCompTune	2: Stationary Auto-Tuning for Line-to-Line Resistance 3: Rotational Auto-Tuning for V/f Control Energy Saving	Default: 2 Range: 2, 3	143
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	143
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>	144
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	144
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	144
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	144
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.: 14400	144
T1-11 (070B)	Motor Iron Loss	Mtr Iron Loss(W)	Sets the iron loss for determining the Energy Saving coefficient. The value is set to E2-10 (motor iron loss) set when the power is cycled. If T1-02 is changed, a default value appropriate for the motor capacity that was entered will appear.	Default: <4> Min.: 0 Max.: 65535	144
T1-12 (FFF0)	T1 Tuning Start	Tuning Ready	The drive starts tuning.	No setting available	144

<1> The availability of certain Auto-Tuning methods depends on the control mode selected for the drive.

<2> Default setting is dependent on parameter o2-04, Drive Model Selection.

<3> Values shown are specific to 200 V class drives. Double the value for 400 V class drives.

<4> Default setting value differs depending on the motor code value, motor parameter settings, and E2-11, Motor Rated Power.

◆ T2: PM Motor Auto-Tuning

No. (Addr. Hex)	Name	LCD Display	Description	Values	Page
T2-01 (0750)	PM Motor Auto-Tuning Mode Selection	PM Tuning Mode 0: Standard Tuning 1: Tune-No Rotate 2: Term Resistance 14: PM Rotation Tune	OLV/PM 0: PM Motor Parameter Settings 1: PM Stationary Auto-Tuning 2: PM Stationary Auto-Tuning for Stator Resistance 14: PM Rotational Auto-Tuning	Default: 0 Range: 0 to 2; 14	–
T2-02 (0751)	PM Motor Code Selection	PM Mtr Code Sel	OLV/PM Enter the motor code when using a Yaskawa PM motor. After entering the motor code, the drive automatically sets parameters T2-03 through T2-09. Set parameters T2-10 to T2-14 according the motor nameplate or the motor test report. When using a motor without a supported motor code or a non-Yaskawa motor, set FFFF and adjust the other T2 parameters according to the motor nameplate or the motor test report.	Default: <1> Min: 0000 Max: FFFF	–
T2-03 (0752)	PM Motor Type	PM Motor Type 0: IPM motor 1: SPM motor	OLV/PM 0: IPM motor 1: SPM motor	Default: 1 Range: 0, 1	–
T2-04 (0730)	PM Motor Rated Power	Mtr Rated Power	OLV/PM Sets the motor rated power. **Note:** Use the following formula to convert horsepower into kilowatts: 1HP = 0.746 kW.	Default: <1> Min.: 0.00 kW Max.: 650.00 kW	–
T2-05 (0732)	PM Motor Rated Voltage	Rated Voltage	OLV/PM Enter the motor rated voltage as indicated on the motor nameplate.	Default: 200.0 V <2> Min.: 0.0 Max.: 255.0 <2>	–
T2-06 (0733)	PM Motor Rated Current	Rated Current	OLV/PM Enter the motor rated current as indicated on the motor nameplate.	Default: <1> Min.: 10% of drive rated current Max.: 150% of drive rated current	–
T2-07 (0753)	PM Motor Base Frequency	Base Frequency	OLV/PM Enter the motor base frequency as indicated on the motor nameplate.	Default: 87.5 Hz Min.: 0.0 Max.: 400.0	–
T2-08 (0734)	Number of PM Motor Poles	Number of Poles	OLV/PM Enter the number of motor poles for the PM motor as indicated on the motor nameplate.	Default: 6 Min.: 2 Max.: 48	–
T2-10 (0754)	PM Motor Stator Resistance	Arm Resistance	OLV/PM Enter the rotor resistance for the PM motor as indicated on the motor nameplate.	Default: <3> Min.: 0.000 Ω Max.: 65.000 Ω	–
T2-11 (0735)	PM Motor d-Axis Inductance	d-Axis Induct	OLV/PM Enter the d-axis inductance for the PM motor as indicated on the motor nameplate.	Default: <3> Min.: 0.00 mH Max.: 600.00 mH	–
T2-12 (0736)	PM Motor q-Axis Inductance	q-Axis Induct	OLV/PM Enter the q-axis inductance for the PM motor as indicated on the motor nameplate.	Default: <3> Min.: 0.00 mH Max.: 600.00 mH	–
T2-13 (0755)	Induced Voltage Constant Unit Selection	Iduct Volt Unit 0: mV/RPM 1: mV/(rad/sec)	OLV/PM 0: mV/(r/min). E5-09 will automatically be set to 0.0, and E5-24 will be used. 1: mV/(rad/sec). E5-24 will automatically be set to 0.0, and E5-09 will be used.	Default: 1 Range: 0, 1	–

B.13 T: Motor Tuning

No. (Addr. Hex)	Name	LCD Display	Description	Values	Page
T2-14 (0737)	PM Motor Induced Voltage Constant	Induct Volt Coef	OLV/PM Enter the induced voltage coefficient for the PM motor as indicated on the motor nameplate. Setting units are determined by parameter T2-13, Induced Voltage Constant Unit Selection.	Default: <3> Min.: 0.1 Max.: 2000.0	–
T2-15 (0756)	Pull-In Current Level for PM Motor Tuning	Pull-In I Lvl	OLV/PM Sets the amount of pull-in current to use for Auto-Tuning as a percentage of the motor rated current. Increase this setting for high inertia loads.	Default: 30% Min.: 0 Max.: 120	–

<1> Default setting is determined by parameter o2-04, Drive Model Selection.

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

<3> Default setting is dependent on parameter T2-02, PM Motor Code Selection, and the drive capacity.

B.14 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	No signal output available	–
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 rated power (kW)	<4>
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)	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 MD-ME-MF) 1 Multi-Function Digital Output (terminal M1-M2) 1 Multi-Function Digital Output (terminal M3-M4) 0 Not Used 1 Fault Relay (terminal MA-MC closed MA/MB-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% (-10 to +10 V)	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
U1-17 (0058)	DI-A3 Input Status	DI Opt Status	Displays the reference value input from the DI-A3 option card. Display will appear in hexadecimal as determined by the digital card input selection in F3-01. 3FFFF: Set (1 bit) + sign (1 bit) + 16 bit	No signal output available	–
U1-18 (0061)	oPE Fault Parameter	OPE Error Code	Displays the parameter number that caused the oPE□□ or Err (EEPROM write error) error.	No signal output available	–
U1-19 (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	–
U1-21 (0077)	AI-A3 Terminal V1 Input Voltage Monitor	AI Opt Ch1 Level	Displays the input voltage to terminal V1 on analog input card AI-A3.	10 V: 100% (-10 to +10 V)	0.1%
U1-22 (072A)	AI-A3 Terminal V2 Input Voltage Monitor	AI Opt Ch2 Level	Displays the input voltage to terminal V2 on analog input card AI-A3.	10 V: 100% (-10 to +10 V)	0.1%
U1-23 (072B)	AI-A3 Terminal V3 Input Voltage Monitor	AI Opt Ch3 Level	Displays the input voltage to terminal V3 on analog input card AI-A3.	10 V: 100% (-10 to +10 V)	0.1%
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	–
U1-27 (07A8)	Message ID (OPR)	MessageID(OPR)	OPR ID	No signal output available	–
U1-28 (07A9)	Message ID (INV)	MessageID(DRV)	INV ID	No signal output available	–
U1-54 (1083)	Drive Input Power Voltage Effective Value	PowerSupply Volt	Displays the effective value of the drive input power voltage.	200 V class 10 V: 400 V 400 V class 10 V: 800 V	1 V
U1-58 (1087)	Power Supply Frequency	PoweSupply Freq	Displays the frequency of the drive input power supply.	10 V: Rated frequency	0.1 Hz

No. (Addr. Hex)	Name	LCD Display	Description	Analog Output Level	Unit
U1-72 (1095)	Input Power Supply Information	Power Supply Sts	Displays information on the input power supply. U1-72=00000000 Bit 0: AUv reset. (0: Not completed, 1: Reset) Bit 1: PF reset (0: Not completed, 1: Reset) Bit 2: Rated frequency detection (0: Not completed, 1: Completed) Bit 3: Phase order detection (0: Not completed, 1: Completed) Bit 4: Power supply established (0: Not completed, 1: Completed) Bit 5: Fdv detection (0: Not detected, 1: Detected) Bit 6: PF detection (0: Not detected, 1: Detected) Bit 7: Reserved.	No signal output available	–

<1> Display is in the following units:
2□0028, 2□0042, and 4□0011 to 4□0027: 0.01 A units
2□0054 to 2□0248 and 4□0034 to 4□0414: 0.1 A units

<2> When reading the value of this monitor via MEMOBUS/Modbus, a value of 8192 is equal to 100% of the drive rated output current.

<3> Values shown are specific to 200 V class drives. Double the value for 400 V class drives.

<4> Display is in the following units:
2□0028, 2□0042, and 4□0011 to 4□0027: 0.01 kW units
2□0054 to 2□0248 and 4□0034 to 4□0414: 0.1 kW units

◆ 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
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)	Control Circuit DC Voltage at Previous Fault	DC Bus Voltage	Displays the control circuit DC 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
U2-11 (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/PM 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

No. (Addr. Hex)	Name	LCD Display	Description	Analog Output Level	Unit
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	–
U2-50 (085C)	Input Power Supply	Power Supply Sts	Information at Previous Fault Displays the input power supply information at the previous fault. Displayed as in U1-72.	No signal output available	–
U2-54 (0843)	Power Supply Voltage at Previous Fault	PowerSupply Volt	Displays the power supply voltage at the previous fault. Displayed as in U1-54.	No signal output available	1 V
U2-58 (0847)	Power Supply Frequency at Previous Fault	PowerSupply Freq	Displays the power supply frequency at the previous fault. Displayed as in U1-58.	No signal output available	0.1 Hz

<1> Display is in the following units:
2☐0028, 2☐0042, and 4☐0011 to 4☐0027: 0.01 A units
2☐0054 to 2☐0248 and 4☐0034 to 4☐0414: 0.1 A units

<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 (0090 to 0093 (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	–
U3-11 to U3-14 (0094 to 0097 (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	–

No. (Addr. Hex)	Name	LCD Display	Description	Analog Output Level	Unit
U3-29 (3013)	Time Hours and Minutes at 3rd Most Recent Fault	Fault 3 HHMM	Displays the time when the third most recent fault occurred.	No signal output available	–
U3-30 (3014)	Date Year at 4th Most Recent Fault	Fault 4 YYYY	Displays the year when the fourth most recent fault occurred.	No signal output available	–
U3-31 (3015)	Date Month and Day at 4th Most Recent Fault	Fault 4 MMDD	Displays the date and day when the fourth most recent fault occurred.	No signal output available	–
U3-32 (3016)	Time Hours and Minutes at 4th Most Recent Fault	Fault 4 HHMM	Displays the time when the fourth most recent fault occurred.	No signal output available	–
U3-33 (3017)	Date Year at 5th Most Recent Fault	Fault 5 YYYY	Displays the year when the fifth most recent fault occurred.	No signal output available	–
U3-34 (3018)	Date Month and Day at 5th Most Recent Fault	Fault 5 MMDD	Displays the date and day when the fifth most recent fault occurred.	No signal output available	–
U3-35 (3019)	Time Hours and Minutes at 5th Most Recent Fault	Fault 5 HHMM	Displays the time when the fifth most recent fault occurred.	No signal output available	–
U3-36 (301A)	Date Year at 6th Most Recent Fault	Fault 6 YYYY	Displays the year when the sixth most recent fault occurred.	No signal output available	–
U3-37 (301B)	Date Month and Day a 6th Most Recent Fault	Fault 6 MMDD	Displays the date and day when the sixth most recent fault occurred.	No signal output available	–
U3-38 (301C)	Time Hours and Minutes at 6th Most Recent Fault	Fault 6 HHMM	Displays the time when the most sixth recent fault occurred.	No signal output available	–
U3-39 (301D)	Date Year at 7th Most Recent Fault	Fault 7 YYYY	Displays the year when the most seventh recent fault occurred.	No signal output available	–
U3-40 (301E)	Date Month and Day at 7th Most Recent Fault	Fault 7 MMDD	Displays the date and day when the seventh most recent fault occurred.	No signal output available	–
U3-41 (301F)	Time Hours and Minutes at 7th Most Recent Fault	Fault 7 HHMM	Displays the time when the seventh most recent fault occurred.	No signal output available	–
U3-42 (3020)	Date Year at 8th Most Recent Fault	Fault 8 YYYY	Displays the year when the eighth most recent fault occurred.	No signal output available	–
U3-43 (3021)	Date Month and Day 8th at Most Recent Fault	Fault 8 MMDD	Displays the date and day when the eighth most recent fault occurred.	No signal output available	–
U3-44 (3022)	Time Hours and Minutes at 8th Most Recent Fault	Fault 8 HHMM	Displays the time when the eighth most recent fault occurred.	No signal output available	–
U3-45 (3023)	Date Year at 9th Most Recent Fault	Fault 9 YYYY	Displays the year when the ninth most recent fault occurred.	No signal output available	–
U3-46 (3024)	Date Month and Day at 9th Most Recent Fault	Fault 9 MMDD	Displays the date and day when the ninth most recent fault occurred.	No signal output available	–
U3-47 (3025)	Time Hours and Minutes at 9th Most Recent Fault	Fault 9 HHMM	Displays the time when the ninth most recent fault occurred.	No signal output available	–
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 default value is 0. The value counts up from 0. 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. The default value is 0. The 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. The default value is 0. The 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. The default value is 0. The value counts up from 0. Parameter o4-03 can be used to reset this monitor.	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. The default value is 0. The value counts up from 0. Parameter o4-05 can be used to reset this monitor.	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. The default value is 0. The value counts up from 0. Parameter o4-07 can be used to reset this monitor.	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.	No signal output available	–
U4-10 (005C)	kWh, Lower 4 Digits	kWh Lower 4 dig	Monitors the drive output power. The value is shown as a 9-digit number displayed across two monitor parameters, U4-10 and U4-11. Example: 12345678.9 kWh is displayed as: U4-10: 678.9 kWh U4-11: 12345 MWh	No signal output available	1 kWh
U4-11 (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> <2>
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:** 0 = OFF 1 = AUTO 2 = HAND **Y-nn: indicates the reference source** 0-01 = HOA keypad 1-00 = Analog (not assigned) 1-01 = Analog (terminal A1) 1-02 = Analog (terminal A2) 2-02 to 17 = Multi-step speed (d1-02 to 17) 3-01 = MEMOBUS/Modbus communications 4-01 = Communication option card 9-01 = Up/Down	No signal output available	–
U4-19 (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	–

No. (Addr. Hex)	Name	LCD Display	Description	Analog Output Level	Unit
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:** 0 = OFF 1 = AUTO 2 = HAND **Y: Input power supply data** 0 = HOA keypad 1 = External terminals 3 = Serial communications (APOGEE FLN, BACnet, MEMOBUS/Modbus, or Metasys N2) 4 = Communication option card **nn: Run command limit status data** 00: No limit status. 01: Run command was left on when stopped in the PRG mode 02: Run command was left on when switching from LOCAL to REMOTE operation 03: Waiting for soft charge bypass contactor after power up (Uv or Uv1 flashes after 10 s) 04: Waiting for “Run command prohibited” time period to end 05: Fast Stop (digital input, HOA keypad) 06: b1-17 (Run command given at power-up) 07: During baseblock while coast to stop with timer 08: Frequency reference is below minimal reference during baseblock 09: Waiting for Enter command	No signal output available	–
U4-22 (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	–

<1> Display is in the following units:
2□0028, 2□0042, and 4□0011 to 4□0027: 0.01 A units
2□0054 to 2□0248 and 4□0034 to 4□0414: 0.1 A units

<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.

