YASKAWA

Z1000U HVAC MATRIX Bypass

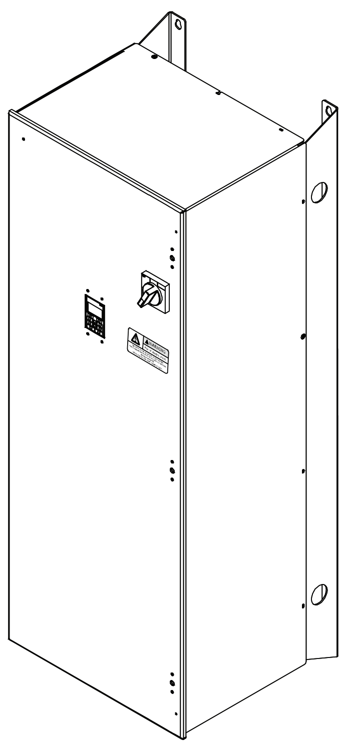
Low Harmonic Drive Bypass for HVAC Applications

Technical Manual

Type: Z1D1

Models: 208 V: 7.5 to 75 HP
480 V: 7.5 to 350 HP

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



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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. 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 the Z1000U Bypass. Read this manual before attempting to install, operate, maintain, or inspect the bypass unit and keep it in a safe, convenient location for future reference. Be sure you understand all precautions and safety information before attempting application.

◆ Product Description

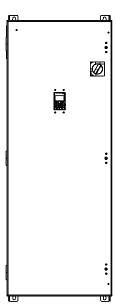
The Z1000U MATRIX HVAC Bypass combines excellent harmonic mitigation, input power factor control, and energy saving capabilities in a design specifically suited for use in HVAC building automation applications that require reliable motor control.

The bypass package provides a Z1000U MATRIX drive in a NEMA rated enclosure with a 2-contactor style bypass to allow motor operation from the drive or across the line. The Z1000U MATRIX drive incorporates MATRIX technology to directly convert input AC voltage to output AC voltage. The Z1000U MATRIX drive offers real choices and benefits for green HVAC applications.

The Z1000U features HVAC application-specific software macros, a Hand/Off/Auto LCD keypad, and a real time clock for system accuracy. Popular building automation communication protocols BACnet, Siemens APOGEE, Johnson Controls Metasys, and MEMOBUS/ Modbus are embedded in the drive.

◆ Applicable Documentation

The following manuals are available for the Z1000U MATRIX Bypass:

	**Z1000U HVAC MATRIX Bypass Technical Manual**
	Read this manual first. This manual is packaged together with the product and contains basic information required to install and wire the bypass. It also gives detailed information on fault diagnostics, parameter settings, and serial communication specifications. The purpose of this manual is to prepare the Z1000U Bypass for a trial run with an application and for basic operation. This manual is also available for download on the Yaskawa documentation website, www.yaskawa.com.
	Z1000U HVAC MATRIX Drive User Manual
	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
	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.

Indicates a term or definition used in this manual.

◆ Terms and Abbreviations

TERMS

- **Bypass:** Yaskawa Z1000U MATRIX Bypass
- **Drive:** Yaskawa Z1000U-Series Drive
- **H:** Hexadecimal Number Format
- **IGBT:** Insulated Gate Bipolar Transistor
- **kbps:** Kilobits per Second
- **MAC:** Media Access Control
- **r/min:** Revolutions per Minute
- **V/f:** V/f Control

◆ Trademarks

This manual may describe trademarked equipment, which is the property of other companies. These trademarks are the property of the registered owner companies and may include the following:

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

i.2 General Safety

◆ Supplemental Safety Information

General Precautions
• The diagrams in this manual may be indicated without covers or safety shields to show details. Replace the covers or shields before operating the drive and run the drive according to the instructions described in this manual. • Any illustrations, photographs, or examples used in this manual are provided as examples only and may not apply to all products to which this manual is applicable. • The products and specifications described in this manual or the content and presentation of the manual may be changed without notice to improve the product and/or the manual. • When ordering a new copy of the manual due to damage or loss, contact 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

⚠ WARNING

Heed the safety messages in this manual.

Failure to comply could 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.

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 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 connect or disconnect wiring while the power is on.

Failure to comply could result in death or serious injury.

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

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

Failure to comply could result in death or serious injury.

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

Do not allow unqualified personnel to use equipment.

Failure to comply could result in death or serious injury.

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

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

Failure to comply could result in death or serious injury.

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

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

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

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

Fire Hazard

Branch Circuit protection is required to be installed according to applicable local codes and the requirements listed on the bypass nameplate. Failure to comply could result in fire and damage to the bypass and drive or injury to personnel. Bypass models without soft-starter option PW are suitable for use on a circuit capable of delivering not more than 100,000 RMS symmetrical amperes, 208 Vac and 480 Vac. Bypass models D169 to D211 and B180 to B414 with option PW are also suitable for use on a circuit capable of delivering not more than 100,000 RMS symmetrical amperes, 208 Vac and 480 Vac. Bypass models D024 to D143 and B011 to B156 with option PW are suitable for use on a circuit capable of delivering not more than 65,000 RMS symmetrical amperes, 208 Vac and 480 Vac.

⚠ WARNING

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.

NOTICE

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

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

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

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

Do not operate damaged equipment.

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

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

Do not expose the drive to halogen group disinfectants.

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

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

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

◆ General Application Precautions

■ Selection

Installing a Reactor

Use an AC reactor in the following situations:

- to suppress harmonic current.
- when the drive is running from a power supply system with thyristor converters.

Drive Capacity

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

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

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.

■ Installation

Enclosure Panels

Keep the drive in a clean environment. 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.

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

Upper Limits

NOTICE: *The drive is capable of running the motor up to 240 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. Install one of the available braking options or increase the capacity of the drive for faster acceleration and deceleration.

■ General Handling

Wiring Check

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

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.*

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

Insulation Tolerance

NOTICE: *Consider motor voltage tolerance levels and motor insulation in applications with an input voltage of over 480 V or particularly long wiring distances.*

High-Speed Operation

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

Torque Characteristics

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

Vibration and Shock

The drive allows selection of high carrier PWM control and low carrier PWM. Selecting high carrier PWM can help reduce motor oscillation.

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 isolation mounts around the base of the motor and enable the Jump frequency selection to prevent continuous operation in the resonant frequency range.

Audible Noise

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

Specialized Motors

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.

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.

◆ Drive Label Warning Example

Always heed the warning information listed in *Figure i.1*.

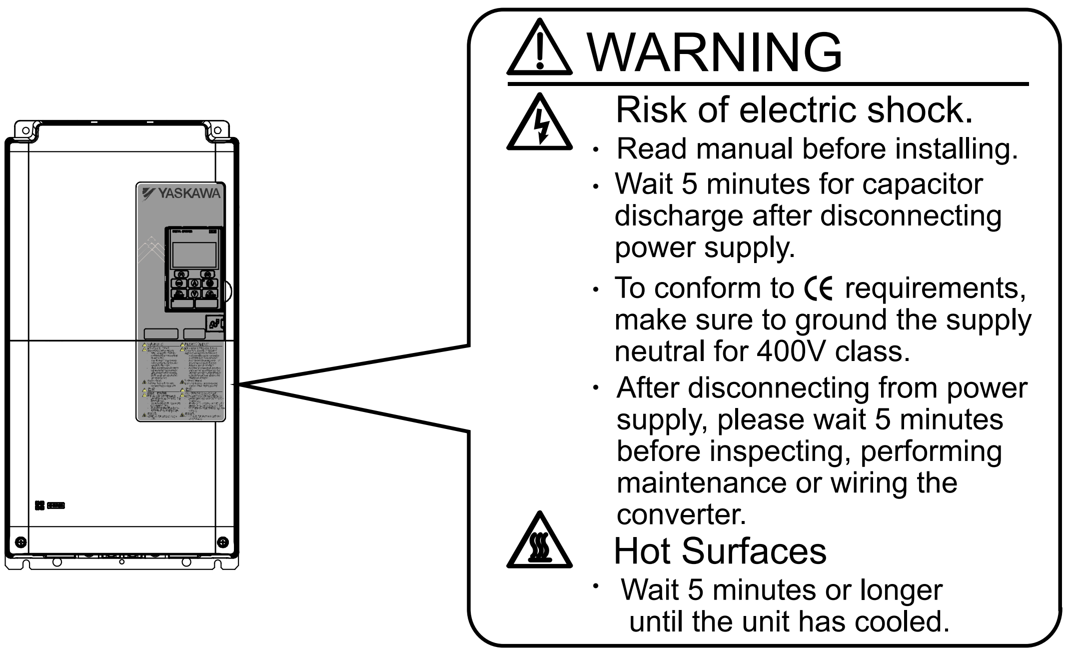


Figure i.1 Warning Information Example and Position

◆ Bypass Label Warning Example

Always heed the warning information listed in *Figure i.2* and *Figure i.3* in the positions shown in *Figure i.4*.

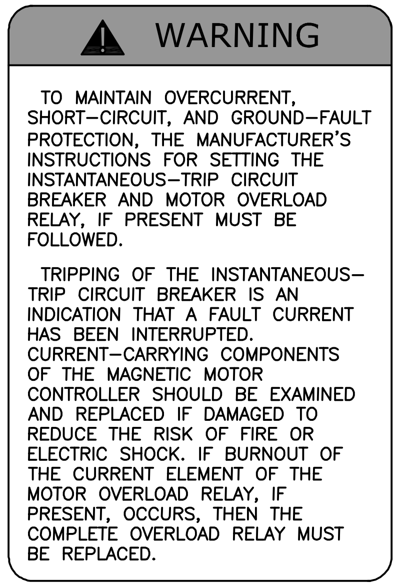


Figure i.2 Warning Information Example A

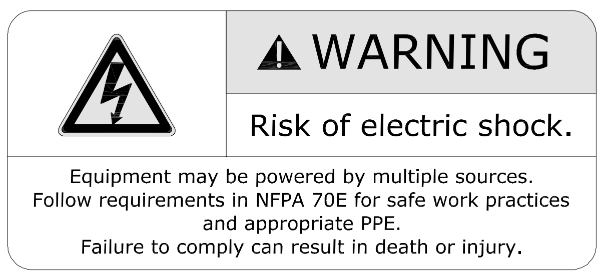


Figure i.3 Warning Information Example B

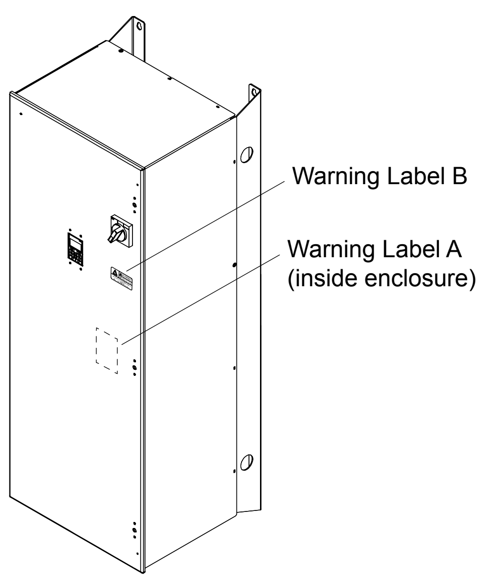


Figure i.4 Bypass Warning Label Locations

◆ Warranty Information

■ 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 bypass upon receipt, and gives an overview of the different enclosure types and components.

1.1 Section Safety

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 PWM drive 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

◆ Control Mode Details

Table 1.1 gives an overview of the various features associated with the bypass.

Table 1.1 Control Mode Features

Motor Type		Induction Motors	Comments
Control Mode		V/f	–
Basic Description		V/f control	–
Type of Applications	Motor Type	IM	–
	Multi Motor	YES	–
	Motor data unknown	YES	–
	High Speed Accuracy	–	–
Control Characteristics	Speed Control Range	1:40	May fluctuate with characteristics and motor temperature.
	Speed Accuracy	±2 to 3%	Speed deviation when operating at constant speed may fluctuate with characteristics and motor temperature.
	Speed Response	3 Hz (approx.)	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	Starting torque may fluctuate with characteristics and motor temperature.
Application-Specific	Auto-Tuning	• Energy Saving Tuning • Line to line resistance	Automatically adjusts parameter settings that concern electrical characteristics of the motor.
	Speed Search	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 Numbers and Nameplate Checks

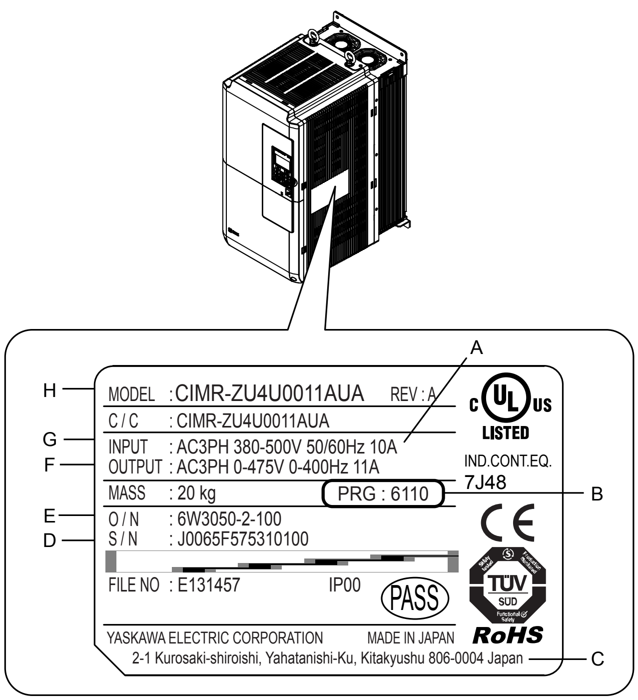
Please perform the following tasks after receiving the bypass

- Inspect the bypass for damage.

  If the bypass 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 bypass does not function properly, contact your supplier.

If you find any irregularities in the above items, contact the shipping company, the distributor or representative you purchased the bypass from or your Yaskawa office immediately. The bypass is thoroughly tested at the factory. Any damages or shortages evident when the equipment is received must be reported immediately to the commercial carrier that transported the material. Shipping damage is not covered by the Yaskawa warranty. After unpacking and inspecting for damage, verify that internal wire connections have not come loose during shipment by spot checking wire terminations with a screwdriver or the appropriate tool. Bypass storage must be in a clean and dry location. Maintain the factory packaging and provide covering as needed to protect the bypass from construction site dirt, water, debris and traffic prior to and during construction.

◆ Drive 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.

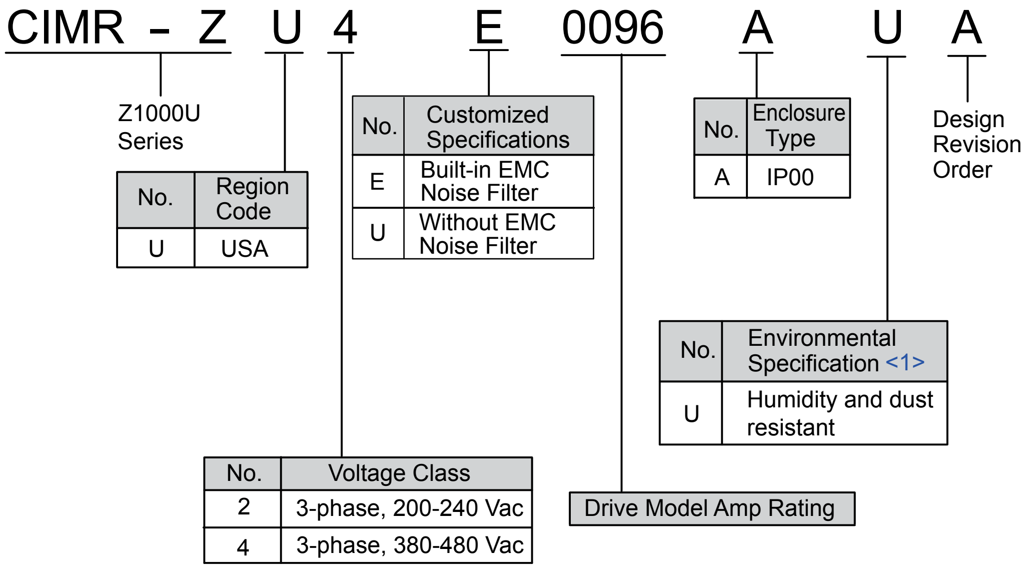


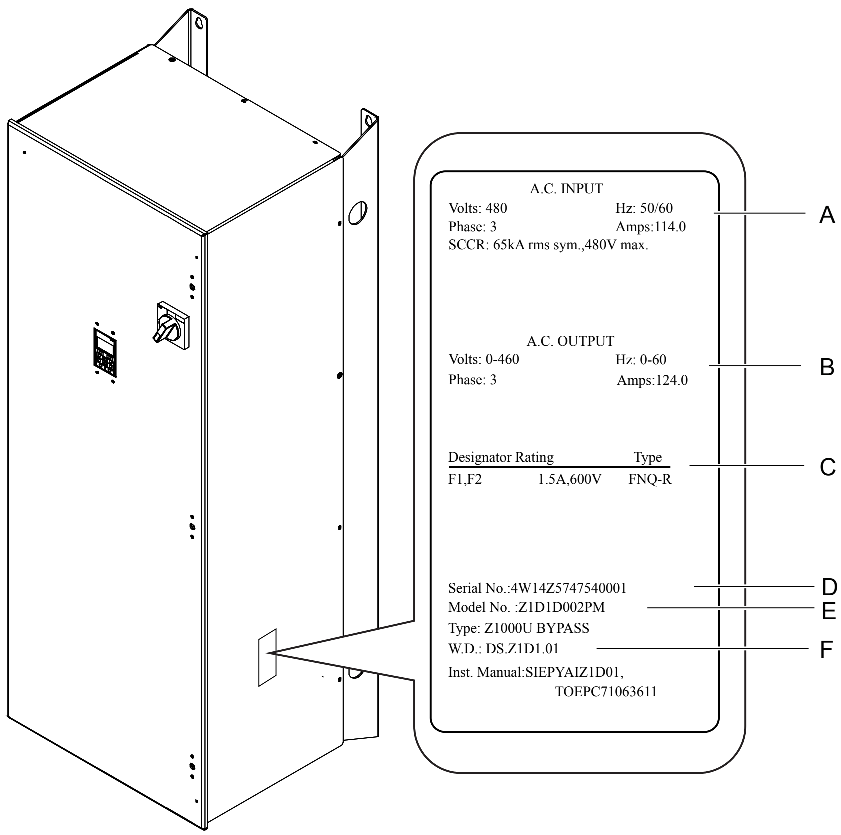
Figure 1.2 Drive Model Number Definition

<1> Drives with these specifications do not guarantee complete protection for the environmental conditions indicated.

◆ Bypass Nameplate

The nameplate is located on the inside of the enclosure door.

The nameplate shown below is an example for a standard Z1000U Bypass.



A – Input specifications
B – Output specifications
C – Control transformer fuse specifications
D – Serial number
E – Bypass model number
F – Schematic document number

Figure 1.3 Bypass Nameplate Information Example

Z1D 1 B 040 P B/G K W N T D/L W Z K

Z1000U Bypass

No.	Enclosure Type
1	IP20/UL Type 1
2	IP55/UL Type 12

No.	Voltage
D	208 Vac
B	480 Vac

No.	Power Options
G	Drive Service Switch
B	3-Contactor Bypass
K	Output Reactor 5%
N	EMC Filter
W	Soft Start Bypass

No.	Control Options
W	Custom Nameplate
D	Ethernet/IP
L	LonWorks
Z	Speed Pot
K	200 VA Transformer (CPT)

Refer to the following table

■ UL Type 1 Bypasses, Drive Models, and Capacities

Bypass Unit Model Z1D1	Capacity			Drive Model	Electrical Schematic	Weight (lb)
	HP	Input (A)	Output (A)			
208 Vac						
D024	7.5	23.3	24.2	2□0028	DS.Z1D1.01	230
D030	10	29.5	30.8	2□0042	DS.Z1D1.01	325
D046	15	43.6	16.2	2□0054	DS.Z1D1.01	340
D059	20	55.8	59.4	2□0068	DS.Z1D1.01	350
D074	25	70	74.8	2□0081	DS.Z1D1.01	350
D088	30	82.1	88.0	2□0104	DS.Z1D1.01	465
D114	40	105.2	114.0	2□0130	DS.Z1D1.01	475
D143	50	132.4	143.0	2□0154	DS.Z1D1.01	825
D169	60	156.4	169.0	2□0192	DS.Z1D1.01	825
D211	75	194.7	211.0	2□0248	DS.Z1D1.01	1050
480 Vac						
B011	7.5	10.7	11.0	4□0011	DS.Z1D1.01	220
B014	10	13.7	14.0	4□0014	DS.Z1D1.01	230
B021	15	19.7	21.0	4□0021	DS.Z1D1.01	230
B027	20	25.7	27.0	4□0027	DS.Z1D1.01	300
B034	25	31.7	34.0	4□0034	DS.Z1D1.01	300
B040	30	36.7	40.0	4□0040	DS.Z1D1.01	315
B052	40	47.7	52.0	4□0052	DS.Z1D1.01	350
B065	50	60	65.0	4□0065	DS.Z1D1.01	360
B077	60	71	77.0	4□0077	DS.Z1D1.01	375
B096	75	88	96.0	4□0096	DS.Z1D1.01	475
B124	100	114	124	4□0124	DS.Z1D1.01	490
B156	125	143	156	4□0156	DS.Z1D1.01	850
B180	150	165	180	4□0180	DS.Z1D1.01	900
B240	200	219	240	4□0240	DS.Z1D1.01	1100
B302	250	276	302	4□0302	DS.Z1D1.01	1600
B361	300	330	361	4□0361	DS.Z1D1.01	1750
B414	350	378	414	4□0414	DS.Z1D1.01	1800

■ UL Type 12 Bypasses, Drive Models, and Capacities

Bypass Unit Model Z1D2	Capacity			Drive Model	Electrical Schematic	Weight (lb)
	HP	Input (A)	Output (A)			
480 Vac						
B011	7.5	11.7	11.0	4□0011	DS.Z1D2.01	220
B014	10	14.7	14.0	4□0014	DS.Z1D2.01	230
B021	15	21.7	21.0	4□0021	DS.Z1D2.01	230
B027	20	27.7	27.0	4□0027	DS.Z1D2.01	300
B034	25	35.0	34.0	4□0034	DS.Z1D2.01	300
B040	30	41.0	40.0	4□0040	DS.Z1D2.01	315
B052	40	53.0	52.0	4□0052	DS.Z1D2.01	350
B065	50	66.0	65.0	4□0065	DS.Z1D2.01	360
B077	60	78.0	77.0	4□0077	DS.Z1D2.01	375
B096	75	97.0	96.0	4□0096	DS.Z1D2.01	475
B124	100	125.0	124	4□0124	DS.Z1D2.01	490
B156	125	157.6	156	4□0156	DS.Z1D2.01	850
B180	150	181.6	180	4□0180	DS.Z1D2.01	900

◆ Bypass Enclosures

All bypass units are intended for non-hazardous locations.

UL Type 1 Enclosures are for indoor use and provide a degree of protection against incidental contact with enclosed electrical equipment and falling dust or dirt.

UL Type 12 Enclosures are for indoor use and provide a degree of protection against incidental contact with enclosed electrical equipment and falling dust or dirt, and a degree of protection against harmful effects on the equipment from water.

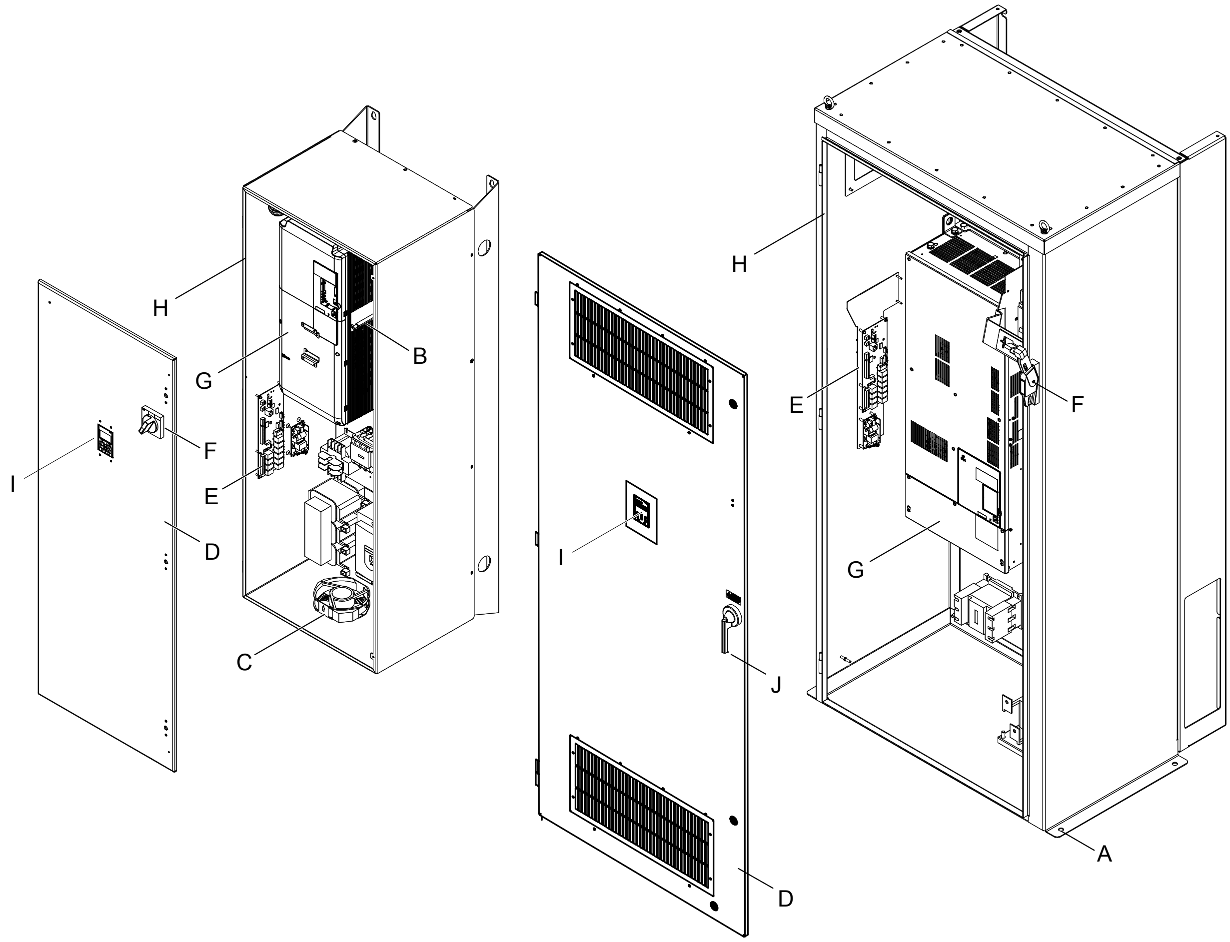
◆ Bypass Product Options

Refer to Bypass Options on page 275 for details on available bypass product configuration options.

1.4 Bypass Component Names

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

Note: Arrangement of components differs on models B302 to B414.



A – Bypass bracket mounting hole
B – Disconnect shaft
C – Bypass enclosure fan
D – Bypass front door
E – Bypass control board
F – Circuit breaker handle
G – Z1000U drive
H – Bypass enclosure
I – HOA keypad
J – Floor mount door handle

Figure 1.4 View of Bypass Components

1.5 Bypass Component Descriptions

◆ Bypass Front Control Panel

The external appearance and component names of the bypass are shown in *Figure 1.5*.

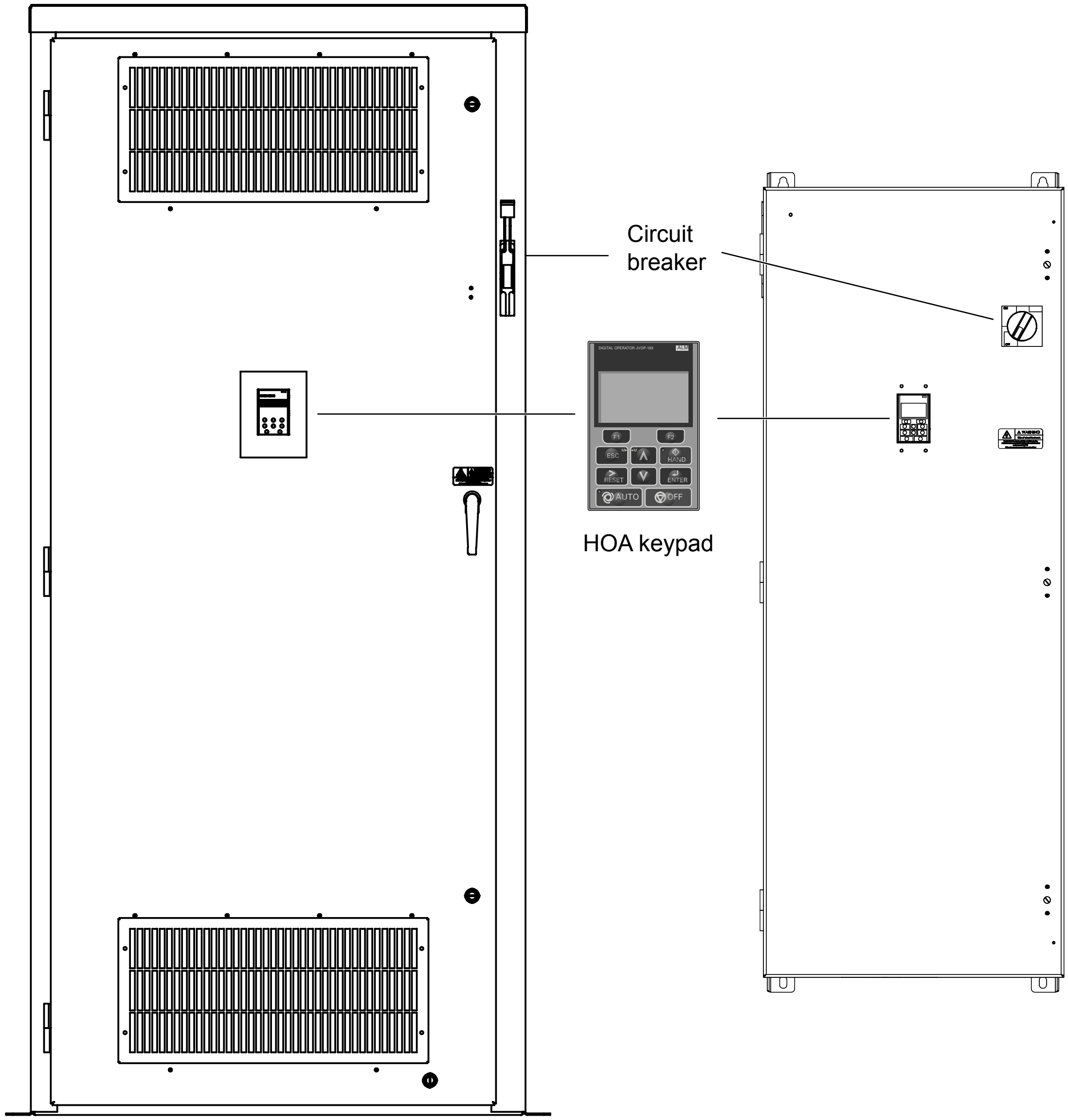


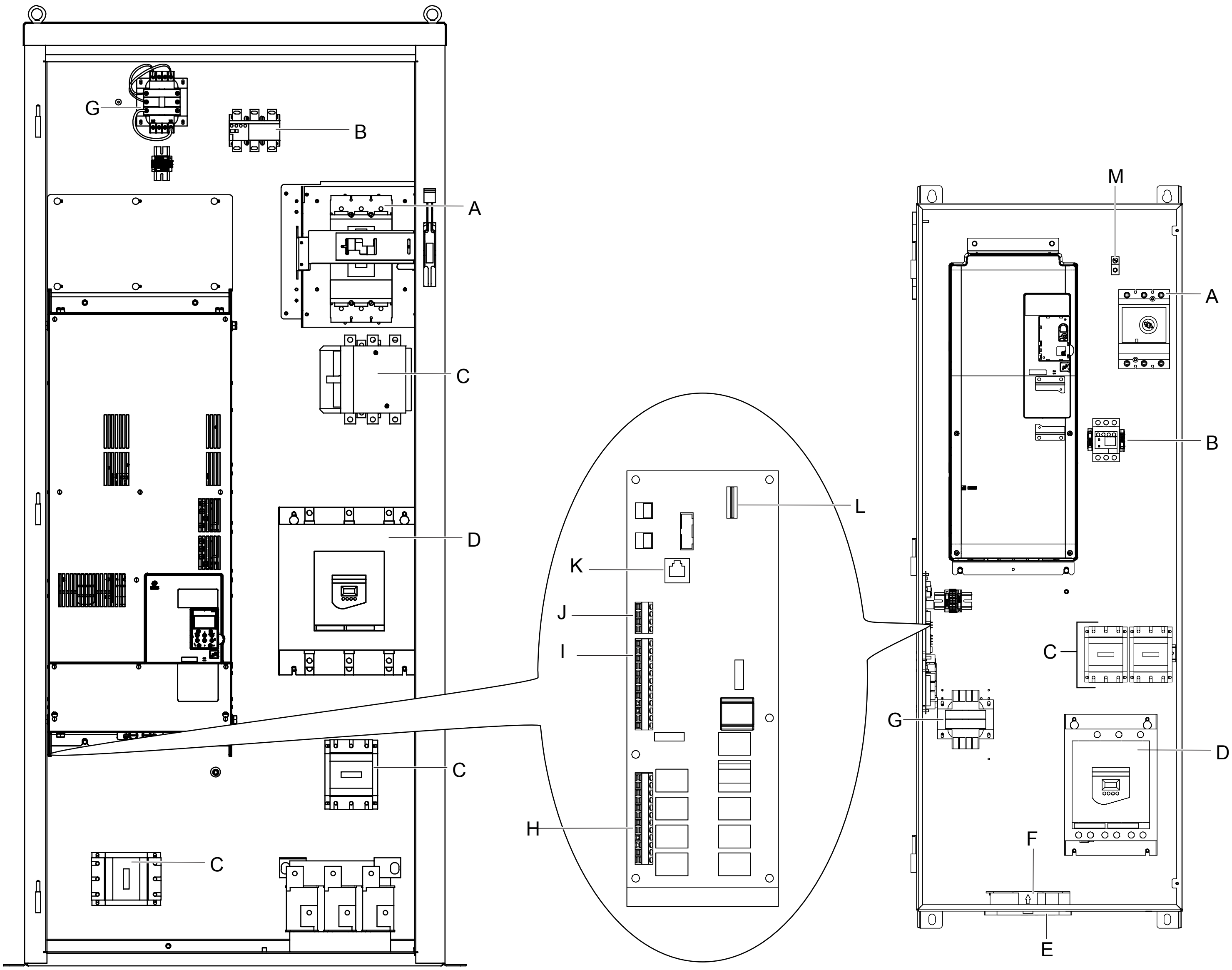
Figure 1.5 Bypass Control Panel with Keypad Operator Controls

Refer to Using the HOA Keypad on page 79 for details on the HOA keypad.

◆ Bypass Internal Components

The appearance and internal component names of the bypass are shown in *Figure 1.6*.

Note: Arrangement of components differs on models B302 to B414.



A – Main input disconnect
B – Motor overload
C – Bypass contactor
D – Soft starter option PW
E – Air filter
F – Enclosure cooling fan
G – 120 V control transformer
H – Terminal TB1
I – Terminal TB2
J – Terminal TB3
K – Communications port CN2
L – Option card connector CN5
M – Ground terminal

Figure 1.6 Interior View of Bypass Unit

■ Circuit Breaker (100 kAIC)

Electrically located on the input power side of the bypass, the door mounted circuit breaker provides a means of disconnecting the bypass from line power for equipment maintenance. The circuit breaker must be in the OFF position to open the bypass enclosure door. When opened, the handle can be locked in the OFF position using a padlock.

Branch short circuit protection for the bypass must be supplied by the customer.

■ Contactors

The bypass is a 2-contactor or 3-contactor bypass circuit employing IEC rated contactors in an electrically interlocked arrangement to allow mutually exclusive operation in Drive or Bypass modes.

The control logic and “soft start” characteristic of the drive limit the drive input and output contactors to motor FLA current or less. For this reason, the drive output contactor has a lower current rating than the bypass contactor. The bypass contactor is exposed to motor inrush current (LRA) when starting the motor across-the-line and therefore requires a higher current rating.

Use an optional soft starter on the line side of the bypass contactor to limit the current on the bypass circuit to motor FLA or less. In this case, the bypass contactor is tested for a short-circuit combination rating of 65 kA or greater with the soft starter and large enough to handle the motor FLA current.

■ Overload Relay

The adjustable thermal overload relay (OLR) provides overload protection for the motor in Drive and Bypass operating modes. The bypass three-phase output power connection to the motor is made to the output terminals of the OLR. The OLR is set up in the factory to be a manual reset device, requiring operator attention if an overload trip-out is experienced.

■ Control Power Transformer

A Control Power Transformer (CPT) is provided to power the bypass 120 Vac control circuit. The VA capacity is determined by the control circuit and optional functions specified for the unit. The CPT primary is fused in both legs, the secondary is fused when required by NEC (transformer VA and wire size dependent). One side of the transformer secondary is grounded to the bypass enclosure.

■ Electronic Bypass Control Logic

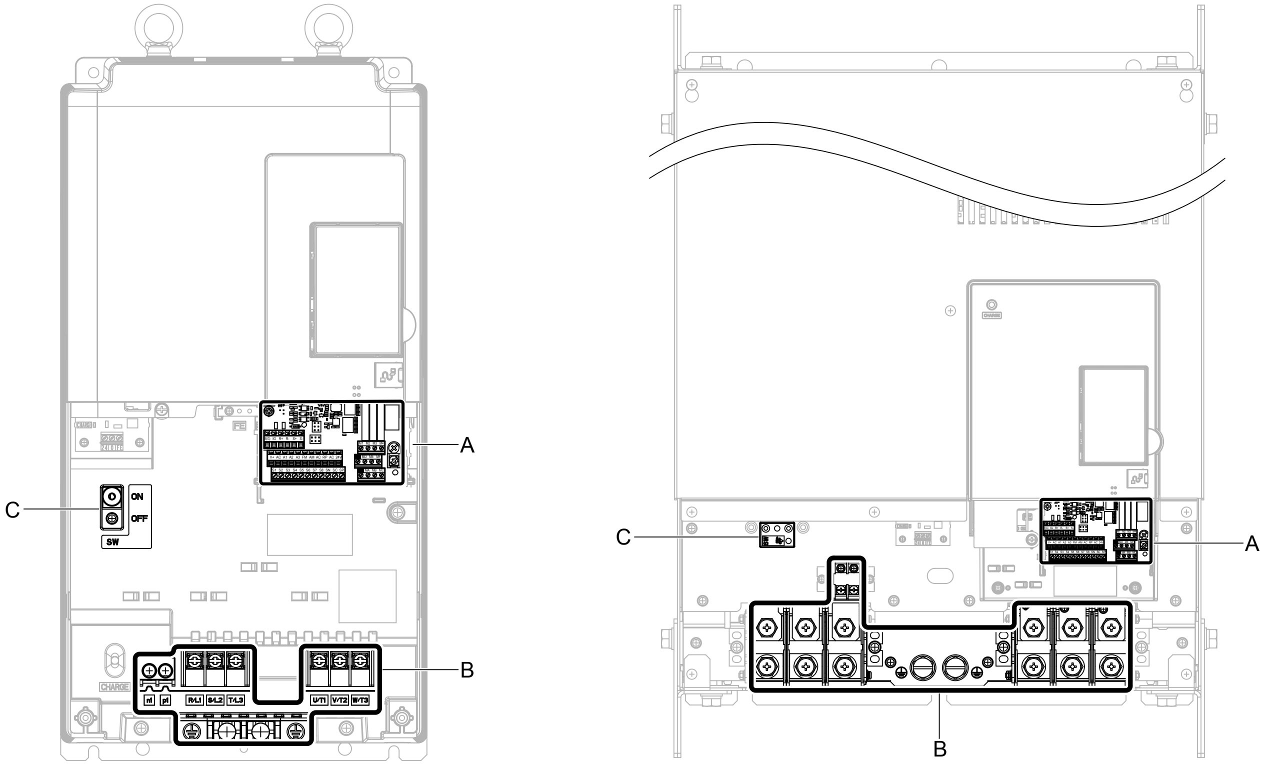
Operating elements such as indicating LEDs, selector buttons, and control logic are incorporated into a PCB assembly to eliminate the potential for loose wires after shipment.

The operating elements are located on PCB A3 and the control logic PCB A2 contains the control circuit field wiring terminal blocks TB1 through TB5.

■ Drive/Bypass Logic Interlocks

The bypass 120 Vac logic circuit is interconnected with the drive multi-function digital input terminals and multi-function digital output terminals to allow a single customer interface to control both drive and bypass circuits. These drive terminals are not available for field connections. All field control connections are landed at terminal blocks TB1 through TB5 on control logic PCB A2 and drive PCB A1.

◆ Front Views of Drive



A – Terminal board (*Refer to Control Circuit Wiring on page 64*)

B – Main circuit terminal (*Refer to Wiring the Main Input Circuit on page 61*)

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

Figure 1.7 Front Views of Drives

2

Mechanical Installation

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

2.1 Section Safety

WARNING

Crush Hazard

Use a dedicated lifting device when moving or positioning 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 480 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 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.
Never lift or move the drive 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 bypass.

◆ Installation Environment

Install the bypass in an environment matching the conditions below to prolong its optimum performance life.

Table 2.1 Installation Environment

Environment	Conditions
Installation Area	Indoors
Ambient Temperature	-10 to + 40 °C (+14 to +104 °F) NEMA Type 1 Enclosure
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	Up to 1000 meters without derating. Up to 3000 meters with output current and voltage derating
Orientation	Install the bypass vertically to maintain maximum cooling effects.

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

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

◆ Installation Orientation and Spacing

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

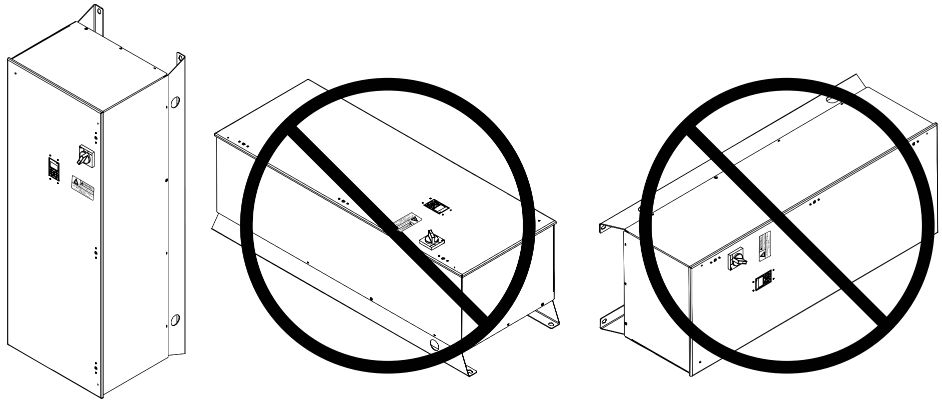


Figure 2.1 Correct Installation Orientation

◆ Exterior and Mounting Dimensions

Refer to bypass dimension drawing DD.Z1U.□.□□.01 packaged with the bypass for bypass enclosure dimensions and proper installation clearances necessary to maintain sufficient space for airflow and wiring.

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3

Electrical Installation

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

3.1 Section Safety

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 connect or disconnect wiring while the power is on.

Failure to comply may result in death or serious injury.

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

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 servicing must be performed only by authorized personnel familiar with installation, adjustment, and maintenance of AC drives.

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

Failure to comply could result in death or serious injury.

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

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.

Do not install the drive to a combustible surface. Never place combustible materials on the drive.

⚠ WARNING

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.

Properly handle the HOA keypad battery.

Improper use of the battery may cause fire by explosion and personal injury.

Correctly install the battery, paying attention to polarity (+/-).

Do not attempt to charge the battery or improperly disassemble the HOA keypad.

⚠ 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.

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.

Do not modify the drive circuitry.

Failure to comply could result in damage to the drive and will void warranty.

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

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

Failure to comply could result in damage to the drive.

Do not heat or throw the battery into fire.

The battery remains in use even when power to the drive has been shut off. Be sure to also remove the battery in the HOA keypad when the drive will be shut off for long periods of time.

A dead battery left inside the HOA keypad may leak and damage the keypad and drive. Be sure to replace the battery with a new one immediately after the expected lifespan has passed or when the “bAT” error is displayed on the HOA keypad.

Be sure to observe the Perchlorate Best Management Practices (BMPs).

BMPs apply to primary lithium (manganese dioxide) coin batteries sold or distributed in California. Perchlorate Material-special handling may apply, please refer to: www.dtsc.ca.gov/hazardouswaste/perchlorate.

3.2 Standard Connection Diagram

Connect the bypass and peripheral devices as shown in ***Figure 3.1***. It is possible to set and run the bypass via the HOA keypad without connecting digital I/O wiring. This section does not discuss drive operation; ***Refer to Start-Up Programming & Operation on page 77*** for instructions on operating the drive.

WARNING! *Fire Hazard. Branch Circuit protection is required to be installed according to applicable local codes and the requirements listed on the bypass nameplate. Failure to comply could result in fire and damage to the bypass and drive or injury to personnel. Bypass models without soft-starter option PW are suitable for use on a circuit capable of delivering not more than 100,000 RMS symmetrical amperes, 208 Vac and 480 Vac. Bypass models D169 to D211 and B180 to B414 with option PW are also suitable for use on a circuit capable of delivering not more than 100,000 RMS symmetrical amperes, 208 Vac and 480 Vac. Bypass models D024 to D143 and B011 to B156 with option PW are suitable for use on a circuit capable of delivering not more than 65,000 RMS symmetrical amperes, 208 Vac and 480 Vac.*

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

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

Note: The minimum load for relay outputs DO-7, DO-8, DO-9, DO-10, M1-M2, M3-M4, M5-M6, and MA-MB-MC is 10 mA.

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 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.*

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

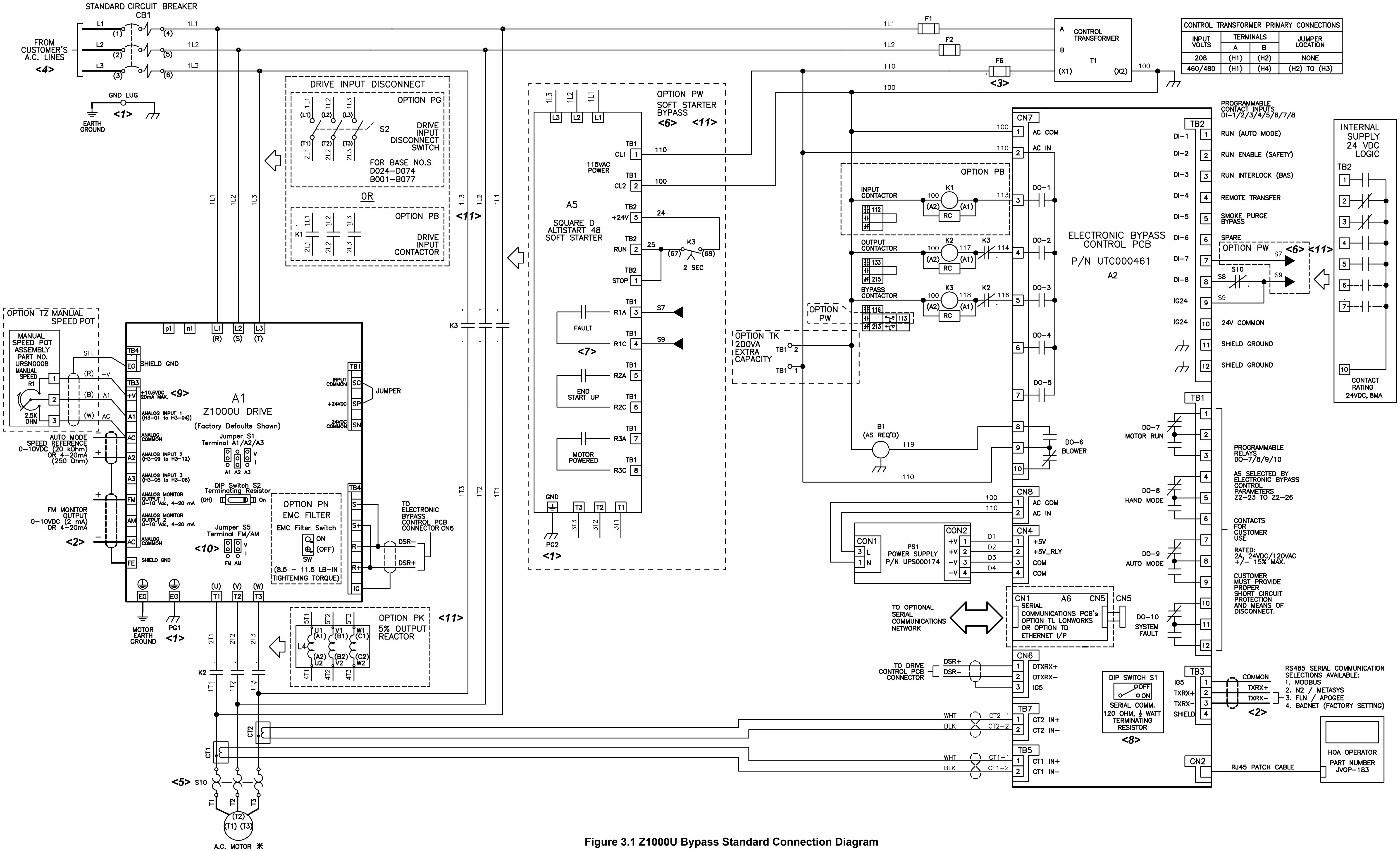

Figure 3.1 Z1000U Bypass Standard Connection Diagram

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<1> Connect the cabinet ground lug to earth ground and utility ground.

<2> Insulated twisted shielded wire is required. Connect the shield only at one end to avoid ground loops. Do not run these wires in the same conduit as AC power or AC control wires.

<3> Secondary fuse F6 is added with control transformer T1 or a power rating 350 VA or greater.

<4> Set E1-05 to 208 for 208 Vac applications.

<5> The motor overload relay is factory set for manual reset. Adjust the motor overload relay trip setting for the actual AC motor full load amps.

<6> Bypasses with option PW should set Z1-42 to 1, and Z2-07 to 36 and Z2-15 to 1 to trigger an “EFb” fault with the motor coasting to stop when the soft starter faults.

<7> R1 is a fail-safe contact. It is shown de-energized.

<8> Set DIP switch S1 to the ON position to enable the termination resistor only in the last drive in a MEMOBUS/Modbus network.

<9> The maximum output current capacity for the +V terminal on the control circuit is 20 mA. Never short terminals +V and AC, as it can cause erroneous operation or damage the drive.

<10> Use jumper S5 to select between voltage or current output signals at terminals FM and AM. Set parameters H4-07 and H4-08 accordingly.

<11> Not available on Type 12 enclosures.

3.3 Main Circuit Wiring

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

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

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

◆ Opening the Bypass Enclosure

WARNING! *Electrical Shock Hazard. Do not open the bypass enclosure while the power is on. Failure to comply may result in death or serious injury. Make sure that the circuit breaker is in the "OFF" position before attempting to open the doors.*

■ Models D024 to D114 and B011 to B124

1. Turn the circuit breaker to the "OFF" position.

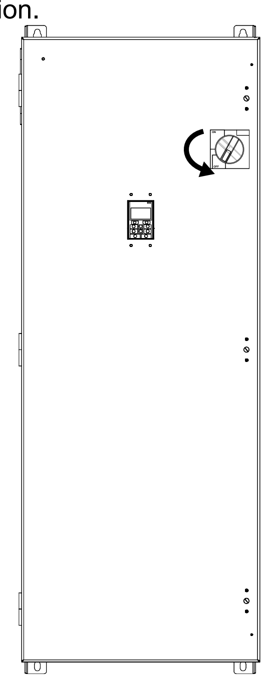


Figure 3.2 Disconnect Power

2. Turn the flat head screw fasteners on the cover 1/2 turn counter-clockwise.

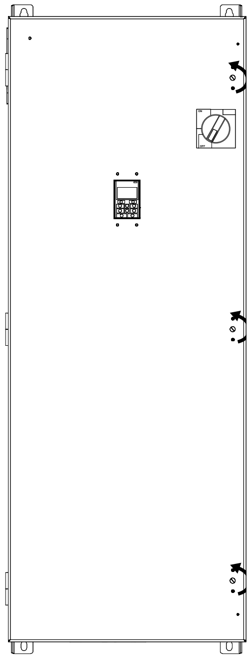


Figure 3.3 Turn Fasteners

3. Door will now swing open on hinges located on left side of the bypass.

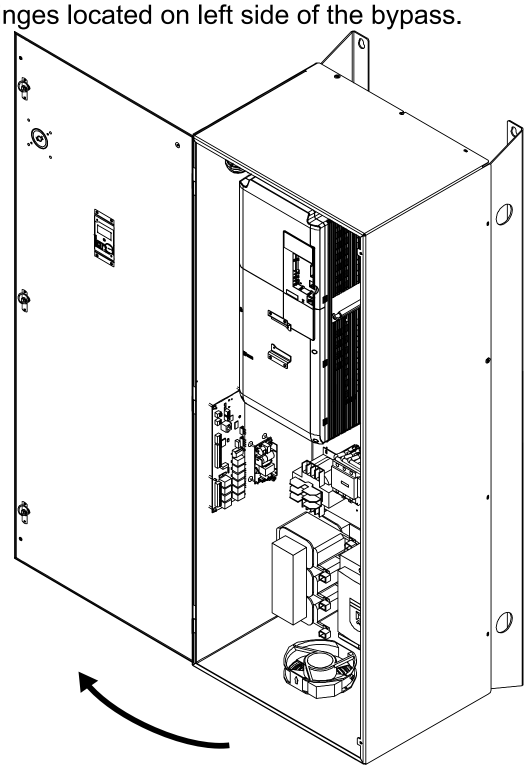


Figure 3.4 Swing Open Door

■ Models D143 to D211, B156 to B240, and B302 to B414

1. Move the circuit breaker handle to the "OFF" position.

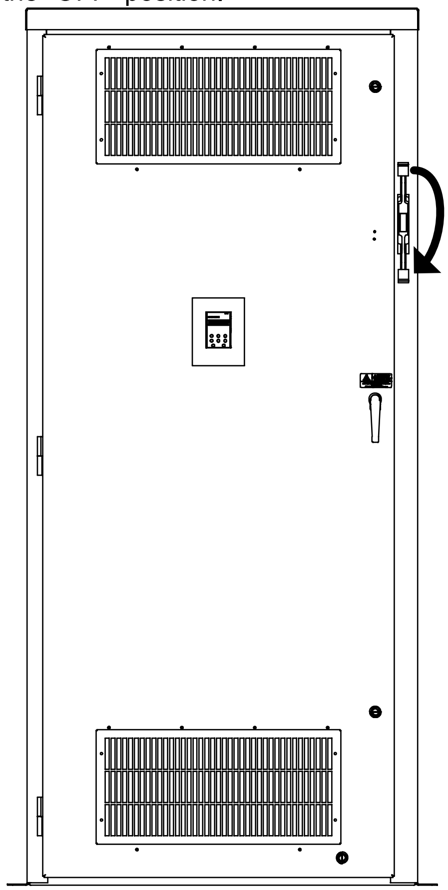


Figure 3.5 Disconnect Power

2. Turn the door handle 1/4 towards the door hinges and open the door.

Note: Models B302 to B414 have two doors.

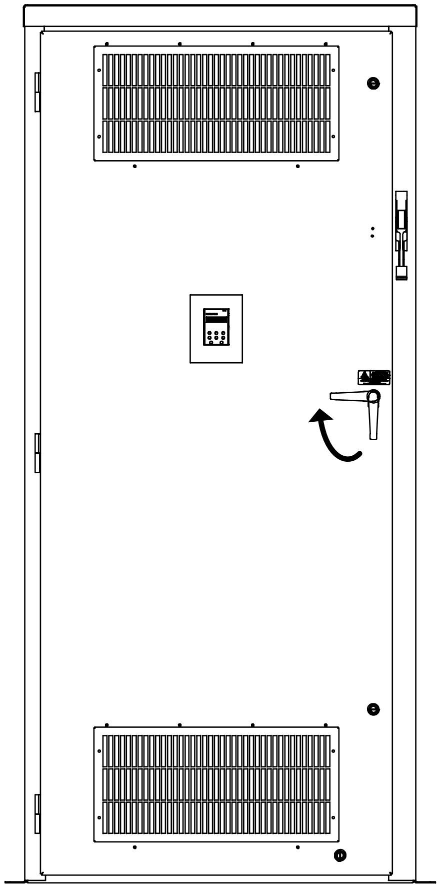


Figure 3.6 Turn Door Handle

◆ Bypass Main Circuit Terminal Block Configuration

Figure 3.7 shows the different main circuit terminal arrangements by model.

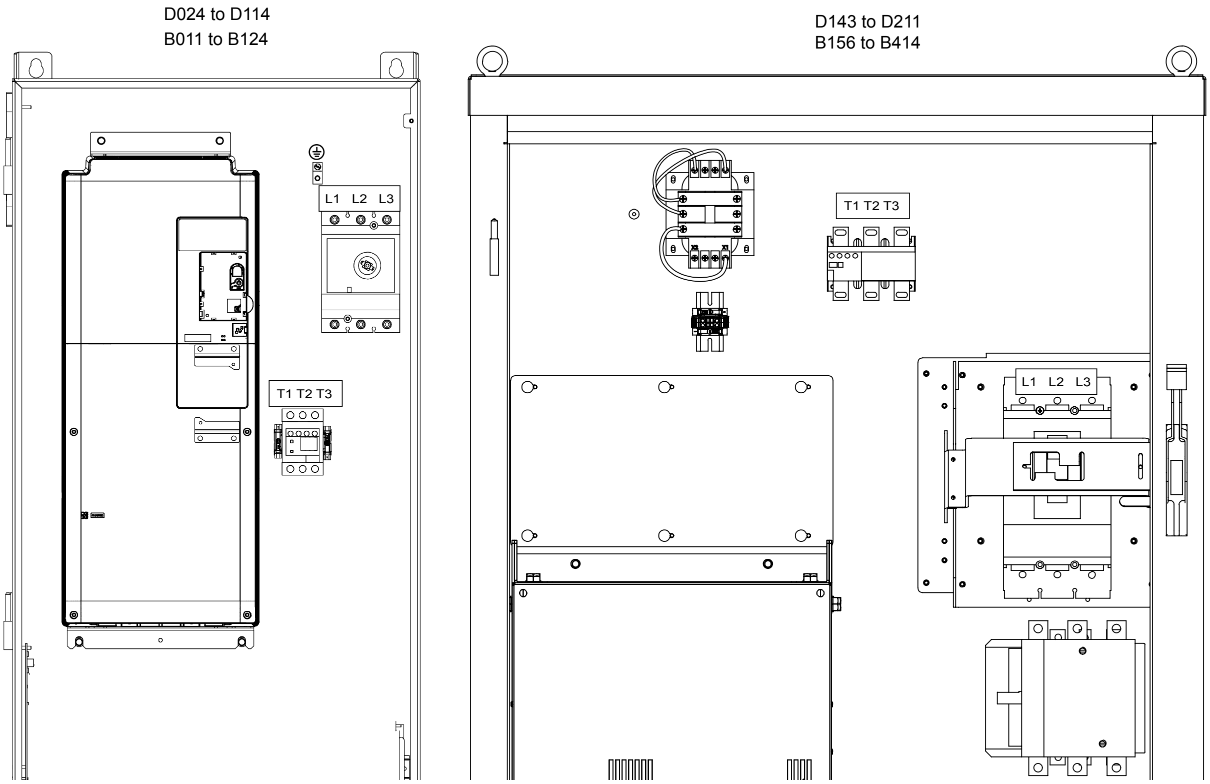
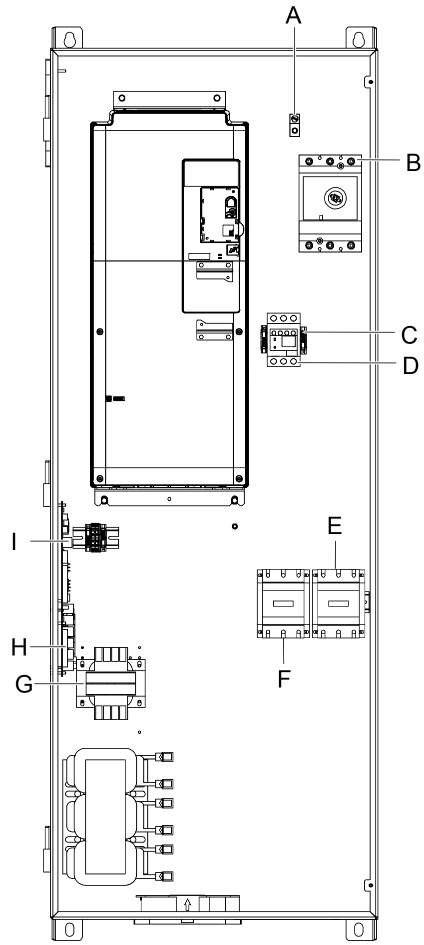


Figure 3.7 Main Circuit Terminal Block Configuration

3.4 Input and Output Power Wiring Connections

The input disconnect switch is located in the upper right hand side of the bypass. The three-phase input power connection is made to the input terminals of the disconnect. Refer to *Figure 3.8* for a representative example.

The Overload Relay (OLR) is mounted to the contactor assembly or back panel (depending on rating), just above the bypass contactor. The bypass three-phase output power connection to the motor is made to the output terminals of the Overload Relay.



A – Ground screw
B – Input power terminals
C – Motor overload relay
D – Motor connections
E – Drive output contactor K2 (Type 1 only)
F – Bypass contactor K3
G – 120 V control transformer
H – A2 bypass control board
I – 5 V bypass power supply board

Figure 3.8 Bypass Circuit Components

◆ Factory Recommended Branch Circuit Protection

WARNING! *Fire Hazard. Branch Circuit protection is required to be installed according to applicable local codes and the requirements listed on the bypass nameplate. Failure to comply could result in fire and damage to the bypass and drive or injury to personnel. Bypass models without soft-starter option PW are suitable for use on a circuit capable of delivering not more than 100,000 RMS symmetrical amperes, 208 Vac and 480 Vac. Bypass models D169 to D211 and B180 to B414 with option PW are also suitable for use on a circuit capable of delivering not more than 100,000 RMS symmetrical amperes, 208 Vac and 480 Vac. Bypass models D024 to D143 and B011 to B156 with option PW are suitable for use on a circuit capable of delivering not more than 65,000 RMS symmetrical amperes, 208 Vac and 480 Vac.*

Yaskawa recommends installing branch circuit protection according to maintain compliance with UL508C. Semiconductor protective type fuses are preferred. Alternate branch circuit protection devices are also listed in this manual.

Electrical Installation

3

◆ Main Circuit Terminal Functions

Table 3.1 Main Circuit Terminal Functions

Terminal	Description	Function	Page
1/L1	Main circuit power supply input	Connects line power to the bypass	*44*
2/L2			
3/L3			
1/T1	Drive output	Connects to the motor	*44*
2/T2			
3/T3			
⏚	For 208 Vac: 100 Ω or less For 480 Vac: 10 Ω or less	Grounding terminal	*56*

◆ Wire Gauge and Tightening Torque Specifications

Note:
1. For 0 to 100 A, use a minimum of 60 °C - 75 °C copper wire.
2. For above 100 A, use a minimum of 75 °C copper wire.
3. Wire gauge recommendations based on drive continuous current ratings using 75 °C 600 Vac vinyl-sheathed wire assuming ambient temperature within 40 °C and wiring distance less than 100 m.

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

  Line drop voltage (V) = $\sqrt{3}$ × wire resistance (Ω/km) × wire length (m) × current (A) × 10^{-3}
- *Refer to UL Standards Compliance on page 420* for information on UL compliance.

Table 3.2 Main Input Circuit Wiring Tightening Torques and Wire Gauges Without Option PW

Bypass Model Z1D☐		Standard Circuit Breaker Without Option PW		
208 Vac	480 Vac	Current Rating (A)	Wire Size Range (AWG)	Tightening Torque (lb. in.)
–	B011	25	14-10 or 8-3/0	50 or 120
–	B014	30		
–	B021	45		
D024	B027	60		
D030	B034	70		
–	B040	80		
D046	B052	110		
D059	B065	125		
D074	B077	150		
D088	B096			
D114	–			
–	B124	250	4-4/0	225
D143	B156		3/0-350 kcmil	225
D169	B180			
D211	–	400	(1-2) x (2/0-500 kcmil)	(1-2) x 442
–	B240	600		
–	B032		(1-3) x (3/0-500 kcmil)	(1-3) x 450
–	B361			
–	B414			

Table 3.3 Main Input Circuit Wiring Tightening Torques and Wire Gauges With Option PW

Bypass Model Z1D☐		Standard Circuit Breaker With Option PW		
208 Vac	**480 Vac**	**Current Rating (A)**	**Wire Size Range (AWG)**	**Tightening Torque (lb. in.)**
–	B011	25	14-10 or 8-3/0	50 or 120
–	B014			
–	B021	40		
D024	–	45		
–	B027	50		
D030	B034	60		
–	B040	80		
D046	B052	110		
D059	B065			
D074	B077			
D088	B096	125		
D114	–	175	4-4/0	225
D143	B124	200		
–	B156	225		
D169	B180	400	(1-2) x (2/0-500 kcmil)	(1-2) x 442
D211	–			
–	B240	600		
–	B032			
–	B361		(1-3) x (3/0-500 kcmil)	(1-3) x 450
–	B414			

Table 3.4 Motor and Ground Wire Gauges and Tightening Torques

Bypass Model Z1D☐		Output Circuit Motor Wiring		Earth Ground Wiring	
		Motor Overload Relay		**Ground Lug**	
208 Vac	**480 Vac**	**Wire Size Range (AWG)**	**Tightening Torque (lb. in.)**	**Wire Size Range (AWG)**	**Tightening Torque (lb. in.)**
–	B011	18-8	15	14-10 or 8 or 6-4 or 2	35 or 40 or 45 or 50
–	B014				
D024	B021				
D030	B027				
–	B034	16-2	70		
–	B040				
D046	–				
D059	B052				
–	B065	10-1/0	100		
D074	B077				
D088	B096	6-3/0	200		
D114	B124				
D143	–			14-2/0	120
D169	B156	6–300 kcmil	275		
–	B180				
D211	B240	(1-2) x (2-600 kcmil)	(1-2) x 500		
–	B302				
–	B361				
–	B414	(1-3) x (2-600 kcmil)	(1-3) x 500		

◆ Main Input Circuit and Motor Wiring

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

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

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.*

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

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

■ Cable Length Between Bypass and Motor

Voltage drop along the motor cable may cause reduced motor torque when the wiring between the bypass 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. Bypass 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 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 122***.

Table 3.5 Cable Length Between Bypass and Motor

Cable Length	50 m or less	100 m or less	Greater than 100 m
Carrier Frequency	12.5 kHz or less	5 kHz or less	2 kHz or less

Note:
1. When setting carrier frequency for bypasses running multiple motors, calculate cable length as the total wiring distance to all connected motors.
2. Do not use a long distance shielded line if there is an overvoltage problem at start. Either lower the carrier frequency or switch on the internal EMC filter if the power supply has a neutral ground.

■ Ground Wiring

Follow the precautions below when wiring the ground for one bypass or a series of bypasses.

WARNING! *Electrical Shock Hazard. Do not touch SW screw while power is applied to the drive. Failure to comply could result in death or serious injury. Before servicing, disconnect all power to the equipment. The internal capacitor remains charged even after the power supply is turned off. The charge indicator LED will extinguish when the DC bus voltage is below 50 Vdc. To prevent electric shock, wait for at least the time specified on the warning label, once all indicators are OFF, measure for unsafe voltages to confirm the drive is safe prior to servicing.*

WARNING! *Electrical Shock Hazard. Make sure the protective earthing conductor complies with technical standards and local safety regulations. Because the leakage current exceeds 3.5 mA, IEC/EN 61800-5-1 states that either the power supply must be automatically disconnected in case of discontinuity of the protective earthing conductor or a protective earthing conductor with a cross-section of at least 10 mm^2 (Cu) or 16 mm^2 (Al) must be used. Failure to comply may result in death or serious injury.*

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

WARNING! *Electrical Shock Hazard. Be sure to ground the drive ground terminal (208 Vac: ground to 100 Ω or less and 480 Vac: 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 3.9*** when using multiple drives. Do not loop the ground wire.

The drive ground lug (terminal ⏚) is connected to the enclosure. The enclosure ground lug must be connected to earth ground. See ***Figure 3.8***.

The drive has a second ground lug to accept the motor ground lead.

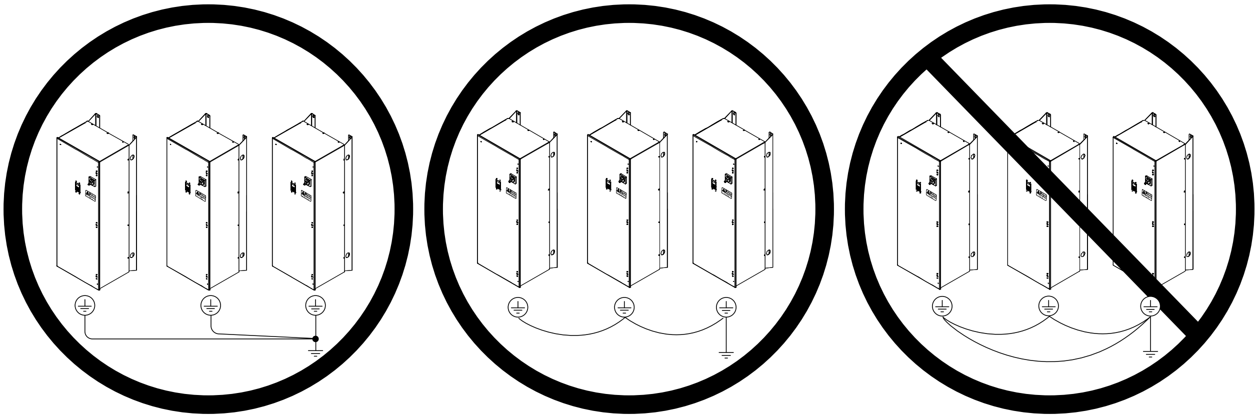


Figure 3.9 Ground Wiring for Multiple Bypass Units

■ Enable the Internal EMC Filter

If EMC is a concern and the network is grounded symmetrically, install the SW screw to the ON position. Installing the SW screw enables the internal EMC filter (Drives are shipped with the SW screw installed at the OFF position).

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.*

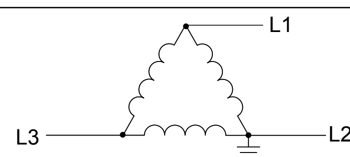
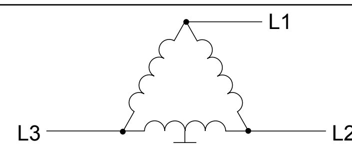
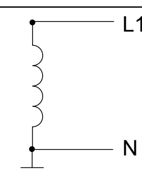
WARNING! *Electrical Shock Hazard. Connect the ground cable correctly. Failure to comply may result in death or serious injury.*

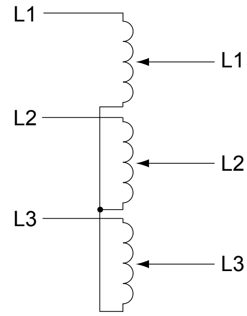
NOTICE: *When disabling the internal EMC filter, move the screws from ON to OFF and then tighten to the specified torque. Completely removing the screws or tightening the screws to an incorrect torque may cause drive failure.*

Note: For floating, impedance grounded, or asymmetrically grounded networks, disconnect the internal EMC filter by moving the SW screw to the OFF position.

Table 3.6 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 3.6 Asymmetrical Grounded Network

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	

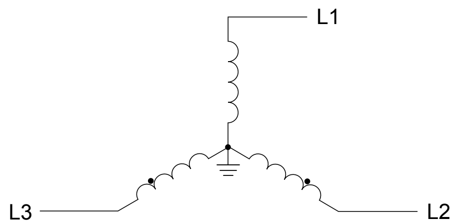
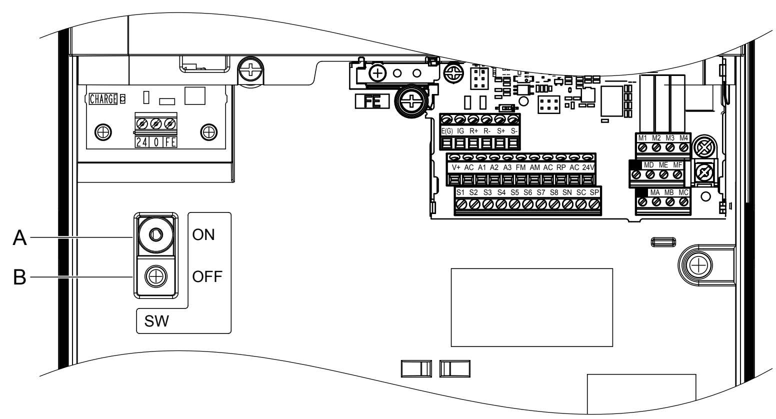
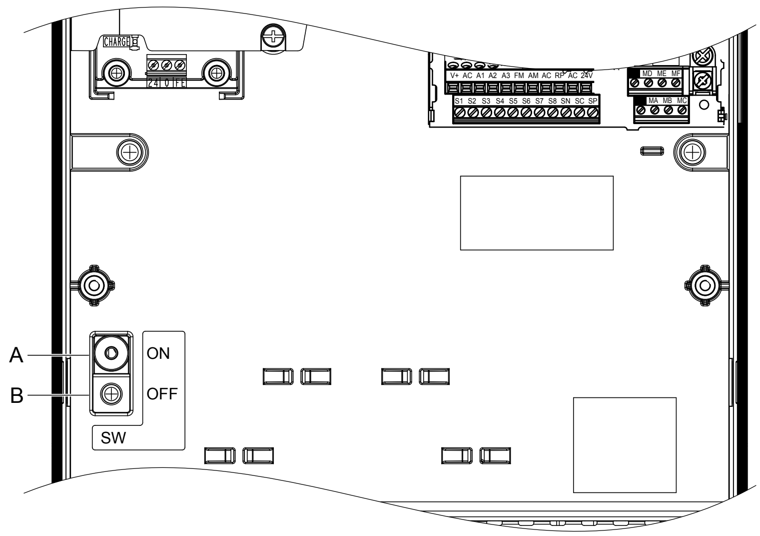


Figure 3.10 Symmetrical Grounded Network



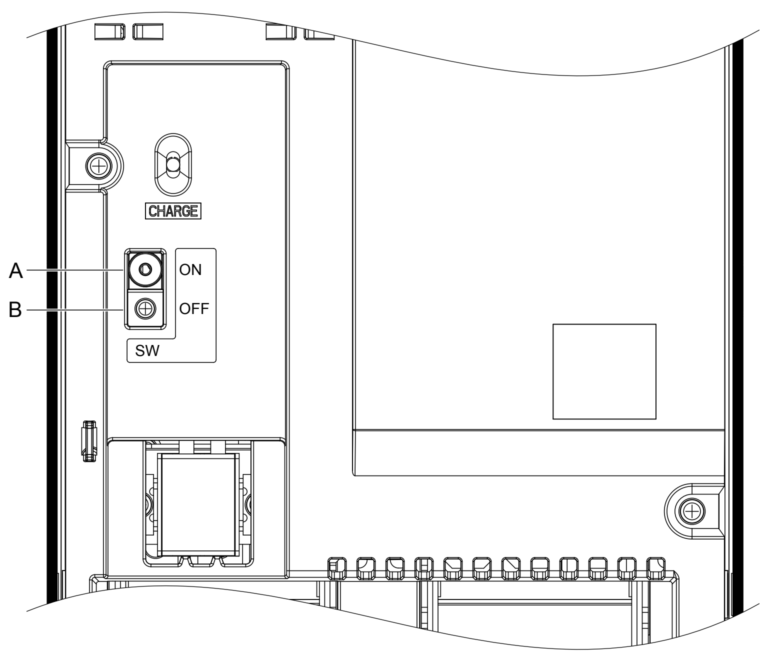
A – SW (ON) **B – Screw (OFF)**

Figure 3.11 EMC Filter Switch Location
(Models 2E0028, 2W0028, 4E0011 to 4E0034, and 4W0011 to 4W0034)



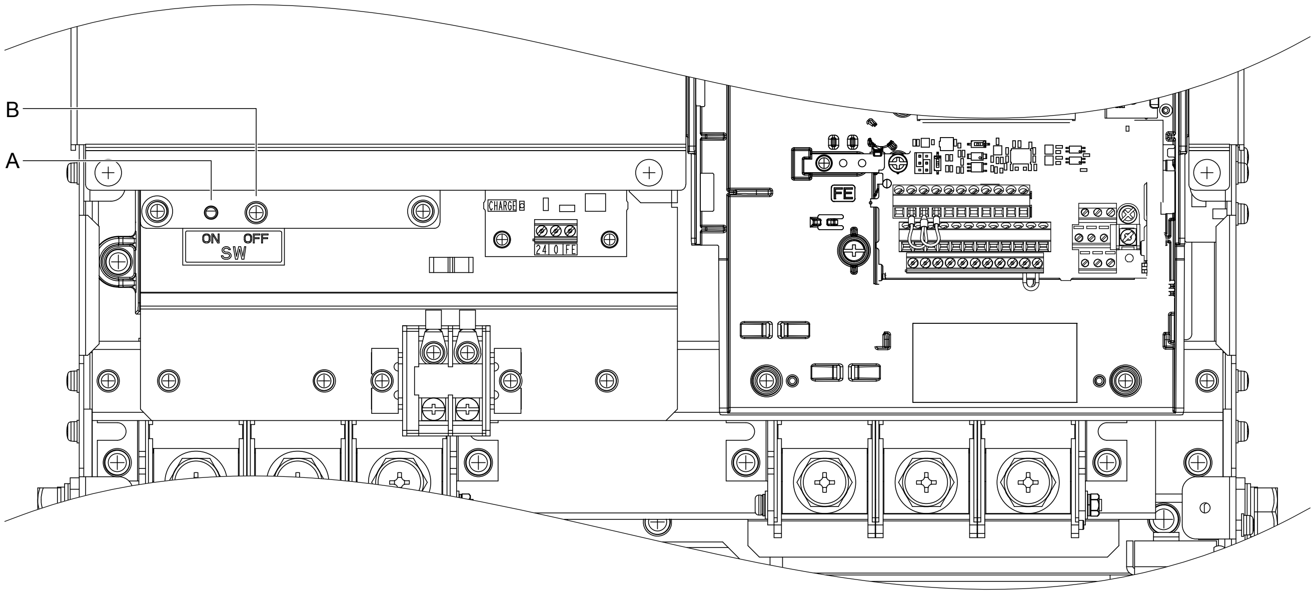
A – SW (ON) **B – Screw (OFF)**

Figure 3.12 EMC Filter Switch Location (Models 2E0042, 2W0042, 2E0054, 2W0054, 4E0040 to 4E0077, and 4W0040 to 4W0077)



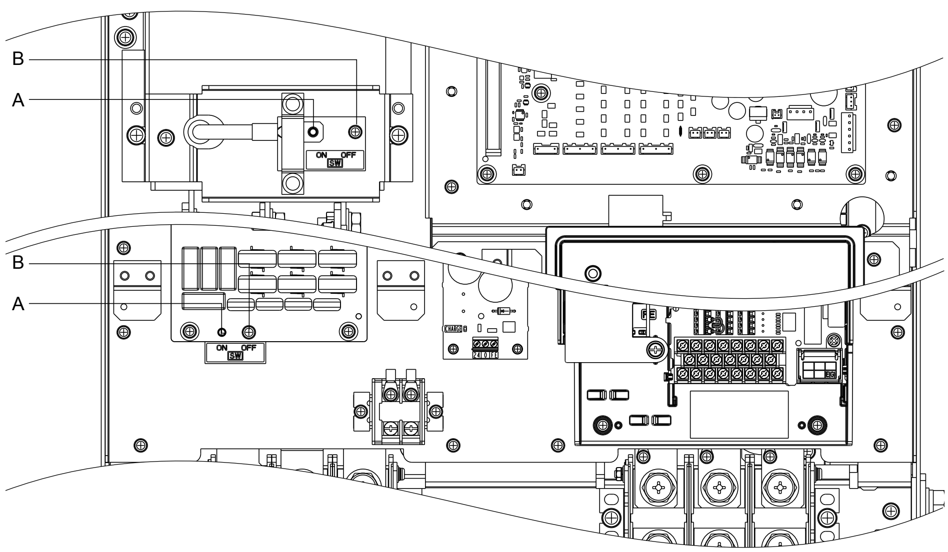
A – SW (ON) **B – Screw (OFF)**

Figure 3.13 EMC Filter Switch Location (Models 2E0104, 2W0104, 2E0130, 2W0130, 4E0096, 4W0096, 4E0124, and 4W0124)



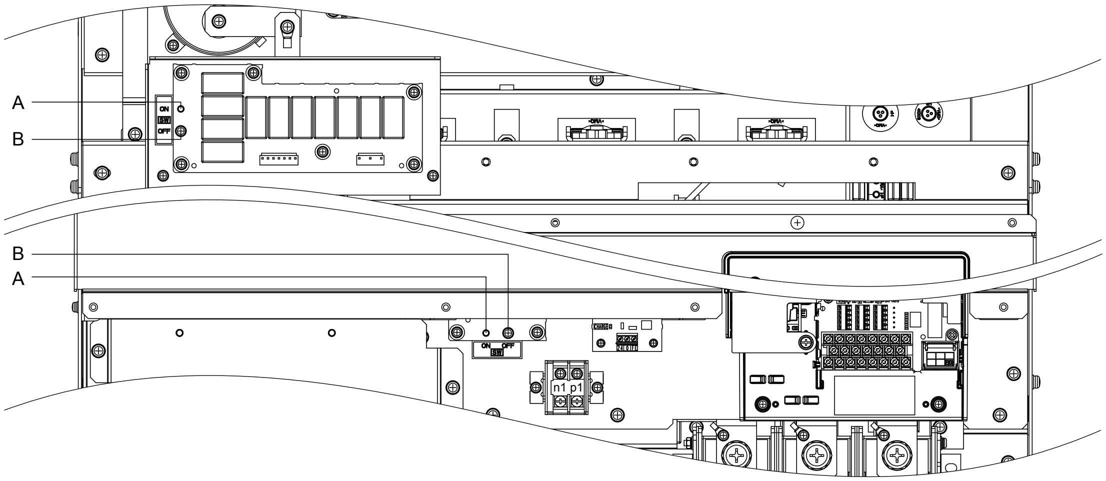
A – SW (ON) **B – Screw (OFF)**

Figure 3.14 EMC Filter Switch Location
(Models 2E0154, 2W0154, 2E0192, 2W0192, 4E0156, 4W0156, 4E0180, and 4W0180)



A – SW (ON) **B – Screw (OFF)**

Figure 3.15 EMC Filter Switch Location
(Models 2E0248, 2W0248, 4EU0216, 4W0216, 4E0240, and 4W0240)



A – SW (ON) **B – Screw (OFF)**

Figure 3.16 EMC Filter Switch Location (Models 4E0302 to 4E0414 and 4W0302 to 4W0414)

◆ Wiring the Main Input Circuit

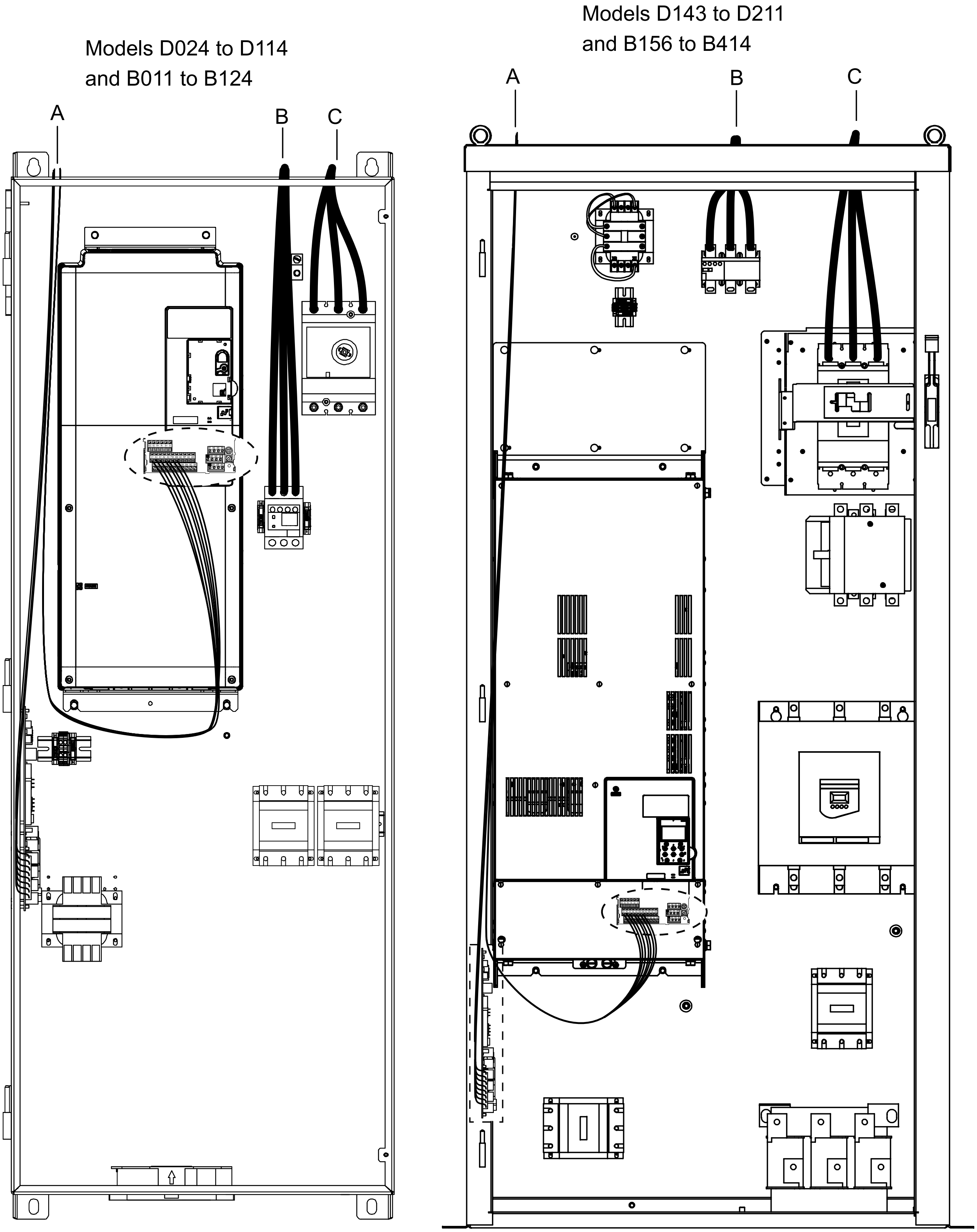
WARNING! *Electrical Shock Hazard. Shut off the power supply to the drive before wiring the main circuit terminals. Failure to comply may result in death or serious injury.*

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

■ Main Input Circuit Wire Routing

Figure 3.17 shows suggested wire entry and bending areas for representative enclosures.

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.*



A – Control, frequency reference, and communications wiring
B – Motor output circuit
C – Main input circuit

Figure 3.17 Bypass Wire Routing Example

3.5 Control Circuit Wiring

◆ Control Circuit Connection Diagram

Refer to *Figure 3.1* on page *45* when wiring terminals on the bypass and drive control circuits.

◆ Control Circuit Terminal Block Functions

WARNING! *Sudden Movement Hazard. Always check the operation and wiring of control circuits after being wired. Operating a bypass 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 Z1-01 may change the I/O terminal function automatically from the default setting.* ***Refer to Application Selection on page 91****. Failure to comply may result in death or serious injury.*

The functions of the control circuit terminals are shown in *Table 3.7*.

The control circuit terminals on Terminal Board A2 are arranged as shown in *Figure 3.18*.

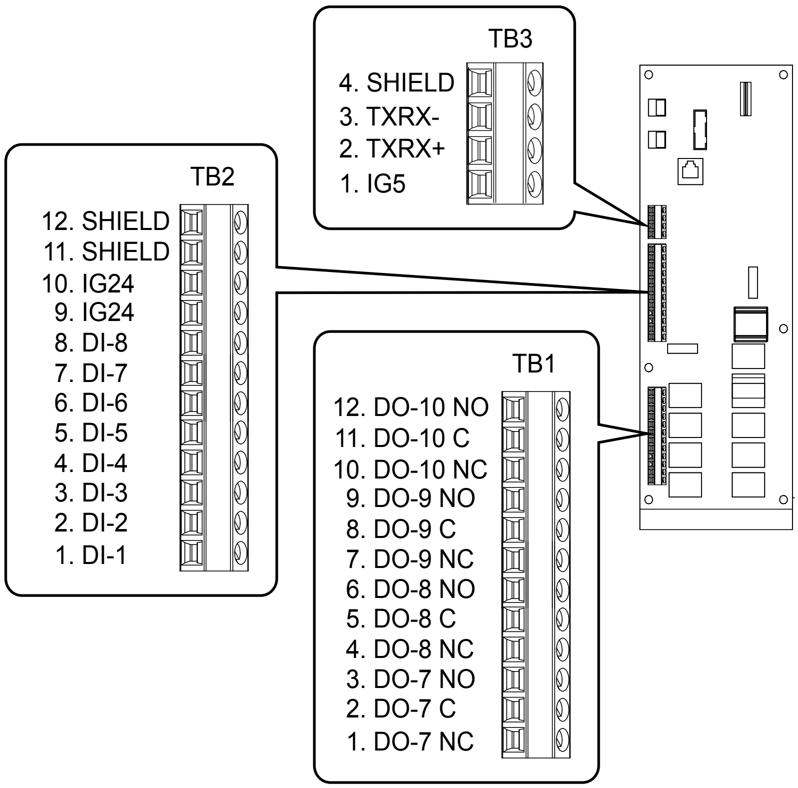


Figure 3.18 Control Circuit Terminal Board A2 Arrangement

Table 3.7 Bypass Control Circuit Terminal Board A2

Type	Signal Name	Description	Specification
Digital Inputs	DI-1	Digital Input 1	Dry contact rated, photocoupler sinking input to IG, 24 Vdc 8 mA, ground fault protected
	DI-2	Digital Input 2	
	DI-3	Digital Input 3	
	DI-4	Digital Input 4	
	DI-5	Digital Input 5	
	DI-6	Digital Input 6	
	DI-7	Digital Input 7	
	DI-8	Digital Input 8	
	IG24	Isolated Ground	Digital Input Common

Type	Signal Name	Description	Specification
Digital Outputs 120 Vac	DO-1	Digital Output 1	(Factory use only) 120 Vac, 66 VA sealed, 1650 inrush
	DO-2	Digital Output 2	
	DO-3	Digital Output 3	
	DO-4	Digital Output 4	
	DO-5	Digital Output 5	
Digital Outputs	DO-6	Digital Output 6	Relay, dry contact form C, 30 Vdc or 120 Vac, DO-6 (factory use only), 3.7 Amp 360 VA, DO-7 to DO-10 for customer use, 2 Amp
	DO-7	Digital Output 7	
	DO-8	Digital Output 8	
	DO-9	Digital Output 9	
	DO-10	Digital Output 10	

Table 3.8 lists the available control circuit input terminals on the drive. Text in parenthesis indicates the default setting for each multi-function input.

The drive control circuit terminals on Terminal Board A1 are arranged as shown in *Figure 3.19*.

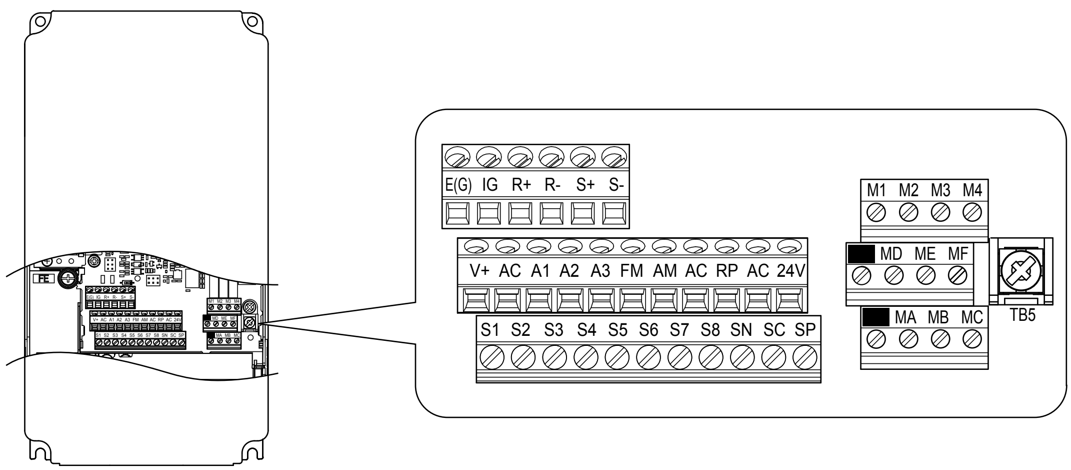


Figure 3.19 Control Circuit Terminal Arrangement

Table 3.8 Control Circuit Input Terminals

Type	No.	Terminal Name (Function)	Function (Signal Level) Default Setting	Page
Analog Inputs	+V	Power supply for analog inputs	10.5 Vdc (max allowable current 20 mA)	177
	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.	177 142
	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.	177 177 144
	A3	Multi-function analog input 3 (Aux reference 1)	• -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.	177
	AC	Frequency reference common	0 V	177
	E (G)	Ground for shielded lines	–	–

◆ Bypass Analog Outputs

There are two analog outputs that can be configured for a signal level of 0 to 10 Vdc or 4 to 20 mA. The signal level is controlled by the position of jumpers J2 and J3 on Control PCB A2 and by the values set to drive parameters H4-07 and H4-08.