◆ U5: PID Monitors

No. (Addr. Hex)	Name	LCD Display	Description	Analog Output Level	Unit
U5-01 (0057)	PID Feedback	PID Feedback 1	Displays the PID feedback value.	10 V: 100%	0.01%
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%
U5-05 (07D2)	PID Differential Feedback	PID Feedback 2	Displays the second 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 PID Square Root Feedback or Differential Feedback are enabled, U5-01 ≠ U5-06. If PID Square Root Feedback or Differential Feedback are NOT enabled, U5-01= U5-06.	10 V: 100%	0.01%
U5-07 (72)	AUTO Mode Frequency Reference Value	AUTO mode Fref	Displays the Frequency reference value at AUTO Mode.	No signal output available	0.01 Hz
U5-08 (0073)	HAND Mode Frequency Reference Value	HAND mode Fref	Displays the Frequency reference value at HAND Mode.	No signal output available	0.01 Hz
U5-14 (086B)	PID Output Upper 4 Digits	PID Output U4	Displays Custom PID output. U5-14 shows the upper 4 digits.	10V: (b5-43 x 10000) + b5-44 <1>	1

No. (Addr. Hex)	Name	LCD Display	Description	Analog Output Level	Unit
U5-15 (086C)	PID Output Lower 4 Digits	PID Output L4	Displays Custom PID output. U5-15 shows the lower 4 digits.	No signal output available	0.01
U5-17 (302A)	PI2 Setpoint	PI2 Set-point	Displays the secondary PI setpoint.	10 V: Max frequency	0.01%
U5-18 (302B)	PI2 Feedback	PI2 Feedback	Displays the secondary PI feedback value.	10 V: Max frequency	0.01%
U5-19 (302C)	PI2 Input	PI2 Input	Displays the secondary PI input (deviation between PID target and feedback).	10 V: Max frequency	0.01%
U5-20 (302D)	PI2 Output	PI2 Output	Displays the secondary PI control output.	10 V: Max frequency	0.01%
U5-30 (3000)	Time Hr Min HHMM	Time Hr Min HHMM	Displays the current time (Hours and Minutes).	No signal output available	1
U5-31 (3001)	Date Year	Date Year	Displays the current year.	No signal output available	1
U5-32 (3002)	Date Mo Day MMDD	Date Mo Day MMDD	Displays the current date (Month and Day).	No signal output available	1
U5-33 (3003)	Day of the Week	Date Week 0: Sun 1: Mon 2: Tues 3: Wed 4: Thur 5: Fri 6: Sat	Displays the current day of the week. 0: Sunday 1: Monday 2: Tuesday 3: Wednesday 4: Thursday 5: Friday 6: Saturday	No signal output available	1

<1> Analog Output selection text is: "PID Output 2".

◆ 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/PM Displays the value calculated for the motor excitation current (Id). Motor rated secondary current is 100%.	10 V: Motor secondary rated current	0.1%
U6-05 (0059)	Output Voltage Reference (Vq)	Voltage Ref (Vq)	OLV/PM Output voltage reference (Vq) for the q-Axis.	10 V: 200 Vrms <1>	0.1 Vac
U6-06 (005A)	Output Voltage Reference (Vd)	Voltage Ref (Vd)	OLV/PM Output voltage reference (Vd) for the d-Axis.	10 V: 200 Vrms <1>	0.1 Vac
U6-21 (07D5)	Offset Frequency	Offset Frequency	Displays the frequency added to the main frequency reference.	–	0.1%
U6-80 to U6-99 (07B0 to 07F9)	Option Monitors 1 to 20	–	Output monitor for option card. Refer to Option Instruction manual for details	No signal output available.	–

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

◆ U9: Power Monitors

No. (Addr. Hex)	Name	LCD Display	Description	Analog Output Level	Unit
U9-01 (0820)	Electric Power (GWh)	GWh Consumed	Shows the total amount of electric power. 000 000 000 kWh U9-03 U9-02 U9-01	No signal output available	1 GWh
U9-02 (0821)	Electric Power (MWh)	MWh Consumed		No signal output available	1 MWh
U9-03 (0822)	Electric Power (kWh)	kWh Consumed		No signal output available	1 kWh
U9-04 (0823)	Regenerative Power (GWh)	GWh Produced	Shows the total amount of regenerated power. 000 000 000 kWh U9-06 U9-05 U9-04	No signal output available	1 GWh
U9-05 (0824)	Regenerative Power (MWh)	MWh Produced		No signal output available	1 MWh
U9-06 (0825)	Regenerative Power (kWh)	kWh Produced		No signal output available	1 kWh
U9-07 to U9-10 (0826 to 0829)	Electric Power Rates 1 to 4	Consumed ☐ ($)	These parameters show the electric power rate in Power Unit Price (o4-19) that is calculated from the total electrical power consumptions in U9-01 to U9-03. U9-10: Digit 1 to digit 3 U9-09: Digit 4 to digit 6 U9-08: Digit 7 to digit 9 U9-07: Digit 10 to digit 12 000 000 000 000 U9-10 U9-09 U9-08 U9-07 The unit price is set in o4-19, and U9-07 to U9-10 are U9-01 to U9-03 x o4-19.	No signal output available	–
U9-11 to U9-14 (082A to 082D)	Regenerative Power Rates 1 to 4	Produced ☐ ($)	These parameters show the regenerative power rate in Power Unit Price (o4-19) that is calculated from the total electrical power consumptions in U9-04 to U9-06. U9-14: Digit 1 to digit 3 U9-13: Digit 4 to digit 6 U9-12: Digit 7 to digit 9 U9-11: Digit 10 to digit 12 000 000 000 000 U9-14 U9-13 U9-12 U9-11 The unit price is set in o4-19, and U9-11 to U9-14 are U9-04 to U9-06 x o4-19.	No signal output available	–

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Appendix: C

BACnet Communications

C.1 BACnet Configuration

Drives can be monitored and controlled by a controller on a Building Automation and Control network (BACnet) using RS-485 technology and MS-TP (Master-Slave/Token-Passing) protocol. The drives conform to the BACnet application specific controller (B-ASC) device profile.

Up to 127 drives can communicate on a single BACnet MS-TP network. If more drives or BACnet devices are required, then a BACnet router is required to allow another MS-TP network to be available with up to another 127 drives.

The BACnet node address is configurable by a parameter in the drive. This defines the physical address of the drive on the MS-TP network. In addition, both the Device Object instance ID and the Device Object Name are configurable. These allow the drive to have a virtual address, thus simplifying controller configuration.

Once the addressing is set, a controller can initiate communication to the drive. The drive will perform the specified function and then send a response back to the controller. The drive will usually respond immediately, but may delay its response until it gets the token for commands that may take extra local processing time.

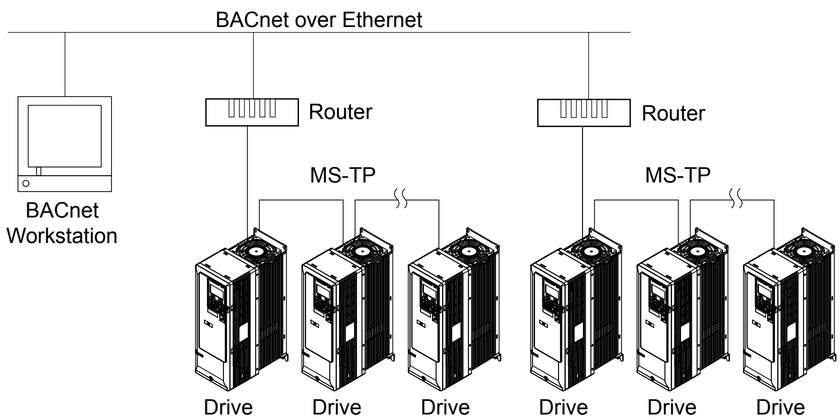

Figure C.1 Connecting Multiple Drives to a BACnet Workstation

C.2 Communication Specifications

BACnet specifications appear in the following table:

Item	Specifications
Interface	MS-TP (Master-Slave/Token-Passing) RS-485
Communication Parameters	Communication Speeds: 1200, 2400, 4800, 9600, 19200, 38400, 57600, 76800 bps Data Length: 8-bit (fixed) Parity: Select Even, Odd, or None Stop Bit: 1-bit (fixed)
Protocol	BACnet MS-TP
Max Number of Drives	127 per MS-TP Network Segment

C.3 Connecting to a Network

This section explains how to connect the drive to a BACnet network and the network termination required for a connection.

◆ Network Cable Connection

Follow the instructions below to connect the drive to a BACnet network.

1. With the power shut off, connect the communications cable to the drive and the master. Use terminal TB5 for BACnet.

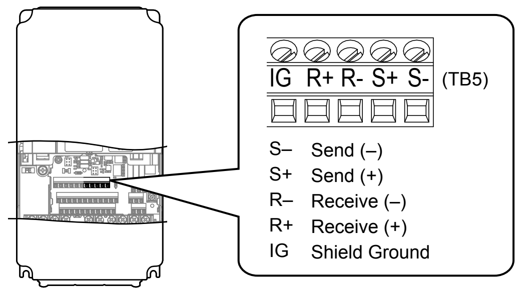

Figure C.2 Serial Communications Cable Connection Terminal (TB5)

Note: Separate the communications cables from the main circuit cables and other wiring and power cables. Use shielded cables for the communications cables, and properly shielded clamps to prevent problems with noise. When using RS-485 communications, connect S+ to R+, and S- to R- as shown in the diagram below.

2. Check or set the termination resistor selection at all slaves. Use the description in *Network Termination* on page *331* for slaves that are Z1000U drives.
3. Switch the power on.
4. Set the parameters needed for serial communications (H5-01 through H5-12) using the digital operator.
5. Shut the power off and wait until the drive display goes out completely.
6. Turn the power back on.
7. The drive is now ready to begin communicating with the master.

◆ Wiring Diagram for Multiple Connections

Figure C.3 explains the wiring diagrams for multiple connections using BACnet communication.

■ RS-485 Interface

Note: The isolated ground (IG) connection is optional but strongly recommended to improve network immunity to electrical interference.

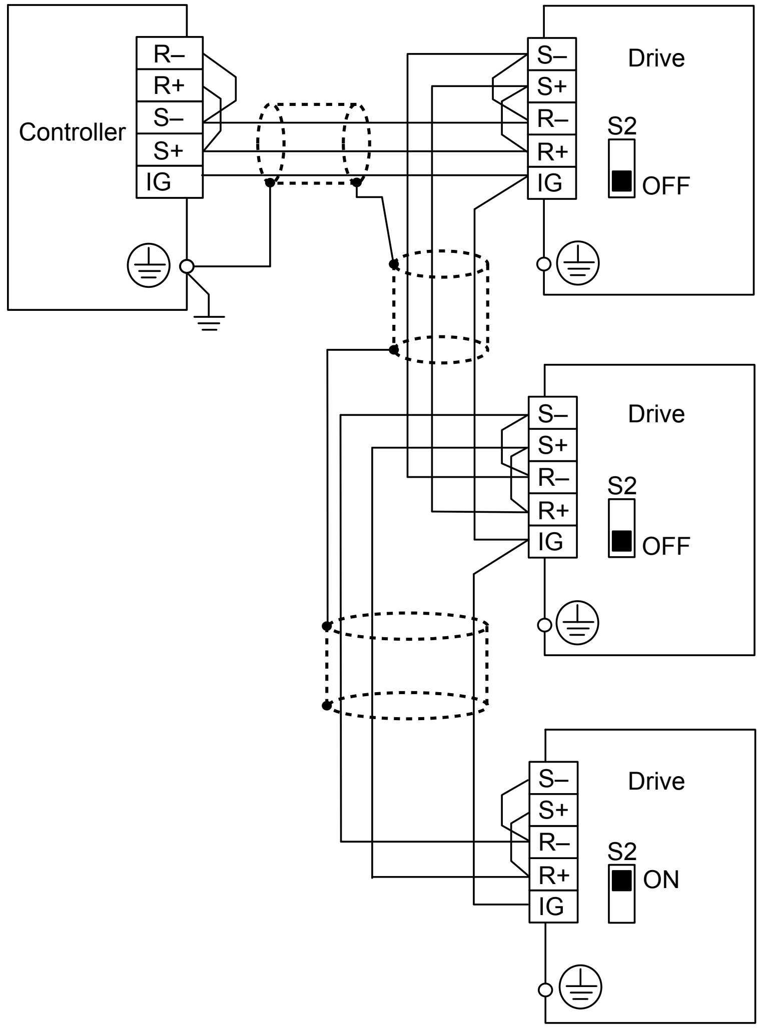

Figure C.3 RS-485 Interface

Note:
1. Set DIP switch S2 to the ON position on the drive located at the end of the network. Set DIP switch S2 to the OFF positions on all other slave devices.
2. Set H5-07 to 1 when using the RS-485 interface.

◆ Network Termination

The two ends of the BACnet network line have to be terminated. The drive has a built in termination resistor that can be enabled or disabled using DIP switch S2. If a drive is located at the end of a network line, enable the termination resistor by setting DIP switch S2 to the ON position. Disable the termination resistor on all slaves that are not located at the network line end.

C.4 BACnet Setup Parameters

◆ BACnet Serial Communication

This section describes parameters necessary to set up BACnet communications.

■ H5-01: Drive Slave Address

Sets the drive slave address used for communications.

Note: Cycle power for the setting to take effect.

No.	Name	Setting Range	Default
H5-01	Drive Slave Address	0 to FFH	1FH

Each slave drive must be assigned a unique slave address for serial communications to work. Slave addresses do not need to be assigned in sequential order, but no two drives may share the same address.

■ H5-02: Communication Speed Selection

Sets the communications speed for APOGEE FLN, BACnet, MEMOBUS/Modbus, and Metasys N2.

Note:
1. Cycle power for the setting to take effect.
2. When Metasys N2 communications are selected (H5-08 = 1), selecting a baud rate other than 9600 bps will trigger an oPE29 error.
3. When APOGEE FLN (P1) communications are selected (H5-08 = 2), selecting a baud rate other than 4800 bps will trigger an oPE29 error.
4. When BACnet communications are selected (H5-08 = 3), selecting 115200 bps (Setting 8) will trigger an oPE29 error.

No.	Name	Setting Range	Default
H5-02	Communication Speed Selection	0 to 8	<1>

<1> Default depends on H5-08 setting:
H5-08 = 0, MEMOBUS/Modbus; default: 3
H5-08 = 1, N2 (Metasys); default: 3
H5-08 = 2, P1 (APOGEE FLN); default: 2
H5-08 = 3, BACnet; default: 3

H5-02	Communication Speed	H5-02	Communication Speed
0 <1>	1200 bps	5 <1>	38400 bps
1 <1>	2400 bps	6 <1>	57600 bps
2	4800 bps	7 <1>	76800 bps
3 <1>	9600 bps	8 <1> <2>	115200 bps
4 <1>	19200 bps		

<1> Not available when H5-08 is set to 2 P1 (APOGEE FLN).

<2> Not available when H5-08 is set to 0 (MEMOBUS/Modbus) or 1 (Metasys N2).

■ H5-03: Communication Parity Selection

Sets the parity used for communications.

Note: Cycle power for the setting to take effect.

No.	Name	Setting Range	Default
H5-03	Communication Parity Selection	0 to 2	0

Setting 0: No parity

Setting 1: Even parity

Setting 2: Odd parity

■ H5-04: Stopping Method after Communication Error

Selects the stopping method after a communications error (CE) has occurred.

No.	Name	Setting Range	Default
H5-04	Stopping Method after CE	0 to 4	3

Setting 0: Ramp to Stop

Uses the deceleration time currently enabled.

Setting 1: Coast to Stop

Setting 2: Fast Stop

Setting 3: Alarm Only - Operation Continues

Setting 4: Run at d1-04

■ H5-05: Communication Fault Detection Selection

Enables or disables the CE detection for communications.

No.	Name	Setting Range	Default
H5-05	Communication Fault Detection Selection	0 or 1	1

Setting 0: Disabled

No communication error detection. The drive continues operation.

Setting 1: Enabled

If the drive does not receive data from the master for longer than the time set to H5-09, then a CE fault will be triggered and the drive will operate as determined by parameter H5-04.

■ H5-06: Drive Transmit Wait Time

Sets the time the drive waits after receiving data from a master until responding data.

Note: Cycle power for the setting to take effect.

No.	Name	Setting Range	Default
H5-06	Drive Transmit Wait Time	5 to 65 ms	5 ms

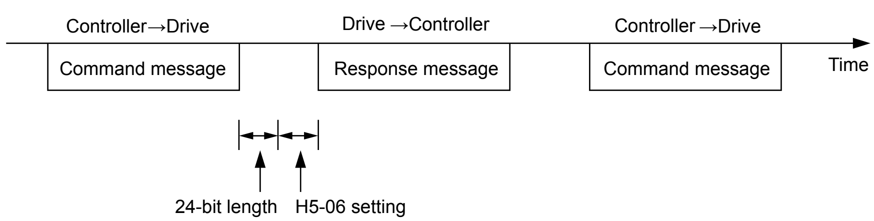

Figure C.4 Drive Transmit Wait Time Setting

■ H5-07: RTS Control Selection

Enables or disables RTS control.

Note: Cycle power for the setting to take effect.

No.	Name	Setting Range	Default
H5-07	RTS Control Selection	0 or 1	1

Setting 0: Disabled. RTS is always on.

Use this setting with point-to-point RS-422 communications.

Setting 1: Enabled. RTS switches while sending.

Use this setting with RS-485 communications or when using multi-drop RS-422 communications.

■ H5-08: Communications Protocol Selection

Selects the communications protocol.

No.	Name	Setting Range	Default
H5-08	Communications Protocol Selection	0 to 3	0

Setting 0: MEMOBUS/Modbus

Setting 1: N2 (Metasys)

Setting 2: P1 (APOGEE FLN)

Setting 3: BACnet

■ H5-09: Communications Fault Detection Time

Sets the time the communications must be lost before the drive triggers a CE fault.

No.	Name	Setting Range	Default
H5-09	Communications Fault Detection Time	0.0 to 10.0 s	2.0 s

■ H5-10: Unit Selection for MEMOBUS/Modbus Register 0025H

Sets the unit for the output voltage monitor value in MEMOBUS/Modbus register 0025H.

No.	Name	Setting Range	Default
H5-10	Unit Selection for MEMOBUS/Modbus Register 0025H	0 or 1	0

Setting 0: 0.1 V units

Setting 1: 1 V units

■ H5-11: Communications Enter Function Selection

Selects whether an Enter command is necessary to change parameter values via MEMOBUS/Modbus communications. ***Refer to Enter Command on page 343***.

No.	Name	Setting Range	Default
H5-11	Communications Enter Function Selection	0 or 1	0

Setting 0: Enter command necessary

Parameter changes become effective after an Enter command. An Enter command must only be sent after the last parameter change, not for each single parameter.

Setting 1: Enter command not necessary

Parameter value changes become effective immediately without the need to send an Enter command.

■ H5-12: Run Command Method Selection

Selects the type of sequence used when the Run command source is set to MEMOBUS/Modbus communications (b1-02, b1-16 = 2).

No.	Name	Setting Range	Default
H5-12	Run Command Method Selection	0 or 1	0

Setting 0: FWD/Stop, REV/Stop

Setting bit 0 of MEMOBUS/Modbus register 0001H will start and stop the drive in the forward direction. Setting bit 1 will start and stop the drive in reverse.

Setting 1: Run/Stop, FWD/REV

Setting bit 0 of MEMOBUS/Modbus register 0001H will start and stop the drive. Setting bit 1 changes the direction.

■ H5-14, H5-15: BACnet Device Object Identifiers 0 and 1

These parameters set the Instance Identifier of the BACnet Device Object, where the H5-14 value is the least significant word and the H5-15 value is the most significant word.

No.	Name	Setting Range	Default
H5-14	BACnet Device Object Identifier 0	0 to FFFFH	1
H5-15	BACnet Device Object Identifier 1	0 to 3FH	0

Example 1: Set Device Object Instance Identifier of “1234”

1234 decimal is equal to 4D2H (hexadecimal)

Set H5-14 to 4D2H and set H5-15 to 0.

Example 2: Set Device Object Instance Identifier of “1234567”

12334567 decimal is equal to 12D687H

Set H5-14 to D687H and set H5-15 to 12H.

C.5 Drive Operations by BACnet

The drive operations that can be performed by BACnet communication depend on drive parameter settings. This section explains the functions that can be used and related parameter settings.

◆ Observing the Drive Operation

A controller can perform the following actions with BACnet communications at any time regardless of parameter settings (except for H5-□□parameters):

- Observe drive status and drive control terminal status from a controller
- Read and write parameters
- Set and reset faults
- Set multi-function inputs.

Note: Input settings from the input terminals S□ and from BACnet communications are both linked by a logical OR operation.

◆ Controlling the Drive

Select an external reference and adjust the parameters in *Table C.1* accordingly to start and stop the drive or set the frequency reference using BACnet communications.

Table C.1 Setting Parameters for Drive Control from BACnet

Reference Source	Parameter	Name	Required Setting
External Reference 1	b1-01	Frequency Reference Selection 1	2
	b1-02	Run Command Selection 1	2
External Reference 2	b1-15	Frequency Reference Selection 2	2
	b1-16	Run Command Selection 2	2

Refer to b1-01: Frequency Reference Selection for AUTO Mode on page 123 and *Refer to b1-02: Run Command Selection for AUTO Mode on page 124* for details on external reference parameter selections.

C.6 Communications Timing

To prevent a communications overrun in the slave drive, the master should wait a certain time between sending messages to the same drive. In the same way, the slave drive must wait before sending response messages to prevent an overrun in the master. This section explains the message timing.

◆ Command Messages from Master to Drive

The master must wait for a specified time between receiving a response and resending the same type of command to the same slave drive to prevent overrun and data loss. The minimum wait time depends on the command as shown in *Table C.2*.

Table C.2 Minimum Wait Time for Sending Messages

Command Type	Example	Minimum Wait Time
1	• Control command (Run, Stop) • Set inputs/outputs • Read monitors and parameter values	5 ms <1>
2	Write parameters	H5-11 = 0: 50 ms H5-11 = 1: 200 ms <1>
3	Save changes using an Enter command	200 ms to 2 s, depending on the number of parameters that were changed <1>
4	Enter with storage to drive EEPROM after initialization	5 s

<1> If the drive receives command type 1 data during the minimum wait time, it will perform the command and then respond. However, if it receives a command type 2 or 3 during that time, either a communication error will result or the command will be ignored.

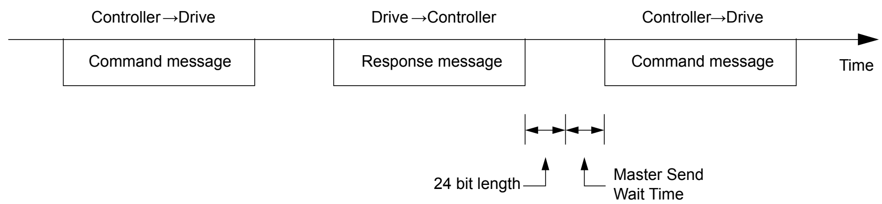

Figure C.5 Minimum Wait Time for Sending Messages

Set a timer in the master to check how long it takes for the slave drive(s) to respond to the master. If no response is received within a certain amount of time, the master should try resending the message.

◆ Response Messages from Drive to Master

If the drive receives a command from the master, it will process the data received and wait for the time set in H5-06 until it responds. Increase H5-06 if the drive response causes overrun in the master.

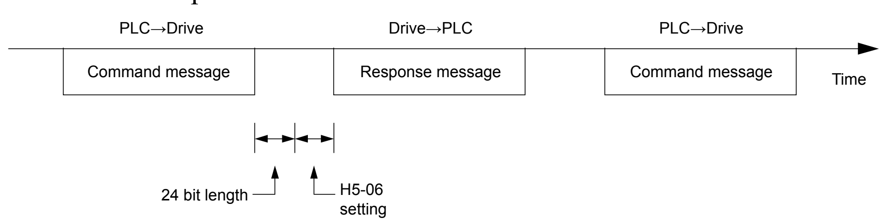

Figure C.6 Minimum Response Wait Time

BACnet Communications

C

C.7 BACnet Objects Supported

◆ Present Value Access

The Present Value (PV) of BACnet objects can always be read. In addition, some PVs can be written or commanded. A commandable PV is similar to writing the value, but the value is actually written into a priority array. The value occupying the highest priority in the array will be used by the drive. The convention for showing how the PV is accessed is shown in *Table C.3* and will be noted for the PV of each object.

Table C.3 Present Value Access Values

PV Access	Name	Description
C	Commandable	Value written to a priority array. The highest priority value in the array is then written to the drive.
R	Readable	Value is read-only
W	Writable	Value written to the drive

◆ Supported Properties of Objects

Table C.4 Object Properties

Property	Object Type						
	Device	Analog Input	Analog Output	Analog Value	Binary Output	Binary Output	Binary Value
Object_Identifier	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Object_Name	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Object_Type	Yes	Yes	Yes	Yes	Yes	Yes	Yes
System_Status	Yes	–	–	–	–	–	–
Vendor_Name	Yes	–	–	–	–	–	–
Vendor_Identifier	Yes	–	–	–	–	–	–
Model_Name	Yes	–	–	–	–	–	–
Firmware_Revision	Yes	–	–	–	–	–	–
Protocol_Version	Yes	–	–	–	–	–	–
Protocol_Revision	Yes	–	–	–	–	–	–
Protocol_Services_Supported	Yes	–	–	–	–	–	–
Protocol_Object_Types_Supported	Yes	–	–	–	–	–	–
Object_List	Yes	–	–	–	–	–	–
Max_ADPU_Length_Accepted	Yes	–	–	–	–	–	–
Segmentation_Supported	Yes	–	–	–	–	–	–
Local_Time	Yes	–	–	–	–	–	–
Local_Date	Yes	–	–	–	–	–	–
ADPU_Timeout	Yes	–	–	–	–	–	–
Number_Of_ADPU_Retries	Yes	–	–	–	–	–	–
Max_Masters	Yes	–	–	–	–	–	–
Max_Info_Frames	Yes	–	–	–	–	–	–
Device_Address_Binding	Yes	–	–	–	–	–	–
Database_Revision	Yes	–	–	–	–	–	–
Present_Value	–	Yes	Yes	Yes	Yes	Yes	Yes
Status_Flags	–	Yes	Yes	Yes	Yes	Yes	Yes
Event_State	–	Yes	Yes	Yes	Yes	Yes	Yes
Reliability	–	Yes	Yes	Yes	Yes	Yes	Yes
Out_Of_Service	–	Yes	Yes	Yes	Yes	Yes	Yes
Units	–	Yes	Yes	Yes	–	–	–
Priority_Array	–	–	Yes <1>	Yes <1>	–	Yes	Yes
Relinquish_Default	–	–	Yes <1>	Yes <1>	–	Yes	Yes
Polarity	–	–	–	–	Yes	Yes	–

Property	Object Type						
	Device	Analog Input	Analog Output	Analog Value	Binary Output	Binary Output	Binary Value
Inactive_Text	–	–	–	–	Yes	Yes	Yes
Active_Text	–	–	–	–	Yes	Yes	Yes

<1> For Commandable Object Instances only.

◆ Analog Input Objects

Table C.5 Analog Input Objects

Object ID	Object Name	Modbus Address	Precision	Range	Units	PV Access
AI1	Analog Input 1 Level	004EH	XXXX.X	–	%	R
AI2	Analog Input 2 Level	004FH	XXXX.X	–	%	R
AI3	Not used	–	–	–	–	–
AI4	Not used	–	–	–	–	–
AI5	Not used	–	–	–	–	–
AI6	Display Format o1-03	0502H	XXXXX	–	–	R
AI7	Scale Format b5-20	01E2H	XXXXX	–	–	R
AI8	Inverter Model o2-04	0508F	XXXXX	–	–	R
AI9	Rated Current n9-01	05D0H	XXXX.X	–	Amps	R

◆ Analog Output Objects

Table C.6 Analog Output Objects

Object ID	Object Name	Modbus Address	Precision	Range	Units	PV Access
AO1	Analog Output 1 Level	0007H	XXXX.X	0 to 100.0	%	C
AO2	Analog Output 2 Level	0008H	XXXX.X	0 to 100.0	%	C

◆ Analog Value Objects

Table C.7 Analog Value Objects

Object ID	Object Name	Modbus Address	Precision	Range	Units	PV Access
AV1	Not used	–	–	–	–	–
AV2	Frequency Command	0002H	XXX.XX Depends on o1-03	0.00 to 600.00	Hz Depends on o1-03	C
AV3	PI Setpoint	0006H	XXX.XX	0.00 to 100.00	%	C
AV4	Not used	–	–	–	–	–
AV5	Not used	–	–	–	–	–
AV6	Not used	–	–	–	–	–
AV7	Not used	–	–	–	–	–
AV8	Not used	–	–	–	–	–
AV9	Frequency Reference	0040H	XXX.XX Depends on o1-03	–	Hz Depends on o1-03	R
AV10	Output Frequency	0041H	XXX.XX Depends on o1-03	–	Hz Depends on o1-03	R
AV11	Output Voltage	0045H	XXXX.X	–	Volts	R

Object ID	Object Name	Modbus Address	Precision	Range	Units	PV Access
AV12	Output Current	0042H	XXXX.X (for drives rated above 11 kVA) XXX.XX (for drives rated 11 kVA or lower)	–	Amps	R
AV13	Output Power	0047H	XXXX.X (for drives rated above 11 kVA) XXX.XX (for drives rated 11 kVA or lower)	–	Watts	R
AV14	Torque Reference	0048H	XXXX.X	–	%	R
AV15	Not used	–	–	–	–	–
AV16	Not used	–	–	–	–	–
AV17	Not used	–	–	–	–	–
AV18	DC Bus Voltage	0031H	XXXX.X	–	Volts	R
AV19	PI Feedback Level	0038H	XXXX.X	–	%	R
AV20	PI Input Level	0039H	XXXX.X	–	%	R
AV21	PI Output Level	003AH	XXXX.X	–	%	R
AV22	CPU Software	005BH	XXXXX	–	–	R
AV23	Flash Number	004DH	XXXXX	–	–	R
AV24	Not used	–	–	–	–	–
AV25	kVA Setting	003EH	XXXXX	–	–	R
AV26	Control Method	003FH	XXXXX	–	–	R
AV27	Accel Time	0200H	XXXX.X (when C1-10 = 1) XXX.XX (when C1-10 = 0)	0.0 to 6000.0 (when C1-10 = 1) 0.00 to 600.00 (when C1-10 = 0)	Sec	W
AV28	Decel Time	0201H	XXXX.X (when C1-10 = 1) XXX.XX (when C1-10 = 0)	0.0 to 6000.0 (when C1-10 = 1) 0.00 to 600.00 (when C1-10 = 0)	Sec	W
AV29 <1>	Param Number	–	XXXXX	0 to FFFFH	–	W
AV30 <1>	Param Data	–	XXXXX	0 to FFFFH	–	W

<1> ***Refer to Accessing Drive Parameters and the Enter Command on page 343*** for an explanation of how to read and write drive parameters not listed in the analog or binary objects.