◆ Serial Communications

Refer to BACnet Communications on page 331 or *Refer to MEMOBUS/Modbus Communications on page 351* for details depending on the applicable serial communications protocol.

■ Serial Communication Terminals

Table 3.9 Control Circuit Terminals: Serial Communications

Type	Name	Description	Notes
MEMOBUS/Modbus, BACnet, Metasys N2, or Apogee P1 Communication	IG5	Isolated ground	Ground reference for RS-485 signals. This is an isolated ground used only for communications and may be used in certain circumstances to connect to other communication devices floating ground references.
	TXRX+	(+) Differential communication signal	RS-485 signal levels
	TXRX-	(-) Differential communication signal	
	SHIELD	Shield tie point	Connected to chassis ground

■ Bypass and Drive Control Circuit Wire Size and Torque Specifications

Select appropriate wire type and gauges from *Table 3.10*. For simpler and more reliable wiring, use crimp ferrules on the wire ends. Refer to *Table 3.11* for ferrule terminal types and sizes.

Table 3.10 Bypass and Drive Control Circuit Gauge and Torque Values

Terminal	Screw Size	Tightening Torque N•m (lb. in)	Bare Wire Terminal		Ferrule-Type Terminal		Wire Type
			Applicable wire size mm^2 (AWG)	Recomm. wire size mm^2 (AWG)	Applicable wire size mm^2 (AWG)	Recomm. wire size mm^2 (AWG)	
DO-7, DO-8, DO-9, DO-10 DI-1, DI-2, DI-3, DI-4, DI-5, DI-6, DI-7, DI-8, IG24 IG5, TXRX+, TXRX-, SHIELD	M3	0.5 to 0.6 (4.4 to 5.3)	Stranded wire: 0.2 to 1.0 (24 to 16) Solid wire: 0.2 to 1.5 (24 to 16)	0.75 (18)	0.25 to 0.5 (24 to 20)	0.5 (20)	Shielded wire, etc.
+V, A1, A2, AC FM, AM, AC R+, R-, S+, S-, IG	M3	0.5 to 0.6 (4.4 to 5.3)	Stranded wire: 0.2 to 1.0 (24 to 16) Solid wire: 0.2 to 1.5 (24 to 16)	0.75 (18)	0.25 to 0.5 (24 to 20)	0.5 (20)	Shielded wire, etc.

■ 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 3.11* for dimensions.

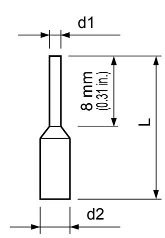


Figure 3.20 Ferrule Dimensions

Table 3.11 Ferrule Terminal Types and Sizes

Size mm^2 (AWG)	Type	L mm (in)	d1 mm (in)	d2 mm (in)	Manufacturer
0.25 (24)	AI 0.25-8YE	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)	

◆ Drive Cover Removal

Follow the procedures below to remove and reattach the drive covers for wiring.

◆ Drives in Bypass Models D024 to D114 and B011 and B124

■ Removing the Terminal Cover

1. Loosen the terminal cover screw.

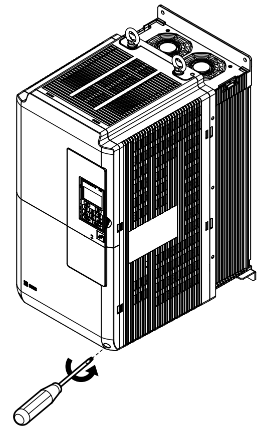


Figure 3.21 Removing the Terminal Cover

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

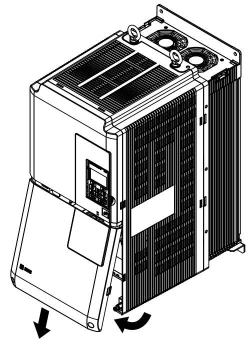


Figure 3.22 Removing the Terminal Cover

■ Reattaching the Terminal Cover

Power lines and signal wiring should pass through the opening provided. ***Refer to Wiring the Main Input Circuit on page 61*** and ***Wiring the Drive Control Circuit Terminal*** on page *70* for details on wiring.

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

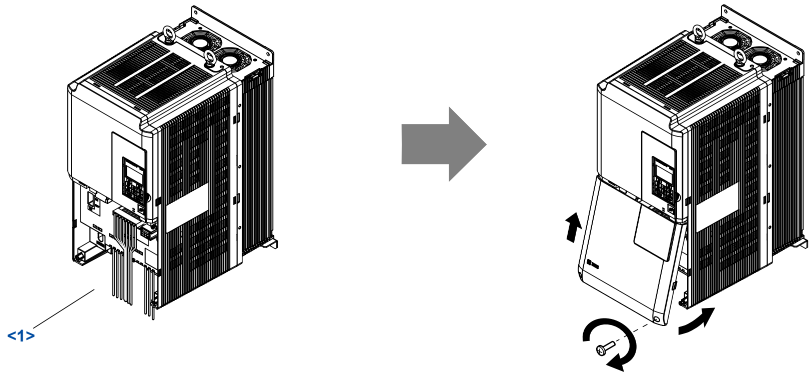


Figure 3.23 Reattaching the Terminal Cover

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

◆ Drives in Bypass Models D143 to D211 and B156 to B414

■ 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.*

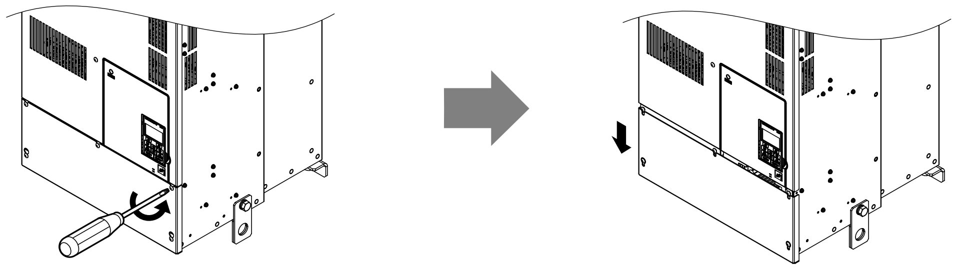


Figure 3.24 Removing the Terminal Cover

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

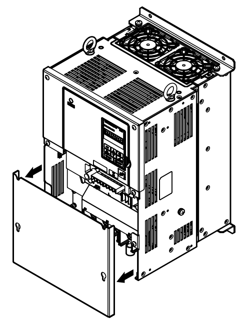


Figure 3.25 Removing the Terminal Cover

■ 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 Input Circuit on page 61*** and ***Wiring the Drive Control Circuit Terminal*** on page *70* for details on wiring.

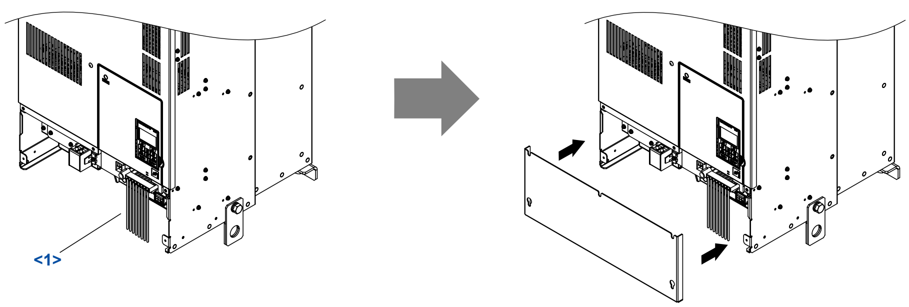


Figure 3.26 Reattaching the Terminal Cover

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

◆ 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.

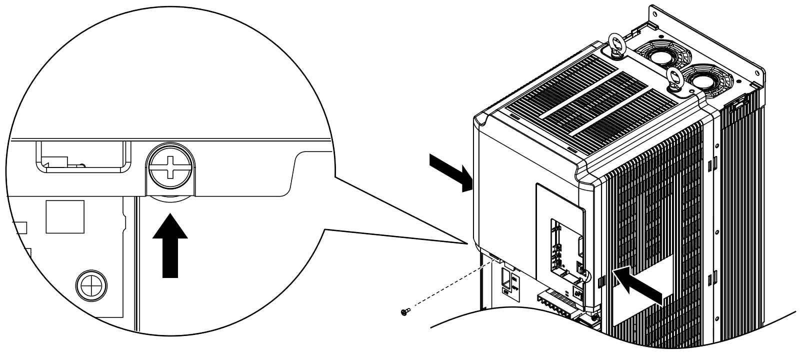


Figure 3.27 Remove the Front Cover (Drive Models 2□0028 to 2□0130 and 4□0011 to 4□0124)

Drive Models 2□0154 to 2□0248 and 4□0156 to 4□0930

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.

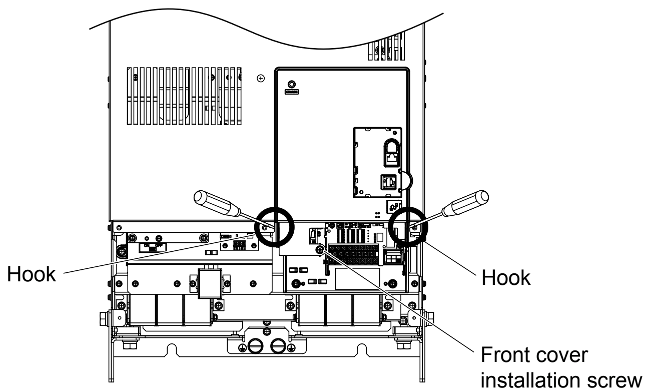


Figure 3.28 Remove the Front Cover (Drive Models 2□0154 to 2□0248 and 4□0156 to 4□0930)

4. Unhook the left side of the front cover then swing the left side towards you as shown in *Figure 3.29* until the cover comes off.

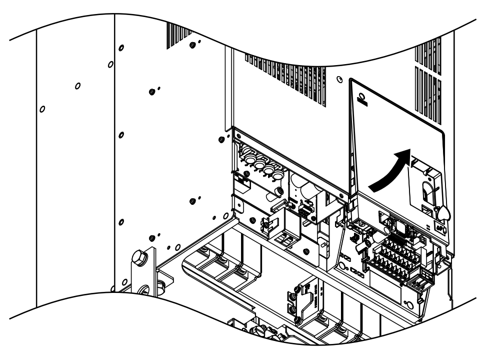


Figure 3.29 Remove the Front Cover (Drive Models 2□0154 to 2□0248 and 4□0156 to 4□0930)

■ 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 *69* 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□0930

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

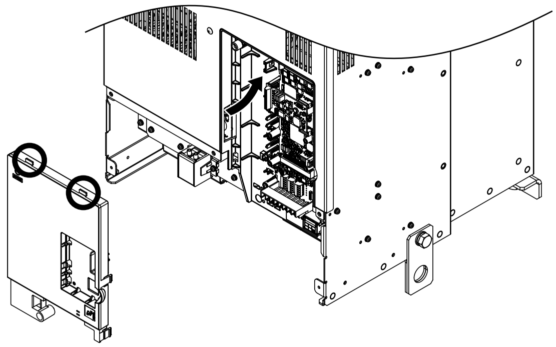


Figure 3.30 Reattach the Front Cover (Drive Models 2□0154 to 2□0248 and 4□0156 to 4□0930)

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

◆ Wiring the Drive Control Circuit Terminal

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

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

NOTICE: *Separate control circuit wiring from main circuit wiring (terminals R/L1, S/L2, T/L3, U/T1, V/T2, W/T3, p1, n1) and other high-power lines. Improper wiring practices could result in drive malfunction due to electrical interference.*

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

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

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

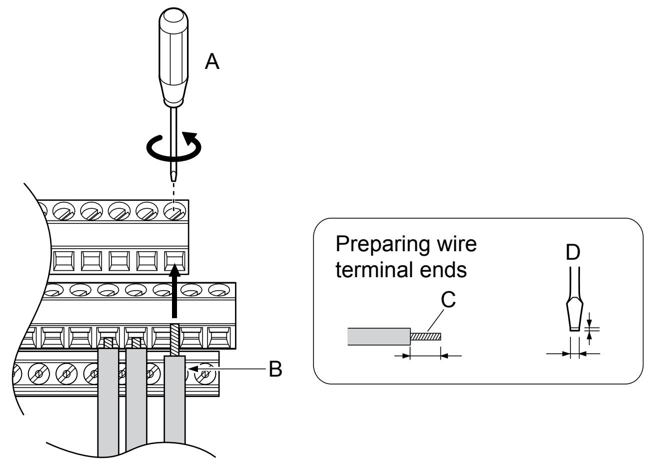
NOTICE: *Connect the shield of shielded cable to the appropriate ground terminal. Improper equipment grounding could result in drive or equipment malfunction or nuisance trips.*

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 71*** for details. Prepare the ends of the control circuit wiring as shown in ***Figure 3.33***.

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.*

Connect control wires as shown in ***Figure 3.31*** and ***Figure 3.32***.



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 3.31 Terminal Board Wiring Guide

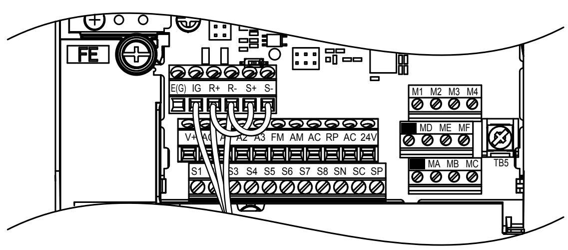
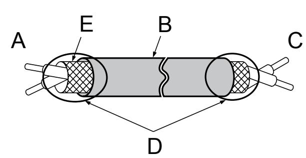


Figure 3.32 Terminal Board Location Inside the Drive



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

Figure 3.33 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 3.34* shows the location of these switches. *Refer to Bypass and Drive Control I/O Connections on page 73* for setting instructions.

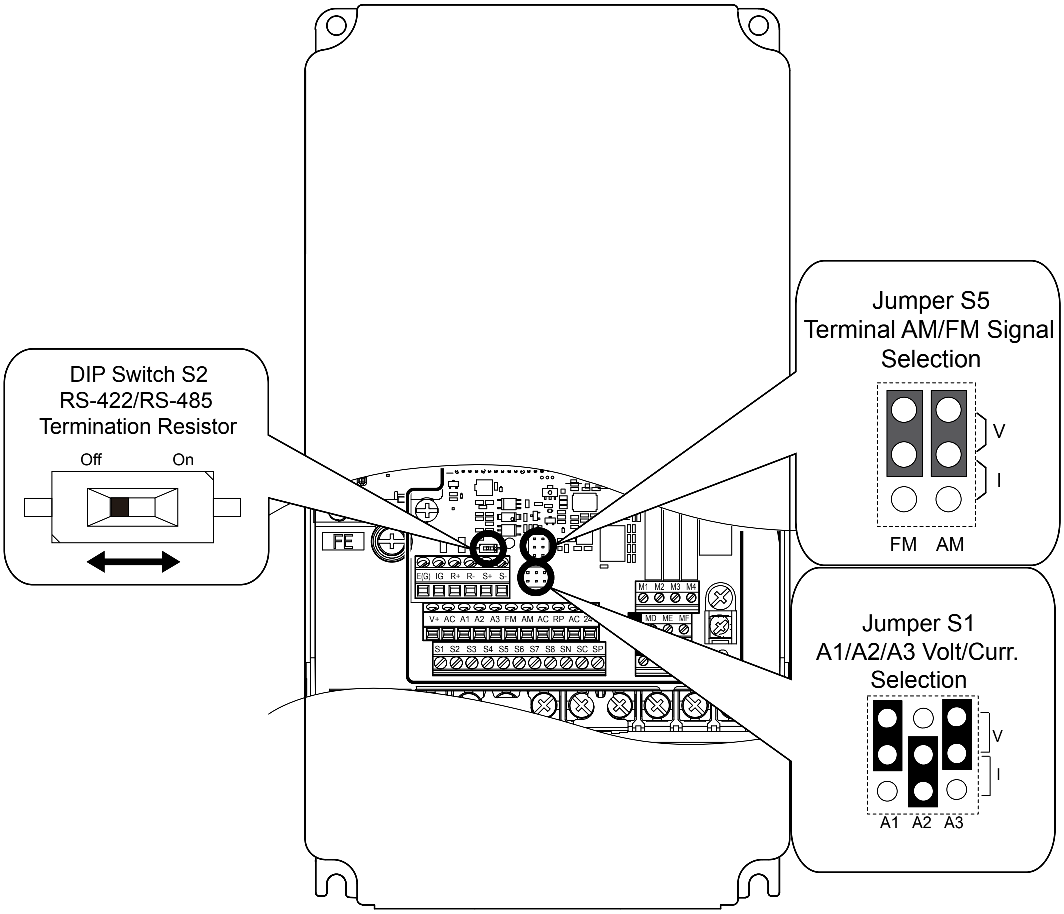


Figure 3.34 Locations of Jumpers and Switches on the Terminal Board

3.6 Bypass and Drive Control I/O Connections

◆ 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*. *Refer to Switches and Jumpers on the Terminal Board on page 72* for locating jumper S1.

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.

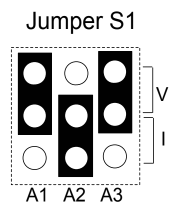


Figure 3.35 Terminal A2 Set to Current Input; A1 and A3 Set to Voltage Input

Table 3.12 Jumper S1 Settings

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

Table 3.13 Voltage/Current Selection Parameter Details

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

◆ Terminal AM/FM Signal Selection

The signal type for terminals AM and FM can be set to either voltage or current output using jumper S5 on the terminal board as explained in *Table 3.14*. When changing the setting of jumper S5, parameters H4-07 and H4-08 must be set accordingly. The default selection is voltage output for both terminals. *Refer to Switches and Jumpers on the Terminal Board on page 72* for locating jumper S5.

Table 3.14 Jumper S5 Settings

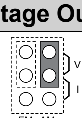
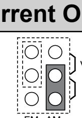
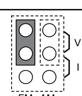
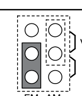
Terminal	Voltage Output	Current Output
Terminal AM		
Terminal FM		

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 72* 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)

3.7 External Interlock

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

◆ Annunciation Contact Outputs

Annunciation contacts for customer use are provided at terminal blocks TB1 as indicated in *Table 3.17*. Annunciation contacts are used to indicate the status of bypass operation. Contacts are rated for 2 Amps, 24 Vdc/120 Vac +/- 15% maximum.

Table 3.17 Annunciation Contact Details

Function <1>	Name	Terminal Block	Terminals	Type
Motor Run	DO-7	TB1	1-2-3	Form C
Hand Mode	DO-8	TB1	4-5-6	Form C
Auto Mode	DO-9	TB1	7-8-9	Form C
System Fault	DO-10	TB1	10-11-12	Form C

<1> Default settings are shown. Set parameters Z2-23 to Z2-26 to choose other functions.

The function of output relays DO-7 through DO-10 may be reprogrammed via bypass parameters Z2-23 through Z2-26. These form C dry contact relays are for customer use in annunciation to building automation systems (BAS) or other circuits. Each contact is rated for 2 amps at 120 Vac.

Refer to Z2-01 to Z2-08: Digital Input 1 to 8 Function Select on page 187 for descriptions of the programmable functions of annunciation contacts.

◆ Building Automation System Run/Stop Circuit

DI-1 (TB2-1 by default setting in Z2-01) is available to connect the normally open (N.O.) Run/Stop contact from a BAS or other remote controller for auto mode control.

These terminals must have contact closure for the motor to run in AUTO mode.

◆ Safety Interlock Circuit

DI-2 (TB2-2 by default setting in Z2-02) is provided to connect safety devices in a normally-closed series circuit, such as: freeze up thermostats, smoke/fire sensors, high pressure limits, temperature limits or vibration detectors.

The HOA keypad will display the status “Safety Open”, and trigger a Safety Open fault if a N.C. safety circuit is not closed between DI-2 and IG24 (TB2-10) on PCB A2 at power-up with a Run command in HAND or AUTO mode. An open circuit between DI-2 and IG24 will prevent bypass operation.

Take one of the following steps to ensure proper operation prior to startup:

1. Install a N.C. safety circuit between DI-2 and IG24 on PCB A2.
2. Install a jumper between DI-2 and IG24 (on PCB A2. A normally-closed safety circuit may also be used in place of this jumper.

◆ Building Automation System Interlock Circuit (Drive and Bypass Enable Input)

The HOA keypad will display the status “INTRLOCK OPN” and possibly a “BAS Ilock-open” alarm or “BAS Ilock TO” fault if a N.C. safety circuit is not closed between DI-3 (TB2-3 by default setting of Z2-03) and IG24 on PCB A2 at power-up with a Run command in HAND or AUTO mode. An open circuit between TB2-3 and IG24 (TB2-10) will prevent bypass operation.

Take one of the following steps to ensure proper operation prior to startup:

1. Install a N.C. BAS Interlock Circuit/Damper Interlock between DI-3 and IG24 on PCB A2.
2. Install a jumper between DI-3 and IG24 on PCB A2. A normally-closed BAS interlock may also be used in place of this jumper.

◆ Remote Transfer to Bypass

Terminal TB2-4 is a programmable input with a default setting of "Remote Transfer to Bypass" operation. The function of this terminal can be changed using bypass parameter Z2-04.

This function allows a contact closure from a BAS, between terminals TB2-4 and TB2-10, to transfer motor operation from Drive mode to Bypass mode. An open contact allows operation in Drive mode and a closed contact allows operation in Bypass mode.

◆ Smoke Purge Operation

Terminal TB2-5 is a programmable input with a default setting of "Smoke Purge" operation. The function of this terminal can be changed using bypass parameter Z2-05.

This function allows a contact closure between terminals TB2-5 and TB2-10 to transfer motor operation to bypass for smoke purge operation. The motor overload and Safety Interlock circuit are overridden during smoke purge or in emergency fire/ smoke situations to place priority on personnel protection.

Note: Smoke purge overrides all control inputs and bypass selector buttons. Smoke purge operation can only be terminated by opening the contact closure at terminal TB2-5 or by opening the disconnect switch.

◆ Spare Multi-Function Digital Inputs

Terminals TB2-6 and TB2-7 are spare programmable inputs. The bypass +24 V logic circuit is interconnected with the drive multi-function digital inputs to allow a single customer interface to control both drive and bypass circuits. The function of these terminals can be set using bypass parameters Z2-06 and Z2-07.

4

Start-Up Programming & Operation

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

4.1 Section Safety

⚠ WARNING

Electrical Shock Hazard

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

Failure to comply could result in death or serious injury.

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

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.

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.

◆ HOA Keypad Keys and Displays

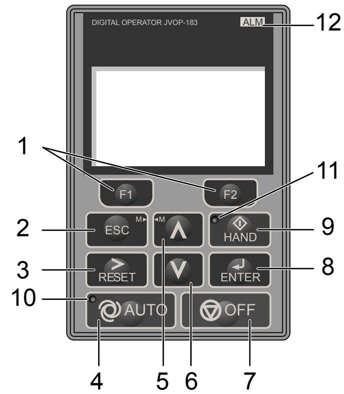


Figure 4.1 Description of HOA Keypad Keys and Displays

No.	Display	Name	Function
1	F1	Function Key F1 (Drive Test)	Selects Drive Test Mode
	F2	Function Key F2 (Bypass/Drive)	Toggles selection between Bypass Mode and Drive Mode.
2	ESC	ESC Key	• Returns to the previous display. • Moves the cursor one space to the left. • In Drive Mode, repeatedly pressing this button will return to the Frequency Reference display. • In Bypass Mode, repeatedly pressing this button will return to the UB-01 “Bypass Current” display. • During parameter entry, allows aborting the current edited value and exits the parameter editing mode.
3	RESET	RESET Key	• Moves the cursor to the right. • Resets the bypass or drive to clear a fault situation.
4	AUTO	AUTO Key	Selects AUTO mode.
5	∧	Up Arrow Key	Scrolls up to display the next item, selects parameter numbers, and increments setting values.
6	∨	Down Arrow Key	Scrolls down to display the previous item, selects parameter numbers, and decrements setting values.
7	OFF	OFF Key	Selects OFF mode. If the drive was operating the motor, the motor will stop according to the stopping method selected in b1-03. If the bypass was operating the motor, the bypass contactor opens and the motor coasts to a stop.
8	ENTER	ENTER Key	• Enters parameter values and settings. • Selects a menu item to move between displays.
9	HAND	HAND Key	Selects HAND mode.
10	AUTO	AUTO Light	Lit while the drive is in AUTO mode. Refer to page *82* for details.
11	HAND	HAND Light	Lit while the drive is in HAND mode. Refer to page *82* for details.
12	ALM	ALM LED Light	Flashing: Indicates Alarm (minor fault) Solid: Indicates Fault (major fault)

◆ LCD Display

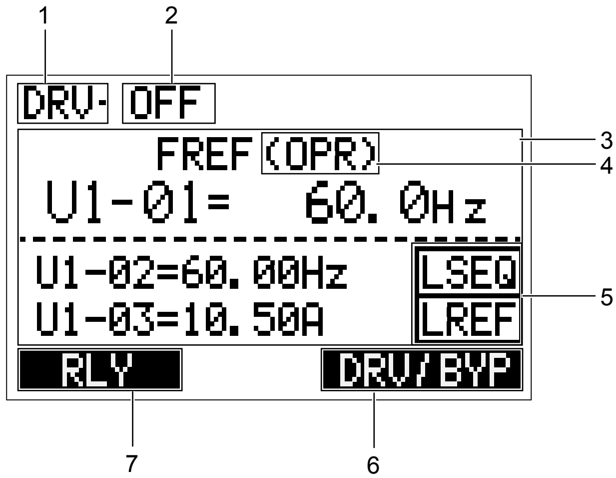


Figure 4.2 LCD Display

Table 4.1 Display and Contents

No.	Name	Display	Content
1	Bypass/Drive Status Display	DRV (not blinking)	Displayed when In Drive Mode. The bypass will run in Drive Mode when a Run command is present.
		DRV (blinking)	Displayed when in Drive Mode, but a condition is making the bypass run in Bypass Mode.
		BYP (not blinking)	Displayed when in Bypass Mode. The bypass will run in Bypass Mode when a Run command is present. In a three-contactor bypass, drive input contactor K1 is open and the drive will be powered down.
		BYP (blinking)	Displayed when in Bypass Mode with Drive Test Mode set. The bypass will run in Bypass Mode when a Run command is present. In a three-contactor bypass, drive input contactor K1 is closed and the drive is powered on.
2	Bypass Status Display	POWERUP	Displayed when the bypass is powering up.
		OFF	Displayed when no Run command is present and the safety circuit is closed.
		WAIT_FOR _RUN	Displayed when Run is requested, the safety circuit is closed, and the bypass is waiting for Run input.
		SAFETY OPEN	Displayed when the safety circuit input is open.
		INTRLOCK OPN	Displayed when a Run command is present, the safety circuit is closed, but the Interlock input is open.
		PRE RUN DRIVE	Displayed when the bypass is running in the Pre-Run State at the programmed frequency for the programmed time.
		RUN DRIVE	Displayed when running in Drive Mode.
		RUN BYPASS	Displayed when running in Bypass Mode.
		RMOT XFER EN	Displayed when running in Remote Transfer.
		SMOK PRG BYP	Displayed when running in Smoke Purge Bypass.
		SMOK PRG DRV	Displayed when running in Smoke Purge Drive.

No.	Name	Display	Content
2	Bypass Status Display	AUTO XFER EN	Displayed when running in Auto Transfer, a fault was detected and switched to Bypass Mode.
		ENRGY SAVEN	Displayed when running in Energy Savings Mode
		MTR STOPPING	Displayed when fault is removed but motor is still ramping down.
		FAULTED	Displayed when a fault has been detected causing motor output contactors to open.
3	Data Display	—	Displays specific data and operation data.
4	Frequency Reference Source <1>	OPR	Displayed when the frequency reference source is the HOA keypad.
		COM	Displayed when the frequency reference source is the MEMOBUS/Modbus Communication Inputs of the drive.
		OP	Displayed when the frequency reference source is an option card connected to the drive.
		AI	Displayed when the function reference is assigned to an analog input.
		OFF	Displayed when HAND mode is OFF.
5	HAND/OFF/AUTO (Run or Stop) Display <2>	RSEQ	Displayed when the Run command is supplied from a remote source in OFF or AUTO Modes.
		LSEQ	Displayed when the Run command is supplied from the operator keypad in HAND Mode.
		RREF	Displayed when the Run command is supplied from a remote source in OFF or AUTO Modes.
		LREF	Displayed when the Run command is supplied from the operator keypad in HAND Mode.
6	Function Key 2 (F2)	DATA	Pressing F2 scrolls to the next display.
		→	Pressing F2 scrolls the cursor to the right.
		DRV/BYP	Pressing F2 toggles selection between Bypass Mode and Drive Mode.
7	Function Key 1 (F1)	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.
		RLY	Pressing F1 selects/deselects Drive Test Mode. During Drive Test Mode, power is applied to the drive while in Bypass Mode by forcing the drive input contactor to close (3-contactor bypass only).

<1> Displayed when in Frequency Reference Mode.

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

◆ Bypass Control Board LEDs

The bypass control board has six bi-color LEDs.

The operational states of the bypass LEDs after completion of the power-up diagnostic LED sequence are described in *Table 4.2*. Wait at least 2 seconds for the power-up diagnostic process to complete before verifying LED states.

Table 4.2 Bypass Control Board LED States

Name	Description	Color	Behavior
MS	Module Status	Green	Turns ON when transmitting Turns OFF when receiving (Internal serial communications)
NS	Network Status	Green	Turns ON when transmitting Turns OFF when receiving (External serial communications)
ST1	ST1, Status 1	Green	Round status Toggles ON/OFF every 500 rounds
ST2	ST2, Status 2	Green	Scan status Toggles ON/OFF every 500 scans
ST3	ST3, Status 3	Green	Not used
ST4	ST4, Status 4	Green	Not used

◆ ALARM (ALM) LED Displays

Table 4.3 ALARM (ALM) LED Status and Contents

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

◆ AUTO LED and HAND LED Indications

Table 4.4 AUTO LED and HAND LED Indications

AUTO LED	HAND LED	State
Off	Off	OFF mode
Off	On solid	HAND mode (Also during DC injection braking)
Off	Long blink (50% duty)	HAND mode when the Frequency Reference is 0 and/or decelerating in HAND mode, or during PI Sleep or Snooze.
On solid	Off	Running in AUTO mode (Also during DC injection braking)
Off	Double blink	HAND mode, cycle the Run command.
Long blink (50% duty)	Off	Running in AUTO mode when the Frequency Reference is 0 and/or decelerating in AUTO mode, or during PI Sleep or Snooze. AUTO mode, Ready, No Run command input.
Double blink	Off	AUTO mode, stopped by a Fast- Stop from a Multi-Function Digital Input.

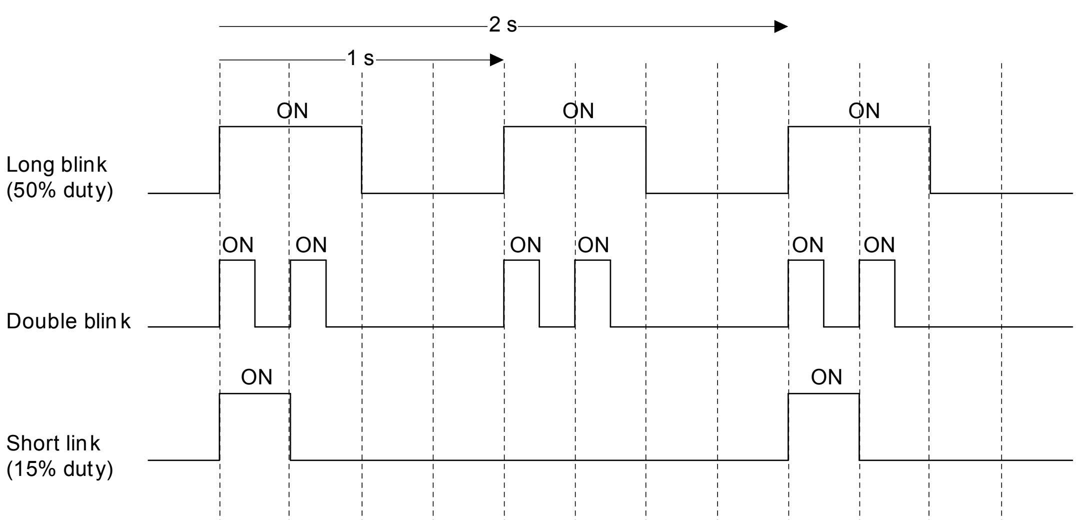


Figure 4.3 AUTO LED and HAND LED Timing Status

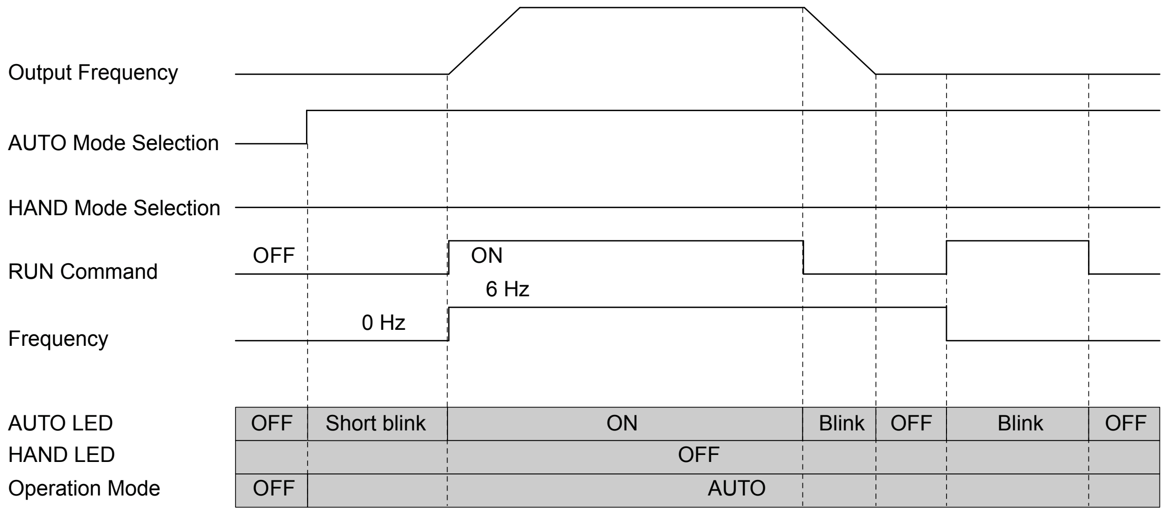


Figure 4.4 LEDs and Drive Operation in AUTO and HAND Modes

Start-Up Programming & Operation

4

◆ HOA Keypad Menu Structure

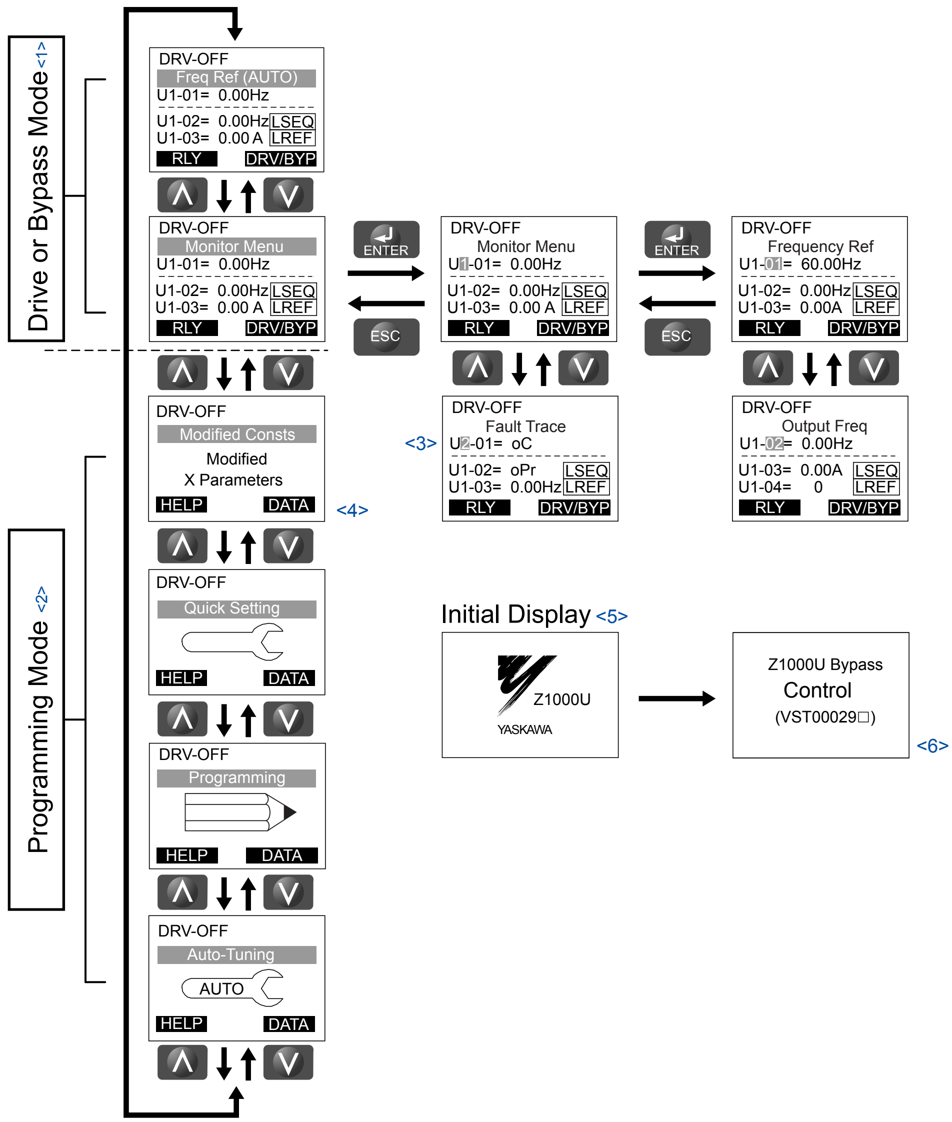


Figure 4.5 HOA Keypad Menu and Screen Structure

<1> Pressing AUTO or HAND will start the motor.
<2> In Programming Mode, the AUTO and HAND keys are ignored.
<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.

◆ HOA Keypad Parameter Display (Drive Off)

When in bypass mode, (3-contactor bypass), or if there is no power to the drive, the way the drive-specific parameters are displayed changes.

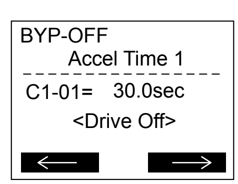


Figure 4.6 Drive-Specific Parameter

Figure 4.6 shows the LCD display with a typical drive-specific parameter displayed and no power to the drive. In this example, the parameter displayed is stored both in the drive and in the bypass controller, so the present value is shown. The parameter cannot be changed when there is no power present on the drive. All drive-specific parameter numbers will NOT begin with the letter “Z”.

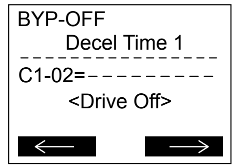


Figure 4.7 Drive-Specific Parameter

Figure 4.7 shows the LCD display with a typical drive-specific parameter displayed and no power to the drive. In this example, the parameter displayed is only stored in the drive so the present value of the parameter is not displayed. This parameter cannot be changed when there is no power present on the drive. All drive-specific parameter numbers will NOT begin with the letter “Z”.

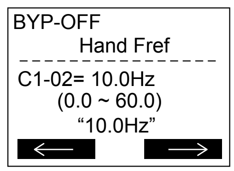


Figure 4.8 Bypass-Specific Parameter

Figure 4.8 shows the LCD display with a typical bypass-specific parameter displayed. This value can be changed regardless if there is power present on the drive or not. All bypass-specific parameter numbers will begin with the letter “Z”.

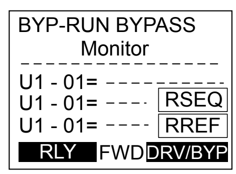


Figure 4.9 Drive-Specific Monitors

Figure 4.9 shows the LCD display with drive-specific monitors displayed and no power to the drive. With no power to the drive, the bypass controller cannot retrieve the information from the drive and the present values of the monitor is replaced with dashes. Drive-specific monitor numbers begin with “U1”, “U2”, “U3”, “U4”, or “U5”.

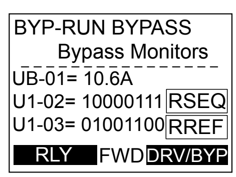


Figure 4.10 Bypass-Specific Monitors

Figure 4.10 shows the LCD display with bypass-specific monitors displayed. Bypass-specific monitor numbers begin with “UB”.

4.3 The Drive and Programming Modes

The bypass controller has a Drive Mode to operate the motor and a Programming Mode to edit parameter settings.

Drive Mode: In Drive Mode the user can operate the motor and observe U Monitor parameters. Certain 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, the “AUTO” and “HAND” keys are ignored.

■ 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.
- **Modified Constants:** View a list of bypass parameters that have been changed from the default values.
- **Quick Setting Group:** Access a list of commonly used parameters to simplify setup
- **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 (default) to 20.0 seconds.

	Step		Display/Result
1.	Turn on the power to the drive. The initial display appears.	➜	DRV-OFF Freq Ref (AUTO) U1-01= 60.00Hz U1-02= 0.00Hz LSEQ U1-03= 0.00 A LREF RLY DRV/BYP
2.	Press ∧ or ∨ until the Parameter Setting Mode screen appears.	➜	DRV-OFF Programming HELP DATA
3.	Press ENTER to enter the parameter menu tree.	➜	DRV-OFF Bypass Parms Z1-01= 0 Initialize ← →
4.	Press ∧ or ∨ to select the C parameter group.	➜	DRV-OFF Basic Setup C1-01= 30.0sec Accel Time 1 ← →
5.	Press ENTER two times.	➜	DRV-OFF Accel/Decel C1-01= 30.0sec Accel Time 1 ← → → DRV-OFF Accel Time 1 C1-01= 30.0sec (0.1-6000.0) "20.0sec" ← →
6.	Press ∧ or ∨ to select parameter C1-02.	➜	DRV-OFF Decel Time 1 C1-02= 30.0sec (0.1-6000.0) "30.0sec" ← →

Step			Display/Result
7.	Press ENTER to view the current setting value (30.0 s). The leftmost digit flashes.	➡	DRV-OFF Decel Time 1 C1-02= 0030.0sec (0.1-6000.0) "30.0sec" ⟵ ⟶
8.	Press F1, F2, or RESET until the desired number is selected. “3” flashes.	➡	DRV-OFF Decel Time 1 C1-02= 0030.0sec (0.1-6000.0) "30.0sec" ⟵ ⟶
9.	Press ∧ to change the value to 0020.0.	➡	DRV-OFF Decel Time 1 C1-02= 0020.0sec (0.1-6000.0) "30.0sec" ⟵ ⟶
10.	Press ENTER to confirm the change.	➡	Entry Accepted
11.	The display automatically returns to the screen shown in Step 4.	➡	DRV-OFF Decel Time 1 C1-02= 20.0sec (0.1-6000.0) "30.0sec" ⟵ ⟶
12.	Press ESC as many times as necessary to return to the initial display.	➡	DRV-OFF Freq Ref (AUTO) U1-01= 60.00Hz U1-02= 0.00Hz LSEQ U1-03= 0.00 A LREF RLY DRV/BYP

◆ Verifying Parameter Changes: Modified Constants

The Modified Constants display lists edited bypass parameters from the Programming Mode. The Modified Constants display helps determine which bypass parameter settings have been changed, and is particularly useful when replacing a bypass. If no bypass parameter settings have been changed, the Modified Constants display will read “None”. The Modified Constants display also allows users to quickly access and re-edit any bypass parameter settings that have been changed. <1>

To check the list of edited parameters:

Step			Display/Result
1.	Turn on the power to the drive. The initial display appears.	➡	DRV-OFF Freq Ref (AUTO) U1-01= 60.00Hz U1-02= 0.00Hz LSEQ U1-03= 0.00 A LREF RLY DRV/BYP
2.	Press ∧ or ∨ until the display shows "Modified Consts".	➡	DRV-OFF Modified Consts Modified X Parameters ⟵ ⟶
3.	Press ENTER to enter the list of parameters that have been edited from their original default settings. If parameters other than Z1-09 have been changed, use ∧ or ∨ to view them.	➡	DRV-OFF Hand Fref Z1-09= 45.0Hz (0.0~60.0) “10.0Hz” ⟵ ⟶
4.	Press ENTER to access the setting value. The most significant digit flashes.	➡	DRV-OFF Hand Fref Z1-09= 0045.0Hz (0.0~60.0) “10.0 Hz” ⟵ ⟶

<1> The "Modified Constants" menu on the bypass will only display bypass parameters (Z☐-☐☐ parameters) that have changed. The menu will not display drive parameters that have changed.

◆ Simplified Setup Using the Quick Setting Group

The Quick Setting Group lists only the basic parameters necessary to set up the bypass. This group expedites the startup process by showing only the most important bypass parameters.

■ Quick Setting Parameters

Table 4.5 lists the parameters in the Quick Setting Group.

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

Table 4.5 Quick Setting Group Parameters

No.	Name	LCD Display	Description	Values	Page
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	100
E1-05 (0304)	Maximum Voltage	Max Voltage	These parameters are only applicable when E1-03 is set to F.	Default: <2> Min.: 0.0 V Max.: 255.0 V <1>	130
E2-01 (030E)	Motor Rated Current	Motor Rated FLA	Sets the motor nameplate full load current in amps. Automatically set during Auto-Tuning.	Default: <2> Min.: 10% of drive rated current Max.: 150% of drive rated current <3>	131
Z1-07 (85CC) RUN	Speed Reference Select	Spd Ref Sel 0: Operator 1: Analog Input 2: Bypass Serial 3: Option Board	Determines the source of the Frequency Reference sent from the Bypass Controller to the Drive. 0: Operator 1: Analog Input 2: Bypass Serial 3: Option Board (CN5)	Default: 1 Range: 0 to 3	177
Z1-08 (85CD) RUN	Run Command Select	Run Cmd Sel 0: Operator 1: Bypass DI 2: Bypass Serial 3: Option Board	Determines the source of the Auto Mode Run command used by the Bypass Controller. 0: Operator 1: Bypass Controller Digital Input 2: Bypass Serial 3: Option Board (CN5)	Default: 1 Range: 0 to 3	178
Z1-09 (85CE) RUN	HAND Mode Drive Speed Reference	Hand Fref	This is the speed reference used when the Drive is running in HAND mode. Units are in Hz.	Default: 10.0 Hz <4> Min.: 0.0 Max.: 60.0	178
Z1-37 (85EA) RUN	Set Time	Set Time 0: Normal display 1: Time Setting 2: Reset Time	Changes the LCD display to time setting to set the Real Time Clock. 0: Normal display 1: Displays time and date setting mode 2: Reset time	Default: 0 Range: 0 to 2	183
Z3-01 (8500) RUN	Serial Communications Protocol Select	Serial Protocol 0: Modbus 1: N2 2: P1 3: BACnet	Selects the bypass serial communications protocol. 0: Modbus 1: N2 2: P1 3: BACnet	Default: 3 Range: 0 to 3	191
Z3-02 (8501) RUN	Serial Communications Node Address Select	Node Address	Selects the bypass serial communications node address.	Default: 1 Min.: 0 Max.: 127	191

No.	Name	LCD Display	Description	Values	Page
Z3-03 (8502) RUN	Serial Communications Baud Rate Select	Baud Rate 0: 1200 1: 2400 2: 4800 3: 9600 4: 19200 5: 38400 6: 57600 7: 76800 8: 115200	Selects the bypass serial communications speed. 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	Default: 3 Range: 0 to 8	*191*
Z3-04 (8503) RUN	Serial Communications Parity Select	Parity 0: No Parity 1: Even Parity 2: Odd Parity	Selects the bypass serial communications parity. 0: No Parity 1: Even Parity 2: Odd Parity	Default: 0 Range: 0 to 2	*191*
Z3-05 (8504) RUN	Serial Communications Fault Select	Fault Sel 0: Ignore 1: Alarm only 2: Fault Send EF0 3: Flt EF0 Open K3 4: Alarm(Z3-10)	Selects the action to take when a serial communications fault is detected. 0: Ignore. A serial communications loss will result in no action being taken. 1: Alarm only. 2: Fault with EF0. An EF0 will be sent to the drive. If running in Bypass mode, the bypass contactor will NOT open and the motor will keep running. 3: Fault with EF0 and Open Contactors. An EF0 fault will be sent to the drive and the bypass contactor (K3) will be opened. 4: Alarm and run at preset speed set in Z3-10. Display AL14 alarm on Operator.	Default: 1 Range: 0 to 4	*192*
Z3-06 (8505) RUN	Serial Communications Fault Time Select	Fault Time	Sets the time allowed to elapse since receiving serial communications before triggering a communications fault. A setting of 0.0 will never time out.	Default: 2.0 s Min.: 0.0 Max.: 99.9	*192*
Z3-07 (8506) RUN	Serial Communications Receive to Transmit Wait Time	Rx to Tx Wait	Sets the time to delay a serial communications response to a serial communications command.	Default: 5 ms Min.: 0 Max.: 99	*192*
Z3-08 (8507) RUN	BACnet Device Object Identifier 0	BAC Dev ID0	BACnet only. Sets the least significant word of 22-bit virtual address.	Default: 1 Min.: 0 Max.: FFFF	*192*
Z3-09 (8508) RUN	BACnet Device Object Identifier 1	BAC Dev ID1	BACnet only. Sets the most significant word of 22-bit virtual address.	Default: 0 Min.: 0 Max.: 003F	*192*

<1> Values shown are specific to 208 Vac. Double the value for 480 Vac.

<2> Default setting is dependent on parameter o2-04, Drive Model Selection.

<3> Default setting is dependent on parameter o2-04, Drive Model Selection.

<4> Values are given in Hz, but actual values are dependent upon unit settings using drive parameters o1-03, o1-09, o1-10, and o1-11.

4.4 Powering Up the Drive

◆ Powering Up the Drive and Operation Status Display

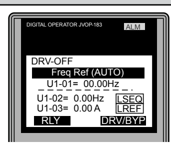
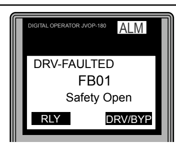
■ Powering Up the Drive

Review the following checklist before turning the power on.

Item to Check	Description
Power supply voltage	208 Vac: Three-phase 200 to 240 Vac 50/60 Hz 480 Vac: Three-phase 380 to 480 Vac 50/60 Hz
	Properly wire the power supply input terminals (L1, L2, L3).
	Check for proper grounding of drive and motor.
Drive output terminals and motor terminals	Properly wire drive output terminals T1, T2, and 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. DRV is lit.
Fault	 External fault (example)	Data displayed varies by the type of fault. ***Refer to Fault Displays, Causes, and Possible Solutions on page 205*** for more information. ALM and DRV are lit.

4.5 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 Quick Setting Parameters on page 88***) 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 Z1-01 to 1 or 3 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.*

Table 4.6 Application Selection

No.	Name	LCD Display	Description	Values
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

◆ Setting 1: Fan Application

Table 4.7 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 PID Control Application

Table 4.8 Fan with PID 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	PID Function Setting	1: Output frequency = PID output 1
b5-03	Integral Time Setting (I)	30 s
b5-08	PID Primary Delay Time Constant	2 s
b5-13	PID Feedback Low Detection Level	2%
b5-14	PID 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 PID Control Application

Table 4.9 Return Fan with PID 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	PID Function Setting	1: Output frequency = PID output 1
b5-03	Integral Time Setting (I)	30 s

No.	Parameter Name	Default Setting
b5-08	PID Primary Delay Time Constant	2 s
b5-13	PID Feedback Low Detection Level	2%
b5-14	PID 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: PID feedback
H3-10	Terminal A2 Function Selection	16: Differential PID 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: PID Differential Feedback

◆ Setting 4: Cooling Tower Fan Application

Table 4.10 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 PID Control Application

Table 4.11 Cooling Tower Fan with PID 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	PID Function Setting	1: Output frequency = PID output 1
b5-03	Integral Time Setting (I)	30 s
b5-08	PID Primary Delay Time Constant	2 s
b5-09	PID Output Level Selection	1: Reverse Output
b5-13	PID Feedback Low Detection Level	2%
b5-14	PID Feedback Low Detection Time	25 s
b5-15	PID Sleep Function Start Level	10.8 Hz
b5-16	PID 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 4.12 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 PID Control Application

Table 4.13 Pump with PID Control: Parameter Settings

No.	Parameter Name	Default Setting
b1-04	Reverse Operation Selection	1: Reverse operation disabled
b5-01	PID Function Setting	1: Enabled (PID output becomes output frequency reference)
b5-03	Integral Time Setting (I)	15 s
b5-08	PID Primary Delay Time Constant	10.0 s
b5-13	PID Feedback Low Detection Level	2%
b5-14	PID Feedback Low Detection Time	25 s
b5-15	PID Sleep Function Start Level	72%
b5-16	PID 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)

4.6 Auto-Tuning

◆ Types of Auto-Tuning

Refer to *Table 4.14* to select the type of Auto-Tuning that bests suits the application.

■ Auto-Tuning for Induction Motors

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

Table 4.14 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	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 4.15 lists the data that must be entered for Auto-Tuning. Make sure this data is available before starting Auto-Tuning. The necessary information is usually listed on the motor nameplate or in the motor test report provided by the motor manufacturer.

Table 4.15 Auto-Tuning Input Data

Input Value	Input Parameter	Unit	Tuning Type (T1-01)	
			2 Line-to-Line Resistance	3 Rotational for V/f Control
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

◆ 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 208 V models and 40 V for 480 V 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 4.16 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

■ 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.*

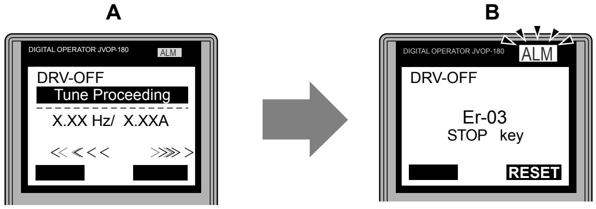
Stationary Auto-Tuning for Line-to-Line Resistance

- 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



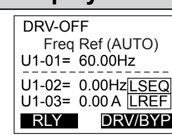
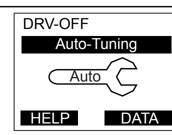
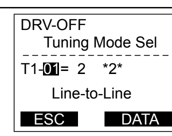
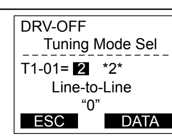
A – During Auto-Tuning **B – Auto-Tuning Aborted**

Figure 4.11 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.	➡	
2.	Press ∧ or ∨ until the Auto-Tuning display appears.	➡	
3.	Press ENTER to begin setting parameters.	➡	
4.	Press ENTER to display the value for T1-01.	➡	

Start-Up Programming & Operation

4

Step			Display/Result
5.	Save the setting by pressing ENTER.	➡	Entry Accepted
6.	The display automatically returns to the display shown in Step 3.	➡	DRV-OFF Tuning Mode Sel T1-01= 3 *3* V/f Engy Sav Tun ESC 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 Λ to access the motor output power parameter T1-02.	➡	DRV-OFF Mtr Rated Power T1-02= 0.75kW (0.00 - 650.00) “0.75kW” ESC DATA
2.	Press ENTER to view the default setting.	➡	DRV-OFF Mtr Rated Power T1-02= 000.75kW (0.00 - 650.00) “0.75kW” ← →
3.	Press F1 left, F2 right, > RESET, Λ, and V to enter the motor power nameplate data in kW.	➡	DRV-OFF Mtr Rated Power T1-02= 000.40kW (0.00 - 650.00) “0.75kW” ← →
4.	Press ENTER to save the setting.	➡	Entry Accepted
5.	The display automatically returns to the display in Step 1.	➡	DRV-OFF Mtr Rated Power T1-02= 0.40kW (0.00 - 650.00) “0.75kW” ESC DATA
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	➡	DRV-OFF Rated Voltage T1-03= 200.0VAC (0.00 - 255.00) “200.0VAC” ESC DATA ⇣ DRV-OFF Mtr Rated Slip T1-10= X.XXHz (0.00 - 20.00) “X.XX Hz” ESC DATA

Note:
1. For details on each setting, ***Refer to T1: Parameter Settings during Induction Motor Auto-Tuning on page 97***.
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 the motor cannot spin freely. 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.	➡	DRV-OFF Auto-Tuning 0.00 Hz/ 0.00A Tuning Ready? Press HAND Key ESC DATA
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.	➡	DRV-OFF Tune Proceeding 0.00 Hz/ 0.00A Tuning Ready? Press HAND Key
3.	Auto-Tuning finishes in approximately one to two minutes.	➡	MODE End Tune Successful 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 the User Manual packaged with the drive for details on the different types of Auto-Tuning.

No.	Name	Setting Range	Default
T1-01	Auto-Tuning Mode Selection	2, 3	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 208 Vac. Double the value for 480 Vac.

■ 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 14400 r/min	1750 r/min

■ T1-11: Motor Iron Loss

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

No.	Name	Setting Range	Default
T1-11	Motor Iron Loss	0 to 65535 W	14 W

5

Programming

5.1 A: Initialization

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

◆ A1: Initialization

■ A1-06: 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.

Refer to Application Selection on page 91 for details on parameter A1-06.

5.2 b: Application

◆ b1: Operation Mode Selection

■ b1-03: Stopping Method Selection

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

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

Setting 0: Ramp to Stop

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

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

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.

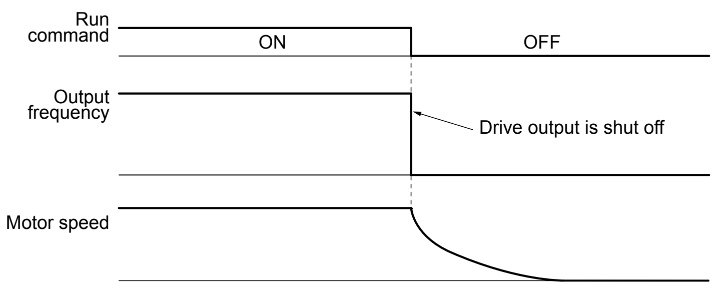


Figure 5.1 Coast to Stop

Note: After a stop is initiated, any subsequent Run command entered will be ignored until the minimum baseblock time (L2-03) has expired. Do not enter Run command until it has come to a complete stop. Use DC Injection at Start (*Refer to b2-03: DC Injection Braking Time at Start on page 104*) or Speed Search (*Refer to b3: Speed Search on page 104*) 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.

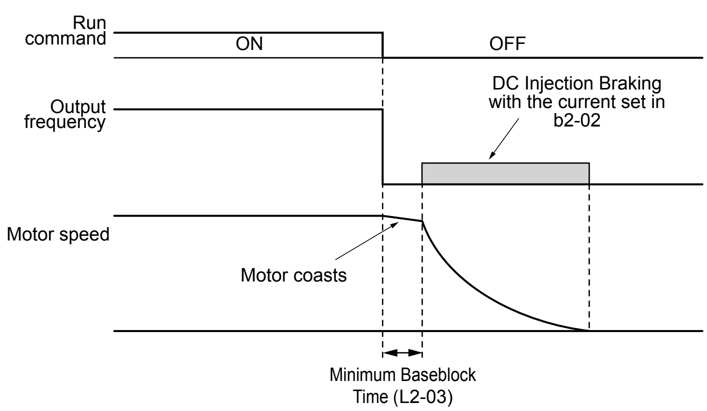


Figure 5.2 DC Injection Braking to Stop

Programming

5

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:

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

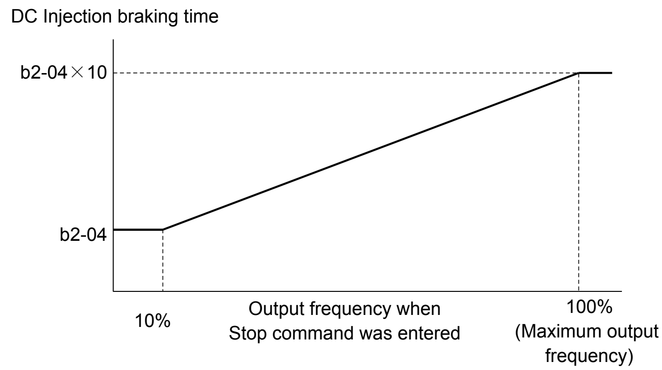


Figure 5.3 DC Injection Braking Time Depending on Output Frequency

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

Setting 3: Coast with Timer

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

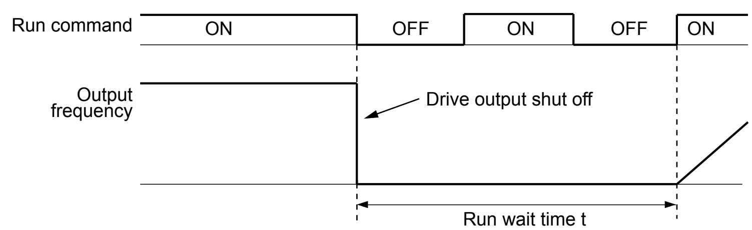


Figure 5.4 Coast with Timer

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

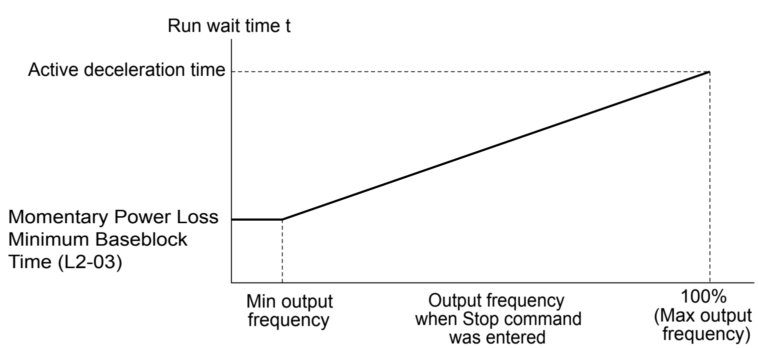


Figure 5.5 Run Wait Time Depending on Output Frequency

■ b1-04: Reverse Operation Selection

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

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

Setting 0: Reverse Enabled

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

Setting 1: Reverse Disabled

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

■ b1-24: Commercial Power Operation Switching Selection

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.

Note:
1. Switching can be enabled when an inductive motor is being driven.
2. Current value may change when a switch is made.
3. Verify that the induction motor can be driven with the commercial power supply (e.g., the rated voltage and rated speed) prior to enabling the commercial power switching selection.

No.	Parameter Name	Setting Range	Default
b1-24	Commercial Power Switching Selection	0, 1	0

Setting 0: Disabled

A voltage will be output with PWM switching operation regardless of the output frequency.

Setting 1: Enabled

When the deviation between the output frequency and the power supply frequency is less than or equal to the commercial power switching output frequency coincidence level (b1-26), the PWM switching operation stops and switches to operation with a direct commercial power supply connection.

Operation with a direct commercial power supply continues until the deviation between the output frequency and the power supply frequency is greater than or equal to the commercial power switching output frequency coincidence/non-coincidence level (b1-25 + b1-26).

■ b1-25/b1-26: Commercial Power Supply Operation Cancellation Level/Switching Level

These parameters set the value in 0.1 Hz increments at which commercial power supply switching selection is enabled and disabled.

Entering Eco Mode

When the deviation between the output frequency and the power supply frequency becomes equal to or less than the setting values of b1-26, an output frequency coincidence condition exists. The drive will operate in commercial power switching mode. If the drive will not switch to commercial power supply switching mode, set b1-26.

Exiting Eco Mode

When the deviation between the output frequency and the power supply frequency becomes equal to or greater than the setting value of b1-25 + b1-26, the drive will operate in PWM switching mode. If commercial power switching mode and PWM switching mode are repeated frequently, increase the setting value of b1-25.

Note: The drive will not switch to commercial power switching mode when L3-06, Stall Prevention Level during Run, is exceeded and L3-05, Stall Prevention Selection during Run, is enabled.

No.	Parameter Name	Setting Range	Default
b1-25	Commercial Power Supply Operation Cancellation Level	0.4 to 6.0 Hz	1.0 Hz
b1-26	Commercial Power Supply Operation Switching Level	0.0 to 3.0 Hz	0.2 Hz

◆ b2: DC Injection Braking and Short Circuit Braking

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

■ b2-01: DC Injection Braking Start Frequency

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

No.	Name	Setting Range	Default
b2-01	DC Injection Braking Start Frequency	0.0 to 10.0 Hz	0.5 Hz

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.

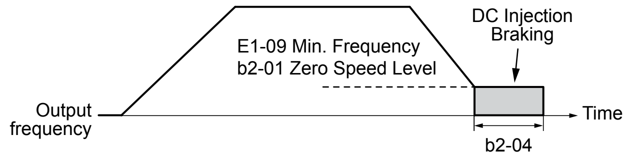


Figure 5.6 DC Injection Braking at Stop for V/f

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

b2-02: DC Injection Braking Current

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

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

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

b2-03: DC Injection Braking Time at Start

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

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

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

b2-04: DC Injection Braking Time at Stop

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

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

b3: Speed Search

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

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

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

Speed Search Activation

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

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

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

Use the input functions for H1-☐☐ in *Table 5.1*.

Table 5.1 Speed Search Activation by Digital Inputs

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

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

Method 3. After automatic fault restart.

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

Method 4. After momentary power loss.

This mode requires that the Power Loss Ride-Thru function is enabled during CPU operation (L2-01 = 1 or 2). ***Refer to L2-01: Momentary Power Loss Operation Selection on page 151***.

Method 5. After external baseblock is released.

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

■ b3-01: Speed Search Selection at Start

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

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

Setting 0: Disabled

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

Setting 1: Enabled

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

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

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

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

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

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

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

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

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

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

No.	Name	Setting Range	Default
b3-09	Current Control Integral Time during Speed Search (Speed Estimation Type)	0.0 to 1000.0 ms	2.0 ms

■ 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

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

Within the type of the speed measurement, the search method can be switched automatically by the amount of remaining voltage in the motor. This parameter sets the switching level. (208 Vac at 100% = 208 V, and 480 Vac at 100% = 480 V).

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

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

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

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

b3-14: Bi-Directional Speed Search Selection (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

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.

No.	Name	Setting Range	Default
b3-24	Speed Search Method Selection	1, 2	2

Setting 1: Speed Estimation

Setting 2: Current Detection 2

b3-25: Speed Search Wait Time

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

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

■ b3-31: Speed Search Operation Current Level 1 (Current Detection Type 2)

Sets the current level used to limit the output current during Current Detection Type Speed Search 2 as a ratio to E2-03, Motor No-Load Current.

The current level is determined for a no-load current that is 30% of the rated motor current when the setting value of E2-03 is less than or equal to 30% of the rated motor current.

Note: If the setting value is too large, a stopped inductive motor may accelerate too quickly. In such cases, set this parameter to a value that is smaller than the rated motor current.

No.	Name	Setting Range	Default
b3-31	Speed Search Operation Current Level 1 (Current Detection Type 2)	1.50 to 3.50	1.50

■ b3-32: Speed Search Operation Current Level 2 (Current Detection 2)

Sets the current level at which to end the Speed Search for Current Detection Type Speed Search 2 as a ratio to E2-03, Motor No-Load Current.

The current level is determined for a no-load current that is 30% of the rated motor current when the setting value of E2-03 is less than or equal to 30% of the rated motor current.

No.	Name	Setting Range	Default
b3-32	Speed Search Operation Current Level 2 (Current Detection 2)	0.00 to 1.49	1.20

■ b3-33: Speed Search Selection when Run Command is Given during Uv

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.

No.	Name	Setting Range	Default
b3-33	Speed Search Selection when Run Command is Given during Uv	0, 1	0

Setting 0: Disabled

Setting 1: Enabled

■ b3-50/b3-51: Backspin Search Direction Judgment Time 1/2

The direction of the Speed Search is adjusted to allow for backspin.

When momentary power loss time t is shorter than the time set in b3-50, the search operates according to the direction command. When momentary power loss time t is equal to or longer than the time set in b3-51, the search operates from the opposite direction of the direction command. When momentary power loss time t is equal to or longer than the time set in b3-50 and shorter than b3-15, baseblock continues until momentary power loss time t exceeds the time set in b3-51. The search then operates from the opposite direction of the direction command.

Note:
1. Use these parameters only in applications in which backspin can occur
2. Be sure to set b3-50 < b3-51.
3. Backspin detection is not necessary with a PM motor.

No.	Name	Setting Range	Default
b3-50	Backspin Search Direction Judgment Time 1	0.0 to 10.0	Determined by A1-02
b3-51	Backspin Search Direction Judgment Time 2	0.0 to 10.0	0.0

Speed Search from the Direction Command (0.0 ≤ Momentary Power Loss Time t < b3-50)

When time t from the momentary power loss to recovery is shorter than the setting value of b3-50, Speed Search is performed in the direction specified by the direction command. The deceleration time set in b3-52 is used for the search frequency and the setting value of the frequency reference is used as the starting search frequency.

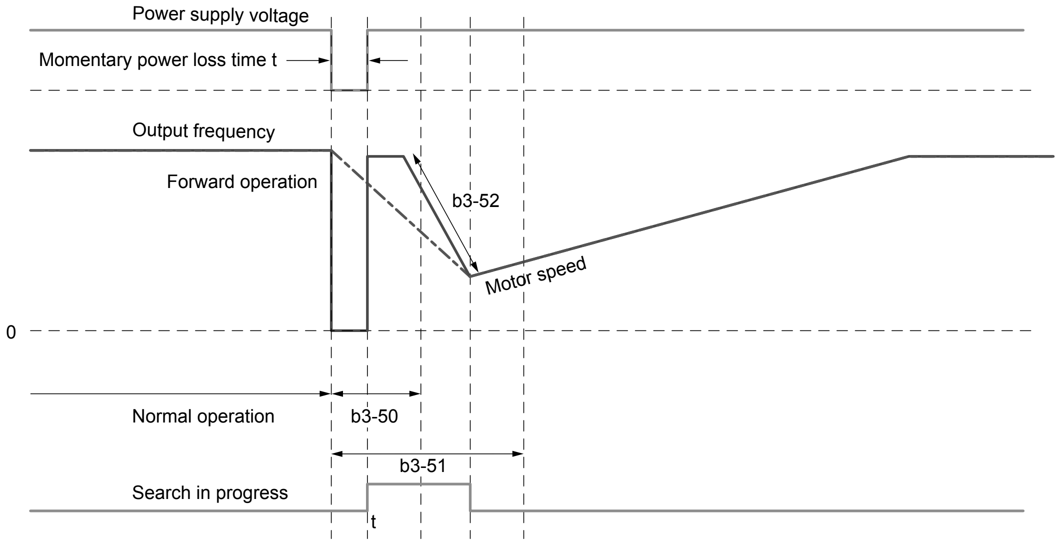


Figure 5.7 Speed Search from Forward Run Command (0 ≤ t < b3-50)

Continuous Baseblock (b3-50 ≤ t < b3-51)

When time t from the momentary power loss to recovery is between the times set for b3-50 and b3-51, operation will not be restarted and the baseblock will continue. The drive will stay in baseblock for the time set in b3-51 even after restoring power. After the time set in b3-51 passes, Speed Search starts in the opposite direction of the direction command. The deceleration time in b3-53 is used for the search frequency and the setting value of the frequency reference is used as the starting search frequency.

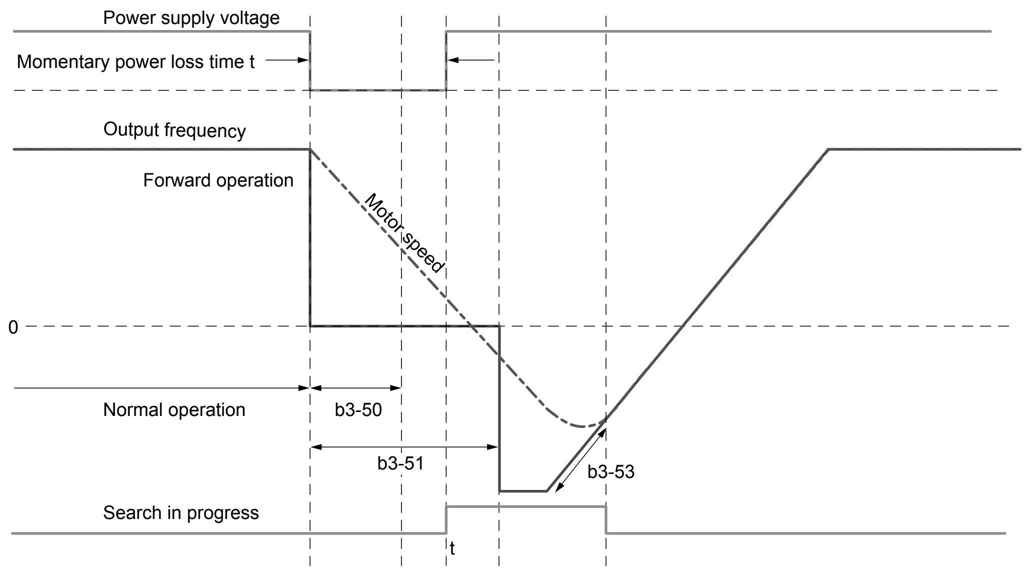


Figure 5.8 Continuous Baseblock (b3-50 ≤ t < b3-51)

Speed Search in Direction Opposite to Direction Command (b3-51 ≤ t)

When time t from the momentary power loss to recovery exceeds the setting value of b3-51, Speed Search is performed in the opposite direction of the direction command. The deceleration time in b3-53 is used for the search frequency and the setting value of the frequency reference is used as the starting search frequency.

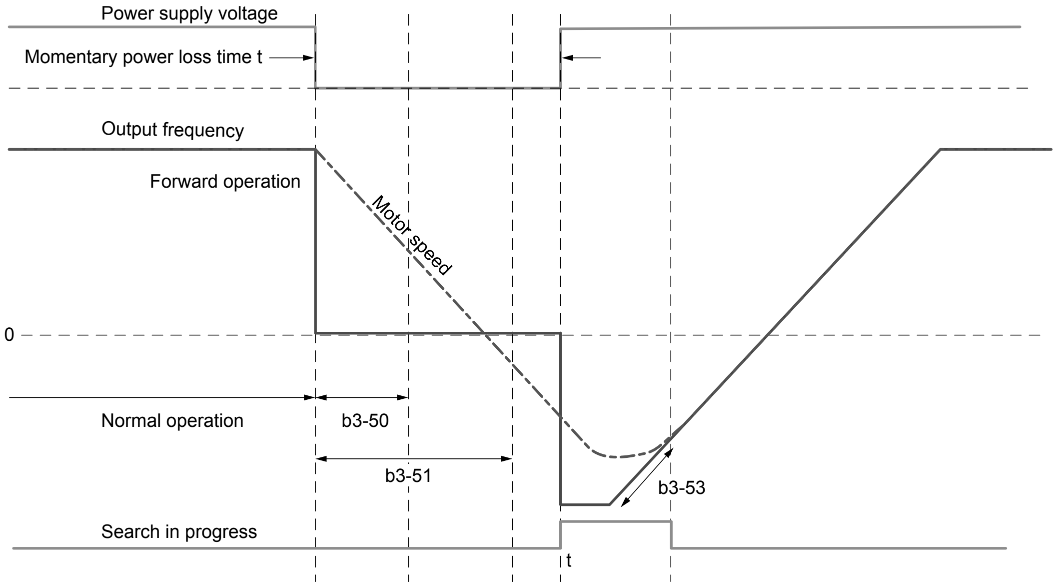


Figure 5.9 Speed Search in Direction Opposite to Direction Command (b3-51 ≤ t)

■ b3-52: Backspin Search Deceleration Time 1

Sets the search frequency deceleration rate when searching from the direction command when momentary power loss time t is shorter than the time set in b3-50.

Set the value lower than the motor deceleration rate during coasting.

No.	Name	Setting Range	Default
b3-52	Backspin Search Deceleration Time 1	0.1 to 10.0 s	2.0 s

■ b3-53: Backspin Search Deceleration Time 2

Sets the search frequency deceleration rate for a Speed Search from the opposite direction of the direction command when momentary power loss time t is equal to or longer than the time set in b3-51.

No.	Name	Setting Range	Default
b3-53	Backspin Search Deceleration Time 2	0.1 to 10.0 s	2.0 s

◆ b5: PID Control

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

■ P Control

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

■ I Control

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

■ D Control

D control predicts the deviation signal by multiplying its derivative (slope of the deviation) with a time constant, then adds this value to the PID input. This way the D portion of a PID controller provides a braking action to the controller response and can reduce the tendency to oscillate and overshoot.

D control tends to amplify noise on the deviation signal, which can result in control instability. Only use D control when absolutely necessary.

PID Operation

To better demonstrate PID functionality, *Figure 5.10* illustrates the PID output when the PID input (deviation) is at a constant level.

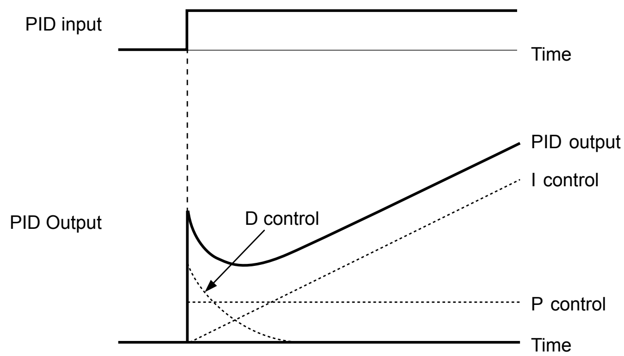


Figure 5.10 PID Operation

Using PID Control

Applications for PID control are listed in *Table 5.2*.

Table 5.2 Using PID Control

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

PID Setpoint Input Methods

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

If parameter b5-01 is set to 1, the frequency reference source in b1-01 or one of the inputs listed in *Table 5.3* becomes the PID setpoint.

If b5-01 is set to 3, then the PID setpoint can be input from one of the sources listed in *Table 5.3*.

Table 5.3 PID Setpoint Sources

PID Setpoint Source	Settings
Analog Input A1	Set H3-02 = C
Analog Input A2	Set H3-10 = C
Analog Input A3	Set H3-06 = C
MEMOBUS/Modbus Register 0006 H	Set bit 1 in register 000F H to 1 and input the setpoint to register 0006 H
Pulse Input RP	Set H6-01 = 2
Parameter b5-19	Set parameter b5-18 = 1 and input the PID setpoint to b5-19

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

PID Feedback Input Methods

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

Normal PID Feedback

Input the PID feedback signal from one of the sources listed in *Table 5.4*:

Table 5.4 PID Feedback Sources

PID Feedback Source	Settings
Analog Input A1	Set H3-02 = B
Analog Input A2	Set H3-10 = B
Analog Input A3	Set H3-06 = B
Pulse Input RP	Set H6-01 = 1

Note: A duplicate allocation of the PID feedback input will cause an oPE07 (Multi-Function Analog Input Selection Error) alarm.

Differential Feedback

The second PID feedback signal for differential feedback can come from the sources listed in ***Table 5.5***. The differential feedback function is automatically enabled when a differential feedback input is assigned.

Table 5.5 PID Differential Feedback Sources

PID Differential Feedback Source	Settings
Analog Input A1	Set H3-02 = 16 (Differential PID Feedback)
Analog Input A2	Set H3-10 = 16 (Differential PID Feedback)
Analog Input A3	Set H3-06 = 16 (Differential PID Feedback)

Note: A duplicate allocation of the PID differential feedback input will cause an oPE07 (Multi-Function Analog Input Selection Error) alarm.

■ PID Block Diagram

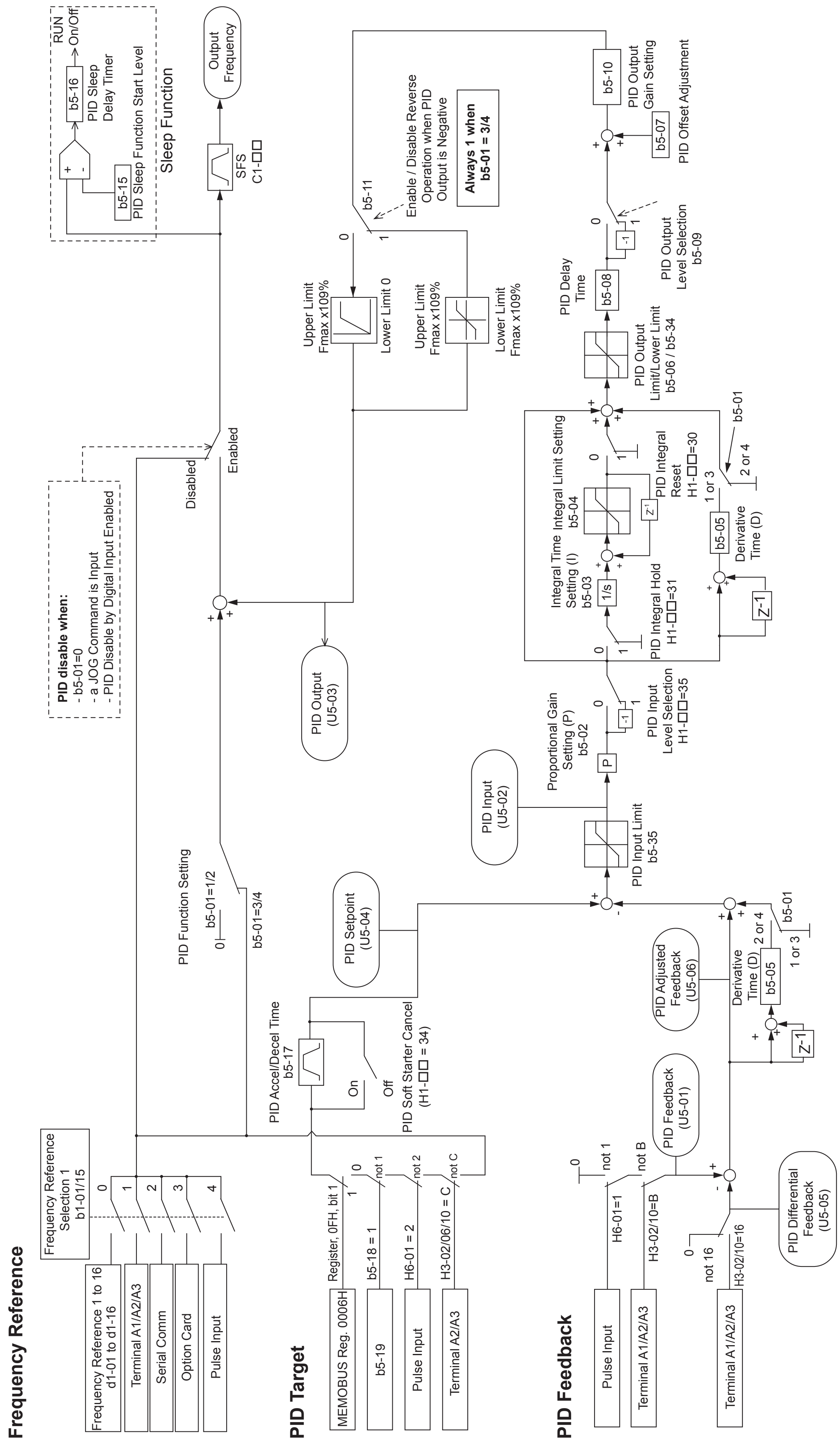


Figure 5.11 PID Block Diagram

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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	0.5 s

b5-04: Integral Limit Setting

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

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

Note: On some applications, especially those with rapidly varying loads, the output of the 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).

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) 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.

■ PID Feedback Loss Detection

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

Feedback loss can be detected in two ways:

- **Feedback Low Detection**

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

- **Feedback High Detection**

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

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

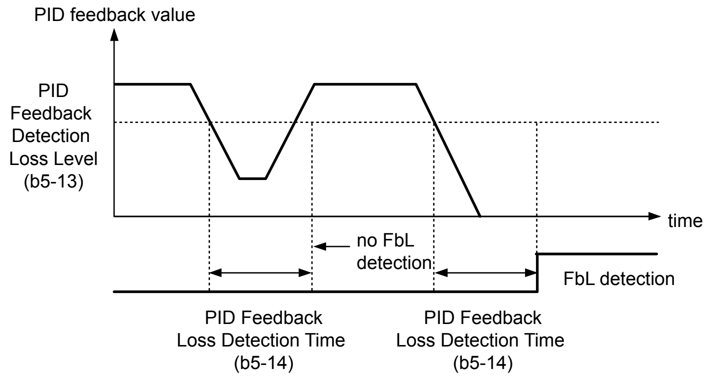

Figure 5.12 PID Feedback Loss Detection

■ 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

■ b5-36: 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

■ PID Sleep

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

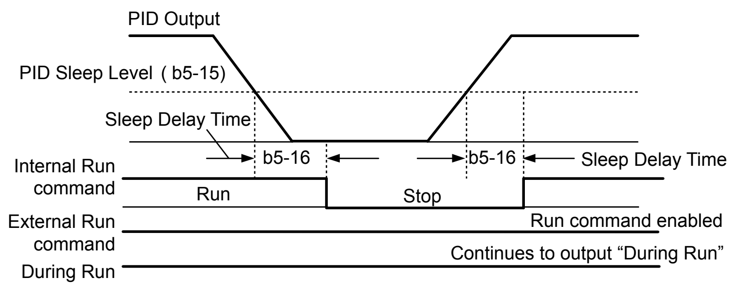

Figure 5.13 PID Sleep Operation

Notes on using the PID Sleep function

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

The parameters necessary to control the PID Sleep function are explained below.

■ 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.

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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.

■ b5-34: 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%

■ b5-38, 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.

■ b5-46: 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), 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.

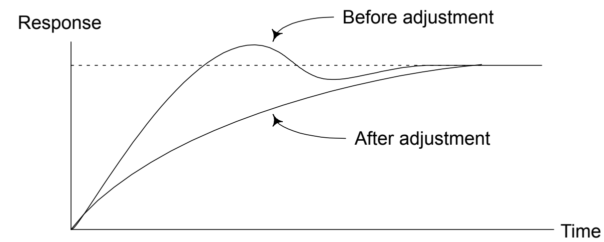
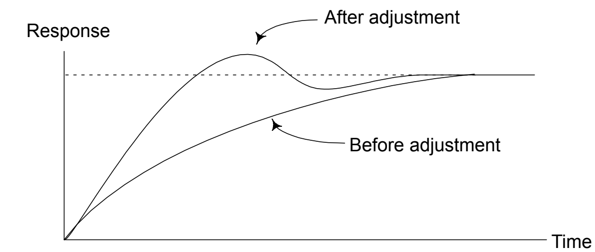
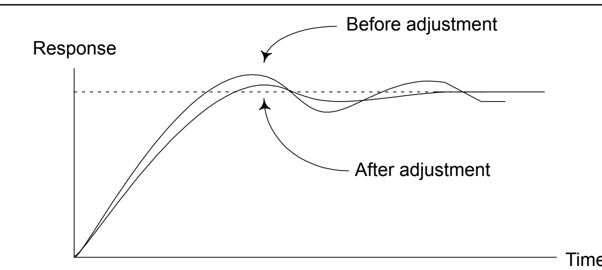
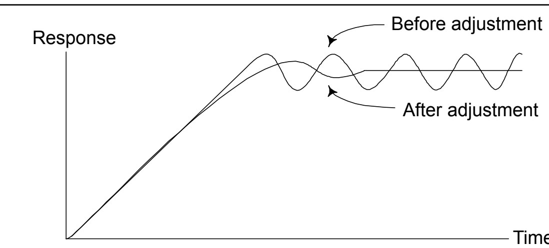
Setting 1: Reverse Enabled

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

■ Fine-Tuning PID

Follow the directions below to fine tune PID control parameters:

Table 5.6 PID Fine Tuning

Goal	Tuning Procedure	Result
Suppress overshoot	• Reduce the derivative time (b5-05) • Increase the integral time (b5-03)	
Achieve stability quickly while allowing some overshoot	• Decrease the integral time (b5-03) • Increase the derivative time (b5-05)	
Suppress long cycle oscillations (longer than the integral time setting)	Increase the integral time (b5-03)	
Suppress short cycle oscillations	• If oscillation cycle time is close to the derivative time, reduce the derivative time (b5-05). • If the derivative time is set to 0.00 s and oscillations are still a problem, reduce the proportional gain (b5-02) or increase the PID primary delay time (b5-08)	

5.3 C: Tuning

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

◆ C1: Acceleration and Deceleration Times

■ C1-01 and C1-02: Accel, Decel Time 1

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		

■ C1-09: Fast Stop Time

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

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

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

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

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

◆ C2: S-Curve Characteristics

Use S-curve characteristics to smooth acceleration and deceleration and minimize abrupt shock to the load. Set S-curve characteristic time during acceleration/deceleration at start and acceleration/deceleration at stop.

■ 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	0.20 s
C2-02	S-Curve Characteristic at Accel End		0.20 s

Figure 5.14 illustrates S-curve application.

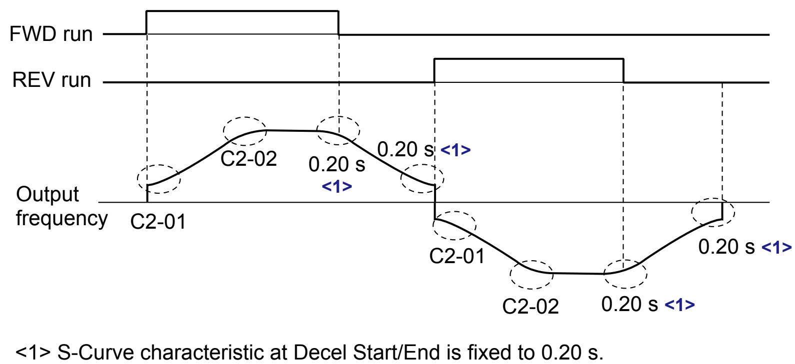


Figure 5.14 S-Curve Timing Diagram - FWD/REV Operation

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

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

◆ C4: Torque Compensation

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

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

■ C4-01: Torque Compensation Gain

Sets the gain for the torque compensation function.

No.	Parameter Name	Setting Range	Default
C4-01	Torque Compensation Gain	0.00 to 2.50	1.00

Torque Compensation:

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

Adjustment

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

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

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

◆ C6: Carrier Frequency

■ C6-02: Carrier Frequency Selection

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

Note: Increasing the carrier frequency above the default value automatically lowers the drive current rating.

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

Setting 1: 4.0 kHz

Setting 2: 6.0 kHz

Setting 3: 8.0 kHz

Setting 4: 10.0 kHz

◆ C7: Voltage Adjustment

■ C7-60: Output Voltage Limit Mode Selection

Sets the mode to limit the output voltage.

Set this parameter to 0 (Harmonic suppression priority mode) to give priority to harmonic suppression. The maximum output voltage is automatically limited to suppress harmonics.

Set this parameter to 1 (High output voltage mode) to give priority to the output voltage over harmonic suppression. The effectiveness of harmonic suppression will be reduced because the maximum output voltage will be used.

No.	Parameter Name	Setting Range	Default
C7-60	Output Voltage Limit Mode Selection	0, 1	Determined by A1–02

Setting 0: Harmonic Suppression Priority Mode

Setting 1: High Output Voltage Mode

5.4 d: Reference Settings

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

◆ d1: Frequency Reference

■ d1-01 to d1-04: Frequency References 1 to 4

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>

<1> The upper limit is determined by the maximum output frequency (E1-04) and upper limit for the frequency reference (d2-01). Parameter d2-01 is not accessible.

<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 Z2-□□ (DI-□□ Select) parameters to 5 (S5) and 6 (S6). To assign the Jog reference to a digital input, set Z2-□□ (DI-□□ Select) to 7 (S7) .

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

- The first frequency reference (Multi-Speed 1) comes from the source specified in Z1-07. When using an analog input terminal to supply the frequency reference, assign the frequency reference source to the control terminals (Z1-07 = 1).
- When an analog input is set to “Auxiliary frequency 1” (H3-02 or H3-10 = 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 5.7***. ***Figure 5.15*** illustrates the multi-step speed selection.