◆ Binary Input Objects

Table C.8 Binary Input Objects

Object ID	Object Name	Modbus Address	Active Text	Inactive Text	PV Access
BI1	Input Terminal 1	002BH:bit 0	ON	OFF	R
BI2	Input Terminal 2	002BH:bit 1	ON	OFF	R
BI3	Input Terminal 3	002BH:bit 2	ON	OFF	R
BI4	Input Terminal 4	002BH:bit 3	ON	OFF	R
BI5	Input Terminal 5	002BH:bit 4	ON	OFF	R
BI6	Input Terminal 6	002BH:bit 5	ON	OFF	R
BI7	Input Terminal 7	002BH:bit 6	ON	OFF	R
BI8	Multi-Function Out 1	0020H:bit 5	ON	OFF	R
BI9	Multi-Function Out 2	0020H:bit 6	ON	OFF	R

◆ Binary Output Objects

Table C.9 Binary Output Objects

Object ID	Object Name	Modbus Address	Active Text	Inactive Text	PV Access
BO1	MF Output M1-M2	0009H:bit 0	ON	OFF	C
BO2	MF Output M3-M4	0009H:bit 1	ON	OFF	C
BO3	MF Output MA-MC	0009H:bit 2	ON	OFF	C
BO4	Ref Sel: PI Setpoint	000FH:bit 1	ON	OFF	C
BO5	Ref Sel: Term S5 IN	000FH:bit 12	ON	OFF	C
BO6	Ref Sel: Term S6 IN	000FH:bit 13	ON	OFF	C
BO7	Refl Sel: Term S7 IN	000FH:bit 14	ON	OFF	C

◆ Binary Value Objects

Table C.10 Binary Value Objects

Object ID	Object Name	Modbus Address	Active Text	Inactive Text	PV Access
BV1	RUN FWD	0001H:bit 0	RUN	OFF	C
BV2	RUN REV	0001H:bit 1	REV	OFF	C
BV3	EXT FAULT	0001H:bit 2	FAULT	OFF	C
BV4	FAULT RESET	0001H:bit 3	RESET	OFF	C
BV5	COM NET	0001H:bit 4	COM	LOCAL	C
BV6	COM CNTRL	0001H:bit 5	COM	LOCAL	C
BV7	MF Input 3 Cmd	0001H:bit 6	ON	OFF	C
BV8	MF Input 4 Cmd	0001H:bit 7	ON	OFF	C
BV9	MF Input 5 Cmd	0001H:bit 8	ON	OFF	C
BV10	MF Input 6 Cmd	0001H:bit 9	ON	OFF	C
BV11	MF Input 7 Cmd	0001H:bit 10	ON	OFF	C
BV12	Set Fault Contact Cmd	0009H:bit 6	ENABLE	OFF	C
BV13	RUN-STOP	0020H:bit 0	RUN	OFF	R
BV14	REV-FWD	0020H:bit 1	REV	FWD	R
BV15	READY	0020H:bit 2	READY	OFF	R
BV16	FAULT	0020H:bit 3	FAULTED	OFF	R
BV17	Data Set Error	0020H:bit 4	ERROR	OFF	R
BV18	Overcurrent – Ground Fault	0021H:bit 0	OC-GF	OFF	R
BV19	Main Circuit Overvoltage	0021H:bit 1	OV	OFF	R
BV20	Drive Overload	0021H:bit 2	OL2	OFF	R
BV21	Drive Overheat	0021H:bit 3	OH1-OH2	OFF	R
BV22	Fuse Blown	0021H:bit 5	PUF	OFF	R
BV23	PI Feedback Loss	0021H:bit 6	FBL	OFF	R
BV24	External Fault	0021H:bit 7	EF0-EF	OFF	R
BV25	Hardware Error	0021H:bit 8	CPF	OFF	R
BV26	Mtr Ovrld-OvrTorque	0021H:bit 9	OL1-OL3	OFF	R
BV27	Overspeed	0021H:bit 10	OS-DEV	OFF	R
BV28	Main CKT Undervoltage	0021H:bit 11	UV	OFF	R
BV29	MCU, Cntl Pwr Sy Err	0021H:bit 12	UV1-2-3	OFF	R
BV30	Output Phase Loss	0021H:bit 13	LF	OFF	R
BV31	Communication Error	0021H:bit 14	CE	OFF	R
BV32	Operator Disconnect	0021H:bit 15	OPR	OFF	R
BV33	Operating	002CH:bit 0	OPERATING	OFF	R
BV34	Aero Speed	002CH:bit 1	ON	OFF	R

Object ID	Object Name	Modbus Address	Active Text	Inactive Text	PV Access
BV35	Frequency Agree	002CH:bit 2	ON	OFF	R
BV36	Desired Frequency Agree	002CH:bit 3	ON	OFF	R
BV37	Frequency Detect 1	002CH:bit 4	ON	OFF	R
BV38	Frequency Detect 2	002CH:bit 5	ON	OFF	R
BV39	Drive Startup Complete	002CH:bit 6	ON	OFF	R
BV40	Low Voltage Detect	002CH:bit 7	ON	OFF	R
BV41	Base Block	002CH:bit 8	ON	OFF	R
BV42	Frequency Reference Mode	002CH:bit 9	COM	LOCAL	R
BV43	Run Command Mode	002CH:bit 10	COM	LOCAL	R
BV44	Overtorque Detect	002CH:bit 11	ON	OFF	R
BV45	Frequency Refer Lost	002CH:bit 12	ON	OFF	R
BV46	Retry Error	002CH:bit 13	ON	OFF	R
BV47	Modbus Comms Error	002CH:bit 14	ON	OFF	R
BV48	Modbus Timeout Error	002CH:bit 15	ON	OFF	R
BV49	CRC Error	003DH:bit 0	ON	OFF	R
BV50	Invalid Data Length	003DH:bit 1	ON	OFF	R
BV51	Parity Error	003DH:bit 3	ON	OFF	R
BV52	Overrun Error	003DH:bit 4	ON	OFF	R
BV53	Framing Error	003DH:bit 5	ON	OFF	R
BV54	Timeout Error	003DH:bit 6	ON	OFF	R
BV55 <1>	Parameter Accept	0910H:bit 0	ON	OFF	W
BV56 <1>	Parameter Enter	0900H:bit 0	ON	OFF	W
BV57	Drive Comm Error	-	ON	OFF	R

<1> *Refer to Accessing Drive Parameters and the Enter Command on page 343* for an explanation of how to read and write drive parameters not listed in the analog or binary objects.

◆ Device Object

The Device Object fully describes the BACnet device to the network. Notable is that the Device Object Instance ID and the Device Object Name are configurable.

The Device Object Instance ID is a unique internetwork-wide numerical value. It is a 22-bit value that can range from 0 to 4,194,303. It is configurable by parameters H5-14 and H5-15. Any changes to these parameters will not take effect until the power is cycled to the drive.

The Device Object Name is a unique internetwork-wide character string. It is a 20-character string. It is writable from the BACnet network. Any new string written will not take effect until the power is cycled to the drive.

C.8 Accessing Drive Parameters and the Enter Command

◆ Reading Drive Parameters

Reading drive parameters not listed in the analog or digital objects is accomplished using AV29 and AV30 as shown below:

1. In decimal, write the desired Modbus register to AV29.
2. In decimal, read the value at the given register from AV30.

For example, to read the Frequency Reference Upper Limit, read from parameter d2-01.

Parameter d2-01 is located at Modbus register 0289H, which is decimal 649.

Set AV29 to “649”

Read AV30 to get the value.

◆ Writing Drive Parameters

Writing drive parameters not listed in the analog or digital objects is accomplished using AV29, AV30, and BV55 or BV56 as shown below:

1. In decimal, write the desired Modbus register to AV29.
2. In decimal, write the value to be written into AV30.
3. At this point the value is written to the drive, but the location is pending. If necessary, write in more values this way, then the drive will accept these settings by one of two methods:

   Set BV55 to “ON” to move data to active memory.

   Set BV56 to “ON” to move data into active memory and save to non-volatile memory.

For example, to reset the KWH Monitor, write a value of “1” to parameter o1-12.

Parameter o1-12 is located at Modbus register 0512H, which is decimal 1298.

Set AV29 to “1298”

Set AV30 to “1”

Set BV55 to “ON”.

◆ Enter Command

Enter Commands are only required when using AV29 and AV30 to access drive parameters. An Enter command is not required when reading or writing to the other BACnet objects.

When writing parameters to the drive from a controller using BACnet communications, parameter H5-11 determines if an Enter command must be issued to enable these parameters. This section describes the types and functions of the Enter commands.

■ Enter Command Types

The drive supports two types of Enter commands as shown in *Table C.11*.

Table C.11 Enter Command Types

BACnet Object	Modbus Address	Description
BV55 (Write “ON”)	0910H (Write 0)	Writes data in the RAM only. Parameter changes are lost when the drive is shut off.
BV56 (Write “ON”)	0900H (Write 0)	Simultaneously writes data into the EEPROM (non-volatile memory) of the drive and enables the data in RAM. Parameter changes remain after cycling power.

Note: The EEPROM can only be written to 100,000 times, so it is recommended to limit the number of times writing to the EEPROM. The Enter command registers 0900H and 0910H are write-only and if these registers are read, the register address will be invalid. However, BACnet objects BV55 and BV56 can be read without error.

C.9 Communication Errors

Errors that may occur when accessing drive parameters using the BACnet objects are shown in *Table C.12*.

Table C.12 MEMOBUS to BACnet Error Conversion

Error Code	Description
03d	BN_ERR_DEVICE_IS_BUSY Writing to a parameter was attempted while the drive was saving parameters to non-volatile memory.
27d	BN_ERR_READ_ACCESS_DENIED Invalid parameter register number used when reading.
37d	BN_ERR_VALUE_OUT_OF_RANGE Value written to the parameter is out of the valid range.
40d	BN_ERR_WRITE_ACCESS_DENIED An invalid parameter register number was used when writing. Writing to a parameter was attempted while the drive was in a mode that disables writing (i.e., writing while the drive was Auto-Tuning). Writing to a parameter was attempted while the DC Bus had an Undervoltage (Uv) fault

C.10 Self-Diagnostics

The drive has a built-in self-diagnosing function of the serial communication interface circuits. To perform the self-diagnosis function, use the following procedure.

DANGER! *Electrical Shock Hazard. Do not connect or disconnect wiring while the power is on. Failure to comply will result in death or serious injury. Before servicing, disconnect all power to the equipment. The internal capacitor remains charged even after the power supply is turned off. The charge indicator LED will extinguish when the DC bus voltage is below 50 Vdc. To prevent electric shock, wait at least one minute after all indicators are OFF and measure the DC bus voltage level to confirm safe level.*

1. Turn on the power to the drive.
2. Note the present terminal S6 function selection setting (H1-06) and set it for the communications test mode (H1-06 = 67).
3. Set parameter H5-08 to 0.
4. Turn off the power to the drive.
5. With the power off, wire the drive as shown in *Figure C.7*, connecting terminals R+ and S+, R- and S-, and S6 and SN.

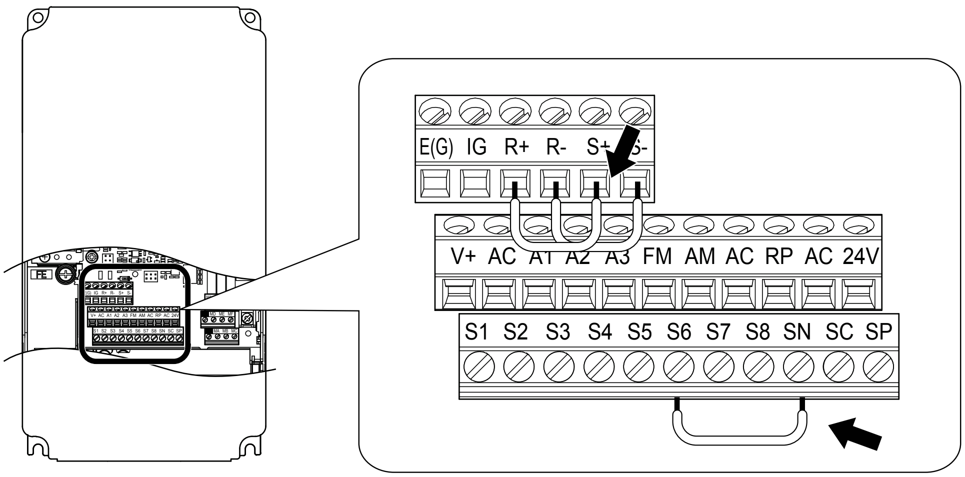

Figure C.7 Terminal Connections for Communication Self-Diagnostics

6. Connect a wire jumper between terminals SN and SC to change to source mode.
7. Turn the power to the drive back on.
8. During normal operation, the drive will display “PASS” to indicate that the communications test mode is operating normally. When a fault occurs, the drive will display “CE” on the keypad display.
9. Turn off the power supply.
10. Remove the wire jumpers from terminal R+, R-, S+, S-, and S6-SN. Reset jumper SC to SP to its original position and set terminal S6 to its original function.
11. Return to normal operation.

BACnet Communications

C

C.11 BACnet Protocol Implementation Conformance Statement

Date: 01/05/2015

Vendor Name: Yaskawa America, Inc.

Product Name: AC Motor Controller

Product Model Number: CIMR-ZU□U□□□□

Application Software Version: VSU90611x / Firmware Revision: 1.0 / BACnet Protocol Revision: 9

Product Description:

The Yaskawa Z1000U HVAC Matrix Drive is a high performance product specifically designed for commercial building automation applications. The Yaskawa BACnet feature connects the Z1000U HVAC Matrix Drive to a standard BACnet MS/TP network. These products may be fully controlled and monitored over BACnet. All drive parameters are available for reading and writing

BACnet Standardized Device Profile (Annex L):

□ BACnet Operator Workstation (B-OWS)

□ BACnet Building Controller (B-BC)

□ BACnet Advanced Application Controller (B-AAC)

■ BACnet Application Specific Controller (B-ASC)

□ BACnet Smart Sensor (B-SS)

□ BACnet Smart Actuator (B-SA)

List all BACnet Interoperability Building Blocks Supported (Annex K):
- Data Sharing-ReadProperty-B (DS-RP-B)
- Data Sharing-WriteProperty-B (DS-WP-B
- Device Management-Dynamic Device Binding-B (DM-DDB-B)
- Device Management-Dynamic Object Binding-B (DM-DOB-B)
- Device Management-DeviceCommunicationControl-B (DM-DCC-B)
- Device Management-ReinitializeDevice-B (DM-RD-B)
- Device Management-TimeSyncronization-B (DM-TS-B)

Segmentation Capability:

□ Segmented requests supported / Window Size

□ Segmented responses supported / Window Size

Standard Object Types Supported:
- Device Object
- Analog Input Object
- Analog Output Object
- Analog Value Object
- Binary Input Object
- Binary Output Object
- Binary Value Object

Data Link Layer Options:

□BACnet IP, (Annex J)

□BACnet IP, (Annex J), Foreign Device

□ISO 8802-3, Ethernet (Clause 7)

□ ANSI/ATA 878.1, 2.5 Mb. ARCNET (Clause 8)

□ANSI/ATA 878.1, RS-485 ARCNET (Clause 8), baud rate(s)

■MS/TP master (Clause 9), baud rate(s): 1200, 2400, 4800, 9600, 19200, 38400, 57600, 76800, 115200

□MS/TP slave (Clause 9), baud rate(s):

□Point-To-Point, EIA 232 (Clause 10), baud rate(s):

□Point-To-Point, modem, (Clause 10), baud rate(s):

□LonTalk, (Clause 11), medium:

□Other:

Device Address Binding:

Is static device binding supported? (This is currently necessary for two-way communication with MS/TP slaves and certain other devices.) □Yes ■ No

Networking Options:

□Router, Clause 6 - List all routing configurations, e.g., ARCNET-Ethernet, Ethernet-MS/TP, etc.

□Annex H, BACnet Tunneling Router over IP

□BACnet/IP Broadcast Management Device (BBMD)

Does the BBMD support registrations by Foreign Devices? □Yes ■ No

Character Sets Supported:

Indicating support for multiple character sets does not imply that they can all be supported simultaneously.

■ ANSI X3.4

□ IBM/Microsoft

□ DBCS

□ ISO 8859-1

□ ISO 10646 (UCS-2)

□ ISO 10646 (UCS-4)

□ JIS C 6226

If this product is a communication gateway, describe the types of non-BACnet equipment/networks(s) that the gateway supports: Not supported

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Appendix: D

Standards Compliance

This appendix explains the guidelines and criteria for maintaining CE and UL standards.

D.1 Section Safety

⚠ DANGER

Electrical Shock Hazard

Before servicing, disconnect all power to the equipment.

The capacitor for the control power supply remains charged even after the power supply is turned off. The charge indicator LED will extinguish when the DC bus voltage is below 50 Vdc. To prevent electric shock, wait for at least the time specified on the warning label, once all indicators are OFF, measure for unsafe voltages to confirm the drive is safe prior to servicing.

Failure to comply will result in death or serious injury.

⚠ WARNING

Electrical Shock Hazard

Do not operate equipment with covers removed.

Failure to comply could result in death or serious injury.

The diagrams in this section may show drives without covers or safety shields to show details. Be sure to reinstall covers or shields before operating the drives and run the drives according to the instructions described in this manual.

Always ground the motor-side grounding terminal.

Improper equipment grounding could result in death or serious injury by contacting the motor case.

Do not touch any terminals before the capacitors have fully discharged.

Failure to comply could result in death or serious injury.

Before wiring terminals, disconnect all power to the equipment. The capacitor for the control power supply 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.

Do not allow unqualified personnel to perform work on the drive.

Failure to comply could result in death or serious injury.

Installation, maintenance, inspection, and service must be performed only by authorized personnel familiar installation, adjustment, and maintenance of drives.

Do not perform work on the drive while wearing loose clothing, jewelry or without eye protection.

Failure to comply could result in death or serious injury.

Remove all metal objects such as watches and rings, secure loose clothing, and wear eye protection before beginning work on the drive.

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

Failure to comply could result in death or serious injury.

Fire Hazard

Tighten all terminal screws to the specified tightening torque.

Loose electrical connections could result in death or serious injury by fire due to overheating of electrical connections.

Do not use an improper voltage source.

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

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

Do not use improper combustible materials.

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

Attach the drive to metal or other noncombustible material.

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.

Never connect or disconnect the motor from the drive while the drive is outputting voltage.

Improper equipment sequencing could result in damage to the drive.

Do not use unshielded wire for control wiring.

Failure to comply may cause electrical interference resulting in poor system performance. Use shielded twisted-pair wires and ground the shield to the ground terminal of the drive.

Do not modify the drive circuitry.

Failure to comply could result in damage to the drive and will void warranty.

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

Check all the wiring to ensure that all connections are correct after installing the drive and connecting other devices.

Failure to comply could result in damage to the drive.

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.

D.2 European Standards

Figure D.1 CE Mark

The CE mark indicates that a product is in compliance with applicable European Directives for safety and environmental regulations. It is required for engaging in business and commerce in Europe.

The applicable European Directives for this product are as follows. We declared the CE marking based on the harmonized standards in *Table D.1*.

Table D.1 European Directives

Applicable European Directive	Applicable Harmonized Standards
Low Voltage Directive (2014/35/EU)	EN 61800-5-1:2007
EMC Guidelines (2014/30/EU)	EN 61800-3:2004+A1:2012
RoHS (2011/65/EU)	EN IEC 63000:2018

The user(s) is solely responsible for ensuring that the end products used with this drive comply with all applicable European directives and with other national regulations (if required).

◆ CE Low Voltage Directive Compliance

This drive has been tested according to European standard IEC/EN 61800-5-1:2007, 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 degree 2 and overvoltage category 3 in accordance with IEC/EN 60664.

■ 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. *Refer to Enable the Internal EMC Filter on page 87* for details.

■ 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.

◆ EMC Guidelines Compliance

When EMC is a concern for drives with internal EMC filters and the network is grounded symmetrically, install the EMC filter screw to the ON position and enable the internal EMC filter.

Drives ship from the factory with EMC filter screws installed in the OFF position.

Drives with internal EMC filters (Z□□E□□□□ and Z□□W□□□□) are tested according to EN 61800-3: 2004+A1: 2012 and comply with EMC guidelines.

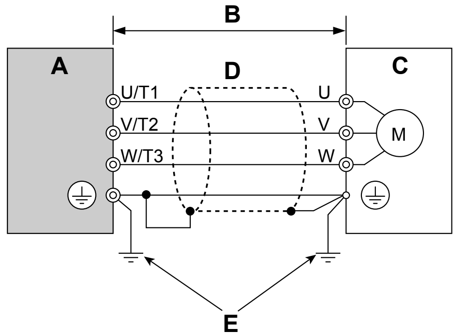
Note: Drives with customized specifications A and P are not compatible. *Refer to Model Number on page 28* for details on customized specifications.

■ Internal EMC Filter Installation

Installation Method

Verify the following installation conditions to ensure that other devices and machinery used in combination with drive models Z□□E□□□□ and Z□□W□□□□ also comply with EMC guidelines.

1. Place the drive in the enclosure.
2. Use braided shield cable for the drive and motor wiring, or run the wiring through a metal conduit.
3. Keep wiring as short as possible. Ground the shield on both the drive side and the motor side.

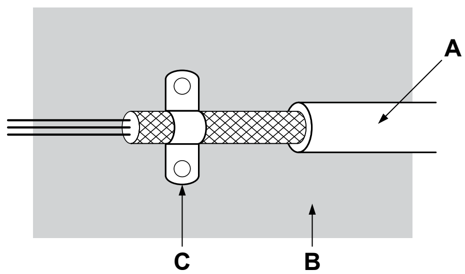


A – Drive
B – 10 m max cable length between drive and motor
C – Motor
D – Metal conduit
E – Ground wire should be as short as possible.

Figure D.2 Installation Method

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

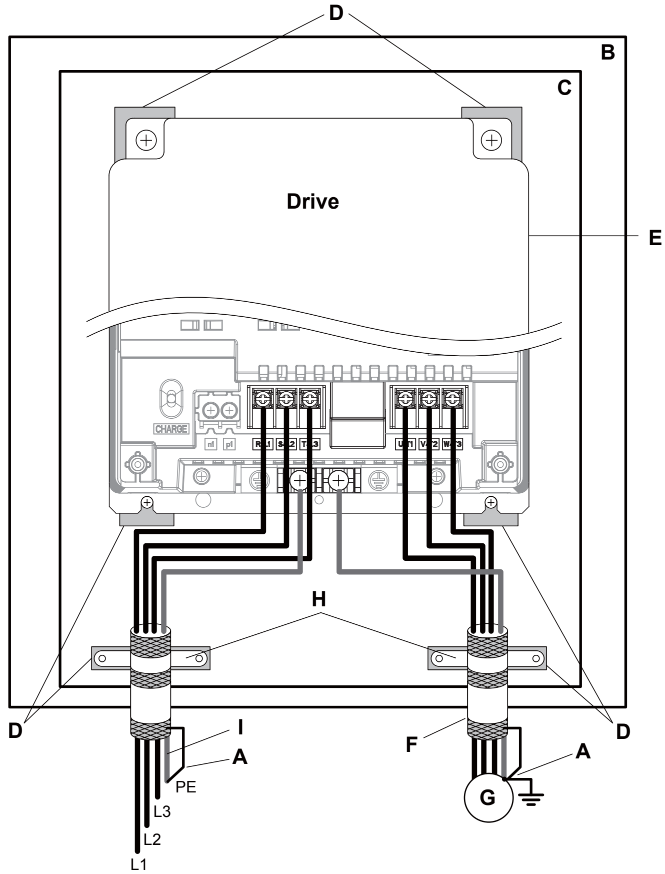
WARNING! *Electrical Shock Hazard. Because the leakage current exceeds 3.5 mA in models 4□0302 and larger, IEC/EN 61800-5-1:2007 states that either the power supply must be automatically disconnected in case of discontinuity of the protective earthing conductor, or a protective earthing conductor with 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 D.3 Ground Area

Three-Phase 200 V / 400 V Class



A – Ground the cable shield
B – Enclosure panel
C – Metal plate
D – Grounding surface (remove any paint or sealant)
E – Drive
F – Motor cable (braided shield cable, max. 10 m)
G – Motor
H – Cable clamp
I – Ground plate (scrape off any visible paint)

Figure D.4 Internal EMC Filter and Drive Installation for CE Compliance (Three-Phase 200 V / 400 V Class)

D.3 UL and CSA Standards

◆ UL Standards Compliance

Figure D.5 UL/cUL Mark

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.

This drive is tested in accordance with UL standard UL 61800-5-1 and complies with UL requirements. The conditions described below must be met to maintain compliance when using this drive in combination with other equipment:

■ Conditions of Acceptability

Install the drive and peripherals in a suitable enclosure for end use.

■ Installation Area

Do not install the drive to an area greater than pollution degree 2 (UL standard).

■ Ambient Temperature

IP00/Open Type Enclosure: -10 °C to +50 °C (14 °F to 122 °F)

IP20/UL Type 1 Enclosure: -10 to +40 °C (14 °F to 104 °F)

Finless Type: IP20/IP00 Enclosure: -10 to +45 °C (14 °F to 113 °F)

■ Main Circuit Terminal Wiring

Yaskawa recommends using closed-loop crimp terminals on all drive models. Use only the tools recommended by the terminal manufacturer for crimping. ***Refer to Closed-Loop Crimp Terminal Recommendations on page 360*** 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.

Note: The ⏚ mark indicates the terminals for protective ground connection.
Grounding impedance:
200 V: 100 Ω or less
400 V: 10 Ω or less

■ Three-Phase 200 V Class Drives

Table D.2 Drive Wire Gauge and Torque Specifications (Three-Phase 200 V Class)

Drive Model	Terminal	For USA and Canada		For South America		Screw Size	Tightening Torque N·m (lb.in.)
		Recomm. Gauge mm^2 (AWG, kcmil)	Wire Range mm^2 (AWG, kcmil)	Recomm. Gauge mm^2 (AWG, kcmil)	Wire Range mm^2 (AWG, kcmil)		
2□0028	R/L1, S/L2, T/L3	10 (8)	6 to 10 (10 to 8)	4 (12)	2.5 to 10 (14 to 8)	M5	2.3 to 2.7 (20.4 to 23.9)
	U/T1, V/T2, W/T3	10 (8)	6 to 10 (10 to 8)	4 (12)	2.5 to 10 (14 to 8)	M5	
	⏚	10 (8)	6 to 16 (10 to 6)	6 (10)	6 to 16 (10 to 5)	M6	3.9 to 4.9 (34.7 to 43.4)
	p1, n1	2.5 (14)	2.5 to 4 (14 to 12)	2.5 (14)	2.5 to 4 (14 to 12)	M4	1 to 1.4 (8.9 to 12.4)

Drive Model	Terminal	For USA and Canada		For South America		Screw Size	Tightening Torque N·m (lb.in.)
		Recomm. Gauge mm^2 (AWG, kcmil)	Wire Range mm^2 (AWG, kcmil)	Recomm. Gauge mm^2 (AWG, kcmil)	Wire Range mm^2 (AWG, kcmil)		
2□0042	R/L1, S/L2, T/L3	16 (6)	10 to 25 (8 to 3)	10 (8)	6 to 25 (10 to 3)	M6	4 to 6 (35.4 to 53.1)
	U/T1, V/T2, W/T3	16 (6)	10 to 25 (8 to 3)	10 (8)	6 to 25 (10 to 3)	M6	
	⏚	10 (8)	6 to 25 (10 to 3)	10 (8)	6 to 25 (10 to 3)	M8	8.8 to 10.8 (78.1 to 95.5)
	p1, n1	2.5 (14)	2.5 to 4 (14 to 12)	2.5 (14)	2.5 to 4 (14 to 12)	M4	1 to 1.4 (8.9 to 12.4)
2□0054	R/L1, S/L2, T/L3	25 (4)	16 to 25 (6 to 3)	16 (5)	10 to 25 (8 to 3)	M6	4 to 6 (35.4 to 53.1)
	U/T1, V/T2, W/T3	25 (4)	16 to 25 (6 to 3)	16 (5)	10 to 25 (8 to 3)	M6	
	⏚	16 (6)	10 to 25 (8 to 3)	10 (8)	10 to 25 (8 to 3)	M8	8.8 to 10.8 (78.1 to 95.5)
	p1, n1	2.5 (14)	2.5 to 4 (14 to 12)	2.5 (14)	2.5 to 4 (14 to 12)	M4	1 to 1.4 (8.9 to 12.4)
2□0068	R/L1, S/L2, T/L3	25 (4)	25 (4 to 3)	16 (5)	16 to 25 (5 to 3)	M6	4 to 6 (35.4 to 53.1)
	U/T1, V/T2, W/T3	25 (4)	25 (4 to 3)	16 (5)	16 to 25 (5 to 3)	M6	
	⏚	16 (6)	16 to 25 (6 to 3)	16 (5)	16 to 25 (5 to 3)	M8	8.8 to 10.8 (78.1 to 95.5)
	p1, n1	2.5 (14)	2.5 to 4 (14 to 12)	2.5 (14)	2.5 to 4 (14 to 12)	M4	1 to 1.4 (8.9 to 12.4)
2□0081	R/L1, S/L2, T/L3	16 × 2 (6 × 2P)	16 to 25 × 2 (6 to 3 × 2P)	25 (3)	16 to 25 (5 to 3 × 2P)	M6	4 to 6 (35.4 to 53.1)
	U/T1, V/T2, W/T3	16 × 2 (6 × 2P)	16 to 25 × 2 (6 to 3 × 2P)	25 (3)	16 to 25 (5 to 3 × 2P)	M6	
	⏚	16 (6)	16 to 25 (6 to 3)	16 (5)	16 to 25 (5 to 3)	M8	8.8 to 10.8 (78.1 to 95.5)
	p1, n1	2.5 (14)	2.5 to 4 (14 to 12)	2.5 (14)	2.5 to 4 (14 to 12)	M4	1 to 1.4 (8.9 to 12.4)
2□0104	R/L1, S/L2, T/L3	35 (1)	16 to 50 × 2 (6 to 1/0 × 2P)	35 (1)	10 to 50 × 2P (8 to 1/0 × 2P)	M8	8 to 10 (70.8 to 88.5)
	U/T1, V/T2, W/T3	35 (1)	16 to 50 × 2 (6 to 1/0 × 2P)	35 (1)	10 to 50 × 2P (8 to 1/0 × 2P)	M8	
	⏚	25 (4)	25 to 35 (4 to 1)	25 (3)	10 to 35 (8 to 1)	M8	8.8 to 10.8 (78.1 to 95.5)
	p1, n1	2.5 (14)	2.5 to 4 (14 to 12)	2.5 (14)	2.5 to 4 (14 to 12)	M4	1.2 to 2.0 (10.4 to 17.4)
2□0130	R/L1, S/L2, T/L3	25 × 2 (4 × 2P)	16 to 50 × 2 (6 to 1/0 × 2P)	16 × 2P (5 × 2P)	10 to 50 × 2P (8 to 1/0 × 2P)	M8	8 to 10 (70.8 to 88.5)
	U/T1, V/T2, W/T3	25 × 2 (4 × 2P)	16 to 50 × 2 (6 to 1/0 × 2P)	16 × 2P (5 × 2P)	10 to 50 × 2P (8 to 1/0 × 2P)	M8	
	⏚	25 (4)	25 to 35 (4 to 1)	16 (5)	16 to 35 (5 to 1)	M8	8.8 to 10.8 (78.1 to 95.5)
	p1, n1	2.5 (14)	2.5 to 4 (14 to 12)	2.5 (14)	2.5 to 4 (14 to 12)	M4	1.2 to 2.0 (10.4 to 17.4)
2□0154	R/L1, S/L2, T/L3	25 × 2 (3 × 2P)	25 to 95 × 2 (4 to 4/0 × 2P)	25 × 2P (3 × 2P)	16 to 95 × 2P (5 to 4/0 × 2P)	M10	15 to 20 (130 to 173)
	U/T1, V/T2, W/T3	25 × 2 (3 × 2P)	25 to 95 × 2 (4 to 4/0 × 2P)	25 × 2P (3 × 2P)	16 to 95 × 2P (5 to 4/0 × 2P)	M10	
	⏚	25 (4)	25 to 70 (4 to 2/0)	25 (3)	25 to 70 (3 to 2/0)	M10	17.7 to 22.6 (156 to 200)
	p1, n1	2.5 (14)	2.5 to 4 (14 to 12)	2.5 (14)	2.5 to 4 (14 to 12)	M4	1.2 to 2.0 (10.4 to 17.4)

Drive Model	Terminal	For USA and Canada		For South America		Screw Size	Tightening Torque N·m (lb.in.)
		Recomm. Gauge mm^2 (AWG, kcmil)	Wire Range mm^2 (AWG, kcmil)	Recomm. Gauge mm^2 (AWG, kcmil)	Wire Range mm^2 (AWG, kcmil)		
2☐0192	R/L1, S/L2, T/L3	35 × 2 (1 × 2P)	25 to 95 × 2 (3 to 4/0 × 2P)	35 × 2P (1 × 2P)	25 to 95 × 2P (3 to 4/0 × 2P)	M10	15 to 20 (130 to 173)
	U/T1, V/T2, W/T3	35 × 2 (1 × 2P)	25 to 95 × 2 (3 to 4/0 × 2P)	35 × 2P (1 × 2P)	25 to 95 × 2P (3 to 4/0 × 2P)	M10	
	⏚	25 (3)	25 to 70 (4 to 2/0)	25 (3)	25 to 70 (3 to 2/0)	M10	17.7 to 22.6 (156 to 200)
	p1, n1	2.5 (14)	2.5 to 4 (14 to 12)	2.5 (14)	2.5 to 4 (14 to 12)	M4	1.2 to 2.0 (10.4 to 17.4)
2☐0248	R/L1, S/L2, T/L3	70 × 2 (2/0 × 2P)	35 to 95 × 2 (1 to 4/0 × 2P)	50 × 2P (1/0 × 2P)	35 to 95 × 2P (1 to 4/0 × 2P)	M10	15 to 20 (130 to 173)
	U/T1, V/T2, W/T3	70 × 2 (2/0 × 2P)	35 to 95 × 2 (1 to 4/0 × 2P)	50 × 2P (1/0 × 2P)	35 to 95 × 2P (1 to 4/0 × 2P)	M10	
	⏚	25 (3)	25 to 95 (4 to 4/0)	35 (1)	25 to 95 (3 to 4/0)	M12	31.4 to 39.2 (278 to 347)
	p1, n1	2.5 (14)	2.5 to 4 (14 to 12)	2.5 (14)	2.5 to 4 (14 to 12)	M4	1.2 to 2.0 (10.4 to 17.4)

■ Three-Phase 400 V Class Drives

Table D.3 Drive Wire Gauge and Torque Specifications (Three-Phase 400 V Class)