Table 5.7 Multi-Step Speed Reference and Terminal Switch Combinations

Reference	Multi-Step Speed Z2-□□ = 5	Multi-Step Speed 2 Z2-□□ = 6	Jog Reference Z2-□□ = 7
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

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

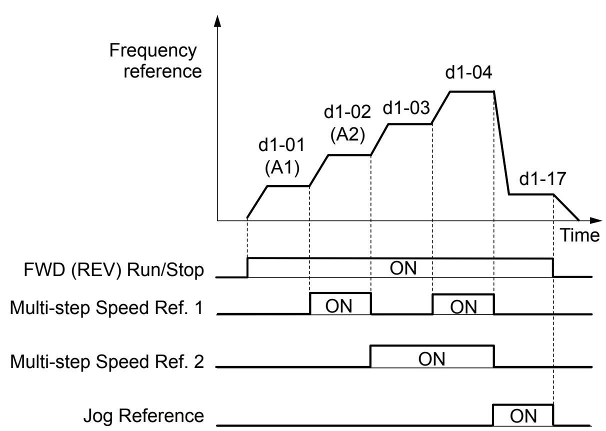


Figure 5.15 Preset Reference Timing Diagram

◆ d2: Frequency Upper/Lower Limits

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

■ d2-01: Frequency Reference Upper Limit

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

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

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

Note: This value is overwritten by the energy savings function. When energy savings is enabled, (Z1-16 = 1 or 2), this value will be set to 110%. When energy savings is not enabled (Z1-16 = 0), the bypass controller will not change this value.

■ 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%

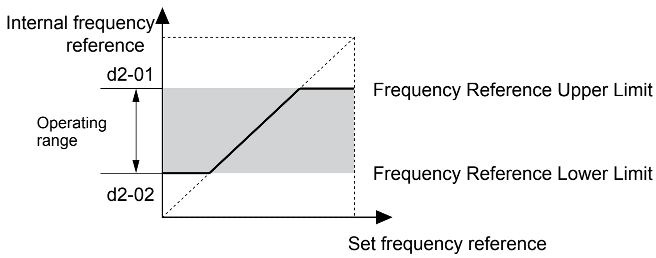


Figure 5.16 Frequency Reference: Upper and Lower Limits

■ d2-03: Master Speed Reference Lower Limit

Sets a lower limit as a percentage of the maximum output frequency that will only affect a frequency reference entered from the analog input terminals (A1, 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: Jump Frequency

■ 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 5.17 shows the relationship between the Jump Frequency and the frequency reference.

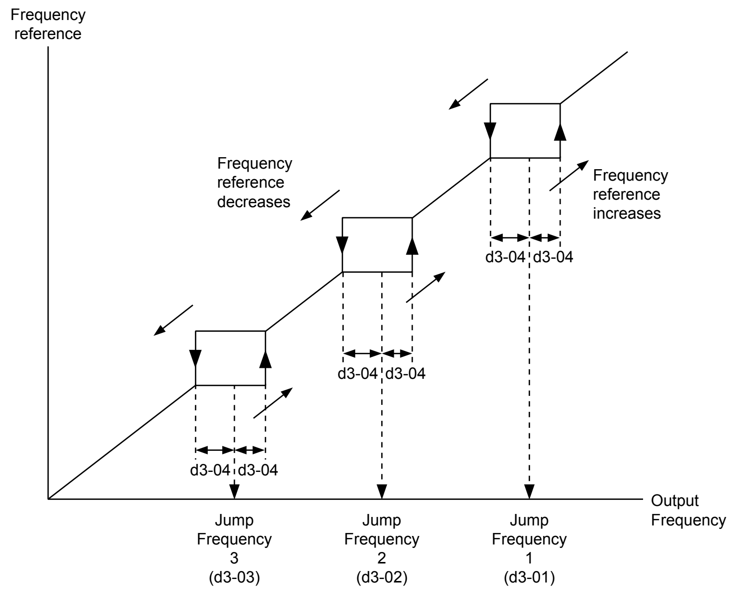


Figure 5.17 Jump Frequency Operation

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.

5.5 E: Motor Parameters

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

◆ E1: V/f Pattern for Motor 1

■ V/f Pattern Settings (E1-03)

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

■ E1-03: V/f Pattern Selection

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

No.	Parameter Name	Setting Range	Default
E1-03	V/f Pattern Selection	0 to 9; A to F	F

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

Choose the V/f pattern that best meets the application demands from the table below. Set the correct value to E1-03. Parameter E1-05 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 5.8 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	50 Hz, Variable torque 3		
7	50 Hz, Variable torque 4		
8	50 Hz, Mid starting torque	High starting torque	Select high starting torque when: • Wiring between the drive and motor exceeds 150 m. • A large amount of starting torque is required. • An AC reactor is installed.
9	50 Hz, High starting torque		
A	60 Hz, Mid starting torque		
B	60 Hz, High starting torque		
C	90 Hz (with 60 Hz base)	Constant output	Output voltage is constant when operating at greater than 60 Hz.
D	120 Hz (with 60 Hz base)		
E	180 Hz (with 60 Hz base)		
F <1>	60 Hz	Variable torque	Used for variable torque applications. The default setting is the same as V/f pattern Setting 7.

<1> Setting F enables a custom V/f pattern by changing parameters E1-05. When the bypass is shipped, the default values for parameter E1-05 is are equal to predefined V/f pattern 1.

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

Predefined V/f Patterns for Models B011 and B014

Table 5.9 Constant Torque Characteristics, Settings 0 to 3

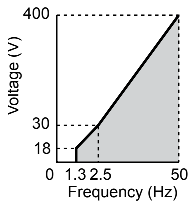
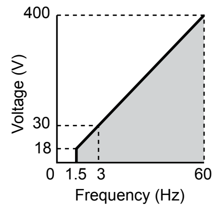
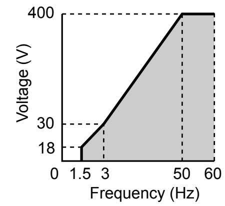
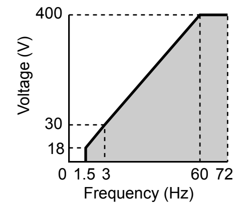
Setting = 0	50 Hz	Setting = 1	60 Hz	Setting = 2	60 Hz	Setting = 3	72 Hz
							

Table 5.10 Derated Torque Characteristics, Settings 4 to 7

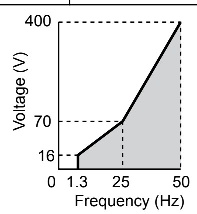
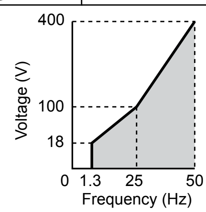
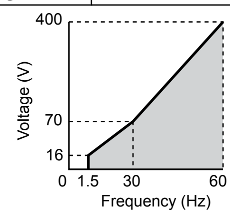
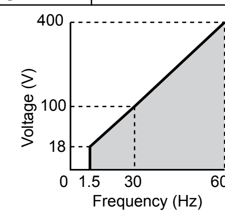
Setting = 4	50 Hz	Setting = 5	50 Hz	Setting = 6	60 Hz	Setting = 7	60 Hz
							

Table 5.11 High Starting Torque, Settings 8 to B

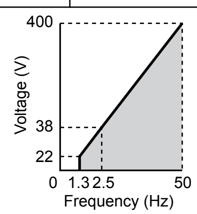
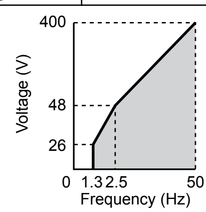
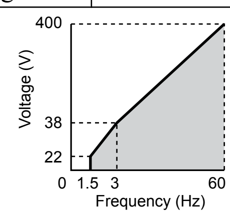
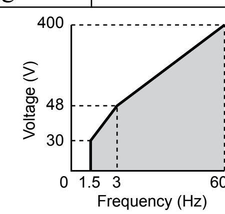
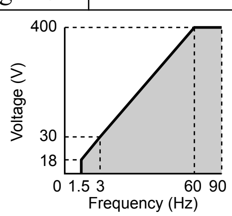
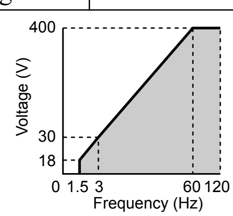
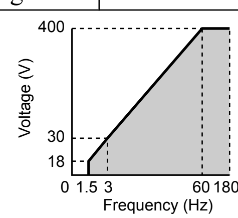
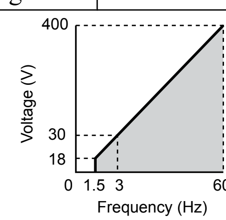
Setting = 8	50 Hz	Setting = 9	50 Hz	Setting = A	60 Hz	Setting = B	60 Hz
							

Table 5.12 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 D024 to D169 and B021 to B124

The values in settings 0 to E in the following graphs are specific to 200 V motors; double the values for 400 V motors. Setting F is for 230 V motors; double the values for 460 V motors.

Table 5.13 Rated Torque Characteristics, Settings 0 to 3

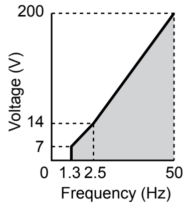
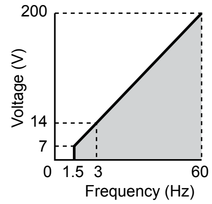
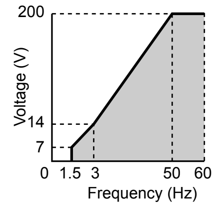
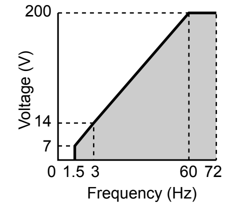
Setting = 0	50 Hz	Setting = 1	60 Hz	Setting = 2	60 Hz	Setting = 3	72 Hz
							

Table 5.14 Derated Torque Characteristics, Settings 4 to 7

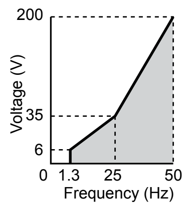
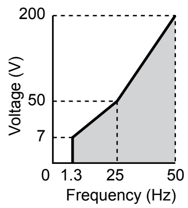
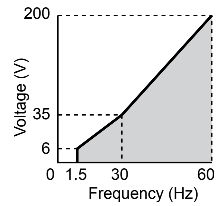
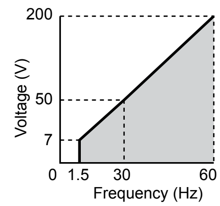
Setting = 4	50 Hz	Setting = 5	50 Hz	Setting = 6	60 Hz	Setting = 7	60 Hz
							

Table 5.15 High Starting Torque, Settings 8 to B

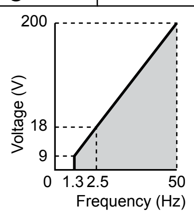
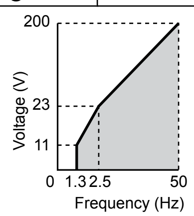
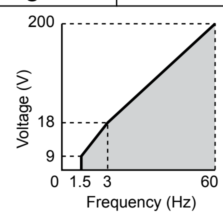
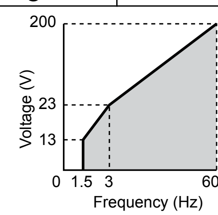
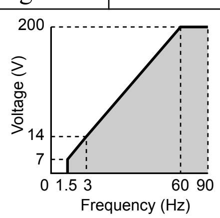
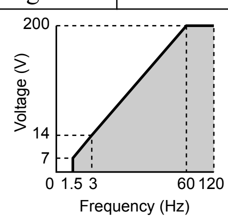
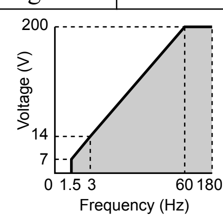
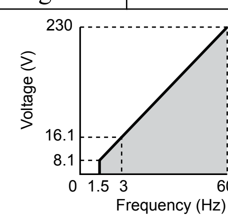
Setting = 8	50 Hz	Setting = 9	50 Hz	Setting = A	60 Hz	Setting = B	60 Hz
							

Table 5.16 Constant Output, Settings C to F

Setting = C	90 Hz	Setting = D	120 Hz	Setting = E	180 Hz	Setting = F	60 Hz
							

Programming

5

Predefined V/f Patterns for Models D211 and B156 to B414

The values in settings 0 to E in the following graphs are specific to 200 V motors; double the values for 400 V motors. Setting F is for 230 V motors; double the values for 460 V motors.

Table 5.17 Rated Torque Characteristics, Settings 0 to 3

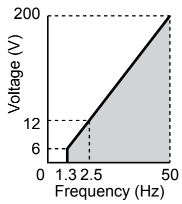
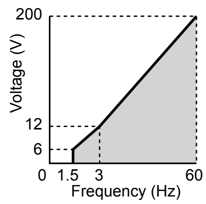
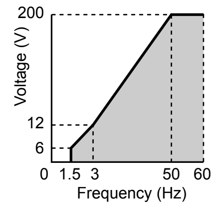
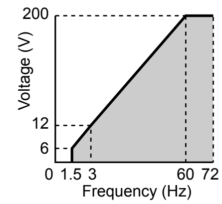
<table>
<tr><td>Setting = 0</td><td>50 Hz</td><td>Setting = 1</td><td>60 Hz</td><td>Setting = 2</td><td>60 Hz</td><td>Setting = 3</td><td>72 Hz</td></tr>
<tr><td colspan="2">
</td><td colspan="2">
</td><td colspan="2">
</td><td colspan="2">
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Table 5.18 Derated Torque Characteristics, Settings 4 to 7

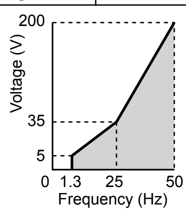
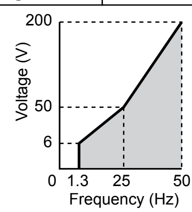
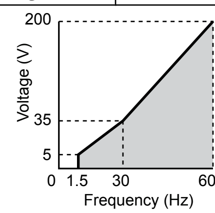
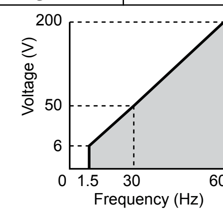
<table>
<tr><td>Setting = 4</td><td>50 Hz</td><td>Setting = 5</td><td>50 Hz</td><td>Setting = 6</td><td>60 Hz</td><td>Setting = 7</td><td>60 Hz</td></tr>
<tr><td colspan="2">
</td><td colspan="2">
</td><td colspan="2">
</td><td colspan="2">
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Table 5.19 High Starting Torque, Settings 8 to B

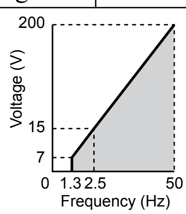
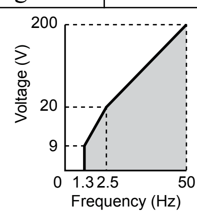
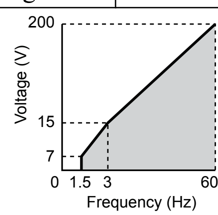
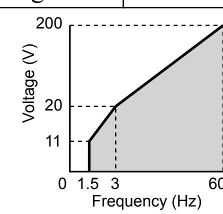
<table>
<tr><td>Setting = 8</td><td>50 Hz</td><td>Setting = 9</td><td>50 Hz</td><td>Setting = A</td><td>60 Hz</td><td>Setting = B</td><td>60 Hz</td></tr>
<tr><td colspan="2">
</td><td colspan="2">
</td><td colspan="2">
</td><td colspan="2">
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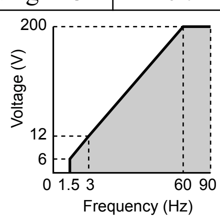
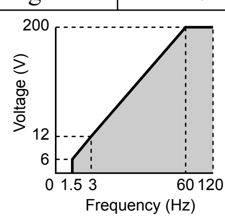
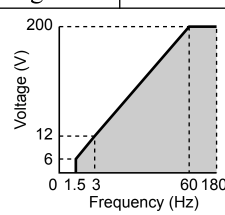
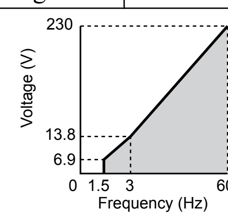
Table 5.20 Constant Output, Settings C to F

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

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

Setting parameter E1-03 to F allows the user to set up a custom V/f pattern by changing parameter E1-05.

■ V/f Pattern Settings E1-05

If E1-03 is set to a preset V/f pattern (i.e., a value other than F), the user can monitor the maximum voltage in parameters E1-05. To create a new V/f pattern, set E1-03 to F.

No.	Parameter Name	Setting Range	Default
E1-05	Maximum Voltage	0.0 to 255.0 V <1>	230 or 460 Depending on parameter o2-04, Drive Model Selection setting.

<1> Values shown are specific to 200 V Class; double the value for 400 V class.

◆ E2: Motor 1 Parameters

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

■ 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 based on drive model:
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: An oPE02 error will occur if the motor rated current in E2-01 is set lower than the motor no-load current in E2-03. Set E2-03 correctly to prevent this error.

■ E2-03: Motor No-Load Current

Set the no-load current for the motor in amperes when operating at the rated frequency and the no-load voltage. The drive sets E2-03 during the Auto-Tuning process (Rotational Auto-Tuning and Stationary Auto-Tuning 2, 3). The motor no-load current listed in the motor test report can also be entered to E2-03 manually. Contact the motor manufacturer to receive a copy of the motor test report.

No.	Parameter Name	Setting Range	Default
E2-03	Motor No-Load Current	0.00 A to [E2-01] <1>	Determined by o2-04

<1> Display is in the following units based on drive model:
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

5.6 F: Options

◆ F6: Drive/Bypass Communications

■ F6-01: Communications Error Operation Selection

Determines drive operation when a communication error occurs.

No.	Parameter Name	Setting Range	Default
F6-01	Communications Error Operation Selection	0 to 5	1

Setting 0: Ramp to Stop (Use the Deceleration Time Set to C1-02)

Setting 1: Coast to Stop

Setting 2: Fast Stop (Use the Fast Stop Time Set to C1-09)

Setting 3: Alarm Only (Continue Operation)

Setting 4: Alarm Only (Continue Operation Using the Frequency Reference Set in d1-04)

Setting 5: Alarm Only (Use the Deceleration Time Set to C1-02)

■ F6-02: External Fault from Bypass Controller Detection Selection

Determines the detection method of an external fault initiated by the bypass controller (EF0).

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

Setting 0: Always detected

Setting 1: Detection during Run only

■ F6-03: External Fault from Bypass Controller Operation Selection

Determines drive operation when an external fault is initiated by the bypass controller (EF0).

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

Setting 0: Ramp to stop

Setting 1: Coast to stop

Setting 2: Fast Stop

Setting 3: Alarm only (continue operation)

5.7 H: Terminal Functions

H parameters assign functions to the external terminals.

◆ H1: Multi-Function Digital Inputs

■ H1-03 to H1-08: Functions for Terminals S3 to S8

These parameters assign functions to the multi-function digital inputs. The various functions and settings are listed in *Table 5.21*.

No.	Parameter Name	Setting Range	Default
H1-03	Multi-Function Digital Input Terminal S3 Function Selection	3 to 60	24: External Fault
H1-04	Multi-Function Digital Input Terminal S4 Function Selection	3 to 60	14: Fault Reset
H1-05	Multi-Function Digital Input Terminal S5 Function Selection	3 to 60	3: Multi-Step Speed Reference 1
H1-06	Multi-Function Digital Input Terminal S6 Function Selection	3 to 60	4: Multi-Step Speed Reference 2
H1-07	Multi-Function Digital Input Terminal S7 Function Selection	3 to 60	F: Not Used (Through Mode)
H1-08	Multi-Function Digital Input Terminal S8 Function Selection	3 to 60	F: Not Used (Through Mode)

Table 5.21 Multi-Function Digital Input Terminal Settings

Setting	Function	Page
3	Multi-Step Speed Reference 1	*133*
4	Multi-Step Speed Reference 2	
6	Jog reference Selection	*133*
C	Analog Terminal Input Selection	*133*
F	Not Used (Through Mode)	*133*
10	Up Command	*133*
11	Down Command	
14	Fault Reset	*135*
19	PID Disable	*135*
24	External Fault	*135*
60	Motor Pre-Heat 1	*135*

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

Switches multi-step speed frequency references d1-01 to d1-04 by digital inputs. *Refer to d1: Frequency Reference on page 124* for details.

Setting 6: Jog Reference Selection

The Jog frequency set in parameter d1-17 becomes the frequency reference when the input terminal closes. *Refer to d1: Frequency Reference on page 124* for details.

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

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

Setting F: Not Used (Through Mode)

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

Settings 10 and 11: Up/Down Function

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

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

The inputs operate as shown in the table below:

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

Note:
1. An oPE03 alarm occurs when only one of the Up/Down functions is programmed to a digital input.
2. An oPE03 alarm occurs when the Up/Down function is assigned to the terminals and a different digital input is programmed for the Accel/decel ramp hold function. Refer to the Troubleshooting chapter in the User Manual packaged with the drive for more information on alarms.
3. The Up/Down function can only be used for External reference 1. Consider this when using Up/Down and the external reference switching command (H1-☐☐ = 2).

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

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

Using the Up/Down Function with Frequency Reference Limits

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

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

Figure 5.18 shows an Up/Down function example with a lower frequency reference limit set by d2-02, and the frequency reference hold function both enabled and disabled.

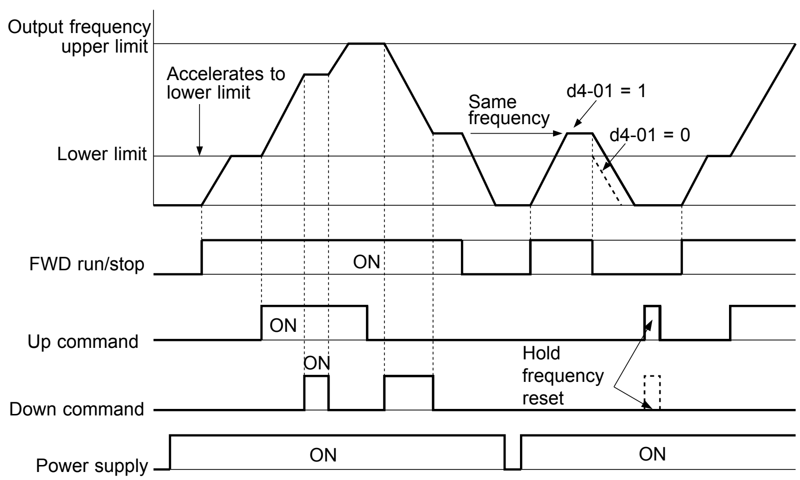


Figure 5.18 Up/Down Command Operation

Setting 14: Fault Reset

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

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

Setting 19: PID Disable

Close a digital input to indefinitely disable the PID function. When the input is released, the drive resumes PID operation. *Refer to PID Block Diagram on page 113*.

Setting 24: External Fault

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

To use the External fault command, set one of the multi-function digital inputs to 24. The HOA keypad will display EF☐ where ☐ is the number of the terminal to which the external fault signal is assigned.

For example, if an external fault signal is input to terminal DI-3, “EF3” will be displayed.

The conditions of setting 24 are:

- Terminal status is normally open
- Detection condition is always detected
- Stopping method is coast to stop.

Setting 60: Motor Pre-Heat 1

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

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

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

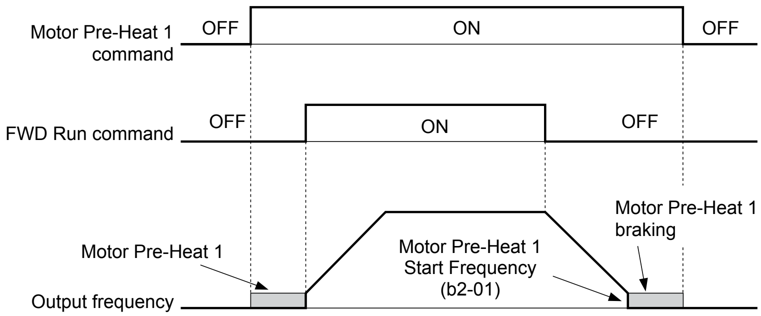


Figure 5.19 Motor Pre-Heat 1 Input Timing Diagram

◆ H2: Multi-Function Digital Outputs

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

The drive has three multi-function output terminals. *Table 5.22* lists the functions available for theses terminals using H2-01, H2-02, and H2-03.

No.	Parameter Name	Setting Range	Default
H2-01	Terminal M1-M2 Function Selection (relay)	0 to 164	0: During Run
H2-02	Terminal M3-M4 Function Selection (relay)	0 to 164	1: Zero Speed
H2-03	Terminal MD-ME-MF Function Selection (relay)	0 to 164	2: Speed Agree 1

Table 5.22 Multi-Function Digital Output Terminal Settings

Setting	Function	Page	Setting	Function	Page
0	During Run 1	136	B	Torque Detection 1 (N.O.)	139
1	Zero Speed	136	C	Frequency Reference Loss	139
2	Speed Agree 1	136	E	Fault	139
3	User-Set Speed Agree 1	137	F	Through Mode	139
4	Frequency Detection 1	137	10	Minor Fault	139
5	Frequency Detection 2	138	11	Fault Reset Command Active	139
6	Drive Ready	138	13	Speed Agree 2	139
7	DC Bus Undervoltage	138	14	User-Set Speed Agree 2	139
8	During Baseblock 1 (N.O.)	138	15	Frequency Detection 3	140

Setting	Function	Page
16	Frequency Detection 4	140
17	Torque Detection 1 (N.C.)	139
1A	During Reverse	141
1B	During Baseblock 2 (N.C.)	141
1E	Restart Enabled	141
20	Drive Overheat Pre-Alarm (oH)	141
2F	Maintenance Period	141
37	During Run 2	141
38	Drive Enable	142
39	Energy Pulse Output	142
3A	Regenerated Power Pulse Output	142
3D	During Speed Search	142
4C	During Fast Stop	142
4D	oH Pre-Alarm Time Limit	142
60	Internal Cooling Fan Alarm	142
64	During Commercial Power Operation	142
100 to 164	Functions 0 to 64 with Inverse Output	142

Setting 0: During Run

The output closes when the drive is outputting a voltage.

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

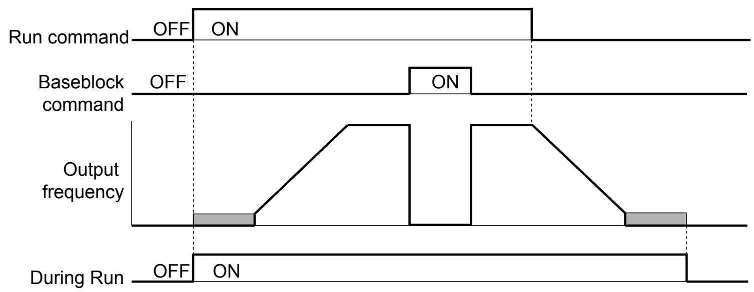


Figure 5.20 During Run Time Chart

Setting 1: Zero Speed

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

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

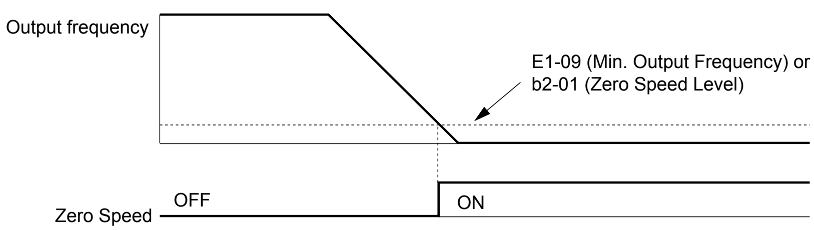


Figure 5.21 Zero-Speed Time Chart

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

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

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

Note: Detection works in forward and reverse.

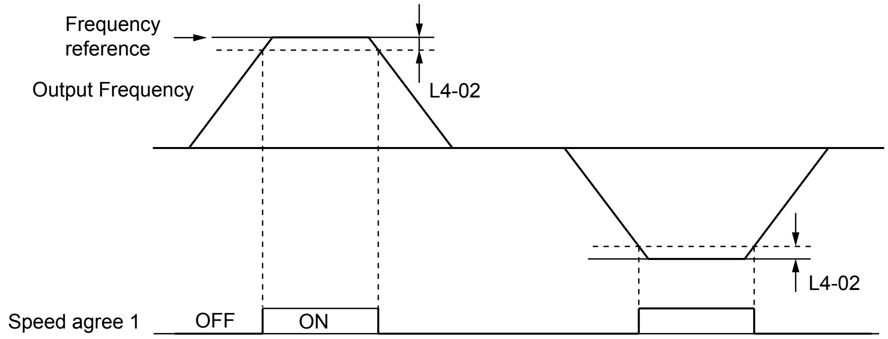


Figure 5.22 Speed Agree 1 Time Chart

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

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

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

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

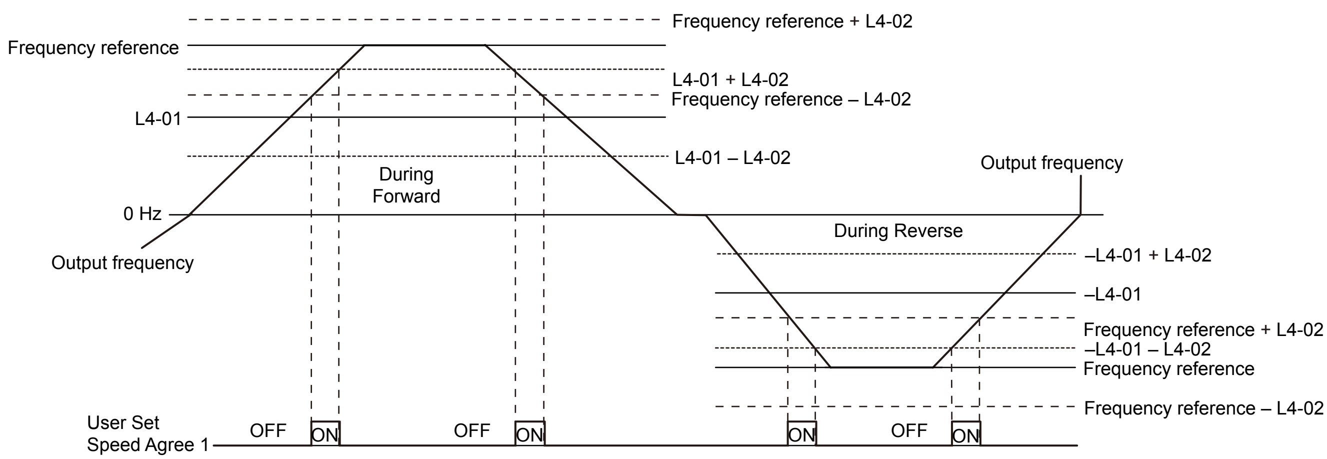


Figure 5.23 User Set Speed Agree 1 Time Chart

Setting 4: Frequency Detection 1

The output opens when the output frequency or motor speed rises above the detection level set in L4-01 plus the detection width set in L4-02. The terminal remains open until the output frequency or motor speed fall below the level set in L4-01.

Status	Description
Open	Output frequency or motor speed exceeded L4-01 + L4-02.
Closed	Output frequency or motor speed is below L4-01 or has not exceeded L4-01 + L4-02.

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

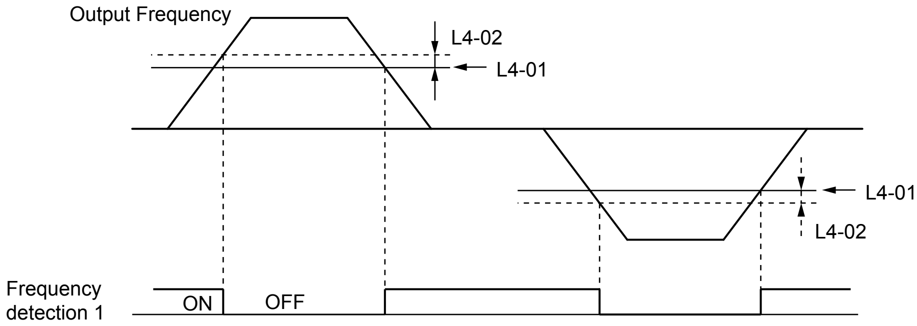


Figure 5.24 Frequency Detection 1 Time Chart

Setting 5: Frequency Detection 2

The output closes when the output frequency or motor speed is above the detection level set in L4-01. The terminal remains closed until the output frequency or motor speed fall below L4-01 minus the setting of L4-02.

Status	Description
Open	Output frequency or motor speed is below L4-01 minus L4-02 or has not exceeded L4-01.
Closed	Output frequency or motor speed exceeded L4-01.

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

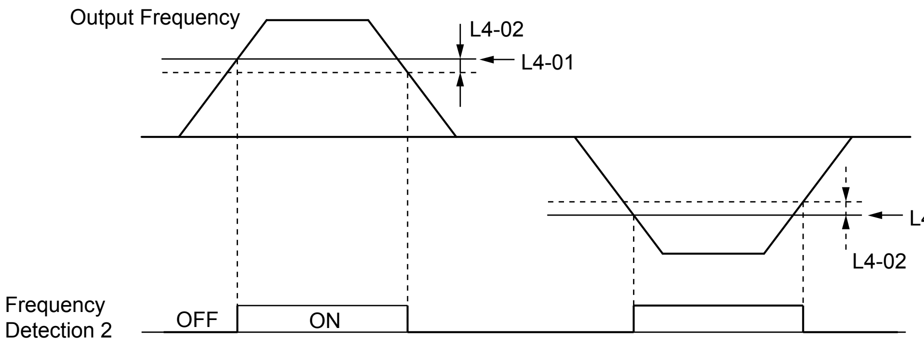


Figure 5.25 Frequency Detection 2 Time Chart

Setting 6: Drive Ready

The output closes when the drive is ready to operate the motor. The terminal will not close under the conditions listed below, and any Run commands will be disregarded.

- When the power is shut off
- During a fault
- When the internal power supply of the drive has malfunctioned
- When a parameter setting error makes it impossible to run
- Although stopped, an overvoltage or undervoltage situation occurs
- While editing a parameter in the Programming Mode (when b1-08 = 0)

Setting 7: DC Bus Undervoltage

The output closes when the DC bus voltage or control circuit power supply drops below the trip level set in L2-05. A fault in the DC bus circuit will also cause the terminal set for “DC bus undervoltage” to close.

Status	Description
Open	DC bus voltage is above the level set to L2-05.
Closed	DC bus voltage has fallen below the trip level set to L2-05.

Setting 8: During Baseblock 1 (N.O.)

The output closes to indicate that the drive is in a baseblock state. While in baseblock, output transistors do not switch and no main circuit voltage is output.

Status	Description
Open	Drive is not in a baseblock state.
Closed	Baseblock is being executed.

Settings B and 17: Torque Detection 1 (N.O., N.C.)

These digital output functions signal an overtorque or undertorque situation to an external device.

Set up the torque detection levels and select the output function from the table below.

Setting	Status	Description
B	Closed	Torque detection 1 (N.O.): Output current/torque exceeds (overtorque detection) or is below (undertorque detection) the torque value set in parameter L6-02 for longer than the time specified in parameter L6-03.
17	Open	Torque detection 1 (N.C.): Output current/torque exceeds (overtorque detection) or is below (undertorque detection) the torque value set in parameter L6-02 for longer than the time specified in parameter L6-03.

Setting C: Frequency Reference Loss

The output closes when frequency reference loss is detected.

Setting E: Fault

The output closes when the drive faults (excluding CPF00 and CPF01 faults).

Setting F: Through Mode

Select this setting when using the terminal in a pass-through mode. When set to F, an output does not trigger any function in the drive. Setting F, however, still allows the output status to be read by a PLC via BACnet, P1, N2, or MEMOBUS/Modbus communications.

Setting 10: Minor Fault

The output closes when a minor fault condition is present.

Setting 11: Fault Reset Command Active

The output closes when there is an attempt to reset a fault situation from the control circuit terminals, via serial communications, or using a communications option card.

Setting 13: Speed Agree 2 (f_{ref} /f_{out} Agree 2)

The output closes when the actual output frequency or motor speed is within the speed agree width (L4-04) of the current frequency reference, regardless of the direction.

Status	Description
Open	Output frequency or motor speed does not match the frequency reference while the drive is running.
Closed	Output frequency or motor speed is within the range of frequency reference ±L4-04.

Note: Detection works in forward and reverse.

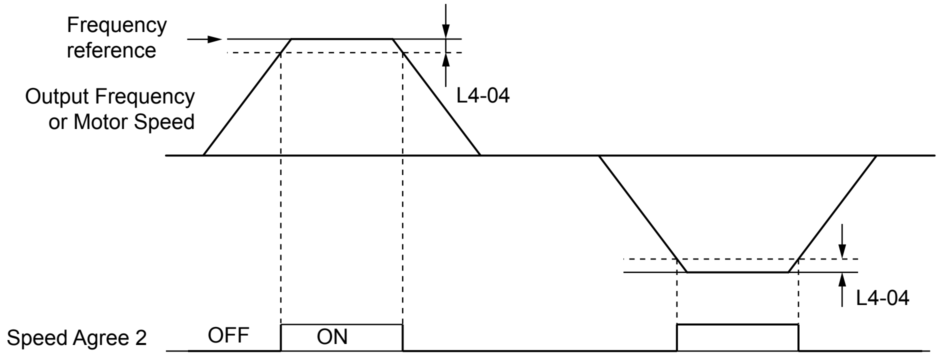


Figure 5.26 Speed Agree 2 Time Chart

Setting 14: User-Set Speed Agree 2 (f_{ref} /f_{set} Agree 2)

The output closes when the actual output frequency or motor speed and the frequency reference are within the speed agree width (L4-04) of the programmed speed agree level (L4-03).

Programming

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Status	Description
Open	Output frequency or motor speed and frequency reference are both outside the range of L4-03 ±L4-04.
Closed	Output frequency or motor speed and the frequency reference are both within the range of L4-03 ±L4-04.

Note: The detection level L4-03 is a signed value; detection works in the specified direction only.

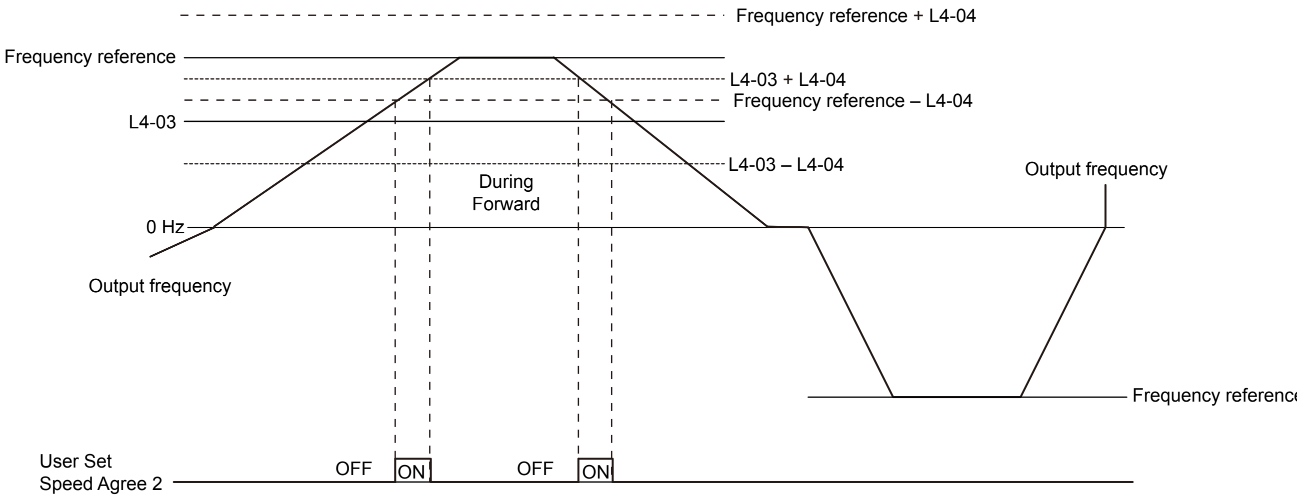

Figure 5.27 User-Set Speed Agree 2 Example with a Positive L3-04 Value

Setting 15: Frequency Detection 3

The output opens when the output frequency or motor speed rises above the detection level set in L4-03 plus the detection with set in L4-04. The terminal remains open until the output frequency or motor speed falls below the level set in L4-03. The detection level L4-03 is a signed value; detection works in the specified direction only.

Status	Description
Open	Output frequency or motor speed exceeded L4-03 plus L4-04.
Closed	Output frequency or motor speed is below L4-03 or has not exceeded L4-03 plus L4-04.

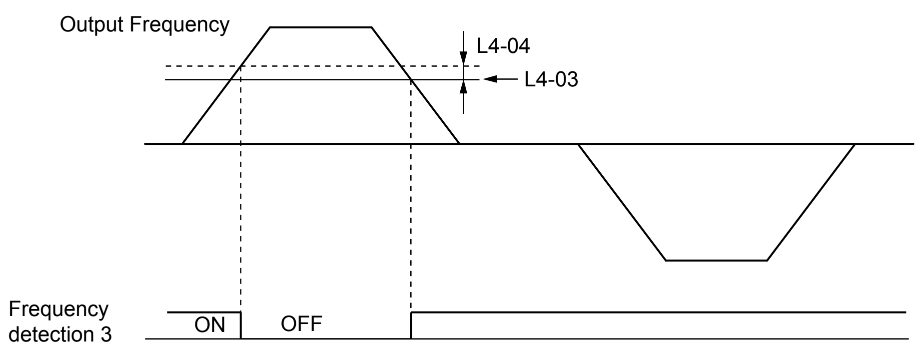

Figure 5.28 Frequency Detection 3 Example with a Positive L3-04 Value

Setting 16: Frequency Detection 4

The output closes when the output frequency or motor speed is above the detection level set in L4-03. The terminal remains closed until the output frequency or motor speed falls below L4-03 minus the setting of L4-04.

Status	Description
Open	Output frequency or motor speed is below L4-03 minus L4-04 or has not exceeded L4-03.
Closed	Output frequency or motor speed exceeded L4-03.

Note: The detection level L4-03 is a signed value; detection works in the specified direction only.

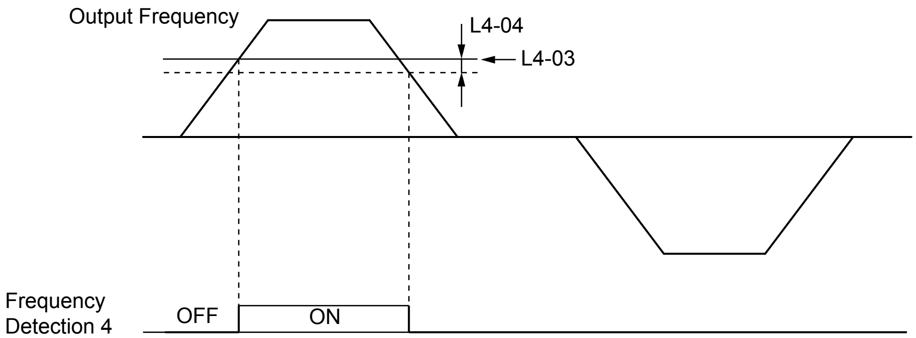

Figure 5.29 Frequency Detection 4 Example with Positive L3-04 Value

Setting 1A: During Reverse

The output closes when the drive is running the motor in the reverse direction.

Status	Description
Open	Motor is being driven in the forward direction or stopped.
Closed	Motor is being driven in reverse.

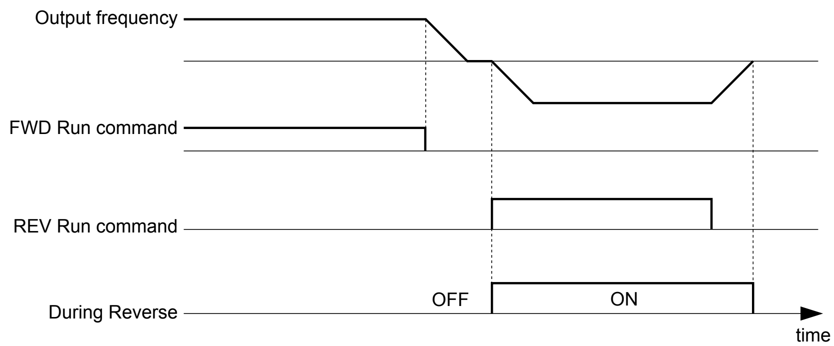

Figure 5.30 Reverse Direction Output Example Time Chart

Setting 1B: During Baseblock 2 (N.C.)

The output opens to indicate that the drive is in a baseblock state. While baseblock is executed, output transistors do not switch and no main circuit voltage is output.

Status	Description
Open	Baseblock is being executed.
Closed	Drive is not in a baseblock state.

Setting 1E: Restart Enabled

The output closes when the drive attempts to restart after a fault has occurred.

The fault restart function allows the drive to automatically clear a fault. The terminal set to 1E will close after the fault is cleared and the drive has attempted to restart. If the drive cannot successfully restart within the number of attempts permitted by L5-01, a fault will be triggered and the terminal set to 1E will open.

Setting 20: Drive Overheat Pre-Alarm (oH)

The output closes when the drive heatsink temperature reaches the level specified by parameter L8-02.

Setting 2F: Maintenance Period

The output closes when the cooling fan, DC bus capacitors, or DC bus pre-charge relay may require maintenance as determined by the estimated performance life span of those components. Components performance life is displayed as a percentage on the HOA keypad screen.

Setting 37: During Run 2

The output closes when the drive is outputting a frequency.

Status	Description
Open	Drive is stopped or one of the following functions is being performed: baseblock, DC Injection Braking, Short Circuit Braking.
Closed	Drive is outputting frequency.

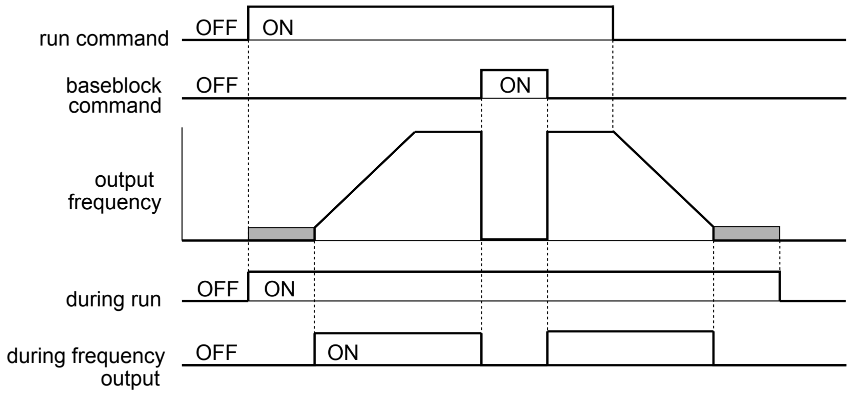

Figure 5.31 During Frequency Output Time Chart

Setting 38: Drive Enable

Reflects the status of a digital input configured as a “Drive enable” input (H1-□□ = 6A). If that digital input closes, then the digital output set for “Drive enable” will also close.

Setting 39: Energy Pulse Output

Outputs a pulse to indicate the watt hours.

Setting 3A: Regen Pulse Output

Outputs a pulse to indicate the regenerated power.

Setting 3D: During Speed Search

The output terminal closes while Speed Search is being performed.

Setting 4C: During Fast Stop

The output terminal closes when a Fast Stop is being executed. .

Setting 4D: oH Pre-Alarm Time Limit

The output terminal closes when the drive is reducing the speed due to a drive overheat alarm (L8-03 = 4) and the overheat alarm has not disappeared after 10 frequency reduction operation cycles.

Setting 60: Internal Cooling Fan Alarm

The output closes when the drive internal cooling fan has failed.

Setting 64: During Commercial Power Operation

Output closes when operating on commercial power when commercial power switching is selected (b1-24 = 1).

Setting 100 to 164: Functions 0 to 64 with Inverse Output

These settings have the same function as settings 0 to 64, but with inverse output. Set as 1□□, where the “1” indicates inverse output and the last two digits specify the setting number of the function.

Examples:

- Set 108 for inverse output of “8: During Baseblock 1 (N.O.)”.
- Set 14D for inverse output of “4D: oH Pre-Alarm Time Limit”.

◆ H3: Multi-Function Analog Inputs

The drive is equipped with multi-function analog input terminals A1, A2, and A3. ***Refer to Multi-Function Analog Input Terminal Settings on page 146*** for a listing of the functions that can be set to these terminals.

■ H3-01: Terminal A1 Signal Level Selection

Selects the input signal level for analog input A1. Set jumper S1 on the terminal board accordingly for voltage input or current input.

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

Setting 0: 0 to 10 V with Zero Limit

The input level is 0 to 10 Vdc with zero limit. The minimum input level is limited to 0%, so that a negative input signal due to gain and bias settings will be read as 0%.

Setting 1: 0 to 10 V without Zero Limit

The input level is 0 to 10 Vdc without zero limit. If the resulting voltage is negative after being adjusted by gain and bias settings, then the motor will rotate in reverse.

Setting 2: 4 to 20 mA Current Input

The input level is 4 to 20 mA. Negative input values by negative bias or gain settings are limited to 0%.

Setting 3: 0 to 20 mA Current Input

The input level is 0 to 20 mA. Negative input values by negative bias or gain settings are limited to 0%.

■ H3-02: Terminal A1 Function Selection

Selects the input signal level for analog input A1. *Refer to Multi-Function Analog Input Terminal Settings on page 146* for instructions on adjusting the signal level.

No.	Name	Setting Range	Default
H3-02	Terminal A1 Function Selection	0 to 26	0

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

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

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

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

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

Setting Examples

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

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

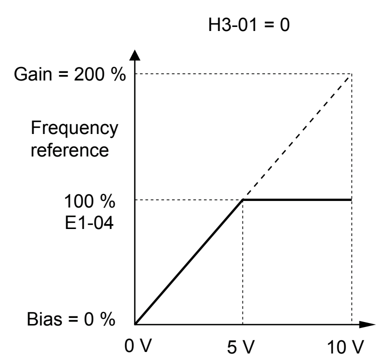

Figure 5.32 Frequency Reference Setting by Analog Input with Increased Gain

- 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.

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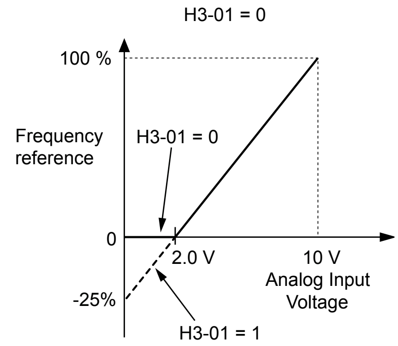

Figure 5.33 Frequency Reference Setting by Analog Input with Negative Bias

■ 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 146* 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 143*.

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 143*.

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 146* for a list of functions and descriptions.

No.	Name	Setting Range	Default
H3-06	Terminal A3 Function Selection	0 to 26	2

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

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

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

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

■ H3-09: Terminal A2 Signal Level Selection

Selects the input signal level for analog input A2. Set Jumper S1 on the terminal board accordingly for a voltage input or current input.

No.	Name	Setting Range	Default
H3-09	Terminal A2 Signal Level Selection	0 to 3	2

Setting 0: 0 to 10 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 143*.

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 143*.

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 146* 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.

■ H3-11, H3-12: Terminal A2 Gain and Bias Setting

Parameter H3-11 sets the level of the input value selected that is equal to 10 Vdc input or 20 mA input to terminal A2.

Parameter H3-12 sets the level of the input value selected that is equal to 0 V, 4 mA or 0 mA input at terminal A2.

Use both parameters to adjust the characteristics of the analog input signal to terminal A2. The setting works in the same way as parameters H3-03 and H3-04 for analog input A1.

No.	Name	Setting Range	Default
H3-11	Terminal A2 Gain Setting	-999.9 to 999.9%	100.0%
H3-12	Terminal A2 Bias Setting	-999.9 to 999.9%	0.0%

■ H3-13: Analog Input Filter Time Constant

Parameter H3-13 sets the time constant for a first order filter that will be applied to the analog inputs.

An analog input filter prevents erratic drive control when using a "noisy" analog reference. Drive operation becomes more stable as the programmed time becomes longer, but it also becomes less responsive to rapidly changing analog signals.

No.	Name	Setting Range	Default
H3-13	Analog Input Filter Time Constant	0.00 to 2.00 s	0.03 s

■ H3-14: Analog Input Terminal Enable Selection

When one of the multi-function digital input parameters is set for "Analog input enable" (H1-☐☐ = C), the value set to H3-14 determines which analog input terminals are enabled when the input is closed. All of the analog input terminals will be enabled all of the time when H1-☐☐≠ C. The terminals not set as the target are not influenced by input signals.

No.	Name	Setting Range	Default
H3-14	Analog Input Terminal Enable Selection	1 to 7	7

Setting 1: A1 Only Enabled

Setting 2: A2 Only Enabled

Setting 3: A1 and A2 Only Enabled

Setting 4: A3 Only Enabled

Setting 5: A1 and A3 Only Enabled

Setting 6: A2 and A3 Only Enabled

Setting 7: All Analog Input Terminals Enabled

■ H3-16 to H3-18: Terminal A1/A2/A3 Offset

Set the offset level of the selected input value to terminals A1, A2, or A3 that is equal to 0 Vdc input. These parameters rarely require adjustment.

No.	Name	Setting Range	Default
H3-16	Terminal A1 Offset	-500 to 500	0
H3-17	Terminal A2 Offset	-500 to 500	0
H3-18	Terminal A3 Offset	-500 to 500	0

■ Multi-Function Analog Input Terminal Settings

See *Table 5.23* for information on how H3-02 and H3-10 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 5.23 Multi-Function Analog Input Terminal Settings

Setting	Function	Page	Setting	Function	Page
0	Frequency Bias	146	B	PID Feedback	147
1	Frequency Gain	146	C	PID Setpoint	148
2	Auxiliary Frequency Reference 1	146	D	Frequency Bias	148
3	Auxiliary Frequency Reference 2	146	E	Motor Temperature (PTC Input)	148
4	Output Voltage Bias	146	F	Through Mode	148
5	Accel/Decel Time Gain	147	16	Differential PID Feedback	148
6	DC Injection Braking Current	147	1F	HAND Reference	148
7	Overtorque/Undertorque Detection Level	147	25	Secondary PI Setpoint	148
8	Stall Prevention Level During Run	147	26	Secondary PI Feedback	148
9	Output Frequency Lower Limit Level	147			

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 124* 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 124* for details.

Setting 4: Output Voltage Bias

Voltage bias boosts the output voltage of the V/f curve as a percentage of the maximum output voltage (E1-05). Available only when using V/f Control.

Setting 5: Accel/Decel Time Gain

Adjusts the gain level for the acceleration and deceleration times set to parameters C1-01 through C1-08.

The drive acceleration time is calculated by multiplying the gain level to C1-☐☐ as follows:

C1-☐☐ × Accel/decel time gain = Drive accel/decel time

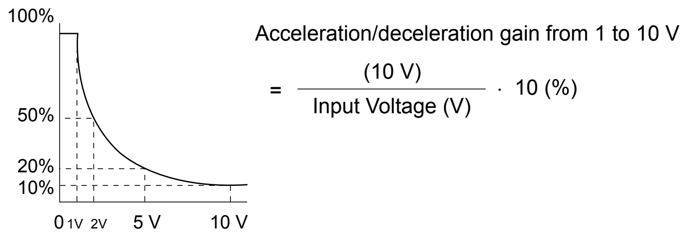

Figure 5.34 Accel/Decel Time Gain with Analog Input Terminal

Setting 6: DC Injection Braking Current

The current level used for DC Injection Braking is set as a percentage of the drive rated current.

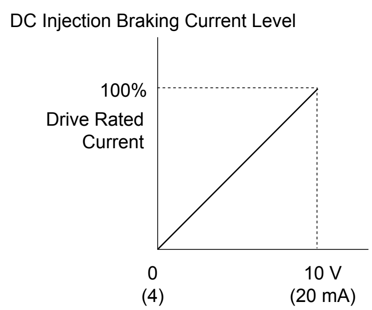

Figure 5.35 DC Injection Braking Current Using an Analog Input Terminal

Setting 7: Torque Detection Level

Using this setting, the overtorque/undertorque detection level for torque detection 1 (L6-01) can be set by an analog input. The analog input replaces the level set to L6-02. An analog input of 100% (10 V or 20 mA) sets a torque detection level equal to 100% drive rated current/motor rated torque. Adjust the analog input gain if higher detection level settings are required. *Refer to L6: Torque Detection on page 158* for details on torque detection.

Setting 8: Stall Prevention Level

Allows an analog input signal to adjust the Stall Prevention level. *Figure 5.36* shows the setting characteristics. The drive will use the lower value of the Stall Prevention level set to L3-06 or the level coming from the selected analog input terminal.

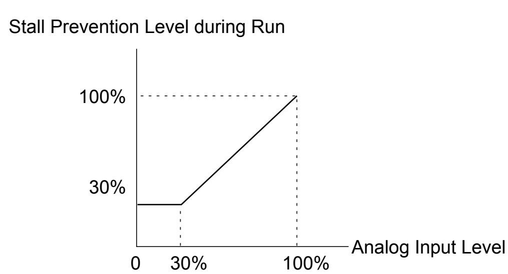

Figure 5.36 Stall Prevention During Run Using an Analog Input Terminal

Setting 9: Output Frequency Lower Limit Level

The user can adjust the lower limit of the output frequency using an analog input signal.

Setting B: PID Feedback

Supplies the PID feedback value. This setting requires PID operation to be enabled in b5-01. *Refer to PID Feedback Input Methods on page 111*.

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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. *Refer to PID Setpoint Input Methods on page 111*.

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 BACnet, P1, N2, or MEMOBUS/Modbus 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. *Refer to PID Feedback Input Methods on page 111*.

Setting 1F: HAND Reference

Sets the frequency reference when in HAND Mode and parameter Z1-41, HAND Speed Reference Selection, is set to 1 (Analog).

Setting 25: Secondary PI Setpoint

10 V = S3-02 (Maximum Output Frequency).

Setting 26: Secondary PI Feedback

10 V = S3-02 (Maximum Output Frequency).

◆ H4: Multi-Function Analog Outputs

These parameters assign functions to analog output terminals FM and AM for monitoring a specific aspect of drive performance.

■ H4-01, H4-04: Multi-Function Analog Output Terminal FM, AM Monitor Selection

Sets the desired drive monitor parameter U□-□□ to output as an analog value via terminal FM and AM. *Refer to U: Monitor Parameters on page 175* for a list of all monitors. The “Analog Output Level” column indicates whether a monitor can be used for analog output.

Example: Enter “103” for U1-03.

No.	Name	Setting Range	Default
H4-01	Multi-Function Analog Output Terminal FM Monitor Selection	000 to 621	102
H4-04	Multi-Function Analog Output Terminal AM Monitor Selection	000 to 621	103

A setting of 031 or 000 applies no drive monitor to the analog output. With this setting, terminal functions as well as FM and AM output levels can be set by a PLC via a communication option or MEMOBUS/Modbus (through mode).

■ H4-02, H4-03: Multi-Function Analog Output Terminal FM Gain and Bias H4-05, H4-06: Multi-Function Analog Output Terminal AM Gain and Bias

Parameters H4-02 and H4-05 set the terminal FM and AM output signal level when the value of the selected monitor is at 100%. Parameters H4-03 and H4-06 set the terminal FM and AM output signal level when the value of the selected monitor is at 0%. Both are set as a percentage, where 100% equals 10 Vdc or 20 mA analog output and 0% equals 0 V or 4 mA. The output voltage of both terminals is limited to +/-10 Vdc.

The output signal range can be selected between 0 to +10 Vdc or -10 to +10 Vdc, or 4 to 20 mA using parameter H4-07 and H4-08. *Figure 5.37* illustrates how gain and bias settings work.

No.	Name	Setting Range	Default
H4-02	Multi-Function Analog Output Terminal FM Gain	-999.9 to 999.9%	100.0%
H4-03	Multi-Function Analog Output Terminal FM Bias	-999.9 to 999.9%	0.0%

No.	Name	Setting Range	Default
H4-05	Multi-Function Analog Output Terminal AM Gain	-999.9 to 999.9%	50.0%
H4-06	Multi-Function Analog Output Terminal AM Bias	-999.9 to 999.9%	0.0%

Using Gain and Bias to Adjust Output Signal Level

When viewing a gain setting parameter (H4-02 or H4-05) on the HOA keypad, the analog output will supply a voltage signal equal to 100% of the monitor value (including changes made from bias and gain settings). When viewing a bias setting parameter (H4-03 or H4-06), the analog output voltage will supply a signal equal to 0% monitor value.

Example 1: Set H4-02 to 50% for an output signal of 5 V at terminal FM when the monitored value is at 100%.

Example 2: Set H4-02 to 150% for an output signal of 10 V at terminal FM when the monitored value is at 76.7%.

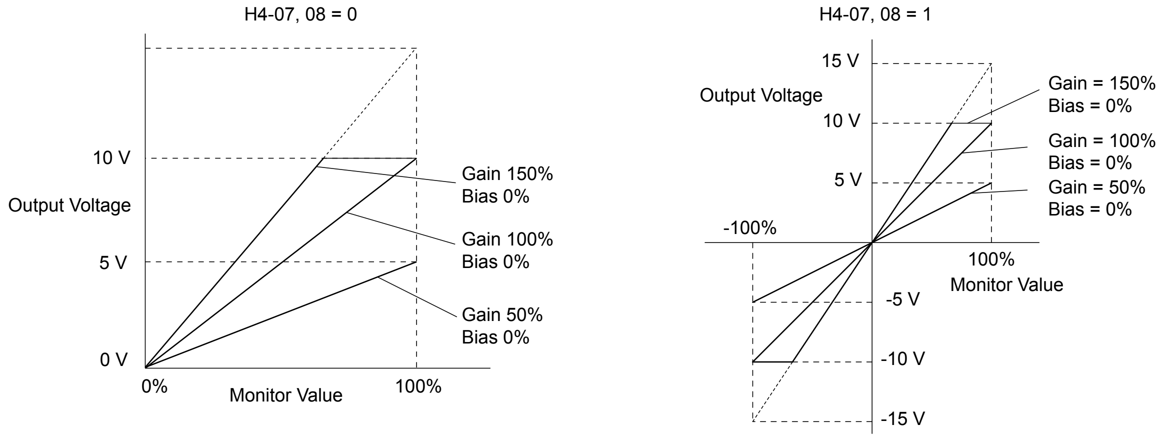

Figure 5.37 Analog Output Gain and Bias Setting Example 1 and 2

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

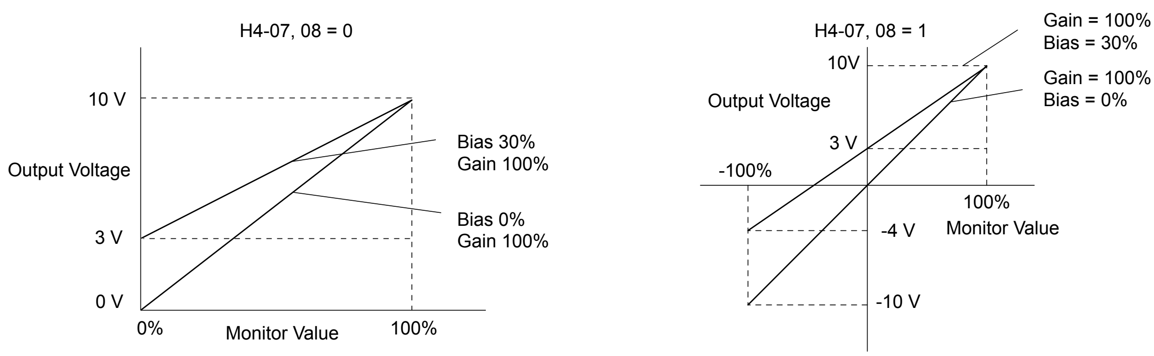

Figure 5.38 Analog Output Gain and Bias Setting Example 3

■ H4-07, H4-08: Multi-Function Analog Output Terminal FM, AM Signal Level Selection

Sets the voltage output level of U parameter (monitor parameter) data to terminal FM and terminal AM using parameters H4-07 and H4-08.

Set jumper S5 on the terminal board accordingly when changing these parameters.

No.	Name	Setting Range	Default
H4-07	Multi-Function Analog Output Terminal FM Signal Level Selection	0 to 2	0
H4-08	Multi-Function Analog Output Terminal AM Signal Level Selection	0 to 2	0

Setting 0: 0 to 10 V

Setting 1: -10 V to 10 V

Setting 2: 4 to 20 mA

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5.8 L: Protection Functions

◆ L1: Motor Protection

■ L1-01: Motor Overload Protection Selection

The drive has an electronic overload protection function that estimates the motor overload level based on output current, output frequency, thermal motor characteristics, and time. When the drive detects a motor overload an oL1 fault is triggered and the drive output shuts off.

L1-01 sets the overload protection function characteristics according to the motor being used.

No.	Name	Setting Range	Default
L1-01	Motor Overload Protection Selection	0, 1	1

Note:
1. When the motor protection function is enabled (L1-01≠ 0), an oL1 alarm can be output through one of the multi-function outputs by setting H2-01 to 1F. The output closes when the motor overload level reaches 90% of the oL1 detection level.
2. Set L1-01 to a value between 1 and 5 when running a single motor from the drive to select a method to protect the motor from overheat. An external thermal relay is not necessary.

Setting 0: Disabled (Motor Overload Protection Is not Provided)

Use this setting if no motor overheat protection is desired or if multiple motors are connected to a single drive. If multiple motors are connected to a single drive, install a thermal relay for each motor as shown in *Figure 5.39*.

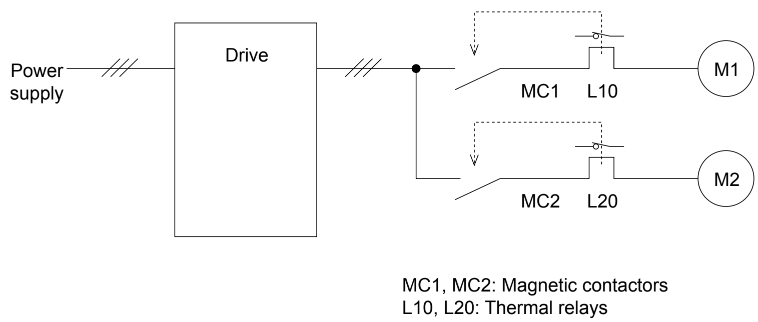


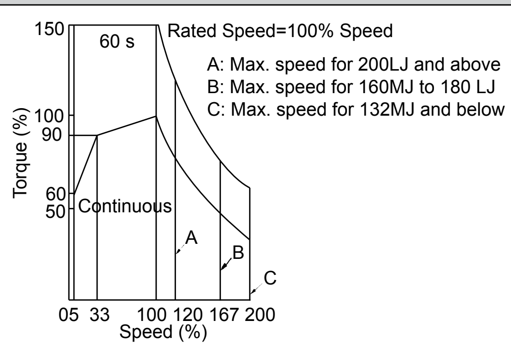
Figure 5.39 Example of Protection Circuit Design for Multiple Motors

NOTICE: *Thermal protection cannot be provided when running multi-motors simultaneously with the same drive, or when using motors with a relatively high current rating compared to other standard motors (such as a submersible motor). Failure to comply could result in motor damage. Disable the electronic overload protection of the drive (L1-01 = "0: Disabled") and protect each motor with individual motor thermal overloads.*

Note: Close MC1 and MC2 before operating the drive. MC1 and MC2 cannot be switched off during run.

Setting 1: General-Purpose Motor (Standard Self-Cooled)

Because the motor is self-cooled, the overload tolerance drops when the motor speed is lowered. The drive appropriately adjusts the electrothermal trigger point according to the motor overload characteristics, protecting the motor from overheat throughout the entire speed range.

Overload Tolerance	Cooling Ability	Overload Characteristics
	Motor designed to operate from line power. Motor cooling is most effective when running at rated base frequency (check the motor nameplate or specifications).	Continuous operation at less than line power frequency with 100% load can trigger motor overload protection (oL1). A fault is output and the motor will coast to stop.

■ L1-02: Motor Overload Protection Time

Sets the detection time of motor overheat due to overload. This setting rarely requires adjustment, but should correlate with the motor maximum load current protection time for performing a hot start.

No.	Name	Setting Range	Default
L1-02	Motor Overload Protection Time	0.1 to 50.0 minutes	1.0 minute

Defaulted to operate with an allowance of 150% overload operation for one minute in a hot start.

Figure 5.40 illustrates an example of the electrothermal protection operation time using a general-purpose motor operating at the value of E1-06, Motor Base Speed, with L1-02 set to one minute.

During normal operation, motor overload protection operates in the area between a cold start and a hot start.

- Cold start: Motor protection operation time in response to an overload situation that was suddenly reached when starting a stationary motor.
- Hot start: Motor protection operation time in response to an overload situation that occurred during sustained operation at rated current.

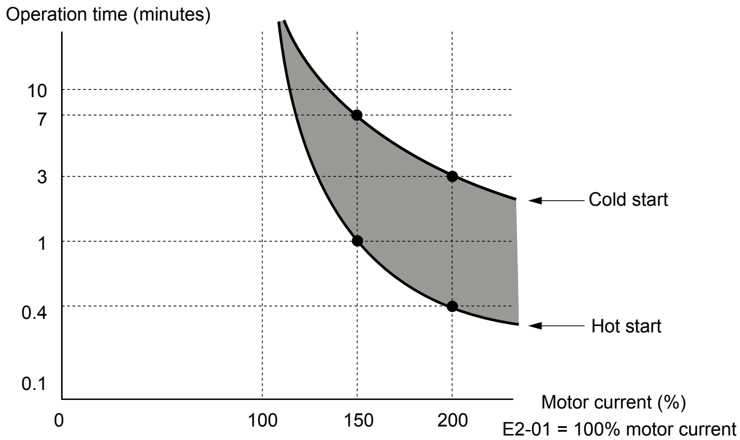


Figure 5.40 Motor Protection Operation Time

◆ L2: Momentary Power Loss Ride-Thru

■ L2-01: Momentary Power Loss Operation Selection

When a momentary power loss occurs (DC bus voltage falls below the level set in L2-05), the drive can automatically return to the operation it was performing prior to the power loss based on certain conditions.

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

Setting 0: Disabled

If power is not restored within 15 ms, a Uv1 fault will result and the motor coasts to stop.

Setting 1: Recover within L2-02

When a momentary power loss occurs, the drive output will be shut off. If the power returns within the time set to parameter L2-02, the drive will perform Speed Search and attempt to resume operation. If the power does not return within this time, it will trigger a Uv1 fault.

Note: L2-02 value is dependent on drive model selection and is not accessible.

Setting 2: Recover as long as CPU Has Power

When a momentary power loss occurs, the drive output will be shut off. If the power returns and the drive control circuit has power, the drive will attempt to perform Speed Search and resume the operation. This will not trigger a Uv1 fault.

Notes on Settings 1 and 2

“Uv” will flash on the operator while the drive is attempting to recover from a momentary power loss. A fault signal is not output at this time.

■ 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 (Momentary Power Loss Operation Selection = 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

■ L2-03: Momentary Power Loss Minimum Baseblock Time

Sets the minimum baseblock time when power is restored following a momentary power loss. This determines the time the drive waits for the residual voltage in the motor to dissipate. Increase this setting if overcurrent or overvoltage occurs at the beginning of Speed Search, after a power loss, or during DC Injection Braking.

No.	Name	Setting Range	Default
L2-03	Momentary Power Loss Minimum Baseblock Time	0.1 to 5.0 s	Determined by o2-04

◆ L3: Stall Prevention

The motor may experience excessive slip because it cannot keep up with the frequency reference when the load is too high or acceleration and deceleration times are too short. If the motor slips during acceleration, it usually causes an overcurrent fault (oC), drive overload (oL2), or motor overload (oL1). If the motor slips during deceleration, it can cause excessive regenerative power to flow back into the DC bus capacitors, and eventually cause the drive to fault out from overvoltage (ov). The Stall Prevention Function prevents the motor from stalling and while allowing the motor to reach the desired speed without requiring the user to change the acceleration or deceleration time settings. The Stall Prevention function can be set separately for acceleration, operating at constant speeds, and deceleration.

■ L3-02: Stall Prevention Level during Acceleration

Sets the output current level at which the Stall Prevention during acceleration is activated.

No.	Name	Setting Range	Default
L3-02	Stall Prevention Level during Acceleration	0 to 150% <1>	<1>

<1> The upper limit and default values are determined by parameter L8-38, Carrier Frequency Derating Selection.

- Lower L3-02 if stalling occurs when using a motor that is relatively small compared to the drive.
- Also set parameter L3-03 when operating the motor in the constant power range.

■ L3-03: Stall Prevention Limit during Acceleration

The Stall Prevention level is automatically reduced when the motor is operated in the constant power range. L3-03 sets the lower limit for this reduction as a percentage of the drive rated current.

No.	Name	Setting Range	Default
L3-03	Stall Prevention Limit during Acceleration	0 to 100%	50%

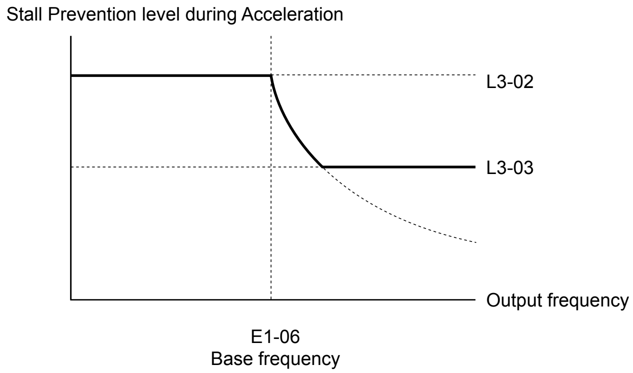


Figure 5.41 Stall Prevention Level and Limit During Acceleration

■ L3-04: Stall Prevention Selection during Deceleration

Stall prevention during deceleration prevents the motor from stalling when a large load is imposed on the motor or rapid deceleration is performed.

No.	Name	Setting Range	Default
L3-04	Stall Prevention Selection During Deceleration	0, 1, 4, 6	1

Setting 0: Disabled

The drive decelerates according to the set deceleration time. High inertia loads or rapid deceleration may trigger an overcurrent (oC) fault. Switch to another L3-04 selection if an oC fault occurs.

Setting 1: General-purpose Stall Prevention

The drive tries to decelerate within the set deceleration time. The drive pauses deceleration when the output current exceeds the Stall Prevention level and then continues deceleration when the output current drops below that level. Stall Prevention may be triggered repeatedly to avoid an overcurrent (oC) fault.

Figure 5.42 illustrates the function of Stall Prevention during deceleration.

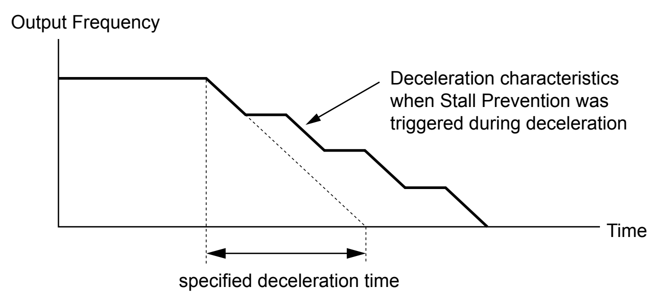


Figure 5.42 Stall Prevention During Deceleration

Setting 4: Overexcitation Deceleration

Overexcitation Deceleration (increasing the motor flux) is faster than deceleration with no Stall Prevention (L3-04 = 0). Setting 4 changes the selected decel time and functions to provide protection from an overvoltage trip.

Setting 6: Enable (Current Limit)

The deceleration rate is automatically adjusted during deceleration of the load while limiting the regeneration current at the setting value of the stall prevention level during deceleration (L3-14).

The stall prevention level may be reached if an external force is applied in the regeneration direction, dramatically decreasing the possibility of stopping the motor.

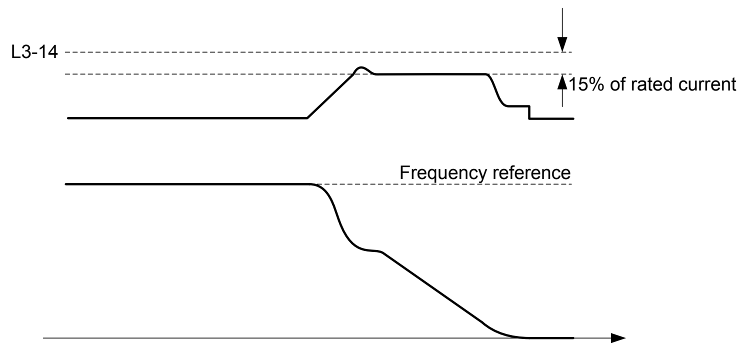


Figure 5.43 Deceleration for Current Limit

■ L3-06: Stall Prevention Level during Run

Sets the current level to trigger Stall Prevention during run. Depending on the setting of parameter L3-23, the level is automatically reduced in the constant power range (speed beyond base speed).

The Stall Prevention level can be adjusted using an analog input. *Refer to Multi-Function Analog Input Terminal Settings on page 146* for details.

No.	Name	Setting Range	Default
L3-06	Stall Prevention Level During Run	30 to 150 <1>	<1>

<1> The upper limit and default values are determined by parameter L8-38, Carrier Frequency Derating Selection.

◆ L4: Reference Detection

These parameters set up the Loss of Frequency Reference function.

■ L4-01, L4-02: Speed Agree Detection Level and Detection Width

Parameter L4-01 sets the detection level for the digital output functions Speed agree 1, User-set speed agree 1, Frequency detection 1, and Frequency detection 2.

Parameter L4-02 sets the hysteresis level for these functions.

No.	Name	Setting Range	Default
L4-01	Speed Agree Detection Level	0.0 to 400.0 Hz	0.0 Hz
L4-02	Speed Agree Detection Width	0.0 to 20.0 Hz	2.0 Hz

Refer to H2-01 to H2-03: Terminal M1-M2, M3-M4, and MD-ME-MF Function Selection on page 135, Settings 2, 3, 4, and 5.

■ L4-03, L4-04: Speed Agree Detection Level and Detection Width (+/-)

Parameter L4-03 sets the detection level for the digital output functions Speed agree 2, User-set speed agree 2, Frequency detection 3, and Frequency detection 4.

Parameter L4-04 sets the hysteresis level for these functions.

No.	Name	Setting Range	Default
L4-03	Speed Agree Detection Level (+/-)	-400.0 to 400.0 Hz	0.0 Hz
L4-04	Speed Agree Detection Width (+/-)	0.0 to 20.0 Hz	2.0 Hz

Refer to H2-01 to H2-03: Terminal M1-M2, M3-M4, and MD-ME-MF Function Selection on page 135, Settings 13, 14, 15, and 16.

■ L4-05: Frequency Reference Loss Detection Selection

The drive can detect a loss of an analog frequency reference from input A1, 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.

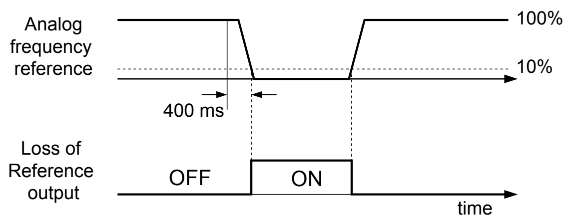


Figure 5.44 Loss of Reference Function

Set H2-01 or H2-02 to C for a digital output to trigger when frequency reference loss occurs. ***Refer to Setting C: Frequency Reference Loss on page 139*** for details on setting the output function.

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

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

Setting 0: Stop. Drive 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%

■ L4-07: Speed Agree Detection Selection

Determines when frequency detection is active using parameters L4-01 through L4-04.

No.	Name	Setting Range	Default
L4-07	Speed Agree Detection Selection	0, 1	0

Setting 0: No Detection during baseblock

Setting 1: Detection always enabled

◆ L5: Fault Restart

After a fault has occurred, Fault Restart attempts to automatically restart the motor and continue operation instead of stopping.

The drive can perform a self-diagnostic check and resume the operation after a fault has occurred. If the self-check is successful and the cause of the fault has disappeared, the drive restarts by first performing Speed Search (***Refer to b3: Speed Search on page 104*** for details).

Note:
1. The wiring sequence should remove the Forward/Reverse command when a fault is triggered and output is shut off.
2. When the Forward/Reverse command is removed, the drive can perform a self-diagnostic check and attempt to restart the fault automatically.

WARNING! *Sudden Movement Hazard. Do not use the fault restart function in lifting applications. Fault restart may cause the machine to drop the load, which could result in death or serious injury.*

The drive can attempt to restart itself following the faults listed below.

Fault	Name	Fault	Name
GF	Ground Fault	oL2	Drive Overload
LF	Output Open Phase	oL3	Overtorque 1
oC	Overcurrent	oL4	Overtorque 2
oH1	Drive Overheat	ov	DC Bus Overvoltage
oL1	Motor Overload	PF	Input Phase Loss

Fault	Name	Fault	Name
Uv1	Control Circuit Undervoltage <1>	STo	Pull-Out Detection

<1> When L2-01 is set to 0 through 2 (continue operation during momentary power loss).

Use parameters L5-01 to L5-05 to set up automatic fault restart.

Set H2-01, H2-02, or H2-03 to 1E. to output a signal during fault restart.

■ L5-01: Number of Auto Restart Attempts

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

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

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

The number of fault restarts is reset to zero when:

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

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

■ L5-02: Auto Restart Fault Output Operation Selection

Determines if a fault output is triggered (H2-☐☐ = E) when the drive attempts to restart.

No.	Name	Setting Range	Default
L5-02	Auto Restart Fault Output Operation Selection	0, 1	0

Setting 0: No Fault Output

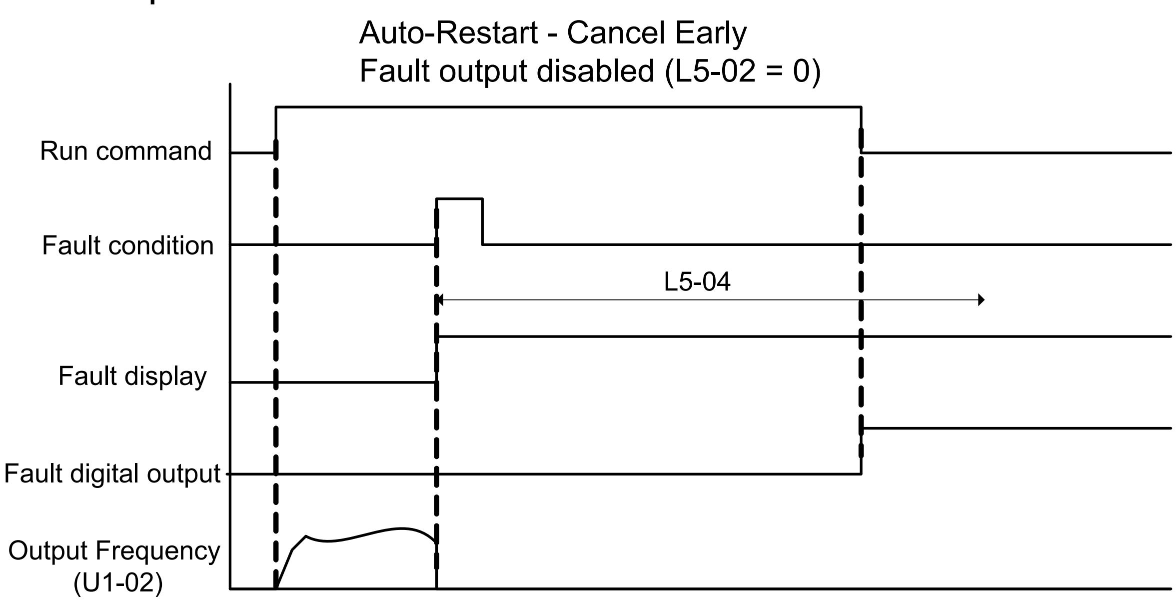


Figure 5.45 Auto Restart Cancel Early

Setting 1: Fault Output Is Set

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

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

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

No.	Name	Setting Range	Default
L5-03	Time to Continue Making Fault Restarts	0.00 to 600.0 s	180.0 s

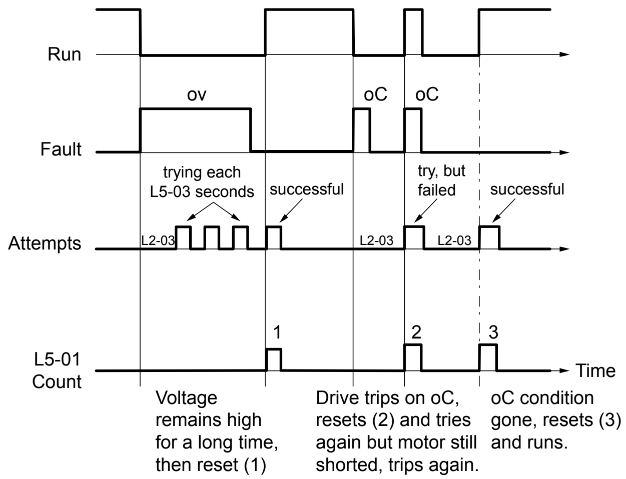


Figure 5.46 Automatic Restart Timing Diagram

The auto restart count is reset back to 0 if any of the following occur:

- No further faults for 10 minutes after the last retry.
- The drive power is turned off (the drive must be without power long enough to let control power dissipate).
- The RESET key is pushed after the last reset attempt.

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

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

The following faults will allow the Auto Restart function to initiate:

- oC (Overcurrent)
- LF (Output Phase Loss)
- PF (Input Phase Loss)
- oL1 (Motor Overload)
- oL3 (Overtorque Detection 1)
- oL2 (Drive Overload)
- ov (Overvoltage)
- GF (Ground Fault)
- Uv1 (Undervoltage)
- oH1 (Heatsink Overheat)

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

■ L5-04: Fault Reset Interval Time

Determines the amount of time to wait between restart attempts when parameter L5-05 is set to 1.

No.	Name	Setting Range	Default
L5-04	Fault Reset Interval Time	0.5 to 600.0 s	10.0 s

■ L5-05: Fault Reset Operation Selection

No.	Name	Setting Range	Default
L5-05	Fault Reset Operation Selection	0, 1	1

Setting 0: Count Successful Restarts

The drive will continuously attempt to restart. If it restarts successfully, the restart counter is increased. This operation is repeated each time a fault occurs until the counter reaches the value set to L5-01.

Setting 1: Count Restart Attempts

The drive will attempt to restart using the time interval set to parameter L5-04. A record is kept of the number of attempts to restart to the drive, regardless of whether those attempts were successful. When the number of attempted restarts exceeds the value set to L5-01, the drive stops attempting to restart.

◆ L6: Torque Detection

The drive provides two independent torque detection functions that trigger an alarm or fault signal when the load is too heavy (oL), or suddenly drops (UL). These functions are set up using the L6-☐☐ parameters. Program the digital outputs as shown below to indicate the underload or overload condition to an external device:

Note: When overtorque occurs in the application, the drive may stop due to overcurrent (oC) or overload (oL1). To prevent the drive from stopping, use torque detection to indicate an overload situation to the controller before oC or oL1 occur. Use undertorque detection to discover application problems like a torn belt, a pump shutting off, or other similar trouble.

H2-01, H2-02, H2-03 Setting	Description
B	Torque detection 1, N.O. (output closes when overload or underload is detected)
17	Torque detection 1, N.C. (output opens when overload or underload is detected)

Figure 5.47 and *Figure 5.48* illustrate the functions of overtorque and undertorque detection.

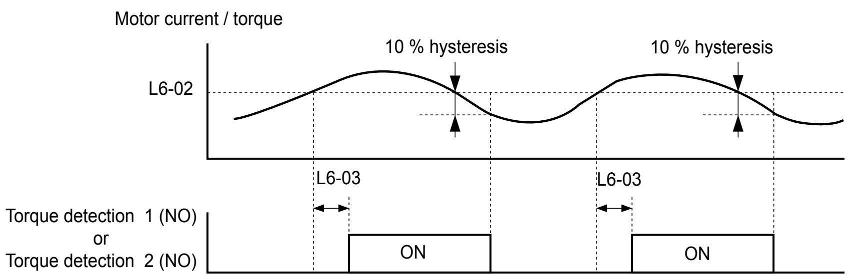


Figure 5.47 Overtorque Detection Operation

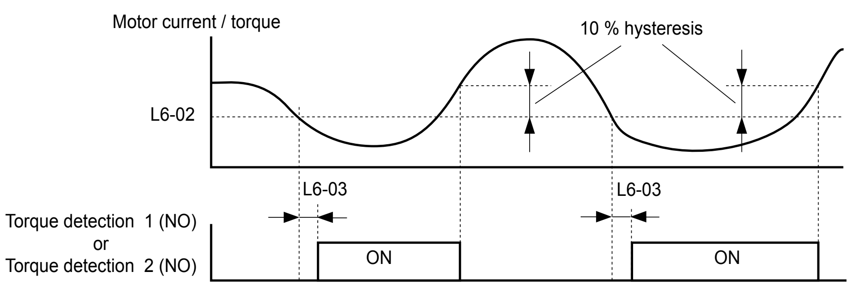


Figure 5.48 Undertorque Detection Operation

Note:
1. The torque detection function uses a hysteresis of 10% of the drive rated output current and motor rated torque.
2. The level is set as a percentage of the drive rated output current.

■ L6-01: Torque Detection Selection 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 8	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.

■ 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

■ L6-13: Motor Underload Protection Selection

Sets Motor Underload Protection (UL6) based on motor load and determines whether the level of L6-02 refers to fbase or fmax.

Selects the operation of underload detection UL6. Underload is detected when the output current falls below the underload detection level defined by L6-14 and L2-02.

No.	Name	Setting Range	Default
L6-13	Motor Underload Protection Selection	0, 1	0

Setting 0: Fbase Motor Load Enabled

Setting 1: Fmax Base Motor Load Enabled

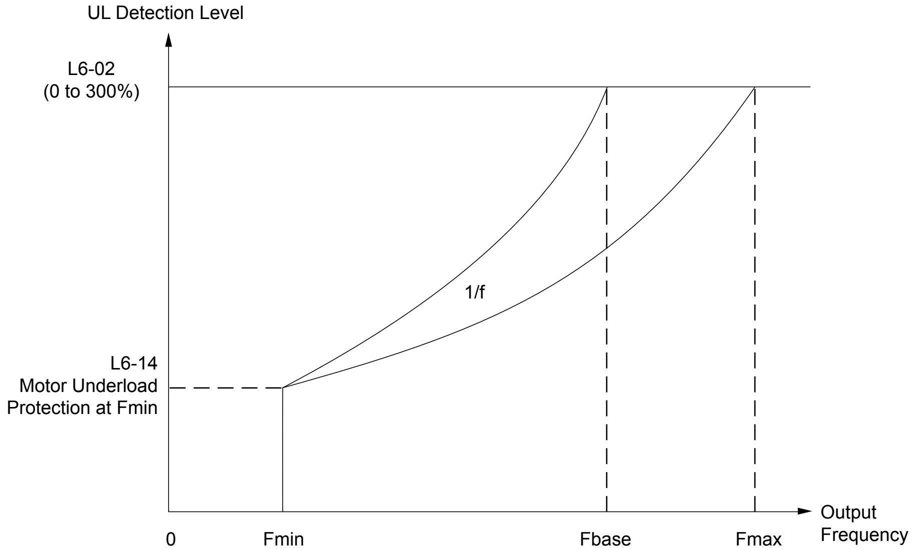


Figure 5.49 Motor Underload Protection

■ L6-14: Motor Underload Protection Level at Minimum Frequency

Sets the UL6 detection level at minimum frequency by percentage of drive rated current

No.	Name	Setting Range	Default
L6-14	Motor Underload Protection Level at Minimum Frequency	0 to 300%	15%

◆ L8: Drive Protection

■ L8-02: Overheat Alarm Level

Sets the overheat alarm (oH) detection level.

The drive outputs an alarm when the heatsink temperature exceeds the overheat alarm level. If the drive is set to continue operation after this alarm occurs (L8-03 = 4) and the temperature reaches the overheat fault level, the drive will trigger an oH1 fault and stop operation.

When an output is set for the oH pre-alarm (H2-□□ = 20), the switch closes when the heatsink temperature rises above L8-02.

No.	Name	Setting Range	Default
L8-02	Overheat Alarm Level	50 to 150 °C	Det. by o2-04

■ L8-05: Input Phase Loss Protection Selection

Enables or disables the input phase loss detection.

No.	Name	Setting Range	Default
L8-05	Input Phase Loss Protection Selection	0, 1	1

Setting 0: Disabled

Setting 1: Enabled

Enables input phase loss detection. Since measuring the DC bus ripple detects input phase loss, a power supply voltage imbalance or main circuit capacitor deterioration may also trigger a phase loss fault (PF).

Detection is disabled if:

- The drive is decelerating.
- No Run command is active.
- Output current is less than or equal to 30% of the drive rated current.

■ L8-06: Input Phase Loss Detection Level

Sets the Input Phase Loss Detection (PF) Level.

Triggers PF fault when there is an imbalance larger than the value set to L8-06 in the drive input power voltage.

Detection Level = 100% = Voltage Class × $\sqrt{2}$

No.	Name	Setting Range	Default
L8-06	Input Phase Loss Detection Level	0.0 to 50.0%	Det. by o2-04

■ L8-07: Output Phase Loss Protection Selection

Enables or disables the output phase loss detection triggered when the output current falls below 5% of the drive rated current.