Drive Model	Terminal	For USA and Canada		For South America		Screw Size	Tightening Torque N·m (lb.in.)
		Recomm. Gauge mm^2 (AWG, kcmil)	Wire Range mm^2 (AWG, kcmil)	Recomm. Gauge mm^2 (AWG, kcmil)	Wire Range mm^2 (AWG, kcmil)		
4☐0011	R/L1, S/L2, T/L3	2.5 (14)	2.5 to 10 (14 to 8)	2.5 (14)	2.5 to 10 (14 to 8)	M5	2.3 to 2.7 (20.4 to 23.9)
	U/T1, V/T2, W/T3	2.5 (14)	2.5 to 10 (14 to 8)	2.5 (14)	2.5 to 10 (14 to 8)	M5	
	⏚	6 (10)	4 to 16 (12 to 6)	2.5 (14)	2.5 to 16 (14 to 5)	M6	3.9 to 4.9 (34.7 to 43.4)
	p1, n1	2.5 (14)	2.5 to 4 (14 to 12)	2.5 (14)	2.5 to 4 (14 to 12)	M4	1 to 1.4 (8.9 to 12.4)
4☐0014	R/L1, S/L2, T/L3	4 (12)	2.5 to 10 (14 to 8)	2.5 (14)	2.5 to 10 (14 to 8)	M5	2.3 to 2.7 (20.4 to 23.9)
	U/T1, V/T2, W/T3	4 (12)	2.5 to 10 (14 to 8)	2.5 (14)	2.5 to 10 (14 to 8)	M5	
	⏚	6 (10)	4 to 16 (12 to 6)	2.5 (14)	2.5 to 16 (14 to 5)	M6	3.9 to 4.9 (34.7 to 43.4)
	p1, n1	2.5 (14)	2.5 to 4 (14 to 12)	2.5 (14)	2.5 to 4 (14 to 12)	M4	1 to 1.4 (8.9 to 12.4)
4☐0021	R/L1, S/L2, T/L3	6 (10)	4 to 10 (12 to 8)	2.5 (14)	2.5 to 10 (14 to 8)	M5	2.3 to 2.7 (20.4 to 23.9)
	U/T1, V/T2, W/T3	6 (10)	4 to 10 (12 to 8)	2.5 (14)	2.5 to 10 (14 to 8)	M5	
	⏚	6 (10)	4 to 16 (12 to 6)	2.5 (14)	2.5 to 16 (14 to 5)	M6	3.9 to 4.9 (34.7 to 43.4)
	p1, n1	2.5 (14)	2.5 to 4 (14 to 12)	2.5 (14)	2.5 to 4 (14 to 12)	M4	1 to 1.4 (8.9 to 12.4)
4☐0027	R/L1, S/L2, T/L3	10 (8)	6 to 10 (10 to 8)	4 (12)	2.5 to 10 (14 to 8)	M5	2.3 to 2.7 (20.4 to 23.9)
	U/T1, V/T2, W/T3	10 (8)	6 to 10 (10 to 8)	4 (12)	2.5 to 10 (14 to 8)	M5	
	⏚	10 (8)	4 to 16 (12 to 6)	4 (12)	4 to 16 (12 to 5)	M6	3.9 to 4.9 (34.7 to 43.4)
	p1, n1	2.5 (14)	2.5 to 4 (14 to 12)	2.5 (14)	2.5 to 4 (14 to 12)	M4	1 to 1.4 (8.9 to 12.4)

Drive Model	Terminal	For USA and Canada: Recomm. Gauge mm² (AWG, kcmil)	For USA and Canada: Wire Range mm² (AWG, kcmil)	For South America: Recomm. Gauge mm² (AWG, kcmil)	For South America: Wire Range mm² (AWG, kcmil)	Screw Size	Tightening Torque N·m (lb.in.)
4□0034	R/L1, S/L2, T/L3	10 (8)	10 (8)	6 (10)	4 to 10 (12 to 8)	M5	2.3 to 2.7 (20.4 to 23.9)
	U/T1, V/T2, W/T3	10 (8)	10 (8)	6 (10)	4 to 10 (12 to 8)	M5	
	⏚	10 (8)	6 to 16 (10 to 6)	6 (10)	6 to 16 (10 to 5)	M6	3.9 to 4.9 (34.7 to 43.4)
	p1, n1	2.5 (14)	2.5 to 4 (14 to 12)	2.5 (14)	2.5 to 4 (14 to 12)	M4	1 to 1.4 (8.9 to 12.4)
4□0040	R/L1, S/L2, T/L3	10 (8)	10 to 25 (8 to 3)	10 (8)	6 to 25 (10 to 3)	M6	4 to 6 (35.4 to 53.1)
	U/T1, V/T2, W/T3	10 (8)	10 to 25 (8 to 3)	10 (8)	6 to 25 (10 to 3)	M6	
	⏚	10 (8)	10 to 25 (10 to 3)	10 (8)	6 to 25 (10 to 3)	M8	8.8 to 10.8 (78.1 to 95.5)
	p1, n1	2.5 (14)	2.5 to 4 (14 to 12)	2.5 (14)	2.5 to 4 (14 to 12)	M4	1 to 1.4 (8.9 to 12.4)
4□0052	R/L1, S/L2, T/L3	16 (6)	10 to 25 (8 to 3)	10 (8)	10 to 25 (8 to 3)	M6	4 to 6 (35.4 to 53.1)
	U/T1, V/T2, W/T3	16 (6)	10 to 25 (8 to 3)	10 (8)	10 to 25 (8 to 3)	M6	
	⏚	16 (6)	10 to 25 (8 to 3)	10 (8)	10 to 25 (8 to 3)	M8	8.8 to 10.8 (78.1 to 95.5)
	p1, n1	2.5 (14)	2.5 to 4 (14 to 12)	2.5 (14)	2.5 to 4 (14 to 12)	M4	1 to 1.4 (8.9 to 12.4)
4□0065	R/L1, S/L2, T/L3	25 (4)	16 to 25 (6 to 3)	16 (5)	10 to 25 (8 to 3)	M6	4 to 6 (35.4 to 53.1)
	U/T1, V/T2, W/T3	25 (4)	16 to 25 (6 to 3)	16 (5)	10 to 25 (8 to 3)	M6	
	⏚	16 (6)	16 to 25 (6 to 3)	16 (5)	16 to 25 (5 to 3)	M8	8.8 to 10.8 (78.1 to 95.5)
	p1, n1	2.5 (14)	2.5 to 4 (14 to 12)	2.5 (14)	2.5 to 4 (14 to 12)	M4	1 to 1.4 (8.9 to 12.4)
4□0077	R/L1, S/L2, T/L3	25 (3)	25 (4 to 3)	25 (3)	16 to 25 (5 to 3)	M6	4 to 6 (35.4 to 53.1)
	U/T1, V/T2, W/T3	25 (3)	25 (4 to 3)	25 (3)	16 to 25 (5 to 3)	M6	
	⏚	16 (6)	16 to 25 (6 to 3)	16 (5)	16 to 25 (5 to 3)	M8	8.8 to 10.8 (78.1 to 95.5)
	p1, n1	2.5 (14)	2.5 to 4 (14 to 12)	2.5 (14)	2.5 to 4 (14 to 12)	M4	1 to 1.4 (8.9 to 12.4)
4□0096	R/L1, S/L2, T/L3	35 (1)	10 to 50 (8 to 1/0 × 2P)	35 (1)	10 to 50 × 2P (8 to 1/0 × 2P)	M8	8 to 10 (70.8 to 88.5)
	U/T1, V/T2, W/T3	35 (1)	10 to 50 (8 to 1/0 × 2P)	35 (1)	10 to 50 × 2P (8 to 1/0 × 2P)	M8	
	⏚	25 (4)	25 to 35 (4 to 1)	25 (3)	10 to 35 (8 to 1)	M8	8.8 to 10.8 (78.1 to 95.5)
	p1, n1	2.5 (14)	2.5 to 4 (14 to 12)	2.5 (14)	2.5 to 4 (14 to 12)	M4	1.2 to 2.0 (10.4 to 17.4)
4□0124	R/L1, S/L2, T/L3	25 × 2 (4 × 2P)	16 to 50 × 2 (6 to 1/0 × 2P)	16 × 2P (5 × 2P)	10 to 50 × 2P (8 to 1/0 × 2P)	M8	8 to 10 (70.8 to 88.5)
	U/T1, V/T2, W/T3	25 × 2 (4 × 2P)	16 to 50 × 2 (6 to 1/0 × 2P)	16 × 2P (5 × 2P)	10 to 50 × 2P (8 to 1/0 × 2P)	M8	
	⏚	25 (4)	25 to 35 (4 to 1)	16 (5)	16 to 35 (5 to 1)	M8	8.8 to 10.8 (78.1 to 95.5)
	p1, n1	2.5 (14)	2.5 to 4 (14 to 12)	2.5 (14)	2.5 to 4 (14 to 12)	M4	1.2 to 2.0 (10.4 to 17.4)

Drive Model	Terminal	For USA and Canada: Recomm. Gauge mm² (AWG, kcmil)	For USA and Canada: Wire Range mm² (AWG, kcmil)	For South America: Recomm. Gauge mm² (AWG, kcmil)	For South America: Wire Range mm² (AWG, kcmil)	Screw Size	Tightening Torque N·m (lb.in.)
4□0156	R/L1, S/L2, T/L3	25 × 2 (3 × 2P)	25 to 95 × 2 (4 to 4/0 × 2P)	25 × 2P (3 × 2P)	16 to 95 × 2P (5 to 4/0 × 2P)	M10	15 to 20 (130 to 173)
	U/T1, V/T2, W/T3	25 × 2 (3 × 2P)	25 to 95 × 2 (4 to 4/0 × 2P)	25 × 2P (3 × 2P)	16 to 95 × 2P (5 to 4/0 × 2P)	M10	
	⏚	25 (4)	25 to 70 (4 to 2/0)	25 (3)	25 to 70 (3 to 2/0)	M10	17.7 to 22.6 (156 to 200)
	p1, n1	2.5 (14)	2.5 to 4 (14 to 12)	2.5 (14)	2.5 to 4 (14 to 12)	M4	1.2 to 2.0 (10.4 to 17.4)
4□0180	R/L1, S/L2, T/L3	35 × 2 (2 × 2P)	25 to 95 × 2 (3 to 4/0 × 2P)	25 × 2P (3 × 2P)	25 to 95 × 2P (3 to 4/0 × 2P)	M10	15 to 20 (130 to 173)
	U/T1, V/T2, W/T3	35 × 2 (2 × 2P)	25 to 95 × 2 (3 to 4/0 × 2P)	25 × 2P (3 × 2P)	25 to 95 × 2P (3 to 4/0 × 2P)	M10	
	⏚	25 (3)	25 to 70 (4 to 2/0)	25 (3)	25 to 70 (3 to 2/0)	M10	17.7 to 22.6 (156 to 200)
	p1, n1	2.5 (14)	2.5 to 4 (14 to 12)	2.5 (14)	2.5 to 4 (14 to 12)	M4	1.2 to 2.0 (10.4 to 17.4)
4□0216	R/L1, S/L2, T/L3	50 × 2 (1/0 × 2P)	35 to 95 × 2 (2 to 4/0 × 2P)	35 × 2P (1 × 2P)	25 to 95 × 2P (3 to 4/0 × 2P)	M10	15 to 20 (130 to 173)
	U/T1, V/T2, W/T3	50 × 2 (1/0 × 2P)	35 to 95 × 2 (2 to 4/0 × 2P)	35 × 2P (1 × 2P)	25 to 95 × 2P (3 to 4/0 × 2P)	M10	
	⏚	25 (3)	25 to 95 (4 to 4/0)	35 (1)	25 to 95 (3 to 4/0)	M12	31.4 to 39.2 (278 to 347)
	p1, n1	2.5 (14)	2.5 to 4 (14 to 12)	2.5 (14)	2.5 to 4 (14 to 12)	M4	1.2 to 2.0 (10.4 to 17.4)
4□0240	R/L1, S/L2, T/L3	50 × 2 (1/0 × 2P)	50 to 95 × 2 (1/0 to 4/0 × 2P)	50 × 2P (1/0 × 2P)	35 to 95 × 2P (1 to 4/0 × 2P)	M10	15 to 20 (130 to 173)
	U/T1, V/T2, W/T3	50 × 2 (1/0 × 2P)	50 to 95 × 2 (1/0 to 4/0 × 2P)	50 × 2P (1/0 × 2P)	35 to 95 × 2P (1 to 4/0 × 2P)	M10	
	⏚	35 (2)	35 to 95 (2 to 4/0)	50 (1/0)	35 to 95 (1 to 4/0)	M12	31.4 to 39.2 (278 to 347)
	p1, n1	2.5 (14)	2.5 to 4 (14 to 12)	2.5 (14)	2.5 to 4 (14 to 12)	M4	1.2 to 2.0 (10.4 to 17.4)
4□0302 <1>	R/L1, S/L2, T/L3	70 × 2 (3/0 × 2P)	50 to 95 × 2 (1/0 to 4/0 × 2P)	70 × 2P (3/0 × 2P)	50 to 95 × 2P (1/0 to 4/0 × 2P)	M10	15 to 20 (130 to 173)
	U/T1, V/T2, W/T3	70 × 2 (3/0 × 2P)	50 to 95 × 2 (1/0 to 4/0 × 2P)	70 × 2P (3/0 × 2P)	50 to 95 × 2P (1/0 to 4/0 × 2P)	M10	
	⏚	35 (1)	35 to 150 (1 to 300)	70 (3/0)	35 to 150 (1 to 300)	M12	31.4 to 39.2 (278 to 347)
	p1, n1	2.5 (14)	2.5 to 4 (14 to 12)	2.5 (14)	2.5 to 4 (14 to 12)	M4	1.2 to 2.0 (10.4 to 17.4)
4□0361 <1>	R/L1, S/L2, T/L3	95 × 2 (4/0 × 2P)	70 to 95 × 2 (3/0 to 4/0 × 2P)	95 × 2P (4/0 × 2P)	70 to 95 × 2P (3/0 to 4/0 × 2P)	M10	15 to 20 (130 to 173)
	U/T1, V/T2, W/T3	95 × 2 (4/0 × 2P)	70 to 95 × 2 (3/0 to 4/0 × 2P)	95 × 2P (4/0 × 2P)	70 to 95 × 2P (3/0 to 4/0 × 2P)	M10	
	⏚	50 (1/0)	50 to 150 (1/0 to 300)	95 (4/0)	70 to 150 (3/0 to 300)	M12	31.4 to 39.2 (278 to 347)
	p1, n1	2.5 (14)	2.5 to 4 (14 to 12)	2.5 (14)	2.5 to 4 (14 to 12)	M4	1.2 to 2.0 (10.4 to 17.4)
4□0414 <1>	R/L1, S/L2, T/L3	150 × 2 (300 × 2P)	95 to 150 × 2 (4/0 to 300 × 2P)	95 × 2P (4/0 × 2P)	95 to 150 × 2P (4/0 to 300 × 2P)	M12	25 to 35 (217 to 304)
	U/T1, V/T2, W/T3	150 × 2 (300 × 2P)	95 to 150 × 2 (4/0 to 300 × 2P)	95 × 2P (4/0 × 2P)	95 to 150 × 2P (4/0 to 300 × 2P)	M12	
	⏚	50 (1/0)	50 to 240 (1/0 to 400)	95 (4/0)	70 to 240 (3/0 to 400)	M12	31.4 to 39.2 (278 to 347)
	p1, n1	2.5 (14)	2.5 to 4 (14 to 12)	2.5 (14)	2.5 to 4 (14 to 12)	M4	1.2 to 2.0 (10.4 to 17.4)

<1> Take additional measures in accordance with IEC/EN 61800-5-1:2007 when wiring an EMC filter is installed. ***Refer to Internal EMC Filter Installation on page 352*** for details.

■ Closed-Loop Crimp Terminal Recommendations

Yaskawa recommends crimp terminals made by JST and Tokyo DIP (or equivalent) for the insulation cap. ***Table D.4*** matches the wire gauges and terminal screw sizes with Yaskawa-recommended crimp terminals, tools, and insulation caps. Use the appropriate wire gauge and screw size for your drive model. Place orders with a Yaskawa representative or the Yaskawa sales department. Select suitable crimp terminals in accordance with national, state, or local codes.

Drive Models 2□0028 to 2□0248 and 4□0011 to 4□0414

Table D.4 Closed-Loop Crimp Terminal Size

Drive Model	Wire Gauge (AWG, kcmil)	Screw Size	Crimp Terminal Model Number	Tool		Insulation Cap Model No.	Code <1>
	R/L1, S/L2, T/L3 U/T1, V/T2, W/T3			Machine No.	Die Jaw		
200 V Class							
2□0028	10	M5	R5.5-5	YA-4	AD-900	TP-005	100-054-030
	8 <2>		R8-5		AD-901	TP-008	100-054-032
2□0042	8	M6	R8-6	YA-4	AD-901	TP-008	100-065-184
	6 <2>		R14-6		AD-902	TP-014	100-051-261
	4		R22-6	YA-5	AD-953	TP-022	100-051-262
	3		R22-6				
2□0054	6	M6	R14-6	YA-5	AD-952	TP-014	100-051-261
	4 <2>		R22-6		AD-953	TP-022	100-051-262
	3						
2□0068	4 <2>	M6	R22-6	YA-5	AD-953	TP-022	100-051-262
	3						
2□0081	6 <2>	M6	R14-6	YA-5	AD-952	TP-014	100-051-261
	4		R22-6		AD-953	TP-022	100-051-262
	3						
2□0104	6	M8	R14-8	YA-4	AD-902	TP-014	100-054-035
	4		R22-8	YA-5	AD-953	TP-022	100-051-263
	3						
	2		R38-8		AD-954	TP-038	100-051-264
	1 <2>						
	1/0		R60-8		AD-955	TP-060	100-051-265
2□0130	6	M8	R14-8	YA-5	AD-952	TP-014	100-054-035
	4 <2>		R22-8		AD-953	TP-022	100-051-263
	3						
	2		R38-8		AD-954	TP-038	100-051-264
	1						
	1/0		R60-8		AD-955	TP-060	100-0051-265
2□0154	4	M10	R22-10	YA-5	AD-953	TP-022	100-061-113
	3 <2>						
	2		R38-10		AD-954	TP-038	100-061-114
	1						
	1/0		R60-10		AD-955	TP-060	100-051-266
	2/0		70-10	YF-1 YET-300-1	TD-322 TD-311	TP-080	100-064-251
	3/0		80-10		TD-323 TD-312		100-051-267
	4/0		R100-10	YF-1	TD-324	TP-100	100-051-269

Drive Model	Wire Gauge (AWG, kcmil)	Screw Size	Crimp Terminal Model Number	Tool		Insulation Cap Model No.	Code <1>
	R/L1, S/L2, T/L3 U/T1, V/T2, W/T3			Machine No.	Die Jaw		
2□0192	3	M10	R22-10	YA-5	AD-953	TP-022	100-061-113
	2		R38-10		AD-954	TP-038	100-061-114
	1 <2>						
	1/0		R60-10		AD-955	TP-060	100-051-266
	2/0		70-10	YF-1 YET-300-1	TD-322 TD-311	TP-080	100-064-251
	3/0		80-10		TD-323 TD-312		100-051-267
	4/0		R100-10		TD-324 TD-312	TP-100	100-051-269
2□0248	1	M10	R38-10	YA-5	AD-954	TP-038	100-061-114
	1/0		R60-10	YF-1 YET-300-1	TD-321 TD-311	TP-060	100-051-266
	2/0 <2>		70-10		TD-322 TD-311	TP-080	100-064-251
	3/0		80-10		TD-323 TD-312		100-051-267
	4/0		R100-10		TD-324 TD-312	TP-100	100-051-269
400 V Class							
4□0011	14 <2>	M5	R2-5	YA-4	AD-900	TP-003	100-123-030
	12		R5.5-5			TP-005	100-054-030
	10						
	8		R8-5		AD-901	TP-008	100-054-032
4□0014	14	M5	R2-5	YA-4	AD-900	TP-003	100-123-030
	12 <2>		R5.5-5			TP-005	100-054-030
	10						
	8		R8-5		AD-901	TP-008	100-054-032
4□0021	12	M5	R5.5-5	YA-4	AD-900	TP-005	100-054-030
	10 <2>						
	8		R8-5		AD-901	TP-008	100-054-032
4□0027	10	M5	R5.5-5	YA-4	AD-900	TP-005	100-054-030
	8 <2>		R8-5		AD-901	TP-008	100-054-032
4□0034	8 <2>	M5	R8-5	YA-4	AD-901	TP-008	100-054-032
4□0040	8 <2>	M6	R8-6	YA-4	AD-901	TP-008	100-065-184
	6		R14-6		AD-902	TP-014	100-051-261
	4		R22-6	YA-5	AD-953	TP-022	100-051-262
	3						
4□0052	8	M6	R8-6	YA-4	AD-901	TP-008	100-065-184
	6 <2>		R14-6		AD-902	TP-014	100-051-261
	4		R22-6	YA-5	AD-953	TP-022	100-051-262
	3						
4□0065	6	M6	R14-6	YA-5	AD-952	TP-014	100-051-261
	4 <2>		R22-6		AD-953	TP-022	100-051-262
	3						
4□0077	4	M6	R22-6	YA-5	AD-953	TP-022	100-051-262
	3 <2>						

Drive Model	Wire Gauge (AWG, kcmil) R/L1, S/L2, T/L3 U/T1, V/T2, W/T3	Screw Size	Crimp Terminal Model Number	Tool: Machine No.	Tool: Die Jaw	Insulation Cap Model No.	Code <1>
4□0096	8	M8	R8-8	YA-4	AD-901	TP-008	100-601-111
	6		R14-8		AD-902	TP-014	100-054-035
	4		R22-8	YA-5	AD-953	TP-022	100-051-263
	3						
	2		R38-8		AD-954	TP-038	100-051-264
	1 <2>						
	1/0		R60-8		AD-955	TP-060	100-051-265
4□0124	6	M8	R14-8	YA-5	AD-952	TP-014	100-054-035
	4 <2>		R22-8		AD-953	TP-022	100-051-263
	3						
	2		R38-8		AD-954	TP-038	100-051-264
	1						
	1/0		R60-8		AD-955	TP-060	100-051-265
4□0156	4	M10	R22-10	YA-5	AD-953	TP-022	100-061-113
	3 <2>						
	2		R38-10		AD-954	TP-038	100-061-114
	1						
	1/0		R60-10		AD-955	TP-060	100-051-266
	2/0		70-10	YF-1 YET-300-1	TD-322 TD-311	TP-080	100-064-251
	3/0		80-10		TD-323 TD-312		100-051-267
	4/0		R100-10		TD-324 TD-312	TP-100	100-051-269
4□0180	3	M10	R22-10	YA-5	AD-953	TP-022	100-061-113
	2 <2>		R38-10		AD-954	TP-038	100-061-114
	1						
	1/0		R60-10		AD-955	TP-060	100-051-266
	2/0		70-10	YF-1 YET-300-1	TD-322 TD-311	TP-080	100-064-251
	3/0		80-10		TD-323 TD-312		100-051-267
	4/0		R100-10		TD-324 TD-312	TP-100	100-051-269
4□0216	2	M10	R38-10	YA-5	AD-954	TP-038	100-061-114
	1						
	1/0 <2>		R60-10	YF-1 YET-300-1	TD-321 TD-311	TP-060	100-051-266
	2/0		70-10		TD-322 TD-311	TP-080	100-064-251
	3/0		80-10		TD-323 TD-312		100-051-267
	4/0		R100-10		TD-324 TD-312	TP-100	100-051-269
4□0240	1/0 <2>	M10	R60-10	YF-1 YET-300-1	TD-321 TD-311	TP-060	100-051-266
	2/0		70-10		TD-322 TD-311	TP-080	100-064-251
	3/0		80-10		TD-323 TD-312		100-051-267
	4/0		R100-10		TD-324 TD-312	TP-100	100-051-269

Drive Model	Wire Gauge (AWG, kcmil) R/L1, S/L2, T/L3 U/T1, V/T2, W/T3	Screw Size	Crimp Terminal Model Number	Tool: Machine No.	Tool: Die Jaw	Insulation Cap Model No.	Code <1>
4□0302	1/0	M10	R60-10	YF-1 YET-300-1	TD-321 TD-311	TP-060	100-051-266
	2/0		70-10		TD-322 TD-311	TP-080	100-064-251
	3/0 <2>		80-10		TD-323 TD-312		100-051-267
	4/0		R100-10		TD-324 TD-312	TP-100	100-051-269
4□0361	3/0	M10	80-10	YF-1 YET-300-1	TD-323 TD-312	TP-080	100-051-267
	4/0 <2>		R100-10		TD-324 TD-312	TP-100	100-051-269
4□0414	4/0	M12	R100-12	YF-1 YET-300-1	TD-324 TD-312	TP-100	100-051-270
	250		R150-12		TD-325 TD-313	TP-150	100-051-273
	300 <2>						

<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.

<2> Recommended wire gauges. Refer to local codes for proper selections.

Note: Use crimp insulated terminals or insulated shrink tubing for wiring connections. Wires should have a continuous maximum allowable temperature of 75 °C (167 °F) 600 Vac UL-approved vinyl-sheathed insulation.

■ 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 D.5 Control Circuit Terminal Power Supply

Input / Output	Terminal Signal	Power Supply Specifications
Multi-function digital inputs	S1 to S8, SC	Use the internal LVLC power supply of the drive or an external class 2 power supply.
Multi-function analog inputs	+V, A1, A2, A3, AC, FM, AM	

■ 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: 4E□□□□ and 4W□□□□), and 500 Vac maximum (400 V class: 4U□□□□ and 4P□□□□) with built-in fuses manufactured by Hinode Electric Co., Ltd. and Mersen (or equivalent).

◆ 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: 10% to 150% of the drive rated current.

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 and T2-06 are 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 D.6 Overload Protection Settings

Setting	Description	
0	Disabled	Disabled the internal motor overload protection of the drive.
1	Standard fan-cooled motor	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.
4	Permanent Magnet motor with variable torque	Selects protection characteristics for a variable torque PM motor. 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, 1, or 4) 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.

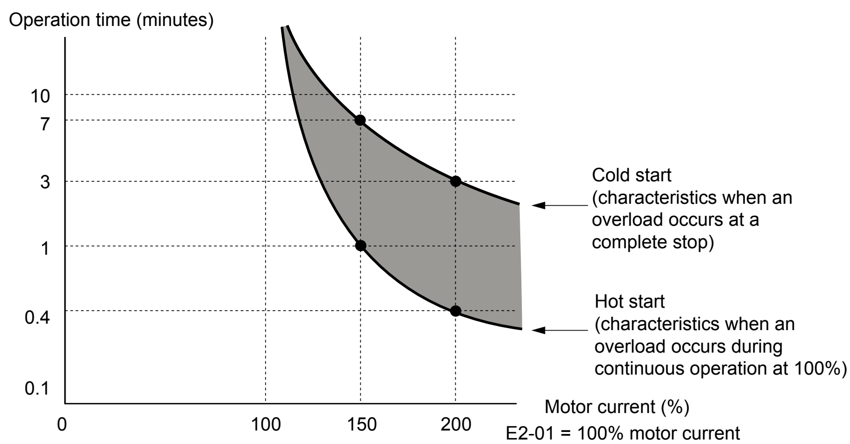


Figure D.6 Motor Overload Protection Time

■ L1-03: Motor Overheat Alarm Operation Selection (PTC input)

Sets the drive operation when the PTC input signal reaches the motor overheat alarm level (oH3).

No.	Name	Setting Range	Default
L1-03	Motor Overheat Alarm Operation Selection (PTC input)	0 to 3	3

Setting 0: Ramp to Stop

The drive stops the motor using the deceleration time 1 set in parameter C1-02.

Setting 1: Coast to Stop

The drive output is switched off and the motor coasts to stop.

Setting 2: Fast Stop

The drive stops the motor using the Fast Stop time set in parameter C1-09.

Setting 3: Alarm Only

The operation is continued and an oH3 alarm is displayed on the digital operator.

■ L1-04: Motor Overheat Fault Operation Selection (PTC input)

Sets the drive operation when the PTC input signal reaches the motor overheat fault level (oH4).

No.	Name	Setting Range	Default
L1-04	Motor Overheat Fault Operation Selection (PTC input)	0 to 2	1

Setting 0: Ramp to Stop

The drive stops the motor using the deceleration time 1 set in parameter C1-02.

Setting 1: Coast to Stop

The drive output is switched off and the motor coasts to stop.

Setting 2: Fast Stop

The drive stops the motor using the Fast Stop time set in parameter C1-09.

D.4 CSA Standards Compliance

◆ Conditions of Acceptability

Refer to Conditions of Acceptability on page 355 for details.

◆ Branch Circuit Protection

For installation in Canada, branch circuit protection must be provided in accordance with the Canadian Electrical Code and any applicable provincial codes.

◆ Main Circuit Terminal Wiring

Yaskawa recommends using closed-loop crimp terminals on all drive models. To maintain CSA approval, CSA Certified closed-loop crimp terminals are specifically required when wiring the drive main circuit terminals on models 2□0028 to 2□0248 and 4□0011 to 4□0414. Use only the tools recommended by the terminal manufacturer for crimping.

Refer to Closed-Loop Crimp Terminal Recommendations on page 360 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.

The external power supply shall be a CSA certified or cUL Listed Class 2 power source only or equivalent. Refer to *Table D.5* for details.

◆ CSA for Industrial Control Equipment

Figure D.7 CSA Mark

The drive is CSA certified as Industrial Control Equipment Class 3211.

Specifically, the drive is certified to: CAN/CSA C22.2 No.0-10 and CAN/CSA C22.2 No.274.

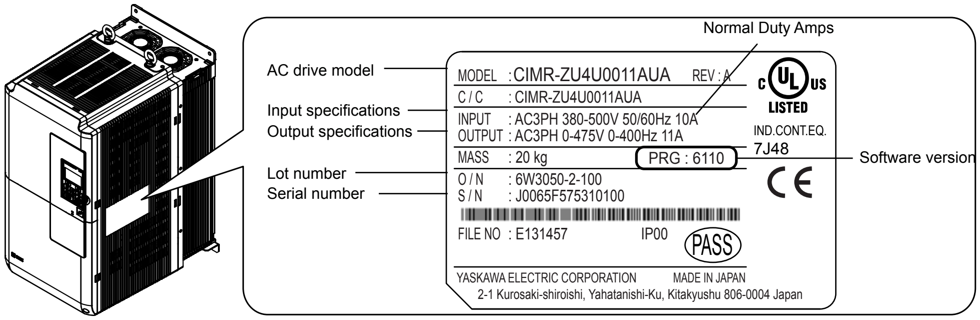
Appendix: E

Quick Reference Sheet

This section provides tables to keep record of the drive specifications, motor specifications, and drive settings. Fill in the table data after commissioning the application and have them ready when contacting Yaskawa for technical assistance.

E.1 Drive and Motor Specifications

◆ Drive Specifications



Items	Description
Model	CIMR-ZU
Serial Number	
Software Version (PRG)	
Options Used	
Date of Usage	

◆ Motor Specifications

■ Induction Motor

Items	Description		Items	Description	
Manufacturer			**Motor Rated Current (T1-04)**		A
Model			**Motor Base Frequency (T1-05)**		Hz
Motor Rated Power (T1-02)		HP	**Number of Motor Poles (T1-06)**		
Motor Rated Voltage (T1-03)		V	**Motor Base Speed (T1-07)**		r/min

Note: These values must be entered as part of the Auto-Tuning process.

■ Permanent Magnet Motor

Items	Description		Items	Description	
Manufacturer			**Induction Voltage Constant**		mVs/rad
Model			**Induction Voltage Constant**		mV/ (r/min)
PM Motor Rated Power (T2-04)		HP	**PM Motor Rated Current (T2-06)**		A
PM Motor Rated Voltage (T2-05)		V	**PM Motor Base Frequency (T2-07)**		Hz
q-Axis Inductance		mH	**Number of PM Motor Poles (T2-08)**		
d-Axis Inductance		mH			

Note: These values must be entered as part of the Auto-Tuning process.

E.2 Basic Parameter Settings

Use the following tables to keep records of important parameters. Have this data available when contacting Yaskawa technical support.