Note: Output phase loss detection may mistakenly trigger if the motor rated current is very small compared to drive rating. Disable L8-07 in such cases.

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 and the motor coasts to stop when one output phase is lost.

Setting 2: Fault when Two Phases Are Lost

An output phase loss fault (LF) is triggered and the motor coasts to stop when two or more output phases are lost.

■ 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.

■ L8-38: Carrier Frequency Reduction Selection

Selects 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, 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	Det. by 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.

5.9 n: Special Adjustments

These parameters control a variety of specialized adjustments and functions, including Hunting Prevention and High Slip Braking.

◆ n1: Hunting Prevention

Hunting Prevention prevents the drive from hunting as a result of low inertia and operating with light load. Hunting often occurs with a high carrier frequency and an output frequency below 30 Hz.

■ n1-01: Hunting Prevention Selection

Enables and disables the Hunting Prevention function.

Note: Disable Hunting Prevention when drive response is more important than suppressing motor oscillation. This function may be disabled without problems in applications with high inertia loads or relatively heavy loads.

No.	Name	Setting Range	Default
n1-01	Hunting Prevention Selection	0, 1	1

Setting 0: Disabled

Setting 1: Enabled

■ n1-02: Hunting Prevention Gain Setting

Sets the gain for the Hunting Prevention Function.

No.	Name	Setting Range	Default
n1-02	Hunting Prevention Gain Setting	0.00 to 2.50	1.00

Although this parameter rarely needs to be changed, it may require adjustment in the following situations:

- If the motor vibrates while lightly loaded and n1-01 = 1, increase the gain by 0.1 until vibration ceases.
- If the motor stalls while n1-01 = 1, decrease the gain by 0.1 until the stalling ceases.

◆ n3: Overexcitation Braking

■ n3-13: Overexcitation Deceleration Gain

Multiplies a gain to the V/f pattern output value during Overexcitation Deceleration to determine the level of overexcitation. The drive returns to the normal V/f value after the motor has stopped or when it is accelerating to the frequency reference.

No.	Name	Setting Range	Default
n3-13	Overexcitation Deceleration Gain	1.00 to 2.00	1.10

The optimum setting for n3-13 depends on the motor flux saturation characteristics.

- Gradually increase the gain to improve the braking power of Overexcitation Deceleration.
- Lower n3-13 when flux saturation characteristics cause overcurrent. A high setting sometimes causes overcurrent (oC), motor overload (oL1), or drive overload (oL2).

5.10 o: Operator-Related Settings

These parameters control the various functions, features, and display of the HOA keypad.

◆ o1: HOA Keypad Display Selection

These parameters determine the data display on the HOA keypad.

■ o1-01: Drive Mode Unit Monitor Selection

The frequency reference display appears when the drive is powered up. Pressing the up arrow key will display the following data: frequency reference → rotational direction → output frequency → output current → o1-01 selection.

Parameter o1-01 selects the content of the last monitor in this sequence.

No.	Name	Setting Range	Default
o1-01	Drive Mode Unit Monitor Selection	104 to 699 U1-04 (Control Mode) to U6-99 (Option Monitors 20) <1>	106 (U1-06)

<1> U2-☐☐ and U3-☐☐ parameters cannot be selected.

Note: Available for bypass control software versions VST800401 and later.

■ o1-02: User Monitor Selection after Power Up

Selects which monitor parameter is displayed upon power up by entering the 1- ☐☐ part of U1-☐☐. Certain monitors are not available in some control modes. ***Refer to U: Monitor Parameters on page 175*** for a list of monitors.

No.	Name	Setting Range	Default
o1-02	User Monitor Selection after Power Up	1 to 5	1

Setting 1: Frequency Reference (U1-01)

Setting 2: Motor Direction

Setting 3: Output Frequency (U1-02)

Setting 4: Output Current (U1-03)

Setting 5: User Monitor

The monitor value selected by o1-01 will be displayed.

Note: Available for bypass control software versions VST800401 and later.

■ 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.

■ 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

◆ o2: HOA Keypad Functions

These parameters determine the functions assigned to the operator keys.

■ o2-04: Drive Model Selection

Set this parameter when replacing the control board or the terminal board. *Refer to Defaults by Drive Model on page 329* for information on drive model selection.

NOTICE: *Drive performance will suffer and protective functions will not operate properly if the correct drive capacity is not set to o2-04.*

No.	Name	Setting Range	Default
o2-04	Drive Model Selection	-	Determined by drive capacity

Note: Change o2-04 setting only when necessary.

◆ o4: Maintenance Monitor Settings

■ 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

■ o4-11: U2-□□, U3-□□, and UB-09 to UB-16 Initialization

Resets the drive and bypass fault trace and fault history monitors.

Note: Initializing the drive using A1-03 does not reset these monitors.

No.	Name	Setting Range	Default
o4-11	U2, U3, and UB-09 to UB-16 Initialization	0, 1	0

Setting 0: No Action

The drive and bypass keep the previously saved record concerning fault trace and fault history.

Setting 1: Reset Fault Data

Resets the data for the U2-□□, U3-□□, and UB-09 to UB-16 monitors. Setting o4-11 to 1 and pressing the ENTER key erases fault data in the bypass and drive and returns the display to 0.

■ o4-19: Power Unit Price

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).

No.	Name	Setting Range	Default
o4-19	Power Unit Price	0.00 to 650.00	000.00

5.11 S: Special Parameters

◆ S1: Dynamic Audible Noise Control Function

The Dynamic Audible Noise Control Function reduces audible noise by suppressing the output voltage.

This function is available when using V/f Control mode and can help to quickly restore output voltage after an impact has caused a sudden increase in the time constant. Dynamic Audible Noise Control is useful in applications where load impact is common.

Procedure

1. Set S1-01 to 1 to enable Dynamic Audible Noise Control.

Note:
1. When S1-01 is set to 1, the tolerance to impact loading is reduced when compared to V/f Control (without Energy Saving).
2. Disable Dynamic Audible Noise Control for applications without an impact load.

2. Responsiveness is increased because the addition of a load causes the level of the current to rise.

   Increase the value of S1-02. The flux will become stronger and the torque will rise, but load movement will be minimized by the Dynamic Audible Noise Control function.

   Set S1-03 and S1-04 to a small value. Voltage is recovered quicker during impact load conditions. Under certain conditions voltage stability may become poor.

   Lower the value of S1-05. The voltage level will drop and speed up voltage restoration when the load is increased.
3. Increase the value of S1-03 to increase the effectiveness of Dynamic Audible Noise Control if the output voltage remains high.
4. Decrease the value of S1-06 to increase drive response to an impact load.
5. When the output voltage is unstable, increase the difference between S1-03 and S1-04 and increase S1-05 and S1-06 to slow the load response.

■ S1-01: Dynamic Audible Noise Control Selection

Reduces audible noise by decreasing the output voltage in variable torque applications with light loads.

No.	Name	Setting Range	Default
S1-01	Dynamic Audible Noise Control Selection	0 or 1	1

Setting 0: Disabled

Setting 1: Enabled

■ S1-02: Voltage Reduction Rate

Sets the rate at which the output voltage will be reduced as a percentage of the V/f pattern when operating with no load.

No.	Name	Setting Range	Default
S1-02	Voltage Reduction Rate	50.0 to 100.0%	50.0%

■ S1-03: Voltage Restoration Level

Sets the level when the drive should start restoring the voltage as a percentage of the drive rated torque.

The voltage is reduced when the torque output has decreased to the level set in S1-03.

The method used to reduce the voltage level is selected in accordance with the characteristics of the voltage reduction rate defined by the S1-03 and S1-04 settings.

Note: Setting S1-04 to a value less than that of S1-03 + 10.0 will trigger an oPE02 error.

No.	Name	Setting Range	Default
S1-03	Voltage Restoration Level	0.0 to 90.0%	20.0%

■ S1-04: Voltage Restoration Complete Level

Sets the level at which voltage restoration for the V/f pattern is complete as a percentage of the drive rated torque. If the output torque rises above the value of S1-04, then the voltage will be controlled in a manner specified by the V/f pattern setting.

Note: Setting S1-04 to a value less than that of S1-03 + 10.0 will trigger an oPE02 error.

No.	Name	Setting Range	Default
S1-04	Voltage Restoration Complete Level	S1-03 + 10.0 to 100.0%	50.0%

■ S1-05: Voltage Restoration Sensitivity Time Constant

Sets the level of sensitivity of the output torque as well as that of the LPF time constant for the voltage reduction rate. The level of sensitivity can be adjusted in accordance with the load response.

The LPF time constant is used to calculate the value of the output torque sensitivity time constant.

The voltage reduction rate is based on the torque output. Select LPF to prevent voltage fluctuation.

The Dynamic Audible Noise Control Function outputs the rate of voltage reduction as a percentage within the allowable range (Max: 100%, Min: S1-02 value).

No.	Name	Setting Range	Default
S1-05	Voltage Restoration Sensitivity Time Constant	0.000 to 3.000 s	1.000 s

■ S1-06: Voltage Restoration Time Constant at Impact

Sets the voltage restoration time constant if an impact load is added.

Sets the time constant that enables the voltage level to rise if the speed suddenly changes upon impact.

No.	Name	Setting Range	Default
S1-06	Voltage Restoration Time Constant at Impact	0.000 to 1.000 s	0.050 s

◆ S2: Sequence Timers

■ Programmable Run Timers for Real Time Clock (RTC)

Programmable run timers allow the drive to start and stop automatically at specified times. The timers can be configured to run daily, on weekdays, on weekends, or only on specific days of the week.

Sequence Timer 1

When the current time reaches the value set in parameter S2-01 (Sequence Timer 1 Start Time), the drive will execute the action set in parameter S2-04 (Sequence Timer 1 Selection), provided the current day is selected via S2-03 (Sequence Timer 1 Day Selection). The drive will stop executing the S2-04 action when the S2-02 (Sequence Timer 1 Stop Time) is reached.

When S2-04 = 0 or the Disable Sequence Timers multi-function input (H1-□□= 50) is closed, Sequence Timer 1 has no effect on the drive Run command. The drive runs normally based on the status of the selected run source (b1-02). If S2-04 = 1 or 2 and the Disable Sequence Timers input is open, the drive will run during the Sequence Timer 1 active time, provided the drive has a valid Run command. The frequency reference that is used is set by S2-05 (Sequence Timer 1 Reference Source). When S2-04 = 2, PID control is disabled.

If the Cancel Active Sequence Timer multi-function input (H1-□□ = 51) transitions from open to closed while Sequence Timer 1 is active, the timer will be disabled until the next scheduled sequence timer occurrence. Sequence Timer 1 can be re-enabled by cycling the drive Run command. The Sequence Timer 1 multi-function output (H2-□□ = 50) will close while Sequence Timer 1 is active regardless of the S2-04 selection.

When S2-01 = S2-02, Sequence Timer 1 is active continuously for the days selected in S2-03. The timer will start at the S2-01/ S2-02 time on the first day and stop at the same time on the last day. If only one day is selected in S2-03, the timer will stop at 11:59 on that day.

When S2-04 = 1 or 2, Sequence Timer 1 is active and the drive is running, the HOA Keypad will display “Sequence Timer 1 RUN”. When the drive has a run command, S2-04 = 1 or 2 and Sequence Timer 1 is not active, the HOA Keypad will display “Sequence Timer OFF”.

When the drive has a run command, S2-04 = 1 or 2 and Sequence Timer 1 is not active, the drive should not fault on undervoltage or overvoltage conditions (should be Alarm only).

Sequence Timers 2 to 4

These timers operate identically to Sequence Timer 1. Parameters S2-06 to S2-20 configure Sequence Timers 2 to 4.

Priority

If multiple sequence timers overlap, the timer with the lowest number has priority.

Sequence Timer 1 = highest priority

Sequence Timer 4 = lowest priority

■ S2-01/S2-06/S2-11/S2-16: Sequence Timers 1 to 4 Start Time

Sets the start times for timers 1 to 4.

If the Stop Time is set to a higher value than the Start Time, the Sequence Timers will be active starting from the set Start Time, run through midnight, and stop the following day at the set Stop Time.

Note: Setting the sequence timer start time to a higher value than the sequence timer stop time disables that sequence timer in drive software versions PRG: 8551 and earlier.

No.	Name	Setting Range	Default
S2-01	Sequence Timer 1 Start Time	12:00AM to 11:59PM <1>	12:00AM <1>
S2-06	Sequence Timer 2 Start Time	12:00AM to 11:59PM <1>	12:00AM <1>
S2-11	Sequence Timer 3 Start Time	12:00AM to 11:59PM <1>	12:00AM <1>
S2-16	Sequence Timer 4 Start Time	12:00AM to 11:59PM <1>	12:00AM <1>

<1> Default is 00:00 and range is 00:00 to 24:00 when o4-20 is set to 1 (24-hour).

■ S2-02/S2-07/S2-12/S2-17: Sequence Timers 1 to 4 Stop Time

Sets the stop times for timers 1 to 4. The values must be set greater than or equal to S2-01/S2-06/S2-11/S2-16.

No.	Name	Setting Range	Default
S2-02	Sequence Timer 1 Stop Time	00:00 to 24:00	00:00
S2-07	Sequence Timer 2 Stop Time	00:00 to 24:00	00:00
S2-12	Sequence Timer 3 Stop Time	00:00 to 24:00	00:00
S2-17	Sequence Timer 4 Stop Time	00:00 to 24:00	00:00

■ S2-03/S2-08/S2-13/S2-18: Sequence Timers 1 to 4 Day Selection

Sets the days for which sequence timers 1 to 4 are active.

No.	Name	Setting Range	Default
S2-03	Sequence Timer 1 Day Selection	0 to 10	0
S2-08	Sequence Timer 2 Day Selection	0 to 10	0
S2-13	Sequence Timer 3 Day Selection	0 to 10	0
S2-18	Sequence Timer 4 Day Selection	0 to 10	0

Setting 0: Timer Disabled

Setting 1: Daily

Setting 2: Mon - Fri

Setting 3: Sat - Sun

Setting 4: Monday

Setting 5: Tuesday

Setting 6: Wednesday

Setting 7: Thursday

Setting 8: Friday

Setting 9: Saturday

Setting 10: Sunday

■ S2-04/S2-09/S2-14/S2-19: Sequence Timers 1/2/3/4 Selection

Sets the action that occurs when sequence timers 1 to 4 are active.

No.	Name	Setting Range	Default
S2-04	Sequence Timer 1 Selection	0 to 2	0
S2-09	Sequence Timer 2 Selection	0 to 2	0
S2-14	Sequence Timer 3 Selection	0 to 2	0
S2-19	Sequence Timer 4 Selection	0 to 2	0

Setting 0: Digital Output Only

Setting 1: Run

Setting 2: Run - PID Disable

■ S2-05/S2-10/S2-15/S2-20: Sequence Timers 1/2/3/4 Reference Source

Selects the frequency reference source used for running the drive when sequence timers 1 to 4 are active (only applicable when S2-04/S2-09/S2-14/S2-19 are set to 1 or 2).

No.	Name	Setting Range	Default
S2-05	Sequence Timer 1 Reference Source	0 to 5	0
S2-10	Sequence Timer 2 Reference Source	0 to 5	0
S2-15	Sequence Timer 3 Reference Source	0 to 5	0
S2-20	Sequence Timer 4 Reference Source	0 to 5	0

Setting 0: Operator (d1-01)

Setting 1: Operator (d1-02)

Setting 2: Operator (d1-03)

Setting 3: Operator (d1-04)

Setting 4: Terminals

Setting 5: Serial Communication

◆ Examples of Sequence Timers

■ Sequence Timer Example 1

Set the parameters as shown in *Table 5.24* to accomplish the timer sequencing in *Figure 5.50*.

Table 5.24 Sequence Timer Example 1 Parameter Settings

No.	Name	Setting	Comment
S2-01	Sequence Timer 1 Start Time	05:00	
S2-02	Sequence Timer 1 Stop Time	15:00	
S2-03	Sequence Timer 1 Day Selection	2	Mon to Fri
S2-04	Sequence Timer 1 Selection	1	Run
S2-05	Sequence Timer 1 Reference Source	0	Operator (d1-01)
S2-06	Sequence Timer 2 Start Time	19:00	
S2-07	Sequence Timer 2 Stop Time	22:00	
S2-08	Sequence Timer 2 Day Selection	2	Mon to Fri
S2-09	Sequence Timer 2 Selection	2	Run PID Disable
S2-10	Sequence Timer 2 Reference Source	1	Operator (d1-02)
S2-11	Sequence Timer 3 Start Time	06:00	
S2-12	Sequence Timer 3 Stop Time	14:00	
S2-13	Sequence Timer 3 Day Selection	3	Sat to Sun
S2-14	Sequence Timer 3 Selection	1	Run
S2-15	Sequence Timer 3 Reference Source	2	Operator (d1-03)
S2-16	Sequence Timer 4 Start Time	17:00	
S2-17	Sequence Timer 4 Stop Time	21:00	
S2-18	Sequence Timer 4 Day Selection	10	Sun
S2-19	Sequence Timer 4 Selection	0	Digital Output Only
S2-20	Sequence Timer 4 Reference Source	0	n/a

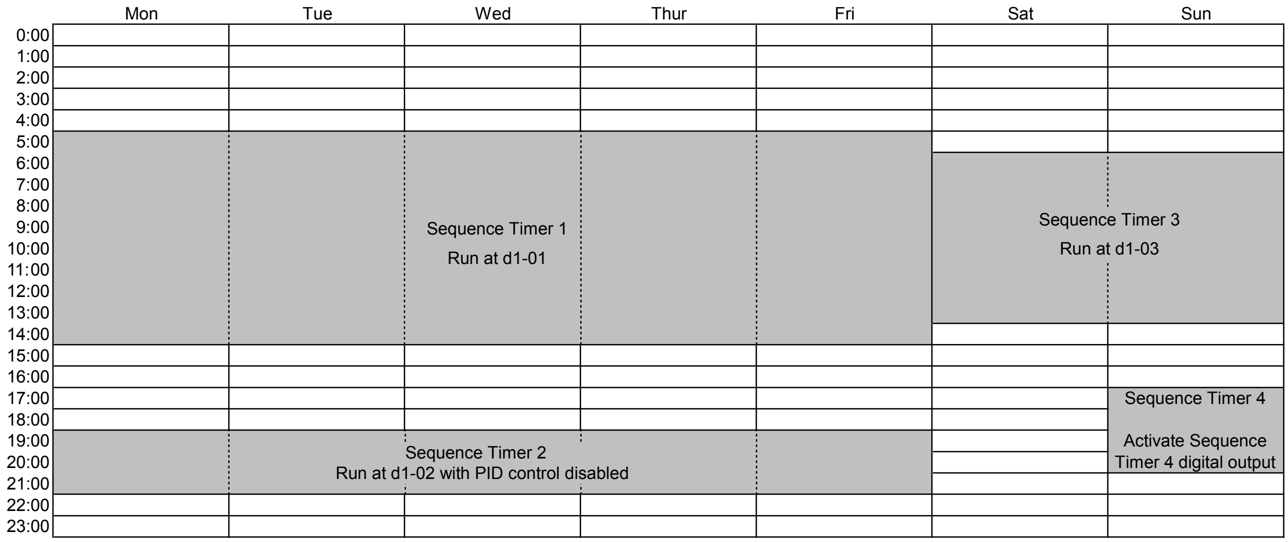


Figure 5.50 Sequence Timer Example 1

■ Sequence Timer Example 2

Set the parameters as shown in *Table 5.25* to accomplish the timer sequencing in *Figure 5.51*.

Table 5.25 Sequence Timer Example 2 Parameter Settings

No.	Name	Setting	Comment
S2-01	Sequence Timer 1 Start Time	00:00	
S2-02	Sequence Timer 1 Stop Time	24:00	
S2-03	Sequence Timer 1 Day Selection	2	Mon to Fri
S2-04	Sequence Timer 1 Selection	1	Run
S2-05	Sequence Timer 1 Reference Source	0	Operator (d1-01)
S2-06	Sequence Timer 2 Start Time	06:00	
S2-07	Sequence Timer 2 Stop Time	06:00	
S2-08	Sequence Timer 2 Day Selection	3	Sat to Sun
S2-09	Sequence Timer 2 Selection	1	Run
S2-10	Sequence Timer 2 Reference Source	2	Operator (d1-03)
S2-11	Sequence Timer 3 Start Time	0:00	n/a
S2-12	Sequence Timer 3 Stop Time	0:00	n/a
S2-13	Sequence Timer 3 Day Selection	0	Timer Disabled
S2-14	Sequence Timer 3 Selection	0	n/a
S2-15	Sequence Timer 3 Reference Source	0	n/a
S2-16	Sequence Timer 4 Start Time	00:00	n/a
S2-17	Sequence Timer 4 Stop Time	00:00	n/a
S2-18	Sequence Timer 4 Day Selection	0	Timer Disabled
S2-19	Sequence Timer 4 Selection	0	n/a
S2-20	Sequence Timer 4 Reference Source	0	n/a

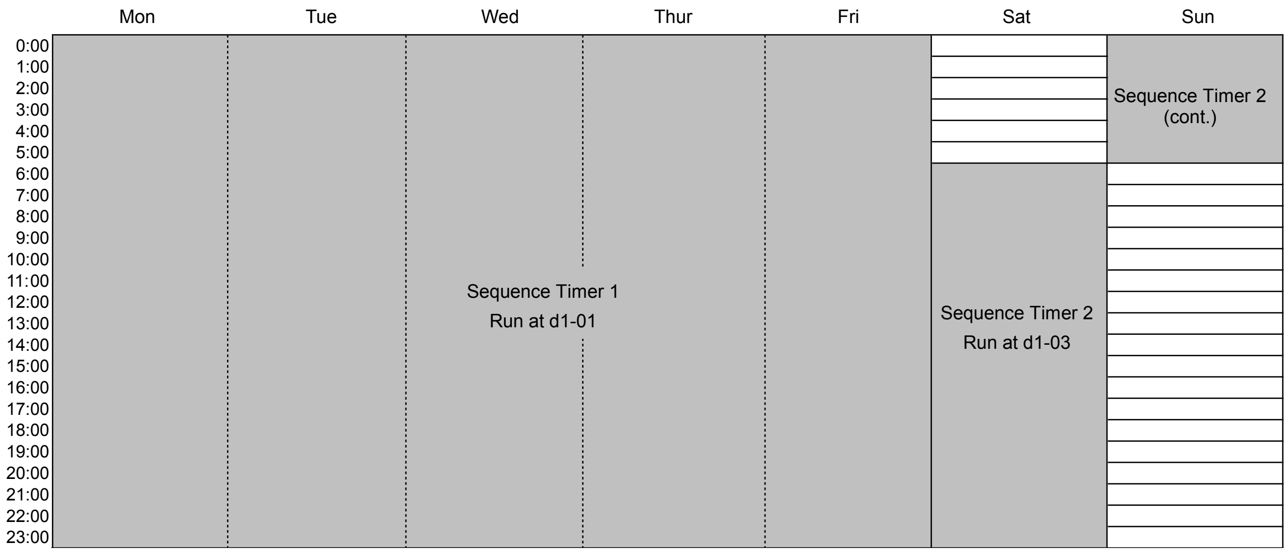


Figure 5.51 Sequence Timer Example 2

■ Sequence Timer Example 3

Set the parameters as shown in *Table 5.26* to accomplish the timer sequencing in *Figure 5.52*.

Table 5.26 Sequence Timer Example 3 Parameter Settings

No.	Name	Setting	Comment
S2-01	Sequence Timer 1 Start Time	05:00	
S2-02	Sequence Timer 1 Stop Time	15:00	
S2-03	Sequence Timer 1 Day Selection	2	Mon to Fri
S2-04	Sequence Timer 1 Selection	1	Run
S2-05	Sequence Timer 1 Reference Source	0	Operator (d1-01)
S2-06	Sequence Timer 2 Start Time	15:00	
S2-07	Sequence Timer 2 Stop Time	22:00	
S2-08	Sequence Timer 2 Day Selection	2	Mon to Fri
S2-09	Sequence Timer 2 Selection	2	Run PID Disable
S2-10	Sequence Timer 2 Reference Source	1	Operator (d1-02)
S2-11	Sequence Timer 3 Start Time	09:00	
S2-12	Sequence Timer 3 Stop Time	24:00	
S2-13	Sequence Timer 3 Day Selection	9	Sat
S2-14	Sequence Timer 3 Selection	1	Run
S2-15	Sequence Timer 3 Reference Source	2	Operator (d1-03)
S2-16	Sequence Timer 4 Start Time	0:00	n/a
S2-17	Sequence Timer 4 Stop Time	0:00	n/a
S2-18	Sequence Timer 4 Day Selection	0	Timer Disabled
S2-19	Sequence Timer 4 Selection	0	n/a
S2-20	Sequence Timer 4 Reference Source	0	n/a

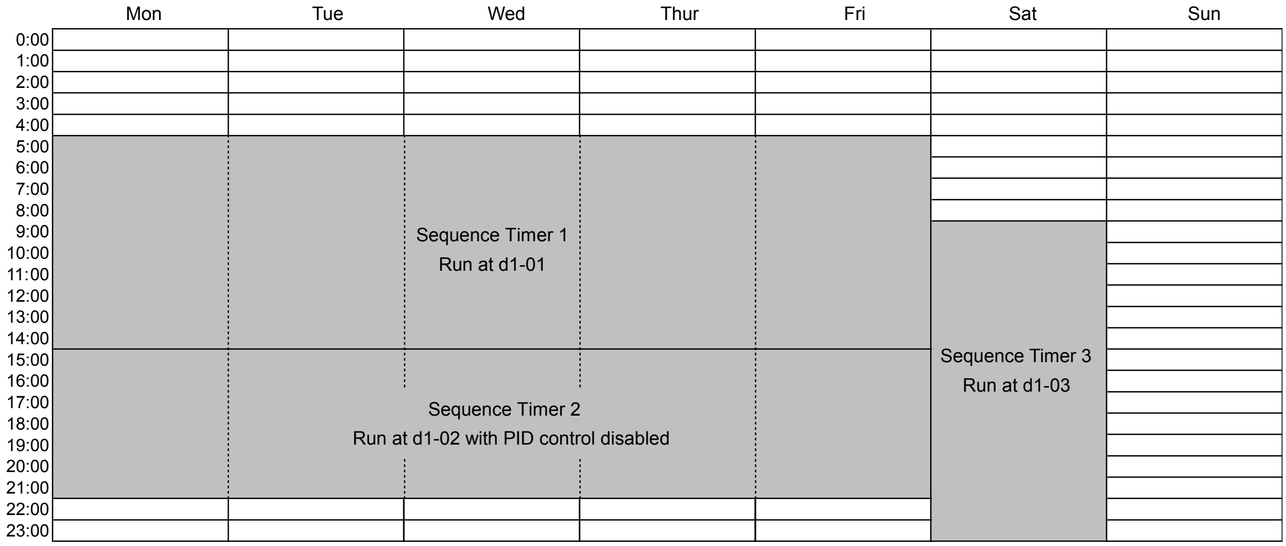


Figure 5.52 Sequence Timer Example 3

5.12 T: Motor Tuning

Auto-Tuning automatically sets and tunes parameters required for optimal motor performance.

Refer to T: Motor Tuning on page 310 for a list of T parameters in the bypass.

5.13 U: Monitor Parameters

Monitor parameters let the user view various aspects of drive performance using the HOA keypad display. Some monitors can be output from terminals FM and AM by assigning the specific monitor parameter number (U□-□□) to H4-01 and H4-04. *Refer to H4-01, H4-04: Multi-Function Analog Output Terminal FM, AM Monitor Selection on page 148* for details on assigning functions to an analog output.

◆ UB: Bypass Monitors

These monitors display various aspects of bypass control. *Refer to UB: Bypass Control Monitors on page 311* for a complete list of UB-□□ monitors and descriptions.

◆ 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 312* 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 314* for a complete list of U2-□□ monitors and descriptions.

U2-□□ monitors are not reset when the drive is initialized.

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 315* for a complete list of U3-□□ monitors and descriptions.

U3-□□ monitors are not reset when the drive is initialized.

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 317 for a complete list of U4-□□ monitors and descriptions.

◆ U5: PID Monitors

These monitors display various aspects of PID control. *Refer to PID Block Diagram on page 113* for details on how these monitors display PID data.

Refer to U5: PID Monitors on page 318 for a complete list of U5-□□ 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 319* for a complete list of U9-□□ monitors and descriptions.

5.14 Z: Bypass Parameters

Z parameters control bypass-specific functions.

◆ Z1: Bypass Control System

■ Z1-01: Initialize

Sets parameters to default values.

No.	Name	Setting Range	Default
Z1-01	Initialize	0 to 3	0

Setting 0: No Initialize

Setting 1: Set all parameters to default values

Setting 2: Set only Bypass Controller parameters to default values

Setting 3: Set only Drive Controller parameters to default values

■ Z1-02: Password

Allows and restricts access to all parameters. Setting this value equal to the value in Z1-03 toggles access to all parameter settings, except Z1-02. If the value entered to Z1-02 matches the value entered to Z1-03, the access to all parameters is denied or granted.

No.	Name	Setting Range	Default
Z1-02	Password	–	–

■ Z1-03: Password Change

The value entered to this parameter is the password.

No.	Name	Setting Range	Default
Z1-03	Password Change	0 to 9999	0

■ Z1-05: Auto Transfer to Bypass Upon Drive Fault

Switches operation to Bypass mode when the drive is running and a drive fault occurs. When the fault is cleared, operation will switch back to Drive mode

No.	Name	Setting Range	Default
Z1-05	Auto Transfer to Bypass Upon Drive Fault	0, 1	0

Setting 0: Disable

Setting 1: Enable

■ Z1-06: Power-Up Mode

Determines the mode of the Bypass Control upon power-up.

No.	Name	Setting Range	Default
Z1-06	Power-Up Mode	0 to 4	0

Setting 0: OFF

When drive powers up , it will be in “OFF” mode and will need an “AUTO” or “HAND” command to run.

Setting 1: AUTO-DRIVE

When drive powers up , the drive will get an “AUTO” command and needs an “OFF” command to stop.

Setting 2: HAND-DRIVE

When drive powers up , the drive will get a "HAND” command and needs an “OFF” command to stop.

Setting 3: AUTO-BYPASS

When drive powers up , the bypass will get an “AUTO” command and needs an “OFF” command to stop.

Setting 4: HAND-BYPASS

When drive powers up , the bypass will get a "HAND" command and needs an "OFF" command to stop.

■ Z1-07: Speed Reference Select

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.	Name	Setting Range	Default
Z1-07	Speed Reference Select	0 to 3	1

Setting 0: HOA Keypad

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

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

Setting 1: Terminals (analog input terminals)

Using this setting, an analog frequency reference can be entered as a voltage or current signal from terminals A1, 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 5.27* for the input used.

Table 5.27 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				

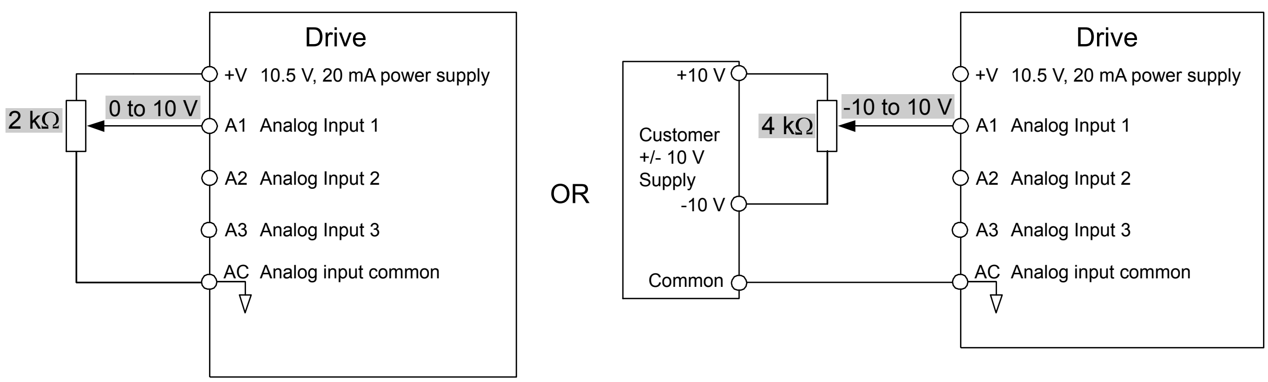


Figure 5.53 Setting the Frequency Reference as a Voltage Signal at Terminal A1

Current Input

Input terminals, A1, A2, and A3 can accept a current input signal. Refer to *Table 5.28* for an example to set terminal A2 for current input.

Table 5.28 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				

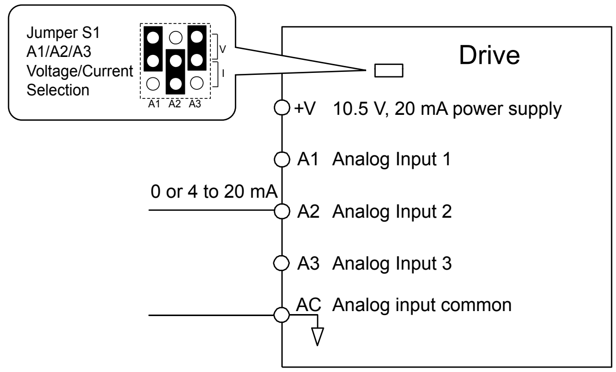


Figure 5.54 Setting the Frequency Reference as a Current Signal to Terminal A2

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 124*** for details on using this function.

Setting 2: BACnet, MEMOBUS/Modbus, P1, or N2 Communications

This setting requires entering the frequency reference via the RS-485 serial communications port (control terminals TXRX+ and TXRX-).

Setting 3: Option Card

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

■ Z1-08: Run Command Select

Determines the source of the Auto Mode RUN command used by the Bypass Controller.

No.	Name	Setting Range	Default
Z1-08	Run Command Select	1 to 3	1

Setting 0: HOA Keypad

Setting 1: Bypass Controller Digital Input

This setting requires entering the Run command via the digital input terminals.

Setting 2: BACnet, MEMOBUS/Modbus, P1, or N2 Communications

This setting requires entering the Run command via serial communications by connecting the RS-485 serial communication cable to control terminals TXRX+ and TXRX- on the terminal block. ***Refer to MEMOBUS/Modbus Configuration on page 352*** for instructions.

Setting 3: Option Card

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

■ Z1-09: HAND Mode Drive Speed Reference

The speed reference used when the Drive is running in HAND mode.

No.	Name	Setting Range	Default
Z1-09	HAND Mode Drive Speed Reference	0.0 to 60.0 Hz <1>	10.0 Hz <1>

<1> Values are given in Hz, but actual values are dependent upon unit settings using drive parameters o1-03, o1-09, o1-10, and o1-11.

■ Z1-10: Smoke Purge Preset Frequency Reference

Sets the speed at which the drive will run when the Smoke Purge Drive input is active.

No.	Name	Setting Range	Default
Z1-10	Smoke Purge Preset Frequency Reference	0.0 to 60.0 Hz <1>	10.0 Hz <1>

<1> Values are given in Hz, but actual values are dependent upon unit settings using drive parameters o1-03, o1-09, o1-10, and o1-11.

■ Z1-11: 2-Motor AND/OR Function Select

No.	Name	Setting Range	Default
Z1-11	2-Motor AND/OR Function Select	0 to 10	0

Setting 0: Disabled (Ignore Digital Inputs)

Setting 1: Always Use Only Motor 1

Setting 2: Always Use Only Motor 2

Setting 3: Always Use Motor 1 and Motor 2

Setting 4: OR Function Motor Selected by Digital Input in HAND and AUTO Modes

Setting 5: OR Function Uses Motor 1 in HAND Mode and Motor Selected by Digital Input in AUTO Mode

Setting 6: OR Function Uses Motor 2 in HAND Mode and Motor Selected by Digital Input in AUTO Mode

Setting 7: AND/OR Function Motor Selected (1, 2, or both) by (2) Digital Inputs in HAND and AUTO Modes

Setting 8: AND/OR Function Uses Motor 1 in HAND Mode and Motor Selected (1, 2, or both) by (2) Digital Inputs in AUTO Mode

Setting 9: AND/OR Function Uses Motor 2 in HAND Mode and Motor Selected (1, 2, or both) by (2) Digital Inputs in AUTO Mode

Setting 10: AND/OR Function Uses Motor 1 and Motor 2 in HAND Mode and Motor Selected (1, 2, or both) by (2) Digital Inputs in AUTO Mode

■ Z1-12 to Z1-15: Run Delay with Preset Speed

Parameters Z1-12 to Z1-15 allow running the bypass at a preset speed before the BAS Interlock Input is active and continuing at the preset speed for a delay time after the BAS Interlock Input becomes active. Refer to *Figure 5.55* to *Figure 5.58* for examples.

■ Z1-12: Run Delay Time

Delays the drive or bypass Run after RUN, RUN ENABLE, and RUN INTERLOCK are all asserted.

No.	Name	Setting Range	Default
Z1-12	Run Delay Time	0.0 to 300.0 s	0.0 s

■ Z1-13: Pre-Interlock Run Select

Allows running at a preset speed starting immediately upon entering a Run command, ignoring the BAS Interlock Input. The drive frequency reference stays at this preset speed until the Run Delay Time (Z1-12) times out.

No.	Name	Setting Range	Default
Z1-13	Pre-Interlock Run Select	0, 1	0

Setting 0: Disabled

Setting 1: Enable Delay Time Only

■ Z1-14: Run Delay Frequency Reference

Sets the frequency used while delaying the Run command.

No.	Name	Setting Range	Default
Z1-14	Run Delay Frequency Reference	0.0 to 60.0 Hz <1>	60.0 Hz <1>

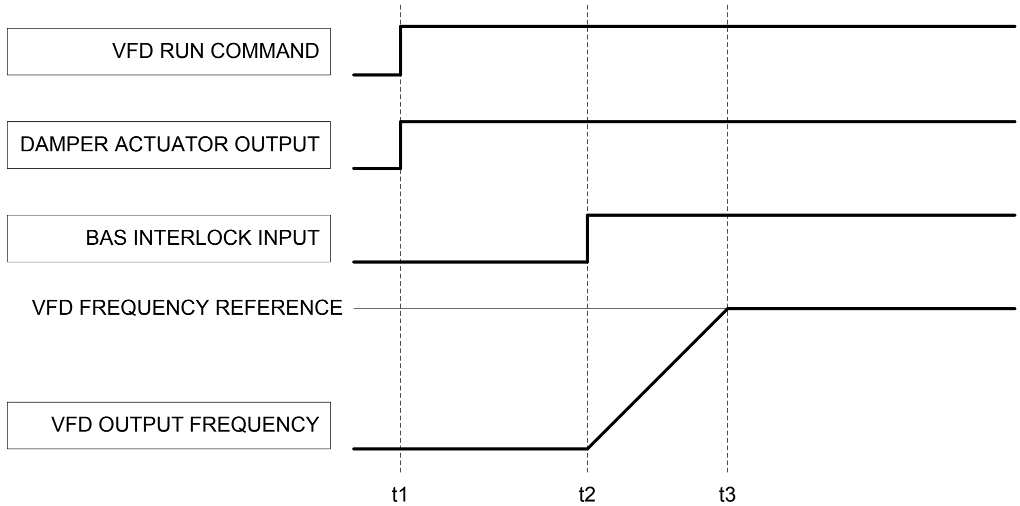
<1> Values are given in Hz, but actual values are dependent upon unit settings using drive parameters o1-03, o1-09, o1-10, and o1-11.

■ Z1-15: Interlock Wait Time

When an input is programmed for Interlock and the time set to this parameter is reached before the Interlock input goes active, a fault will be declared. The default setting of 0.0 will never time out.

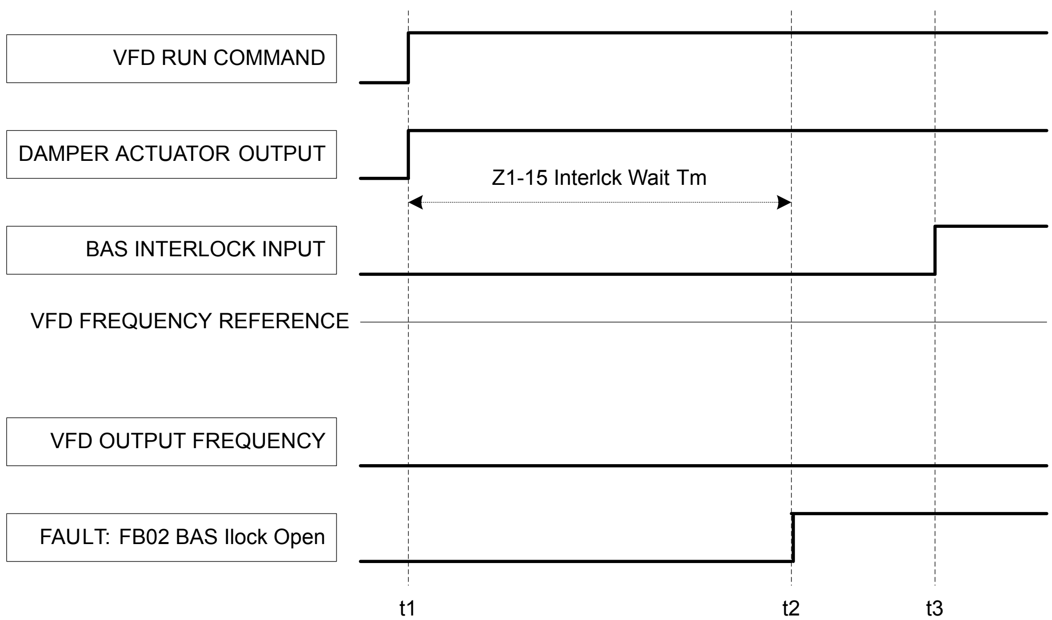
No.	Name	Setting Range	Default
Z1-15	Interlock Wait Time	0.0 to 300.0 s	0.0 s

Run Delay with Preset Speed Examples



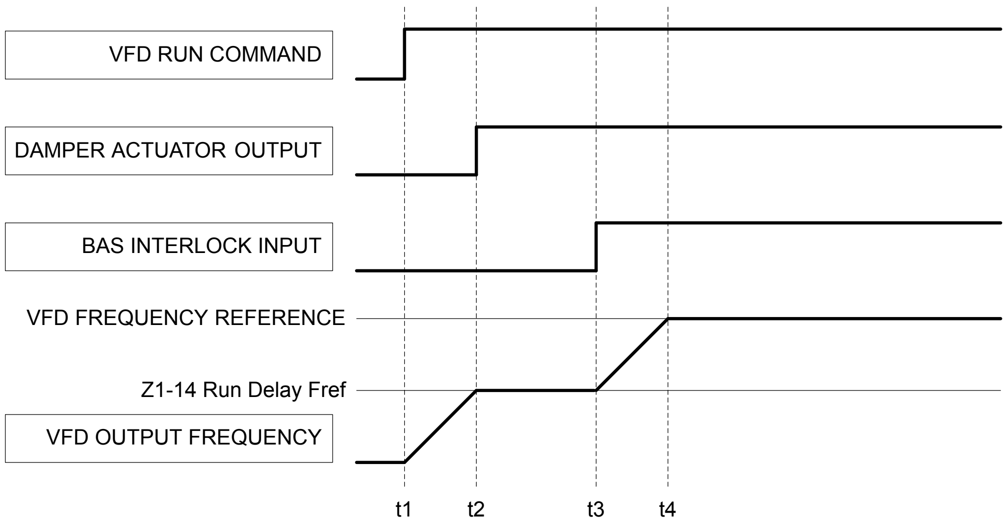
Parameter Settings:
Z1-12 Run Delay Time = 0.0 sec
Z1-13 Pre Int Run Sel = 0 (Disabled)
Z1-14 Run Delay Fref = 60.0 Hz
Z1-15 Interlck Wait Tm = 0.0 sec (Never Time Out)

Figure 5.55 Run Delay with Preset Speed Example: Default Setting



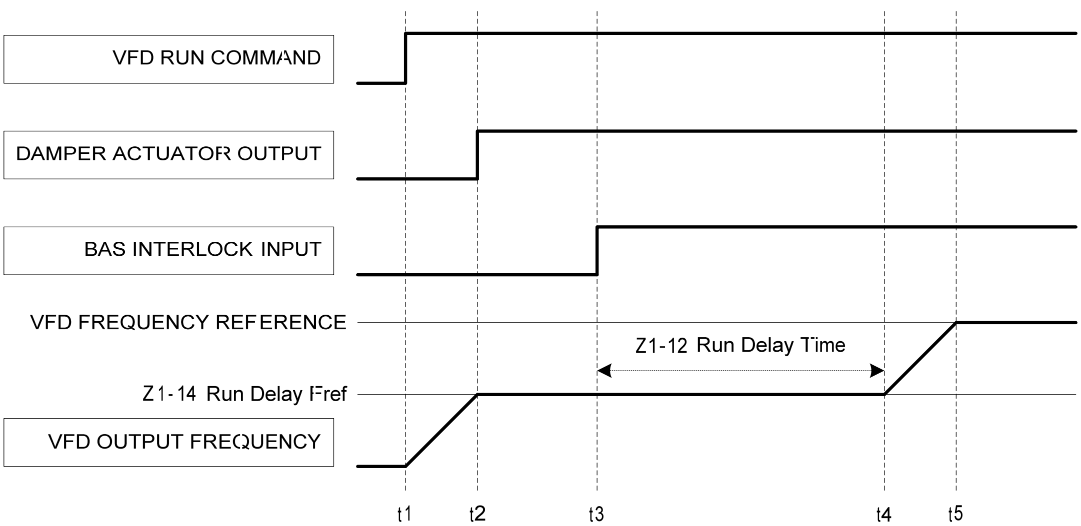
Parameter Settings:
Z1-12 Run Delay Time = 0.0 sec
Z1-13 Pre Int Run Sel = 0 (Disabled)
Z1-14 Run Delay Fref = 60.0 Hz
Z1-15 Interlck Wait Tm = 10.0 sec

Figure 5.56 Run Delay with Preset Speed Example: BAS Interlock Wait Time Fault



Parameter Settings:
Z1-12 Run Delay Time = 0.0 sec
Z1-13 Pre Int Run Sel = 1 (Enable)
Z1-14 Run Delay Fref = 30.0 Hz
Z1-15 Interlck Wait Tm = 0.0 sec (Never Time Out)

Figure 5.57 Run Delay with Preset Speed Example: Preset Speed



Parameter Settings:
Z1-12 Run Delay Time = 10.0 sec
Z1-13 Pre Int Run Sel = 1 (Enable)
Z1-14 Run Delay Fref = 30.0 Hz
Z1-15 Interlck Wait Tm = 0.0 sec (Never Time Out)

Figure 5.58 Run Delay with Preset Speed Example: Preset Speed with Run Delay

■ Z1-24: Contactor Open Delay Time

Sets the time to delay after commanding the drive output contactor K2 or bypass contactor K3 or 2-Motor AND/OR contactors K4 and K5 to open to allow the contacts to open.

No.	Name	Setting Range	Default
Z1-24	Contactor Open Delay Time	0.0 to 5.0 s	0.2 s

■ Z1-25: Contactor Close Delay Time

Sets the time to delay after commanding the drive output contactor K2 or bypass contactor K3 or 2-Motor AND/OR contactors K4 and K5 to open to allow the contacts to close.

No.	Name	Setting Range	Default
Z1-25	Contactor Close Delay Time	0.0 to 5.0 s	0.2 s

■ Z1-27 to Z1-29: Control Voltage Protection

The Bypass controller monitors the voltage to the contactor coils and the Bypass controller power supply. The controller will detect brownout and blackout conditions. Blackout and brownout conditions will trigger an FB08 or FB09 fault and de-energize the contactor coils.

■ Z1-27: Phase Loss Brownout Voltage Level

Sets the brownout condition voltage level.

No.	Name	Setting Range	Default
Z1-27	Phase Loss Brownout Voltage Level	0 to 150 V	98 V

■ Z1-28: Phase Loss Brownout Detection Time

Sets the time that the input voltage is continuously measured to be below the Brownout Voltage level before declaring a brownout fault.

No.	Name	Setting Range	Default
Z1-28	Phase Loss Brownout Detection Time	0.0 to 300.0 s	3.0 s

■ Z1-29: Phase Loss Blackout Voltage Level

Sets the voltage level below which is considered a blackout condition.

No.	Name	Setting Range	Default
Z1-29	Phase Loss Blackout Voltage Level	0 to 150 V	0 V

■ Z1-30: EF0 Fault Delay Time

Sets the time between declaring a drive fault and opening the drive and bypass contactors.

No.	Name	Setting Range	Default
Z1-30	EF0 Fault Delay Time	0.0 to 300.0 s	1.0 s

■ Z1-31: Loss of Load Detection Enable

No.	Name	Setting Range	Default
Z1-31	Loss of Load Detection Enable	0 to 2	0

Setting 0: Disable

Setting 1: Enable and Declare Fault

Setting 2: Enable and Alarm Only

■ Z1-32: Loss of Load Drive Frequency

Sets the value to which the drive output frequency must be equal to or greater than for the drive to detect a loss of load.

No.	Name	Setting Range	Default
Z1-32	Loss of Load Drive Frequency	0.0 to 60.0 Hz <1>	60.0 Hz <1>

<1> Values are given in Hz, but actual values are dependent upon unit settings using drive parameters o1-03, o1-09, o1-10, and o1-11.

■ Z1-33: Loss of Load Drive Output Current

Sets the value to which the drive output current must be equal to or less than for the drive to detect a loss of load.

No.	Name	Setting Range	Default
Z1-33	Loss of Load Drive Output Current	0.0 to 999.9 A	0.0 A

■ Z1-34: Loss of Load Drive Time

While in Drive mode, the Loss of Load detection conditions must be met for the length of time entered here before detecting a loss of load.

No.	Name	Setting Range	Default
Z1-34	Loss of Load Drive Time	0.0 to 300.0 s	1.0 s

■ Z1-35: Loss of Load Bypass Output Current

The motor current must be equal to or less than this value to detect a loss of load.

No.	Name	Setting Range	Default
Z1-35	Loss of Load Bypass Output Current	0.0 to 999.9	0.0 A

■ Z1-36: Loss of Load Bypass Time

While in Bypass mode, the Loss of Load detection conditions must be met for the length of time entered here before detecting a loss of load.

No.	Name	Setting Range	Default
Z1-36	Loss of Load Bypass Time	0.0 to 300.0	1.0 s

■ Z1-37: Set Time

Changes the LCD display to time setting to set the Real Time Clock.

No.	Name	Setting Range	Default
Z1-37	Set Time	0 to 2	0

Setting 0: Normal Display

Setting 1: Displays Time and Date Setting Mode

Setting 2: Reset Time

■ Z1-38: HOA Source Select

No.	Name	Setting Range	Default
Z1-38	HOA Source Select	0 to 2	0

Setting 0: Operator

The HOA keypad controls the HAND/OFF/AUTO commands.

Setting 1: Digital Inputs

The H1-☐☐ multi-function digital input parameters control the HAND/OFF/AUTO commands.

Setting 2: Serial Communications

The serial communications protocol selected in parameter Z3-01 control the HAND/OFF/AUTO commands.

■ Z1-39: Drive/Bypass Source Select

No.	Name	Setting Range	Default
Z1-39	Drive/Bypass Source Select	0 to 2	0

Setting 0: Operator

The HOA keypad selects the Drive or Bypass as the source.

Setting 1: Digital Inputs

The H1-☐☐ multi-function digital input parameters select the Drive or Bypass as the source.

Setting 2: Serial Communications

The serial communications protocol selected in parameter Z3-01 selects the Drive or Bypass as the source.

■ Z1-40: Auto Transfer Wait Time

Sets the length of time that the bypass controller will wait before switching to bypass when Auto Transfer is enabled and a drive fault is detected.

No.	Name	Setting Range	Default
Z1-40	Auto Transfer Wait Time	0.0 to 300.0 s	0.0 s

■ Z1-41: HAND Speed Reference Selection

Selects the frequency reference source when in HAND Mode.

No.	Name	Setting Range	Default
Z1-41	HAND Speed Reference Selection	0, 1	0

Setting 0: Parameter Z1-09

Parameter Z1-09 sets the frequency reference for the drive when in HAND Mode.

Setting 1: Analog

An analog input sets the frequency reference when in HAND Mode.

Note:
1. Set H3-02 to "1F - HAND Mode" when using Terminal A1 for HAND Mode frequency reference.
2. Set H3-10 to "1F - HAND Mode" when using Terminal A2 for HAND Mode frequency reference.
3. Set H3-06 to "1F - HAND Mode" when using Terminal A3 for HAND Mode frequency reference.

■ Z1-42: Bypass Device Type

Selects either contactor or soft-starter bypass type. This parameter should be set to 1 at the factory on bypasses with the soft-starter option PW. It is not necessary for the customer to adjust this setting.

No.	Name	Setting Range	Default
Z1-42	Bypass Device Type	0, 1	0

Setting 0: Contactor

The cabinet blowers operate only when the drive is running.

Setting 1: Soft Starter

The cabinet blowers operate in drive and bypass run modes.

■ Z1-50: Bypass Unbalanced Current Detection Level

Sets the current unbalance level between phases as a percentage of parameter E2-01 when operating in Bypass Mode. This function is used in conjunction with parameter Z1-51 to detect input or output phase loss during bypass operation.

The unbalance level is determined by measuring the RMS current in each of the output phases. The amount of current unbalance between the phases is calculated using the following formula:

Unbalance Level = $(I_{(max)} - I_{(min)}) / I_{(max)} \times 100\%$

When the unbalance level exceeds the Z1-50 setting for longer than the time set to Z1-51, an "FB15 – Input Phase Loss" fault is triggered and the drive will coast to stop.

This parameter rarely needs to be changed.

No.	Name	Setting Range	Default
Z1-50	Bypass Unbalanced Current Detection Level	5.0 to 50.0%	25.0%

■ Z1-51: Bypass Unbalance Trip Time Detection Level

Sets the trip time for an unbalance condition when operating in Bypass Mode. This function is used in conjunction with parameter Z1-50 to detect input or output phase loss during bypass operation.

Note: Setting this parameter to 0.0 will disable unbalance (bypass phase loss) protection.

No.	Name	Setting Range	Default
Z1-51	Bypass Unbalance Trip Time Detection Level	0.0 to 30.0 s	5.0 s

■ Z1-52: Bypass Phase Rotation

Input phase rotation is ignored when operating in Drive Mode. Input phase rotation determines motor direction when operating in Bypass Mode.

If input phase rotation is reversed and this parameter is set to 1, an "AL16 – Inp Phase Rotation" alarm will be displayed when operation starts in Bypass Mode and operation continues.

If input phase rotation is reversed and this parameter is set to 2, an “FB16 – Inp Phase Rotation” fault will be displayed when operation starts in Bypass Mode and the drive will coast to stop.

Controls the behavior of the bypass phase rotation detection when operating in Bypass Mode.

No.	Name	Setting Range	Default
Z1-52	Bypass Phase Rotation	0 to 2	1

Setting 0: Disabled

Setting 1: Alarm

Setting 2: Fault

■ Z1-53: Load Verification Fault Select

Enables and disables verification that the motor is running when commanded to run.

When this function is enabled and the bypass detects a loss of output current, such as an open external motor disconnect, or a zero frequency reference command for longer than 10 seconds, the bypass will display a “Load Lost” fault, coast to stop, and any digital output programmed to “Damper Act Out” (Z2-2☐ = 20) will open.

The "Load Lost" fault is disabled during smoke purge operation.

Note: Parameter available in bypass controller software versions VST800400 and later.

No.	Name	Setting Range	Default
Z1-53	Load Verification Fault Select	0 to 1	0

Setting 0: Disabled

Setting 1: Enabled

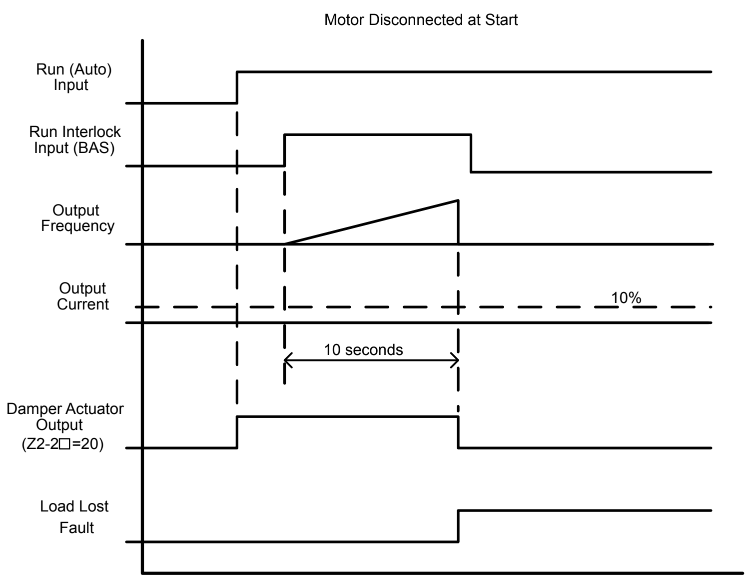


Figure 5.59 Motor Disconnected at Start

Programming

5

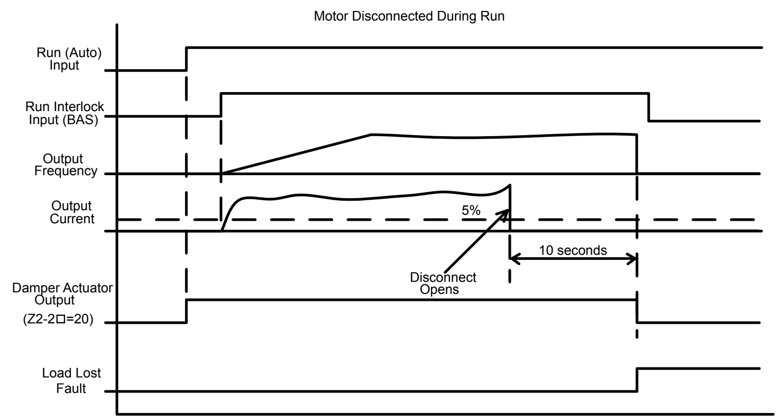


Figure 5.60 Motor Disconnected During Run

■ Z1-54: LCD Contrast Control

Sets the contrast of the LCD operator display on the bypass.

Note: Parameter available in bypass controller software versions VST800400 and later.

No.	Name	Setting Range	Default
Z1-54	LCD Contrast Control	1 to 5	3

■ Z1-55: Welded K3 Contactor Fault Select

Enables and disables monitoring of bypass contactor K3 for a "welded contactor" condition.

This detection is active when the bypass is taken out of bypass run mode or when power is first applied to the bypass package.

The bypass will display an "FB18 - K3 Welded" fault upon detection of the condition. Cycle power to the bypass package to clear this fault.

Note: Parameter available in bypass controller software versions VST800400 and later.

No.	Name	Setting Range	Default
Z1-55	Welded K3 Contactor Fault Select	0, 1	0

Setting 0: Disabled

Setting 1: Enabled

■ Z1-60: Black Out Selection

Determines the bypass behavior when contactor voltage drops below Z1-29 setting.

Note: Parameter available in bypass controller software versions VST800401 and later.

No.	Name	Setting Range	Default
Z1-60	Black Out Selection	0, 1	0

Setting 0: Fault

Setting 1: Restart

■ Z1-61: Restart Delay

Sets the time delay for restart.

Note: Parameter available in bypass controller software versions VST800401 and later.

No.	Name	Setting Range	Default
Z1-61	Restart Delay	1 to 300 s	10 s

◆ Z2: Bypass Control Input/Output

■ Z2-01 to Z2-08: Digital Input 1 to 8 Function Select

No.	Name	Setting Range	Default
Z2-01	Digital Input 1 Function Select	0 to 36	21
Z2-02	Digital Input 2 Function Select	0 to 36	22
Z2-03	Digital Input 3 Function Select	0 to 36	23
Z2-04	Digital Input 4 Function Select	0 to 36	24
Z2-05	Digital Input 5 Function Select	0 to 36	25
Z2-06	Digital Input 6 Function Select	0 to 36	0
Z2-07	Digital Input 7 Function Select	0 to 36	0
Z2-08	Digital Input 8 Function Select	0 to 36	29

■ Bypass Digital Input Terminal Settings

Table 5.29 Bypass Digital Input Terminal Settings

Setting	Function	Page
0 <1>	Unused (Available for Serial Comms) **Note:** Multiple digital input terminals can be programmed for “Unused (Available for Serial Comms)” (Z2-0□ = 0). The drive will run only when all digital inputs programmed for “0” are active. This feature applies to settings 0 and 22. Set all other selections only once in parameters Z2-01 to Z2-08.	187
3	DRV Multi-Function Input S3 (H1-03 Setting)	187
4	DRV Multi-Function Input S4 (H1-04 Setting)	187
5	DRV Multi-Function Input S5 (H1-05 Setting)	187
6	DRV Multi-Function Input S6 (H1-06 Setting)	188
7	DRV Multi-Function Input S7 (H1-07 Setting)	188
8	DRV Multi-Function Input S8 (H1-08 Setting)	188
21	Run (AUTO Mode)	188
22 <1>	Run Enable (Safety) **Note:** Multiple digital input terminals can be programmed for “Run Enable (Safety)” (Z2-0□ = 22). The drive will run only when all digital inputs programmed for “22” are active. This feature applies to settings 0 and 22. Set all other selections only once in parameters Z2-01 to Z2-08.	188
23	Run Interlock (BAS)	188
24	Remote Transfer to Bypass	188
25	Smoke Purge Bypass Run to Destruction	188
26	Smoke Purge Drive Run to Destruction at Smoke Purge Preset Speed	188
27	Motor OR Select	188
28	Motor AND Select	188
29	Motor 1 Overload Contact	188
30	Motor 2 Overload Contact	188
31	HAND Select	188
32	AUTO Select	188
33	DRIVE/BYPASS Select	188
34	Fault Reset	189
35	External Fault (EF0)	189
36	External Fault (EFB)	189
37	Run Reverse	189

<1> Can be set to multiple digital input parameters at the same time.

Setting 0: Unused (Available for Serial Comms)

Note: Multiple digital input terminals can be programmed for “Unused (Available for Serial Comms)” (Z2-0□ = 0). The drive will run only when all digital inputs programmed for “0” are active. This feature applies to settings 0 and 22. All other selections should only be set once in parameters Z2-01 to Z2-08.

Setting 3: DRV Multi-Function Input S3 (H1-03 Setting)

Refer to H1-03 to H1-08: Functions for Terminals S3 to S8 on page 133 for available H1-03 multi-function input settings.

Setting 4: DRV Multi-Function Input S4 (H1-04 Setting)

Refer to H1-03 to H1-08: Functions for Terminals S3 to S8 on page 133 for available H1-04 multi-function input settings.

Setting 5: DRV Multi-Function Input S5 (H1-05 Setting)

Refer to H1-03 to H1-08: Functions for Terminals S3 to S8 on page 133 for available H1-05 multi-function input settings.

Setting 6:DRV Multi-Function Input S6 (H1-06 Setting)

Refer to H1-03 to H1-08: Functions for Terminals S3 to S8 on page 133 for available H1-06 multi-function input settings.

Setting 7: DRV Multi-Function Input S7 (H1-07 Setting)

Refer to H1-03 to H1-08: Functions for Terminals S3 to S8 on page 133 for available H1-07 multi-function input settings.

Setting 8: DRV Multi-Function Input S8 (H1-08 Setting)

Refer to H1-03 to H1-08: Functions for Terminals S3 to S8 on page 133 for available H1-08 multi-function input settings.

Setting 21: Run (AUTO Mode)

Starts and stops the bypass when Z1-08 is set to 1.

Setting 22: Run Enable (Safety)

Stops the drive from running regardless of Z1-08 setting. Z2-31 controls the message displayed on the HOA keypad when this input is open.

Note: Multiple digital input terminals can be programmed for “Run Enable (Safety)” (Z2-0☐ = 22). The drive will run only when all digital inputs programmed for “22” are active. This feature applies to settings 0 and 22. All other selections should only be set once in parameters Z2-01 to Z2-08.

Setting 23: Run Interlock (BAS)

Stops the drive and triggers alarm AL02. Use parameters Z1-13 and Z1-15 to modify Interlock settings.

Setting 24: Remote Transfer to Bypass

Stops the drive and turns on the bypass when a Run command is issued while in Drive Mode. The fault for this mode is controlled by parameter Z1-05. Parameter Z1-40 controls the length of time that the drive must be faulted before switching to Bypass Mode.

Setting 25: Smoke Purge Bypass Run to Destruction

Stops the drive, turns on the bypass, and triggers alarm AL03. The bypass runs continuously regardless of any faults or alarms.

Setting 26: Smoke Purge Drive Run to Destruction at Smoke Purge Preset Speed

Bypass controller will stay in this state even if the drive faults or is unavailable. The preset speed is equal to the value set to Z1-10.

Setting 27: Motor OR Select

2-Motor OR function; 0/1 for Motor 1/2. Behavior defined by Z1-11.

Setting 28: Motor AND Select

2-Motor AND function; 0/1 for 1/2 motor. If 1 motor, then look to Motor OR input for selected motor. Behavior defined by Z1-11.

Setting 29: Motor 1 Overload Contact

When input is open, declare an oL Fault, issue an EF0 fault to the drive, delay per EF0 Fault Delay Time (Z1-30), and open bypass (K3) contactors.

Setting 30: Motor 2 Overload Contact

When input is open, declare an oL Fault, issue an EF0 fault to the drive, delay per EF0 Fault Delay Time (Z1-30), and open bypass (K3) contactors.

Setting 31: HAND Select

When this is selected, the HAND function command will come from a digital input while the HAND key on the HOA operator will be ignored. If both HAND and AUTO functions are configured to come from digital inputs, the lack of both of these inputs being active will put the HOA function into the OFF state. The OFF key on the HOA operator will always place the HOA function to the OFF state.

Setting 32: AUTO Select

When this is selected, the AUTO function command will come from a digital input while the AUTO key on the HOA operator will be ignored. If both HAND and AUTO functions are configured to come from digital inputs, the lack of both of these inputs being active will put the HOA function into the OFF state. The OFF key on the HOA operator will always place the HOA function to the OFF state

Setting 33: DRIVE/BYPASS Select

When this is selected, the DRIVE/BYPASS select function command will come from a digital input while the DRV/BYP key on the HOA operator will be ignored.

Input OFF: Drive Mode is selected.

Input ON: Bypass Mode is selected.

Setting 34: Fault Reset

Resets any faults that are present.

Setting 35: External Fault (EF0)

Issues external fault EF0 to the drive from the bypass. Use parameter Z1-30 to modify the fault delay time.

Setting 36: External Fault (EFB)

Triggers external EFB on the bypass.

Setting 37: Run Reverse (AUTO Mode)

Starts and stops the bypass in reverse when Z1-08 is set to 1.

■ Z2-09 to Z2-16: Digital Input 1 to 8 Invert Select

No.	Name	Setting Range	Default
Z2-09	Digital Input 1 Invert Select	0, 1	0
Z2-10	Digital Input 2 Invert Select	0, 1	0
Z2-11	Digital Input 3 Invert Select	0, 1	0
Z2-12	Digital Input 4 Invert Select	0, 1	0
Z2-13	Digital Input 5 Invert Select	0, 1	0
Z2-14	Digital Input 6 Invert Select	0, 1	0
Z2-15	Digital Input 7 Invert Select	0, 1	0
Z2-16	Digital Input 8 Invert Select	0, 1	0

■ Bypass Digital Input Invert Settings

Table 5.30 Bypass Digital Input Invert Settings

Setting	Function	Page	Setting	Function	Page
0	Normal	*189*	1	Inverted	*189*

Setting 0: Normal

Lack of input signal = OFF

Setting 1: Inverted

Lack of input signal = ON

■ Z2-23 to Z2-26: Digital Output 7 to 10 Function Select

No.	Name	Setting Range	Default
Z2-23	Digital Output 7 Function Select	0 to 23; 99	7
Z2-24	Digital Output 8 Function Select	0 to 23; 99	10
Z2-25	Digital Output 9 Function Select	0 to 23; 99	12
Z2-26	Digital Output 10 Function Select	0 to 23; 99	15

■ Bypass Digital Output Terminal Settings

Table 5.31 Bypass Digital Output Terminal Settings

Setting	Function	Setting	Function
0	Serial Comm Controlled	7	RUN Active (Drive or Bypass)
1	K1 Drive Input Contactor	8	Drive RUN Active
2	K2 Drive Output Contactor	9	Bypass RUN Active
3	K3 Bypass Contactor	10	HAND Mode Active
4	K4 Motor 1 Select	11	OFF Mode Active
5	K5 Motor 2 Select	12	AUTO Mode Active
6	READY (Drive and Bypass)	13	Drive Mode Selected

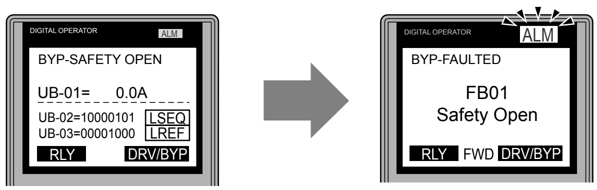
Setting	Function
14	Bypass Mode Selected
15	Drive or Bypass Fault Active
16	Drive Fault Active
17	Bypass Fault Active
18	Auto Transfer Active
19	Serial Run Command Active
20	Damper Actuator Output
21	ON Always
22	Loss of Load Detected
23	Run Verify The digital output closes when the drive or bypass output current exceeds 10% of the value set in E2-01. The digital output opens when the drive or bypass output current falls below 5% of the value set in E2-01.
99	Not Used (Through Mode) This setting allows serial communications to control the output.

■ Z2-31: Safety Open Message Selection

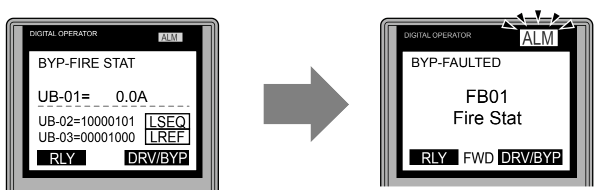
Sets the fault message displayed when an FB01 fault is triggered. This parameter also determines the text that is displayed on the top line of the HOA keypad.

No.	Name	Setting Range	Default
Z2-31	Safety Open Message Selection	0 to 6	0

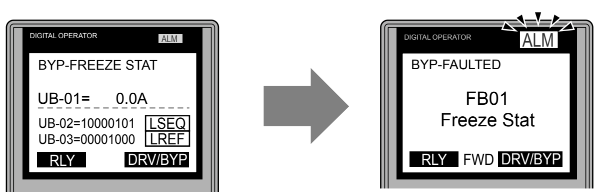
Setting 0: Safety Open



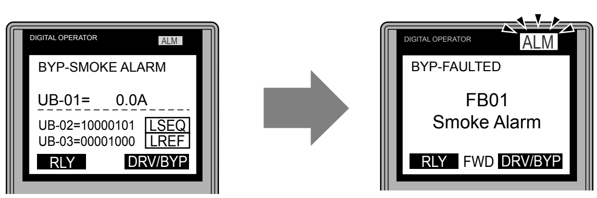
Setting 1: Fire Stat



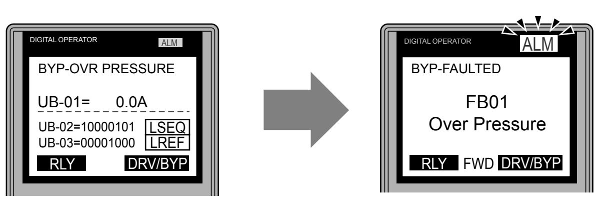
Setting 2: Freeze Stat



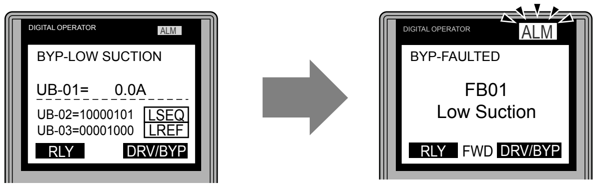
Setting 3: Smoke Alarm



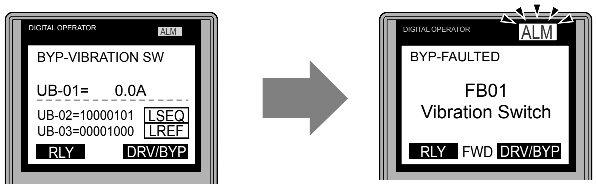
Setting 4: Over Pressure



Setting 5: Low Suction



Setting 6: Vibration Switch



◆ Z3: Bypass Control Communication

■ Z3-01: Serial Communications Protocol Select

Selects the bypass serial communications protocol.

No.	Name	Setting Range	Default
Z3-01	Serial Communications Protocol Select	0 to 3	3

Setting 0: Modbus

Setting 1: N2

Setting 2: P1

Setting 3: BACnet

■ Z3-02: Serial Communications Node Select

Selects the bypass serial communications node address.

Note: Each slave must be assigned a unique slave address for serial communications to work properly. Slave addresses do not need to be assigned in sequential order, but no two slaves may share the same address.

No.	Name	Setting Range	Default
Z3-02	Serial Communications Node Select	0 to 127	1

■ Z3-03: Serial Communications Baud Rate Select

Selects the bypass serial communications speed.

Selecting settings 0, 1, or 2 will trigger an oPE29 error when using BACnet communication (Z3-01 = 3) in bypass controller software versions VST800400 and later.

No.	Name	Setting Range	Default
Z3-03	Serial Communications Baud Rate Select	0 to 8	3

Setting 0: 1200 bps

Setting 1: 2400 bps

Setting 2: 4800 bps

Setting 3: 9600 bps

Setting 4: 19200 bps

Setting 5: 38400 bps

Setting 6: 57600 bps

Setting 7: 76800 bps

Setting 8: 115200 bps

■ Z3-04: Serial Communications Parity Select

Selects the bypass serial communications parity. This setting is ignored when BACnet protocol is selected.

No.	Name	Setting Range	Default
Z3-04	Serial Communications Parity Select	0 to 2	0

Setting 0: No Parity

Setting 1: Even Parity

Setting 2: Odd Parity

■ Z3-05: Serial Communications Fault Select

Selects the action to take when a serial communications fault is detected. A serial communications fault is detected when after last communicating, no communications occurs within the time set to Z3-06.

No.	Name	Setting Range	Default
Z3-05	Serial Communications Fault Select	0 to 4	1

Setting 0: Ignore

Setting 1: Alarm Only

Setting 2: Fault with EF0

An EF0 fault will be sent to the drive.

Setting 3: Fault with EF0 and Open Contactors

An EF0 fault will be sent to the drive and the bypass contactor (K3) will be opened.

Setting 4: Alarm and run at preset speed set in Z3-10

Display AL14 alarm on operator.

■ Z3-06: Serial Communications Fault Time Select

Sets the time allowed to elapse since receiving serial communications before triggering a communications fault.

A value of 0.0 means to never time out.

No.	Name	Setting Range	Default
Z3-06	Serial Communications Fault Time Select	0.0 s to 99.9 s	2.0 s

■ Z3-07: Serial Communications Receive to Transmit Wait Time

Sets the time to delay a serial communications response to a serial communications command.

No.	Name	Setting Range	Default
Z3-07	Serial Communications Receive to Transmit Wait Time	0 to 99 ms	5 ms

■ Z3-08, Z3-09: BACnet Device Object Identifier

These parameters set the Instance Identifier of the BACnet Device Object, where Z3-08 is the least significant word and Z3-09 is the most significant word.

No.	Name	Setting Range	Default
Z3-08	BACnet Device Object Identifier 0	0 to FFFFH	1
Z3-09	BACnet Device Object Identifier 1	0 to 003FH	0

Example 1: Set Device Object Instance Identifier of “1234”.

1234 decimal is equal to 4D2H (hexadecimal).

Set Z3-08 to 4D2H and set Z3-09 to 0.

Example 2: Set Device Object Instance Identifier of “123456”.

123456 decimal is equal to 1E240H.

Set Z3-08 to D687H and set Z3-09 to 12H.

■ Z3-10: Cable Loss Pre-set Speed

Sets the frequency reference when a serial communications fault is detected and Z3-05 is set to 4.

No.	Name	Setting Range	Default
Z3-10	Cable Loss Pre-set Speed	0.0 to 60.0 Hz	0.0 Hz

■ Z3-11: Communication Fault Detection Selection

No.	Name	Setting Range	Default
Z3-11	Communication Fault Detection Selection	0 to 1	1

Setting 0: Disabled

Ignore setting in Z3-05.

Setting 1: Enabled

Behavior defined by Z3-05.

■ Z3-12: Network Digital Input Select

Determines whether the serial communication digital input simulation is active.

No.	Name	Setting Range	Default
Z3-12	Network Digital Input Select	0, 1	0

Setting 0: Disable

Serial communications physical digital inputs are ignored.

For MEMOBUS/Modbus (Z3-01 = 0): Command Register 8402H is disabled.

For Metasys N2 (Z3-01 = 1): Binary Outputs B05, B06, B07, B08, and B09 are disabled.

For P1 Apogee (Z3-01 = 2): Points LDO44, LDO45, LDO46, LDO47, and LDO48 are disabled.

For BACnet (Z3-01 = 3): BV72, BV73, BV74, BV75, BV76, BV77, BV78, and BV79 are disabled.

Setting 1: Enable

Physical digital inputs S1 to S8 are logically OR'd with the serial communications digital inputs.

WARNING! *Sudden Movement Hazard. Setting this parameter to 1 may cause the system to run unexpectedly or not stop when required even if the physical digital input is de-energized, resulting in death or serious injury. Clear all personnel from the drive, motor and machine area before applying power. Set this parameter to 0 to prevent serial communications from triggering undesired and unexpected system operation.*

■ Z3-13: BACnet Command Register Retention

WARNING! *Sudden Movement Hazard. Setting this parameter to 2 or 3 will allow the bypass unit to start before receiving a valid network message. Clear all personnel from the drive, motor, and machine area before reapplying power. Failure to comply could result in injury to personnel.*

Determines whether to restore the frequency reference, bypass command, or both upon the reapplication of power after losing power. The feature restores all bypass command register values except the fault reset bit.

Set Z1-06 ≠ 0 or Z1-38 = 2 to allow the bypass to start running upon application of power.

Note:
1. Parameter is effective only when Z3-01 = 3 (Serial Communications Protocol Select = BACnet), Z1-07 = 2 (Speed Reference Select = Bypass Serial), and/or Z1-08 =2 (Run Command Select = Bypass Serial).
2. Parameter is available in bypass controller software versions VST800400 and later.

No.	Name	Setting Range	Default
Z3-13	BACnet Command Register Retention	0 to 3	0

Setting 0: Disabled

Reapplying power will not restore any BACnet objects.

Setting 1: Reference Only

Reapplying power restores the frequency reference object (AV2).

Setting 2: Run/Stop Only

Reapplying power restores various command objects including the Run commands. ***Refer to BACnet Values Restored When Z3-13 = 2 or 3 on page 194*** for a list of command objects.

Setting 3: Ref & Run/Stop

Reapplying power restores the frequency reference object (AV2) and various command objects. ***Refer to BACnet Values Restored When Z3-13 = 2 or 3 on page 194*** for a list of command objects.

Table 5.32 BACnet Values Restored When Z3-13 = 2 or 3

Object ID	Object Name
BV58	BYP Run Fwd CMD
BV59	BYP Run Rev CMD
BV61	BYP Xfer to BYP CMD
BV62	BYP Smok Prg BYP CMD
BV63	BYP Smok Prg DRV CMD
BV64	BYP Mtr OR Sel CMD
BV65	BYP Mtr AND Sel CMD
BV66	BYP HAND Select CMD
BV67	BYP Auto Select CMD
BV69	BYP BYPASS Sel CMD
BV71	BYP Ext Fault CMD (EFB)

◆ Z4: Ethernet Option Bypass Control

■ Z4-01 to Z4-04: IP Address 1 to 4

Sets the network static IP address. Z4-01 is the most significant octet of the network static IP address; Z4-04 is the least significant.

No.	Parameter Name	Setting Range	Default
Z4-01	IP Address 1	0 to 255	192
Z4-02	IP Address 2		168
Z4-03	IP Address 3		1
Z4-04	IP Address 4		20

■ Z4-05 to Z4-08: Subnet Mask 1 to 4

Sets the network static subnet mask. Z4-05 is the most significant octet of the network static subnet mask; Z4-08 is the least significant.

No.	Parameter Name	Setting Range	Default
Z4-05	Subnet Mask 1	0 to 255	255
Z4-06	Subnet Mask 2		255
Z4-07	Subnet Mask 3		255
Z4-08	Subnet Mask 4		0

■ Z4-09 to Z4-12: Gateway Address 1 to 4

Sets the network gateway address. Z4-09 is the most significant octet of the network gateway address; Z4-12 is the least significant.

No.	Parameter Name	Setting Range	Default
Z4-09	Gateway Address 1	0 to 255	192
Z4-10	Gateway Address 2		168
Z4-11	Gateway Address 3		1
Z4-12	Gateway Address 4		1

■ Z4-13: Address Startup Mode

Selects the option address setting method.

No.	Name	Setting Range	Default
Z4-13	Address Startup Mode	0 to 2	2

Setting 0: User-Defined (Static IP)

Setting 1: BOOTP

Setting 2: DHCP

■ Z4-14: Duplex Mode Setting

No.	Name	Setting Range	Default
Z4-14	Duplex Mode Setting	0 to 2	1

Setting 0: Forced Half Duplex

Setting 1: Auto Negotiate Duplex Mode and Communication Speed

This setting also auto-negotiates Z4-15, Speed Mode Setting.

Setting 2: Forced Full Duplex

■ Z4-15: Speed Mode Setting

No.	Name	Setting Range	Default
Z4-15	Speed Mode Setting	10, 100	10

Setting 10: 10 Mbps

Setting 100: 100 Mbps

■ Z4-16: Timeout

Sets the Control Connection Timeout value for detection of communication loss in tenths of a second. A value of 0 disables the connection timeout.

Example: An entered value of 100 represents 10.0 seconds.

No.	Name	Setting Range	Default
Z4-16	Timeout	0 to 300 s	0 s

■ Z4-17 to Z4-22: Scaling Factors

These parameters define scaling factors for drive monitors in the ODVA AC/DC Drive Object (Class 2AH), Instance 1, and the attribute given below:

Speed Scale is attribute 22

Current Scale is attribute 23

Torque Scale is attribute 24

Power Scale is attribute 26

Voltage Scale is attribute 27

Time Scale is attribute 28.

No.	Parameter Name	Setting Range	Default
Z4-17	Speed Scaling	-15 to 15	0
Z4-18	Current Scaling		0
Z4-19	Torque Scaling		0
Z4-20	Power Scaling		0
Z4-21	Voltage Scaling		0
Z4-22	Time Scaling		0

■ Z4-23 to Z4-32: 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.

No.	Parameter Name	Setting Range	Default
Z4-23	DOA116 1	0 to FFFFH	0
Z4-24	DOA116 2	0 to FFFFH	0
Z4-25	DOA116 3	0 to FFFFH	0

No.	Parameter Name	Setting Range	Default
Z4-26	DOA116 4	0 to FFFFH	0
Z4-27	DOA116 5	0 to FFFFH	0
Z4-28	DOA116 6	0 to FFFFH	0
Z4-29	DOA116 7	0 to FFFFH	0
Z4-30	DOA116 8	0 to FFFFH	0
Z4-31	DOA116 9	0 to FFFFH	0
Z4-32	DOA116 10	0 to FFFFH	0

■ Z4-33 to Z4-42: 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.

No.	Parameter Name	Setting Range	Default
Z4-33	DIA116 1	0 to FFFFH	0
Z4-34	DIA116 2	0 to FFFFH	0
Z4-35	DIA116 3	0 to FFFFH	0
Z4-36	DIA116 4	0 to FFFFH	0
Z4-37	DIA116 5	0 to FFFFH	0
Z4-38	DIA116 6	0 to FFFFH	0
Z4-39	DIA116 7	0 to FFFFH	0
Z4-40	DIA116 8	0 to FFFFH	0
Z4-41	DIA116 9	0 to FFFFH	0
Z4-42	DIA116 10	0 to FFFFH	0

6

Diagnostics & Troubleshooting

This chapter provides descriptions of faults, alarms, errors, related displays, and guidance for troubleshooting. This chapter can also serve as a reference guide for tuning the bypass during a trial run.

6.1 Section Safety

⚠ DANGER

Electrical Shock Hazard

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

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 capacitors have fully discharged.

Failure to comply could result in death or serious injury.

Before servicing, disconnect all power to the equipment. The internal capacitor remains charged even after the power supply is turned off. The charge indicator LED will extinguish when the DC bus voltage is below 50 Vdc. To prevent electric shock, wait for at least the time specified on the warning label; 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 your supplier 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 servicing must be performed only by authorized personnel familiar with installation, adjustment and maintenance of AC drives.

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

Failure to comply could result in death or serious injury.

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

Do not 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 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.

6.2 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 6.1 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 (2 kHz)	1 to max. setting
• 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	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	V/f Pattern Selection (E1-03)	• Increase the setting if motor torque is insufficient at speeds below 10 Hz. • Reduce the setting If motor instability occurs at motor start. • Set E1-03 to a pattern that fits the application.	Depends on o2-04	Default setting ±5 V

◆ Parameters to Minimize Motor Hunting and Oscillation

In addition to the parameters discussed in *Table 6.1*, parameters in *Table 6.2* indirectly affect motor hunting and oscillation.

Table 6.2 Parameters that Affect Control Performance in Applications

Name (Parameter No.)	Application
Accel/Decel Time (C1-01 and C1-02)	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.

6.3 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 79*.

If problems occur that are not covered in this manual, contact the nearest Yaskawa representative with the following information:

- Bypass model (located on nameplate inside bypass enclosure)
- Software version
- Date of purchase
- Description of the problem

Table 6.3 contains descriptions of the various types of alarms, faults, and errors that may occur during operation.

Table 6.3 Types of Alarms, Faults, and Errors

Type	Drive Response
Faults	When the bypass 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 TB1 11 and 12 will close, and TB1 10 and 11 will open. The bypass will remain inoperable until the fault is cleared. *Refer to Fault Reset Methods on page 234*.
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. • 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 bypass 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.

◆ Alarm and Error Displays

■ Faults

Table 6.4 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 203*** for a list of alarm codes.

Table 6.4 Fault Displays

HOA Keypad Display	Name	Page
Aov	Power Supply Overvoltage	205
AUv	Power Supply Undervoltage	205
bAT	HOA Keypad Battery Low	205
bUS	Option Communication Error	205
CE	MEMOBUS/Modbus Communication Error	206
CoF	Current Offset Fault	206
CPF00 to CPF03, CPF07, CPF08, CPF11 to CPF14, CPF16 to CPF24 CPF26 to CPF35 CPF40 to CPF45 <1> <2>	Control Circuit Error	206
CPF06	Control Circuit Error	206
CPF25	Terminal Board Not Connected	206
doH	Damping Resistor Overheat	206
EF0	Option Card External Fault	207
EF1 to EF8	External Fault (input terminal S1 to S8)	207
Err	EEPROM Write Error	207
FAn	Fan Fault	207
FB01	Safety Open	208
FB02	BAS Interlock Open Time Out	208
FB03	External Fault Bypass (EFB)	208
FB05	Motor Overload	208
FB06	External Motor 1 Overload	209
FB07	External Motor 2 Overload	209
FB08	Phase Loss Brownout	209
FB09	Phase Loss Blackout	209
FB10	No Drive Comms	210
FB11	Bypass Board Hardware Error	210
FB12	Option Board Comms	210
FB13	Loss of Load	210
FB14	Serial Communications Fault	210
FB15	Input Phase Loss	211
FB16	Input Phase Rotation	211
FbH	Excessive PID Feedback	211
FbL	PID Feedback Loss	211

HOA Keypad Display	Name	Page
Fdv	Power Supply Frequency Fault	211
GF	Ground Fault	211
LF	Output Phase Loss	212
LF2	Current Imbalance	212
nSE	CanOpenNID Error	212
oC	Overcurrent	212
oFA00 <3>	Option Card Connection Error at Option Port CN5-A	213
oFA01	Option Card Fault at Option Port CN5-A	213
oFA03 to oFA06	Option Card Error Occurred at Option Port CN5-A	213
oFA10, oFA11	Option Card Error (CN5-A)	213
oFA12 to oFA17	Option Card Connection Error (CN5-A)	213
oFA30 to oFA43	Comm Option Card Connection Error (CN5-A)	213
oFb00	Option Card Fault at Option Port CN5-B	214
oFb01	Option Card Fault at Option Port CN5-B	214
oFb02	Option Card Fault at Option Port CN5-B	214
oFb03, oFb11	Option Card Error Occurred at Option Port CN5-B	214
oFb12 to oFb17	Option Card Error Occurred at Option Port CN5-B	214
oFC00	Option Card Connection Error at Option Port CN5-C	214
oFC01	Option Card Fault at Option Port CN5-C	214
oFC02	Option Card Fault at Option Port CN5-C	215
oFC03, oFC11	Option Card Error Occurred at Option Port CN5-C	215
oFC12 to oFC17	Option Card Error Occurred at Option Port CN5-C	215
oFC50 to oFC55	Option Card Error Occurred at Option Port CN5-C	215
oH	Heatsink Overheat	215
oH1	Overheat 1 (Heatsink Overheat)	215
oH3	Motor Overheat Alarm (PTC input)	215
oH4	Motor Overheat Fault (PTC input)	216
oL1	Motor Overload	216
oL2	Drive Overload	217
oL3	Overtorque Detection 1	217
oL4	Overtorque Detection 2	217
oL5	Mechanical Weakening Detection 1	217
oPr	External Digital Operator Connection Fault	217

HOA Keypad Display	Name	Page
ov	Control Circuit Overvoltage	218
SCF	Safety Circuit Fault	218
SEr	Too Many Speed Search Restarts	218
SoH	Snubber Discharge Resistor Overheat	218
SrC	Phase Order Detection Fault	218
Srr	Internal Resistance Fault	219
SvE	Zero Servo Fault	219
TdE	Time Data Error	219
TIM	Time Not Set	219
UL3	Undertorque Detection 1	219
UL5	Mechanical Weakening Detection 2	220
Uv1 <3>	Control Circuit Undervoltage Fault	220
Uv2 <3>	Control Power Supply Voltage Fault	220
Uv3 <3>	Undervoltage 3 (Soft-Charge Bypass Circuit Fault)	220

<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 6.5* 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 202* for information on fault codes.

Table 6.5 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	221
AL02	BAS Interlock Open	–	221
AL03	Smoke Purge in Bypass	–	221
AL04	Smoke Purge in Drive	–	221
AL09 <1>	Run Active during Restart Delay	–	221
AL13	Loss of Load	–	221
AL14	Serial Communications Alarm	–	221
AL16	Input Phase Rotation	–	222
AUv	Power Supply Undervoltage	YES	205
bb	Baseblock	No output <2>	222
bUS	Option Card Communications Error	YES	222
CALL	Serial Communication Transmission Error	YES	223
CE	MEMOBUS/Modbus Communication Error	YES	223
CrST	Cannot Reset	YES	223
dnE	Drive Disabled	YES	223
doH	Damping Resistor Overheat	–	206
EF	Forward/Reverse Run Command Input Error	YES	224
EF0	Option Card External Fault	YES	224
EF1 to EF8	External Fault (input terminal S1 to S8)	YES	224
FbH	Excessive PID Feedback	YES	224
FbL	PID Feedback Loss	YES	225
Fdv	Power Supply Frequency Fault	–	211
HCA	Current Alarm	YES	225
inTLK	Interlock Open	–	225
LT-1	Cooling Fan Maintenance Time	No output <1>	226
LT-2	Capacitor Maintenance Time	No output <1>	226
LT-3	Soft Charge Bypass Relay Maintenance Time	No output <1>	226
oH	Heatsink Overheat	YES	226
oH2	Heatsink Overheat Warning	YES	226
oH3	Motor Overheat	YES	226
oL3	Overtorque 1	YES	227
ov	Control Circuit Overvoltage	YES	227
PASS	MEMOBUS/Modbus Test Mode Complete	No output	227
SAFE	Customer Safety	–	227
SE	MEMOBUS/Modbus Test Mode Fault	YES	227
SoH	Snubber Discharge Resistor Overheat	YES	218
SrC	Phase Order Detection Fault	–	218
UL3	Undertorque Detection 1	YES	228
Uv1	Control Circuit Undervoltge	YES	228
WrUn	Waiting for Run	YES	228

<1> Available in bypass controller software versions VST800401 and later.

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<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 output for “bb”.