◆ Basic Setup

Item	Setting Value	Memo
Control Mode	A1-02 =	
Frequency Reference Source	b1-01 =	
Run Command Source	b1-02 =	

◆ Motor Setup

Motor Type	Item	Setting Value	Memo
Induction	**Motor Rated Current**	E2-01 =	
	Motor Rated Slip	E2-02 =	
	Motor No-Load Current	E2-03 =	
	No. of Motor Poles	E2-04 =	
	Line-to-Line Resistance	E2-05 =	
Permanent Magnet	**Motor Code Selection**	E5-01 =	
	Motor Rated Power	E5-02 =	
	Motor Rated Current	E5-03 =	
	No. of Motor Poles	E5-04 =	
	Motor Stator Resistance	E5-05 =	
	Motor d-Axis Inductance	E5-06 =	
	Motor q-Axis Inductance	E5-07 =	
	Induction Volt. Const. 1	E5-09 =	
	Induction Volt. Const. 2	E5-24 =	

◆ Multi-Function Digital Inputs

Terminal	Input Used	Setting Value and Function Name	Memo
S1		H1-01 =	
S2		H1-02 =	
S3		H1-03 =	
S4		H1-04 =	
S5		H1-05 =	
S6		H1-06 =	
S7		H1-07 =	
S8		H1-08 =	

◆ Analog Inputs

Terminal	Input Used	Setting Value and Function Name	Memo
A1		H3-02 =	
A2		H3-10 =	
A3		H3-06 =	

◆ Multi-Function Digital Outputs

Terminal	Output Used	Setting Value and Function Name	Memo
M1-M2		H2-01 =	
M3-M4		H2-02 =	
MD-ME-MF		H2-03 =	

◆ Monitor Outputs

Terminal	Output Used	Setting Value and Function Name	Memo
FM		H4-01 =	
AM		H4-04 =	

E.3 User Setting Table

Use the Verify Menu to see which parameters have been changed from their original default settings

RUN below the parameter number indicates that the parameter setting can be changed during run.

Parameter names in **bold face type** are included in the Setup Group of parameters.

No.	Name	User Setting
A1-00 RUN	Language Selection	
A1-01 RUN	Access Level Selection	
A1-02	**Control Method Selection**	
A1-03	Initialize Parameters	
A1-04	Password	
A1-05	Password Setting	
A1-06	Application Preset	
A2-01 to A2-32	User Parameters, 1 to 32	
A2-33	User Parameter Automatic Selection	
b1-01	**Frequency Reference Selection 1**	
b1-02	**Run Command Selection 1**	
b1-03	**Stopping Method Selection**	
b1-04	Reverse Operation Selection	
b1-06	Digital Input Reading	
b1-08	Run Command Selection while in Programming Mode	
b1-11	Drive Delay Time Setting	
b1-14	Phase Order Selection	
b1-17	Run Command at Power Up	
b1-24	Commercial Power Operation Switching Selection	
b1-25	Commercial Power Supply Operation Cancellation Level	
b1-26	Commercial Power Supply Operation Switching Level	
b2-01	Zero Speed Level (DC Injection Braking Start Frequency)	
b2-02	DC Injection Braking Current	
b2-03	DC Injection Braking Time at Start	
b2-04	DC Injection Braking Time at Stop	
b2-09	Motor Pre-Heat Current 2	
b3-01	Speed Search Selection at Start	
b3-03	Speed Search Deceleration Time	
b3-04	V/f Gain during Speed Search	
b3-05	Speed Search Delay Time	
b3-06	Output Current 1 during Speed Search (Speed Estimation Type)	
b3-07	Output Current 2 during Speed Search (Speed Estimation Type)	

No.	Name	User Setting
b3-08	Current Control Gain during Speed Search (Speed Estimation Type)	
b3-09	Current Control Integral Time during Speed Search (Speed Estimation Type)	
b3-10	Speed Search Detection Compensation Gain (Speed Estimation Type)	
b3-11	Speed Search Method Switching Level (Speed Estimation Type)	
b3-12	Minimum Current Detection Level during Speed Search	
b3-14	Bi-Directional Speed Search Selection (Speed Estimation Type)	
b3-17	Speed Search Restart Current Level (Speed Estimation Type)	
b3-18	Speed Search Restart Detection Time (Speed Estimation Type)	
b3-19	Number of Speed Search Restarts (Speed Estimation Type)	
b3-24	Speed Search Method Selection	
b3-25	Speed Search Wait Time (Speed Estimation Type)	
b3-27	Start Speed Search Select	
b3-29	Speed Search Induced Voltage Level	
b3-31	Speed Search Operation Current Level 1 (Current Detection Type 2)	
b3-32	Speed Search Operation Current Level 2 (Current Detection 2)	
b3-33	Speed Search Selection when Run Command is Given during Uv	
b3-50	Backspin Search Direction Judgment Time 1	
b3-51	Backspin Search Direction Judgment Time 2	
b3-52	Backspin Search Deceleration Time 1	
b3-53	Backspin Search Deceleration Time 2	
b3-59	PM Speed Search DC Injection Braking Time at Low Speed	
b4-01	Timer Function On-Delay Time	
b4-02	Timer Function Off-Delay Time	
b4-03	H2-01 ON Delay Time	
b4-04	H2-01 OFF Delay Time	
b4-05	H2-02 ON Delay Time	
b4-06	H2-02 OFF Delay Time	
b4-07	H2-03 ON Delay Time	
b4-08	H2-03 OFF Delay Time	
b5-01	PI Function Setting	

No.	Name	User Setting
b5-02 RUN	Proportional Gain Setting (P)	
b5-03 RUN	Integral Time Setting (I)	
b5-04 RUN	Integral Limit Setting	
b5-05 RUN	Derivative Time (D)	
b5-06 RUN	PI Output Limit	
b5-07 RUN	PI Offset Adjustment	
b5-08 RUN	PI Primary Delay Time Constant	
b5-09	PI Output Level Selection	
b5-10	PI Output Gain Setting	
b5-11	PI Output Reverse Selection	
b5-12	PI Feedback Loss Detection Selection	
b5-13	PI Feedback Loss Detection Level	
b5-14	PI Feedback Loss Detection Time	
b5-15	PI Sleep Function Start Level	
b5-16	PI Sleep Delay Time	
b5-17	PI Accel/Decel Time	
b5-18	PI Setpoint Selection	
b5-19 RUN	PI Setpoint Value	
b5-20	PI Setpoint Scaling	
b5-21	PI Sleep Input Source	
b5-22	PI Snooze Level	
b5-23	PI Snooze Delay Time	
b5-24	PI Snooze Deactivation Level	
b5-25	PI Setpoint Boost Setting	
b5-26	PI Maximum Boost Time	
b5-27	PI Snooze Feedback Level	
b5-28	PI Feedback Function Selection	
b5-29	PI Square Root Gain	
b5-30	PI Feedback Offset	
b5-34 RUN	PI Output Lower Limit	
b5-35 RUN	PI Input Limit	
b5-36	PI Feedback High Detection Level	
b5-37	PI Feedback High Detection Time	
b5-38	PI Setpoint User Display	
b5-39	PI Setpoint Display Digits	
b5-40	Frequency Reference Monitor Content during PI	
b5-41	PI Unit Selection	
b5-42 RUN	PI Output Monitor Calculation Method	
b5-43 RUN	Custom PI Output Monitor 1	
b5-44 RUN	Custom PI Output Monitor 2	
b5-45 RUN	Custom PI Output Monitor 3	
b5-46	PI Setpoint Monitor Unit Selection	
b5-47	Reverse Operation Selection 2 by PI Output	
b8-01	Energy Saving Control Selection	
b8-04	Energy Saving Coefficient Value	
b8-05	Power Detection Filter Time	
b8-06	Search Operation Voltage Limit	
C1-01 RUN	**Acceleration Time 1**	
C1-02 RUN	**Deceleration Time 1**	
C1-03 RUN	Acceleration Time 2	
C1-04 RUN	Deceleration Time 2	
C1-09	Fast-Stop Time	
C1-11	Accel/Decel Time Switching Frequency	
C2-01	S-Curve Characteristic at Accel Start	
C2-02	S-Curve Characteristic at Accel End	
C4-01 RUN	Torque Compensation Gain	
C4-02 RUN	Torque Compensation Primary Delay Time	
C6-02	**Carrier Frequency Selection**	
C6-03	Carrier Frequency Upper Limit	
C6-04	Carrier Frequency Lower Limit	
C6-05	Carrier Frequency Proportional Gain	
C6-09	Carrier Frequency during Rotational Auto-Tuning	
C7-56	Power Factor Control Selection	
C7-60	Output Voltage Limit Mode Selection	
d1-01 RUN	Frequency Reference 1	

No.	Name	User Setting
d1-02 RUN	Frequency Reference 2	
d1-03 RUN	Frequency Reference 3	
d1-04 RUN	Frequency Reference 4	
d1-16 RUN	Frequency Reference 16	
d1-17 RUN	Jog Frequency Reference	
d2-01	**Frequency Reference Upper Limit**	
d2-02	**Frequency Reference Lower Limit**	
d2-03	Master Speed Reference Lower Limit	
d3-01	Jump Frequency 1	
d3-02	Jump Frequency 2	
d3-03	Jump Frequency 3	
d3-04	Jump Frequency Width	
d4-01	Frequency Reference Hold Function Selection	
d4-10	Up/Down Frequency Reference Limit Selection	
d6-01	Field Weakening Level	
d6-02	Field Weakening Frequency Limit	
d7-01 RUN	Offset Frequency 1	
d7-02 RUN	Offset Frequency 2	
d7-03 RUN	Offset Frequency 3	
E1-03	V/f Pattern Selection	
E1-04	**Maximum Output Frequency**	
E1-05	**Maximum Voltage**	
E1-06	**Base Frequency**	
E1-07	Middle Output Frequency	
E1-08	Middle Output Frequency Voltage	
E1-09	Minimum Output Frequency	
E1-10	Minimum Output Frequency Voltage	
E1-11	Middle Output Frequency 2	
E1-12	Middle Output Frequency Voltage 2	
E1-13	Base Voltage	
E2-01	**Motor Rated Current**	
E2-02	Motor Rated Slip	
E2-03	Motor No-Load Current	
E2-04	Number of Motor Poles	
E2-05	Motor Line-to-Line Resistance	

No.	Name	User Setting
E2-10	Motor Iron Loss for Torque Compensation	
E2-11	**Motor Rated Power**	
E5-01	Motor Code Selection (for PM Motors)	
E5-02	Motor Rated Power	
E5-03	Motor Rated Current	
E5-04	Number of Motor Poles	
E5-05	Motor Stator Resistance	
E5-06	Motor d-Axis Inductance	
E5-07	Motor q-Axis Inductance	
E5-09	Motor Induction Voltage Constant 1	
E5-24	Motor Induction Voltage Constant 2	
H1-01	Multi-Function Digital Input Terminal S1 Function Selection	
H1-02	Multi-Function Digital Input Terminal S2 Function Selection	
H1-03	Multi-Function Digital Input Terminal S3 Function Selection	
H1-04	Multi-Function Digital Input Terminal S4 Function Selection	
H1-05	Multi-Function Digital Input Terminal S5 Function Selection	
H1-06	Multi-Function Digital Input Terminal S6 Function Selection	
H1-07	Multi-Function Digital Input Terminal S7 Function Selection	
H1-08	Multi-Function Digital Input Terminal S8 Function Selection	
H2-01	Multi-Function Contact Output (terminal M1-M2)	
H2-02	Multi-Function Contact Output 2 (terminal M3-M4)	
H2-03	Multi-Function Contact Output 3 (terminal MD-ME-MF)	
H3-01	Terminal A1 Signal Level Selection	
H3-02	Terminal A1 Function Selection	
H3-03 RUN	**Terminal A1 Gain Setting**	
H3-04 RUN	**Terminal A1 Bias Setting**	
H3-05	Terminal A3 Signal Level Selection	
H3-06	Terminal A3 Function Selection	
H3-07	Terminal A3 Gain Setting	
H3-08	Terminal A3 Bias Setting	
H3-09	Terminal A2 Signal Level Selection	
H3-10	Terminal A2 Function Selection	
H3-11 RUN	**Terminal A2 Gain Setting**	

No.	Name	User Setting
H3-12 RUN	**Terminal A2 Bias Setting**	
H3-13	Analog Input Filter Time Constant	
H3-14	Analog Input Terminal Enable Selection	
H3-16	Terminal A1 Offset	
H3-17	Terminal A2 Offset	
H3-18	Terminal A3 Offset	
H4-01	Multi-Function Analog Output Terminal FM Monitor Selection	
H4-02 RUN	Multi-Function Analog Output Terminal FM Gain	
H4-03 RUN	Multi-Function Analog Output Terminal FM Bias	
H4-04	Multi-Function Analog Output Terminal AM Monitor Selection	
H4-05 RUN	Multi-Function Analog Output Terminal AM Gain	
H4-06 RUN	Multi-Function Analog Output Terminal AM Bias	
H4-07	Multi-Function Analog Output Terminal FM Signal Level Selection	
H4-08	Multi-Function Analog Output Terminal AM Signal Level Selection	
H5-01	Drive Slave Address	
H5-02	Communication Speed Selection	
H5-03	Communication Parity Selection	
H5-04	Stopping Method After Communication Error (CE)	
H5-05	Communication Fault Detection Selection	
H5-06	Drive Transmit Wait Time	
H5-07	RTS Control Selection	
H5-08	Communication Protocol Selection	
H5-09	CE Detection Time	
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			Chapter 3	Revision:	Changed connection diagram to be correct.
			Appendix A	Revision:	Power Ratings harmonics footnotes Specifications table momentary motor and control power ride-thru
			Back Cover	Revision:	Address
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Low Harmonic Drive for HVAC Applications

Z1000U HVAC MATRIX Drive

User Manual

YASKAWA AMERICA, INC.
2121, Norman Drive South, Waukegan, IL 60085, U.S.A.
Phone: +1-800-YASKAWA (927-5292) or +1-847-887-7000 Fax: +1-847-887-7310
www.yaskawa.com

DRIVE CENTER (INVERTER PLANT)
2-13-1, Nishimiyaichi, Yukuhashi, Fukuoka, 824-8511, Japan
Phone: +81-930-25-2548 Fax: +81-930-25-3431
www.yaskawa.co.jp

YASKAWA ELECTRIC CORPORATION
New Pier Takeshiba South Tower, 1-16-1, Kaigan, Minatoku, Tokyo, 105-6891, Japan
Phone: +81-3-5402-4502 Fax: +81-3-5402-4580
www.yaskawa.co.jp

YASKAWA ELÉTRICO DO BRASIL LTDA.
777, Avenida Piraporinha, Diadema, São Paulo, 09950-000, Brasil
Phone: +55-11-3585-1100 Fax: +55-11-3585-1187
www.yaskawa.com.br

YASKAWA EUROPE GmbH
Hauptstraße 185, 65760 Eschborn, Germany
Phone: +49-6196-569-300 Fax: +49-6196-569-398
www.yaskawa.eu.com E-mail: info@yaskawa.eu.com

YASKAWA ELECTRIC KOREA CORPORATION
6F, 112, LS-ro, Dongan-gu, Anyang-si, Gyeonggi-do, Korea
Phone: +82-31-8015-4224 Fax: +82-31-8015-5034
www.yaskawa.co.kr

YASKAWA ASIA PACIFIC PTE. LTD.
30A, Kallang Place, #06-01, 339213, Singapore
Phone: +65-6282-3003 Fax: +65-6289-3003
www.yaskawa.com.sg

YASKAWA ELECTRIC (THAILAND) CO., LTD.
59, 1F-5F, Flourish Building, Soi Ratchadapisek 18, Ratchadapisek Road, Huaykwang, Bangkok, 10310, Thailand
Phone: +66-2-017-0099 Fax: +66-2-017-0799
www.yaskawa.co.th

YASKAWA ELECTRIC (CHINA) CO., LTD.
22F, Link Square 1, No.222, Hubin Road, Shanghai, 200021, China
Phone: +86-21-5385-2200 Fax: +86-21-5385-3299
www.yaskawa.com.cn

YASKAWA ELECTRIC (CHINA) CO., LTD. BEIJING OFFICE
Room 1011, Tower W3 Oriental Plaza, No. 1, East Chang An Avenue,
Dong Cheng District, Beijing, 100738, China
Phone: +86-10-8518-4086 Fax: +86-10-8518-4082

YASKAWA ELECTRIC TAIWAN CORPORATION
12F, No. 207, Section 3, Beishin Road, Shindian District, New Taipei City 23143, Taiwan
Phone: +886-2-8913-1333 Fax: +886-2-8913-1513 or +886-2-8913-1519
www.yaskawa.com.tw

YASKAWA INDIA PRIVATE LIMITED
#17/A, Electronics City, Hosur Road, Bengaluru, 560 100 (Karnataka), India
Phone: +91-80-4244-1900 Fax: +91-80-4244-1901
www.yaskawaindia.in

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