■ Operation Errors

Table 6.6 Operation Error Displays

HOA Keypad Display	Name	Page
oPE01	Unit Capacity Setting Fault	229
oPE02	Parameter Range Setting Error	229
oPE03	Multi-Function Input Selection Error	229
oPE04	Initialization Required	230
oPE05	Run Command/Frequency Reference Source Selection Error	230
oPE07	Multi-Function Analog Input Selection Error	230
oPE08	Parameter Selection Error	230
oPE09	PID Control Selection Fault	230
oPE10	V/f Data Setting Error	231
oPE11	Carrier Frequency Setting Error	231
oPE16	Energy Saving Constants Error	231
oPE27	BP Program Error	231
oPE28	Sequence Timer Error	231
oPE30	Incorrect Input Voltage Adjustment	231

■ Auto-Tuning Errors

Table 6.7 Auto-Tuning Error Displays

HOA Keypad Display	Name	Page
End3	Rated Current Setting Alarm (displayed after Auto-Tuning is complete)	232
End4	Adjusted Slip Calculation Error	232
End5	Resistance Tuning Error	232
End7	No-Load Current Alarm	232
Er-01	Motor Data Error	232
Er-02	Minor Fault	233
Er-03	OFF Button Input	233
Er-04	Line-to-Line Resistance Error	233
Er-05	No-Load Current Error	233
Er-08	Rated Slip Error	233
Er-09	Acceleration Error	233
Er-12	Current Detection Error	233

6.4 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 6.8 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
Cause	**Possible Solution**
• The power supply voltage exceeded the range listed in drive input power specifications. • Regenerative operation was performed when the power supply capacity was too small. • The power supply circuit opened during regeneration.	• Reduce the voltage to within the range in the power supply specifications. • Increase the capacity of the power supply.

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
Cause	**Possible Solution**
The capacity of the power supply is too small.	Increase the capacity of the power supply.
The distortion in the power supply is too large.	Lower the impedance of the input power supply wiring.
A phase loss occurred in the input power supply.	Check the input power supply for phase loss or an imbalance in the interphase voltages. Investigate and correct the cause and then reset the fault.
The built-in fuse is open.	An internal transistor was destroyed. The input wiring is grounded or short circuited. The output transistor has failed because the drive output has grounded or short circuited. Replace the board or the drive. For instructions on replacing the control board, contact Yaskawa or your nearest sales representative.

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.

HOA Keypad Display	Fault Name
The option card is not properly connected to the drive	• The connector pins on the option card do not line up properly with the connector pins on the drive. • Reinstall the option card.

HOA Keypad Display	Fault Name
CE	MEMOBUS/Modbus Communication Error
	Control data was not received for the CE detection time set to H5-09.
Cause	**Possible Solution**
Faulty communications wiring or an existing short circuit	• Check for faulty wiring. • Correct the wiring. • Check for disconnected cables and short circuits and repair as needed.
Communication data error occurred due to noise	• Check the various options available to minimize the effects of noise. • Counteract noise in the control circuit, main circuit, and ground wiring. • Use only recommended cables or other shielded line. Ground the shield on the controller side or the drive input power side. • Ensure that other equipment such as switches or relays do not cause noise. Use surge suppressors if required. • Separate all communication wiring from drive power lines.

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).
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
Cause	**Possible Solution**
Hardware is damaged.	• Cycle power to the drive. • If the problem continues, replace either the bypass control board or the entire drive. For instructions on replacing the control board, contact Yaskawa or your nearest sales representative.
Connector on the operator is damaged.	Replace the operator.

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
Cause	**Possible Solution**
• The capacity of the power supply is too small. • The distortion in the power supply is too large.	• Increase the capacity of the power supply. • Lower the impedance of the input power supply wiring.
A phase loss occurred in the input power supply.	Check the input power supply for phase loss or an imbalance in the interphase voltages.

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.
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-☐☐ = 24). • Reconnect the signal line.
Multi-function contact input setting is incorrect	• Check for unused terminals set for H1-☐☐ = 24 (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**

HOA Keypad Display	Fault Name
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. • Refer to cooling fan replacement instructions in ***Refer to Drive Cooling Fans on page 255***if the cooling fan has exceeded its expected performance life or is damaged in any other way.
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
FB01	Safety Open <1> **Note:** A fault reset is not required. Bypass contactor K3 is opened.
Cause	**Possible Solution**
The digital input set to Safety open is open	• Install a NC safety circuit between DI-☐ and IG-24 on PCB A2 • Install a jumper between DI-2 and IG-24 on PCB A2. Use this method if a safety circuit will be added in the future or is no safety circuit will be used at all.

<1> Parameter Z2-31, Safety Open Message Selection, determines the fault message displayed when FB01 is triggered.

HOA Keypad Display	Fault Name
FB02	BAS Interlock Open Time Out **Note:** A fault reset is required. An EF0 is sent to the drive and bypass contactor K3 is not affected.
	BAS/Damper Interlock Open, Interlock Wait Timer Expired
Cause	**Possible Solution**
The digital input set to BAS Interlock is open	• Install a NC BAS Interlock Circuit/Damper Interlock between DI-☐ and IG-24 on PCB A2 • Install a jumper between DI-2 and IG-24 on PCB A2. Use this method if a safety circuit will be added in the future or is no safety circuit will be used at all. • Verify that the input assigned for the BAS Interlock is active within the timeout period set in Z1-15.

HOA Keypad Display	Fault Name
FB03	External Fault Bypass (EFB) **Note:** A fault reset is required. An EF0 is sent to the drive and drive output contactor K2 and bypass contactor K3 are opened.
	External fault to bypass set
Cause	**Possible Solution**
An external fault (EFB) digital input became active.	Remove the cause of the external fault.
An external fault (EFB) was received from the serial communications network.	• Remove the cause of the external fault • Remove the external fault input from the controller. • Verify that the controller program is correct.

HOA Keypad Display	Fault Name
FB05	Motor Overload **Note:** A fault reset is required. An EF0 is sent to the drive and bypass contactor K3 is opened.
	Motor Overload detected
Cause	**Possible Solution**
Load is too heavy	Reduce the load.
Cycle times are too short during acceleration and deceleration.	Increase the acceleration and deceleration times (C1-01 and C1-02).
A general-purpose motor is driven below the rated speed with a high load	• Reduce the load. • Increase the speed. • If the motor is supposed to operate at low speeds, either increase the motor capacity or use a motor specifically designed to operate in the desired speed range.

HOA Keypad Display	Fault Name
The wrong motor rated current is set to E2-01	• Check the motor-rated current. • Enter the motor rated current to parameter E2-01 as indicated on the motor nameplate.
The maximum output frequency is set incorrectly	Check the E1-03 setting.
Multiple motors are running off the same bypass	Set L1-01 to 0 to disable the motor protection function and then install a thermal relay to each motor.
The electrical thermal protection characteristics and motor overload characteristics do not match.	• Check the motor characteristics. • Correct the type of motor protection that has been selected (L1-01). • Install an external thermal relay.
The electrical thermal relay is operating at the wrong level.	• Check the current rating listed on the motor nameplate. • Check the value set for the motor rated current (E2-01)

HOA Keypad Display	Fault Name
FB06	External Motor 1 Overload **Note:** A fault reset is not required. An EF0 is sent to the drive and bypass Contactor K3 is opened.
	S10 overload input is active for motor 1
Cause	**Possible Solution**
Load is too heavy	Reduce the load.
Cycle times are too short during acceleration and deceleration	Increase the acceleration and deceleration times (C1-01 and C1-02).
A general-purpose motor is driven below the rated speed with a high load	• Reduce the load. • Increase the speed. • If the motor is supposed to operate at low speeds, either increase the motor capacity or use a motor specifically designed to operate in the desired speed range.

HOA Keypad Display	Fault Name
FB07	External Motor 2 Overload **Note:** A fault reset is not required. An EF0 is sent to the drive and bypass contactor K3 is opened.
	External overload input is active for motor 2
Cause	**Possible Solution**
Load is too heavy	Reduce the load.
Cycle times are too short during acceleration and deceleration	Increase the acceleration and deceleration times (C1-01 and C1-02).
A general-purpose motor is driven below the rated speed with a high load	• Reduce the load. • Increase the speed. • If the motor is supposed to operate at low speeds, either increase the motor capacity or use a motor specifically designed to operate in the desired speed range.

HOA Keypad Display	Fault Name
FB08	Phase Loss Brownout **Note:** A fault reset is required. An EF0 is sent to the drive and drive output contactor K2 and bypass contactor K3 are opened.
	The contactor coil voltage was continuously detected below the configured brownout voltage level for the configured brownout time.
Cause	**Possible Solution**
Input power is too low.	Verify input power is sufficient to power the bypass.
Settings for brownout are incorrect.	Verify Z1-27 (Brownout Voltage Level) and Z1-28 (Brownout Time) are set properly.

HOA Keypad Display	Fault Name
FB09	Phase Loss Blackout **Note:** A fault reset is required. An EF0 is sent to the drive and drive output contactor K2 and bypass contactor K3 are opened.
	The contactor coil voltage was detected below the configured blackout voltage level.
Cause	**Possible Solution**
Input power is too low or has dipped too low.	Verify input power is sufficient to power the bypass.
Settings for blackout are incorrect.	Verify Z1-29 (Blackout Voltage Level) is set properly.

HOA Keypad Display	Fault Name
FB10	No Drive Comms **Note:** A fault reset is required. An EF0 is not sent to the drive and bypass contactor K3 is not affected.
	An unexpected loss of communication to the drive lasting longer than 15 seconds has been detected.
Cause	**Possible Solution**
The cable between the bypass controller and the drive is disconnected or has been damaged.	Verify the cable between the bypass controller board (A2) connector CN6 to drive terminal TB4 is connected at both ends and is not damaged.
The bypass controller circuit has become defective.	Replace the bypass control board.
The drive circuitry has become defective.	Replace the drive.

HOA Keypad Display	Fault Name
FB11	Bypass Board Hardware Error **Note:** A fault reset is not required. An EF0 is not sent to the drive. The drive output contactor K2 and bypass contactor K3 are opened.
	The bypass control board failed.
Cause	**Possible Solution**
An unexpected event occurred with the bypass controller circuitry.	Replace the bypass controller board.

HOA Keypad Display	Fault Name
FB12	Option Board Comms **Note:** Fault reset will not remove the fault.
	Loss of communication to the communication option board. This fault can only occur if the bypass is programmed to be controlled by the option card (one or more of the following): Z1-07 = 3, Z1-08 = 2, Z1-38 = 2, or Z1-39 = 2.
Cause	**Possible Solution**
Communication between the option card and bypass board have timed out and communication has stopped	Ensure the option card is mounted properly. Replace the option card and cycle power to the bypass board.

HOA Keypad Display	Fault Name
FB13	Loss of Load **Note:** A fault reset is required. An EF0 fault is sent to the drive and drive output contactor K2 and bypass contactor K3 are opened.
	The conditions were such that it appears the motor has become disconnected from the load.
Cause	**Possible Solution**
The motor is disconnect from the drive	Check the continuity between the drive/bypass and the motor.
The load has been disconnected from the motor	Check the belt/coupling between the motor and the load
The Loss of Load settings are not proper.	Review and adjust the Loss of Load parameters Z1-31 to Z1-36.

HOA Keypad Display	Fault Name
FB14	Serial Communications Fault **Note:** A fault reset is required. Behavior of the drive and the contactors during an FB14 fault is determined by parameter Z3-05.
	Serial communications timeout
Cause	**Possible Solution**
Faulty communication wiring or an existing short circuit.	• Check for faulty serial communication wiring • Correct the wiring • Check for disconnected cables and short circuits and repair as needed.
Communication data error occurred due to noise.	• Check the various options available to minimize the effects of noise • Counteract noise in the control circuit, main circuit, and ground wiring • Use only recommended cables or other shielded line. Ground the shield on the controller side • Ensure that other equipment such as switches or relays do not cause noise. Use surge suppressors if required • Separate all communication wiring from power lines. When the lines must cross, make the lines cross at a right angle to minimize noise coupling.

HOA Keypad Display	Fault Name
Communication Error timeout time not set properly.	Verify the setting of the serial communications fault time (Z3-06) is set properly.
Controller is not sending data soon enough to stop the timeout.	Verify the scan rate in the controller that is communicating with the bypass controller is proper. Adjust as necessary.

HOA Keypad Display	Fault Name
FB15	Input Phase Loss
Cause	**Possible Solutions**
Bypass Mode current unbalance condition exceeded the unbalance level limit set by Z1-50 for the amount of time specified in Z1-51.	• Check input wiring including fuses, breakers, and connections upstream from the bypass. • Check the motor wiring and connections.

HOA Keypad Display	Fault Name
FB16	Input Phase Rotation
Cause	**Possible Solution**
Incorrect phase rotation while Z1-52 is set to 2 in Bypass Mode.	Check the sequence (phase rotation) of the input wiring to the bypass package.

HOA Keypad Display	Fault Name
FbH	Excessive PID Feedback
	PID 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 PID 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
FbL	PID Feedback Loss
	This fault occurs when PID feedback loss detection is programmed to trigger a fault (b5-12 = 2) and the PID 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 PID 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.
Cause	**Possible Solution**
A momentary power loss occurred.	Reset the fault.
An input power supply wiring terminal is loose.	Check for loose terminals.
The fluctuation in the voltage of the input power supply is too large.	Increase the power supply frequency fault detection width (L2-27).
The built-in fuse is open.	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	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.

HOA Keypad Display	Fault Name
A damaged motor cable is creating a short circuit	• Check the motor cable. • Remove the short circuit and reapply power to the drive
	• Check the resistance between the cable and the ground terminal ⏚. • Replace the cable.
Excessive leakage current at the drive output	• Reduce the carrier frequency. • Reduce the amount of stray capacitance.
The drive started to run during a current offset fault or while coasting to a stop	• Set b3-01 to 1 to enable Speed Search at Start. • Perform Speed Search 1 or 2 (H1-□□ = 61 or 62) via one of the external terminals.
Hardware problem	If the problem continues, replace the control board or the entire drive. Contact Yaskawa or a Yaskawa representative for instructions on replacing the control board.

HOA Keypad Display	Fault Name
LF	Output Phase Loss
	• Phase loss on the output side of the drive. • Setting L8-07 to 1 or 2 enables Phase Loss Detection.
Cause	**Possible Solution**
The output cable is disconnected	• Check for wiring errors and properly connect the output cable. • Correct the wiring.
The motor winding is damaged	• Check the resistance between motor lines. • Replace the motor if the winding is damaged.
The output terminal is loose	• Apply the tightening torque specified in this manual to fasten the terminals. ***Refer to Wire Gauge and Tightening Torque Specifications on page 54*** 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 Wire Gauge and Tightening Torque Specifications on page 54*** 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	CanOpenNID 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.

HOA Keypad Display	Fault Name
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) • 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 on page 241 and check the control circuit lines, main circuit lines, and ground wiring.
Overexcitation gain is set too high	• Check if the fault occurs simultaneously with overexcitation function operation. • Consider motor flux saturation and reduce the value of n3-13 (Overexcitation Deceleration Gain).
Run command was applied while motor was coasting	• Set b3-01 to 1 to enable Speed Search at Start. • Program the Speed Search command input through one of the multi-function contact input terminals (H1-☐☐ = 61 or 62).
The rated output current of the drive is too small	Use a larger drive.

HOA Keypad Display	Fault Name
oFA00	Option Card Connection Error at Option Port CN5-A
	Option compatibility error
Cause	**Possible Solution**
The option card installed into port CN5-A is incompatible with the drive	Check if the drive supports the option card to be installed. Contact Yaskawa for assistance.

HOA Keypad Display	Fault Name
oFA01	Option Card Fault at Option Port CN5-A
	Option not properly connected
Cause	**Possible Solution**
The option card connection to port CN5-A is faulty	• Turn off the power and reconnect the option card. • Check if the option card is properly plugged into the option port. Make sure the card is fixed properly.

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**

Diagnostics & Troubleshooting

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HOA Keypad Display	Fault Name
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	Option card error occurred at Option Port CN5-B
oFb12 to oFb17	
Cause	**Possible Solution**
Option card or hardware is damaged	• Cycle power to the drive. • If the problem continues, replace the control board or the entire drive. Contact Yaskawa or a Yaskawa representative for instructions on replacing the control board.

HOA Keypad Display	Fault Name
oFC00	Option Card Connection Error at Option Port CN5-C
	Option compatibility error
Cause	**Possible Solution**
The option card installed into port CN5-C is incompatible with the drive	Confirm that the drive supports the option card to be installed. Contact Yaskawa for assistance.
A communication option card has been installed in option port CN5-C	Communication option cards are only supported by option port CN5-A. It is not possible to install more than one communication option.

HOA Keypad Display	Fault Name
oFC01	Option Card Fault at Option Port CN5-C
	Option not properly connected
Cause	**Possible Solution**
The option card connection to port CN5-C is faulty.	• Turn the power off and reconnect the option card. • Check if the option card is properly plugged into the option port. Make sure the card is fixed properly. • Try to use the card in a different option port. If the option card works properly in a different option port, CN5-C is damaged, and the drive requires replacement. If the error persists (oFA01 or oFb01 occur), replace the option card.

HOA Keypad Display	Fault Name
oFC02	Option Card Fault at Option Port CN5-C
	Same type of option card is currently connected
Cause	**Possible Solution**
An option card of the same type is already installed in option port CN5-A or CN5-B.	Only one of each option card type can only be installed simultaneously. Make sure only one type of option card is connected.
An input option card is already installed in option port CN5-A or CN5-B.	Install a communication option, a digital input option, or an analog input option. More than one of the same type of card cannot be installed simultaneously.

HOA Keypad Display	Fault Name
oFC03 to oFC11	Option Card Error Occurred at Option Port CN5-C
oFC12 to oFC17	
Cause	**Possible Solution**
Option card or hardware is damaged	• Cycle power to the drive. • If the problem continues, replace the control board or the entire drive. Contact Yaskawa or a Yaskawa representative for instructions on replacing the control board.

HOA Keypad Display	Fault Name
oFC50 to oFC55	Option Card Error Occurred at Option Port CN5-C
Cause	**Possible Solution**
Option card or hardware is damaged	Refer to the option manual for details.

HOA Keypad Display	Fault Name
oH	Heatsink Overheat
	The heatsink temperature exceeded the overheat pre-alarm level set to L8-02. The default value for L8-02 is determined by drive capacity (o2-04).
Cause	**Possible Solution**
Surrounding temperature is too high	• Check the temperature surrounding the drive. Verify temperature is within drive specifications. • Improve the air circulation within the enclosure panel. • Install a fan or air conditioner to cool the surrounding area. • Remove anything near the drive that might be producing excessive heat.
Load is too heavy	• Measure the output current. • Decrease the load. • Lower the carrier frequency (C6-02).
External cooling fan is stopped	• Replace the cooling fan. ***Refer to Drive Cooling Fan Replacement: Models 2□0028 to 2□0130 and 4□0011 to 4□0124 on page 257***. • 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, A2, or A3 exceeded the alarm detection level. • Detection requires setting multi-function analog inputs H3-02, H3-06, or H3-10 to E.
Cause	**Possible Solution**

HOA Keypad Display	Fault Name
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 and C1-02).
	• 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 and C1-02).
	• 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
Cause	**Possible Solution**
Load is too heavy	Reduce the load. **Note:** Reset oL1 when the U4-16 value falls below 100.0%. U4-16 value must be less than 100.0% before oL1 can be reset.
Cycle times are too short during acceleration and deceleration	Increase the acceleration and deceleration times (C1-01 and C1-02).
A general-purpose motor is driven below the rated speed with a high load	• Reduce the load. • Increase the speed. • If the motor is supposed to operate at low speeds, either increase the motor capacity or use a motor specifically designed to operate in the desired speed range.
The output voltage is too high	• Adjust the user-set V/f pattern (E1-04 through E1-10) by reducing E1-08 and E1-10. • Do not set E1-08 and E1-10 too low. This reduces load tolerance at low speeds.
The wrong motor rated current is set to E2-01	• Check the motor-rated current. • Enter the motor rated current to parameter E2-01 as indicated on the motor nameplate.
The base frequency is set incorrectly	• Check the rated frequency indicated on the motor nameplate. • Enter the rated frequency to E1-06 (Base Frequency).
The electrical thermal protection characteristics and motor overload characteristics do not match	• Check the motor characteristics. • Correct the type of motor protection that has been selected (L1-01). • Install an external thermal relay.
The electrical thermal relay is operating at the wrong level	• Check the current rating listed on the motor nameplate. • Check the value set for the motor rated current (E2-01).
Motor overheated by overexcitation operation	• Overexcitation increases the motor loss and the motor temperature. Excessive duration of overexcitation may cause motor damage. Prevent excessive overexcitation operation or apply proper cooling to the motor. • Reduce the excitation deceleration gain (n3-13). • Set L3-04 (Stall Prevention during Deceleration) to a value other than 4.

HOA Keypad Display	Fault Name
Parameters related to Speed Search are set incorrectly	• Check values set to Speed Search related parameters. • Reduce the Speed Search Operation Current Level 1 (Current Detection Type 2) (b3-31). • After Auto-Tuning, set b3-24 to 1 to enable Speed Estimation Speed Search.
Output current fluctuation due to power supply loss	Check the power supply for phase loss.

HOA Keypad Display	Fault Name
oL2	Overload
	The thermal sensor of the drive triggered overload protection.
Cause	**Possible Solution**
Load is too heavy	Reduce the load.
Acceleration or deceleration time is too short	Increase the settings for the acceleration and deceleration times (C1-01 and C1-02).
The output voltage is too high	• Adjust the preset V/f pattern (E1-04 through E1-10) by reducing E1-08 and E1-10. • Do not lower E1-08 and E1-10 excessively. This reduces load tolerance at low speeds.
Drive capacity is too small	Use a larger drive.
Overload occurred when operating at low speeds	• Reduce the load when operating at low speeds. • Use a larger drive. • Lower the carrier frequency (C6-02).
Excessive torque compensation	Reduce the torque compensation gain in parameter C4-01 until there is no speed loss but less current.
Parameters related to Speed Search are set incorrectly	• Check the settings for all Speed Search related parameters. • Adjust the current used during the Speed Search deceleration time (b3-03). • After Auto-Tuning, set b3-24 to 1 to enable Speed Estimation Speed Search.
Output current fluctuation due to input phase loss	Check the power supply for phase loss.

HOA Keypad Display	Fault Name
oL3	Overtorque Detection 1
	The current has exceeded the value set for Torque Detection Level 1 (L6-02) for longer than the allowable time (L6-03).
Cause	**Possible Solution**
Parameter settings are not appropriate for the load	Check L6-02 and L6-03 settings.
Fault on the machine side (e.g., machine is locked up)	Check the status of the load. Remove the cause of the fault.

HOA Keypad Display	Fault Name
oL4	Overtorque Detection 2
	The current has exceeded the value set for Torque Detection Level 2 (L6-05) for longer than the allowable time (L6-06).
Cause	**Possible Solution**
Parameter settings are not appropriate for the load	Check the settings of parameters L6-05 and L6-06.

HOA Keypad Display	Fault Name
oL5	Mechanical Weakening Detection 1
	Overtorque occurred, matching the conditions specified in L6-08.
Cause	**Possible Solution**
Overtorque triggered mechanical weakening detection level set to L6-08	Identify the cause of mechanical weakening.

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**

HOA Keypad Display	Fault Name
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
Cause	**Possible Solution**
Ground fault in the output circuit causing the capacitor to overcharge.	• Check the motor wiring for ground faults. • Correct grounding shorts and reapply power.
Drive input power voltage is too high.	• Check the voltage. • Lower drive input power voltage within the limits listed in the specifications.
The capacity of the input power supply is too small.	Use a power supply that has at least twice the input capacity of the drive.
The input power supply repeatedly turned on and off over a short period of time.	Implement countermeasures so that chattering does not occur for the input power supply.
An I/O terminal is loose.	Check the tightening torque of the I/O terminals.
Chattering in the magnetic contactor (MC) installed between the drive output terminals and the motor.	Implement countermeasures so that chattering does not occur for the MC.
There is a phase loss or an imbalance in the interphase voltages of the input power supply.	Check the status of the input power supply and eliminate phase losses and imbalance.

HOA Keypad Display	Fault Name
SCF	Safety Circuit Fault
	Safety Circuit Fault is detected.
Cause	**Possible Solution**
The safety 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	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.

HOA Keypad Display	Fault Name
SoH	Snubber Discharge Resistor Overheat
Cause	**Possible Solution**
• The input power supply voltage is too high. • The capacity of the power supply is too small. • The distortion in the power supply is too large.	• Reduce the voltage to within the range in the power supply specifications. • Increase the capacity of the power supply. • Lower the impedance of the input power supply wiring.
The load was too large during repetitious operation.	• Check the load conditions. Reduce the load. • Increase the acceleration/deceleration time.
A phase loss occurred in the input power supply.	Check the input power supply for phase loss or an imbalance in the interphase voltages.

HOA Keypad Display	Fault Name
SrC	Phase Order Detection Fault
	The phase rotation direction for the input power supply changed.

HOA Keypad Display	Fault Name
Cause	**Possible Solution**
The power supply phase order changed during operation.	Investigate and correct the cause and reset the fault. *Refer to Diagnosing and Resetting Faults on page 234*.
An input power supply wiring terminal is loose.	
The fluctuation in the voltage of the input power supply is too large.	

HOA Keypad Display	Fault Name
Srr	Internal Resistance Fault
	An operation failure occurred in the snubber discharge resistor circuit.
Cause	**Possible Solution**
The snubber discharge resistor or peripheral circuits failed.	• Cycle power to the drive. • 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.

HOA Keypad Display	Fault Name
SvE	Zero Servo Fault
	Position deviation during zero servo.
Cause	**Possible Solution**
Torque limit is set too low	Set the torque limit to an appropriate value using parameters L7-01 to L7-04.
Excessive load torque	Reduce the amount of load torque.

HOA Keypad Display	Fault Name
TdE	Time Data Error
Cause	**Possible Solution**
An error has occurred in the Real-Clock Time function of the HOA keypad	Replace the HOA keypad. For instructions on replacing the HOA keypad, contact Yaskawa or your nearest sales representative.
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**
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 Wire Gauge and Tightening Torque Specifications on page 54*** 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.

6.5 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 6.9 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 parameters to the proper values when using options.

HOA Keypad Display	Fault Name
AL02	BAS Interlock Open
Cause	**Possible Solution**
The digital input set to BAS interlock is open	Check to see if the damper is functioning properly. The damper may be in the process of opening and the end switch may not have closed.

HOA Keypad Display	Fault Name
AL03	Smoke Purge in Bypass **Note:** Also referred to as “Fireman's Override” (Bypass).
Cause	**Possible Solution**
Smoke Purge Bypass input is activated	This is typically an intentional emergency run state. Check the Z2-□□ digital input settings to determine which is set to 25, then check to the physical digital input terminal DI-□□ to determine why it is closed.

HOA Keypad Display	Fault Name
AL04	Smoke Purge in Drive **Note:** Also referred to as “Fireman's Override” (Drive).
Cause	**Possible Solution**
Smoke Purge Drive input is activated	This is typically an intentional emergency run state. Check the digital input settings (Z2-□□) to determine which is set to 25. Then check to the physical digital input terminal DI-□□ to determine why it is closed.

HOA Keypad Display	Fault Name
AL09	Run Active during Restart Delay
Cause	**Possible Solution**
Drive run command is asserted during the restart delay.	This is not a fault condition, just informative to show why the drive is not running. If the run command to the drive is removed, the AL09 alarm will not be shown.

HOA Keypad Display	Fault Name
AL13	Loss of Load
Cause	**Possible Solution**
The conditions were such that it appears that the motor has been disconnected from the load.	Replace the belt or coupling between the motor and the load. In the event of a false detection, review parameters Z1-27 to Z1-32 and set them to more appropriate values.

HOA Keypad Display	Fault Name
AL14	Serial Comm Alarm
Cause	**Possible Solution**

HOA Keypad Display	Fault Name
Faulty communication wiring or an existing short circuit.	• Check for faulty serial communication wiring • Correct the wiring • Check for disconnected cables and short circuits and repair as needed.
Communication data error occurred due to noise.	• Check the various options available to minimize the effects of noise • Counteract noise in the control circuit, main circuit, and ground wiring • Use only recommended cables or other shielded line. Ground the shield on the controller side • Ensure that other equipment such as switches or relays do not cause noise. Use surge suppressors if required • Separate all communication wiring from power lines. When the lines must cross, make the lines cross at a right angle to minimize noise coupling.
Communication Error timeout time not set properly.	Verify the setting of the serial communications fault time (Z3-06) is set properly.
Controller is not sending data soon enough to stop the timeout.	Verify the scan rate in the controller that is communicating with the bypass controller is proper. Adjust as necessary.

HOA Keypad Display	Minor Fault Name
AL16	Input Phase Rotation
Cause	**Possible Solution**
Incorrect phase rotation while Z1-52 is set to 1 in Bypass Mode.	Check the sequence (phase rotation) of the input wiring to the bypass package.

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
Cause	**Possible Solution**
The power supply voltage is low.	Increase the power supply voltage.
A phase loss occurred in the input power supply.	Check the input power supply for phase loss or an imbalance in the interphase voltages. Investigate and correct the cause and then reset the fault.
Voltage detection failed.	Correctly wire r1/ l11, s1/ l21, and t1/ l31.

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.

HOA Keypad Display	Minor Fault Name
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**
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.
Cause	**Possible Solution**
• The capacity of the power supply is too small. • The distortion in the power supply is too large.	• Increase the capacity of the power supply. • Lower the impedance of the input power supply wiring.
A phase loss occurred in the input power supply.	Check the input power supply for phase loss or an imbalance in the interphase voltages.

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.

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-☐☐ = 24). • Reconnect the signal line.
Multi-function contact inputs are set incorrectly	• Check if the unused terminals have been set for H1-☐☐ = 24 (External Fault). • Change the terminal settings.

HOA Keypad Display	Minor Fault Name
FbH	Excessive PID Feedback
	The PID 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**

HOA Keypad Display	Minor Fault Name
Parameter settings for b5-36 and b5-37 are incorrect	Check parameters b5-36 and b5-37.
PID 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	PID Feedback Loss
	The PID 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.
PID 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
Fdv	Power Supply Frequency Fault
	The input power supply frequency exceeded the allowable frequency fluctuation.
Cause	**Possible Solution**
A momentary power loss occurred.	Reset the fault.
An input power supply wiring terminal is loose.	Check for loose terminals.
The fluctuation in the voltage of the input power supply is too large.	Increase the Power Supply Frequency Fault Detection Width (L2-27).
The built-in fuse is open.	Replace either the control board or the entire drive. For instructions on replacing the control board, contact Yaskawa or your nearest sales representative.
The phase rotation direction has changed in the input power supply.	Correct the wiring.
The detected power supply frequency exceeded the allowable value.	Improve the power supply.

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 and C1-02). • 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
inTLK	Interlock Open
	ALM LED will not blink
Cause	**Possible Solutions**
BAS Interlock multi-function input is open	Check the cause of interlock.

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**
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 39*** for details. • Allow for the proper space and ensure that there is sufficient circulation around the control panel.
	• Check for dust or other foreign materials clogging the cooling fan. • Clear debris caught in the fan that restricts air circulation.

HOA Keypad Display	Minor Fault Name
oH2	Drive Overheat Warning
	"Drive Overheat Warning" was input to a multi-function input terminal, S1 through S8 (H1-☐☐= B).
Cause	**Possible 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.

HOA Keypad Display	Minor Fault Name
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 and C1-02). • 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
Cause	**Possible Solution**
Surge voltage present in the drive input power.	Voltage surge can result from a thyristor convertor and a phase advancing capacitor operating on the same drive input power system.
Drive input power voltage is too high.	• Check the voltage. • Lower drive input power voltage within the limits listed in the specifications.
The capacity of the input power supply is too small.	Use a power supply that has at least twice the input capacity of the drive.
The input power supply repeatedly turned on and off over a short period of time.	Implement countermeasures so that chattering does not occur for the input power supply.
An I/O terminal is loose.	Check the tightening torque of the I/O terminals.
There is a phase loss or an imbalance in the interphase voltages of the input power supply.	Check the status of the input power supply and eliminate phase losses and imbalance.

HOA Keypad Display	Minor Fault Name
PASS	MEMOBUS/Modbus Comm. Test Mode Complete
Cause	**Possible Solutions**
MEMOBUS/Modbus test has finished normally	This verifies that the test was successful.

HOA Keypad Display	Minor Fault Name
SAFE	Customer Safety
	Customer Safeties multi-function input is open. This alarm has display priority over the Interlock Open (inTLK).
Cause	**Possible Solutions**
External contact from customer wiring is open.	Check the cause of the open safety.

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**

HOA Keypad Display	Minor Fault Name
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.
Cause	**Possible Solution**
An input power supply wiring terminal is loose.	Investigate and correct the cause and reset the fault. *Refer to Diagnosing and Resetting Faults on page 234*.
The fluctuation in the voltage of the input power supply is too large.	

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 and DC bus voltage is under L2-05.
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 Wire Gauge and Tightening Torque Specifications on page 54*.
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.

6.6 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 6.10* 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 6.10 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 H1-08.
Cause	**Possible Solutions**
• The same function is assigned to two multi-function inputs • Excludes “Not used” and “External Fault”	• Ensure all multi-function inputs are assigned to different functions. • Re-enter the multi-function settings to ensure this does not occur.
The Up command was set but the Down command was not, or vice versa (settings 10 vs. 11)	Properly set the functions that required for use in combination with other functions.
• 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 PID control (b5-01) are enabled simultaneously	Set b5-01 to 0 to disable control PID or disable the Up/Down command.
Settings for N.C. and N.O. input for the following functions were selected simultaneously: • External Search Command 1 and External Search Command 2 (61 vs. 62) • Fast Stop N.O. and Fast Stop N.C. (15 vs. 17) • 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
H2-□□ is set to 38 (Drive Enabled) and H1-□□ is not set to 6A (Drive Enable)	Correct the settings for the multi-function input terminal parameters.

HOA Keypad Display	Error Name
oPE04	Initialization Required
Cause	**Possible Solutions**
The drive, control board, or terminal board have been replaced and the parameter settings between the control board and the terminal board no longer match.	Set A1-03 to 5550 to load the parameter settings stored in the terminal board to the drive. Initialize parameters after drive replacement by setting A1-03 to 2220 or 3330.

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, H3-10, and H3-06 and PID functions conflict.
Cause	**Possible Solutions**
At least two analog input terminals are set to the same function	Change the settings to H3-02, H3-10, and H3-06 so that functions no longer conflict. **Note:** Both 0 (Frequency Reference Bias) and F (Not Used) can be set to H3-02, H3-10, and H3-06 simultaneously.
The following simultaneous contradictory settings: H3-02, H3-10, or H3-06 = C (PID Target Value) while b5-18 = 1 (enables b5-19 as the target PID value)	Disable one of the PID selections.

HOA Keypad Display	Error Name
oPE08	Parameter Selection Error
Cause	**Possible Solutions**
A function has been set that cannot be used in the control mode.	The bypass only supports V/f control mode. Limit selections to those with V/f mode compatibility.
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	PID Control Selection Fault
	PID control function selection is incorrect. Requires that PID 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 (PID Sleep Function Operation Level) • The stopping method is set to either DC Injection Braking or coast to stop with a timer (b1-03 = 2 or 3)	• Set b5-15 to a value other than 0.0. • Set the stopping method to coast to stop or ramp to stop (b1-03 = 0 or 1).
b5-01 is set to 1, enabling PID control, but the lower limit for the frequency reference (d2-02) is not set to 0 while reverse output is enabled (b5-11 = 1)	Correct the parameter settings.
b5-01 is set to 3, enabling PID control, but the lower limit for the frequency reference (d2-01) is not 0	Correct the parameter settings.

HOA Keypad Display	Error Name
oPE10	V/f Data Setting Error
	One of the following setting errors has occurred: E1-04 ≥ 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)	

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.
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.

6.7 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 6.11 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.

6.8 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 234*** 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

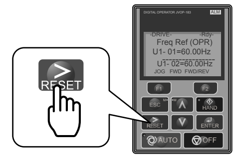
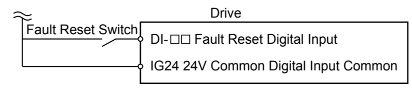
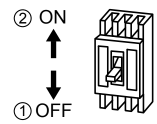
1. Look at the HOA keypad for information on the fault that occurred.
2. ***Refer to Fault Displays, Causes, and Possible Solutions on page 205***.
3. Reset the fault. ***Refer to Fault Reset Methods on page 234***.

◆ Viewing Fault Trace Data After Fault

	Step		Display/Result
1.	Turn on the drive input power. The first screen displays.	➡	DRV-OFF Freq Ref (AUTO) U1-01= 0.00Hz U1-02= 0.00Hz LSEQ U1-03= 0.00 A LREF RLY DRV/BYP
2.	Press ∧ or ∨ until the monitor screen is displayed.	➡	DRV-OFF Monitor Menu U1-01= 60.00Hz U1-02= 0.00Hz LSEQ U1-03= 0.00 A LREF RLY DRV/BYP
3.	Press ENTER to display the parameter setting screen.	➡	DRV-OFF Monitor U1-01= 60.00Hz U1-02= 0.00Hz LSEQ U1-03= 0.00 A LREF RLY DRV/BYP
4.	Press ∧ and RESET to scroll to monitor U2-02. The fault code shown in U2-02 is the fault that occurred most recently.	➡	DRV-OFF Last Fault U2-02= oC U2-03= 0.00Hz LSEQ U2-04= 0.00Hz LREF RLY DRV/BYP
5.	Press ∧ to view drive status information when fault occurred. Parameters U2-03 through U2-32 help determine the cause of a fault. Parameters to be monitored differ depending on the control mode.	➡	DRV-OFF Frequency Ref U2-03= 0.00Hz U2-04= 0.00Hz LSEQ U2-05= 0.00A LREF RLY DRV/BYP ⇣ ⇡ DRV-OFF Heatsink Temp U2-20= XX°C U2-01= - - - - - LSEQ U2-02= - - - - - LREF RLY DRV/BYP

◆ Fault Reset Methods

When a fault occurs, the cause of the fault must be removed and the drive must be restarted. The table below lists the different ways to restart the drive.

After the Fault Occurs	Procedure	
Fix the cause of the fault, restart the drive, and reset the fault	Press RESET on the HOA keypad.	
Resetting via Fault Reset Digital Input DI-☐☐ Resetting via Fault Reset serial command.	Close then open the fault signal digital input via the digital input defined as Fault Reset (one of Z2-01 through Z2-08 set to 34).	
Turn off the main power supply if the above methods do not reset the fault. Reapply power after the HOA keypad display has turned off. When an “SC” error occurs, contact Yaskawa or a Yaskawa agent before cycling the power to the drive.		

Note: If the Run command is present, the drive will disregard any attempts to reset the fault. Remove the Run command or press “OFF” on the HOA keypad before attempting to clear a fault situation.

Diagnostics & Troubleshooting

6

6.9 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 200* for guidance on troubleshooting.

- Motor hunting and oscillation
- Poor motor torque
- Poor speed precision
- Poor motor torque and speed response
- Motor noise

◆ Common Problems

Common Problems		Page
Cannot Change Parameter Settings		236
Motor Does Not Rotate Properly after Pressing RUN Button or after Entering External Run Command	Motor Does Not Rotate	237
	Motor Rotates in the Opposite Direction from the Run Command	239
	Motor Rotates in One Direction Only	239
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The Safety Controller Does Not Recognize Safe Disable Monitor Output Signals (Terminals DM+ and DM-)		243

◆ 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 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 and Programming Modes on page 86*.
A multi-function contact input terminal is set to allow or restrict parameter editing (H1-01 through H1-07 = 1B).	• When the terminal is open, parameters cannot be edited. • Turn on the multi-function contact input set to 1B.
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 Z1-02. Press OFF and Λ simultaneously. Parameter Z1-03 will appear. • Set a new password to parameter Z1-03.
Undervoltage was detected.	• Check the drive input power voltage by looking at the DC bus voltage (U1-07). • Check all main circuit wiring.

◆ Motor Does Not Rotate Properly after Pressing AUTO Button or after Entering External Run Command

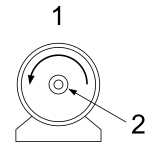
■ Motor Does Not Rotate

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 and Programming Modes on page 86***.
HAND was pushed.	Stop the drive and check if the correct frequency reference source is selected. If the operator keypad shall be the source, the LO/RE button LED must be on. If the source is REMOTE, it must be off. Take the following steps to solve the problem: • Push HAND.
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 and Programming Modes on page 86***.
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 Z1-08 (Run Command Selection). Set Z1-08 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.	If the frequency reference is set at terminal A1, check parameter H3-01 for the correct signal level selection. If terminal A2 is used, check parameter H3-09. If terminal A3 is used, check parameter H3-06. ***Refer to Terminals A1, A2, and A3 Input Signal Selection on page 73***.
Selection for the sink/source mode and the internal/external power supply is incorrect.	Check wire jumper connection between terminals SC and SP.
Frequency reference is too low.	Check the frequency reference monitor (U1-01).
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 inputs A1 or A2 are set for frequency reference gain (H3-02, H3-10 = 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 and H3-10 have been set to the proper values. • Check if the analog input value has been set properly. (U1-13 and U1-14)
OFF was pressed when the drive was started from a REMOTE source.	• Pressing OFF 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 OFF.
Motor starting torque is too low.	***Refer to Motor Performance Fine-Tuning on page 200***.
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.

■ 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 and Programming Modes on page 86*.
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 and Programming Modes on page 86*.
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.	If the frequency reference is set at terminal A1, check parameter H3-01 for the correct signal level selection. If terminal A2 is used, check parameter H3-09. If terminal A3 is used, check parameter H3-06. *Refer to Terminals A1, A2, and A3 Input Signal Selection on page 73*.
Selection for the sink/source mode and the internal/external power supply is incorrect.	Check wire jumper connection between terminals SC and SP.
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 200*.
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.
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 max voltage surge. • Use an inverter-duty motor rated for use with AC drives when using the motor on drives rated higher than 208 V. • Install an AC reactor on the output side of the drive. The carrier frequency should be set to 2 kHz when installing an AC reactor.
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.

◆ 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 parameter has been set too long (C1-01).
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.
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 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).

Cause	Possible Solutions
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 time C1-02 to a more appropriate value.
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 parameter C6-02.
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
Gain is too low when using PI control.	*Refer to b5: PID Control on page 110* 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 for line-to-line resistance. • 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.
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 110* 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.

◆ 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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7

Periodic Inspection & Maintenance

This chapter describes the periodic inspection and maintenance of the bypass to ensure that it receives the proper care to maintain overall performance.

7.1 Section Safety

⚠ WARNING

Electrical Shock Hazard

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

Failure to comply could result in death or serious injury.

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

Do not operate equipment with covers removed.

Failure to comply could result in death or serious injury.

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

Always ground the motor-side grounding terminal.

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

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

Failure to comply could result in death or serious injury.

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

Failure to comply could result in death or serious injury.

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

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

Failure to comply could result in death or serious injury.

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

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

Failure to comply could result in death or serious injury.

Before servicing, disconnect all power to the equipment. The internal capacitor remains charged even after the power supply is turned off. The charge indicator LED will extinguish when the DC bus voltage is below 50 Vdc. To prevent electric shock, wait for at least the time specified on the warning label; after all indicators are OFF, measure the DC bus voltage level to confirm it has reached a safe level.

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.

Follow cooling fan replacement instructions. The cooling fan cannot operate properly when it is installed incorrectly and could seriously damage the drive.

Follow the instructions in this manual to replace the cooling fan, making sure that the label is on top before inserting the cooling fan into the drive. To ensure maximum useful product life, replace both cooling fans when performing maintenance.

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

Improper equipment sequencing could result in damage to the drive.

Do not use unshielded cable for control wiring.

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

Do not allow unqualified personnel to use the product.

Failure to comply could result in damage to the drive or braking circuit.

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

Do not modify the drive circuitry.

Failure to comply could result in damage to the drive and will void warranty.

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

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

Failure to comply could result in damage to the drive.

Comply with proper wiring practices.

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

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

Frequently switching the drive power supply to stop and start the motor can damage the drive.

To get the full performance life out of the electrolytic capacitors and circuit relays, refrain from switching the drive power supply off and on more than once every 30 minutes. Frequent use can damage the drive. Use the drive to stop and start the motor.

Do not operate damaged equipment.

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

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

7.2 Inspection

Power electronics have limited life and may exhibit changes in characteristics or performance deterioration after years of use under normal conditions. To help avoid such problems, it is important to perform preventive maintenance and periodic inspection on the drive.

Drives contain a variety of power electronics such as power transistors, semiconductors, capacitors, resistors, fans, and relays. The electronics in the drive serve a critical role in maintaining proper motor control.

Follow the inspection lists provided in this chapter as a part of a regular maintenance program.

Note: The drive will require more frequent inspection if it is placed in harsh environments, such as:

- High ambient temperatures
- Frequent starting and stopping
- Fluctuations in the AC supply or load
- Excessive vibrations or shock loading
- Dust, metal dust, salt, sulfuric acid, chlorine atmospheres
- Poor storage conditions.

Perform the first equipment inspection one to two years after installation.

◆ Recommended Daily Inspection

Table 7.1 outlines the recommended daily inspection for Yaskawa drives. Check the following items on a daily basis to avoid premature deterioration in performance or product failure. Copy this checklist and mark the “Checked” column after each inspection.

Table 7.1 General Recommended Daily Inspection Checklist

Inspection Category	Inspection Points	Corrective Action	Checked
Motor	Inspect for abnormal oscillation or noise coming from the motor.	• Check the load coupling. • Measure motor vibration. • Tighten all loose components.	
Cooling	Inspect for abnormal heat generated from the drive or motor and visible discoloration.	Check for the following: • Excessive load. • Loose connections. • Dirty heatsink or motor. • Ambient temperature.	
	Inspect drive cooling fan and circulation fan operation.	Check for the following: • Clogged or dirty fan. • Correct Fan operation parameter setting.	
Environment	Verify the drive environment complies with the specifications listed in the Specifications chapter in the User Manual packaged with the drive.	Eliminate the source of contaminants or correct poor environment.	
Load	The drive output current should not be higher than the motor or drive rating for an extended period of time.	Check for the following: • Excessive load. • Correct motor parameter settings.	
Power Supply Voltage	Check main power supply and control voltages.	• Correct the voltage or power supply to within nameplate specifications. • Verify all main circuit phases.	

◆ Recommended Periodic Inspection

Table 7.2 outlines the recommended periodic inspections for Yaskawa drive installations. Although periodic inspections should generally be performed once a year; the drive may require more frequent inspection in harsh environments or with rigorous use. Operating and environmental conditions, along with experience in each application, will determine the actual inspection frequency for each installation. Periodic inspection will help to avoid premature deterioration in performance or product failure. Copy this checklist and mark the "Checked" column after each inspection.

■ Periodic Inspection

WARNING! *Electrical Shock Hazard. Do not inspect, connect, or disconnect any wiring while the power is on. Failure to comply can result in serious personal injury. Before servicing, disconnect all power to the equipment. The internal capacitor remains charged even after the power supply is turned off. The charge indicator LED will extinguish when the DC bus voltage is below 50 Vdc. To prevent electric shock, wait for at least the time specified on the warning label; after all indicators are OFF, measure for unsafe voltages to confirm the drive is safe prior to servicing.*

Table 7.2 Periodic Inspection Checklist

Inspection Area	Inspection Points	Corrective Action	Checked
Main Circuit Periodic Inspection			
General	• Inspect equipment for discoloration from overheating or deterioration. • Inspect for damaged or deformed parts.	• Replace damaged components as required. • The drive has few serviceable parts and may require complete drive replacement.	
	Inspect for dirt, foreign particles, or dust collection on components.	• Inspect enclosure door seal if used. • Remove foreign particles and dust with a vacuum cleaner to avoid touching parts. • Replace components if cleaning is not possible.	
Conductors and Wiring	• Inspect wiring and connections for discoloration, damage, or heat stress. • Inspect wire insulation and shielding for wear.	Repair or replace damaged wiring.	
Terminals	Inspect terminals for stripped, damaged, or loose connections.	Tighten loose screws and replace damaged screws or terminals.	
Relays and Contactors	• Inspect contactors and relays for excessive noise during operation. • Inspect coils for signs of overheating such as melted or cracked insulation.	• Check coil voltage for overvoltage or undervoltage conditions. • Replace damaged removable relays, contactors, or circuit board.	
Electrolytic Capacitor	• Inspect for leaking, discoloration, or cracks. • Check if the cap has come off, for any swelling, or if the sides have burst open.	The drive has few serviceable parts and may require complete drive replacement.	
Diode, IGBT (Power Transistor)	Inspect for dust or other foreign material collected on the surface.	Remove foreign particles and dust with a vacuum cleaner to avoid touching parts.	
Motor Periodic Inspection			
Operation Check	Check for increased vibration or abnormal noise.	Stop the motor and contact qualified maintenance personnel as required.	
Control Circuit Periodic Inspection			
General	• Inspect terminals for stripped, damaged, or loose connections. • Make sure all terminals have been properly tightened.	• Tighten loose screws and replace damaged screws or terminals. • If terminals are integral to a circuit board, then board or drive replacement may be required.	
Circuit Boards	Check for any odor, discoloration, and rust. Make sure connections are properly fastened and that no dust or oil mist has accumulated on the surface of the board.	• Fix any loose connections. • If an antistatic cloth or vacuum plunger cannot be used, replace the board. • Do not use any solvents to clean the board. • Remove foreign particles and dust with a vacuum cleaner to avoid touching parts. The drive has few serviceable parts and may require complete drive replacement.	
Cooling System Periodic Inspection			
Cooling Fan, Circulation Fan, Control Board Cooling Fan	• Check for abnormal oscillation or unusual noise. • Check for damaged or missing fan blades.	• Replace as required. • ***Refer to Drive Cooling Fans on page 255*** for information on cleaning or replacing the fan.	
Heatsink	Inspect for dust or other foreign material collected on the surface.	Remove foreign particles and dust with a vacuum cleaner to avoid touching parts.	

Inspection Area	Inspection Points	Corrective Action	Checked
Air Duct	Inspect air intake and exhaust openings. They must be free from obstruction and properly installed.	• Visually inspect the area. • Clear obstructions and clean air duct as required.	
Display Periodic Inspection			
HOA Keypad	• Make sure data appears on the display properly. • Inspect for dust or other foreign material that may have collected on surrounding components.	• Contact the nearest sales office if there is any trouble with the display or keypad. • Clean the HOA keypad.	

7.3 Periodic Maintenance

The drive has Maintenance Monitors that keep track of component wear. This feature provides advance maintenance warning and eliminates the need to shut down the entire system for unexpected problems. The drive allows the user to check predicted maintenance periods for the components listed below.

- Cooling Fan, Circulation Fan, Control Board Cooling Fan
- Electrolytic Capacitors
- Inrush Prevention Circuit
- IGBTs

For replacement parts, contact the distributor where the drive was purchased or contact Yaskawa directly.

◆ Replacement Parts

Table 7.3 contains the estimated performance life of components that require replacement during the life of the drive. Only use Yaskawa replacement parts for the appropriate drive model and revision.

Table 7.3 Estimated Performance Life

Component	Estimated Performance Life
Cooling Fan, Circulation Fan	5 years
Electrolytic Capacitors	5 years <1>

<1> The drive has few serviceable parts and may require complete drive replacement.

NOTICE: *Estimated performance life based on specific usage conditions. These conditions are provided for the purpose of replacing parts to maintain performance. Some parts may require more frequent replacement due to poor environments or rigorous use.*
Usage conditions for estimated performance life:
Ambient temperature: Yearly average of 30 °C (IP20/NEMA Type 1 enclosure, external heatsink)
Load factor: 80% maximum
Operation time: 24 hours a day

■ Performance Life Monitors Maintenance Monitors

The drive calculates the maintenance period for components that may require replacement during the life of the drive. A percentage of the maintenance period is displayed on the HOA keypad by viewing the appropriate monitor parameter.

When the maintenance period reaches 100%, there is increased risk that the drive may malfunction. Yaskawa recommends checking the maintenance period regularly to ensure maximum performance life.

Refer to Recommended Periodic Inspection on page 249 for more details.

Table 7.4 Performance Life Monitors Used for Component Replacement

Parameter	Component	Contents
U4-03	Cooling Fan Circulation Fan Control Board Cooling Fan	Displays the accumulated operation time of the fan, from 0 to 99999 hours. This value is automatically reset to 0 once it reaches 99999.
U4-04		Displays the accumulated fan operation time as a percentage of the specified maintenance period.
U4-05	DC Bus Capacitors	Displays the accumulated time the capacitors are used as a percentage of the specified maintenance period.
U4-06	Inrush (pre-charge) Relay	Displays the number of times the drive is powered up as a percentage of the performance life of the inrush circuit.

■ Alarm Outputs for Maintenance Monitors

An output can be set up to inform the user when a specific components has neared its expected performance life.

When one of multi-function digital output terminals has been assigned the maintenance monitor function (H2-□□ = 2F), the terminal will close when the cooling fan, DC bus capacitors, or DC bus pre-charge relay reach 90% of the expected performance life, or when the IGBTs have reached 50% of their expected performance life. Additionally the HOA keypad will display an alarm like shown in *Table 7.5* to indicate the specific components that may need maintenance.

Table 7.5 Maintenance Alarms

HOA Keypad Alarm Display		Function	Corrective Action
LT-1	LT-1	The cooling fans have reached 90% of their designated life time.	Replace the cooling fan.
LT-2	LT-2	The DC bus capacitors have reached 90% of their designated life time.	Contact a Yaskawa representative or the nearest Yaskawa sales office on possible drive replacement.
LT-3	LT-3	The DC bus charge circuit has reached 90% of its designated life time.	Contact a Yaskawa representative or the nearest Yaskawa sales office on possible drive replacement.

7.4 HOA Keypad Battery Replacement

The HOA keypad contains a monitor battery that allows the user to check drive functions. The battery requires periodic replacement because the lifespan of the battery is shorter than the performance life of the HOA keypad.

WARNING! *Fire Hazard. Properly handle the HOA keypad battery. Improper use of the battery may cause fire by explosion and injury. Correctly install the battery, paying attention to polarity (+/-). Do not charge the battery or improperly disassemble the HOA keypad.*

When replacing the battery, use a Hitachi Maxell CR1220 Lithium Manganese Dioxide Battery or an equivalent battery with the following specifications:

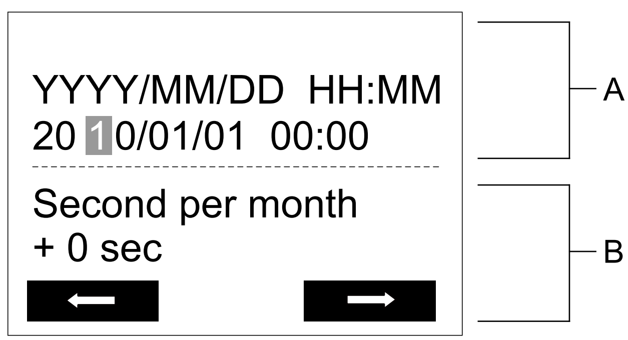
- Nominal Voltage 3 V
- Operating Temperature Range -20 °C to +85 °C
- Nominal battery life of 2 years (ambient temperature of +20 °C).

NOTICE: *Do not heat or throw the battery into fire. The battery remains in use even when power to the drive has been shut off. Be sure to also remove the battery in the HOA keypad when the drive will be shut off for long periods of time.*
A dead battery left inside the HOA keypad may leak and damage the keypad and drive. Replace the battery with a new one immediately after the expected lifespan has passed or when the "bAT" error is displayed on the HOA keypad.

NOTICE: *Observe Perchlorate Best Management Practices (BMPs). BMPs apply to primary lithium (manganese dioxide) coin batteries sold or distributed in California. Perchlorate Material special handling may apply, please refer to: www.dtsc.ca.gov/hazardouswaste/perchlorate.*

◆ Real-Time Clock Adjustment

The HOA keypad will display the Real Time Clock Adjustment Display as shown in ***Figure 7.1*** where the user the user can adjust the Real-Time Clock. ***Refer to Manual Clock Adjustment Procedure on page 254*** for the Real-Time Clock setting procedure.



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

Figure 7.1 Real Time Clock Adjustment Display

Display	Description
YYYY	Set the year with the last two digits.
MM	Set the month with two digits.
DD	Set the day with two digits.
HH:MM	Set the hours and minutes, with two digits for each.
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.

■ Manual Clock Adjustment by Setting Z1-37 to 1

If time and date stamps are required by the user for faults and other data, the Real-time clock will need to be set upon receipt of the bypass or after HOA keypad battery replacement.

Refer to Z1-37: Set Time on page 183 for details on parameter Z1-37.

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 7.6 illustrates how to set the Real-Time Clock manually.

Table 7.6 Manual Clock Adjustment Procedure

Procedure			Display
1	Use the up and down arrow keys to scroll through display menu until the screen shows “Programming”.	➡	DRV-OFF Programming HELP DATA
2	Press the ENTER key to enter select the parameter setting mode.	➡	DRV-OFF Application Sel A1-06=0 *0* General HOME DATA
3	Use the up and down arrow keys to scroll through display menu until parameter Z1-37 appears.	➡	DRV-OFF Maintenance Z1-37= 0 *0* Set time ← →
4	Press the ENTER key until “0” flashes.	➡	DRV-OFF Set time Z1-37=0 *0* “0” ← →
5	Press the up arrow key so that the display changes to “1”.	➡	DRV-OFF Set time Z1-37=1 *0* Set “0” ← →
6	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.	➡	YYYY/MM/DD HH:MM 2010/01/01 00:00 Second per month + 0 sec ← →
7	After entering the correct time, press the ENTER key to save the changes.	➡	Entry Accepted

7.5 Drive Cooling Fans

NOTICE: *Follow cooling fan replacement instructions. The cooling fan cannot operate properly when installed incorrectly and could seriously damage the drive. To ensure maximum useful product life, replace all cooling fans when performing maintenance.*

Contact Yaskawa or a Yaskawa representative to order replacement cooling fans as required.

For drives with multiple cooling fans, replace all the fans when performing maintenance to ensure maximum product performance life.

◆ Number of Cooling Fans

Bypass Model	Drive Model	Cooling Fans	Circulation Fans	Bypass Enclosure Fans		Page
				Type 1	Type 12	
Three-Phase 200 V Class						
D024	2□0028	2	–	2	–	257
D030	2□0042	2	–	1	–	
D046	2□0054	2	–	1	–	
D059	2□0068	2	–	1	–	
D074	2□0081	2	–	1	–	
D088	2□0104	2	–	1	–	
D114	2□0130	2	–	1	–	
D143	2□0154	3	–	–	–	259
D169	2□0192	3	–	–	–	
D211	2□0248	1	2	–	–	263
Three-Phase 400 V Class						
B011	4□0011	2	–	2	1	257
B014	4□0014	2	–	2	1	
B021	4□0021	2	–	2	1	
B027	4□0027	2	–	1	1	
B034	4□0034	2	–	1	2	
B040	4□0040	2	–	1	2	
B052	4□0052	2	–	1	2	
B065	4□0065	2	–	1	2	
B077	4□0077	2	–	1	2	
B096	4□0096	2	–	1	2	
B124	4□0124	2	–	1	2	
B156	4□0156	3	–	–	2	259
B180	4□0180	3	–	–	2	
B240	4□0240	1	2	–	4	263
B302	4□0302	2	2	3	4	
B361	4□0361	2	2	3	2	
B414	4□0414	2	2	3	2	

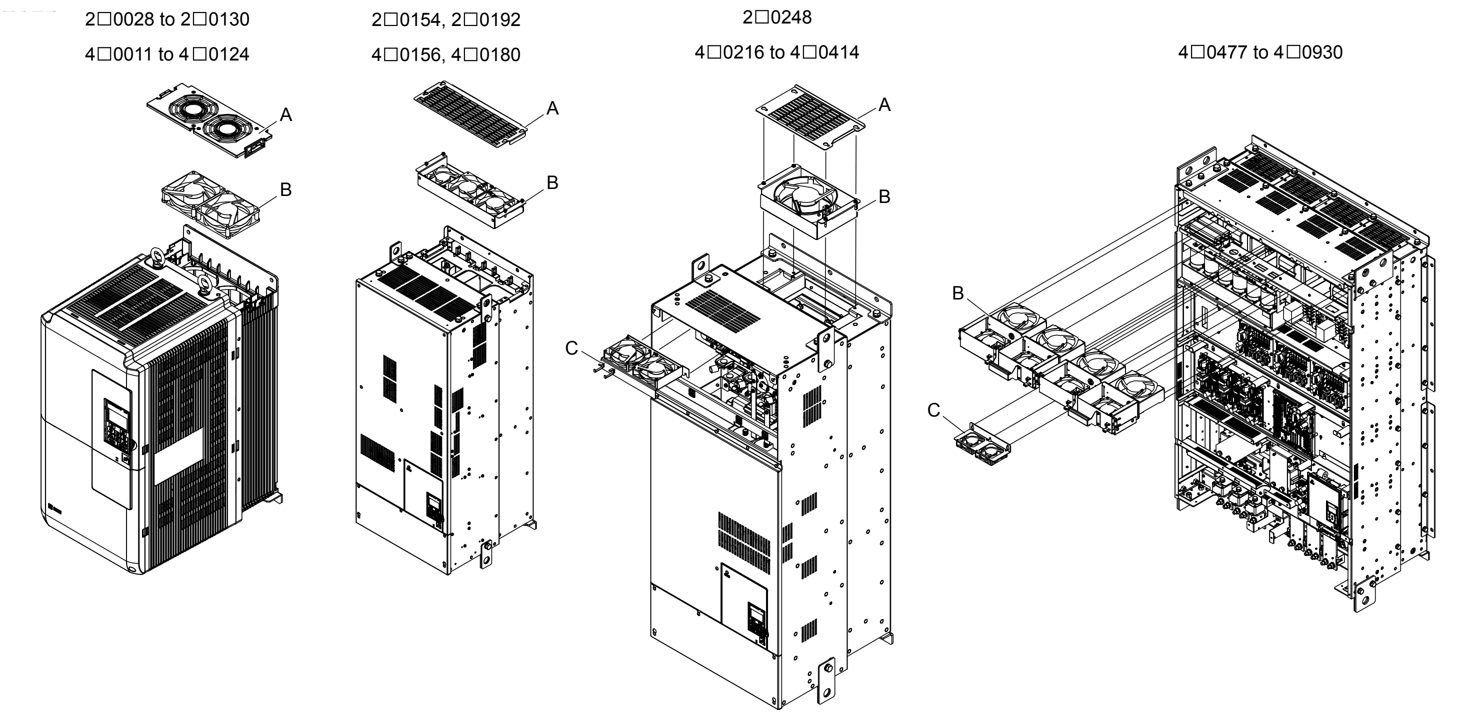
◆ Drive Cooling Fan Component Names

WARNING! *Electrical Shock Hazard. Do not connect or disconnect wiring while the power is on. Failure to comply can result in serious personal injury. Before servicing the drive, disconnect all power to the equipment. The 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.*

CAUTION! *Burn Hazard. Do not touch a hot drive heatsink. Failure to comply could result in minor or moderate injury. Shut off the power to the drive when replacing the cooling fan. To prevent burns, wait at least 15 minutes and ensure the heatsink has cooled down.*

NOTICE: *Prevent Equipment Damage. Follow cooling fan and circulation fan replacement instructions. Fans cannot operate properly when they are installed incorrectly and can damage the drive. Follow the instructions below to replace the fans, making sure that the label is on top before inserting the fan into the drive. To ensure maximum useful product life, replace all fans when performing maintenance.*

Note: Procedures shown in this section use a representative drive model. Figures in these procedures may differ slightly from the actual model used by the customer.



A – Fan guard
B – Cooling Fan/Cooling Fan Unit
C – Circulation Fan Unit

Figure 7.2 Cooling Fan Component Names

◆ Drive Cooling Fan Replacement: Models 2□0028 to 2□0130 and 4□0011 to 4□0124

WARNING! *Electrical Shock Hazard. Do not connect or disconnect wiring while the power is on. Failure to comply can result in serious personal injury. Before servicing the drive, disconnect all power to the equipment. The 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.*

CAUTION! *Burn Hazard. Do not touch a hot drive heatsink. Failure to comply could result in minor or moderate injury. Shut off the power to the drive when replacing the cooling fan. To prevent burns, wait at least 15 minutes and ensure the heatsink has cooled down.*

NOTICE: *Damage to Equipment. Follow cooling fan and circulation fan replacement instructions. Improper fan replacement could cause damage to equipment. Make sure the fan is facing upwards when installing the replacement fan into the drive. Replace all fans when performing maintenance to help ensure maximum useful product life.*

■ Removing the Cooling Fan Guard and Cooling Fan

1. Depress the right and left sides of the fan guard tabs and pull upward. Remove the fan guard from the top of the drive.

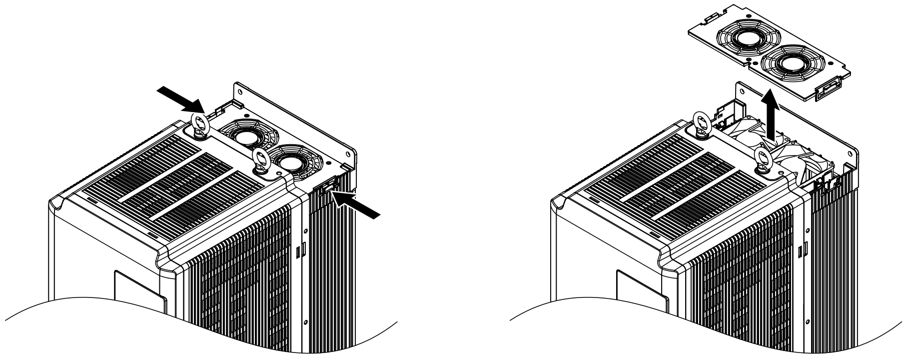


Figure 7.3 Remove the Fan Guard

2. Remove the cooling fan cartridge.

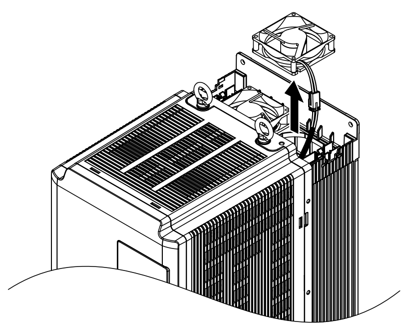


Figure 7.4 Remove the Cooling Fan Cartridge

3. Disconnect the pluggable connector and remove the fan.

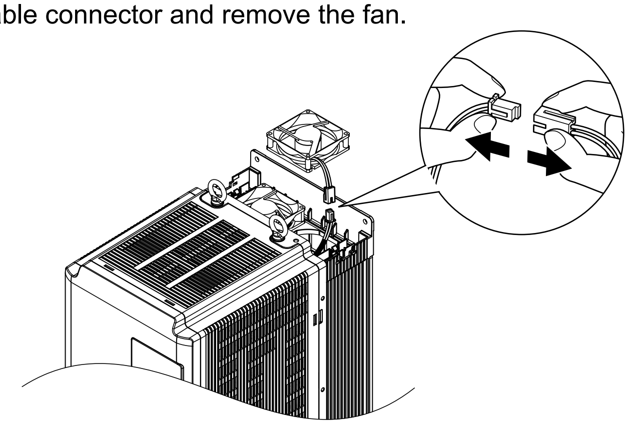


Figure 7.5 Disconnect the Cooling Fan

■ Installing the Cooling Fan

Reverse the procedure described above to reinstall the cooling fan.

1. Properly plug the relay connector.

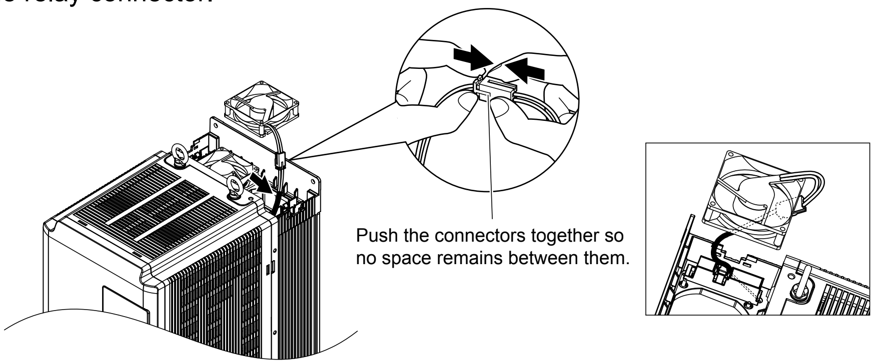
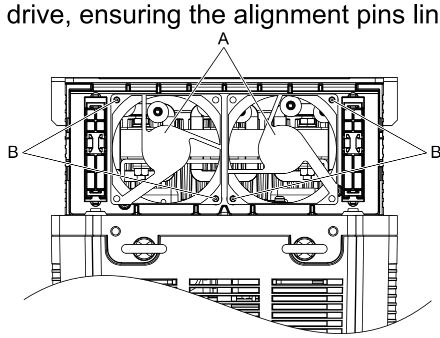


Figure 7.6 Plug the Relay Connector

2. Install the replacement fan into the drive, ensuring the alignment pins line up as shown in ***Figure 7.7***.



A – Label facing up **B – Make sure the alignment pins line up properly.**

Figure 7.7 Install the Cooling Fan

3. Properly connect the fan power lines, then place the cable back into the recess of the drive.

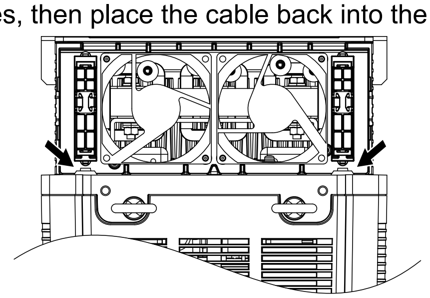


Figure 7.8 Relay Connector Placement

4. While pressing in on the tabs on the left and right sides of the fan guard, guide the fan guard until it clicks back into place.

Note: The fan guard has a cutout on the front side for proper alignment.

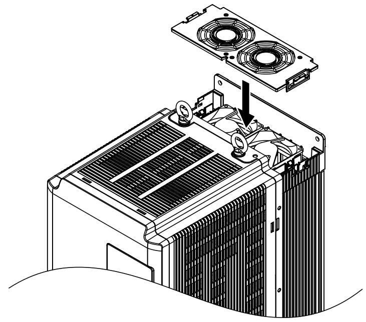


Figure 7.9 Reattach the Fan Guard

5. Turn on the power supply and set o4-03 to 0 to reset the Maintenance Monitor cooling fan operation time.

◆ Drive Cooling Fan Replacement: Models 2□0154, 2□0192, 4□0156, and 4□0180

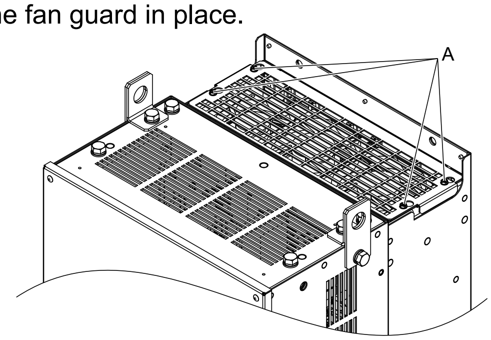
WARNING! *Electrical Shock Hazard. Do not connect or disconnect wiring while the power is on. Failure to comply can result in serious personal injury. Before servicing the drive, disconnect all power to the equipment. The capacitor for the control power supply remains charged even after the power supply is turned off. After shutting off the power, wait for at least the amount of time specified on the drive before touching any components.*

CAUTION! *Burn Hazard. Do not touch a hot drive heatsink. Failure to comply could result in minor or moderate injury. Shut off the power to the drive when replacing the cooling fan. To prevent burns, wait at least 15 minutes and ensure the heatsink has cooled down.*

NOTICE: *Damage to Equipment. Follow cooling fan and circulation fan replacement instructions. Improper fan replacement could cause damage to equipment. Make sure the fan is facing upwards when installing the replacement fan into the drive. Replace all fans when performing maintenance to help ensure maximum useful product life.*

■ Removing the Fan Guard and Cooling Fan

1. Loosen the 4 screws that hold the fan guard in place.



A –Screw locations

Figure 7.10 Loosen the Screws

2. Slide the fan guard toward the front of the drive to remove it from the drive.

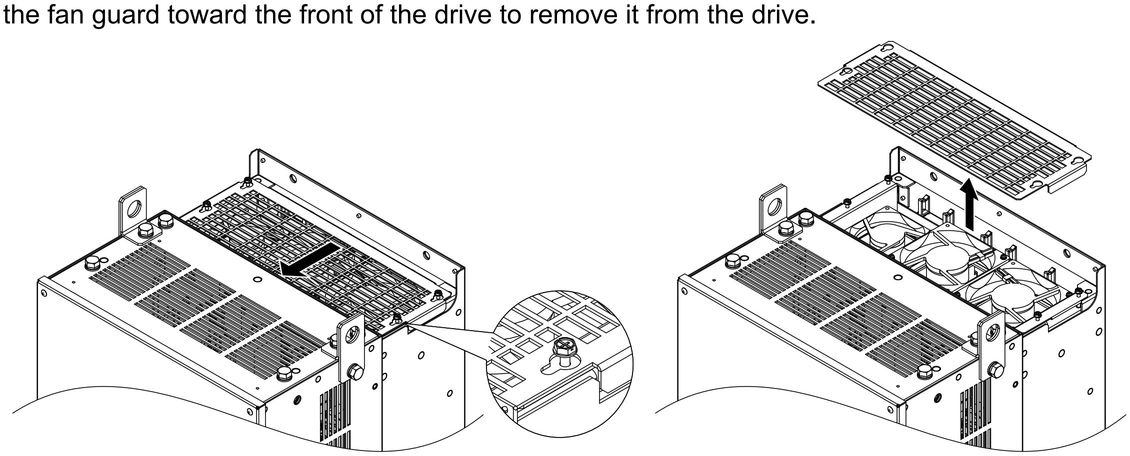
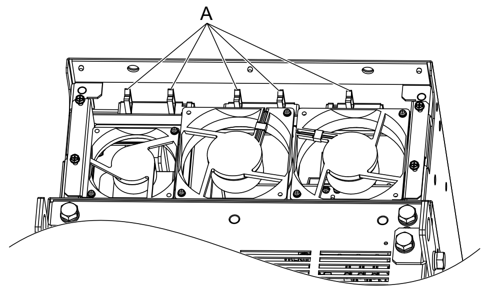


Figure 7.11 Remove the Fan Guard

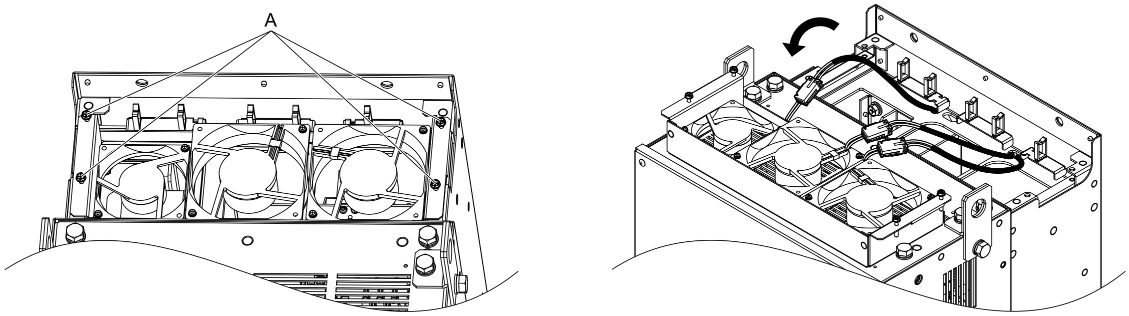
3. Release the cables from the hooks in 5 locations.



A –Hook locations

Figure 7.12 Release the Cables

4. Loosen the 4 screws affixing the cooling fan unit.



A –Screw locations

Figure 7.13 Remove the Cooling Fan Unit

5. Disconnect the 3 pluggable connectors and remove the fan unit from the drive.

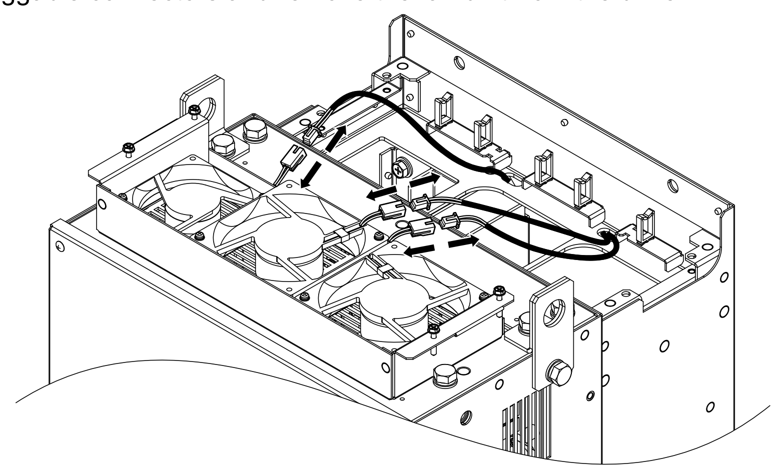


Figure 7.14 Unplug the Relay Connectors

■ Installing the Cooling Fan Unit

1. Connect the relay connectors for the fans in the replacement fan unit.

Note: Replace the whole unit when performing maintenance on the cooling fans.

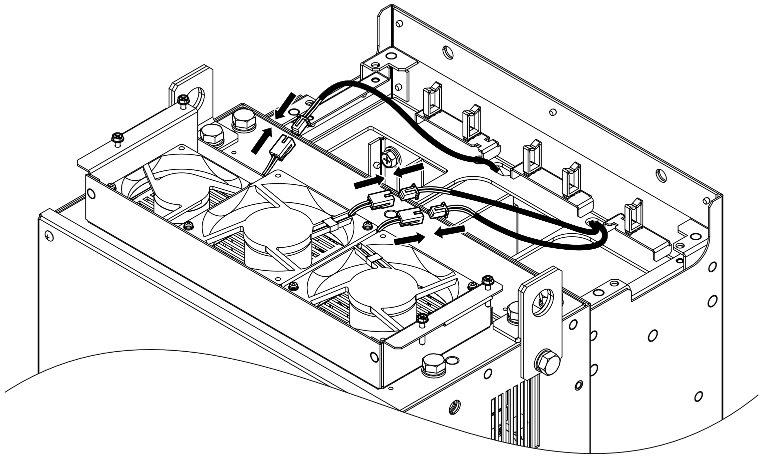


Figure 7.15 Plug the Relay Connectors

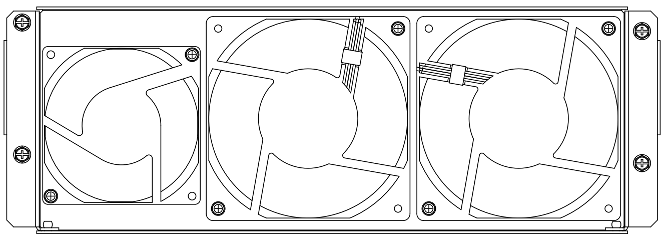
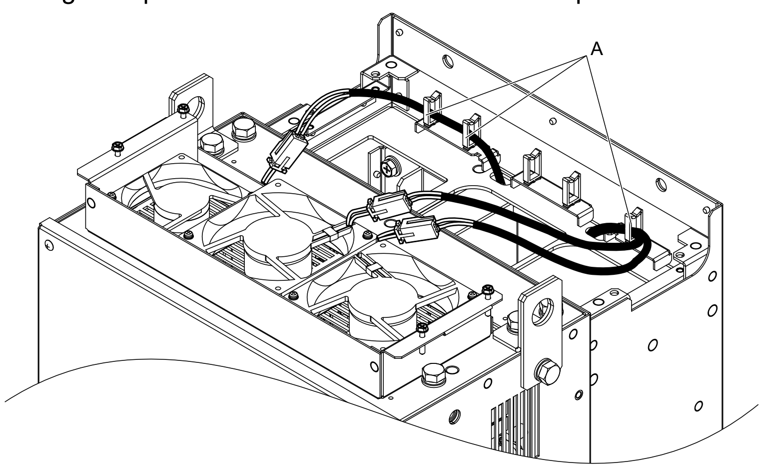


Figure 7.16 Cooling Fan Unit

2. Guide the fan cables through the provided hooks to hold the cables in place.



A –Hook locations

Figure 7.17 Position the Fan Cables

3. Install the cooling fan unit while pulling the cables upward.

Note: Do not pinch the fan cable between parts when reassembling the fan unit.

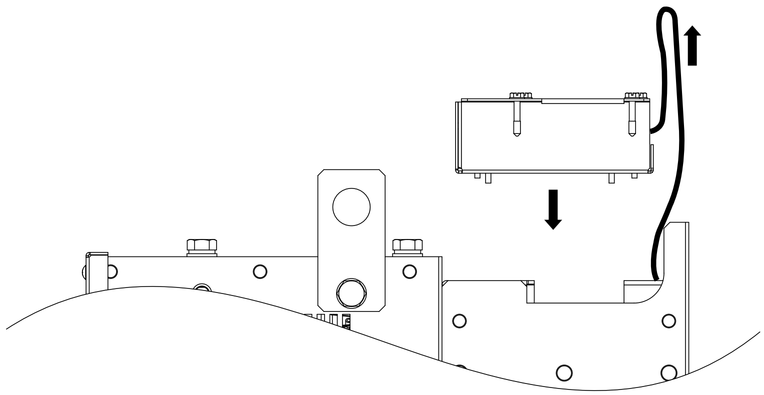
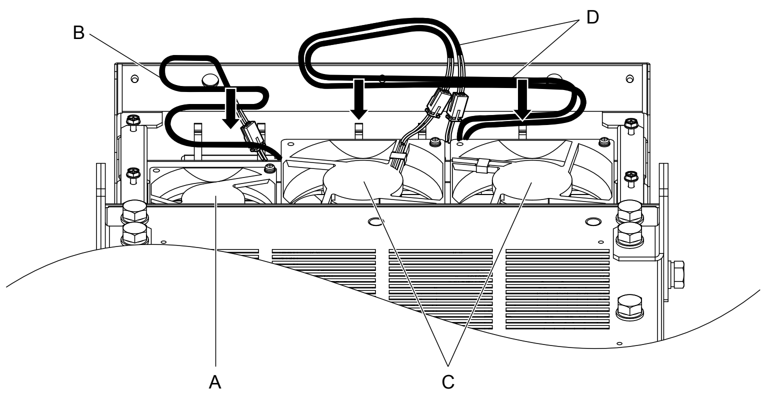


Figure 7.18 Install the Cooling Fan Unit

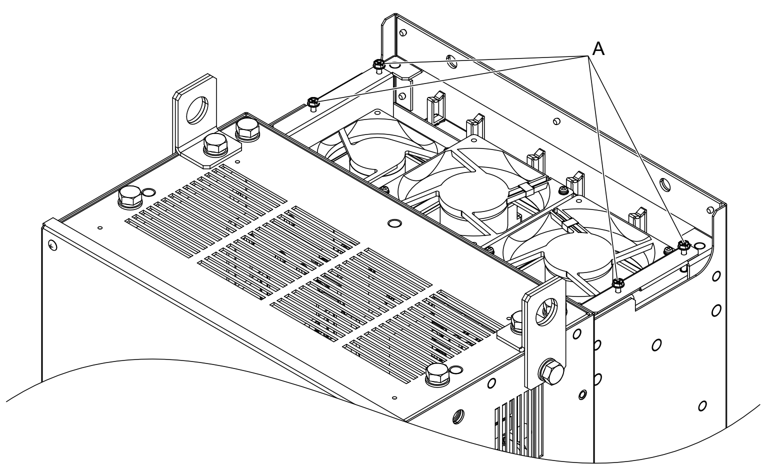
4. Guide the cables through the second set of provided hooks to hold the cables in place.



A – Cooling fan A
B – Bend 3 times
C – Cooling fan B
D – Bend 2 times

Figure 7.19 Cooling Fan Wire Routing

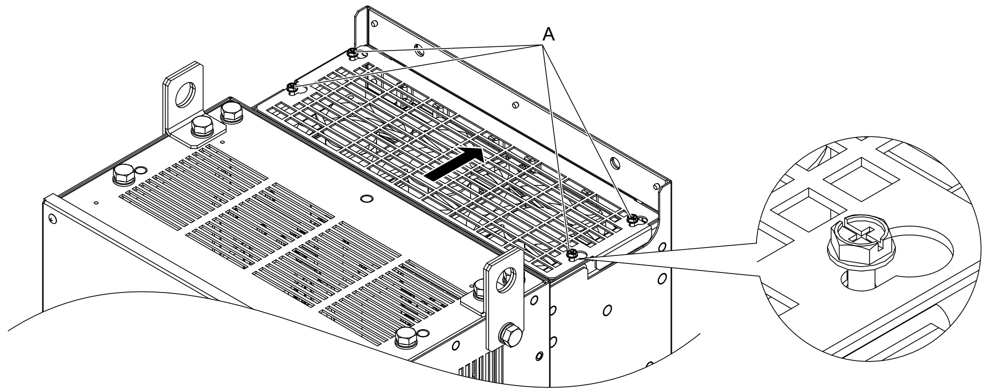
5. Thread the 4 fan unit screws into the proper holes approximately 2/3 of the way. Leave enough space to reinsert the fan guard.



A –Screw locations

Figure 7.20 Insert Cooling Fan Screws

6. Insert the fan guard and firmly tighten the screws so they do not come loose.



A –Screw locations

Figure 7.21 Reattach the Fan Guard

7. Turn on the power supply and set o4-03 to 0 to reset the Maintenance Monitor cooling fan operation time.

◆ Cooling Fan Replacement: 2☐0248 and 4☐0240 to 4☐0414

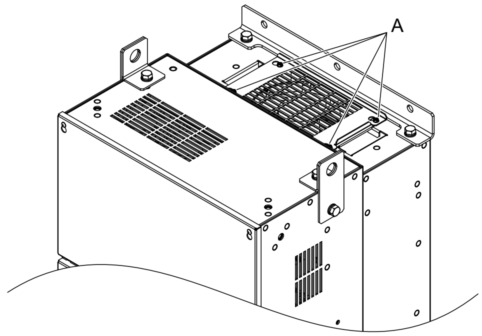
WARNING! *Electrical Shock Hazard. Do not connect or disconnect wiring while the power is on. Failure to comply can result in serious personal injury. Before servicing the drive, disconnect all power to the equipment. The capacitor for the control power supply remains charged even after the power supply is turned off. After shutting off the power, wait for at least the amount of time specified on the drive before touching any components.*

CAUTION! *Burn Hazard. Do not touch a hot drive heatsink. Failure to comply could result in minor or moderate injury. Shut off the power to the drive when replacing the cooling fan. To prevent burns, wait at least 15 minutes and ensure the heatsink has cooled down.*

NOTICE: *Prevent Equipment Damage. Follow cooling fan and circulation fan replacement instructions. Improper fan replacement could cause damage to equipment. Make sure the fan is facing upwards when installing the replacement fan into the drive. Replace all fans when performing maintenance to help ensure maximum useful product life.*

■ Removing the Fan Guard and Cooling Fan

1. Loosen the 4 screws that hold the fan guard in place.



A –Screw locations

Figure 7.22 Loosen the Screws

2. Slide the fan guard toward the right to remove it from the drive.

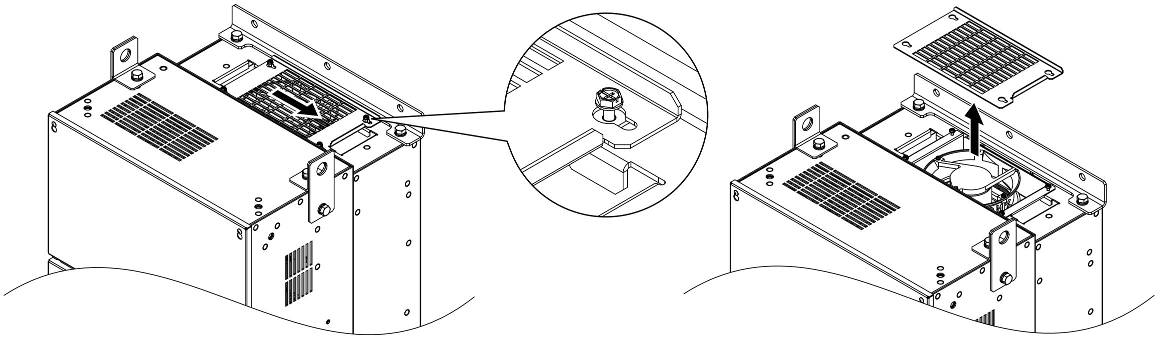
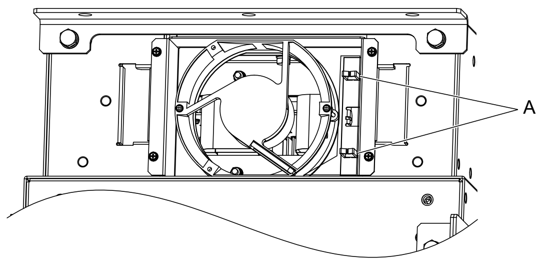


Figure 7.23 Remove the Fan Guard

3. Release the cable from the hooks.

Note: Models 4☐0302 to 4☐0414 have 4 hooks.



A –Hook locations

Figure 7.24 Release the Cable

4. Loosen the 2 screws affixing the cooling fan unit.

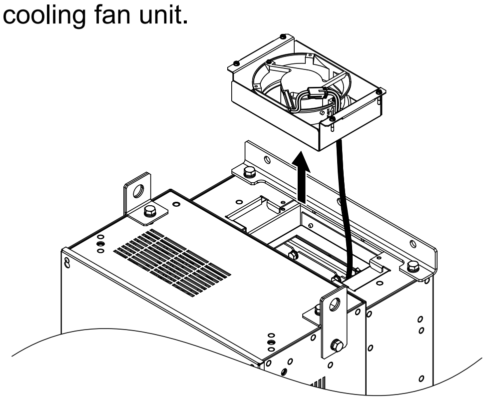


Figure 7.25 Remove the Cooling Fan Unit

5. Unplug the relay connector and release the fan from the drive.

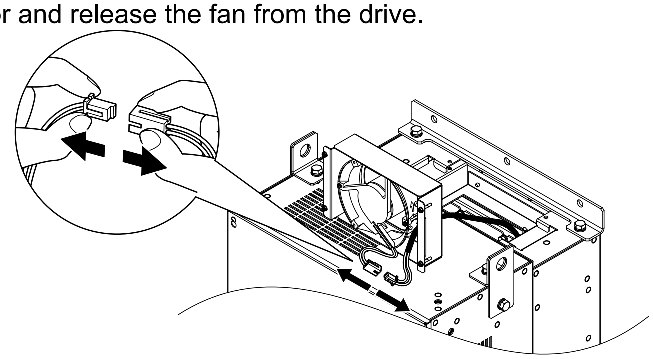
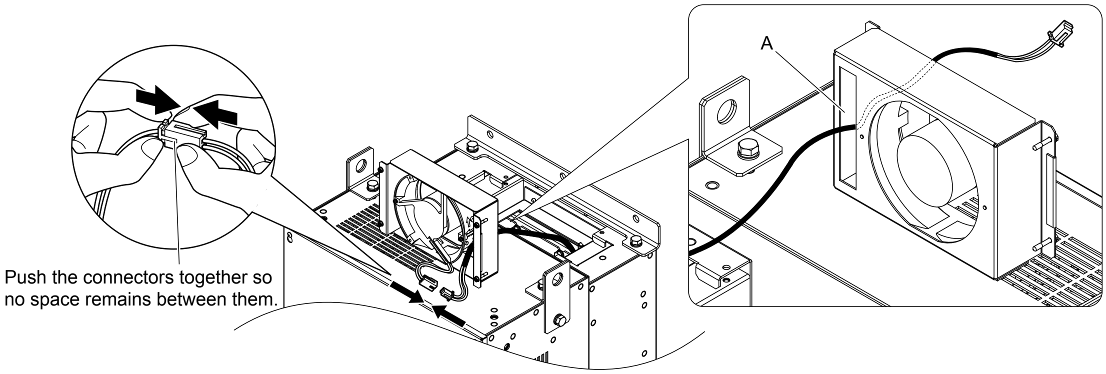


Figure 7.26 Unplug the Relay Connector

◆ Installing the Cooling Fan

1. Pass the cable through the opening of the replacement cooling fan unit from the back side, then plug the relay connector.



A –Opening

Figure 7.27 Attach the Relay Connector

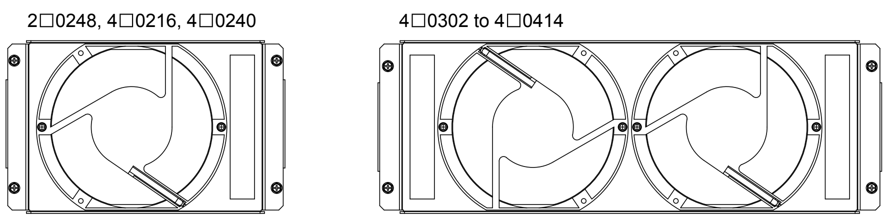
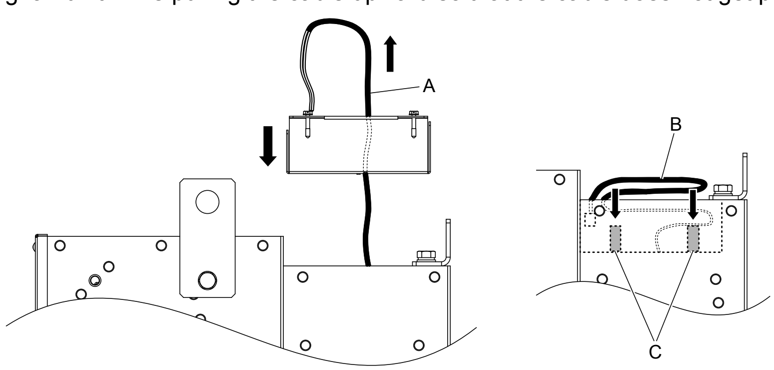


Figure 7.28 Cooling Fan Unit

2. Install the cooling fan unit and place the cable back into position.

Note:
1. Replace the whole unit when performing maintenance on the cooling fans.
2. Install the cooling fan unit while pulling the cable upward so that the cable does not get pinched between parts.



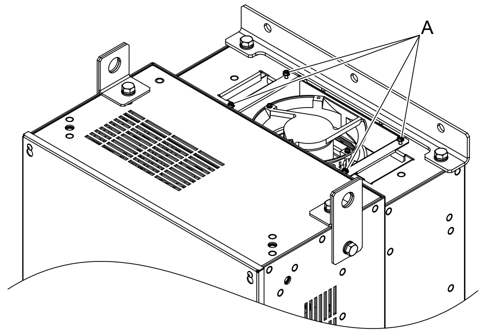
A – Pull the cable upwards
B – Bend 3 times
C – Hook

Figure 7.29 Install the Cooling Fan

3. Thread the 4 fan unit screws into the proper holes approximately 2/3 of the way. Leave enough space to reinsert the fan guard.

Periodic Inspection & Maintenance

7



A –Screw locations

Figure 7.30 Attach the Cooling Fan Unit

4. Reattach the fan guard and then tighten the screws firmly so that the screws do not come loose.

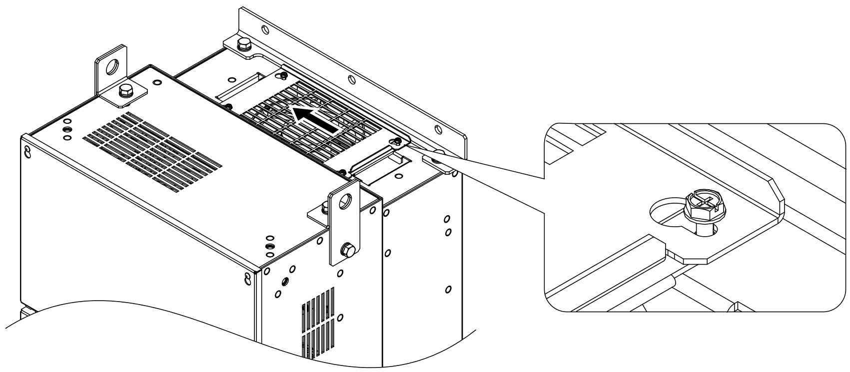
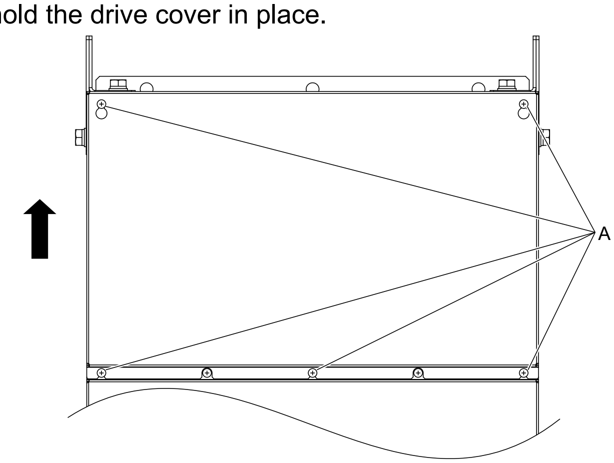


Figure 7.31 Reattach the Fan Cover

■ Removing the Circulation Fan

CAUTION! *Crush Hazard. 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. Take special care when removing/reattaching the terminal covers for larger drives.*

1. Loosen the 5 screws that hold the drive cover in place.



A –Screw locations

Figure 7.32 Remove the Drive Cover

2. Unlock the 2 cable hooks.

Note: The circulation fan unit on models 4☐0302 to 4☐0414 is located on the right side of the drive.

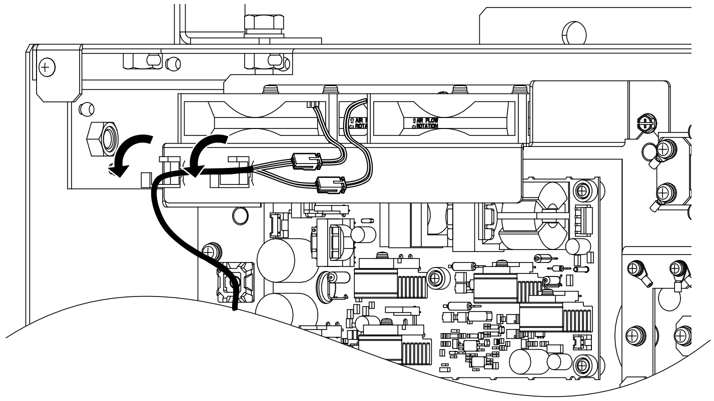


Figure 7.33 Unlock the Cable Hooks

3. Unplug the relay connectors and release the cable from the hooks.

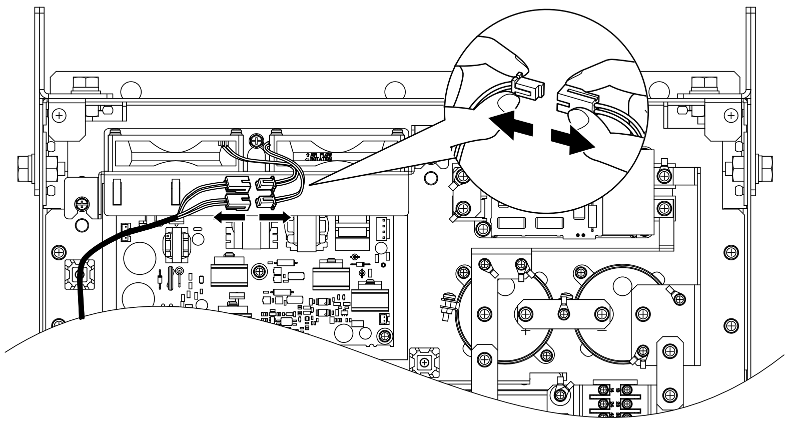
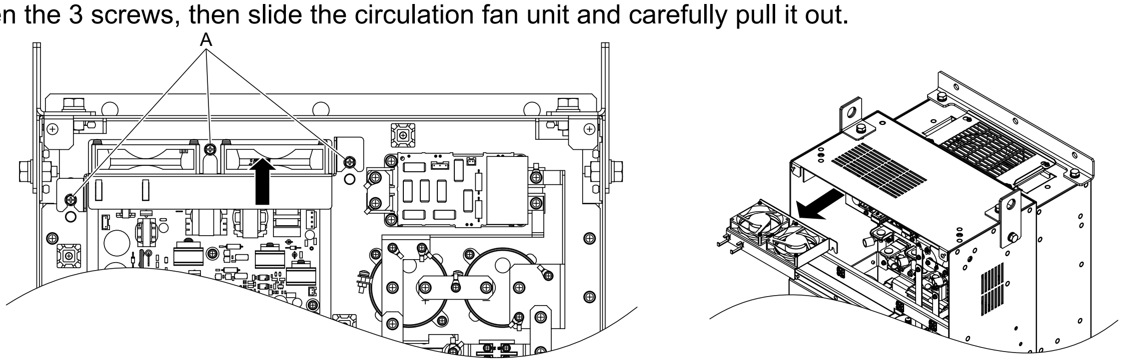


Figure 7.34 Unplug the Relay Connector

4. Loosen the 3 screws, then slide the circulation fan unit and carefully pull it out.



A –Screw locations

Figure 7.35 Remove the Circulation Fan

■ Installing the Circulation Fan

CAUTION! *Crush Hazard. 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. Take special care when removing/reattaching the terminal covers for larger drives.*

1. Reverse the procedure described above to install the replacement circulation fan unit.

Note:
1. Replace the whole unit when performing maintenance on the circulation fans.
2. Place the cables back into the hooks to secure.
3. Do not pinch the fan cable between parts when reassembling the fan unit.
4. Tighten the screws firmly so they do not come loose.

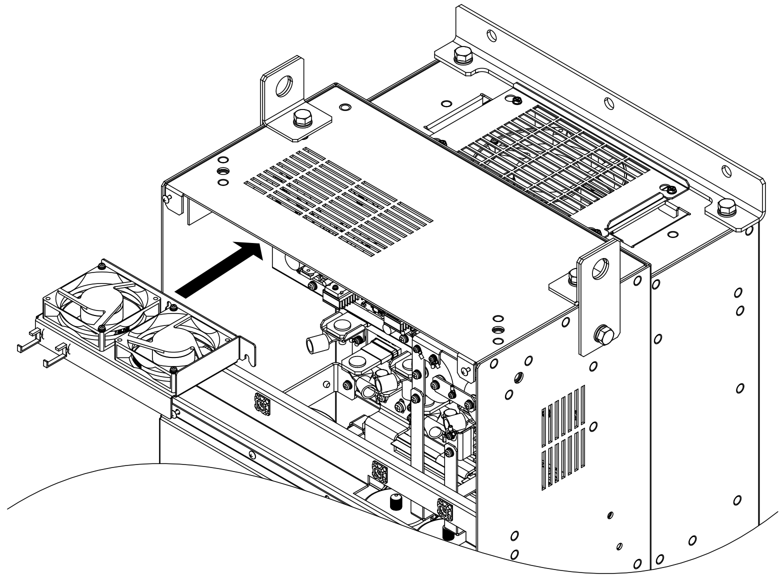


Figure 7.36 Installing the Circulation Fan

2. Turn on the power supply and set o4-03 to 0 to reset the Maintenance Monitor circulation fan operation time.

Appendix: A

Specifications

A.1 Power Ratings

◆ Three-Phase 208 Vac Models D024 to D211

Table A.1 Power Ratings (Three-Phase 208 V)

Item		Specification									
Bypass Model Z1D1		D024	D030	D046	D059	D074	D088	D114	D143	D169	D211
Maximum Applicable Motor Capacity <1>	HP	7.5	10	15	20	25	30	40	50	60	75
Input	Input Current (A) <2>	23.3	29.5	43.6	55.8	70	82.1	105.2	132.4	156.4	194.7
	Rated Voltage Rated Frequency	Three-phase 208 Vac 50/60 Hz									
	Allowable Voltage Fluctuation	-15 to 10%									
	Allowable Frequency Fluctuation	±5%									
Output	Rated Output Current (A)	24.2 <3>	30.8 <3>	16.2 <3>	59.4 <3>	74.8 <3>	88.0 <3>	114.0 <3>	143.0 <3>	169.0 <3>	211.0 <3>
	Overload Tolerance	120% of rated output current for 60 s 150% peak									
	Carrier Frequency	User adjustable between 4 and 10 kHz (Maximum Frequency varies with Rated Output Capacity)									
	Maximum Output Voltage (V)	Three-phase 208 Vac									
	Maximum Output Frequency (Hz)	400 Hz									
EMC	Filter (IEC/EN 61800-3 Category 2)	Built-in									

<1> The motor capacity (HP) refers to an NEC Table 430.250 208 V motor. The rated output current of the drive output amps should be equal to or greater than the motor current. Select the appropriate capacity drive if operating the motor continuously above motor nameplate current.

<2> Assumes operation at the rated output current. Input current rating varies depending on the power supply transformer, input reactor, wiring connections, and power supply impedance.

<3> Carrier frequency is set to 4 kHz. Current derating is required to raise the carrier frequency.

◆ Three-Phase 480 Vac Models B011 to B077

Table A.2 Power Ratings Continued (Three-Phase 480 V)

Item		Specification								
Bypass Model Z1D☐		B011	B014	B021	B027	B034	B040	B052	B065	B077
Maximum Applicable Motor Capacity <1>	HP	7.5	10	15	20	25	30	40	50	60
Input	Type 1 Input Current (A) <2> <2>	10.7	13.7	19.7	25.7	31.7	36.7	47.7	60.0	71.0
	Type 12 Input Current (A) <2> <2>	11.7	14.7	21.7	27.7	35.0	41.0	53.0	66.0	78.0
	Rated Voltage Rated Frequency	Three-phase 480 Vac 50/60 Hz								
	Allowable Voltage Fluctuation	-15 to 10%								
	Allowable Frequency Fluctuation	±5%								
Output	Rated Output Current (A)	11.0 <3>	14.0 <3>	21.0 <3>	27.0 <3>	34.0 <3>	40.0 <3>	52.0 <3>	65.0 <3>	77.0 <3>
	Overload Tolerance	120% of rated output current for 60 s 150% peak								
	Carrier Frequency	User adjustable between 4 and 10 kHz (Maximum Frequency varies with Rated Output Capacity)								
	Maximum Output Voltage (V)	Three-phase 480 V								
	Maximum Output Frequency (Hz)	400 Hz								
EMC	Filter (IEC/EN 61800-3 Category 2)	Built-in								

<1> The motor capacity (HP) refers to an NEC Table 430.250 208 V motor. The rated output current of the drive output amps should be equal to or greater than the motor current. Select the appropriate capacity drive if operating the motor continuously above motor nameplate current.

<2> Assumes operation at the rated output current. Input current rating varies depending on the power supply transformer, input reactor, wiring connections, and power supply impedance.

<3> Carrier frequency is set to 4 kHz. Current derating is required to raise the carrier frequency.

◆ Three-Phase 480 Vac Models B096 to B414

Table A.3 Power Ratings Continued (Three-Phase 480 V)

Item		Specification							
Bypass Model Z1D☐		B096	B124	B156	B180	B240	B302	B361	B0414
Maximum Applicable Motor Capacity <1>	HP	75	100	125	150	200	250	300	350
Input	Type 1 Input Current (A) <2> <2>	88.0	114.0	143.0	165.0	219.0	276.0	330.0	378.0
	Type 12 Input Current (A) <2> <2>	97.0	125.0	157.6	181.6	–	–	–	–
	Rated Voltage Rated Frequency	Three-phase 480 Vac 50/60 Hz							
	Allowable Voltage Fluctuation	-15 to 10%							
	Allowable Frequency Fluctuation	±5%							
Output	Rated Output Current (A)	96.0 <3>	124 <3>	156 <3>	180 <3>	240 <3>	302 <3>	361 <3>	414 <3>
	Overload Tolerance	120% of rated output current for 60 s 150% peak							
	Carrier Frequency	User adjustable between 4 and 10 kHz (Maximum Frequency varies with Rated Output Capacity)							
	Maximum Output Voltage (V)	Three-phase 480 V							
	Maximum Output Frequency (Hz)	400 Hz							
EMC	Filter (IEC/EN 61800-3 Category 2)	Built-in							

<1> The motor capacity (HP) refers to an NEC Table 430.250 208 V motor. The rated output current of the drive output amps should be equal to or greater than the motor current. Select the appropriate capacity drive if operating the motor continuously above motor nameplate current.

<2> Assumes operation at the rated output current. Input current rating varies depending on the power supply transformer, input reactor, wiring connections, and power supply impedance.

<3> Carrier frequency is set to 4 kHz. Current derating is required to raise the carrier frequency.

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 Character-istics	Control Method	V/f Control (V/f)
	Frequency Control Range	0.01 to 400 Hz
	Frequency Accuracy (Temperature Fluctuation)	Digital input: within ±0.01% of the max output frequency (-10 to +40 °C) Analog input: within ±0.1% of the max output frequency (25 °C ±10 °C)
	Frequency Setting Resolution	Digital inputs: 0.01 Hz Analog inputs: 1/2048 of the maximum output frequency setting (11 bit plus sign)
	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	150% at 3 Hz
	Speed Control Range	1:40
	Speed Control Accuracy	V/f: ±0.2 to 3% (25 °C ±10 °C)
	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	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 120% of rated output current <1>
	Overvoltage Protection	208 V: Stops when input voltage exceeds approx. 315 V 480 V: Stops when input voltage exceeds approx. 630 V
	Undervoltage Protection	208 V: Stops when input voltage falls below approx. 150 V 480 V: Stops when input voltage falls below approx. 300 V
	Momentary Power Loss Ride-Thru	Immediately stop after 2 ms or longer power loss <2> Continuous operation during power loss than 2 s (standard) <3>
	Heatsink Overheat Protection	Thermistor
	Stall Prevention	Stall Prevention is available during acceleration, deceleration, and during run.
	Ground Protection	Electronic circuit protection <4>
	Charge LED of Capacitor for Control Power Supply	Remains lit until control power supply voltage falls below 50 V
Environment	Area of Use	Indoors
	Ambient Temperature	IP20/NEMA Type 1 enclosure: -10 °C to +40 °C (14 °F to 104 °F)
	Humidity	95 RH% or less (no condensation)
	Storage Temperature	-20 °C to +60 °C (short-term temperature during transportation)
	Altitude	Up to 1000 meters without derating, up to 3000 m with output current and voltage derating.
Standard		UL508A
Protection Design		IP20/NEMA Type 1 enclosure

<1> Overload protection may be triggered when operating with 150% of the rated output current if the output frequency is less than 6 Hz.

<2> Actual specifications may vary depending on motor characteristics.

<3> Use a separate Momentary Power Loss Ride-Thru Unit if the application needs to continue running for up to 2 s during momentary power loss.

<4> 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.

A.3 Drive Derating Data

The drive can be operated at above the rated temperature, altitude, and default carrier frequency by derating the drive capacity.

◆ Carrier Frequency Derating

Derate the drive according to *Figure A.1* as the carrier frequency increases above the factory default setting.

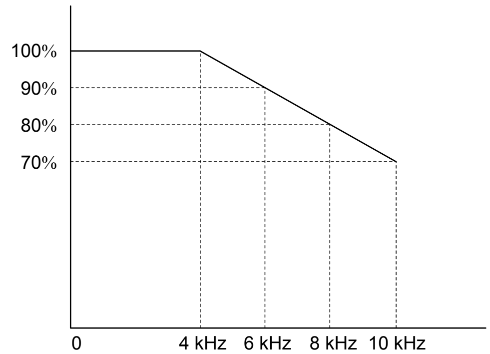


Figure A.1 Carrier Frequency Derating

A.4 Bypass Options

This following configurations are available for the bypass.

◆ Option B

Three-contactor bypass: Isolates the drive circuit by adding a separate drive input contactor.

◆ Option D

Ethernet/IP option.

◆ Option G

Drive Input Disconnect Switch: Provides a disconnect means for the input side of the drive for drive isolation capability during bypass operation. This disconnect is located inside the enclosure with an integral operating handle.

◆ Option K (Control)

200 VA Control Power Transformer.

◆ Option K (Power)

Output Reactor 5%: Provides additional output impedance for long lead lengths or noise reduction.

◆ Option L

Serial Communication, Echelon LonWorks: An isolated circuit board provides LonTalk protocol for network communication to a BAS. This option plugs into the CN5 connection on the bypass control circuit board.

◆ Option N

EMC Filter: Integral EMC Filter supplied with drive.

◆ Option W (Control)

Custom Nameplate: Provides a custom nameplate for placement on the front of the bypass.

◆ Option W (Power)

Soft Start Bypass: Provides a solid-state soft-starter with adjustable ramp to reduce mechanical system stress typically associated with across-the-line bypass motor starts.

◆ Option Z

Speed Pot: Door-mounted speed control.

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Appendix: B

Parameter List

This appendix contains a full list of all parameters and settings available in the drive and bypass.

B.1 Parameter Groups

Table B.1 Parameter Groups

Parameter Group	Name	Page	Parameter Group	Name	Page
A1	Initialization Parameters	280	L4	Speed Detection	301
b1	Operation Mode Selection	281	L5	Fault Restart	302
b2	DC Injection Braking and Short Circuit Braking	281	L6	Torque Detection	302
b3	Speed Search	282	L8	Drive Protection	303
b5	PID Control	283	n1	Hunting Prevention	304
C1	Acceleration and Deceleration Times	286	n3	Overexcitation Braking	304
C2	S-Curve Characteristics	286	o1	HOA Keypad Display Selection	305
C4	Torque Compensation	286	o2	HOA Keypad Functions	305
C6	Carrier Frequency	287	o4	Maintenance Monitor Settings	306
C7	Voltage Adjustment	287	S1	Dynamic Noise Control Function	307
d1	Frequency Reference	288	S2	Sequence Timer Operation	307
d2	Frequency Upper/Lower Limits	288	T1	Induction Motor Auto-Tuning	310
d3	Jump Frequency	288	UB	Bypass Control Monitors	311
E1	V/f Pattern for Motor 1	290	U1	Operation Status Monitors	312
E2	Motor 1 Parameters	291	U2	Fault Trace	314
F6	Drive/Bypass Communications	292	U3	Fault History	315
H1	Multi-Function Digital Inputs	293	U4	Maintenance Monitors	317
H2	Multi-Function Digital Outputs	295	U5	PID Monitors	318
H3	Multi-Function Analog Inputs	296	U9	Power Monitors	319
H4	Multi-Function Analog Outputs	148	Z1	Bypass Control System	320
L1	Motor Protection	300	Z2	Bypass Control Input/Output	324
L2	Momentary Power Loss Ride-Thru	300	Z3	Bypass Control Communication	325
L3	Stall Prevention	301	Z4	Bypass Control Option Boards	326

Table B.2 Symbols and Icons Used in Parameter Descriptions

Symbol	Description
RUN	Parameter can be changed during run.

◆ Parameters Listed in Dark Gray Rows

Parameters and multi-function selections in the following tables that appear in dark gray rows are only available by directly connecting an HOA keypad to the drive inside of the bypass enclosure. Refer to the Z1000U Programming Manual (SIEP C7106160 10) for details on these parameters and selections.

WARNING! *Electrical Shock Hazard. Before opening the bypass enclosure, disconnect all power to the equipment. To prevent electric shock, wait at least 60 seconds before opening the cabinet. After opening the cabinet, verify that the charge indicator on the drive is OFF. Measure for unsafe voltages to confirm the drive is safe prior to servicing. Failure to comply may result in death or serious injury.*

NOTICE: *Parameters listed in dark gray rows in the tables below do not normally require modification. Incorrectly setting these drive parameters may adversely affect bypass performance. Use caution when changing drive parameters to avoid erroneous settings.*

Use the following procedure to view and change parameters listed in dark gray rows:

1. Remove all Run commands from the bypass package or set parameter Z1-06 = 0 to force the package to be in “OFF” state upon power-up.
2. Power down unit, wait for 60 seconds, then open the cabinet and verify that the charge indicator LED is extinguished. Measure for unsafe voltages prior to proceeding to Step 3.
3. After the bypass enclosure is open, disconnect the RJ-45 cable from the back of HOA keypad mounted to the enclosure door.
4. Connect a customer-supplied RJ-45 (Ethernet) patch cable between the door-mounted HOA keypad and the Z1000U drive.
5. Close and latch cabinet door then apply power.
6. View/modify parameters or settings as needed.
7. Power down unit, wait for 60 seconds, then open the cabinet and verify that the charge indicator LED is extinguished. Measure for unsafe voltages prior to proceeding to Step 8.
8. Open bypass enclosure and disconnect the customer-supplied RJ-45 cable connecting the HOA keypad and Z1000U drive.
9. Reconnect the RJ-45 cable from Step 3 to the back of the HOA keypad mounted to the enclosure door.
10. Close and latch cabinet door and re-apply power.
11. If parameter Z1-06 was changed in Step 1, re-set it to its original value.

B.2 A: Initialization Parameters

◆ A1: Initialization

No. (Addr. Hex)	Name	LCD Display	Description	Values	Page
A1-03 (0103)	Initialize Parameters <1>	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	–
A1-04 (0104)	Password	Enter Password	When the value set into A1-04 does not match the value set into A1-05, parameter A1-06 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, parameter A1-06 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	100

<1> Parameter Z1-01, Initialize, will also initialize all drive parameters.

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	–
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: 2 Range: 1 to 3	–
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	101
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	102
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	–
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	–
b1-24 (0B2C)	Commercial Power Operation Switching Selection	CommerclPwrSwSel 0: Disabled 1: Enabled	0: Disabled 1: Enabled	Default: 0 Range: 0, 1	103
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 kHz Min.: 0.4 Max.: 6.0	103
b1-26 (0B2E)	Commercial Power Supply Operation Switching Level	Freq Accept Lvl		Default: 0.2 kHz Min.: 0.0 Max.: 3.0	103

◆ 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: 0.5 Hz Min.: 0.0 Max.: 10.0	103
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	104

No. (Addr. Hex)	Name	LCD Display	Description	Values	Page
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	104
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	104

◆ 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	105
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	105
b3-04 (0194)	V/f Gain during Speed Search	SpdSrch V/f	Determines how much to lower the V/f ratio during Speed Search. Output voltage during Speed Search equals the V/f setting multiplied by b3-04.	Default: <1> Min.: 10% Max.: 100%	105
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	105
b3-06 (0196)	Output Current 1 during Speed Search	Srch Im Lvl1	Sets the current injected to the motor at the beginning of Speed Estimation Speed Search. Set as a coefficient for the motor rated current.	Default: <1> Min.: 0.0 Max.: 2.0	106
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	106
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> Min.: 0.00 Max.: 6.00	106
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: 2.0 ms Min.: 0.0 Max.: 1000.0	106
b3-10 (019A)	Speed Search Detection Compensation Gain	Srch Detect Comp	Sets the gain which is applied to the speed detected by Speed Estimation Speed Search before the motor is reaccelerated. Increase this setting if ov occurs when performing Speed Search after a relatively long period of baseblock.	Default: 1.05 Min.: 1.00 Max.: 1.20	106
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. (208 Vac at 100% = 208 V; 480 V class at 100% = 480 V)	Default: 5.0% Min.: 0.5 Max.: 100.0	106
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	106
b3-14 (019E)	Bi-Directional Speed Search Selection	Bidir Search Sel 0: Disabled 1: Enabled	0: Disabled (uses the direction of the frequency reference) 1: Enabled (drive detects which way the motor is rotating)	Default: 1 Range: 0, 1	107
b3-17 (01F0)	Speed Search Restart Current Level	SrchRestart Lvl	Sets the Speed Search restart current level as a percentage of the drive rated current.	Default: 150% Min.: 0 Max.: 200	107
b3-18 (01F1)	Speed Search Restart Detection Time	SrchRestart Time	Sets the time to detect Speed Search restart.	Default: 0.10 s Min.: 0.00 Max.: 1.00	107

No. (Addr Hex.)	Name	LCD Display	Description	Values	Page
b3-19 (01F2)	Number of Speed Search Restarts	Num of SrchRestr	Sets the number of times the drive can attempt to restart when performing Speed Search.	Default: 3 Min.: 0 Max.: 10	107
b3-24 (01C0)	Speed Search Method Selection	SpdSrch Method 1: Speed Estimation 2: CurrentDetect2	1: Speed Estimation 2: Current Detection	Default: 2 Range: 1, 2	107
b3-25 (01C8)	Speed Search Wait Time	SpdSrch WaitTime	Sets the time the drive must wait between each Speed Search restart attempt.	Default: 0.5 s Min.: 0.0 Max.: 30.0	107
b3-27 (01C9)	Start Speed Search Select	SpdSrch Start 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	107
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	108
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	108
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	108
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	108
b3-51 (0BC8)	Backspin Search Direction Judgment Time 2	Bkspin Srch Time2		Default: 0.0 s Min.: 0.0 Max.: 10.0	108
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	110
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	110

<1> Default setting is dependent on parameter o2-04, Drive Model Selection.

◆ 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	114
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	114
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	114
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	114

No. (Addr. Hex)	Name	LCD Display	Description	Values	Page
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	114
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	114
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	114
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	114
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	115
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	115
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	115
b5-12 (01B0)	PID Feedback Loss Detection Selection	Fb loss Det Sel 0: DO Only – Always 1: Alarm – Always 2: Fault – Always 3: DO Only@PID Enb 4: Alarm @ PID Enbl 5: Fault @ PID Enbl	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	116
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	116
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	116
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	117
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	117
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	117
b5-18 (01DC)	PID Setpoint Selection	PID Setpoint Sel 0: Disabled 1: Enabled	0: Disabled 1: Enabled	Default: 0 Range: 0, 1	118
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>	118
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	118

No. (Addr. Hex)	Name	LCD Display	Description	Values	Page
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	118
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	118
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	117
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	117
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	118
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	118
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	119
b5-46 (0165)	PID Setpoint Monitor Unit Selection	PID 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	119
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	119

<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: 0 Range: 0, 1	–

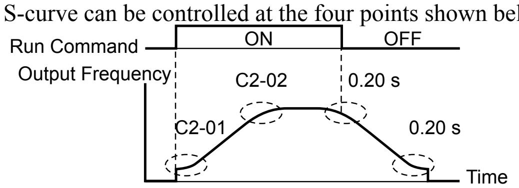
B.4 C: Tuning

C parameters are used to adjust the acceleration and deceleration times 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	121
C1-02 (0201) RUN	Deceleration Time 1	Decel Time 1	Sets the time to decelerate from maximum frequency to 0.		121
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	121

◆ C2: S-Curve Characteristics

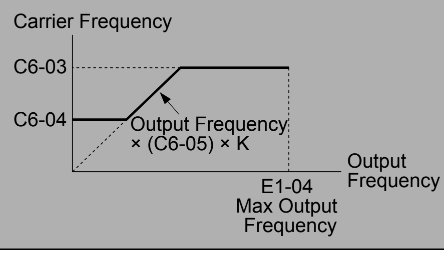
No. (Addr. Hex)	Name	LCD Display	Description	Values	Page
C2-01 (020B)	S-Curve Characteristic at Accel Start	SCrv Acc @ Start	The S-curve can be controlled at the four points shown below. 	Default: 0.20 s Min.: 0.00 Max.: 10.00	121
C2-02 (020C)	S-Curve Characteristic at Accel End	SCrv Acc @ End		Default: 0.20 s Min.: 0.00 Max.: 10.00	121

◆ C4: Torque Compensation

No. (Addr. Hex)	Name	LCD Display	Description	Values	Page
C4-01 (0215) RUN	Torque Compensation Gain	Torq Comp Gain	Sets the gain for the automatic torque (voltage) boost function and helps to produce better starting torque. Used for motor 1.	Default: 1.00 Min.: 0.00 Max.: 2.50	122
C4-02 (0216) RUN	Torque Compensation Primary Delay Time 1	Torq Comp Time	Sets the torque compensation filter time.	Default: <1> Min.: 0 ms Max.: 60000 ms	–

<1> Default setting is determined by parameter 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	1: 4.0 kHz 2: 6.0 kHz 3: 8.0 kHz 4: 10.0 kHz	Default: <1> Range: 1 to 4	122
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	–
C6-04 (0226)	Carrier Frequency Lower Limit	CarrierFreq Min		Default: <2> Min.: 4.0 kHz Max.: 10.0 kHz	–
C6-05 (0227)	Carrier Frequency Proportional Gain	CarrierFreq Gain		Default: <2> Min.: 0 Max.: 99	–

<1> Default setting value is dependent on parameter o2-04, Drive Model Selection.

<2> Default setting value is dependent on parameter C6-02, Carrier Frequency Selection.

◆ C7: Voltage Adjustment

No. (Addr. Hex)	Name	LCD Display	Description	Values	Page
C7-60 (0B1C)	Output Voltage Limit Mode Selection	V Out Limit Sel 0: THD Priority 1: Vout Priority	0: Harmonic suppression priority mode 1: High output voltage mode	Default: 1 Range: 0, 1	123

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>	124
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>	124
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>	124
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>	124
d1-17 (0292) RUN	Jog Frequency Reference	Jog Reference	Sets the Jog frequency reference. Setting units are determined by parameter o1-03.	Default: 6.00 Hz Min.: 0.00 Max.: 400.00 <1>	–

<1> Range upper limit is determined by parameters d2-01, Frequency Reference Upper Limit.

◆ 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	125
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	125
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	125

◆ 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	126
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	126

No. (Addr. Hex)	Name	LCD Display	Description	Values	Page
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	*126*
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	*126*

◆ d4: Frequency Reference Hold Function

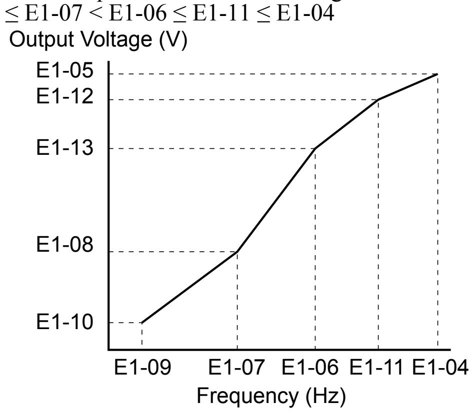
No. (Addr. Hex)	Name	LCD Display	Description	Values	Page
d4-01 (0298)	Frequency Reference Hold Function Selection	Fref Hold Sel 0: Disabled 1: Enabled	0: Disabled. Drive starts from zero when the power is switched on. 1: Enabled. At power up, the drive starts the motor at the Hold frequency that was 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	–

◆ 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: 50 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: 50 Hz, Constant torque 3 (50 Hz base) 3: 72 Hz, Constant torque 4 (60 Hz base) 4: 50 Hz, Variable torque 1 5: 50 Hz, Variable torque 2 6: 60 Hz, Variable torque 3 7: 60 Hz, Variable torque 4 8: 50 Hz, High starting torque 1 9: 50 Hz, High starting torque 2 A: 60 Hz, High starting torque 3 B: 60 Hz, High starting torque 4 C: 90 Hz (60 Hz base) D: 120 Hz (60 Hz base) E: 180 Hz (60 Hz base) F: Custom V/f E1-04 through E1-13 settings define the V/f pattern	Default: F <2> Range: 0 to 9; A to F	127
E1-04 (0303)	Maximum Output Frequency	Max Frequency	These parameters are only applicable when E1-03 is set to F. To set linear V/f characteristics, set the same values for E1-07 and E1-09. In this case, the setting for E1-08 will be disregarded. Ensure that the four frequencies are set according to these rules: E1-09 ≤ E1-07 < E1-06 ≤ E1-11 ≤ E1-04 	Default: <3> Min.: 40.0 Hz Max.: 400.0 Hz	–
E1-05 (0304)	Maximum Voltage	Max Voltage		Default: <4> Min.: 0.0 V Max.: 255.0 V <1>	130
E1-06 (0305)	Base Frequency	Base Frequency		Default: <3> Min.: 0.0 Hz Max.: E1-04	–
E1-07 (0306)	Middle Output Frequency	Mid Frequency A		Default: <3> Min.: 0.0 Hz Max.: E1-04	–
E1-08 (0307)	Middle Output Frequency Voltage	Mid Voltage A		Default: <5> Min.: 0.0 V Max.: 255.0 V <1>	–
E1-09 (0308)	Minimum Output Frequency	Min Frequency		Default: <3> Min.: 0.0 Hz Max.: E1-04	–
E1-10 (0309)	Minimum Output Frequency Voltage	Min Voltage		Default: <6> Min.: 0.0 V Max.: 255.0 V <1>	–
E1-11 (030A)	Middle Output Frequency 2	Mid Frequency B		Default: 0.0 Hz Min.: 0.0 Max.: E1-04	–

<1> Value is specific to 200 V class drives; double the value for 400 V class models.
<2> Parameter setting is not reset to the default value when drive is initialized.
<3> Default setting is dependent on parameter o2-04, Drive Model Selection.
<4> Default is 230 or 460, depending on parameter o2-04, Drive Model Selection setting.
<5> Default is 17.3 or 34.6, depending on parameter o2-04, Drive Model Selection setting.
<6> Default is 10.2 or 20.4, depending on parameter o2-04, Drive Model Selection setting.

◆ 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>	131
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>	131
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	–

<1> Default setting is dependent on parameter o2-04, Drive Model Selection.

<2> Display is in the following units based on drive model:
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

Parameter List

B

B.7 F: Options

F parameters control the communication between the drive and the bypass.

◆ F6: Drive/Bypass Communications

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)	Selects the drive behavior when the drive detects a CE fault. 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>	Default: 1 Range: 0 to 4	132
F6-02 (03A3)	External Fault from Comm. Option Detection Selection	EF0 Detection 0: Always Detected 1: Only During Run	Selects when the drive should detect an EF0 fault issued by the bypass controller. 0: Always detected 1: Detection during run only	Default: 0 Range: 0, 1	132
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	132

<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.

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
H1-03 (0400)	Multi-Function Digital Input Terminal S3 Function Selection	Term S3 Func Sel	Assigns a function to the multi-function digital inputs through Z2-☐☐ = 3. Refer to pages 133 to 135 for descriptions of setting values. **Note:** Set unused terminals to F.	Default: 24 Min.: 3 Max.: 60	133
H1-04 (0401)	Multi-Function Digital Input Terminal S4 Function Selection	Term S4 Func Sel	Assigns a function to the multi-function digital inputs through Z2-☐☐ = 4. Refer to pages 133 to 135 for descriptions of setting values. **Note:** Set unused terminals to F.	Default: 14 Min.: 3 Max.: 60	133
H1-05 (0402)	Multi-Function Digital Input Terminal S5 Function Selection	Term S5 Func Sel	Assigns a function to the multi-function digital inputs through Z2-☐☐ = 5. Refer to pages 133 to 135 for descriptions of setting values. **Note:** Set unused terminals to F.	Default: 3 Min.: 3 Max.: 60	133
H1-06 (0403)	Multi-Function Digital Input Terminal S6 Function Selection	Term S6 Func Sel	Assigns a function to the multi-function digital inputs through Z2-☐☐ = 6. Refer to pages 133 to 135 for descriptions of setting values. **Note:** Set unused terminals to F.	Default: 4 Min.: 3 Max.: 60	133
H1-07 (0404)	Multi-Function Digital Input Terminal S7 Function Selection	Term S7 Func Sel	Assigns a function to the multi-function digital inputs through Z2-☐☐ = 7. Refer to pages 133 to 135 for descriptions of setting values. **Note:** Set unused terminals to F.	Default: F Min.: 3 Max.: 60	133
H1-08 (0405)	Multi-Function Digital Input Terminal S8 Function Selection	Term S8 Func Sel	Assigns a function to the multi-function digital inputs through Z2-☐☐ = 8. Refer to pages 133 to 135 for descriptions of setting values. **Note:** Set unused terminals to F.	Default: F Min.: 3 Max.: 60	133

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.	133
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.	133
6	Jog reference selection	jog Freq Ref	Closed: Jog frequency reference (d1-17) selected. Jog has priority over all other reference sources.	133
C	Analog terminal input selection	Term A2 Enable	Open: Function assigned by H3-14 is disabled. Closed: Function assigned by H3-14 is enabled.	133
8	Baseblock command (N.O.)	Ext BaseBlk N.O.	Closed: No drive output	–
9	Baseblock command (N.C.)	Ext BaseBlk N.C.	Open: No drive output	–
A	Accel/decel ramp hold	Acc/Dec RampHold	Open: Accel/decel is not held Closed: The drive pauses during acceleration or deceleration and maintains the output frequency.	–
B	Drive overheat alarm (oH2)	OH2 Alarm Signal	Closed: Closes when an oH2 alarm occurs	–
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.	133

H1 Multi-Function Digital Input Selections				
H1-□□ Setting	**Function**	**LCD Display**	**Description**	**Page**
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.	*133*
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.	*133*
14	Fault reset	Fault Reset	Closed: Resets faults if the cause is cleared and the Run command is removed.	*134*
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.	–
19	PID disable	PID Disable	Open: PID control enabled Closed: PID control disabled	*135*
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.	–
24	External fault	NO/ Always Det, Coast to Stop	N.O., Always detected, coast to stop	*135*
30	PID integral reset	PID Intgrl Reset	Closed: Resets the PID control integral value.	–
31	PID integral hold	PID Intgrl Hold	Open: Performs integral operation. Closed: Maintains the current PID control integral value.	–
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.	–
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.	–
60	Motor pre-heat 1	DCInj Activate	Closed: Triggers Motor pre-heat 1.	*135*
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.	–
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.	–

◆ 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 295 to 296 for descriptions of setting values.	Default: 0 Range: 0 to 164	135
H2-02 (040C)	Terminal M3-M4 function selection (relay)	M3/M4 Func Sel		Default: 1 Range: 0 to 164	135
H2-03 (040D)	Terminal MD-ME-MF function selection (relay)	MD/ME/MF FuncSel		Default: 2 Range: 0 to 164	135

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.	136
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.	136
2	Speed agree 1	Fref/Fout Agree1	Closed: Output frequency equals the speed reference (plus or minus the hysteresis set to L4-02).	136
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).	137
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.	137
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.	138
6	Drive ready	Drive Ready	Closed: Power up is complete and the drive is ready to accept a Run command.	138
7	Power supply error	Power Supply Err	Closed: DC bus voltage is below the Uv trip level set in L2-05.	138
8	During baseblock (N.O.)	BaseBlk 1	Closed: Drive has entered the baseblock state (no output voltage).	138
B	Torque detection 1 (N.O.)	Trq Det 1 N.O.	Closed: An overtorque or undertorque situation has been detected.	139
C	Frequency reference loss	Loss of Ref	Closed: Analog frequency reference has been lost.	139
E	Fault	Fault	Closed: Fault occurred.	139
F	Not Used (Through mode)	Not Used	Set this value when using the terminal in the pass-through mode.	139
10	Minor fault	Minor Fault	Closed: An alarm has been triggered, or the IGBTs have reached 90% of their expected life span.	139
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.	139
13	Speed agree 2	Fref/Fout Agree2	Closed: When drive output frequency equals the frequency reference ±L4-04.	139
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.	139
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.	140
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.	140
17	Torque detection 1 (N.C.)	Trq Det 1 N.C.	Open: Overtorque or undertorque has been detected.	139
1A	During Reverse	Reverse Dir	Closed: Drive is running in the reverse direction.	139
1B	During baseblock (N.C.)	BaseBlk 2	Open: Drive has entered the baseblock state (no output voltage).	141
1E	Restart enabled	Dur Flt Restart	Closed: An automatic restart is performed	141
20	Drive overheat pre-alarm (oH)	OH Prealarm	Closed: Heatsink temperature exceeds the parameter L8-02 value, or an external device has triggered an oH2 alarm via multi-function input H1-□□ = B.	141
2F	Maintenance period	Maintenance	Closed: Cooling fan, electrolytic capacitors, IGBTs, or the soft charge bypass relay may require maintenance.	141

Parameter List

B

H2 Multi-Function Digital Output Settings				
H2-□□ Setting	Function	LCD Display	Description	Page
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).	141
38	Drive Enable	Drive Enable	Closed: The digital output set for “Drive Enable” closes.	142
39	Energy pulse output	Energy Pulse Out	Output units are determined by H2-06. Outputs a pulse every 200 ms to indicate the kWh count.	142
3A	Regenerated power pulse output	RegEn Pulse Out	Outputs a pulse to indicate the regenerated power.	142
3D	During speed search	During SpdSrch	Closed: Speed Search is being executed.	142
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.	142
4D	oH Pre-alarm time limit	OH Pre-Alarm	Closed: oH pre-alarm time limit has passed.	142
60	Internal cooling fan alarm	Fan Alrm Det	Closed: Internal cooling fan alarm	142
64	During Commercial Power Operation	CommerclPwr Mode	Closed: Operating on commercial power.	142
100 to 164	Function 0 to 64 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.	142

◆ 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	142
H3-02 (0434)	Terminal A1 Function Selection	Term A1 FuncSel	Sets the function of terminal A1.	Default: 0 Range: 0 to 26	143
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	143
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	143
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	144
H3-06 (0414)	Terminal A3 Function Selection	Terminal A3 Sel	Sets the function of terminal A3.	Default: 2 Range: 0 to 26	144
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	144

No. (Addr. Hex)	Name	LCD Display	Description	Values	Page
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	144
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	144
H3-10 (0418)	Terminal A2 Function Selection	Term A2 FuncSel	Sets the function of terminal A2.	Default: <1> Range: 0 to 26	145
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	145
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	145
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	145
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	145
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	146
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	146
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	146

<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)	146
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%.	146
2	Auxiliary frequency reference 1 (used as a Multi-Step Speed 2)	Aux Reference1	10 V = E1-04 (maximum output frequency)	146
3	Auxiliary frequency reference 2 (3rd step analog)	Aux Reference2	10 V = E1-04 (maximum output frequency)	146
4	Output voltage bias	Voltage Bias	10 V = E1-05 (motor rated voltage)	146
5	Accel/decel time gain	Acc/DecTime Gain	10 V = 100%	147

H3 Multi-Function Analog Input Settings				
H3-□□ Setting	**Function**	**LCD Display**	**Description**	**Page**
6	DC Injection Braking current	DC Brake Current	10 V = Drive rated current	147
7	Overtorque/undertorque detection level	Torque Det Level	10 V = Drive rated current	147
8	Stall Prevention level during run	Stall Prev Level	10 V = Drive rated current	147
9	Output frequency lower limit level	Ref Lower Limit	10 V = E1-04 (maximum output frequency)	147
B	PID feedback	PID Feedback1	10 V = 100%	147
C	PID setpoint	PID Set Point	10 V = 100%	148
D	Frequency bias	Freq Ref Bias 2	10 V = E1-04 (maximum output frequency)	148
E	Motor temperature (PTC input)	Motor PTC	10 V = 100%	148
F	Through mode	Not Used	Set this value when using the terminal in the pass-through mode.	148
16	Differential PID feedback	PID Feedback 2	10 V = 100%	148
1F	HAND Reference	Hand Ref	Sets the frequency reference when in HAND Mode and parameter Z1-41, HAND Speed Reference Selection, is set to 1 (Analog).	148
25	Secondary PI Setpoint	PI2 Setpoint	10 V = S3-02 (maximum output frequency)	148
26	Secondary PI Feedback	PI2 Feedback	10 V = S3-02 (maximum output frequency)	148

◆ 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 621	148
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	148
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	148
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 621	148
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	148
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	148
H4-07 (0423)	Multi-Function Analog Output Terminal FM Signal Level Selection	Term FM Lvl Sel 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	149
H4-08 (0424)	Multi-Function Analog Output Terminal AM Signal Level Selection	Term AM Lvl Sel 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	149

◆ H5: MEMOBUS/Modbus Serial Communication

No. (Addr. Hex)	Name	LCD Display	Description	Values	Page
H5-09 (0435)	CE Detection Time	CE Detect Time	Sets the time required to detect a communications error. Adjustment may be needed when networking several drives.	Default: 2.0 s Min.: 0.0 Max.: 10.0	–
H5-11 (043C)	Communications ENTER Function Selection	Enter CommandSel 0: Enter Required 1: No EnterRequired	0: Drive requires an Enter command before accepting any changes to parameter settings. 1: Parameter changes are activated immediately without the Enter command.	Default: 0 Range: 0, 1	–
H5-12 (043D)	Run Command Method Selection	Run CommandSel 0: FWD Run &REV Run 1: Run & FWD/REV	0: FWD/Stop, REV/Stop 1: Run/Stop, FWD/REV	Default: 0 Range: 0, 1	–

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 and undertorque 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	0: Disabled 1: General purpose motor (standard fan cooled) 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	150
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	151
L1-04 (0483)	Motor Overheat Fault Operation Selection (PTC input)	Mtr OH Fault Sel 0 : Ramp to Stop 1: Coast to Stop 2: Fast-Stop	Sets stopping method when the motor temperature analog input (H3-02, H3-06, 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	–

◆ 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: 2 Range: 0 to 2	151
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	152
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	152
L2-21 (04F7)	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 <2> Max.: 230 V <2>	–
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> Values shown are specific to 208 Vac. Double the value for 480 Vac.

◆ L3: Stall Prevention

No. (Addr. Hex)	Name	LCD Display	Description	Values	Page
L3-01 (048F)	Stall Prevention Selection during Acceleration	StallP Accel Sel 0: Disabled 1: General purpose 2: Intelligent 3: iLim Mode	0: Disabled. 1: General purpose. Acceleration is paused as long as the current is above the L3-02 setting. 2: Intelligent. Accelerate in the shortest possible time without exceeding the L3-02 level. 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 to 3	–
L3-02 (0490)	Stall Prevention Level during Acceleration	StallP Accel Lvl	Used when L3-01 = 1 or 2. 100% is equal to the drive rated current.	Default: <1> Min.: 0% Max.: 150% <1>	152
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	153
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	153
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: <1> Min.: 30% Max.: 150% <1>	154
L3-14 (04C7)	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 <1>	–
L3-23 (04FD)	Automatic Reduction Selection for Stall Prevention during Run	CHP Stall P Sel 0: Lvl1 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	–

<1> Upper limit and default values are 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	154
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	154
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	154
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	154
L4-05 (049D)	Frequency Reference Loss Detection Selection	Ref Loss Sel 0: Stop 1: Run@L4-06PrevRef	0: Stop. Drive stops when the frequency reference is lost. 1: Run. Drive runs at a reduced speed when the frequency reference is lost.	Default: 1 Range: 0, 1	154

No. (Addr. Hex)	Name	LCD Display	Description	Values	Page
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	155
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	155

◆ 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	156
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	156
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	156
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	157
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. 1: Attempt to restart with the interval time set in L5-04 and increment the restart counter with each attempt.	Default: 1 Range: 0, 1	158

◆ 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	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	Default: 0 Range: 0 to 8	158
L6-02 (04A2)	Torque Detection Level 1	Torq Det 1 Lvl	Sets the overtorque and undertorque detection level.	Default: 15% Min.: 0 Max.: 300	159
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	159
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	158

No. (Addr. Hex)	Name	LCD Display	Description	Values	Page
L6-14 (062F)	Motor Underload Protection Level at Minimum Frequency	Underload Level	Sets the UL6 detection level at minimum frequency by percentage of drive rated current.	Default: 15% Min.: 0 Max.: 300	158

◆ 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	160
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	–
L8-05 (04B1)	Input Phase Loss Protection Selection	Inp Ph Loss Det 0: Disabled 1: Enabled	Selects the detection of input current phase loss, power supply voltage imbalance, or main circuit electrolytic capacitor deterioration. 0: Disabled 1: Enabled	Default: 1 Range: 0, 1	160
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%	161
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	161
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	161
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: <1> Range: 0 to 2	161
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	–

<1> Default setting is dependent on parameter o2-04, Drive Model Selection.

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	162
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	162

◆ 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	162

B.11 o: Operator-Related Settings

The o parameters set up the digital operator displays.

◆ o1: HOA Keypad Display Selection

No. (Addr. Hex)	Name	LCD Display	Description	Values	Page
o1-01 (500) RUN <1>	Drive Mode Unit Monitor Selection	User Monitor Sel	Selects the content of the last monitor that is shown when scrolling through Drive Mode display. Enter the last three digits of the monitor parameter number to be displayed: U□-□□.	Default: 106 Range: 104 to 699	*163*
o1-02 (501) RUN <1>	Drive Mode Unit Monitor 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	*163*
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, E4-04, or E5-04) 3: User-selected units (set by o1-10 and o1-11)	Default: 0 Range: 0 to 3	*163*
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 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) 16: None	Default: 16 Range: 0 to 16	*163*
o1-10 (0520)	User-Set Display Units Maximum Value	UserDisp Scaling	These settings define the display values when o1-03 is set to 3. o1-10 sets the display value that is equal to the maximum output frequency. o1-11 sets the position of the decimal position.	Default: <1> Range: 1 to 60000	*165*
o1-11 (0521)	User-Set Display Units Decimal Display	UserDisp Dec		Default: <1> Range: 0 to 3	*165*

<1> Available in bypass controller software versions VST800401 and later.

◆ 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	–
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	*165*
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	–

◆ o4: Maintenance Monitor Settings

No. (Addr. Hex)	Name	LCD Display	Description	Values	Page
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	165
o4-11 (0510)	U2, U3, and UB-09 to UB-16 Initialization	Fault Data Init 0: No Reset 1: Reset	0: The drive and bypass keep the previously saved record concerning fault trace and fault history. 1: Resets the data for the U2-□□, U3-□□, and UB-09 to UB-16 monitors. Setting o4-11 to 1 and pressing the ENTER key erases fault data in the bypass and drive and returns the display to 0.	Default: 0 Range: 0, 1	165
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	166

B.12 S: HVAC Function

◆ 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	167
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	167
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	167
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	168
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	168
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	168

◆ 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	169
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	169
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	169
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	169
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	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	Default: 0 Range: 0 to 5	170
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	169

No. (Addr. Hex)	Name	LCD Display	Description	Values	Page
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	169
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	169
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	169
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	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	Default: 0 Range: 0 to 5	170
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	169
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	169
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	169
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	169
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	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	Default: 0 Range: 0 to 5	170
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	169
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	169

No. (Addr. Hex)	Name	LCD Display	Description	Values	Page
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	*169*
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	*169*
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	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	Default: 0 Range: 0 to 5	*170*

B.13 T: Motor Tuning

Enter data into the following parameters to tune the motor and drive for optimal performance. When the drive is not accessible, the current values of these parameters are not accessible. The default values are set by the Bypass Controller when a Bypass Control Parameter Initialize (Z1-01 = 1, 2, or 3) command is given.

◆ T1: Induction Motor Auto-Tuning

No. (Addr. Hex)	Name	LCD Display	Description	Values	Page
T1-01 (0701)	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	97
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: <1> Min.: 0.00 kW Max.: 650.00 kW	97
T1-03 (0703)	Motor Rated Voltage	Rated Voltage	Sets the motor rated voltage as specified on the motor nameplate.	Default: 200.0 V <2> Min: 0.0 Max: 255.0 <2>	97
T1-04 (0704)	Motor Rated Current	Rated Current	Sets the motor rated current as specified on the motor nameplate.	Default: <1> Min.: 10% of drive rated current Max.: 150% of drive rated current	98
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	98
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	98
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	98
T1-11 (070B)	Motor Iron Loss	Mtr Iron Loss(W)	Sets the iron loss for determining the Energy Saving coefficient.	Default: 14 W Min.: 0 Max.: 65535	98

<1> Default setting is dependent on parameter o2-04, Drive Model Selection.

<2> Values shown are specific to 208 Vac. Double the value for 480 Vac.

B.14 U: Monitors

Monitor parameters allow the user to view drive status, fault information, and other data concerning drive operation.

◆ UB: Bypass Control Monitors

No. (Addr. Hex)	Name	Description	Unit
UB-01 (8780)	Motor Current	Format is XXX.X amps.	Amp
UB-02 (8781	Bypass Digital Input States	View status of bypass digital inputs XXXXXXXX Where X = 0 (not asserted) or 1 (asserted) The right-most digit is the status of digital input 1.	–
UB-03 (8782)	Bypass Digital Output States	View status of bypass digital outputs XXXXXXXX Where X = 0 (not asserted) or 1 (asserted) The right-most digit is the status of digital output 1.	–
UB-04 (8783)	Bypass Digital Output States	View status of bypass digital outputs XXXXXXXX Where X = 0 (not asserted) or 1 (asserted) The right-most digit is the status of digital output 9.	–
UB-05 (8784)	Bypass Controller Status Register 1	UB-05 = 00000000 0 HAND Mode 0 OFF Mode 0 AUTO Mode 0 DRIVE Mode 0 BYPASS Mode 0 Smoke Purge Bypass Active 0 Smoke Purge Drive Active 0 Safety Open	–
UB-06 (8785)	Bypass Controller Status Register 2	UB-06 = 00000000 0 BAS Interlock Open 0 RUN Active 0 Fault Active 0 Auto Transfer Active 0 Remote Transfer Active 0 Energy Savings Active 0 Motor 1 Selected 0 Motor 2 Selected **Note:** When read over serial communications, address 8785H, contains two additional bits of information: Bit 8: "0" when Z1-07 = 2, otherwise "1". Bit 9: "0" when Z1-08 = 2, otherwise "1".	–
UB-07 (8786)	Bypass Controller Active Faults Register 1	UB-07 = 00000000 0 Drive Fault 0 Safety Open 0 BAS Interlock Open Time Out 0 External Fault Bypass (EFB) 0 Reserved 0 Motor Overload 0 External Motor 1 Overload 0 External Motor 2 Overload	–

No. (Addr. Hex)	Name	Description	Unit
UB-08 (8787)	Bypass Controller Active Faults Register 2	UB-08 = 00000000 0 Phase Loss Brownout 0 Phase Loss Blackout 0 No Drive Comms 0 Available 0 Option Board Comms 0 Loss of Load 0 Serial Communications Fault 0 Available	–
UB-09 (8788)	Current Fault	Displays the current fault. ***Refer to Bypass Fault Codes on page 380*** for details.	–
UB-10 (8789)	Current Fault Year	Displays the year of the current fault.	–
UB-11 (878A)	Current Fault Month Day	Displays the month and day of the current fault.	–
UB-12 (878B)	Current Fault Hour Minute	Displays the hour and minute of the current fault.	–
UB-13 (878C)	Previous Fault	Displays the previous fault. ***Refer to Bypass Fault Codes on page 380*** for details.	–
UB-14 (878D)	Previous Fault Year	Displays the year of the previous fault.	–
UB-15 (878E)	Previous Fault Month Day	Displays the month and day of the previous fault.	–
UB-16 (878F)	Previous Fault Hour Minute	Displays the hour and minute of the previous fault.	–
UB-17 (8790)	Contactor Voltage (120 VAC)	Displays the measured voltage for the power going to the contactor coils.	1 Vac
UB-18 (8791)	Software Version	Displays the software version currently programmed into the bypass.	–
UB-19 (8792)	Date Year	Displays the current year.	–
UB-20 (8793)	Date Month & Day	Displays the current date (Month and Date).	–
UB-21 (8794)	Time Hour & Minute	Displays the current time (Hours and Minutes).	–
UB-90 (87A0)	Service Register 0	Unfiltered CT1 current	–
UB-91 (87A1)	Service Register 1	Unfiltered CT2 current	–
UB-92 (87A2)	Service Register 2	Electronic overload calculations	–
UB-93 (87A3)	Service Register 3	BACnet messages sent	–
UB-94 (87A4)	Service Register 4	BACnet received messages errored	–
UB-96 (87DF)	Bypass Unbalance Level	Displays the percent of current unbalance when operating in Bypass Mode.	0.0 to 100.0%

◆ 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

No. (Addr. Hex)	Name	LCD Display	Description	Analog Output Level	Unit
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	–
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

No. (Addr. Hex)	Name	LCD Display	Description	Analog Output Level	Unit
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	–
U1-25 (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	–
U1-54 (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
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 based on drive model:
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 208 V models. Double the value for 480 V models.

<4> Display is in the following units based on drive model:
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. *Refer to Fault Trace Contents on page 378* for details.	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)	DC Bus Voltage at Previous Fault	DC Bus Voltage	Displays the DC bus voltage at the previous fault.	No signal output available	1 Vdc
U2-09 (0088)	Output Power at Previous Fault	Output kWatts	Displays the output power at the previous fault.	No signal output available	0.1 kW
U2-11 (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	–

No. (Addr. Hex)	Name	LCD Display	Description	Analog Output Level	Unit
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%
U2-20 (008E)	Heatsink Temperature at Previous Fault	Actual Fin Temp	Displays the temperature of the heatsink when the most recent fault occurred.	No signal output available	1 °C
U2-30 (3008)	Date Year at Previous Fault	Date Year YYYY	Displays the year when the most recent fault occurred.	No signal output available	–
U2-31 (3009)	Date Month and Day at Previous Fault	Date Mo Day MMDD	Displays the date and day when the most recent fault occurred.	No signal output available	–
U2-32 (300A)	Time Hours and Minutes at Previous Fault	Time Hr Min HHMM	Displays the time when the most recent fault occurred.	No signal output available	–
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 based on drive model:
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. *Refer to Fault Trace Contents on page 378* for details.	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. *Refer to Fault Trace Contents on page 378* for details.	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	–

No. (Addr. Hex)	Name	LCD Display	Description	Analog Output Level	Unit
U3-24 (300E)	Date Year at 2nd Most Recent Fault	Fault 2 YYYY	Displays the year when the second most recent fault occurred.	No signal output available	–
U3-25 (300F)	Date Month and Day at 2nd Most Recent Fault	Fault 2 MMDD	Displays the date and day when the second most recent fault occurred.	No signal output available	–
U3-26 (3010)	Time Hours and Minutes at 2nd Most Recent Fault	Fault 2 HHMM	Displays the time when the second most recent fault occurred.	No signal output available	–
U3-27 (3011)	Date Year at 3rd Most Recent Fault	Fault 3 YYYY	Displays the year when the most third recent fault occurred.	No signal output available	–
U3-28 (3012)	Date Month and Day at 3rd Most Recent Fault	Fault 3 MMDD	Displays the date and day when the third most recent fault occurred.	No signal output available	–
U3-29 (3013)	Time Hours and Minutes at 3rd Most Recent Fault	Fault 3 HHMM	Displays the time when the third most recent fault occurred.	No signal output available	–
U3-30 (3014)	Date Year at 4th Most Recent Fault	Fault 4 YYYY	Displays the year when the fourth most recent fault occurred.	No signal output available	–
U3-31 (3015)	Date Month and Day at 4th Most Recent Fault	Fault 4 MMDD	Displays the date and day when the fourth most recent fault occurred.	No signal output available	–
U3-32 (3016)	Time Hours and Minutes at 4th Most Recent Fault	Fault 4 HHMM	Displays the time when the fourth most recent fault occurred.	No signal output available	–
U3-33 (3017)	Date Year at 5th Most Recent Fault	Fault 5 YYYY	Displays the year when the fifth most recent fault occurred.	No signal output available	–
U3-34 (3018)	Date Month and Day at 5th Most Recent Fault	Fault 5 MMDD	Displays the date and day when the fifth most recent fault occurred.	No signal output available	–
U3-35 (3019)	Time Hours and Minutes at 5th Most Recent Fault	Fault 5 HHMM	Displays the time when the fifth most recent fault occurred.	No signal output available	–
U3-36 (301A)	Date Year at 6th Most Recent Fault	Fault 6 YYYY	Displays the year when the sixth most recent fault occurred.	No signal output available	–
U3-37 (301B)	Date Month and Day a 6th Most Recent Fault	Fault 6 MMDD	Displays the date and day when the sixth most recent fault occurred.	No signal output available	–
U3-38 (301C)	Time Hours and Minutes at 6th Most Recent Fault	Fault 6 HHMM	Displays the time when the most sixth recent fault occurred.	No signal output available	–
U3-39 (301D)	Date Year at 7th Most Recent Fault	Fault 7 YYYY	Displays the year when the most seventh recent fault occurred.	No signal output available	–
U3-40 (301E)	Date Month and Day at 7th Most Recent Fault	Fault 7 MMDD	Displays the date and day when the seventh most recent fault occurred.	No signal output available	–
U3-41 (301F)	Time Hours and Minutes at 7th Most Recent Fault	Fault 7 HHMM	Displays the time when the seventh most recent fault occurred.	No signal output available	–
U3-42 (3020)	Date Year at 8th Most Recent Fault	Fault 8 YYYY	Displays the year when the eighth most recent fault occurred.	No signal output available	–
U3-43 (3021)	Date Month and Day 8th at Most Recent Fault	Fault 8 MMDD	Displays the date and day when the eighth most recent fault occurred.	No signal output available	–
U3-44 (3022)	Time Hours and Minutes at 8th Most Recent Fault	Fault 8 HHMM	Displays the time when the eighth most recent fault occurred.	No signal output available	–
U3-45 (3023)	Date Year at 9th Most Recent Fault	Fault 9 YYYY	Displays the year when the ninth most recent fault occurred.	No signal output available	–
U3-46 (3024)	Date Month and Day at 9th Most Recent Fault	Fault 9 MMDD	Displays the date and day when the ninth most recent fault occurred.	No signal output available	–
U3-47 (3025)	Time Hours and Minutes at 9th Most Recent Fault	Fault 9 HHMM	Displays the time when the ninth most recent fault occurred.	No signal output available	–
U3-48 (3026)	Date Year at 10th Most Recent Fault	Fault 10 YYYY	Displays the year when the tenth most recent fault occurred.	No signal output available	–
U3-49 (3027)	Date Month and Day at 10th Most Recent Fault	Fault 10 MMDD	Displays the date and day when the tenth most recent fault occurred.	No signal output available	–
U3-50 (3028)	Time Hours and Minutes at 10th Most Recent	Fault 10 HHMM	Displays the time when the tenth most recent fault occurred.	No signal output available	–

◆ U4: Maintenance Monitors

No. (Addr. Hex)	Name	LCD Display	Description	Analog Output Level	Unit
U4-01 (004C)	Cumulative Operation Time	Drv Elapsed Time	Displays the cumulative operation time of the drive. The value for the cumulative operation time counter can be reset in parameter o4-01. Use parameter o4-02 to determine if the operation time should start as soon as the power is switched on or only while the Run command is present. The maximum number displayed is 99999, after which the value is reset to 0.	No signal output available	1 h
U4-02 (0075)	Number of Run Commands	RUN Cmd Counter	Displays the number of times the Run command is entered. Reset the number of Run commands using parameter o4-13. This value will reset to 0 and start counting again after reaching 65535.	No signal output available	1 Time
U4-03 (0067)	Cooling Fan Operation Time	Fan Elapsed TIme	Displays the cumulative operation time of the cooling fan. The default value for the fan operation time is reset in parameter o4-03. This value will reset to 0 and start counting again after reaching 99999.	No signal output available	1 h
U4-04 (007E)	Cooling Fan Maintenance	Fan Life Mon	Displays main cooling fan usage time as a percentage of its expected performance life. Parameter o4-03 can be used to reset this monitor.	No signal output available	1%
U4-05 (007C)	Capacitor Maintenance	Cap Life Mon	Displays main circuit capacitor usage time as a percentage of their expected performance life. Parameter o4-05 can be used to reset this monitor.	No signal output available	1%
U4-06 (07D6)	Soft Charge Bypass Relay Maintenance	ChgCirc Life Mon	Displays the soft charge bypass relay maintenance time as a percentage of its estimated performance life. Parameter o4-07 can be used to reset this monitor.	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
U4-12 (00)		CPU Occup Rate			
U4-13 (07CF)	Peak Hold Current	Current PeakHold	Displays the highest current value that occurred during run.	No signal output available	0.01 A <1>
U4-14 (07D0)	Peak Hold Output Frequency	Freq@ I PeakHold	Displays the output frequency when the current value shown in U4-13 occurred.	No signal output available	0.01 Hz
U4-16 (07D8)	Motor Overload Estimate (oL1)	Motor OL1 Level	Shows the value of the motor overload detection accumulator. 100% is equal to the oL1 detection level.	10 V: 100%	0.1%
U4-18 (07DA)	Frequency Reference Source Selection	Reference Source	Displays the source for the frequency reference as XY-nn. **X: indicates which reference is used:** 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) 1-03 = Analog (terminal A3) 2-02 to 17 = Multi-step speed (d1-02 to 17) 3-01 = MEMOBUS/Modbus, BACnet, Metasys, or Apogee 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> 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%
U5-30 (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

No. (Addr. Hex)	Name	LCD Display	Description	Analog Output Level	Unit
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

Analog Output selection text is: “PID Output 2”.

◆ 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	–

B.15 Z: Bypass Parameters

◆ Z1: Bypass Control System

No. (Addr. Hex)	Name	LCD Display	Description	Values	Page
Z1-01 (85C6) RUN	Initialize	Initialize 0: No init 1: Set All Def 2: Set Byp Def 3: Set Drv Def	0: No Initialize 1: Set all parameters to their default values. For drive parameters, first issues two-wire reset, then sets individual parameter default values. 2: Set only Bypass Controller parameters to their default values. 3: Set only Drive Controller parameters to their default values. First issues two-wire reset, then sets individual parameter default values.	Default: 0 Range: 0 to 3	176
Z1-02 (85C7) RUN	Password	Password	Allows and restricts access to all parameters. Setting this value equal to the value in Z1-03 toggles access to all parameter settings except this parameter. If the value entered to Z1-02 matches the value entered to Z1-03, the access to all parameters is denied or granted.	Default: — Min.: — Max.: —	176
Z1-03 (85C8) RUN	Password Change	Pass Chg	The value entered here is the password.	Default: 0 Min.: 0 Max.: 9999	176
Z1-05 (85CA) RUN	Auto Transfer to Bypass Upon Drive Fault	Auto Xfr Byp Flt 0: Disable 1: Enable	When the drive is running and a drive fault occurs, operation will switch to Bypass mode. When the fault is cleared, operation will switch back to Drive mode 0: Disable 1: Enable	Default: 0 Range: 0, 1	176
Z1-06 (85CB) RUN	Power-Up Mode	Power-Up 0: OFF 1: AUTO-DRIVE 2: HAND-DRIVE 3: AUTO-BYPASS 4: HAND-BYPASS	Determines the mode of the Bypass Control upon power-up. 0: OFF 1: AUTO-DRIVE 2: HAND-DRIVE 3: AUTO-BYPASS 4: HAND-BYPASS	Default: 0 Range: 0 to 4	176
Z1-07 (85CC) RUN	Speed Reference Select	Spd Ref Sel 0: Operator 1: Analog Input 2: Bypass Serial 3: Option Board	Determines the source of the Frequency Reference sent from the Bypass Controller to the Drive. 0: Operator 1: Analog Input 2: Bypass Serial 3: Option Board (CN5)	Default: 1 Range: 0 to 3	177
Z1-08 (85CD) RUN	Run Command Select	Run Cmd Sel 0: Operator 1: Bypass DI 2: Bypass Serial 3: Option Board	Determines the source of the Auto Mode Run command used by the Bypass Controller. 0: Operator 1: Bypass Controller Digital Input 2: Bypass Serial 3: Option Board (CN5)	Default: 1 Range: 0 to 3	178
Z1-09 (85CE) RUN	HAND Mode Drive Speed Reference	Hand Fref	This is the speed reference used when the Drive is running in HAND mode. Units are in Hz.	Default: 10.0 Hz <1> Min.: 0.0 Max.: 60.0	178
Z1-10 (85CF) RUN	Smoke Purge Preset Frequency Reference	Smoke Purge	Sets the speed at which the drive will run when the Smoke Purge Drive input is active.	Default: 10.0 Hz <1> Min.: 0.0 Max.: 60.0	178

No. (Addr. Hex)	Name	LCD Display	Description	Values	Page
Z1-11 (85D0) RUN	2-Motor AND/OR Function Select	2-Mtr AND/OR Sel 0: Disable 1: Always Mtr 1 2: Always Mtr 2 3: Alws Mtr 1 AND 2 4: OR DI HAND/ AUTO 5: OR 1 H DI AUTO 6: OR 2 H DI AUTO 7: AND/OR B DI 8: AND/OR 1 H DI A 9: AND/OR 2 H DI A 10: AND/OR B H DI A	0: Disabled (ignore digital inputs) 1: Always use only motor 1 2: Always use only motor 2 3: Always use motors 1 AND 2 4: OR function motor selected by digital input in HAND and AUTO modes 5: OR function use motor 1 in HAND mode and motor selected by digital input in AUTO mode 6: OR function use motor 2 in HAND mode and motor selected by digital input in AUTO mode 7: AND/OR function motor selected (1, 2, or both) by (2) digital inputs in HAND and AUTO mode 8: AND/OR function use motor 1 in HAND mode and motor selected (1, 2, or both) by (2) digital inputs in AUTO mode 9: AND/OR function use motor 2 in HAND mode and motor selected (1, 2, or both) by (2) digital inputs in AUTO mode 10: AND/OR function use motors 1 AND 2 in HAND mode and motor selected (1, 2, or both) by (2) digital inputs in AUTO mode	Default: 0 Range: 0 to 10	179
Z1-12 (85D1) RUN	Run Delay Time	Run Delay Time	Delays the drive or bypass Run from when commanded (after RUN, RUN ENABLE, and RUN INTERLOCK are all asserted).	Default: 0.0 s Min.: 0.0 Max.: 300.0	179
Z1-13 (85D2) RUN	Pre-Interlock Run Select	Pre Int Run Sel 0: Disable 1: Enable	Allows running at a preset speed starting immediately upon a Run command, ignoring the BAS Interlock Input. The drive frequency reference stays at this preset speed until the Run Delay time (Z1-12) times out. 0: Disabled 1: Enable delay time only	Default: 0 Range: 0, 1	179
Z1-14 (85D3) RUN	Run Delay Frequency Reference	Run Delay Fref	Frequency used while delaying the Run command.	Default: 60.0 Hz <1> Min.: 0.0 Max.: 60.0	179
Z1-15 (85D4) RUN	Interlock Wait Time	Interlck Wait	Upon entering a Run command, the damper actuator output will be asserted. When an input is programmed for Interlock and the time set to this parameter is reached before the Interlock input goes active, a fault will be declared. A setting of 0.0 will never time out.	Default: 0.0 s Min.: 0.0 Max.: 300.0	179
Z1-24 (85DD) RUN	Contactor Open Delay Time	Kx Open Delay	Sets the time to delay after commanding the drive output contactor K2 or bypass contactor K3 or 2-Motor OR/AND contactors K4 and K5 to open to allow the contacts to open.	Default: 0.2 s Min.: 0.0 Max.: 5.0	181
Z1-25 (85DE) RUN	Contactor Close Delay Time	Kx Close Delay	Sets the time to delay after commanding the drive output contactor K2 or bypass contactor K3 or 2-Motor OR/AND contactors K4 and K5 to close to allow the contacts to close.	Default: 0.2 s Min.: 0.0 Max.: 5.0	182
Z1-27 (08E0) RUN	Phase Loss Brownout Voltage Level	PL Brownout V	Sets the voltage level below which is considered a brownout condition.	Default: 98 V Min.: 0 Max.: 150	182
Z1-28 (85E1) RUN	Phase Loss Brownout Detection Time PL Brownout T	PL Brownout T	Sets the time that the input voltage is continuously measured to be below the Brownout Voltage level before declaring a Brownout fault.	Default: 3.0 s Min.: 0.0 Max.: 300.0	182
Z1-29 (85E2) RUN	Phase Loss Blackout Voltage Level	PL Blackout V	Sets the voltage level below which is considered a blackout condition. When the input voltage is measured below this level, a Blackout fault will be declared.	Default: 0 V Min.: 0 Max.: 150	182
Z1-30 (85E3) RUN	EF0 Fault Delay Time	EF0 Flt Delay T	Sets the time between declaring a drive fault and opening the drive and bypass contactors.	Default: 1.0 s Min.: 0.0 Max.: 300.0	182
Z1-31 (85E4) RUN	Loss of Load Detection Enable	Loss of Load En 0: Disable 1: Enable Fault 2: Enable Alarm	0: Disable 1: Enable and declare fault. 2: Enable and alarm only	Default: 0 Range: 0 to 2	182
Z1-32 (85E5) RUN	Loss of Load Drive Frequency	Load Drive Freq	Sets the value to which the drive output frequency must be equal to or greater than for the drive to detect a loss of load.	Default: 60.0 Hz <1> Min.: 0.0 Max.: 60.0	182

B.15 Z: Bypass Parameters

No. (Addr. Hex)	Name	LCD Display	Description	Values	Page
Z1-33 (85E6) RUN	Loss of Load Drive Output Current	Load Drive Curr	The drive output current must be equal to or less than this value to detect a loss of load.	Default: 0.0 A Min.: 0.0 Max.: 999.9	182
Z1-34 (85E7) RUN	Loss of Load Drive Time	Load Drive Time	The conditions must be met for the length of time entered here before detecting a loss of load while in Drive mode.	Default: 1.0 s Min.: 0.0 Max.: 300.0	183
Z1-35 (85E8) RUN	Loss of Load Bypass Output Current	Load Byp Cur	The motor current must be equal to or less than this value to detect a loss of load.	Default: 0.0 A Min.: 0.0 Max.: 999.9	183
Z1-36 (85E9) RUN	Loss of Load Bypass Time	Load Byp Time	The conditions must be met for the length of time entered to this parameter before detecting a loss of load while in Bypass mode.	Default: 1.0 s Min.: 0.0 Max.: 300.0	183
Z1-37 (85EA) RUN	Set Time	Set Time 0: Normal display 1: Time Setting 2: Reset Time	Changes the LCD display to time setting to set the Real Time Clock. 0: Normal display 1: Displays time and date setting mode 2: Reset time	Default: 0 Range: 0 to 2	183
Z1-38 (85EB) RUN	HOA Source Select	HOA Select 0: Operator 1: Digital Inputs 2: Ser Comm & Opt	0: Operator 1: Digital Inputs 2: Serial Communications	Default: 0 Range: 0 to 2	183
Z1-39 (85EC) RUN	Drive/Bypass Source Select	Drv/Byp Select 0: Operator 1: Digital Inputs 2: Ser Comm & Opt	0: Operator 1: Digital Inputs 2: Serial Communications	Default: 0 Range: 0 to 2	183
Z1-40 (85ED) RUN	Auto Transfer Wait Time	Auto Xfer Wait T	If Auto Transfer is enabled and a drive fault is detected, the bypass controller will wait this length of time before switching to bypass.	Default: 0.0 s Min.: 0.0 Max.: 300.0	183
Z1-41 (85EE)	Hand Speed Reference Selection	Hand Spd Ref Sel 0: Parameter Z1-09 1: Analog	Selects the frequency reference source when in HAND Mode. 0: Parameter Z1-09 1: Analog	Default: 0 Range: 0, 1	184
Z1-42 (85EF)	Bypass Device Type	Byp Device Type 0: Contactor 1: Soft Starter	Selects the type of device that is used for the bypass. 0: Contactor 1: Soft Starter **Note:** Setting 1 is required for bypasses with the soft-starter option PW. This parameter is set to the correct value at the factory. It should not require adjustment.	Default: 0 Range: 0, 1	184
Z1-50 (85F7)	Bypass Unbalanced Current Detection Level	Byp Unbal Level	Sets the current unbalance level between phases when operating in Bypass Mode.	Default: 25.0% Min.: 5.0 Max.: 25.0	184
Z1-51 (85F8)	Bypass Unbalance Trip Time Detection Level	Byp Unbal Time	Sets the trip time for an unbalance condition operating in Bypass Mode. **Note:** Setting this parameter to 0.0 will disable unbalance detection.	Default: 5.0 s Min.: 0.0 Max.: 30.0	184
Z1-52 (85F9)	Bypass Phase Rotation	Byp Phs Rotation 0: Disabled 1: Alarm 2: Fault	Determines the action to take when Bypass Mode phase rotation is incorrect 0: Disabled 1: Alarm 2: Fault	Default: 1 Range: 0 to 2	184
Z1-53 (85FA) <5>	Load Verification Fault Select	Load Verify	Enables and disables verification that the motor is running when commanded to run. 0: Disabled 1: Enabled	Default: 0 Range: 0, 1	185
Z1-54 (85FB) <5>	LCD Contrast Control	LCD Contrast	Sets the contrast of the LCD operator display on the bypass.	Default: 3 Range: 1 to 5	186

No. (Addr. Hex)	Name	LCD Display	Description	Values	Page
Z1-55 (85FC) <5>	Welded K3 Contactor Fault Select	Welded Contactor	Enables and disables detection of K3 "welded contactor" condition. 0: Disabled 1: Enabled	Default: 0 Range: 0, 1	*186*
Z1-60 (8601) <6>	Black Out Selection	Black out Selection	Determines the bypass behavior when contactor voltage drops below Z1-29 setting. 0: Fault 1: Restart	Default: 0 Range: 0, 1	*186*
Z1-61 (8602) <6>	Restart Delay	Restart Delay	Sets the time delay for restart.	Default: 10 s Min.: 10 s Max.: 300 s	*186*

<1> Values are given in Hz, but actual values are dependent upon unit settings using drive parameters o1-03, o1-09, o1-10, and o1-11.

<5> Available in bypass controller software versions VST800400 and later.

<6> Available in bypass controller software versions VST800401 and later.

◆ Z2: Bypass Control Input/Output

No. (Addr. Hex)	Name	LCD Display	Description	Values	Page
Z2-01 (8563) RUN	Digital Input 1 Function Select	DI-1 Func Sel	0: Unused (Available for Serial Comms) 3: DRV Multi-Function Input S3 (H1-03 Setting) 4: DRV Multi-Function Input S4 (H1-04 Setting) 5: DRV Multi-Function Input S5 (H1-05 Setting) 6: DRV Multi-Function Input S6 (H1-06 Setting) 7: DRV Multi-Function Input S7 (H1-07 Setting) 7: DRV Multi-Function Input S8 (H1-08 Setting) 21: Run (AUTO Mode) 22: Run Enable (Safety) 23: Run Interlock (BAS) 24: Remote Transfer to Bypass 25: Smoke Purge Bypass Run to Destruction 26: Smoke Purge Drive Run to Destruction at Smoke Purge Preset Speed. Bypass controller will stay in this state even if the drive faults or is unavailable. 27: Motor OR Select (2-Motor OR function; 0/1 for Motor 1/2. Behavior defined by Z1-11) 28: Motor AND Select (2-Motor AND function; 0/1 for 1/2 motor. If 1 motor, then look to Motor OR input for selected motor. Behavior defined by Z1-11) 29: Motor 1 Overload Contact. When input is open, declare an OL Fault, issue an EF0 fault to the drive, delay per EF0 Fault Delay Time (Z1-30), and open Drive Output (K2) and Bypass (K3) contactors. 30: Motor 2 Overload Contact. When input is open, declare an OL Fault, issue an EF0 fault to the drive, delay per EF0 Fault Delay Time (Z130), and open Drive Output (K2) and Bypass (K3) contactors. 31: HAND Select 32: AUTO Select 33: DRIVE/BYPASS Select (0/1 for Drive/Bypass) 34: Fault Reset 35: External Fault (EF0) 36: External Fault (EFB) 37: Run Reverse	Default: 21 Range: 0 to 37	*187*
Z2-02 (8564) RUN	Digital Input 2 Function Select	DI-2 Func Sel		Default: 22 Range: 0 to 37	*187*
Z2-03 (8565) RUN	Digital Input 3 Function Select	DI-3 Func Sel		Default: 23 Range: 0 to 37	*187*
Z2-04 (8566) RUN	Digital Input 4 Function Select	DI-4 Func Sel		Default: 24 Range: 0 to 37	*187*
Z2-05 (8567) RUN	Digital Input 5 Function Select	DI-5 Func Sel		Default: 25 Range: 0 to 37	*187*
Z2-06 (8568) RUN	Digital Input 6 Function Select	DI-6 Func Sel		Default: 0 Range: 0 to 37	*187*
Z2-07 (8569)	Digital Input 7 Function Select	DI-7 Func Sel		Default: 0 Range: 0 to 37	*187*
Z2-08 (856A) RUN	Digital Input 8 Function Select	DI-8 Func Sel		Default: 29 Range: 0 to 37	*187*
Z2-09 (856B) RUN	Digital Input 1 Invert Select	DI-1 Invert 0: Normal 1: Inverted	0: Normal. Lack of input signal = OFF 1: Inverted. Lack of input signal = ON	Default: 0 Range: 0, 1	*189*
Z2-10 (856C) RUN	Digital Input 2 Invert Select	DI-2 Invert 0: Normal 1: Inverted	0: Normal. Lack of input signal = OFF 1: Inverted. Lack of input signal = ON	Default: 0 Range: 0, 1	*189*
Z2-11 (856D) RUN	Digital Input 3 Invert Select	DI-3 Invert 0: Normal 1: Inverted	0: Normal. Lack of input signal = OFF 1: Inverted. Lack of input signal = ON	Default: 0 Range: 0, 1	*189*
Z2-12 (856E) RUN	Digital Input 4 Invert Select	DI-4 Invert 0: Normal 1: Inverted	0: Normal. Lack of input signal = OFF 1: Inverted. Lack of input signal = ON	Default: 0 Range: 0, 1	*189*
Z2-13 (856F) RUN	Digital Input 5 Invert Select	DI-5 Invert 0: Normal 1: Inverted	0: Normal. Lack of input signal = OFF 1: Inverted. Lack of input signal = ON	Default: 0 Range: 0, 1	*189*
Z2-14 (8570) RUN	Digital Input 6 Invert Select	DI-6 Invert 0: Normal 1: Inverted	0: Normal. Lack of input signal = OFF 1: Inverted. Lack of input signal = ON	Default: 0 Range: 0, 1	*189*
Z2-15 (8571) RUN	Digital Input 7 Invert Select	DI-7 Invert 0: Normal 1: Inverted	0: Normal. Lack of input signal = OFF 1: Inverted. Lack of input signal = ON	Default: 0 Range: 0, 1	*189*

No. (Addr. Hex)	Name	LCD Display	Description	Values	Page
Z2-16 (8572) RUN	Digital Input 8 Invert Select	DI-8 Invert 0: Normal 1: Inverted	0: Normal. Lack of input signal = OFF 1: Inverted. Lack of input signal = ON	Default: 0 Range: 0, 1	189
Z2-23 (8579) RUN	Digital Output 7 Function Select	DO-7 Func Sel	Digital Output Function Select 0: Serial Comm Controlled 1: K1 Drive Input Contactor 2: K2 Drive Output Contactor 3: K3 Bypass Contactor 4: K4 Motor 1 Select 5: K5 Motor 2 Select 6: READY (Drive and Bypass) 7: RUN Active (Drive or Bypass) 8: Drive RUN Active 9: Bypass RUN Active 10: HAND Mode Active 11: OFF Mode Active 12: AUTO Mode Active 13: Drive Mode Selected 14: Bypass Mode Selected 15: Drive or Bypass Fault Active 16: Drive Fault Active 17: Bypass Fault Active 18: Auto Transfer Active 19: Serial RUN Command Active 20: Damper Actuator Output 21: ON Always 22: Loss of Load Detected 23: Run Verify 99: Not Used	Default: 7 Range: 0 to 23; 99	189
Z2-24 (857A) RUN	Digital Output 8 Function Select	DO-8 Func Sel		Default: 10 Range: 0 to 23; 99	189
Z2-25 (857B) RUN	Digital Output 9 Function Select	DO-9 Func Sel		Default: 12 Range: 0 to 23; 99	189
Z2-26 (857C) RUN	Digital Output 10 Function Select	DO-10 Func Sel		Default: 15 Range: 0 to 23; 99	189
Z2-31 (8581)	Safety Open Message Selection	Safety Msg Sel 0: Safety Open 1: Fire Stat 2: Freeze Stat 3: Smoke Alarm 4: Over Pressure 5: Low Suction 6: Vibration Switch	Sets the fault message displayed when an FB01 fault is triggered. 0: Safety Open 1: Fire Stat 2: Freeze Stat 3: Smoke Alarm 4: Over Pressure 5: Low Suction 6: Vibration Switch	Default: 0 Range: 0 to 6	190

◆ Z3: Bypass Control Communication

No. (Addr. Hex)	Name	LCD Display	Description	Values	Page
Z3-01 (8500) RUN	Serial Communications Protocol Select	Serial Protocol 0: Modbus 1: N2 2: P1 3: BACnet	Selects the bypass serial communications protocol. 0: Modbus 1: N2 2: P1 3: BACnet	Default: 3 Range: 0 to 3	191
Z3-02 (8501) RUN	Serial Communications Node Address Select	Node Address	Selects the bypass serial communications node address.	Default: 1 Min.: 0 Max.: 127	191
Z3-03 (8502) RUN	Serial Communications Baud Rate Select	Baud Rate 0: 1200 1: 2400 2: 4800 3: 9600 4: 19200 5: 38400 6: 57600 7: 76800 8: 115200	Selects the bypass serial communications speed. 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	Default: 3 Range: 0 to 8	191
Z3-04 (8503) RUN	Serial Communications Parity Select	Parity 0: No Parity 1: Even Parity 2: Odd Parity	Selects the bypass serial communications parity. 0: No Parity 1: Even Parity 2: Odd Parity	Default: 0 Range: 0 to 2	191

No. (Addr. Hex)	Name	LCD Display	Description	Values	Page
Z3-05 (8504) RUN	Serial Communications Fault Select	Fault Sel 0: Ignore 1: Alarm only 2: Fault Send EF0 3: Flt EF0 Open K3 4: Alarm(Z3-10)	Selects the action to take when a serial communications fault is detected. 0: Ignore. A serial communications loss will result in no action being taken. 1: Alarm only. 2: Fault with EF0. An EF0 will be sent to the drive. If running in Bypass mode, the bypass contactor will NOT open and the motor will keep running. 3: Fault with EF0 and Open Contactors. An EF0 fault will be sent to the drive and the bypass contactor (K3) will be opened. 4: Alarm and run at preset speed set in Z3-10. Display AL14 alarm on Operator.	Default: 1 Range: 0 to 4	192
Z3-06 (8505) RUN	Serial Communications Fault Time Select	Fault Time	Sets the time allowed to elapse since receiving serial communications before triggering a communications fault. A setting of 0.0 will never time out.	Default: 2.0 s Min.: 0.0 Max.: 99.9	192
Z3-07 (8506) RUN	Serial Communications Receive to Transmit Wait Time	Rx to Tx Wait	Sets the time to delay a serial communications response to a serial communications command.	Default: 5 ms Min.: 0 Max.: 99	192
Z3-08 (8507) RUN	BACnet Device Object Identifier 0	BAC Dev ID0	BACnet only. Sets the least significant word of 22-bit virtual address.	Default: 1 Min.: 0 Max.: FFFF	192
Z3-09 (8508) RUN	BACnet Device Object Identifier 1	BAC Dev ID1	BACnet only. Sets the most significant word of 22-bit virtual address.	Default: 0 Min.: 0 Max.: 003F	192
Z3-10 (8509) RUN	Cable Loss Preset Frequency	Cable Loss Freq	When a serial communications fault is detected and Z3-05=4, the resulting value will become the frequency reference.	Default: 0.0 Hz Min.: 0.0 Max.: 60.0	192
Z3-11 (850A) RUN	Communication Fault Detection Selection	Serial Fault Det 0: Disabled 1: Enabled	Communication Fault Detection Selection 0: Disabled. Serial communications fault detection is completely disabled. 1: Enabled. Behavior defined by Z3-05.	Default: 1 Range: 0, 1	192
Z3-12 (850B)	Network Digital Input Select	Network Dig Inp 0: Disabled 1: Enabled	Enables and disables control of the digital inputs over a network. Wiring to the physical digital input is not required. 0: Disabled 1: Enabled	Default: 0 Range: 0, 1	193

◆ Z4: Bypass Control Option Boards

No. (Addr. Hex)	Name	Description	Values	Page
Z4-01 (8700) RUN	IP Address 1	Sets the most significant octet of network static IP address.	Default: 192 Range: 0 to 255	194
Z4-02 (8701) RUN	IP Address 2	Sets the second most significant octet of network static IP address.	Default: 168 Range: 0 to 255	194
Z4-03 (8702) RUN	IP Address 3	Sets the third most significant octet of network static IP address.	Default: 1 Range: 0 to 255	194
Z4-04 (8703) RUN	IP Address 4	Sets the fourth most significant octet of network static IP address.	Default: 20 Range: 0 to 255	194
Z4-05 (8704) RUN	Subnet Mask 1	Sets the most significant octet of network static subnet mask.	Default: 255 Range: 0 to 255	194

No. (Addr. Hex)	Name	Description	Values	Page
Z4-06 (8705) RUN	Subnet Mask 2	Sets the second most significant octet of network static subnet mask.	Default: 255 Range: 0 to 255	194
Z4-07 (8706) RUN	Subnet Mask 3	Sets the third most significant octet of network static subnet mask.	Default: 255 Range: 0 to 255	194
Z4-08 (8707) RUN	Subnet Mask 4	Sets the fourth most significant octet of network static subnet mask.	Default: 0 Range: 0 to 255	194
Z4-09 (8708) RUN	Gateway IP Address 1	Sets the most significant octet of network gateway address.	Default: 192 Range: 0 to 255	194
Z4-10 (8709) RUN	Gateway IP Address 2	Sets the second most significant octet of network gateway address.	Default: 168 Range: 0 to 255	194
Z4-11 (870A) RUN	Gateway IP Address 3	Sets the third most significant octet of network gateway address.	Default: 1 Range: 0 to 255	194
Z4-12 (870B) RUN	Gateway IP Address 4	Sets the fourth most significant octet of network gateway address.	Default: 1 Range: 0 to 255	194
Z4-13 (870C) RUN	IP Address Mode Select	0: User-Defined (Static IP) 1: BOOTP 2: DHCP	Default: 2 Range: 0 to 2	194
Z4-14 (870D) RUN	Duplex Select	0: Forced Half Duplex 1: Auto Negotiate Duplex Mode and Communication Speed 2: Forced Full Duplex	Default: 1 Range: 0 to 2	195
Z4-15 (870E) RUN	Speed Mode Setting	10: 10 Mbps 100: 100 Mbps	Default: 10 Range: 10, 100	195
Z4-16 (870F) RUN	Communication Loss Timeout	Control connection timeout value for detection of communication loss.	Default: 0 s Min.: 0 Max.: 300	195
Z4-17 (8710) RUN	Ethernet Speed Scale	AC/DC Drive Object, Instance 1, Attribute 22	Default: 0 Min.: -15 Max.: 15	195
Z4-18 (8711) RUN	Ethernet Current Scale	AC/DC Drive Object, Instance 1, Attribute 23	Default: 0 Min.: -15 Max.: 15	195
Z4-19 (8712) RUN	Ethernet Torque Scale	AC/DC Drive Object, Instance 1, Attribute 24	Default: 0 Min.: -15 Max.: 15	195
Z4-20 (8713) RUN	Ethernet Power Scale	AC/DC Drive Object, Instance 1, Attribute 26	Default: 0 Min.: -15 Max.: 15	195
Z4-21 (8714) RUN	Ethernet Voltage Scale	AC/DC Drive Object, Instance 1, Attribute 27	Default: 0 Min.: -15 Max.: 15	195
Z4-22 (8715) RUN	Ethernet Time Scale	AC/DC Drive Object, Instance 1, Attribute 28	Default: 0 Min.: -15 Max.: 15	195

No. (Addr. Hex)	Name	Description	Values	Page
Z4-23 to Z4-32 (8716 to 871F) RUN	Dynamic Output Assembly Parameters DOA116 1 to DOA116 10	Parameters used in Output Assembly 116	Default: 0 Range: 0 to FFFF	*195*
Z4-33 to Z4-42 (8720 to 8729) RUN	Dynamic Input Assembly Parameters DIA166 1 to DIA166 10	Parameters used in Output Assembly 166	Default: 0 Range: 0 to FFFF	*196*

B.16 Defaults by Drive Model

The following tables show parameters and default settings that change with the drive model selection (o2-04).

Table B.3 200 V Class Drives Default Settings by Drive Model Selection

No.	Name	Unit	Default Settings			
–	Drive Model	–	2□0028	2□0042	2□0054	2□0068
o2-04	Drive Model Selection	Hex.	6A	6B	6D	6E
b3-04	V/f Gain during Speed Search	%	100	100	100	100
b3-06	Output Current 1 during Speed Search	–	0.5	0.5	0.5	0.5
b3-08	Current Control Gain during Speed Search (Speed Estimation Type)	–	0.5	0.5	0.5	0.5
C6-02	Carrier Frequency Selection	–	1	1	1	1
E2-01	Motor Rated Current	A	26.6	39.7	53	65.8
E2-03	Motor No-Load Current	A	8	11.2	15.2	15.7
L2-02	Momentary Power Loss Ride-Thru Time	s	0.8	0.9	1	1
L2-03	Momentary Power Loss Minimum Baseblock Time	s	0.3	0.3	0.6	0.6
L8-02	Overheat Alarm Level	°C	130	130	130	130
L8-38	Carrier Frequency Reduction Selection	–	1	1	1	1

Table B.4 200 V Class Drives Default Settings by Drive Model Selection

No.	Name	Unit	Default Settings					
–	Drive Model	–	2□0081	2□0104	2□0130	2□0154	2□0192	2□0248
o2-04	Drive Model Selection	Hex.	6F	70	72	73	74	75
b3-04	V/f Gain during Speed Search	%	100	80	80	80	80	80
b3-06	Output Current 1 during Speed Search	–	0.5	0.5	0.5	0.5	0.5	0.7
b3-08	Current Control Gain during Speed Search (Speed Estimation Type)	–	0.5	0.5	0.5	0.5	0.5	0.5
C6-02	Carrier Frequency Selection	–	1	1	1	1	1	1
E2-01	Motor Rated Current	A	77.2	105	131	160	190	260
E2-03	Motor No-Load Current	A	18.5	21.9	38.2	44	45.6	72
L2-02	Momentary Power Loss Ride-Thru Time	s	1	1.1	1.1	1.2	1.3	1.5
L2-03	Momentary Power Loss Minimum Baseblock Time	s	0.6	0.6	0.6	1	1	1
L8-02	Overheat Alarm Level	°C	130	130	130	130	130	130
L8-38	Carrier Frequency Reduction Selection	–	1	1	1	1	1	1

Table B.5 400 V Class Drives Default Settings by Drive Model Selection

No.	Name	Unit	Default Settings			
–	Drive Model	–	4□0011	4□0014	4□0021	4□0027
o2-04	Drive Model Selection	Hex.	95	97	99	9A
b3-04	V/f Gain during Speed Search	%	100	100	100	100
b3-06	Output Current 1 during Speed Search	–	0.5	0.5	0.5	0.5
b3-08	Current Control Gain during Speed Search (Speed Estimation Type)	–	0.5	0.5	0.5	0.5
C6-02	Carrier Frequency Selection	–	1	1	1	1
E2-01	Motor Rated Current	A	7	9.8	13.3	19.9
E2-03	Motor No-Load Current	A	2.3	2.6	4	5.6
L2-02	Momentary Power Loss Ride-Thru Time	s	0.6	0.7	0.8	0.9
L2-03	Momentary Power Loss Minimum Baseblock Time	s	0.3	0.3	0.3	0.3
L8-02	Overheat Alarm Level	°C	130	130	130	130
L8-38	Carrier Frequency Reduction Selection	–	1	1	1	1

Table B.6 400 V Class Drives Default Settings by Drive Model Selection

No.	Name	Unit	Default Settings			
–	Drive Model	–	4□0034	4□0040	4□0052	4□0065
o2-04	Drive Model Selection	Hex.	9C	9D	9E	9F
b3-04	V/f Gain during Speed Search	%	100	100	100	100
b3-06	Output Current 1 during Speed Search	–	0.5	0.5	0.5	0.5
b3-08	Current Control Gain during Speed Search (Speed Estimation Type)	–	0.5	0.5	0.5	0.5
C6-02	Carrier Frequency Selection	–	1	1	1	1
E2-01	Motor Rated Current	A	26.5	32.9	38.6	52.3
E2-03	Motor No-Load Current	A	7.6	7.8	9.2	10.9
L2-02	Momentary Power Loss Ride-Thru Time	s	1	1	1	1.1
L2-03	Momentary Power Loss Minimum Baseblock Time	s	0.6	0.6	0.6	0.6
L8-02	Overheat Alarm Level	°C	130	130	130	130
L8-38	Carrier Frequency Reduction Selection	–	1	1	1	1

Table B.7 400 V Class Drives Default Settings by Drive Model Selection

No.	Name	Unit	Default Settings			
–	Drive Model	–	4□0077	4□0096	4□0124	4□0156
o2-04	Drive Model Selection	Hex.	A1	A2	A3	A4
b3-04	V/f Gain during Speed Search	%	100	100	80	60
b3-06	Output Current 1 during Speed Search	–	0.5	0.5	0.5	0.7
b3-08	Current Control Gain during Speed Search (Speed Estimation Type)	–	0.5	0.5	0.5	0.8
C6-02	Carrier Frequency Selection	–	1	1	1	1
E2-01	Motor Rated Current	A	65.6	79.7	95	130
E2-03	Motor No-Load Current	A	19.1	22	24	36
L2-02	Momentary Power Loss Ride-Thru Time	s	1.1	1.2	1.2	1.3
L2-03	Momentary Power Loss Minimum Baseblock Time	s	0.6	0.6	1	1
L8-02	Overheat Alarm Level	°C	130	130	130	130
L8-38	Carrier Frequency Reduction Selection	–	1	1	1	1

Table B.8 400 V Class Drives Default Settings by Drive Model Selection

No.	Name	Unit	Default Settings					
–	Drive Model	–	4□0180	4□0216	4□0240	4□0302	4□0361	4□0414
o2-04	Drive Model Selection	Hex.	A5	A6	A7	A8	A9	AA
b3-04	V/f Gain during Speed Search	%	60	60	60	60	60	60
b3-06	Output Current 1 during Speed Search	–	0.7	0.7	0.7	0.7	0.7	0.7
b3-08	Current Control Gain during Speed Search (Speed Estimation Type)	–	0.8	0.8	0.8	0.8	0.8	0.8
C6-02	Carrier Frequency Selection	–	1	1	1	1	1	1
E2-01	Motor Rated Current	A	156	190	223	270	310	370
E2-03	Motor No-Load Current	A	40	49	58	70	81	96
L2-02	Momentary Power Loss Ride-Thru Time	s	1.5	1.7	1.7	1.8	1.9	2
L2-03	Momentary Power Loss Minimum Baseblock Time	s	1	1	1	1	1	1
L8-02	Overheat Alarm Level	°C	130	130	130	130	130	130
L8-38	Carrier Frequency Reduction Selection	–	1	1	1	1	1	1

Appendix: C

BACnet Communications

C.1 BACnet Configuration

The bypass system 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 bypass conforms to the BACnet application specific controller (B-ASC) device profile. BACnet MS/TP connection is made to the bypass controller. Parameters and monitors in both the drive and the bypass controller are made accessible from this one connection.

Up to 127 bypasses can communicate on a single BACnet MS/TP network. If more bypasses 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 bypasses.

The BACnet node address is configurable by a parameter in the bypass. This defines the physical address of the bypass on the MS/TP network. In addition, both the Device Object instance ID and the Device Object Name are configurable. These allow the bypass to have a virtual address, and simplify the controller configuration.

Once the addressing is set, a controller can initiate communication to the bypass. The bypass will perform the specified function and then send a response back to the controller. The bypass will usually respond immediately, but may delay its response until it gets the token for commands that may take extra local processing time.

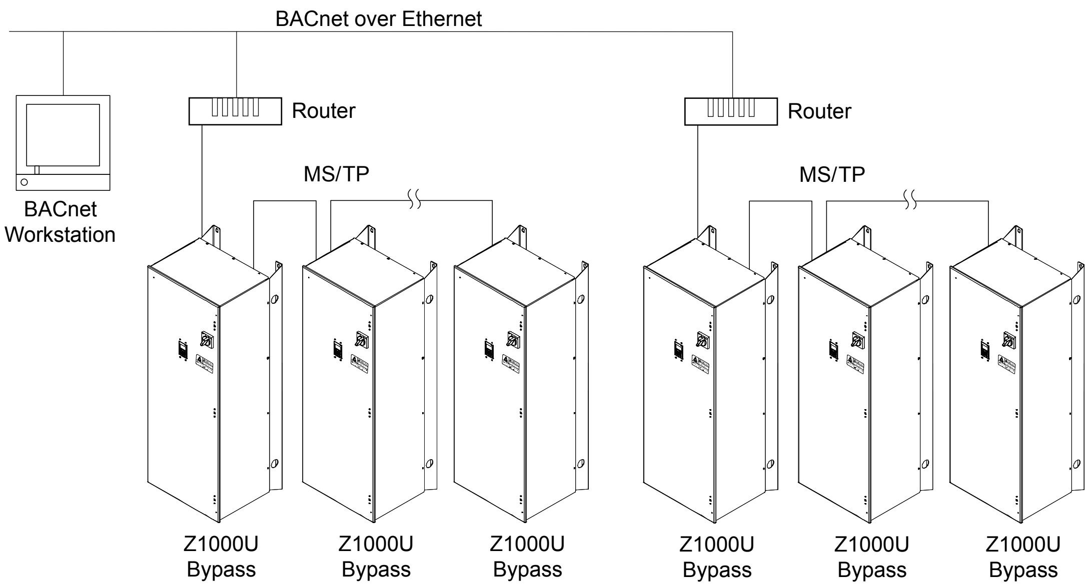


Figure C.1 Connecting Multiple Bypasses to a BACnet Workstation

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 <1>, 2400 <1>, 4800 <1>, 9600, 19200, 38400, 57600, 76800, 115200 bps
Protocol	BACnet MS/TP
Max Number of Bypasses	127 per MS/TP Network Segment

<1> Selecting these settings will trigger an oPE29 error when using BACnet communication in bypass controller software versions VST800400 and later.

C.3 Connecting to a Network

This section explains how to connect the bypass to a BACnet network and the network termination required for a connection.

◆ Network Cable Connection

Follow the instructions below to connect the bypass to a BACnet network.

1. With the power shut off, connect the communications cable to the bypass and the master. Use terminal TB3 for BACnet.

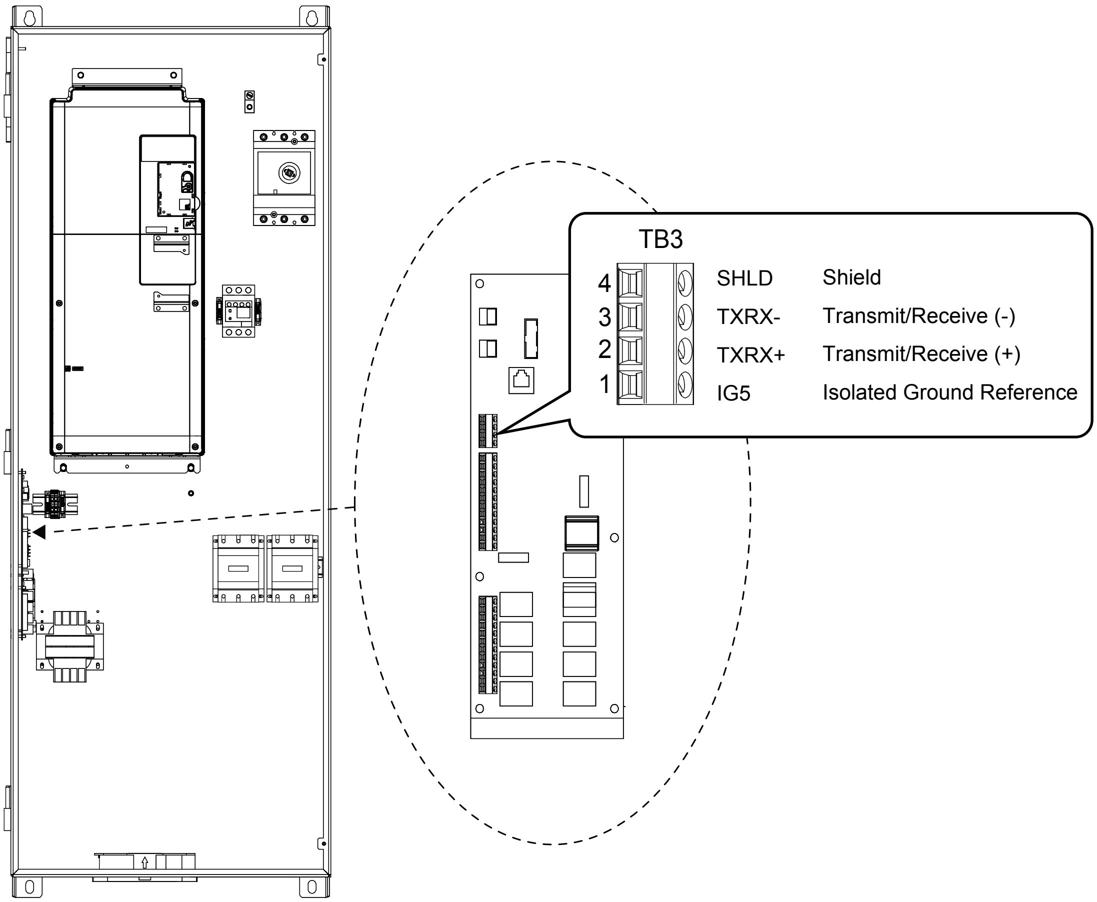


Figure C.2 Serial Communications Cable Connection Terminal (TB3)

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 caused by electrical interference.

2. Check or set the termination resistor selection at all slaves. Use the description in ***Network Termination*** on page ***335*** for slaves that are Z1000U Bypasses.
3. Switch the power on.
4. Set the parameters needed for serial communications (Z3-01 through Z3-09) using the digital operator.
5. Shut the power off and wait until the display on the digital operator goes out completely.
6. Turn the power back on.
7. The bypass 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.

■ MS/TP Interface

Figure C.3 shows typical "daisy-chain" RS-485 wiring. If the bypass is at the end of the network, the drain wire should not be connected and should be insulated from touching other components or ground. Connect the drain wire to earth ground at the controller only to avoid ground loops.

Note: The isolated ground (IG5) connection is optional but strongly recommended to avoid noise issues. Yaskawa recommends using Belden cable 3106A or equivalent for BACnet operation.

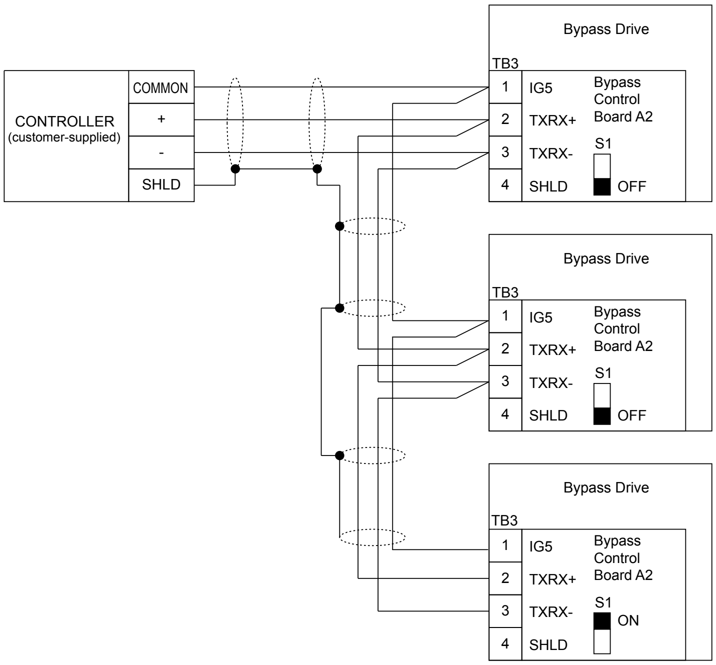


Figure C.3 Connection Diagram for Multiple Connections

Note: Turn on DIP switch S1 on the bypass that is located at the end of the network. If S1 is missing, then an external 120 ohm resistor must be placed across terminals TXRX+ and TXRX-. All other slave devices must have this DIP switch set to the OFF position (or if S1 is missing, no external resistor is used).

◆ Network Termination

The two ends of the BACnet network line have to be terminated with a 120 ohm resistor between the TXRX+ and TXRX- signals. The bypass has a built in termination resistor that can be enabled or disabled using DIP switch S1. If a bypass is located at the end of a network line, enable the termination resistor by setting DIP switch S1 to the ON position. Disable the termination resistor on all slaves that are not located at the network line end.

Note: Some bypass controllers do not have DIP switch S1. If this is the case, then an external 120 ohm resistor must be placed across the TXRX+ and TXRX- signals if the bypass controller is at the end of a network line.

C.4 BACnet Setup Parameters

◆ BACnet Serial Communication

This section describes parameters necessary to set up BACnet communications.

■ Z3-01: Serial Communications Protocol Select

Selects the bypass serial communications protocol.

No.	Name	Setting Range	Default
Z3-01	Serial Communications Protocol Select	0 to 3	3

Setting 0: Modbus

Setting 1: N2

Setting 2: P1

Setting 3: BACnet

■ Z3-02: Serial Communications Node Select

Selects the bypass serial communications node address.

Note: Each slave must be assigned a unique slave address for serial communications to work properly. Slave addresses do not need to be assigned in sequential order, but no two slaves may share the same address.

No.	Name	Setting Range	Default
Z3-02	Serial Communications Node Select	0 to 127	1

■ Z3-03: Serial Communications Baud Rate Select

Selects the bypass serial communications speed.

Selecting settings 0, 1, or 2 will trigger an oPE29 error when using BACnet communication (Z3-01 = 3) in bypass controller software versions VST800400 and later.

No.	Name	Setting Range	Default
Z3-03	Serial Communications Baud Rate Select	0 to 8	3

Setting 0: 1200 bps

Setting 1: 2400 bps

Setting 2: 4800 bps

Setting 3: 9600 bps

Setting 4: 19200 bps

Setting 5: 38400 bps

Setting 6: 57600 bps

Setting 7: 76800 bps

Setting 8: 115200 bps

■ Z3-05: Serial Communications Fault Select

Selects the action to take when a serial communications fault is detected. A serial communications fault is detected when after last communicating, no communications occurs within the time set to Z3-06.

No.	Name	Setting Range	Default
Z3-05	Serial Communications Fault Select	0 to 4	1

Setting 0: Ignore

Setting 1: Alarm Only

Setting 2: Fault with EF0

An EF0 fault will be sent to the drive.

Setting 3: Fault with EF0 and Open Contactors

An EF0 fault will be sent to the drive and the bypass contactor (K3) will be opened.

Setting 4: Alarm and run at preset speed set in Z3-10

Display AL14 alarm on operator.

■ Z3-08, Z3-09: BACnet Device Object Identifier

These parameters set the Instance Identifier of the BACnet Device Object, where Z3-08 is the least significant word and Z3-09 is the most significant word.

No.	Name	Setting Range	Default
Z3-08	BACnet Device Object Identifier 0	0 to FFFFH	1
Z3-09	BACnet Device Object Identifier 1	0 to 003FH	0

Example 1: Set Device Object Instance Identifier of “1234”.

1234 decimal is equal to 4D2H (hexadecimal).

Set Z3-08 to 4D2H and set Z3-09 to 0.

Example 2: Set Device Object Instance Identifier of “123456”.

123456 decimal is equal to 1E240H.

Set Z3-08 to D687H and set Z3-09 to 12H.

■ Z3-13: BACnet Command Register Retention

Refer to *Z3-13: BACnet Command Register Retention* description on page *193*.

BACnet Communications

C

C.5 Bypass Operations by BACnet

The bypass operations that can be performed by BACnet communication depend on parameter settings. This section explains the functions that can be used and related parameter settings.

◆ Observing the Bypass Operation

A controller can perform the following actions with BACnet communications at any time regardless of parameter settings:

- Observe bypass and drive status and 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 Bypass

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	Z1-07	Frequency Reference Select	2
	Z1-08	Run Command Select	2

Refer to Z1-07: Speed Reference Select on page 177 and *Refer to Z1-08: Run Command Select on page 178* for details on external reference parameter selections.

C.6 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 bypass. The convention for showing how the PV is accessed is shown in *Table C.2* and will be noted for the PV of each object.

Table C.2 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 bypass.
R	Readable	Value is read-only
W	Writable	Value written to the bypass

◆ Supported Properties of Objects

Table C.3 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.4 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 AI3	–	–	–	–	–
AI4	Not used AI4	–	–	–	–	–
AI5	Not used AI5	–	–	–	–	–
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
AI10	Motor Current UB-01	8780H	XXXX.X	–	Amps	R
AI11	Contactor Voltage	8790H	XXXXX	–	Volts	R

◆ Analog Output Objects

Table C.5 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.6 Analog Value Objects

Object ID	Object Name	Modbus Address	Precision	Range	Units	PV Access
AV1	Operation Cmd	0001H	–	–	–	C
AV2	Frequency Cmd	8401H	XXX.XX Depends on o1-03	0.00 to 600.00	Hz Depends on o1-03	C
AV3	PID Setpoint Cmd	0006H	XXX.XX	-100.00 to 100.00	%	C
AV4	MF Output Cmd	0009H	–	–	–	C
AV5	Reference Select Cmd	000FH	–	–	–	C
AV6	Drive Status	0020H	–	–	–	R
AV7	Fault Details	0021H	–	–	–	R
AV8	Data Link Status	0022H	–	–	–	R
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
AV12	Output Current	0026H	XXXX.X	–	Amps	R

Object ID	Object Name	Modbus Address	Precision	Range	Units	PV Access
AV13	Output Power	0047H	XXXX.X (for drives rated above 11 kVA) XXX.XX (for drives rated 11 kVA or lower)	–	kW	R
AV14	Torque Reference	0048H	XXXX.X	–	%	R
AV15	MF Input Status	002BH	–	–	–	R
AV16	Drive Status 2	002CH	–	–	–	R
AV17	MF Output Status	002DH	–	–	–	R
AV18	DC Bus Voltage	0031H	XXXXX	–	Volts	R
AV19	PID Feedback Level	0038H	XXXX.X	–	%	R
AV20	PID Input Level	0039H	XXXX.X	–	%	R
AV21	PID Output Level	003AH	XXXX.X	–	%	R
AV22	Drive SW Num	004DH	XXXXX	–	–	R
AV23	Bypass SW Num	8791H	XXXXX	–	–	R
AV24	Comm Error Detail	003DH	–	–	–	R
AV25	KVA Setting	003EH	XXXXX	–	–	R
AV26	Control Method	0043H	XXXXX	–	–	R
AV27	Accel Time	0200H	XXXX.X	0.0 to 6000.0	Sec	W
AV28	Decel Time	0201H	XXXX.X	0.0 to 6000.0	Sec	W
AV29 <1>	Parameter Number	–	XXXXX	0 to FFFFH	–	W
AV30 <1>	Parameter Data	–	XXXXX	0 to FFFFH	–	W
AV31	Motor Current	8780H	XXXX.X	–	Amps	R
AV32	120 V to Kx Coils	8790H	XXXXX	–	Volts	R
AV33	Drive kWH	0x005C and 0x005D	XXXXXXX.X	0.0 to 32767999.9	kWH	R

<1> *Refer to Accessing Bypass Parameters and the Enter Command on page 346* for an explanation of how to read and write drive parameters not listed in the analog or binary objects.

◆ Binary Input Objects

Table C.7 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
BI10	BYP DI-1 STAT	8781H: bit 0	ON	OFF	R
BI11	BYP DI-2 STAT	8781H: bit 1	ON	OFF	R
BI12	BYP DI-3 STAT	8781H: bit 2	ON	OFF	R
BI13	BYP DI-4 STAT	8781H: bit 3	ON	OFF	R
BI14	BYP DI-5 STAT	8781H: bit 4	ON	OFF	R
BI15	BYP DI-6 STAT	8781H: bit 5	ON	OFF	R
BI16	BYP DI-7 STAT	8781H: bit 6	ON	OFF	R

Object ID	Object Name	Modbus Address	Active Text	Inactive Text	PV Access
BI17	BYP DI-8 STAT	8781H: bit 7	ON	OFF	R
BI18	BYP DO-1 STAT	8782H: bit 0	ON	OFF	R
BI19	BYP DO-2 STAT	8782H: bit 1	ON	OFF	R
BI20	BYP DO-3 STAT	8782H: bit 2	ON	OFF	R
BI21	BYP DO-4 STAT	8782H: bit 3	ON	OFF	R
BI22	BYP DO-5 STAT	8782H: bit 4	ON	OFF	R
BI23	BYP DO-6 STAT	8782H: bit 5	ON	OFF	R
BI24	BYP DO-7 STAT	8782H: bit 6	ON	OFF	R
BI25	BYP DO-8 STAT	8782H: bit 7	ON	OFF	R
BI26	BYP DO-9 STAT	8783H: bit 0	ON	OFF	R
BI27	BYP DO-10 STAT	8783H: bit 1	ON	OFF	R

◆ Binary Output Objects

Table C.8 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 M5-M6	0009H:bit 2	ON	OFF	C
BO4	Ref Sel: PID Setpoint	000FH:bit 1	ON	OFF	C
BO5	Ref Sel: Term S5 IN	8480H:bit 8	ON	OFF	C
BO6	Ref Sel: Term S6 IN	8480H:bit 9	ON	OFF	C
BO7	Refl Sel: Term S7 IN	8480H:bit 10	ON	OFF	C
BO8	BYP DO-07 COMMAND	8403H:bit 6	ON	OFF	C
BO9	BYP DO-08 COMMAND	8403H:bit 7	ON	OFF	C
B010	BYP DO-09 COMMAND	8403H:bit 8	ON	OFF	C
B011	BYP DO-10 COMMAND	8403H:bit 9	ON	OFF	C

◆ Binary Value Objects

Table C.9 Binary Value Objects

Object ID	Object Name	Modbus Address	Active Text	Inactive Text	PV Access
BV1	Not Used BV1	–	–	–	–
BV2	Not Used BV2	–	–	–	–
BV3	Ext Fault Cmd	8480H:bit 2	FAULT	OFF	C
BV4	Fault Reset Cmd	8480H:bit 3	RESET	OFF	C
BV5	Not Used BV5	–	–	–	–
BV6	Not Used BV6	–	–	–	–
BV7	MF Input 3 Cmd	8480H:bit 6	ON	OFF	C
BV8	MF Input 4 Cmd	8480H:bit 7	ON	OFF	C
BV9	MF Input 5 Cmd	8480H:bit 8	ON	OFF	C
BV10	MF Input 6 Cmd	8480H:bit 9	ON	OFF	C
BV11	MF Input 7 Cmd	8480H: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

Object ID	Object Name	Modbus Address	Active Text	Inactive Text	PV Access
BV18	Overcurrent – Gnd Flt	0021H:bit 0	OC-GF	OFF	R
BV19	Main Ckt 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	PID 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	Zero Speed	002CH:bit 1	ON	OFF	R
BV35	Frequency Agree	002CH:bit 2	ON	OFF	R
BV36	Desired Freq 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	Drv 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 Ref Mode	8785H:bit 8	COM	LOCAL	R
BV43	Run Command Mode	8485H:bit 9	COM	LOCAL	R
BV44	Over Torque Detect	002CH:bit 11	ON	OFF	R
BV45	Frequency Ref 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 Comms Error	002CH:bit 15	ON	OFF	R
BV58	BYP Run Fwd CMD	8400H: bit 0	ON	OFF	C
BV59	BYP Run Rev CMD	8400H: bit 1	ON	OFF	C
BV60	Not Used BV60	–	ON	OFF	R
BV61	BYP Xfer to BYP CMD	8400H: bit 3	ON	OFF	C
BV62	BYP Smok Prg BYP CMD	8400H: bit 4	ON	OFF	C
BV63	BYP Smok Prg DRV CMD	8400H: bit 5	ON	OFF	C
BV64	BYP Mtr OR Sel CMD	8400H: bit 6	ON	OFF	C
BV65	BYP Mtr AND Sel CMD	8400H: bit 7	ON	OFF	C
BV66	BYP Drive Select CMD	8400H: bit 9	ON	OFF	C

Object ID	Object Name	Modbus Address	Active Text	Inactive Text	PV Access
BV67	BYP Auto Select CMD	8400H: bit 10	ON	OFF	C
BV68	Not Used BV68	8400H: bit 11	ON	OFF	C
BV69	BYP BYPASS Sel CMD	8400H: bit 12	BYP	DRV	C
BV70	BYP Fault Reset CMD	8400H: bit 13	ON	OFF	C
BV71	BYP Ext Fault CMD	8400H: bit 14	ON	OFF	C
BV72 <2>	BYP DI-01 Command	8402H: bit 0	ON	OFF	W
BV73 <2>	BYP DI-02 Command	8402H: bit 1	ON	OFF	W
BV74 <2>	BYP DI-03 Command	8402H: bit 2	ON	OFF	W
BV75 <2>	BYP DI-04 Command	8402H: bit 3	ON	OFF	W
BV76 <2>	BYP DI-05 Command	8402H: bit 4	ON	OFF	W
BV77 <2>	BYP DI-06 Command	8402H: bit 5	ON	OFF	W
BV78 <2>	BYP DI-07 Command	8402H: bit 6	ON	OFF	W
BV79 <2>	BYP DI-08 Command	8402H: bit 7	ON	OFF	W
BV80	BYP HAND Mode Status	8784H: bit 0	ON	OFF	R
BV81	BYP OFF Mode Status	8784H: bit 1	ON	OFF	R
BV82	BYP AUTO Mode Status	8784H: bit 2	ON	OFF	R
BV83	BYP DRV Mode Status	8784H: bit 3	ON	OFF	R
BV84	BYP BYPASS Mode Stat	8784H: bit 4	ON	OFF	R
BV85	BYP Smk Prg BYP Stat	8784H: bit 5	ACTIVE	OFF	R
BV86	BYP Smk Prg DRV Stat	8784H: bit 6	ACTIVE	OFF	R
BV87	BYP Safety Status	8784H: bit 7	OPEN	CLOSED	R
BV88	BYP BAS Interlk Stat	8785H: bit 0	OPEN	CLOSED	R
BV89	BYP RUN Status	8785H: bit 1	RUN	OFF	R
BV90	BYP Fault Status	8785H: bit 2	FAULT	OFF	R
BV91	BYP Auto Xfer Status	8785H: bit 3	ACTIVE	OFF	R
BV92	BYP Remote Xfer Stat	8785H: bit 4	ACTIVE	OFF	R
BV93	BYP Energy Save Stat	8785H: bit 5	ACTIVE	OFF	R
BV94	BYP Motor 1 Sel Stat	8785H: bit 6	SELECT	OFF	R
BV95	BYP Motor 2 Sel Stat	8785H: bit 7	SELECT	OFF	R
BV96	BYP Drive Flt Status	8786H: bit 0	FAULT	OFF	R
BV97	BYP Safety Flt Stat	8786H: bit 1	FAULT	OFF	R
BV98	BYP BAS ILock Status	8786H: bit 2	FAULT	OFF	R
BV99	BYP Ext Fault Stat	8786H: bit 3	FAULT	OFF	R
BV100	Not Used BV100	8786H: bit 4	FAULT	OFF	R
BV101	BYP Motor OL Stat	8786H: bit 5	FAULT	OFF	R
BV102	BYP Motor 1 OL Stat	8786H: bit 6	FAULT	OFF	R
BV103	BYP Mtr 2 OL Stat	8786H: bit 7	FAULT	OFF	R
BV104	BYP Input Phase Loss	8787H: bit 0	FAULT	OFF	R
BV105	BYP Drive Comms	8787H: bit 2	FAULT	OFF	R
BV106	BYP Loss Of Load	8787H: bit 5	FAULT	OFF	R
BV107	BYP Option Brd Comms	8787H: bit 3	FAULT	OFF	R

<1> *Refer to Accessing Bypass Parameters and the Enter Command on page 346* for an explanation of how to read and write drive parameters not listed in the analog or binary objects.

<2> Object is disabled when Z3-12 is set to 0.

◆ 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 Z3-08 and Z3-09. Any changes to these parameters will not take effect until the power is cycled to the bypass.

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 bypass.

C.7 Accessing Bypass Parameters and the Enter Command

◆ Reading Bypass Parameters

Reading bypass 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 Bypass Parameters

Writing bypass 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.

Write “1” to parameter Z1-31 to enable the loss of load function.

Parameter Z1-31 is located at Modbus register 85E4H (decimal 34276).

Set AV29 to “34276”

Set AV30 to “1”

Set BV56 to “ON”.

◆ Enter Command

Enter Commands are only required when using AV29 and AV30 to access bypass parameters. An Enter command is not required when reading or writing to the other BACnet objects.

When writing parameters to the bypass 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 bypass supports two types of Enter commands as shown in ***Table C.10***.

Table C.10 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 or bypass is shut off.
BV56 (Write “ON”)	0900H (Write 0)	Simultaneously writes data into the EEPROM (non-volatile memory) of the drive or bypass 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.8 Communication Errors

Errors that may occur when accessing drive parameters using the BACnet objects are shown in *Table C.11*.

Table C.11 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.9 BACnet Protocol Implementation Conformance Statement

Date: 9/19/2011

Vendor Name: Yaskawa America, Inc.

Product Name: VFD Bypass

Product Model Number: UTC00046X

Application Software Version: VST80029x / Firmware Revision: 1.0 / BACnet Protocol Revision: 4

Product Description:

The Yaskawa VFD Bypass is a high performance product specifically designed for commercial building automation applications. The Yaskawa BACnet feature connects the VFD Bypass to a standard BACnet MS/TP network. These products may be fully controlled and monitored over BACnet. All Bypass and 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): 9600, 19200, 38400, 76800

□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/network(s) that the gateway supports:

Not supported

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Appendix: D

MEMOBUS/Modbus Communications

D.1 MEMOBUS/Modbus Configuration

Bypasses can be controlled from a PLC or other master device via serial communications using the MEMOBUS/Modbus protocol.

MEMOBUS/Modbus communications can be configured using one master (PLC) and up to 31 slaves. The bypass has slave functionality only, and serial communication is normally initiated from the master and responded to by the slaves.

The master performs serial communications with only one slave at a time. The address or node for each slave must be set beforehand so that the master can communicate with the slave at that address. A slave that receives a command from the master will perform the specified function and then send a response back to the master.

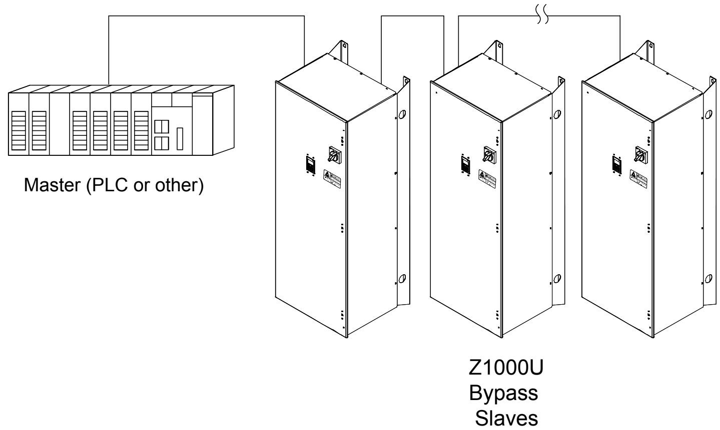


Figure D.1 Connecting Multiple Bypasses to a PLC

D.2 Communication Specifications

MEMOBUS/Modbus specifications appear in the following table:

Item	Specifications	
Interface	RS-485	
Communications Cycle	Asynchronous (Start-stop synchronization)	
Communication Parameters	Communication Speeds Available	1200, 2400, 4800, 9600, 19200, 38400, 57600, 76800, 115200 bps
	Data length	8-bit (fixed)
	Parity	Select even, odd, or none
	Stop bit	1-bit (fixed)
Protocol	MEMOBUS/Modbus (using RTU mode only)	
Max Number of Slaves	31 bypasses	

D.3 Connecting to a Network

This section explains how to connect the drive to a MEMOBUS/Modbus network and the network termination required for a connection.

◆ Network Cable Connection

Follow the instructions below to connect the bypass to a MEMOBUS/Modbus network.

1. With the power shut off, connect the communications cable to the bypass controller and the master. Use terminal TB3 for MEMOBUS/Modbus.

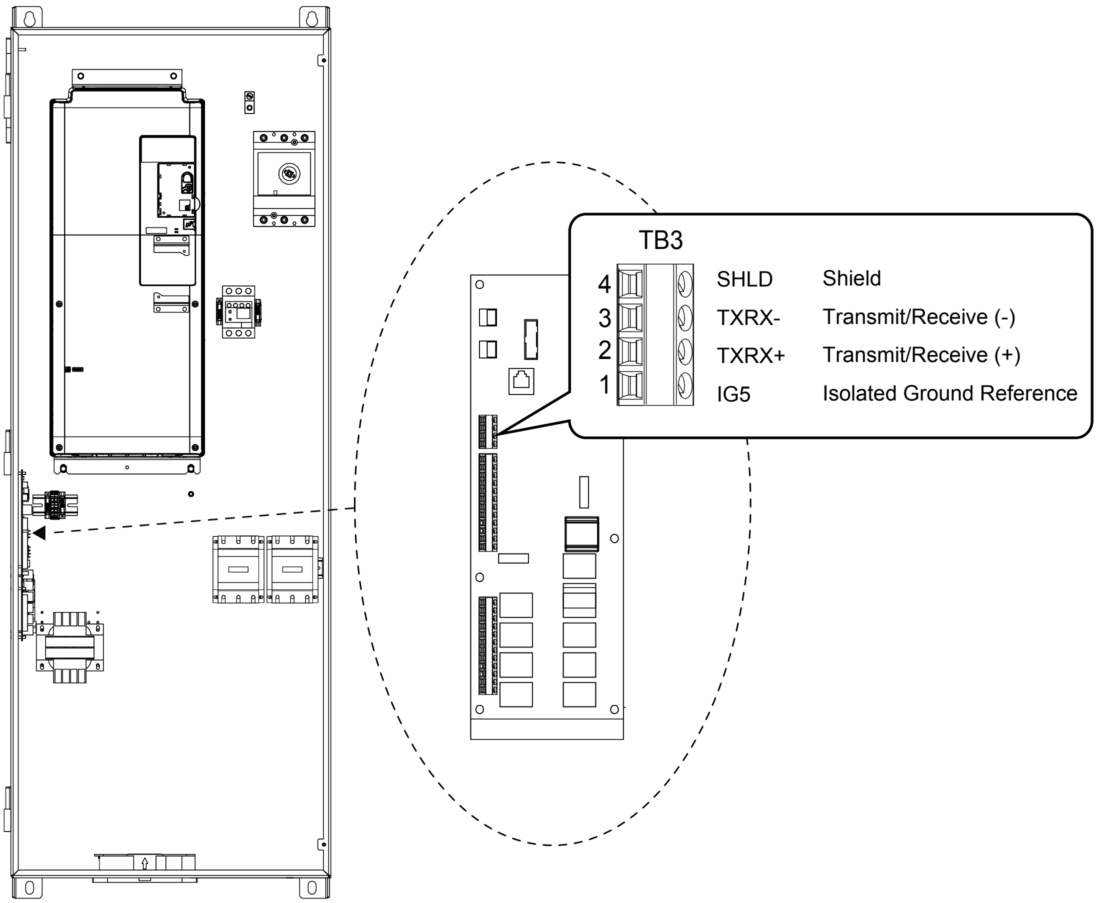


Figure D.2 Serial Communications Cable Connection Terminal (TB3)

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 caused by electrical interference.

2. Check or set the termination resistor selection at all slaves. Use the description in *Network Termination* on page *335* for slaves that are Z1000U Bypasses.
3. Switch the power on.
4. Set the parameters needed for serial communications (Z3-01 through Z3-07) using the digital operator.
5. Shut the power off and wait until the display on the digital operator goes out completely.
6. Turn the power back on.
7. The bypass is now ready to begin communicating with the master.

◆ Wiring Diagram for Multiple Connections

Figure D.3 explains the wiring diagrams for multiple connections using MEMOBUS/Modbus communication.

■ RS-485 Interface

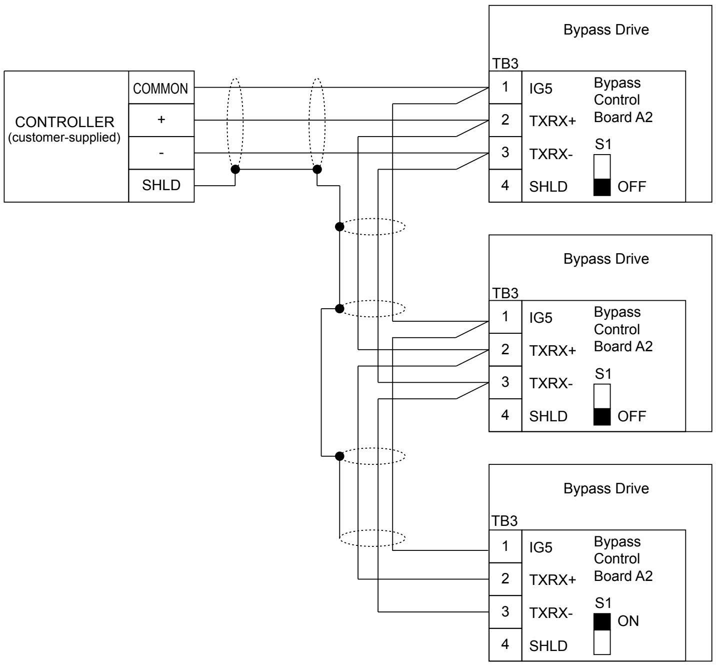


Figure D.3 Connection Diagram for Multiple Connections

Note: Turn on DIP switch S1 on the bypass controller located at the end of the network. If S1 is missing, then an external 120 ohm resistor must be placed across terminals TXRX+ and TXRX-. All other slave devices must have this DIP switch set to the OFF position (or if S1 is missing, no external resistor is used).

◆ Network Termination

The two ends of the MEMOBUS/Modbus network line have to be terminated with a 120 ohm resistor between the TXRX+ and TXRX- signals. The bypass has a built in termination resistor that can be enabled or disabled using DIP switch S1. If a bypass is located at the end of a network line, enable the termination resistor by setting DIP switch S1 to the ON position. Disable the termination resistor on all slaves that are not located at the network line end.

Note: Some bypass controllers do not have DIP switch S1. If this is the case, then an external 120 ohm resistor must be placed across the TXRX+ and TXRX- signals if the bypass controller is at the end of a network line.

D.4 MEMOBUS/Modbus Setup Parameters

◆ MEMOBUS/Modbus Serial Communication

Changes to MEMOBUS/Modbus communications settings become effective after restarting the drive.

■ Z3-01: Serial Communications Protocol Select

Selects the bypass serial communications protocol.

No.	Name	Setting Range	Default
Z3-01	Serial Communications Protocol Select	0 to 3	3

Setting 0: Modbus

Setting 1: N2

Setting 2: P1

Setting 3: BACnet

■ Z3-02: Serial Communications Node Select

Selects the bypass serial communications node address.

Note: Each slave must be assigned a unique slave address for serial communications to work properly. Slave addresses do not need to be assigned in sequential order, but no two slaves may share the same address.

No.	Name	Setting Range	Default
Z3-02	Serial Communications Node Select	0 to 127	1

■ Z3-03: Serial Communications Baud Rate Select

Selects the bypass serial communications speed.

Selecting settings 0, 1, or 2 will trigger an oPE29 error when using BACnet communication (Z3-01 = 3) in bypass controller software versions VST800400 and later.

No.	Name	Setting Range	Default
Z3-03	Serial Communications Baud Rate Select	0 to 8	3

Setting 0: 1200 bps

Setting 1: 2400 bps

Setting 2: 4800 bps

Setting 3: 9600 bps

Setting 4: 19200 bps

Setting 5: 38400 bps

Setting 6: 57600 bps

Setting 7: 76800 bps

Setting 8: 115200 bps

■ Z3-04: Serial Communications Parity Select

Selects the bypass serial communications parity. This setting is ignored when BACnet protocol is selected.

No.	Name	Setting Range	Default
Z3-04	Serial Communications Parity Select	0 to 2	0

Setting 0: No Parity

Setting 1: Even Parity

Setting 2: Odd Parity

■ Z3-05: Serial Communications Fault Select

Selects the action to take when a serial communications fault is detected. A serial communications fault is detected when after last communicating, no communications occurs within the time set to Z3-06.

No.	Name	Setting Range	Default
Z3-05	Serial Communications Fault Select	0 to 4	1

Setting 0: Ignore

Setting 1: Alarm Only

Setting 2: Fault with EF0

An EF0 fault will be sent to the drive.

Setting 3: Fault with EF0 and Open Contactors

An EF0 fault will be sent to the drive and the bypass contactor (K3) will be opened.

Setting 4: Alarm and run at preset speed set in Z3-10

Display AL14 alarm on operator.

■ Z3-06: Serial Communications Fault Time Select

Sets the time allowed to elapse since receiving serial communications before triggering a communications fault.

A value of 0.0 means to never time out.

No.	Name	Setting Range	Default
Z3-06	Serial Communications Fault Time Select	0.0 s to 99.9 s	2.0 s

■ Z3-07: Serial Communications Receive to Transmit Wait Time

Sets the time to delay a serial communications response to a serial communications command.

No.	Name	Setting Range	Default
Z3-07	Serial Communications Receive to Transmit Wait Time	0 to 99 ms	5 ms

D.5 Bypass Operations by MEMOBUS/Modbus

The bypass operations that can be performed by MEMOBUS/Modbus communication depend on parameter settings. This section explains the functions that can be used and related parameter settings.

◆ Observing the Bypass Operation

A controller can perform the following actions with MEMOBUS/Modbus communications at any time regardless of parameter settings:

- Observe bypass and drive status and 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 DI-□□ and S□ and from MEMOBUS/Modbus communications are both linked by a logical OR operation.

D.6 Communications Timing

To prevent a communications overrun in the slave drive, the master should wait a certain time between sending messages to the same drive. In the same way, the slave drive must wait before sending response messages to prevent an overrun in the master. This section explains the message timing.

◆ Command Messages from Master to Bypass

The master must wait for a specified time between receiving a response and resending the same type of command to the same bypass drive to prevent overrun and data loss. The minimum wait time depends on the command as shown in *Table D.1*.

Table D.1 Minimum Wait Time for Sending Messages

Command Type	Example	Minimum Wait Time
1	• Control command (Run, Stop) • Set inputs/outputs • Read monitors and parameter values	5 ms <1>
2	Write parameters	200 ms <1>
3	Save changes using an Enter command	200 ms to 2 s, depending on the number of parameters that were changed <1>
4	Enter with storage to drive EEPROM after initialization	5 s

<1> If the drive receives command type 1 data during the minimum wait time, it will perform the command and then respond. However, if it receives a command type 2 or 3 during that time, either a communication error will result or the command will be ignored.

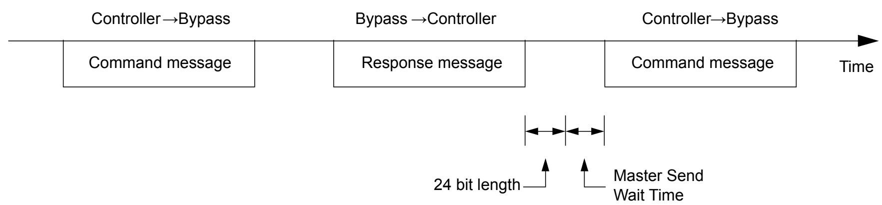


Figure D.4 Minimum Wait Time for Sending Messages

Set a timer in the master to check how long it takes for the slave bypass(es) 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 Bypass to Master

If the bypass receives a command from the master, it will process the data received and wait for the time set in Z3-07 until it responds. Increase Z3-07 if the bypass response causes overrun in the master.

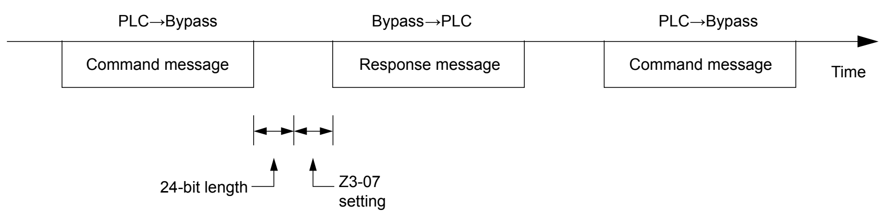


Figure D.5 Minimum Response Wait Time

D.7 Message Format

◆ Message Content

In MEMOBUS/Modbus communications, the master sends commands to the slave, and the slave responds. The message format is configured for both sending and receiving as shown below, and the length of data packets depends on the command (function) content.

SLAVE ADDRESS
FUNCTION CODE
DATA
ERROR CHECK

◆ Slave Address

The slave address in the message defines the note the message is sent to. Use addresses between 0 and FF (hex). If a message with slave address 0 is sent (broadcast), the command from the master will be received by all slaves. The slaves do not provide a response to a broadcast type message.

◆ Function Code

The three types of function codes are shown in the table below.

Function Code	Function Name	Data Length (bytes)			
		Command Message		Response Message	
		Minimum	Maximum	Minimum	Maximum
03H	Read MEMOBUS/Modbus registers	8	8	7	37
08H	Loopback test	8	8	8	8
10H	Write to multiple MEMOBUS/Modbus registers	11	41	8	8

◆ Data

Configure consecutive data by combining the MEMOBUS/Modbus register address (test code in case of a loopback test) and the data the register contains. The data length changes depending on the command details.

A bypass MEMOBUS/Modbus register always has a data length of two bytes. Data written into drive registers must also always have a length of two bytes. Register data read out from the drive will always consist of two bytes.

◆ Error Check

The bypass uses a CRC-16 (cyclic redundancy check, checksum method) for checking data validity. Use the procedure described below when calculating the CRC-16 checksum for command data or when verifying response data.

■ Command Data

When the drive receives data, it calculates the CRC-16 checksum from the data and compares it to the CRC-16 value received within the message. Both must match before a command is processed.

An initial value of FFFFH (i.e., all 16 bits equal 1) must be used for CRC-16 calculations in the MEMOBUS/Modbus protocol.

Calculate the CRC-16 checksum using the following steps:

1. The starting value is FFFFH.
2. Perform an XOR operation of this value and the slave address.
3. Right shift the result.
4. When the overflow bit of the shift operation becomes 1, perform an XOR operation of the result from step 3 above and the fix value A001H.
5. Repeat steps 3 and 4 until eight shift operations have been performed.
6. After eight shift operations, perform an XOR operation with the result and the next data in the message (function code, register address, data). Continue with steps 3 to 5 until the last data has been processed.
7. The result of the last shift or XOR operation is the checksum.

The example in *Table D.2* shows the CRC-16 calculation of the slave address 02H and the function code 03H, yielding the result D140H.

Note: This example does not show the calculation for a complete MEMOBUS/Modbus command. Normally data would follow in the calculation.

Table D.2 CRC-16 Checksum Calculation Example

Description	Calculation	Overflow	Description	Calculation	Overflow
Initial Value (FFFFH)	1111 1111 1111 1111		Function Code 03H	0000 0000 0000 0011	
Address 02H	0000 0000 0000 0010		XOR w result	1000 0001 0011 1101	
XOR w initial value	1111 1111 1111 1101		Shift 1	0100 0000 1001 1110	1
Shift 1	0111 1111 1111 1110	1	XOR w A001H	1010 0000 0000 0001	
XOR w A001H	1010 0000 0000 0001		XOR result	1110 0000 1001 1111	
XOR result	1101 1111 1111 1111		Shift 2	0111 0000 0100 1111	1
Shift 2	0110 1111 1111 1111	1	XOR w A001H	1010 0000 0000 0001	
XOR w A001H	1010 0000 0000 0001		XOR result	1101 0000 0100 1110	
XOR result	1100 1111 1111 1110		Shift 3	0110 1000 0010 0111	0
Shift 3	0110 0111 1111 1111	0	Shift 4	0011 0100 0001 0011	1
Shift 4	0011 0011 1111 1111	1	XOR w A001H	1010 0000 0000 0001	
XOR w A001H	1010 0000 0000 0001		XOR result	1001 0100 0001 0010	
XOR result	1001 0011 1111 1110		Shift 5	0100 1010 0000 1001	0
Shift 5	0100 1001 1111 1111	0	Shift 6	0010 0101 0000 0100	1
Shift 6	0010 0100 1111 1111	1	XOR w A001H	1010 0000 0000 0001	
XOR w A001H	1010 0000 0000 0001		XOR result	1000 0101 0000 0101	
XOR result	1000 0100 1111 1110		Shift 7	0100 0010 1000 0010	1
Shift 7	0100 0010 0111 1111	0	XOR w A001H	1010 0000 0000 0001	
Shift 8	0010 0001 0011 1111	1	XOR result	1110 0010 1000 0011	
XOR w A001H	1010 0000 0000 0001		Shift 8	0111 0001 0100 0001	1
XOR result	1000 0001 0011 1110		XOR w A001H	1010 0000 0000 0001	
Perform operations with next data (function code)			XOR result	1101 0001 0100 0000	
			CRC-16	1101 0001 0100 0000	
				D 1 4 0 (Lower) (Upper)	
			Continue from here with next data.		

■ Response Data

Perform a CRC-16 calculation on the response message data as described above as a validation check. The result should match the CRC-16 checksum received within the response message.

D.8 Message Examples

Below are some examples of command and response messages.

◆ Reading Drive MEMOBUS/Modbus Register Contents

Using the function code 03H (Read), a maximum of 16 MEMOBUS/Modbus registers can be read out at a time.

The following table shows message examples when reading status signals, error details, data link status, and frequency references from the slave 2 drive.

Command Message			Response Message (normal)			Response Message (fault)		
Slave Address		02H	Slave Address		02H	Slave Address		02H
Function Code		03H	Function Code		03H	Function Code		83H
Starting No.	Upper	00H	Data Quantity		08H	Error Code		03H
	Lower	20H	1st storage register	Upper	00H	CRC-16	Upper	F1H
Data Quantity	Upper	00H		Lower	65H		Lower	31H
	Lower	04H	Next storage register	Upper	00H			
CRC-16	Upper	45H		Lower	00H			
	Lower	F0H	Next storage register	Upper	00H			
				Lower	00H			
			Next storage register	Upper	01H			
				Lower	F4H			
			CRC-16	Upper	AFH			
				Lower	82H			

◆ Loopback Test

Function code 08H performs a loopback test that returns a response message with exactly the same content as the command message. The response message can be used to check communications between the master and slave. User-defined test code and data values can also be set.

The following table shows a message example when performing a loopback test with the slave 1 drive.

Command Message			Response Message		
Slave Address		01H	Slave Address		01H
Function Code		08H	Function Code		08H
Test Code	Upper	00H	Test Code	Upper	00H
	Lower	00H		Lower	00H
Data	Upper	A5H	Data	Upper	A5H
	Lower	37H		Lower	37H
CRC-16	Upper	DAH	CRC-16	Upper	DAH
	Lower	8DH		Lower	8DH

◆ Writing to Multiple Registers

Function code 10H allows the user to write multiple MEMOBUS/Modbus registers with one message. This process works similar to reading registers, in that the address of the first register to be written and the data quantity are set in the command message. The data to be written must be consecutive so that the register addresses are in order, starting from the specified address in the command message. The data order must be high byte then lower byte.

The following table shows an example of a message where a forward operation has been set with a frequency reference of 60.0 Hz for the slave 1 drive.

If parameter values are changed using the Write command, an Enter command is necessary to save the data. ***Refer to Enter Command on page 346*** for detailed descriptions.

Command Message		
Slave Address		01H
Function Code		10H
Starting No.	Upper	00H
	Lower	01H
Data Quantity	Upper	00H
	Lower	02H
Number of Bytes		04H
Starting Data	Upper	00H
	Lower	01H
Next Data	Upper	02H
	Lower	58H
CRC-16	Upper	63H
	Lower	39H

Response Message (normal)		
Slave Address		01H
Function Code		10H
Starting No.	Upper	00H
	Lower	01H
Data Quantity	Upper	00H
	Lower	02H
CRC-16	Upper	10H
	Lower	08H

Response Message (fault)		
Slave Address		01H
Function Code		90H
Error Code		02H
CRC-16	Upper	CDH
	Lower	C1H

Note: Double the number of the data quantity for the number of bytes in the command message.

D.9 MEMOBUS/Modbus Data Table

The tables below list all MEMOBUS/Modbus data.

The MEMOBUS register hex addresses for parameters are listed beginning on page *280*.

◆ Command Data

It is possible to both read and write command data.

Note: Bits that are not used should be set to 0. Refrain from writing to reserved registers.

Register No.	Contents	
0000H	Reserved	
0001H	Operation Commands and Multi-function Inputs	
	bit 0	H5-12 = 0: Forward Run Command (0 = Stop, 1 = Forward Run) H5-12 = 1: Run Command (0 = Stop, 1 = Run)
	bit 1	H5-12 = 0: Reverse Run Command (0 = Stop, 1 = Reverse Run) H5-12 = 1: Forward/Reverse (0 = Forward, 1 = Reverse)
	bit 2	Option Card External Fault (EF0)
	bit 3	Fault Reset
	bit 4	Multi-Function Input 1 Function is ComRef when H1-01 = 40 (Forward/Stop). **Note:** When the bit at ComCtrl is turned on, commands from MEMOBUS/Modbus communications take control of the operation. However, when a communications option card is connected, that option card is given priority.
	bit 5	Multi-Function Input 2 Function is ComCtrl when H1-02 = 41 (Reverse/Stop).
	bit 6	Multi-Function Input 3
	bit 7	Multi-Function Input 4
	bit 8	Multi-Function Input 5
	bit 9	Multi-Function Input 6
	bit A	Multi-Function Input 7
	bit B	Multi-Function Input 8
	bit C to F	Reserved
0002H	Frequency Reference	Units are determined by parameter o1-03.
0003H	Output voltage gain/ Unit: 0.1% Range: 20 (2.0%) to 2000 (200.0%), Default when power on: 1000 (100.0%)	
0004H	Torque Reference/Torque Limit, 0.1% units, signed (Usable only if Torque Control is enabled)	
0005H	Torque Compensation, 0.1% units, signed (Usable only if Torque Control is enabled)	
0006H	PID Target, 0.01% units, signed	
0007H	Analog Output Terminal FM Setting (10 V / 4000 H)	
0008H	Analog Output Terminal AM Setting (10 V / 4000 H)	
0009H	Settings for Multi-Function Digital Outputs	
	bit 0	Multi-Function Contact Output 1 (terminal M1-M2)
	bit 1	Multi-Function Contact Output 2 (terminal M3-M4)
	bit 2	Multi-Function Contact Output 3 (terminal MD-ME-MF)
	bit 3 to 5	Reserved
	bit 6	Enables the function in bit 7
	bit 7	Fault Contact Output (terminal MA/MB-MC)
	bit 8 to F	Reserved
000AH	Pulse Output Terminal MP Setting, 1 Hz units, Setting Range: 0 to 32000	
000BH to 000EH	Reserved	

Register No.	Contents	
000FH	Control Selection Setting	
	bit 0	Reserved
	bit 1	PID Setpoint Input
	bit 2	Torque reference / torque limit input (enables the setting from MEMOBUS/Modbus)
	bit 3	Torque compensation input (enables the setting from MEMOBUS/Modbus)
	bit 4 to B	Reserved
	bit C	Enable Terminal S5 Input for Broadcast Data
	bit D	Enable Terminal S6 Input for Broadcast Data
	bit E	Enable Terminal S7 Input for Broadcast Data
	bit F	Enable Terminal S8 Input for Broadcast Data
0010H to 001AH	Reserved	
001BH	Analog Monitor Option AO-A3 Analog Output 1 (10 V/4000 H)	
001CH	Analog Monitor Option AO-A3 Analog Output 2 (10 V/4000 H)	
001DH	Digital Output Option DO-A3 Output (Binary)	
001EH to 001FH	Reserved	

◆ Monitor Data

Monitor data can be read only.

Register No.	Contents	
0020H	Drive Status 1	
	bit 0	During Run
	bit 1	During Reverse
	bit 2	Drive Ready
	bit 3	Fault
	bit 4	Data Setting Error
	bit 5	Multi-Function Contact Output 1 (terminal M1-M2)
	bit 6	Multi-Function Contact Output 2 (terminal M3-M4)
	bit 7	Multi-Function Contact Output 3 (terminal MD-ME-MF)
	bit 8 to bit D	Reserved
	bit E	When ComRef has been enabled
	bit F	When ComCtrl has been enabled

Register No.	Contents	
0021H	Fault Contents 1	
	bit 0	Overcurrent (oC), Ground fault (GF)
	bit 1	Control Circuit Overvoltage (ov)
	bit 2	Overload (oL2)
	bit 3	Overheat 1 (oH1), Heatsink Overheat Warning (oH2)
	bit 4, 5	Reserved
	bit 6	PID Feedback Loss/Excessive PID Feedback (FbL / FbH)
	bit 7	EF to EF8: External Fault
	bit 8	CPF□□: Hardware Fault (includes oFx)
	bit 9	Motor Overload (oL1), Overtorque Detection 1/2 (oL3/oL4), Undertorque Detection 1/2 (UL3/ UL4)
	bit A	PG Disconnect (PGo), PG Hardware Fault (PGoH), Overspeed (oS), Speed Deviation (dEv)
	bit B	Control Circuit Undervoltage (Uv), Power Supply Undervoltage (AUv), Power Supply Frequency Fault (Fdv)
	bit C	Control Circuit Undervoltage Fault (Uv1), Control Power Supply Voltage Fault (Uv2), Undervoltage 3 (Uv3), Power Supply Frequency Fault (Fdv), Power Supply Undervoltage (AUv), Phase Order Detection Fault (SrC)
	bit D	Output Phase Loss (LF)
	bit E	MEMOBUS/Modbus Communication Error (CE), Option Communication Error (bUS)
	bit F	External Digital Operator Connection Fault (oPr)
0022H	Data Link Status	
	bit 0	Writing data or switching motors
	bit 1, 2	Reserved
	bit 3	Upper or lower limit error
	bit 4	Data conformity error
	bit 5	Writing to EEPROM
	bit 6	0: Write into EEPROM. 1: Write in RAM only. **Note:** Enabled only when H5-17 = 1.
	bit 7 to bit F	Reserved
0023H	Frequency Reference <1>	
0024H	Output Frequency <1>	
0025H	Output Voltage Reference, 0.1 V units (units are determined by parameter H5-10)	
0026H	Output Current, 0.1 A units <2>	
0027H	Output Power	
0028H	Torque Reference	
0029H	Fault Contents 2	
	bit 0	Reserved
	bit 1	Ground Fault (GF)
	bit 2	Reserved
	bit 3	Output Phase Loss (LF)
	bit 4, 5	Reserved
	bit 6	Motor Overheat 2 (PTC input) (oH4)
	bit 7 to bit F	Reserved

Register No.	Contents	
002AH	Alarm Contents 1	
	bit 0, 1	Reserved
	bit 2	Forward/Reverse Run Command Input Error (EF)
	bit 3	Baseblock (bb)
	bit 4	Overtorque 1 (oL3)
	bit 5	Heatsink Overheat (oH)
	bit 6	Control Circuit Overvoltage (ov)
	bit 7	Control Circuit Undervoltage (Uv)
	bit 8	Fan Fault (FAn)
	bit 9	MEMOBUS/Modbus Communication Error (CE)
	bit A	Option Communication Error (bUS)
	bit B	Undertorque Detection 1/2 (UL3/UL4)
	bit C	Motor Overheat (oH3)
	bit D	PID Feedback Loss, Excessive PID Feedback (FbL, FbH)
	bit E	Reserved
	bit F	Serial Communication Transmission Error (CALL)
002BH	Input Terminal Status	
	bit 0	Terminal S1 Closed
	bit 1	Terminal S2 Closed
	bit 2	Terminal S3 Closed
	bit 3	Terminal S4 Closed
	bit 4	Terminal S5 Closed
	bit 5	Terminal S6 Closed
	bit 6	Terminal S7 Closed
	bit 7	Terminal S8 Closed
	bit 8 to bit F	Reserved
002CH	Drive Status 2	
	bit 0	During Run
	bit 1	Zero Speed
	bit 2	Speed Agree
	bit 3	User-set Speed Agree
	bit 4	Frequency Detection 1
	bit 5	Frequency Detection 2
	bit 6	Drive Ready
	bit 7	During Undervoltage
	bit 8	During Baseblock
	bit 9	Frequency Reference from Operator Keypad
	bit A	Run Command from Operator Keypad
	bit B	Over/Undertorque Detection 1, 2
	bit C	Frequency Reference Loss
	bit D	During Fault Restart
	bit E	Fault
	bit F	Communication Timeout
002DH	Output Terminal Status	
	bit 0	Multi-Function Contact Output 1 (terminal M1-M2)
	bit 1	Multi-Function Contact Output 2 (terminal M3-M4)
	bit 2	Multi-Function Contact Output 3 (terminal MD-ME-MF)
	bit 3 to 6	Reserved
	bit 7	Fault Contact Output (terminal MA/MB-MC)
	bit 8 to F	Reserved

Register No.	Contents	
002EH	Reserved	
002FH	Frequency Reference Bias (from Up/Down 2 Function), 0.1% units	
0030H	Reserved	
0031H	Control Circuit Voltage, 1 Vdc units	
0032H	Torque Reference (U1-09), 0.1% units	
0033H	Reserved	
0034H	Product Code 1 [ASCII], Product Type (U0 for U1000)	
0035H	Product Code 2 [ASCII], Region Code	
0036H, 0037H	Reserved	
0038H	PID Feedback, 0.1% units, unsigned, 100% / max. output frequency	
0039H	PID Input, 0.1% units, signed, 100% / max. output frequency	
003AH	PID Output, 0.1% units, signed, 100% / max. output frequency	
003BH, 003CH	Reserved	
003DH	Communications Error Contents <3>	
	bit 0	CRC Error
	bit 1	Data Length Error
	bit 2	Reserved
	bit 3	Parity Error
	bit 4	Overrun Error
	bit 5	Framing Error
	bit 6	Timeout
	bit 7 to bit F	Reserved
003EH	Output Frequency	r/min <4>
003FH		0.01% units
0040H to 004AH	Used for various monitors U1-□□. ***Refer to U: Monitors on page 311*** for parameter details.	
004BH	Drive status (U1-12)	
	bit 0	During Run
	bit 1	During Zero Speed
	bit 2	During Reverse Run
	bit 3	During Fault Reset Signal Input
	bit 4	During Speed Agree
	bit 5	Drive Ready
	bit 6	Alarm
	bit 7	Fault
	bit 8	During Operation Error (oPE□□)
	bit 9	During Momentary Power Loss
	bit A	Motor 2 selected
	bit B	Reserved
	bit E	ComRef status, NetRef status
	bit F	ComCtrl status, NetCtrl status
004CH to 007EH	Used for monitors U1-□□, U4-□□, U5-□□ and U6-□□. ***Refer to U2: Fault Trace on page 314*** and ***Refer to U3: Fault History on page 315*** for parameter details.	
007FH	Minor Fault Code, ***Refer to Alarm Register Contents on page 380*** for Minor Fault codes.	
0080H to 0097H	Used for monitors U2-□□, U3-□□. ***Refer to U: Monitors on page 311*** for parameter details and ***Refer to Fault Trace Contents on page 378*** for register value descriptions.	
0098H, 0099H	U4-01 (Cumulative Operation Time) Example: When U4-01 (Cumulative Operation Time) is 12345 hours, then 0098H = 1234 and 0099H = 5.	
009AH, 009BH	U4-03 (Cooling Fan Operation Time) Example: When U4-03 (Cooling Fan Operation Time) is 12345 hours, then 009AH = 1234 and 009BH = 5.	
009CH to 00AAH	Reserved	
00ABH	Drive Rated Current <2>	

Register No.	Contents	
00ACH	Motor Speed (U1-05)	r/min units <4>
00ADH		0.01% units
00AEH to 00B1H	Reserved	
00B2H	Option Code Connected to CN5-B	
00B3H	Option Code Connected to CN5-C	
00B4H	Reserved	
00B5H	Frequency Reference After Soft-starter (U1-16)	r/min units <4>
00B6H		0.01% units
00B7H	Frequency Reference	r/min <4>
00B8H		0.01% units
00B9H to 00BEH	Reserved	
00BFH	Lists the last two digits of operation error code oPE☐☐.	
00C0H	Fault Contents 3	
	bit 1	Control Circuit Undervoltage Fault (Uv1)
	bit 2	Control Power Supply Undervoltage Fault (Uv2)
	bit 3	Undervoltage 3 (Soft-Charge Bypass Circuit Fault) (Uv3)
	bit 4	Reserved
	bit 5	Ground Fault (GF)
	bit 6	Overcurrent (oC)
	bit 7	Control Circuit Overvoltage (ov)
	bit 8	Heatsink Overheat (oH)
	bit 9	Overheat 1 (oH1)
	bit A	Motor Overload (oL1)
	bit B	Overload (oL2)
	bit C	Overtorque Detection 1 (oL3)
	bit D	Overtorque Detection 2 (oL4)
	bit E, F	Reserved
00C1H	Fault Contents 4	
	bit 0	External Fault at input terminal S3 (EF3)
	bit 1	External Fault at input terminal S4 (EF4)
	bit 2	External Fault at input terminal S5 (EF5)
	bit 3	External Fault at input terminal S6 (EF6)
	bit 4	External Fault at input terminal S7 (EF7)
	bit 5	External Fault at input terminal S8 (EF8)
	bit 6	Fan Fault (FAn)
	bit 7	Overspeed (os)
	bit 8	Excessive Speed Deviation (dEv)
	bit 9	PG Disconnect (PGo)
	bit A	Reserved
	bit B	Output Phase Loss (LF)
	bit C	Motor Overheat (PTC input) (oH3)
	bit D	External Digital Operator Connection Fault (oPr)
	bit E	EEPROM Write Error (Err)
	bit F	Motor Overheat Fault (PTC input) (oH4)

Register No.	Contents	
00C2H	Fault Contents 5	
	bit 0	MEMOBUS/Modbus Communication Error (CE)
	bit 1	Option Communication Error (bUS)
	bit 2, 3	Reserved
	bit 4	Control Fault (CF)
	bit 5	Zero Servo Fault (SvE)
	bit 6	Option Card External Fault (EF0)
	bit 7	PID Feedback Loss (FbL)
	bit 8	Undertorque Detection 1 (UL3)
	bit 9	Undertorque Detection 2 (UL4)
	bit A to E	Reserved
	bit F	Hardware Fault (includes oFx)
00C3H	Fault Contents 6	
	bit 0	Reserved
	bit 1	Z Pulse Fault (dv1)
	bit 2	Z Pulse Noise Fault Detection (dv2)
	bit 3	Inversion Detection (dv3)
	bit 4	Inversion Prevention Detection (dv4)
	bit 5	Output Current Imbalance (LF2)
	bit 6	Pull-Out Detection (STo)
	bit 7	PG Hardware Fault (PGoH)
	bit 8	MECHATROLINK Watchdog Timer Error (E5)
	bit 9	Reserved
	bit A	Too Many Speed Search Restarts (SEr)
	bit B to F	Reserved
00C4H	Fault Contents 7	
	bit 0	PID Feedback Loss (FbH)
	bit 1	External Fault 1, input terminal S1 (EF1)
	bit 2	External Fault 2, input terminal S2 (EF2)
	bit 3	Mechanical Weakening Detection 1 (oL5)
	bit 4	Mechanical Weakening Detection 2 (UL5)
	bit 5	Current Offset Fault (CoF)
	bit 6, 7	Reserved
	bit 8	DriveWorksEZ Fault (dWFL)
	bit 9 to F	Reserved
00C5H	Fault Contents 8	
	bit 0	LSo Fault (LSo)
	bit 1	CanOpenNID Error (nSE)
	bit 2 to 9	Reserved
	bit A	Initial Polarity Estimation Timeout (dv7)
	bit B to F	Reserved
00C6H to 00C7H	Reserved	

Register No.	Contents	
00C8H	Alarm Contents 2	
	bit 0	Control Circuit Undervoltage (Uv)
	bit 1	Control Circuit Overvoltage (ov)
	bit 2	Heatsink Overheat (oH)
	bit 3	Heatsink Overheat Warning (oH2)
	bit 4	Overtorque Detection 1 (oL3)
	bit 5	Overtorque Detection 2 (oL4)
	bit 6	Forward/Reverse Run Commands Input Error (EF)
	bit 7	Baseblock (bb)
	bit 8	External Fault 3, input terminal S3 (EF3)
	bit 9	External Fault 4, input terminal S4 (EF4)
	bit A	External Fault 5, input terminal S5 (EF5)
	bit B	External Fault 6, input terminal S6 (EF6)
	bit C	External Fault 7, input terminal S7 (EF7)
	bit D	External Fault 8, input terminal S8 (EF8)
	bit E	Fan Fault (FAn)
	bit F	Overspeed (oS)
00C9H	Alarm Contents 3	
	bit 0	Speed Deviation (dEv)
	bit 1	PG Disconnect (PGo)
	bit 2	External Digital Operator Connection Fault (oPr)
	bit 3	MEMOBUS/Modbus Communication Error (CE)
	bit 4	Option Communication Error (bUS)
	bit 5	Serial Communication Transmission Error (CALL)
	bit 6	Motor Overload (oL1)
	bit 7	Overload (oL2)
	bit 8	Reserved
	bit 9	Option Card External fault (EF0)
	bit A	Motor Switch during Run (rUn)
	bit B	Reserved
	bit C	Serial Communication Transmission Error (CALL)
	bit D	Undertorque Detection 1 (UL3)
	bit E	Undertorque Detection 2 (UL4)
	bit F	MEMOBUS/Modbus Communication Test Mode Error (SE)
00CAH	Alarm Contents 4	
	bit 0	Reserved
	bit 1	Motor Overheat Alarm (PTC Input) (oH3)
	bit 2 to 5	Reserved
	bit 6	PID Feedback Loss (FbL)
	bit 7	Excessive PID Feedback (FbH)
	bit 9	Drive Disabled (dnE)
	bit A	PG Disconnect (PGo)
	bit B to F	Reserved

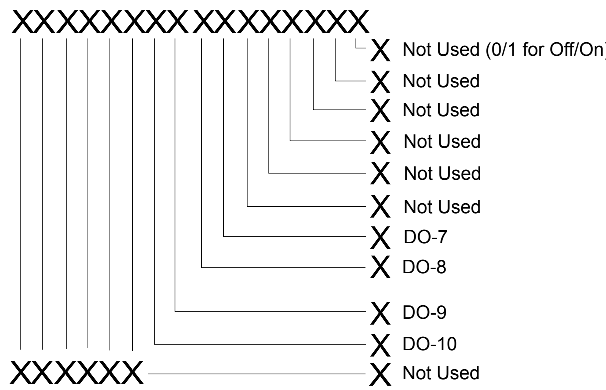
Register No.	Contents	
00CBH	Alarm Contents 5	
	bit 0	MECHATROLINK Watchdog Timer Error (E5)
	bit 1	Station Address Setting Error (AEr)
	bit 2	MECHATROLINK Comm. Cycle Setting Error (CyC)
	bit 3	Current Alarm (HCA)
	bit 4	Cooling Fan Maintenance Time (LT-1)
	bit 5	Maintenance Time (LT-2)
	bit 6	Damping Resistor Overheat (doH)
	bit 7	SI-S EEPROM Error (EEP)
	bit 8	External Fault 1 (input terminal S1) (EF1)
	bit 9	External Fault 2 (input terminal S2) (EF2)
	bit A	Safe Disable Signal Input (HbbF)
	bit B	Safe Disable Signal Input (Hbb)
	bit C	Mechanical Weakening Detection 1 (oL5)
	bit D	Mechanical Weakening Detection 2 (UL5)
	bit E, F	Reserved
00CCH	Alarm Contents 6	
	bit 0, 1	Reserved
	bit 2	Capacitor Maintenance Time (LT-3)
	bit 3 to 7	Reserved
	bit 8	DriveWorksEZ Fault (dWAL)
	bit 9 to F	Reserved
00CDH	Alarm Contents 7	
	bit 0	Power Supply Frequency Fault Detection (Fdv)
	bit 1	Phase Order Detection Fault (SrC)
	bit 2	Reserved
	bit 3	Power Supply Undervoltage (AUv)
	bit 4 to F	Reserved
00CEH	Alarm Contents 8	
	bit 0 to D	Reserved
	bit E	Snubber Discharge Resistor Overheat (SoH)
	bit F	Reserved
00CFH	Reserved	
00D0H	CPF Contents 1	
	bit 0, 1	Reserved
	bit 2	Control Circuit Error (CPF02)
	bit 3	Control Circuit Error (CPF03)
	bit 4, 5	Reserved
	bit 6	Control Circuit Error (CPF06)
	bit 7	Control Circuit Error (CPF07)
	bit 8	Control Circuit Error (CPF08)
	bit 9, A	Reserved
	bit B	Control Circuit Error (CPF11)
	bit C	Control Circuit Error (CPF12)
	bit D	Control Circuit Error (CPF13)
	bit E	Control Circuit Error (CPF14)
	bit F	Reserved

Register No.	Contents	
00D1H	CPF Contents 2	
	bit 0	Control Circuit Error (CPF16)
	bit 1	Control Circuit Error (CPF17)
	bit 2	Control Circuit Error (CPF18)
	bit 3	Control Circuit Error (CPF19)
	bit 4	Control Circuit Error (CPF20)
	bit 5	Control Circuit Error (CPF21)
	bit 6	Control Circuit Error (CPF22)
	bit 7	Control Circuit Error (CPF23)
	bit 8	Control Circuit Error (CPF24)
	bit 9	Terminal Board not Connected (CPF25)
	bit A	Control Circuit Error (CPF26)
	bit B	Control Circuit Error (CPF27)
	bit C	Control Circuit Error (CPF28)
	bit D	Control Circuit Error (CPF29)
	bit E	Control Circuit Error (CPF30)
	bit F	Control Circuit Error (CPF31)
00D2H	CPF Contents 3	
	bit 0	Control Circuit Error (CPF32)
	bit 1	Control Circuit Error (CPF33)
	bit 2	Control Circuit Error (CPF34)
	bit 3	Control Circuit Error (CPF35)
	bit 4 to 7	Reserved
	bit 8	Control Circuit Error (CPF40)
	bit 9	Control Circuit Error (CPF41)
	bit A	Control Circuit Error (CPF42)
	bit B	Control Circuit Error (CPF43)
	bit C	Control Circuit Error (CPF44)
	bit D	Control Circuit Error (CPF45)
	bit E, F	Reserved
00D3H to 00D7H	Reserved	
00D8H	oFA0□ Contents (CN5-A)	
	bit 0	Option Compatibility Error (oFA00)
	bit 1	Option not properly connected (oFA01)
	bit 2	Same type of option card already connected (oFA02)
	bit 3, 4	Reserved
	bit 5	A/D Conversion Error (oFA05)
	bit 6	Option Response Error (oFA06)
	bit 7 to F	Reserved
00D9H	oFA1□ Contents (CN5-A)	
	bit 0	Option RAM Fault (oFA10)
	bit 1	Option Operation Mode Fault (SLMOD) (oFA11)
	bit 2	Unit Receive CRC Error (oFA12)
	bit 3	Unit Receive Frame Error (oFA13)
	bit 4	Unit Receive Abort Error (oFA14)
	bit 5	Option Receive CRC Error (oFA15)
	bit 6	Option Receive Frame Error (oFA16)
	bit 7	Option Receive Abort Error (oFA17)
	bit 8 to F	Reserved
00DAH to 00DBH	Reserved	

Register No.	Contents	
00DBH	oFA3□ Contents (CN5-A)	
	bit 0	Comm. ID Error (oFA30)
	bit 1	Model Code Error (oFA31)
	bit 2	Sumcheck Error (oFA32)
	bit 3	Comm. option timeout waiting for response (oFA33)
	bit 4	MEMOBUS Timeout (oFA34)
	bit 5	Unit timeout waiting for response (oFA35)
	bit 6	CI Check Error (oFA36)
	bit 7	Unit timeout waiting for response (oFA37)
	bit 8	Control Command Selection Error (oFA38)
	bit 9	Unit timeout waiting for response (oFA39)
	bit A	Control Response Selection 1 Error (oFA40)
	bit B	Unit timeout waiting for response (oFA41)
	bit C	Control Response Selection 2 Error (oFA42)
	bit D	Control Response Selection Error (oFA43)
	bit E, F	Reserved
00DCH	oFb0□ Contents (CN5-B)	
	bit 0	Option compatibility error (oFb00)
	bit 1	Option not properly connected (oFb01)
	bit 2	Same type of option card already connected (oFb02)
	bit 3, 4	Reserved
	bit 5	A/D Conversion Fault (oFb05)
	bit 6	Option Response Error (oFb06)
	bit 7 to F	Reserved
00DDH	oFb1□ Contents (CN5-B)	
	bit 0	Option RAM Fault (oFb10)
	bit 1	Option Operation Mode Fault (SLMOD) (oFb11)
	bit 2	Unit Receive CRC Error (oFb12)
	bit 3	Unit Receive Frame Error (oFb13)
	bit 4	Unit Receive Abort Error (oFb14)
	bit 5	Option Receive CRC Error (oFb15)
	bit 6	Option Receive Frame Error (oFb16)
	bit 7	Option Receive Abort Error (oFb17)
	bit 8 to F	Reserved
00DEH to 00DFH	Reserved	

Register No.	Contents	
00E0H	oFb3□ Contents (CN5-B)	
	bit 0	Comm. ID Error (oFb30)
	bit 1	Model Code Error (oFb31)
	bit 2	Sumcheck Error (oFb32)
	bit 3	Comm. option timeout waiting for response (oFb33)
	bit 4	MEMOBUS Timeout (oFb34)
	bit 5	Unit timeout waiting for response (oFb35)
	bit 6	CI Check Error (oFb36)
	bit 7	Unit timeout waiting for response (oFb37)
	bit 8	Control Command Selection Error (oFb38)
	bit 9	Unit timeout waiting for response (oFb39)
	bit A	Control Response Selection 1 Error (oFb40)
	bit B	Unit timeout waiting for response (oFb41)
	bit C	Control Response Selection 2 Error (oFb42)
	bit D	Control Response Selection Error (oFb43)
	bit E, F	Reserved
00E1H	oFC0□ Contents (CN5-C)	
	bit 0	Option compatibility error (oFC00)
	bit 1	Option not properly connected (oFC01)
	bit 2	Same type of option card already connected (oFC02)
	bit 3, 4	Reserved
	bit 5	A/D Conversion Fault (oFC05)
	bit 6	Option Response Error (oFC06)
	bit 7 to F	Reserved
00E2H	oFC1□ Contents (CN5-C)	
	bit 0	Option RAM Fault (oFC10)
	bit 1	Option Operation Mode Fault (SLMOD) (oFC11)
	bit 2	Unit Receive CRC Error (oFC12)
	bit 3	Unit Receive Frame Error (oFC13)
	bit 4	Unit Receive Abort Error (oFC14)
	bit 5	Option Receive CRC Error (oFC15)
	bit 6	Option Receive Frame Error (oFC16)
	bit 7	Option Receive Abort Error (oFC17)
	bit 8 to F	Reserved
00E3H	Reserved	
00E4H	oFC5□ Contents (CN5-C)	
	bit 0	Encoder Option AD Conversion Error (oFC50)
	bit 1	Encoder Option Analog Circuit Error (oFC51)
	bit 2	Encoder Communication Timeout (oFC52)
	bit 3	Encoder Communication Data Error (oFC53)
	bit 4	Encoder Error (oFC54)
	bit 5	Resolver Error (oFC55)
	bit 6 to F	Reserved
00E5H to 00E9H	Reserved	

Register No.	Contents	
00EAH	Fault contents 11	
	bit 0 to 6	Reserved
	bit 7	Damping Resistor Overheat (doH)
	bit 8	Snubber Discharge Resistor Overheat (SoH)
	bit 9	Internal Resistance Fault (Srr)
	bit A to D	Reserved
	bit E	Safety Circuit Fault (SCF)
	bit F	Reserved
00EBH to 00FAH	Reserved	
00FBH	Output Current	
8400H	BYP Command	XXXXXXXX XXXXXXXX X Run X Run Rev X Not Used X Transfer to Bypass X Smoke Purge Bypass X Smoke Purge Drive X Motor OR Select X Motor AND Select X Not Used X HAND Select X AUTO Select X DRIVE Select X BYPASS Select X Fault Reset X External Fault (EFB) X Not Used
8401H	BYP Freq Ref	Bypass Frequency Reference. This value is sent to the drive if selected by bypass parameter Z1-07. The units are determined by drive parameter o1-03.
8402H <5>	BYP DI-☐☐ Command	XXXXXXXX XXXXXXXX X DI-1 (0/1 for Off/On) X DI-2 X DI-3 X DI-4 X DI-5 X DI-6 X DI-7 X DI-8 XXXXXXXX Not Used **Note:** Parameter Z3-12 determines whether the physical inputs will be OR'd with Register 8400H.

Register No.	Contents	
8403H	BYP DO-□□ Command	Bypass Digital Output Command. These bits allow the digital outputs to be set over a network if the corresponding digital output function is unused. 
8404H	Time Set HHMM	Time Set Hours and Minutes. Format is HHMM where HH is hours from 00 to 23 and MM is minutes from 00 to 59. When new HHMM is set to RTC, the seconds will be set to a value of 0.
8405H	Date Set Year	Date Set Year. Format is YYYY where YYYY is the four digit year from 2000 to 2099.
8406H	Date Set MMDD	Date Set Month and Day. Format is MMDD where MM is month from 01 to 12 and DD is day from 01 to 31.
8407H	Set RTC	The date and time values in registers 8404H to 8406H are written to the real time clock (RTC) in the HOA operator connected to the bypass. 0: Do not write values to RTC 1: Write values to RTC
8408H to 843FH	Reserved	
8440H	Time HHMM	Time Hours and Minutes. Reads current time. Format is HHMM where HH is hours from 00 to 23 and MM is minutes from 00 to 59. Reads 0x0000 when no RTC option
8441H	Date Year	Date Year. Reads current date. Format is YYYY where YYYY is the year from 0000 to 9999. Reads 0x0000 when there is no RTC option.
8442H	Date Mo Day MMDD	Date Month and Day. Reads current date. Format is MMDD where MM is month from 01 to12 and DD is day from 01 to 31. Reads 0x0000 when there is no RTC option
8443H to 84FFH	Reserved	
8490H	Product Type Code	
8491H	Product Type Code	
8500H to 87FFH	BYP Parameters and Monitors	Z1-□□, Z2-□□, Z3-□□, Z4-□□ , UB-□□. *Refer to Parameter List on page 277* for Modbus addresses.
8800H to FFFFH	Reserved	

<1> Parameter o1-03, Digital Operator Display Selection, determines the units.

<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

<3> Communication error contents are saved until the fault is reset.

<4> Set the number of motor poles to parameter E2-04.

<5> Disabled when Z3-12 is set to 0.

◆ Broadcast Messages

Data can be written from the master to all slave devices at the same time.

The slave address in a broadcast command message must be set to 00H. All slaves will receive the message, but will not respond.

Register No.	Contents	
0001H	Digital Input Command	
	bit 0	Forward Run (0: Stop 1: Run)
	bit 1	Direction Command (0: Forward, 1: Reverse)
	bit 2, 3	Reserved
	bit 4	External Fault
	bit 5	Fault Reset
	bit 6 to B	Reserved
	bit C	Multi-Function Digital Input S5
	bit D	Multi-Function Digital Input S6
	bit E	Multi-Function Digital Input S7
	bit F	Multi-Function Digital Input S8
0002H	Frequency Reference	30000/100%

◆ Fault Trace Contents

The table below shows the fault codes that can be read out by MEMOBUS/Modbus commands from the U2-□□ monitor parameters.

Table D.3 Fault Trace / History Register Contents

Fault Code	Fault Name	Fault Code	Fault Name
0002H	Control Circuit Undervoltage Fault (Uv1)	0028H	PID Feedback Loss (FbL)
0003H	Control Power Supply Voltage Fault (Uv2)	0029H	Undertorque Detection 1 (UL3)
0004H	Undervoltage 3 (Uv3)	002AH	Undertorque Detection 2 (UL4)
0006H	Ground Fault (GF)	0030H	Hardware Fault (including oFx)
0007H	Overcurrent (oC)	0032H	Z Pulse Fault (dv1)
0008H	Control Circuit Overvoltage (ov)	0033H	Z Pulse Noise Fault Detection (dv2)
0009H	Heatsink Overheat (oH)	0034H	Inversion Detection (dv3)
000AH	Overheat 1 (oH1)	0035H	Inversion Prevention Detection (dv4)
000BH	Motor Overload (oL1)	0036H	Output Current Imbalance (LF2)
000CH	Overload (oL2)	0037H	Pull-Out Detection (Sto)
000DH	Overtorque Detection 1 (oL3)	0038H	PG Hardware Fault (PGoH)
000EH	Overtorque Detection 2 (oL4)	0039H	MECHATROLINK Watchdog Timer Error (E5)
0011H	External Fault at Input Terminal S3 (EF3)	003BH	Too Many Speed Search Restarts (SEr)
0012H	External Fault at Input Terminal S4 (EF4)	0041H	Excessive PID Feedback (FbH)
0013H	External Fault at Input Terminal S5 (EF5)	0042H	External Fault 1, Input Terminal S1 (EF1)
0014H	External Fault at Input Terminal S6 (EF6)	0043H	External Fault 2, Input Terminal S2 (EF2)
0015H	External Fault at Input Terminal S7 (EF7)	0044H	Mechanical Weakening Detection 1 (oL5)
0016H	External Fault at Input Terminal S8 (EF8)	0045H	Mechanical Weakening Detection 2 (UL5)
0017H	Fan Fault (FAn)	0046H	Current Offset Fault (CoF)
0018H	Overspeed (oS)	0049H	DriveWorksEZ Fault (dWFL)
0019H	Speed Deviation (dEv)	004AH	EEPROM Memory DriveWorksEZ Data Error (dWF1)
001AH	PG Disconnect (PGo)	0051H	LSo Fault (LSo)
001CH	Output Phase Loss (LF)	0052H	CanOpenNID Error (nSE)
001DH	Motor Overheat Alarm (PTC input) (oH3)	005BH	Initial Polarity Estimation Timeout (dv7)
001EH	Digital Operator Connection Fault (oPr)	005CH	Ground Fault (GF)
001FH	EEPROM Write Error (Err)	005FH	Power Unit Output Phase Loss 3 (LF3)
0020H	Motor Overheat Fault (PTC input) (oH4)	0066H	Power Supply Undervoltage (AUv)
0021H	MEMOBUS/Modbus Communication Error (CE)	0067H	Power Supply Overvoltage (Aov)
0022H	Option Communication Error (bUS)	0068H	Power Supply Frequency Fault Detection (Fdv)
0025H	Control Fault (CF)	0069H	Phase Order Detection Fault (SrC)
0026H	Zero-Servo Fault (SvE)	0081H	Control Circuit Error (CPF00)
0027H	Option Card External Fault (EF0)		

Fault Code	Fault Name
0082H	Control Circuit Error (CPF01)
0083H	Control Circuit Error (CPF02)
0084H	Control Circuit Error (CPF03)
0087H	Control Circuit Error (CPF06)
0088H	Control Circuit Error (CPF07)
0089H	Control Circuit Error (CPF08)
008CH	Control Circuit Error (CPF11)
008DH	Control Circuit Error (CPF12)
008EH	Control Circuit Error (CPF13)
008FH	Control Circuit Error (CPF14)
0091H	Control Circuit Error (CPF16)
0092H	Control Circuit Error (CPF17)
0093H	Control Circuit Error (CPF18)
0094H	Control Circuit Error (CPF19)
0095H	Control Circuit Error (CPF20)
0096H	Control Circuit Error (CPF21)
0097H	Control Circuit Error (CPF22)
0098H	Control Circuit Error (CPF23)
0099H	Control Circuit Error (CPF24)
009AH	Terminal Board not Connected (CPF25)
009BH	Control Circuit Error (CPF26)
009CH	Control Circuit Error (CPF27)
009DH	Control Circuit Error (CPF28)
009EH	Control Circuit Error (CPF29)
009FH	Control Circuit Error (CPF30)
00A0H	Control Circuit Error (CPF31)
00A1H	Control Circuit Error (CPF32)
00A2H	Control Circuit Error (CPF33)
00A3H	Control Circuit Error (CPF34)
00A4H	Control Circuit Error (CPF35)
00A9H	Control Circuit Error (CPF40)
00AAH	Control Circuit Error (CPF41)
00ABH	Control Circuit Error (CPF42)
00ACH	Control Circuit Error (CPF43)
00ADH	Control Circuit Error (CPF44)
00AEH	Control Circuit Error (CPF45)
0101H	Option Compatibility Error (oFA00)
0102H	Option Not Properly Connected (oFA01)
0103H	Same Type of Option Card Already Connected (oFA02)
0106H	A/D Conversion Error (oFA05)
0107H	Option Response Error (oFA06)
0111H	Option RAM Fault (oFA10)
0112H	Option Operation Mode Fault (SLMOD) (oFA11)
0113H	Unit Receive CRC Error (oFA12)
0114H	Unit Receive Frame Error (oFA13)
0115H	Unit Receive Abort Error (oFA14)
0116H	Option Receive CRC Error (oFA15)
0117H	Option Receive Frame Error (oFA16)
0118H	Option Receive Abort Error (oFA17)
0131H	Comm. ID Error (oFA30)

Fault Code	Fault Name
0132H	Model Code Error (oFA31)
0133H	Sumcheck Error (oFA32)
0134H	Comm. Option Timeout Waiting for Response (oFA33)
0135H	MEMOBUS Timeout (oFA34)
0136H	Unit Timeout Waiting for Response (oFA35)
0137H	CI Check Error (oFA36)
0138H	Unit Timeout Waiting for Response (oFA37)
0139H	Control Command Selection Error (oFA38)
013AH	Unit Timeout Waiting for Response (oFA39)
013BH	Control Response Selection 1 Error (oFA40)
013CH	Unit Timeout Waiting for Response (oFA41)
013DH	Control Response Selection 2 Error (oFA42)
013EH	Control Response Selection Error (oFA43)
0201H	Option Compatibility Error (oFB00)
0202H	Option Connection Error (oFb01)
0203H	Same Type of Option Card Already Connected (oFb02)
0206H	A/D Conversion Error (oFb05)
0207H	Option Response Error (oFb06)
0211H	Option RAM Fault (oFb10)
0212H	Option Operation Mode Fault (SLMOD) (oFb11)
0213H	Unit Receive CRC Error (oFb12)
0214H	Unit Receive Frame Error (oFb13)
0215H	Unit Receive Abort Error (oFb14)
0216H	Option Receive CRC Error (oFb15)
0217H	Option Receive Frame Error (oFb16)
0218H	Option Receive Abort Error (oFb17)
0232H	Model Code Error (oFb31)
0233H	Sumcheck Error (oFb32)
0234H	Comm. option Timeout Waiting for Response (oFb33)
0235H	MEMOBUS Timeout (oFb34)
0236H	Unit Timeout Waiting for Response (oFb35)
0237H	CI Check Error (oFb36)
0238H	Unit Timeout Waiting for Response (oFb37)
0239H	Control Command Selection Error (oFb38)
023AH	Unit Timeout Waiting for Response (oFb39)
023BH	Control Response Selection 1 Error (oFb40)
023CH	Unit Timeout Waiting for Response (oFb41)
023DH	Control Response Selection 2 Error (oFb42)
023EH	Control Response Selection Error (oFb43)
0301H	Option Compatibility Error (oFC00)
0303H	Option Not Properly Connected (oFC01)
0304H	Same Type of Option Card Already Connected (oFC02)
0306H	A/D Conversion Error (oFC05)
0307H	Option Response Error (oFC06)
0311H	Option RAM Fault (oFC10)
0312H	Option Operation Mode Fault (SLMOD) (oFC11)
0313H	Unit Receive CRC Error (oFC12)
0314H	Unit Receive Frame Error (oFC13)

Fault Code	Fault Name	Fault Code	Fault Name
0315H	Unit Receive Abort Error (oFC14)	0354H	Encoder Communication Data Error (oFC53)
0316H	Option Receive CRC Error (oFC15)	0355H	Encoder Error (oFC54)
0317H	Option Receive Frame Error (oFC16)	0356H	Resolver Error (oFC55)
0318H	Option Receive Abort Error (oFC17)	0408H	Damping Resistor Overheat (doH)
0351H	Encoder Option AD Conversion Error (oFC50)	0409H	Snubber Discharge Resistor Overheat (SoH)
0352H	Encoder Option Analog Circuit Error (oFC51)	040AH	Internal Resistance Fault (Srr)
0353H	Encoder Communication Timeout (oFC52)		

◆ Bypass Fault Codes

Table D.4 shows the bypass fault codes that can be read out by MEMOBUS/Modbus commands from the UB-□□ monitor parameters.

Table D.4 Bypass Fault Codes

Fault Code	Fault Name	Fault Code	Fault Name
0001H	Safety Open	0009H	PL Blackout
0002H	BAS InterLock Open	000AH	No Bypass to Drive Communications
0003H	External Fault (EFB)	000BH	Bypass Board Hardware Error
0004H	NA	000CH	Option Board Communication Fault
0005H	Motor Overload	000DH	Loss of Load
0006H	Ext Motor1 Overload	000EH	Serial Communications Timeout
0007H	Ext Motor2 Overload	000FH	Input Phase Loss
0008H	PL Brownout	0010H	Input Phase Rotation

◆ Alarm Register Contents

Table D.5 shows the alarm codes that can be read out from MEMOBUS/Modbus register 007FH.

Table D.5 Alarm Register 007FH Contents

Alarm Number (Decimal)	Alarm Number (Hex)	Alarm Display	Alarm Name	Alarm Number (Decimal)	Alarm Number (Hex)	Alarm Display	Alarm Name
1	001H	Uv	Cntrl Undervolt	26	01AH	EF0	Opt External Flt
2	002H	ov	Cntrl Overvolt	27	01BH	rUn	Motor Running
3	003H	oH	Heatsnk Overtemp	29	01DH	CALL	Option ComCall
4	004H	oH2	Over Heat 2	30	01EH	UL3	Undertorq Det 1
5	005H	oL3	Overtorque Det 1	31	01FH	UL4	Undertorq Det 2
6	006H	oL4	Overtorque Det 2	32	020H	SE	Sequence Err
7	007H	EF	External Fault	34	022H	oH3	Motor Overheat 1
8	008H	bb	Base Block	39	027H	FbL	PID Fdbk Lost
9	009H	EF3	Ext Fault S3	40	028H	FbH	PID Fdbk High
10	00AH	EF4	Ext Fault S4	42	02AH	dnE	Drive not Enable
11	00BH	EF5	Ext Fault S5	43	02BH	PGoH	PG Open Hardware
12	00CH	EF6	Ext Fault S6	52	034H	HCA	HighCurrentAlarm
13	00DH	EF7	Ext Fault S7	53	035H	LT-1	Inspect Fan
14	00EH	EF8	Ext Fault S8	54	036H	LT-2	Inspect Caps
15	00FH	Fan	Cooling FAN Err	55	037H	doH	InternalResistor
16	010H	oS	Overspeed Det	57	039H	EF1	Ext Fault S1
19	013H	oPr	Oper Disconnect	58	03AH	EF2	Ext Fault S2
20	014H	CE	Serial Com Err	59	03BH	HbbF	SafeDisable Ckt
21	015H	bUS	Option Com Err	60	03CH	Hbb	SafeDisable Open
22	016H	CALL	Option ComCall	61	03DH	oL5	Mech Fatigue OL
23	017H	oL1	Motor Overloaded	62	03EH	UL5	Mech Fatigue UL
24	018H	oL2	Drive Overload	63	03FH	PA1	PLC Error 1

Alarm Number (Decimal)	Alarm Number (Hex)	Alarm Display	Alarm Name
64	040H	PA2	PLC Error 2
66	042H	TrPC	Inspect IGBT 90%
67	043H	LT-3	InspectPreCharge
68	044H	LT-4	Inspect IGBT 50%
71	047H	PF	Input Pha Loss
72	048H	oH5	Moter OverTemp
73	049H	dWAL	DWEZ Alarm
77	04DH	THo	NTC open det
78	04EH	UL6	Underload Det 6
79	04FH	WrUn	Waiting for Run
80	050H	AUv	InputUndrvoltage
81	051H	Fdv	Input Freq Dev
82	052H	SrC	Input Phase Err
85	055H	GF1	GF1 Error
99	063H	TIM	Time Not Set
100	064H	bAT	Oper Battery Low
101	065H	TdE	Time Data Err
103	067H	EoF	EmergOverrideFWD
104	068H	Eor	EmergOverrideREV
105	069H	INTLK	Interlock Open
106	06AH	SAFE	Customer Safety
107	06BH	INTLK	Interlock Open
111	06FH	SoH	Snbbr Resist OH

D.10 Enter Command

When writing parameters to the bypass from the PLC using MEMOBUS/Modbus communication, parameters become active immediately. If it is desired to save the parameter value to non-volatile memory, then a separate Enter command must be given. This section describes the Enter command.

The bypass supports the Enter command as shown in *Table C.10*. An Enter command is enabled by writing 0 to register number 0900H. It is only possible to write to this register; attempting to read from this register will cause an error.

Table D.6 Enter Command

Register No.	Description
0900H	Simultaneously writes data into the EEPROM (non-volatile memory) of the bypass 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 register is write-only and if this register is read, the register address will be invalid (Error code: 02H). An Enter command is not required when reference or broadcast data are sent to the drive.

◆ Enter Command Behavior

An enter command is not required when writing registers 0000H to 001FH and 8400H to 83FFH. Changes to those registers cannot be saved to non-volatile memory.

Enter Conditions	Behavior
How parameter settings are enabled	As soon as the value is changed.
Upper/lower limit check	Checks only the upper/lower limits of the parameters that were changed.
Default value of related parameters	Default settings of related parameters are changed automatically.
Error handling when setting multiple parameters	Error occurs if only one setting is invalid. All data that was sent are discarded.

D.11 Communication Errors

◆ MEMOBUS/Modbus Error Codes

A list of MEMOBUS/Modbus errors appears below.

When an error occurs, remove whatever caused the error and restart communications.

Error Code	Error Name / Cause
01H	Function Code Error
	Attempted to set a function code from a PLC other than 03H, 08H, and 10H.
02H	Register Number Error
	• A register number specified in the command message does not exist. • Attempted to send a broadcast message using other register numbers than 0001H or 0002H.
03H	Bit Count Error
	• Read data or write data is greater than 16 bits. Invalid command message quantity. • In a write message, the “Number of Data Items” contained within the message does not equal twice the amount of data words (i.e., the total of Data 1+ Data 2, etc.).
21H	Data Setting Error
	• Control data or parameter write data is outside the allowable setting range. • Attempted to write a contradictory parameter setting.
22H	Write Mode Error
	• During run, the user attempted to write a parameter that cannot be written to during run. • During an EEPROM memory data error (CPF06), the master attempted to write to a parameter other than A1-00 to A1-05, E1-03, or o2-04. • Attempted to write to read-only data.
23H	Power Supply Err
	During an undervoltage situation, the master attempted to write to parameters that cannot be written to during undervoltage.
24H	Write Error During Parameter Process
	Master attempted writing to the drive while the drive was processing parameter data.
25H	Writing into EEPROM Disabled
	An attempt was made to write data into EEPROM by MEMOBUS/Modbus communications when writing EEPROM is not possible. (When this error code occurs, an error message is displayed and the drive continues operation.)

◆ Slave Not Responding

In the following situations, the slave drive will ignore the command message sent from the master, and not send a response message:

- When a communications error (overrun, framing, parity, or CRC-16) is detected in the command message.
- When the slave address in the command message and the slave address in the drive do not match (remember to set the slave address for the drive using Z3-02).
- When the gap between two blocks (8-bit) of a message exceeds 24 bits.
- When the command message data length is invalid.

Note: If the slave address specified in the command message is 00H, all slaves execute the write function, but do not return response messages to the master.

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Appendix: E

Apogee FLN Network Protocol

This appendix explains the specifications and handling of the APOGEE FLN protocol for the bypass. The APOGEE FLN protocol connects the bypass to an APOGEE FLN network and facilitates the exchange of data.

E.1 APOGEE FLN Set-Up

A Yaskawa America representative is responsible for proper configuration of the bypass for its primary application, while a Siemens Building Technologies representative is responsible for field panel programming to make use of the bypass functionality in the building automation system. As such, there must be coordination between the Yaskawa America and Siemens Building Technologies representatives to ensure that the programming of the drive is consistent with the particular application requirements. After verifying that the drive installation and wiring are correct, apply power to the drive. ***Refer to Drive Communication Parameter Settings on page 386*** lists parameters and values required for proper APOGEE FLN communication and control.

◆ Bypass Parameter Settings for APOGEE FLN Communications

Table E.1 Drive Communication Parameter Settings

Parameter Number	Digital Operator Display	Settings for APOGEE FLN Communication
Z1-07	Reference Source	2: Serial Com
Z1-08	Run Source	2: Serial Com
Z3-02	Serial Comm Adr	Select the bypass address
Z3-03	Serial Baud Rate	2: 4800 Baud
Z3-01	Protocol Select	2: P1

NOTICE: *A Yaskawa representative should set the drive parameters to their appropriate values. Changes made to the parameters other than what is listed in the table above can result in damaging the drive or building equipment.*

E.2 Connecting to a Network

◆ Network Cable Connection

Follow the instructions below to connect the bypass to a MEMOBUS/Modbus network.

Note: Separate the communication cables from the main circuit cables and other wiring and power cables. Use shielded cables for the communication cables and properly shielded clamps to prevent problems from electrical interference.

- With the power shut off, connect the communications cable to the bypass controller and the master. Use the terminal TB3 for MEMOBUS/Modbus.

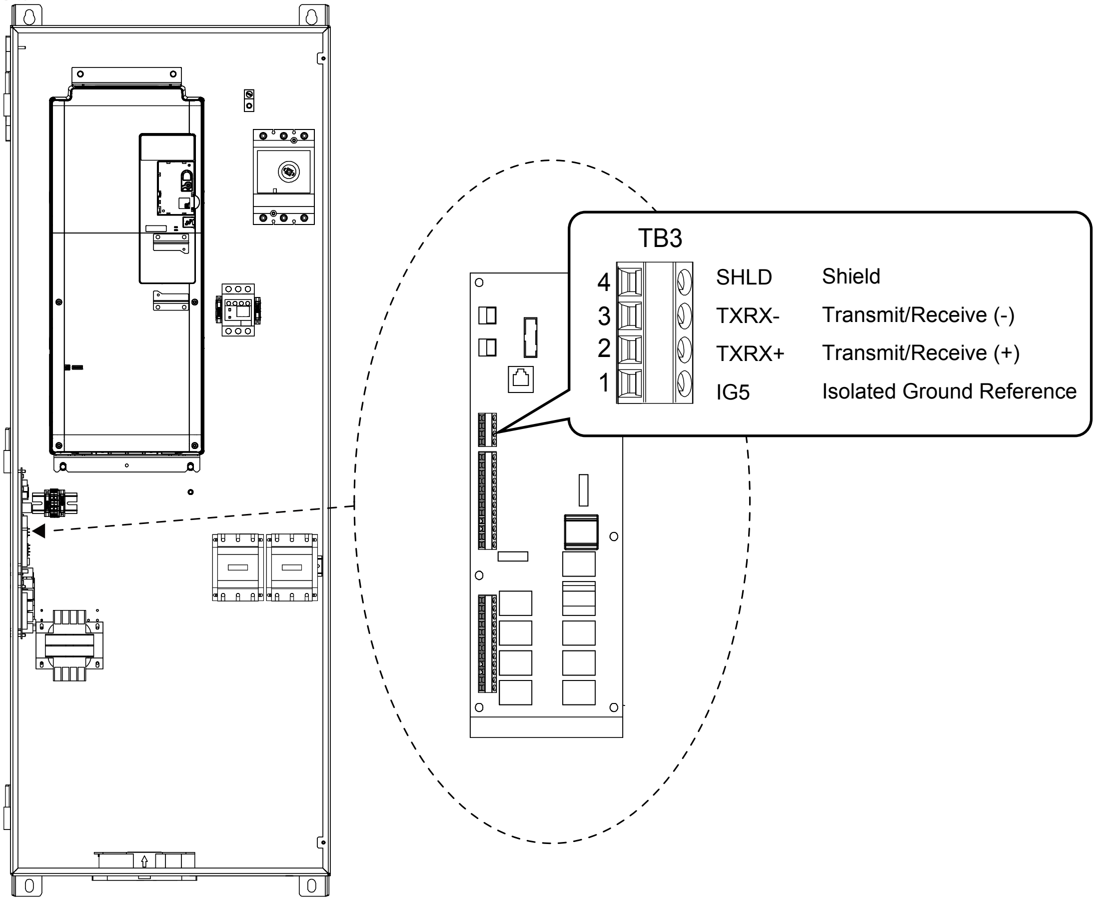


Figure E.1 Serial Communications Cable Connection Terminal (TB3)

- Check or set the termination resistor selection at all slaves. *Refer to Network Termination on page 335* for slaves that are Z1000U Bypasses.
- Apply power.
- Set parameters Z3-01 to Z3-11 needed for serial communications using the HOA keypad.
- Remove power and wait for the display on the HOA keypad to go blank.
- Reapply power.
- The bypass is now ready to begin communicating with the master.

◆ Wiring Diagram for Multiple Connections

■ RS-485 Interface

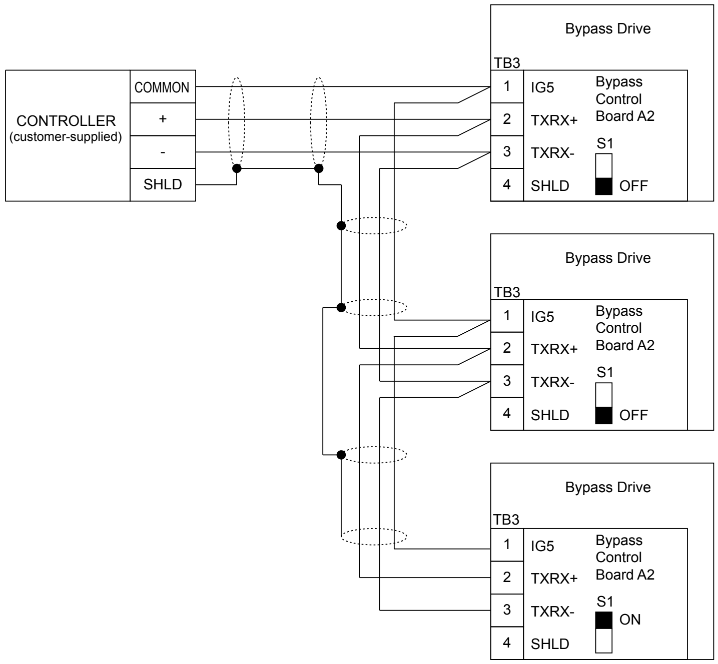


Figure E.2 Connection Diagram for Multiple Connections

Note: Turn on DIP switch S1 on the bypass controller located at the end of the network. If DIP switch S1 is missing place an external 120 ohm resistor across terminals TXRX+ and TXRX–. All other slave devices must have this DIP switch set to the OFF position (or if S1 is missing, no external resistor is used).

◆ Network Termination

The two ends of the P1 network line have to be terminated with a 120 ohm resistor between the TXRX+ and TXRX- signals. The bypass has a built in termination resistor that can be enabled or disabled using DIP switch S1. If a bypass is located at the end of a network line, enable the termination resistor by setting DIP switch S1 to the ON position. Disable the termination resistor on all slaves that are not located on the network line end.

Note: Some bypass controllers do not have DIP switch S1. If this is the case, place an external 120 ohm resistor across the TXRX+ and TXRX- signals if the bypass controller is at the end of a network line.

◆ Recommended Cable

Table E.2 APOGEE FLN Cable Specifications

Specification	Description
Cable Configuration	Twisted Shielded Pair
Gauge	18-20 AWG (Solid or Stranded)
Wire Lay	6 twists per foot
Shields	100% foil with drain wire
NEC Type	UL Type CMP
Temperature	60 °C or higher

E.3 Slope and Intercept Conversion

Several drive parameters are available for monitoring purposes. These include FREQ OUTPUT (Point 3), SPEED (Point 5), CURRENT (Point 6), TORQUE (Point 7), POWER (Point 8), DRIVE TEMP (Point 9), KWH (Point 10), and RUN TIME (Point 12). These points can be unbundled for monitoring or used in various global control strategies.

◆ Drive Controlled Feedback

The most typical application is Supervisory Control. The sensor for the control variable (e.g., water temperature) is hard-wired to the drive and the control device (fan) is modulated using the PID control loop that is built into the drive. The setpoint for the control variable (water temperature setpoint) is unbundled and commanded by the field panel, based on some building control strategy implemented in PPCL.

When this strategy is used, the point to unbundle and command for the setpoint is INPUT REF 1 (Point 60). The control variable (e.g., water temperature) can be monitored by unbundling PID FEEDBACK (Point 62). These points are provided in units of percent, where 0% and 100% correspond to the range of the sensor being used to measure the control variable. These points have default units in Hz. If other units are required, unbundle these points with appropriate slopes and intercepts. The new intercept will be equal to the lowest value of the desired range. You can define a new slope and intercept using the formula below to convert the units:

$$\text{New Slope} = \frac{\text{(Desired Range) x (Slope of Existing Point)}}{\text{(Range of Existing Point)}}$$

$$\text{New Slope} = \frac{\text{(60 - 0)Hz x (0.01)}}{\text{(100 - 0)\%}} = 0.006$$

Conversion Example

You are controlling water temperature from a cooling tower using the drive to control a fan. The temperature sensor has a range of 30 °F to 250 °F. To unbundle the setpoint (INPUT REF 1), for commanding in degrees Fahrenheit, where 0 to 60 Hz is equal to 30 °F to 250 °F:

New Intercept = 30 (the temperature that corresponds to 0%)

$$\text{New Slope} = \frac{\text{(Desired Range) x (Slope of Existing Point)}}{\text{(Range of Existing Point)}}$$

$$\text{New Slope} = \frac{\text{(250 - 30)°F x (0.1)}}{\text{(100 - 0)\%}} = 0.022$$

Formula Notes:

Desired Range = Range Maximum – Range Minimum

Range of Existing Point = Existing Range Maximum – Existing Range Minimum

◆ Field Panel Controlled Feedback

In this strategy, the sensor is connected to the APOGEE FLN network at a remote location, and the control loop is executed in PPCL. The drive speed command is passed from the field panel to the drive by commanding INPUT REF 1 (Point 60).

NOTICE: *This strategy is not recommended because the loop is being closed over the network. Delays from processor scan time and network traffic can cause degradation or loss of control. Damage to HVAC equipment may result.*

Unbundle the FEEDBACK

To unbundle the feedback (PID FEEDBACK) for monitoring in degrees Fahrenheit:

New Intercept = 30

$$\text{New Slope} = \frac{\text{(Desired Range) x (Slope of Existing Point)}}{\text{(Range of Existing Point)}}$$

$$\text{New Slope} = \frac{\text{(250 - 30)°F x (0.1)}}{\text{(100 - 0)\%}} = 0.022$$

Formula Notes:

Desired Range = Range Maximum – Range Minimum

Range of Existing Point = Existing Range Maximum – Existing Range Minimum

◆ Other Functionality

Each of the following functions must be enabled during drive startup:

Enable the drive to run

RUN ENABLE (Point 35) can be commanded to require the drive to have a physical input (DI-2) set before the drive can run. This works in conjunction with CMD RUN.STOP (Point 24) or the CMD REV.STOP (Point 22). If RUN ENABLE (Point 35) is commanded ON then terminal for DI-2 does not need to be on and CMD RUN.STOP (Point 24) or CMD REV.STOP (point 22) needs to be commanded ON for the drive to run. If, on the other hand, RUN ENABLE (Point 35) is commanded OFF, then to run the drive the input terminal for DI-3 needs to be on and either CMD RUN.STOP (Point 24) or CMD REV.STOP (Point 22), needs to be commanded ON.

Start and stop the drive

CMD RUN.STOP (Point 24) can be commanded to run the bypass in the forward direction. STOP.RUN (Point 23) shows the current status of the bypass.

Change directions

CMD REV.STOP (Point 22) can be commanded to run the drive in the reverse direction (ignored in Bypass Mode). FWD.REV (Point 21) shows the current direction of the drive rotation.

NOTICE: *Improper drive direction may damage HVAC equipment if parameter b1-04, Reverse Enable, is improperly set (b1-04 = 0).*

Digital Outputs

MULTI OUT 1 (Point 40), MULTI OUT 2 (Point 41), and MULTI OUT 3 (Point 42) are physical digital outputs on the bypass (DO-7 through DO-9). Their purpose depends on how the bypass has been set-up. The bypass can be programmed so that these points can display various limits, warnings, and status conditions. Some examples include HOA state, Drive or Bypass Mode, Fault Active, and Loss of Load detected.

Loop gain

PID P GAIN (Point 63) and PID I TIME (Point 64) are the gain and integral time parameters similar to the P and I gains in the APOGEE Terminal Equipment Controllers. The bypass PID loop is structured differently than the Siemens loop, so there is not a one-to-one correspondence between the gains.

Reading and resetting faults

OK.FAULT (Point 93) shows the current status of the bypass. FAULT CODE (Point 17) contains the code for the most current fault. LST FLT CODE (Point 66) contains the code for the previous drive fault. See table below for descriptions of the fault codes. The drive can be reset back to OK mode by commanding RESET FAULT (Point 94) to RESET.

E.4 APOGEE FLN Point List Summary

This database is for APOGEE FLN Application 2721 and features 97 logical points: 29 Logical Analog Inputs (LAI), 35 Logical Analog Outputs (LAO), 19 Logical Digital Inputs (LDI) and 14 Logical Digital Outputs (LDO). These points configure, control or monitor the operation of the drive.

Information to consider when referencing this table:

- Points not listed are not used in this application.
- A single value in a column means that the value is the same in English units and in SI units.
- Point numbers that appear in curly brackets, e.g. {03}, can be unbundled at the field panel.

Table E.3 APOGEE FLN Application 2721 Point Number Summary

Point No.	Point Type	Point Name	Factory Default (SI Units)	Engr. Units (SI Units)	Slope (SI Units)	Intercept (SI Units)	On Text	Off Text	Z1000U Parameter
1	LAO	CTLR ADDRESS	31	–	1	0	–	–	Z3-02
2	LAO	APPLICATI ON	–	–	1	0	–	–	–
{03}	LAI	FREQ OUTPUT	0	HZ	0.01	0	–	–	U1-02
{04}	LAI	PCT OUTPUT	0	PCT	0.01	0	–	–	–
{05}	LAI	SPEED	0	RPM	1	0	–	–	–
{06}	LAI	CURRENT	0	AMPS (A)	0.01/0.1 <1>	0	–	–	UB-01
{07}	LAI	TORQUE	0	PCT	0.1	0	–	–	–
{08}	LAI	POWER	0	KW	0.01/0.1 <1>	0	–	–	U1-08
{09}	LAI	DRIVE TEMP	0	DEG F / C	1	0	–	–	U4-08
{10}	LAI	DRIVE KWH	0	KWH	0.1	0	–	–	U4-10
{11}	LAI	MWH	0	MWH	1	0	–	–	U4-11
{12}	LAI	RUN TIME	0	HRS	1	0	–	–	U4-01
{13}	LAI	DC BUS VOLT	0	VOLTS (V)	1	0	–	–	U1-07
{14}	LAI	AC OUT VOLT	0	VOLTS (V)	0.1	0	–	–	U1-06
15	LAI	PAR N9.01	0	AMPS (A)	0.01/0.1 <1>	0	–	–	n9-01
{16}	LAI	RUN TIMEX10K	0	10K HR	1	0	–	–	U4-01
{17}	LAI	FAULT CODE	0	–	1	0	–	–	U2-01/ UB-09
{18} <2>	LDI	MINOR FLT	NO FLT	–	1	0	FAULT	NO FLT	U1-12 (Bit 6)
{19}	LDI	MAJOR FLT	NO FLT	–	1	0	FAULT	NO FLT	UB-06 (Bit 2)
20	LAO	OVRD TIME	1	HRS	1	0	–	–	–
{21}	LDI	FWD.REV	FWD	–	1	0	REV	FWD	U1-12 (Bit 2)
{22}	LDO	CMD REV.STOP	STOP	–	1	0	REV	STOP	–
{23}	LDI	RUN.STOP	STOP	–	1	0	RUN	STOP	UB-06 (Bit 1)
{24}	LDO	CMD RUN.STOP	STOP	–	1	0	FWD	STOP	–
{25}	LDI	ZERO SPEED	OFF	–	1	0	ON	OFF	U1-12 (Bit 1)
{26}	LDI	SPEED AGREE	NO AGR	–	1	0	AGREE	NO AGR	U1-12 (Bit 4)
{27}	LDI	DRIVE READY	NOTRDY	–	1	0	READY	NOTRDY	U1-12 (Bit 5)

Point No.	Point Type	Point Name	Factory Default (SI Units)	Engr. Units (SI Units)	Slope (SI Units)	Intercept (SI Units)	On Text	Off Text	Z1000U Parameter
{28}	LDI	LOC.REM MON	REMOTE	–	1	0	LOCAL	REMOTE	UB-05
{29}	LDO	DAY.NGT	DAY	–	1	0	NGT	DAY	–
30	LAO	CURRENT LMT	0	AMPS (A)	0.01/0.1 <1>	0	–	–	E2-01
31	LAO	ACCEL TIME	0	SEC	0.1	0	–	–	C1-01
32	LAO	DECEL TIME	0	SEC	0.1	0	–	–	C1-02
33	LDO	LOCK PANEL	UNLOCK	–	1	0	LOCK	UNLOCK	–
35 <3>	LDO	RUN ENABLE	STOP	–	1	0	ENABLE	STOP	Bypass DI-2
36	LAO	STALL PRE RN	90	PCT	1	30	–	–	L3-06
37	LAO	STALL PRE AC	120	PCT	1	0	–	–	L3-02
38	LAO	FREQ UP LIM	100	PCT	0.1	0	–	–	d2-01
39	LAO	FREQ LOW LIM	0	PCT	0.1	0	–	–	d2-02
{40}	LDI	MULTI OUT 1	OFF	–	1	0	ON	OFF	UB-03 (Bit 6) Bypass DO-7
{41}	LDI	MULTI OUT 2	OFF	–	1	0	ON	OFF	UB-03 (Bit 7) Bypass DO-8
{42}	LDI	MULTI OUT 3	OFF	–	1	0	ON	OFF	UB-03 (Bit 8) Bypass DO-9
{43}	LDI	SAFETY ILOCK	OFF	–	1	0	ON	OFF	UB-05 (Bit 7)
{44} <4>	LDO	MF INP 1	OFF	–	1	0	ON	OFF	Bypass DI-3
{45} <4>	LDO	MF INP 2	OFF	–	1	0	ON	OFF	Bypass DI-4
{46} <4>	LDO	MF INP 3	OFF	–	1	0	ON	OFF	Bypass DI-5
{47} <4>	LDO	MF INP 4	OFF	–	1	0	ON	OFF	Bypass DI-6
{48} <4>	LDO	MF INP 5	OFF	–	1	0	ON	OFF	Bypass DI-7
49	LAO	JUMP FREQ 1	0	HZ	0.1	0	–	–	d3-01
50	LAO	JUMP FREQ 2	0	HZ	0.1	0	–	–	d3-02
51	LAO	JUMP FREQ 3	0	HZ	0.1	0	–	–	d3-03
52	LAO	JUMP FREQ BW	0	HZ	0.1	0	–	–	d3-04
53	LAO	NUM AUTOSTRT	0	–	1	0	–	–	L5-01
54	LAO	POWER LOSS RT	0.1	SEC	0.1	0	–	–	L2-02
55	LAO	RUN OP MODE	1	–	1	0	–	–	Z1-08
56	LAO	REF OP MODE	1	–	1	0	–	–	Z1-07
57	LAO	OPER DISP MD	0	–	1	0	–	–	o1-03
{58}	LDI	MF IN 1 MON	OFF	–	1	0	ON	OFF	UB-02 (Bit 2) Bypass DI-3
{59}	LDI	MF IN 2 MON	OFF	–	1	0	ON	OFF	UB-02 (Bit 3) Bypass DI-4

Point No.	Point Type	Point Name	Factory Default (SI Units)	Engr. Units (SI Units)	Slope (SI Units)	Intercept (SI Units)	On Text	Off Text	Z1000U Parameter
{60}	LAO	INPUT REF 1	0	HZ	0.01	0	–	–	–
61	LAO	INPUT REF 2	0	HZ	0.01	0	–	–	d1-02
{62}	LAI	PID FEEDBACK	0	PCT	0.01	0	–	–	U5-01
63	LAO	PID P GAIN	2	–	0.01	0	–	–	b5-02
64	LAO	PID I TIM	0.5	SEC	0.1	0	–	–	b5-03
65	LDO	PID MODE SEL	DISABLE	–	1	0	ENABLE	DISABLE	b5-01
{66}	LAI	LST FLT CODE	0	–	1	0	–	–	U2-02
{67}	LAI	FREF.FLT	0	HZ	0.01	0	–	–	U2-03
{68}	LAI	OUT FREQ FLT	0	HZ	0.01	0	–	–	U2-04
{69}	LAI	OUT CUR.FLT	0	AMPS (A)	0.01	0	–	–	U2-05
70	LAO	RD PARAM NUM	1	–	1	0	–	–	–
71	LAI	RD PARAM DAT	0	–	1	0	–	–	–
72	LAO	WR PARAM NUM	1	–	1	0	–	–	–
73	LAO	WR PARAM DAT	0	–	1	0	–	–	–
{74}	LDI	MF IN 3 MON	OFF	–	1	0	ON	OFF	UB-02 (Bit 4) Bypass DI-5
{75}	LAI	OUT VOLT.FLT	0	VOLTS (V)	0.1	0	–	–	U2-07
{76}	LAI	DC BUS.FLT	0	VOLTS (V)	1	0	–	–	U2-08
{77}	LAI	OUT PWR.FLT	0	KW	0.1	0	–	–	U2-09
{78}	LDI	MF IN 4 MON	OFF	–	1	0	ON	OFF	UB-02 (Bit 5) Bypass DI-6
{79}	LAI	PID DEVIATE	0	PCT	0.01	0	–	–	U5-02
80	LAO	PID I LIMIT	100	PCT	0.1	0	–	–	b5-04
81	LAO	PID UP LIMIT	100	PCT	0.1	0	–	–	b5-06
82	LAO	PID OFFS ADJ	100	PCT	0.1	-100	–	–	b5-07
83	LAO	PID PRI DYTM	0	SEC	0.1	0	–	–	b5-08
84	LAO	PID FB RMDS	0	–	1	0	–	–	b5-12
85	LAO	PID FB RMDL	0	PCT	1	0	–	–	b5-13
86	LAO	PID FB RMDT	1	SEC	0.1	0	–	–	b5-14
{87}	LAI	PID OUT CAP	0	PCT	0.01	0	–	–	U5-14
{88}	LAI	PID REF	0	PCT	0.01	0	–	–	U5-04
{89}	LAI	COMM ERR CD	0	–	1	0	–	–	U1-19
90	LDO	COMM FLT ENA	ENABLE	–	1	0	ENABLE	DISABLE	Z3-11

E.4 APOGEE FLN Point List Summary

Point No.	Point Type	Point Name	Factory Default (SI Units)	Engr. Units (SI Units)	Slope (SI Units)	Intercept (SI Units)	On Text	Off Text	Z1000U Parameter
91	LAO	CBL LOSS FRQ	0	HZ	0.01	0	–	–	Z3-10
92	LAO	CBL LOSS TMR	2	SEC	0.1	0	–	–	Z3-06
{93}	LDI	OK.FAULT	OK	–	1	0	FAULT	OK	UB-06 (Bit 2)
{94}	LDO	RESET FAULT	NO	–	1	0	RESET	NO	–
{95}	LDI	DRV COMM ERR	NO FLT	–	1	0	FAULT	NO FLT	–
{96}	LDO	EXTERNAL FLT	OK	–	1	0	FAULT	OK	–
{97}	LDI	MF IN 5 MON	OFF	–	1	0	ON	OFF	UB-02 (Bit 6) Bypass DI-7
{99}	LAI	ERROR STATUS	0	–	1	0	–	–	–

<1> The number of decimal places in the value depends on the bypass model.

<2> Point LDI 18 displays both drive alarms and bypass alarms.

<3> Set Z2-02 to 22 (Run Enable) for point 35 to work properly.

<4> Disabled when Z3-12 is set to 0.

E.5 Cable Loss Configuration and Behavior

This section describes the configurable cable loss feature of the drive. This feature offers a user maximum flexibility in determining drive response to a loss of communication.

◆ Drive Behavior at Loss of Communication

After some interval without receipt of a message, the drive can be configured to respond in one of the following manners:

- Continue at last speed
- Continue at last speed with Alarm
- Continue at preset speed
- Ramp to Stop with FB14 fault
- Coast to Stop with FB14 fault
- Emergency Stop with FB14 fault

◆ Apogee FLN Points

Three APOGEE FLN points are used to select the desired behavior:

- **POINT 92** – CBL LOSS TMR
- **POINT 91** – CBL LOSS FRQ
- **POINT 90** – COMM FLT ENA

Table E.4 Cable Loss Behavior Summary

Behavior	F6-03	Z3-05	CBL LOSS TMR (Point 92)	CBL LOSS FRQ (Point 91)	COMM FLT ENA (Point 90)
Decelerate to stop (stop time in C1-02) **FB14 Fault.** **Note:** In Bypass Mode, bypass contactor will open and motor will coast to stop.	0	3	Timeout Interval	X	On
Coast to stop **FB14 Fault.** **Note:** In Bypass Mode, bypass contactor will open and motor will coast to stop.	1	3	Timeout Interval	X	On
Fast stop (stop time in C1-09) **FB14 Fault**. **Note:** In Bypass Mode, bypass contactor will open and motor will coast to stop.	2	3	Timeout Interval	X	On
Continue at last speed	3	0	0	X	X
Continue at last speed with Alarm	3	1	Timeout Interval	X	On
Continue at preset speed with Alarm	3	4	Timeout Interval	Preset Speed	On

Note:
1. Communication must first be established and then lost for these features to function as described. If a bypass is powered-up without a cable connected or with the master controller offline, a communications timeout does not occur.
2. For modes which describe the bypass running after a communications timeout, a run command must have been issued (RUN ENABLE (Point 35) = 'On' and either CMD RUN.FWD (Point 22) = 'On' or CMD RUN.REV (Point 24) = 'On') prior to loss of communications. For safety purposes, the drive will not automatically restart from a stopped condition. If a user requires the drive to restart automatically, additional external wiring is required to accomplish this (consult factory).

Upon expiration of the communications timeout interval, a CE (Communication Error) fault will be declared and will remain until communication is restored.

Continue at Last Speed

In this mode, CBL LOSS TMR (POINT 92) is set to 0, disabling the cable loss feature. The other two settings CBL LOSS FRQ (POINT 91) and COMM FLT ENA (POINT 90) are ignored. If communication is lost, the drive maintains its last commanded state. The drive will not display an alarm or fault to indicate it has lost communication. This behavior can also be achieved by setting parameter Z3-05 to 0.

Continue at Last Speed with Alarm

For this condition, COMM FLG ENA (Point 90) must be enabled and CBL LOSS TMR (Point 91) should be set to something other than 0. An AL14 Serial Communications Alarm is shown.

Continue at Preset Speed with Alarm

In this mode, CBL LOSS TMR (POINT 92) is set to the desired interval, CBL LOSS FRQ (POINT 91) is set to the desired preset speed and Z3-05 is set to 4. If the time between messages exceeds the timeout interval, the drive speed command, INPUT REF 1, (Point 60) is set to the CBL LOSS FRQ (POINT 91) and the drive continues running at this new speed. COMM FLT ENA (POINT 90) must be set to ON.

Stop with Fault (FB14)

COMM FLT ENA (POINT 90) must be set to ON. In this mode, CBL LOSS TMR (POINT 92) is set to the desired interval and parameter F6-03 is set to a value of 0,1, or 2. If the time between messages exceeds the timeout interval, the drive speed command, INPUT REF 1, (Point 60) is set to 0. The stopping method is determined by the setting of F6-03. An FB14 drive fault will be set and an EF0 will be sent to the drive. The drive behavior is determined by the setting of parameter F6-03.

- F6-03 = 0 selects Ramp to Stop. The deceleration time or the slope of the ramp is determined by the setting of drive parameter C1-02.
- F6-03 = 1 selects Coast to Stop. The drive does not attempt to control the rate of deceleration.
- F6-03 = 2 selects Fast Stop. The deceleration time is determined by the setting of drive parameter C1-09.

E.6 Mailbox Function

◆ Mailbox Function Points

■ Reading a Drive Parameter

Two points are defined for reading any drive parameter:

- Point 70 specifies the parameter to be read from
- Point 71 reports the value of the parameter specified in Point 70

When this point is read, it retrieves data from the parameter and sends it to the controller.

Example:

Writing a value of 387 (183 hex) to Point 70 specifies drive parameter b1-04. Reading Point 71 returns the current setting of parameter b1-04 to the controller.

■ Writing to a Drive Parameter

Two points are defined for writing to any drive parameter:

- Point 72 specifies the parameter to be written to
- Point 73 is the entry location of the value to be written to the parameter specified in Point 72

When this point is written to, it will write the value to the drive. An enter or accept command does not need to be sent for the data to be taken by the drive. The behavior of the write is the same as with the HOA keypad. If the drive is running, there are a limited number of drive parameters that can be written to.

Example:

Writing a value of 387 (183 hex) to Point 72 specifies drive parameter b1-04. Writing a value of 1 to Point 73 enables the drive for reverse run.

E.7 Fault Codes

◆ Communications Fault

Table E.5 Drive Faults

Fault	Description	Cause	Corrective Action
FB14	FB14 Communication Error	Connection is broken or master has stopped communicating	Check all connections Verify all APOGEE FLN software configurations

◆ Bypass Faults–Apogee FLN Configuration

Table E.6 Bypass Faults

Fault Number (Decimal)	Fault Number (Hex)	Fault Name	Fault Number (Decimal)	Fault Number (Hex)	Fault Name
0	0000H	No Fault	66	0042H	EF1 - Ext Fault S1
1	0001H	PUF - DC Bus Fuse Open	67	0043H	EF2 - Ext Fault S2
2	0002H	Uv1 - Cntrl Undervolt	68	0044H	OL5 - Mech Fatigue OL
3	0003H	Uv2 - CTL PS Undervolt	69	0045H	UL5 - Mech Fatigue UL
4	0004H	Uv3 - MC Answerback	70	0046H	CoF - Current Offset
6	0006H	GF - Ground Fault	71	0047H	PE1 - PLC Fault 1
7	0007H	oC - Over Current	72	0048H	PE2 - PLC Fault 2
8	0008H	ov - Cntrl Overvolt	73	0049H	DWFL - DWEZ Fault
9	0009H	oH - Heatsnk Overtemp	74	004AH	DWF1 - DWEZ EEPROM Flt
10	000AH	oH1 - Heatsnk MAX Temp	80	0050H	OH5 - Moter OverTemp
11	000BH	oL1 - Motor Overloaded	81	0051H	LSo - Low Speed STO
12	000CH	oL2 - Drive Overload	90	005AH	UL6 - Underload Det 6
13	000DH	oL3 - Overtorque Det 1	91	005BH	DV7 - Pole Dis T Over
14	000EH	oL4 - Overtorque Det 2	92	005CH	GF1 - GF1 Error
17	0011H	EF3 - Ext Fault S3	102	0066H	AUv - InputUndrvoltage
18	0012H	EF4 - Ext Fault S4	103	0067H	Aov - InputOvervoltage
19	0013H	EF5 - Ext Fault S5	104	0068H	Fdv - Input Freq Dev
20	0014H	EF6 - Ext Fault S6	105	0069H	SrC - Input Phase Err
21	0015H	EF7 - Ext Fault S7	131	0083H	CPF02 - Internal A/D Err
22	0016H	EF8 - Ext Fault S8	132	0084H	CPF03 - CPU Serial Err
23	0017H	FAn - Cooling FAN Err	134	0086H	CPF05 - CPU adjust Err
24	0018H	oS - Overspeed Det	135	0087H	CPF06 - EEPROM Error
28	001CH	LF - Output Pha Loss	136	0088H	CPF07 - Term Serial Err
29	001DH	oH3 - Motor Overheat 1	137	0089H	CPF08 - EEPROM Error
30	001EH	oPr - Oper Disconnect	138	008AH	CPF09 - EEPROM Error
31	001FH	Err - EEPROM R/W Err	140	008CH	CPF11 - RAM-Err
32	0020H	oH4 - Motor Overheat 2	141	008DH	CPF12 - ROM-Err
33	0021H	CE - Serial Com Err	142	008EH	CPF13 - Watchdog Error
34	0022H	bUS - Option Com Err	143	008FH	CPF14 - Ctrl Circuit Err
35	0023H	E-15 - SI-F/G Com Err	145	0091H	CPF16 - CLK-Err
36	0024H	E-10 - SI-F/G CPU down	146	0092H	CPF17 - Interrupt Err
37	0025H	CF - Control Fault 1	147	0093H	CPF18 - Ctrl circuit Err
39	0027H	EF0 - Opt External Flt	148	0094H	CPF19 - Ctrl circuit Err
40	0028H	FbL - Feedback Loss	149	0095H	CPF20 - CPU-Err
41	0029H	UL3 - Undertorq Det 1	150	0096H	CPF21 - CPU-Err
42	002AH	UL4 - Undertorq Det 2	151	0097H	CPF22 - Internal A/D Err
59	003BH	SEr - Search Retry Err	152	0098H	CPF23 - 2 CPU COM Err
65	0041H	FbH - PID Fdbk High	153	0099H	CPF24 - US Signal Error

Fault Number (Decimal)	Fault Number (Hex)	Fault Name
154	009AH	CPF25 - No Tmnl card
155	009BH	CPF26 - BB Circuit ERR
156	009CH	CPF27 - PWM Set Reg ERR
157	009DH	CPF28 - PWM Pattern ERR
158	009EH	CPF29 - On-Delay ERR
159	009FH	CPF30 - BB On ERR
160	00A0H	CPF31 - ASIC Code ERR
161	00A1H	CPF32 - ASIC Startup ERR
162	00A2H	CPF33 - Watch-dog ERR
163	00A3H	CPF34 - Power/Clock ERR
164	00A4H	CPF35 - Ext A/D Conv ERR
257	0101H	oFA00 - Not supported
258	0102H	oFA01 - Connection error
259	0103H	oFA02 - DuplicateOptions
260	0104H	oFA03 - Diagnostic Err
261	0105H	oFA04 - Flash Write Mode
262	0106H	oFA05 - Opt A/D ERR
263	0107H	oFA06 - Opt Comm ERR
273	0111H	oFA10 - Opt RAM ERR
274	0112H	oFA11 - Opt Ope Mode ERR
275	0113H	oFA12 - DRV RCV CRC ERR
276	0114H	oFA13 - DRV RCV FrameERR
277	0115H	oFA14 - DRV RCV AbortERR
278	0116H	oFA15 - Opt RCV CRC ERR
279	0117H	oFA16 - Opt RCV FrameERR
280	0118H	oFA17 - Opt RCV AbortERR
305	0131H	oFA30 - COM ID Error
306	0132H	oFA31 - Type code Error
307	0133H	oFA32 - SUM Chk Error
308	0134H	oFA33 - OPT R TimeOver
309	0135H	oFA34 - MemobusTimeOver
310	0136H	oFA35 - INV R TimeOver 1
311	0137H	oFA36 - CI Chk Error
312	0138H	oFA37 - INV R TimeOver 2
313	0139H	oFA38 - Ctrl Ref Error
314	013AH	oFA39 - INV R TimeOver 3
315	013BH	oFA40 - CtrlResSel 1Err
316	013CH	oFA41 - INV R TimeOver 4
317	013DH	oFA42 - CtrlResSel 2Err
318	013EH	oFA43 - INV R TimeOver 5
337	0151H	oFA50 - EncOp A/D CnvErr
338	0152H	oFA51 - EncOpAnlgCrctErr
339	0153H	oFA52 - Enc Com Timeout
340	0154H	oFA53 - Enc Com Data Flt
341	0155H	oFA54 - Encoder Error
342	0156H	oFA55 - Resolver Error
512	0200H	oFB - Not supported
513	0201H	oFB00 - Not supported
514	0202H	oFB01 - Connection error

Fault Number (Decimal)	Fault Number (Hex)	Fault Name
515	0203H	oFB02 - DuplicateOptions
516	0204H	oFB03 - Diagnostic Err
517	0205H	oFB04 - Flash Write Mode
518	0206H	oFB05 - Opt A/D ERR
519	0207H	oFB06 - Opt Comm ERR
529	0211H	oFB10 - Opt RAM ERR
530	0212H	oFB11 - Opt Ope Mode ERR
531	0213H	oFB12 - DRV RCV CRC ERR
532	0214H	oFB13 - DRV RCV FrameERR
533	0215H	oFB14 - DRV RCV AbortERR
534	0216H	oFB15 - Opt RCV CRC ERR
535	0217H	oFB16 - Opt RCV FrameERR
536	0218H	oFB17 - Opt RCV AbortERR
561	0231H	oFB30 - COM ID Error
562	0232H	oFB31 - Type code Error
563	0233H	oFB32 - SUM Chk Error
564	0234H	oFB33 - OPT R TimeOver
565	0235H	oFB34 - MemobusTimeOver
566	0236H	oFB35 - INV R TimeOver 1
567	0237H	oFB36 - CI Chk Error
568	0238H	oFB37 - INV R TimeOver 2
569	0239H	oFB38 - Ctrl Ref Error
570	023AH	oFB39 - INV R TimeOver 3
571	023BH	oFB40 - CtrlResSel 1Err
572	023CH	oFB41 - INV R TimeOver 4
573	023DH	oFB42 - CtrlResSel 2Err
574	023EH	oFB43 - INV R TimeOver 5
593	0251H	oFB50 - EncOp A/D CnvErr
594	0252H	oFB51 - EncOpAnlgCrctErr
595	0253H	oFB52 - Enc Com Timeout
596	0254H	oFB53 - Enc Com Data Flt
597	0255H	oFB54 - Encoder Error
598	0256H	oFB55 - Resolver Error
768	0300H	oFC - Not supported
769	0301H	oFC00 - Not supported
770	0302H	oFC01 - Connection error
771	0303H	oFC02 - DuplicateOptions
772	0304H	oFC03 - Diagnostic Err
773	0305H	oFC04 - Flash Write Mode
774	0306H	oFC05 - Opt A/D ERR
775	0307H	oFC06 - Opt Comm ERR
785	0311H	oFC10 - Opt RAM ERR
786	0312H	oFC11 - Opt Ope Mode ERR
787	0313H	oFC12 - DRV RCV CRC ERR
788	0314H	oFC13 - DRV RCV FrameERR
789	0315H	oFC14 - DRV RCV AbortERR
790	0316H	oFC15 - Opt RCV CRC ERR
791	0317H	oFC16 - Opt RCV FrameERR
792	0318H	oFC17 - Opt RCV AbortERR

E.7 Fault Codes

Fault Number (Decimal)	Fault Number (Hex)	Fault Name
817	0331H	oFC30 - COM ID Error
818	0332H	oFC31 - Type code Error
819	0333H	oFC32 - SUM Chk Error
820	0334H	oFC33 - OPT R TimeOver
821	0335H	oFC34 - MemobusTimeOver
822	0336H	oFC35 - INV R TimeOver 1
823	0337H	oFC36 - CI Chk Error
824	0338H	oFC37 - INV R TimeOver 2
825	0339H	oFC38 - Ctrl Ref Error
826	033AH	oFC39 - INV R TimeOver 3
827	033BH	oFC40 - CtrlResSel 1Err
828	033CH	oFC41 - INV R TimeOver 4
829	033DH	oFC42 - CtrlResSel 2Err
830	033EH	oFC43 - INV R TimeOver 5
849	0351H	oFC50 - EncOp A/D CnvErr
850	0352H	oFC51 - EncOpAnlgCrctErr
851	0353H	oFC52 - Enc Com Timeout
852	0354H	oFC53 - Enc Com Data Flt
853	0355H	oFC54 - Encoder Error
854	0356H	oFC55 - Resolver Error
1025	0401H	TIM - Time Not Set
1026	0402H	BAT - Oper Battery Low
1027	0403H	TDE - Time Data Err
1028	0404H	TIE - TimeIntervalErr

Fault Number (Decimal)	Fault Number (Hex)	Fault Name
1032	0408H	doH - InternalResistor
1033	0409H	SoH - Snbbr Resist OH
1034	040AH	Srr - Snbbr Resist Err
1039	040FH	SCF - Safe Circuit Err
10001	2711H <1>	FB01 - Safety Open
10002	2712H <1>	FB02 - BAS Ilock TO
10003	2713H <1>	FB03 - External EFB
10004	2714H <1>	FB04 - Smoke Purge Drv
10005	2715H <1>	FB05 - Motor Overload
10006	2716H <1>	FB06 - Ext Motor1 OL
10007	2717H <1>	FB07 - Ext Motor2 OL
10008	2718H <1>	FB08 - PL Brownout
10009	2719H <1>	FB09 - PL Blackout
10010	271AH <1>	FB10 - No Drive Comms
10011	271BH <1>	FB11 - Bypass Bd HW Err
10012	271CH <1>	FB12 - Option Bd Comms
10013	271DH <1>	FB13 - Loss of Load
10014	271EH <1>	FB14 - Serial Comm Flt
10015	271FH <1>	FB15 - Input Phase Loss
10016	2720H <1>	FB16 - Inp Phs Rotation
10017	2721H <1>	FB17 - Load Lost

<1> Displayed by P1 Apogee Point LAI 17.

Appendix: F

Metasys N2 Network Protocol

F.1 N2 Specifications and Configuration

The bypasses can be monitored and controlled by a controller on a Metasys N2 network (N2) using RS-485 technology. The bypass act as slaves on the N2 network.

Up to 255 bypasses can communicate on a single N2 network. If more bypasses or N2 devices are required, another N2 network is required.

The N2 node address is configurable by a parameter in the bypass. This defines the physical address of the bypass on the N2 network.

Once the addressing is set, a controller can initiate communication to the bypass. The bypass will perform the specified function and then send a response back to the controller.

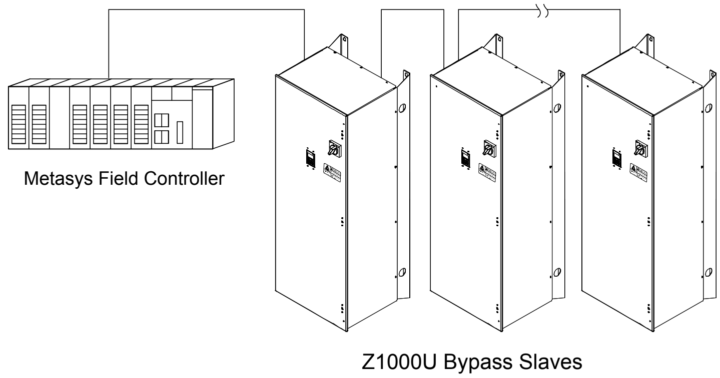


Figure F.1 Connecting Multiple Bypasses to a Metasys N2 Network

N2 specifications appear in the following table:

Item	Specifications
Interface	RS-485
Communication Parameters	Communication Speed: 9600 bps Data Length: 8-bit (fixed) Parity: None Stop Bit: 1-bit (fixed)
Protocol	Metasys N2
Max Number of Drives	255 per N2 Network Segment

F.2 Connecting to a Network

This section explains how to connect the drive to an N2 network and the network termination required for a connection.

◆ Network Cable Connection

Follow the instructions below to connect the bypass to a N2 network.

1. With the power shut off, connect the communications cable to the bypass controller and the master. Use terminal TB3 for N2.

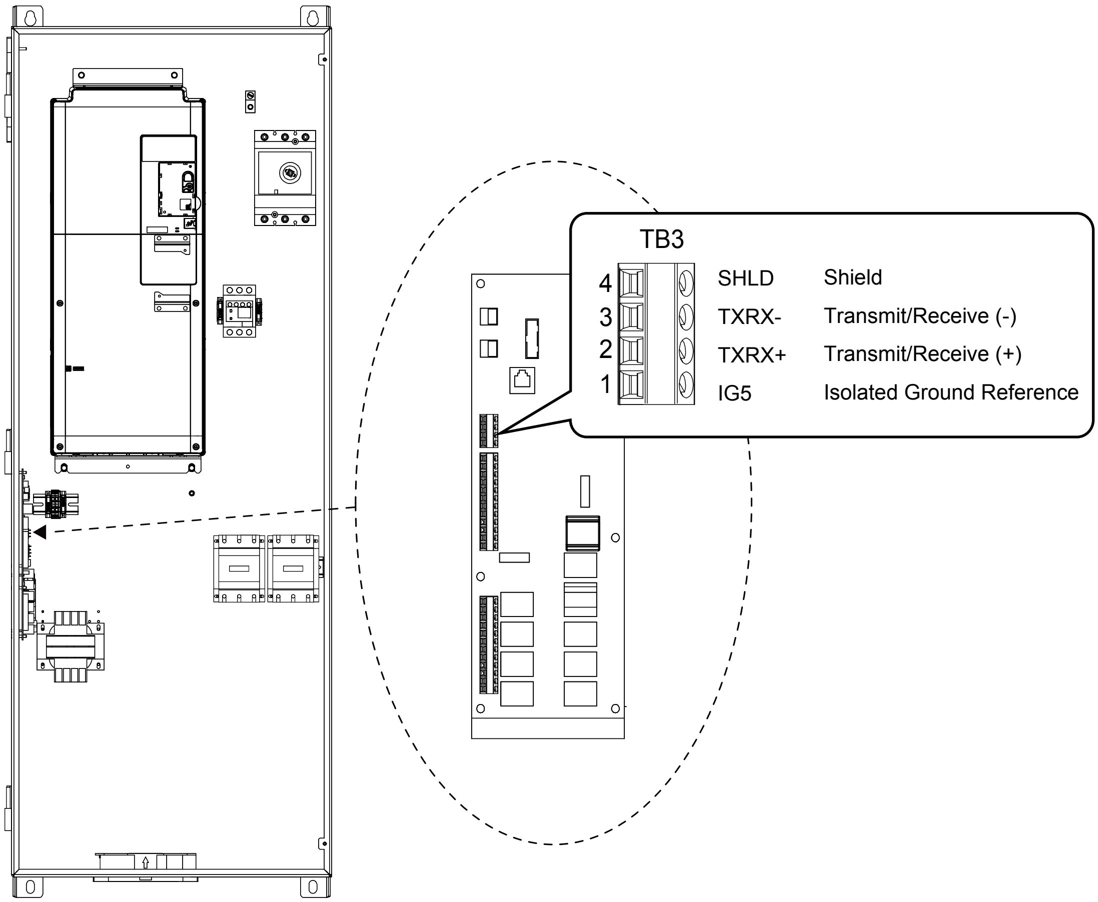


Figure F.2 Serial Communications Cable Connection Terminal (TB3)

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 caused by electrical interference.

2. Check or set the termination resistor selection at all slaves. Refer to the description in the ***Network Termination*** section for details on the termination resistor.
3. Switch the power on.
4. Set the parameters needed for serial communications (Z3-01 through Z3-11) using the digital operator.
5. Shut the power off and wait until the display on the digital operator goes out completely.
6. Turn the power back on.
7. The bypass is now ready to begin communicating with the master.

◆ Wiring Diagram for Multiple Connections

Figure F.3 explains the wiring diagrams for multiple connections using N2 communication.

■ RS-485 Interface

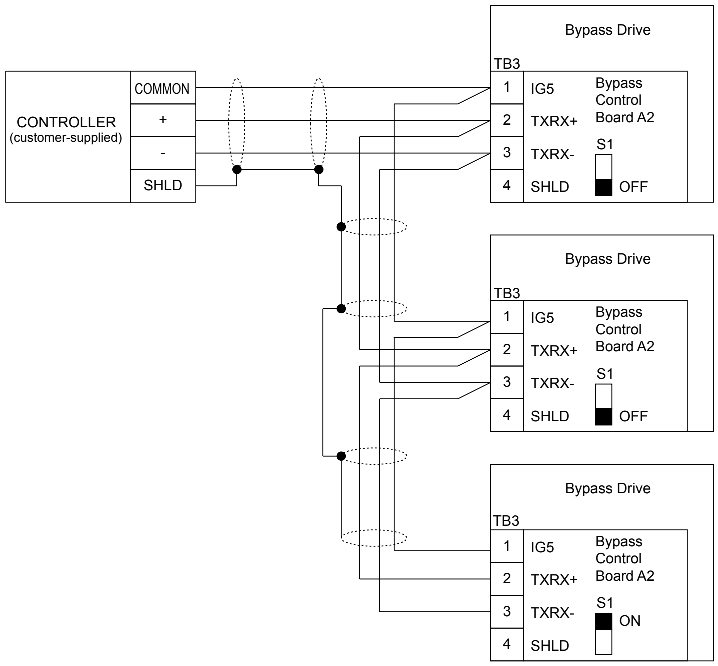


Figure F.3 Connection Diagram for Multiple Connections

Note: Turn on DIP switch S1 on the bypass that is located at the end of the network. If S1 is missing, then an external 120 ohm resistor must be placed across terminals TXRX+ and TXRX-. All other slave devices must have this DIP switch set to the OFF position (or if S1 is missing, no external resistor is used).

◆ Network Termination

The two ends of the network line must be terminated with a 120 ohm resistor between the TXRX+ and TXRX- signals. The bypass has a built in termination resistor that can be enabled or disabled using DIP switch S1. If a bypass is located at the end of a network line, enable the termination resistor by setting DIP switch S1 to the ON position. Disable the termination resistor on all slaves that are not located at the network line end.

Note: Some bypass controllers do not have DIP switch S1. in such cases an external 120 ohm resistor must be placed across the TXRX+ and TXRX- signals if the bypass controller is at the end of a network line.

F.3 N2 Setup Parameters

◆ N2 Serial Communication

This section describes parameters necessary to set up N2 communications.

■ Z3-01: Serial Communications Protocol Select

Selects the communications protocol.

No.	Name	Setting Range	Default
Z3-01	Serial Communications Protocol Selection	0 to 3	0

Setting 0: MEMOBUS/Modbus

Setting 1: N2

Setting 2: P1

Setting 3: BACnet

■ Z3-02: Serial Communications Node Address Select

Sets the drive slave address used for communications.

Note: Cycle the power after changing this parameter to enable the new setting.

No.	Name	Setting Range	Default
Z3-02	Serial Communications Node Address Select	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.

■ Z3-03: Serial Communications Baud Rate Select

Selects the bypass serial communications speed.

Selecting settings 0, 1, or 2 will trigger an oPE29 error when using BACnet communication (Z3-01 = 3) in bypass controller software versions VST800400 and later.

No.	Name	Setting Range	Default
Z3-03	Serial Communications Baud Rate Select	0 to 8	3

Setting 0: 1200 bps

Setting 1: 2400 bps

Setting 2: 4800 bps

Setting 3: 9600 bps

Setting 4: 19200 bps

Setting 5: 38400 bps

Setting 6: 57600 bps

Setting 7: 76800 bps

Setting 8: 115200 bps

■ Z3-04: Serial Communications Parity Select

Sets the parity used for communications.

Note: Cycle the power after changing this parameter to enable the new setting.

No.	Name	Setting Range	Default
Z3-04	Serial Communications Parity Select	0 to 2	0

Setting 0: No parity

Setting 1: Even parity

Setting 2: Odd parity

■ Z3-05: Serial Communications Fault Select

Selects the action to take when a serial communications fault is detected. A serial communications fault is detected when after last communicating, no communications occurs within the time set to Z3-06.

No.	Name	Setting Range	Default
Z3-05	Serial Communications Fault Select	0 to 4	1

Setting 0: Ignore

Setting 1: Alarm Only

Setting 2: Fault with EF0

An EF0 fault will be sent to the drive.

Setting 3: Fault with EF0 and Open Contactors

An EF0 fault will be sent to the drive and the bypass contactor (K3) will be opened.

Setting 4: Alarm and run at preset speed set in Z3-10

Display AL14 alarm on operator.

■ Z3-06: Serial Communications Fault Time Select

Sets the time allowed to elapse since receiving serial communications before triggering a communications fault. A value of 0.0 means to never time out.

No.	Name	Setting Range	Default
Z3-06	Serial Communications Fault Detection Time	0.0 to 99.9 s	2.0 s

■ Z3-07: Serial Communications Receive to Transmit Wait Time

Sets the time to delay a serial communications response to a serial communications command.

No.	Name	Setting Range	Default
Z3-07	Serial Communications Receive to Transmit Wait Time	0 to 99 ms	5 ms

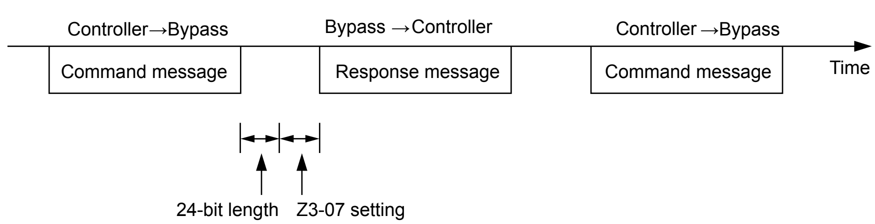


Figure F.4 Serial Communications Receive to Transmit Wait Time Setting

■ Z3-10: Cable Loss Pre-set Speed

When a serial communications fault is detected and Z3-05=4, the value here will become the frequency reference.

No.	Name	Setting Range	Default
Z3-10	Cable Loss Pre-set Speed	0.0 to 60.0 Hz	0.0 Hz

■ Z3-11: Serial Communication Fault Detection Selection

Enables or disables the serial communications fault detection.

No.	Name	Setting Range	Default
Z3-11	Serial Communication Fault Detection Selection	0 or 1	1

Setting 0: Disabled

No communication error detection. Ignore setting in Z3-05.

Setting 1: Enabled

If the bypass does not receive data from the master for longer than the time set to Z3-06, then a FB14 Serial Communications fault will be triggered and the bypass will operate as determined by parameter Z3-05.

F.4 Bypass Operations by N2

The drive operations that can be performed by N2 communication depend on drive parameter settings. This section explains the functions that can be used and related parameter settings.

◆ Observing the Bypass Operation

A controller can perform the following actions with N2 communications at any time regardless of parameter settings (except for Z3-□□ parameters):

- Observe drive status and drive control terminal status from a controller
- Read and write parameters
- Set and reset faults
- Set multi-function inputs.

Note: Input settings from the input terminals S□ and from N2 communications are both linked by a logical OR operation.

◆ Controlling the Bypass

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 N2 communications.

Table F.1 Setting Parameters for Bypass Control from N2

Reference Source	Parameter	Name	Required Setting
External Reference 1	Z1-07	Frequency Reference Select	2
	Z1-08	Run Command Select	2

■ Z1000U Bypass Functions

Each of the following functions must be enabled during start-up:

Start and Stop the Bypass

Set the Run Forward Command (BO 1) to run the in the forward direction. Set the Run Reverse Command (BO 2) to run the in the reverse direction. Run/Stop Monitor (BI 1) shows the current run status. Forward/Reverse Monitor (BI 2) shows the current direction.

NOTICE: *Damage to Equipment. Improper motor direction may damage HVAC equipment if parameter b1-04, Reverse Enable, is set to 0 (Enable).*

Digital Inputs

Multi-Function Input S3 (BO 5) through Multi-Function Input S7 (BO 9) are physical digital inputs on the bypass. They can be set either by external devices, such as limit or pressure switches, or by the network. Their function depends on how the bypass has been programmed. The multi-function input status can be monitored through Multi-Function Input 3 Monitor (BI 15) through Multi-Function Input 7 Monitor (BI 19). The Multi-Function Input # Monitor state is the logical OR of the serial command value (BO 5 through BO 9) and the state of the external connection.

Note: The multi-function inputs can be set by both external devices or over the network. Use caution when connecting the multi-function inputs to external devices to ensure correct system operation.

Digital Outputs

Multi-Function Output 7 (BI 10) through Multi-Function Output 9 (BI 12) are physical digital outputs on the bypass. Their function depends on how the bypass is programmed.

Loop Gain

PID Proportional Gain (AO 4) and PID Integral Time (AO 5) are the gain and integral time parameters used by the drive. The drive PID loop is structured differently than the Metasys loop.

Reading and Resetting Faults

The Fault Monitor (BI 4) and Drive Ready Monitor (BI 3) show the current status of the bypass. The Fault Code (AI 10) contains the code for the most current fault. The LST Fault Code (AI 19) contains the code for the previous drive fault. *Refer to Fault Trace / History Register Contents on page 410* for descriptions of the fault codes. The drive faults can be reset through the Fault Reset Command (BO 4). The Fault Reset Command is only available when the Run Forward Command and the Run Reverse Command are both OFF.

■ Cable Loss Configuration and Behavior

This section describes the configurable cable loss feature of the drive. This feature offers a user maximum flexibility in determining drive response to a loss of communication.

Drive Behavior at Loss of Communication

The drive can be configured to respond to an interval without receipt of a message in one of the following methods:

- Continue at last speed
- Continue at last speed with alarm
- Continue at preset speed
- Ramp to Stop with FB14 fault
- Coast to Stop with FB14 fault
- Emergency Stop with FB14 fault

Metasys N2 I/O

Three Metasys N2 outputs are used to select the desired behavior:

- AO 21 – Cable Loss Timeout
- AO 22 – Cable Loss Speed
- BO 11 – Communication Fault Enable

Table F.2 Cable Loss Behavior Summary

Behavior	F6-03	Z3-05	Cable Loss Timeout (AO 21)	Cable Loss Speed (AO 22)	Communication Fault Enable (BO 11)
Decelerate to stop (stop time in C1-02) FB14 Fault. **Note:** In Bypass mode, bypass contactor will open and motor will coast to stop.	0	3	Timeout Interval	X	On
Coast to stop FB14 fault. **Note:** In Bypass mode, bypass contactor will open and motor will coast to stop.	1	3	Timeout Interval	X	On
Fast stop (stop time in C1-09) FB14 fault. **Note:** In Bypass mode, bypass contactor will open and motor will coast to stop.	2	3	Timeout Interval	X	On
Continue at last speed	3	0	0	X	X
Continue at last speed with alarm	3	1	Timeout Interval	X	On
Continue at preset speed with alarm	3	4	Timeout Interval	Preset speed	On

Note:
1. Communication must first be established and then lost for these features to function as described. If a bypass is powered-up without a cable connected or with the master controller offline, a communications timeout does not occur.
2. For modes that describe the bypass running after a communications timeout, a run command must have been issued (BO 1 = 'On' or BO 2 = 'On') prior to loss of communications. For safety purposes, the drive will not automatically restart from a stopped condition. If a user requires the drive to restart automatically, additional external wiring is required to accomplish this (consult factory).
3. Upon expiration of the communications timeout interval, the FAULT LED lights and remains lit until communication is restored.

Continue at Last Speed

In this mode, Cable Loss Timeout (AO 21) is set to 0, disabling the cable loss feature. The other two settings Cable Loss Speed (AO 22) and Communication Fault Enable (BO 11) are ignored. If communication is lost, the drive simply maintains its last commanded state. The drive will not display an alarm or fault to indicate it has lost communication. This behavior can also be achieved by setting parameter Z3–05 to "0".

Continue at Last Speed with Alarm

For this condition, Communication Fault Enable (BO 11) must be enabled and Cable Loss Speed (AO 22) should be set to a value other than 0. An AL14 Serial Communications Alarm is shown.

Continue at Preset Speed with Alarm

In this mode, Cable Loss Timeout (AO 21) is set to the desired interval, Cable Loss Speed (AO 22) is set to the desired preset speed and Z3–05 is set to “4”. If the time between messages exceeds the timeout interval, the drive speed command (AO 1) is set to the Cable Loss Speed (AO 22) and the drive continues running at this new speed. Communication Fault Enable (BO 11) must be set to ‘On’.

Stop with Fault (FB14)

Communication Fault Enable (BO 11) must be set to ‘On’. In this mode, Cable Loss Timeout (AO 21) is set to the desired interval and parameter F6-03 is set to a value of 0,1 or 2. If the time between messages exceeds the timeout interval, the drive will declare an EF0 fault and the drive speed command (AO 1) will be set to 0. The stopping method is determined by the setting of F6-03.

- F6-03 = 0 selects Ramp to Stop. The deceleration time or the slope of the ramp is determined by the setting of drive parameter C1-02
- F6-03 = 1 selects Coast to Stop. The drive does not attempt to control the rate of deceleration.
- F6-03 = 2 selects Emergency or Fast Stop. The deceleration time is determined by the setting of drive parameter C1-09.

■ Bypass Fault Numbers

Table F.3 Fault Trace / History Register Contents

Fault Code	Fault Name	Fault Code	Fault Name
0002H	Undervoltage (Uv1)	0037H	Pullout Detection (Sto)
0003H	Control Power Supply Undervoltage (Uv2)	003BH	Too Many Speed Search Restarts (SEr)
0004H	Soft Charge Circuit Fault (Uv3)	0041H	PID Feedback Loss (FbH)
0006H	Ground Fault (GF)	0042H	External Fault 1, Input Terminal S1 (EF1)
0007H	Overcurrent (oC)	0043H	External Fault 2, Input Terminal S2 (EF2)
0008H	Overvoltage (ov)	0046H	Current Offset Fault (CoF)
0009H	Heatsink Overheat (oH)	0047H	PLC Detection Error 1 (PE1)
000AH	Heatsink Overheat (oH1)	0048H	PLC Detection Error 2 (PE2)
000BH	Motor Overload (oL1)	004DH	Output Voltage Detection Fault (voF)
000CH	Drive Overload (oL2)	0052H	CanOpenNID Error (nSE)
000DH	Overtorque Detection 1 (oL3)	005AH	Motor Underload Protection (UL6)
0010H	Braking Resistor Overheat (rH)	0083H	A/D Conversion Error (CPF02)
0011H	External Fault at Input Terminal S3 (EF3)	0084H	PWM Data Fault (CPF03)
0012H	External Fault at Input Terminal S4 (EF4)	0087H	EEPROM Memory Data Error (CPF06)
0013H	External Fault at Input Terminal S5 (EF5)	0088H	Terminal Board Connection Error (CPF07)
0014H	External Fault at Input Terminal S6 (EF6)	0089H	EEPROM Serial Communication Fault (CPF08)
0015H	External Fault at Input Terminal S7 (EF7)	008CH	RAM Fault (CPF11)
001BH	Input Phase Loss (PF)	008DH	Flash Memory Circuit Exception (CPF12)
001CH	Output Phase Loss (LF)	008EH	Watchdog Circuit Exception (CPF13)
001DH	Motor Overheat (PTC input) (oH3)	008FH	Control Circuit Fault (CPF14)
001EH	Digital Operator Connection (oPr)	0091H	Clock Fault (CPF16)
001FH	EEPROM Write Error (Err)	0092H	Timing Fault (CPF17)
0020H	Motor Overheat (PTC input) (oH4)	0093H	Control Circuit Fault (CPF18)
0021H	MEMOBUS/Modbus Communication Error (CE)	0094H	Control Circuit Fault (CPF19)
0022H	Option Communication Error (bUS)	0095H	Hardware Fault at Power Up (CPF20)
0027H	Option External Fault (EF0)	0096H	Hardware Fault at Communication Start Up (CPF21)
0028H	PID Feedback Loss (FbL)	0097H	A/D Conversion Fault (CPF22)
0029H	Undertorque Detection 1 (UL3)	0098H	PWM Feedback Fault (CPF23)
002BH	High Slip Braking Overload (oL7)	0099H	Drive Unit Signal Fault (CPF24)
0030H	Hardware Fault (including oFx)	009AH	Terminal Board is Not Properly Connected. (CPF25)
0036H	Output Current Imbalance (LF2)	009BH	ASIC BB Circuit Error (CPF26)

Fault Code	Fault Name
009CH	ASIC PWM Setting Register Error (CPF27)
009DH	ASIC PWM Pattern Error (CPF28)
009EH	ASIC On-delay Error (CPF29)
009FH	ASIC BBON Error (CPF30)
00A0H	ASIC Code Error (CPF31)
00A1H	ASIC Start-up Error (CPF32)
00A2H	Watch-dog Error (CPF33)
00A3H	ASIC Power/Clock Error (CPF34)
00A4H	External A/D Converter Error (CPF35)
00A9H	Control Circuit Error (CPF40)
00AAH	Control Circuit Error (CPF41)
00ABH	Control Circuit Error (CPF42)
00ACH	Control Circuit Error (CPF43)
00ADH	Control Circuit Error (CPF44)
00AEH	Control Circuit Error (CPF45)
0101H	Option Compatibility Error (oFA00)
0102H	Option Not Properly Connected (oFA01)
0106H	A/D Conversion Error (oFA05)
0107H	Option Response Error (oFA06)
0111H	Option RAM Fault (oFA10)
0112H	Option Operation Mode Fault (SLMOD) (oFA11)
0113H	Drive Receive CRC Error (oFA12)
0114H	Drive Receive Frame Error (oFA13)
0115H	Drive Receive Abort Error (oFA14)
0116H	Option Receive CRC Error (oFA15)
0117H	Option Receive Frame Error (oFA16)
0118H	Option Receive Abort Error (oFA17)
0131H	Comm. ID Error (oFA30)
0132H	Model Code Error (oFA31)
0133H	Sumcheck Error (oFA32)
0134H	Comm. Option Timeout Waiting for Response (oFA33)

Fault Code	Fault Name
0135H	MEMOBUS Timeout (oFA34)
0136H	Drive Timeout Waiting for Response (oFA35)
0137H	CI Check Error (oFA36)
0138H	Drive Timeout Waiting for Response (oFA37)
0139H	Control Command Selection Error (oFA38)
013AH	Drive Timeout Waiting for Response (oFA39)
013BH	Control Response Selection 1 Error (oFA40)
013CH	Drive Timeout Waiting for Response (oFA41)
013DH	Control Response Selection 2 Error (oFA42)
013EH	Control Response Selection Error (oFA43)
0401H	Time Not Set (TIM)
0402H	Operator Battery Low (bAT)
0403H	Time Data Error (TdE)
0404H	Time Interval Error (TiE)
0405H	Overvoltage 2 (ov2)
0407H	External Fan Fault (Fn1)
1389H	Safety Open
138AH	BAS InterLock Open
138BH	External Fault (EFB)
138CH	Not Used
138DH	Motor Overload
138EH	Ext Motor1 Overload
138FH	Ext Motor2 Overload
1390H	PL Brownout
1391H	PL Blackout
1392H	No Bypass to Drive Communications
1393H	Bypass Board Hardware Error
1394H	Option Board Communication Fault
1395H	Loss of Load
1396H	Serial Communications Timeout

F.5 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 Bypass

The master must wait for a specified time between receiving a response and resending the same type of command to the same slave bypass to prevent overrun and data loss. The minimum wait time depends on the command as shown in ***Table F.4***.

Table F.4 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 bypass 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.

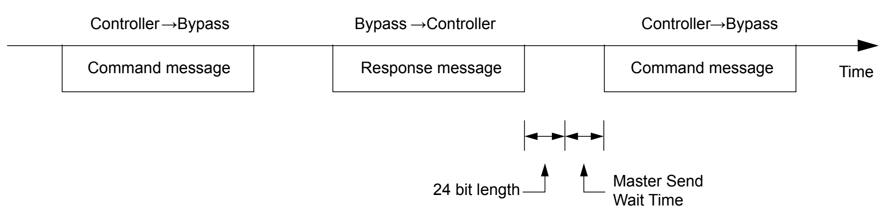


Figure F.5 Minimum Wait Time for Sending Messages

Set a timer in the master to check how long it takes for the slave bypass units 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 Bypass to Master

If the bypass receives a command from the master, it will process the data received and wait for the time set in Z3-07 until it responds. Increase Z3-07 if the drive response causes overrun in the master.

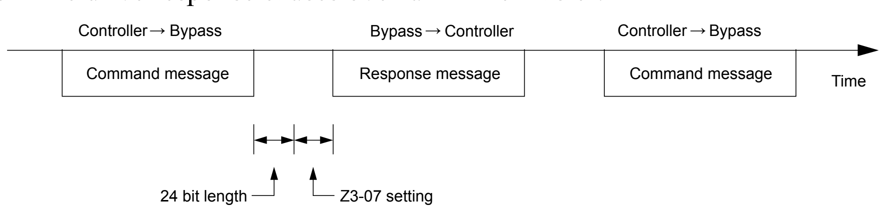


Figure F.6 Minimum Response Wait Time

F.6 Metasys N2 Point Database

This section describes the Metasys N2 point database. This database features 100 logical points: 38 Analog Inputs (AI), 32 Analog Outputs (AO), 19 Binary Inputs (BI) and 11 Binary Outputs (BO). These points configure, control, and monitor the operation of the drive.

◆ Metasys N2 Analog Input (AI) Summary

Table F.5 Metasys N2 Analog Input Summary (Bypass to Metasys N2)

Object ID	Object Name	Units	Bypass Parameter
AI 1	Speed Reference	0.01 Hz	U1-01
AI 2	Output Speed	0.01 Hz	U1-02
AI 3	Output Current	0.1 A	U1-03/UB-01 in Drive/Bypass Mode
AI 4	kWatt Hour Meter	kWh	U4-10
AI 5	Output Power	0.1 kWh	U1-08
AI 6	Drive Temperature	1 °C	U4-08
AI 7	PID Feedback	0.01%	U5-01
AI 8	AC Output Voltage	0.1 Vac	U1-06
AI 9	DC Bus Voltage	1 Vdc	U1-07
AI 10	Fault Code	–	U2-01/UB-09. Reads UB-09 first and if 0 returns U2-01
AI 11	Elapsed Time - Hours	1 hour	U4-01
AI 12	Elapsed Time - 10K Hours	10K hours	U4-01
AI 13	MWatt Hour meter	MWh	U4-11
AI 14	Drive Rated Current	A	n9-01
AI 15	Communication Error Code	–	Not supported. Always returns 0
AI 16	PID Deviation	0.01%	U5-02
AI 17	PID Output Capacity	0.01%	U5-03
AI 18	PID Reference	0.01%	U5-04
AI 19	Last Fault Code	–	U2-02
AI 20	Freq Ref @ Fault	0.01 Hz	U2-03
AI 21	Output Freq @ Fault	0.01 Hz	U2-04
AI 22	Output Current @ Fault	0.1 A	U2-05
AI 23	Out Volt Ref @ Fault	0.1 Vac	U2-07
AI 24	DC Bus Volts @ Fault	1 Vdc	U2-08
AI 25	Output Power @ Fault	0.1 kW	U2-09
AI 26	Input Term Status @ Fault	–	U2-11
AI 27	Output Term Status @ Fault	–	U2-12
AI 28	Operation Status @ Fault	–	U2-13
AI 29	Elapsed Operation Time @ Fault	1 hour	U2-14
AI 30	Most Recent Fault	–	U3-01
AI 31	2nd Most Recent Fault	–	U3-02
AI 32	3rd Most Recent Fault	–	U3-03
AI 33	4th Most Recent Fault	–	U3-04
AI 34	Elapsed Time @ Current Fault	1 hour	U3-11
AI 35	Elapsed Time @ 2nd Fault	1 hour	U3-12
AI 36	Elapsed Time @ 3rd Fault	1 hour	U3-13
AI 37	Elapsed Time @ 4th Fault	1 hour	U3-14
AI 38	Read Parameter Data	–	–

◆ Metasys N2 Analog Output (AO) Summary

Table F.6 Metasys N2 Analog Output Summary (Bypass to Metasys N2)

Object ID	Object Name	Units	Default Value	Bypass Parameter
AO 1	Speed Command	0.01 Hz	–	–
AO 2	Acceleration Time	seconds	30.0	C1-01
AO 3	Deceleration Time	seconds	30.0	C1-02
AO 4	PID Proportional Gain	–	2.00	b5-02
AO 5	PID Integral Time	seconds	5.0	b5-03
AO 6	Stall Prevention Level – Run	%	120	L3-06
AO 7	Stall Prevention Level – Accel	%	120	L3-02
AO 8	Frequency Reference Selection	–	0	Z1-07
AO 9	Run Command Selection	–	1	Z1-08
AO 10	PID Mode Select	–	0	b5-01
AO 11	Frequency Command Upper Limit	% of Max	100.0	d2-01
AO 12	Frequency Command Lower Limit	% of Max	0.0	d2-02
AO 13	Motor Rated Current	A	Motor model dependent	E2-01
AO 14	Jump Frequency 1	0.1 Hz	0.0	d3-01
AO 15	Jump Frequency 2	0.1 Hz	0.0	d3-02
AO 16	Jump Frequency 3	0.1 Hz	0.0	d3-03
AO 17	Jump Frequency Bandwidth	0.1 Hz	1.0	d3-04
AO 18	Number of Auto Restarts	–	0	L5-01
AO 19	Operator Display Mode	–	0	o1-03
AO 20	Power Loss Ride-Thru	seconds	Drive model dependent	L2-02
AO 21	Cable Loss Timeout	seconds	2.0	Z3-06
AO 22	Cable Loss Speed	0.01 Hz	0.00	Z3-10
AO 23	PID Integral Limit	0.1%	100.0	b5-04
AO 24	PID Upper Limit Value	0.1	100.0	b5-06
AO 25	PID Offset Adjustment	0.1	0.0	b5-07
AO 26	PID Primary Delay Time	0.01	0.00	b5-08
AO 27	PID Feedback Reference Missing Detection Select	1	0	b5-12
AO 28	PID Feedback Reference Missing Detection Level	1%	0	b5-13
AO 29	PID Feedback Reference Missing Detection Time	0.1 s	1.0	b5-14
AO 30	Read Parameter Number	–	–	–
AO 31	Write Parameter Number	–	–	–
AO 32	Write Parameter Data	–	–	–

◆ Metasys N2 Binary Input (BI) Summary

Table F.7 Metasys N2 Binary Input Summary (Bypass to Metasys N2)

Object ID	Object Name	Default	Off (0) State	On (1) State
BI 1	Run/Stop Monitor	0	Stopped	Running
BI 2	Forward/Reverse Monitor	0	Forward	Reverse
BI 3	Drive Ready Monitor	0	Not Ready	Ready
BI 4	Fault Monitor	0	Not Faulted	Faulted
BI 5	Zero Speed	0	Not Zero Speed	Zero Speed
BI 6	Speed Agree	0	Not Speed Agree	Speed Agree
BI 7	Minor Fault	0	No Minor Fault	Minor Fault
BI 8	Major Fault	0	No Major Fault	Major Fault
BI 9	Drive Communication Error Monitor	0	No Error	Error

Object ID	Object Name	Default	Off (0) State	On (1) State
BI 10	Multi-Function Output 7 (Z2-23)	0	Off	On
BI 11	Multi-Function Output 8 (Z2-24)	0	Off	On
BI 12	Multi-Function Output 9 (Z2-25)	0	Off	On
BI 13	Safety Interlock Monitor	0	Safety Clear	Safety Set
BI 14	HAND/AUTO Reference Monitor	0	AUTO or OFF	HAND
BI 15	Multi-Function Input 3 Monitor	0	Off	On
BI 16	Multi-Function Input 4 Monitor	0	Off	On
BI 17	Multi-Function Input 5 Monitor	0	Off	On
BI 18	Multi-Function Input 6 Monitor	0	Off	On
BI 19	Multi-Function Input 7 Monitor	0	Off	On

◆ Metasys N2 Binary Output (BO) Summary

Table F.8 Metasys N2 Binary Output Summary (Bypass to Metasys N2)

Object ID	Object Name	Default	Off (0) State	On (1) State
BO 1	Run Forward Command	0	Stop	Forward
BO 2	Run Reverse Command	0	Stop	Reverse
BO 3	External Fault (EFB) Command	0	No Fault	Fault (EFB)
BO 4	Fault Reset Command	0	No Reset	Reset
BO 5 <1>	Multi-Function Input 3 (Z2-03)	0	Off	On
BO 6 <1>	Multi-Function Input 4 (Z2-04)	0	Off	On
BO 7 <1>	Multi-Function Input 5 (Z2-05)	0	Off	On
BO 8 <1>	Multi-Function Input 6 (Z2-06)	0	Off	On
BO 9 <1>	Multi-Function Input 7 (Z2-07)	0	Off	On
BO10	Panel Lock **Note:** Not supported	0	–	–
BO 11	Communication Fault Enable	0	FB14 Not Activated if Cable Loss Occurs	FB14 Activated if Cable Loss Occurs

<1> Disabled when Z3-12 is set to 0.

F.7 Mailbox Function

◆ Reading Drive Parameters

Two points are defined for reading drive parameters:

- AO 30 – Specifies the parameter to be read from the bypass.
- AI 38 – Reports the value of the parameter specified in AO 30.

When this point is read, it retrieves data from the parameter and sends it to the controller

Example: Writing a value of 387 (183 hex) to AO 30 specifies drive parameter b1-04. Reading AI 38 returns the current setting of parameter b1-04 to the controller.

◆ Writing Drive Parameters

Two points are defined for writing to drive parameters:

- AO 31 – Specifies the parameter to be written to
- AO 32 – Entry location of the value to be written to the parameter specified in AO 31. When this point is written to, it will write the value to the drive. An ENTER or ACCEPT command does not need to be sent for the data to be taken by the drive. The behavior of the write is the same as with the digital operator. If the drive is running, there are a limited number of drive parameters that can be written to.

Example: Writing a value of 387 (183 hex) to AO 31 specifies drive parameter b1-04. Writing a value of 1 to AO 32 sets b1-04 to 1 and disables the drive for reverse run.

Appendix: G

Standards Compliance

This appendix explains the guidelines and criteria for maintaining CE and UL standards.

G.1 Section Safety

DANGER

Electrical Shock Hazard

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

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

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

Failure to comply could result in death or serious injury.

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

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

Failure to comply could result in death or serious injury.

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

Do not 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.

G.2 UL/cUL Standards

◆ UL Standards Compliance

The UL/cUL mark applies to products in the United States and Canada. It indicates that UL has performed product testing and evaluation, and determined that their stringent standards for product safety have been met. For a product to receive UL certification, all components inside that product must also receive UL certification.

Figure G.1 UL/cUL Mark

The bypass is tested in accordance with UL standard UL508A, and the drive is tested in accordance with UL standard UL508C; both comply with UL requirements. The conditions described below must be met to maintain compliance when using this drive in combination with other equipment:

■ Installation Area

Do not install the drive to an area greater than pollution degree 2 (UL standard).

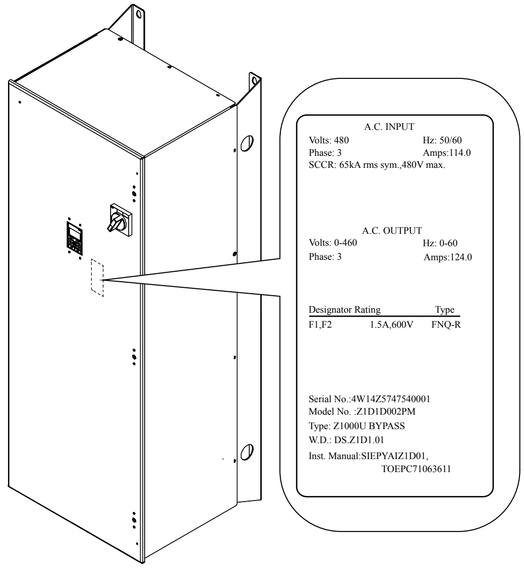
Appendix: H

Quick Reference Sheet

This section provides tables to keep record of the bypass specifications, motor specifications, and parameter settings. Fill in the table data after commissioning the application and have them ready when contacting Yaskawa for technical assistance.

H.1 Z1000U Bypass and Motor Specifications

◆ Z1000U Bypass Specifications



Items	Description
Z1000U Bypass Model	Z1D☐
Z1000U Bypass Serial Number	
Z1000U Bypass Software Version	
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.

H.2 Basic Parameter Settings

Use the following tables to keep records of important parameters. Have this data available when contacting Yaskawa technical support.

◆ Quick Setting Parameters

Parameter Name	Setting Value	Memo
Application Preset	A1-06 =	
Maximum Voltage	E1-05 =	
Motor Rated FLA	E2-01 =	
Speed Reference Select	Z1-07 =	
Run Command Select	Z1-08 =	
HAND Mode Drive Speed Reference	Z1-09 =	
Set Time	Z1-37 =	
Serial Protocol	Z3-01 =	
Node Address	Z3-02 =	
Baud Rate	Z3-03 =	
Parity	Z3-04 =	
Fault Select	Z3-05 =	
Fault Time	Z3-06 =	
Rx to Tx Time	Z3-07=	
BAC Dev ID0	Z3-08 =	
BAC Dev ID1	Z3-09 =	

◆ Motor Setup

Motor Type	Item	Setting Value	Memo
Induction	**Motor Rated Current**	E2-01 =	
	Motor No-Load Current	E2-03 =	

◆ Multi-Function Digital Inputs

Terminal	Input Used	Setting Value and Function Name	Memo
TB2-1		Z2-01 =	
TB2-2		Z2-02 =	
TB2-3		Z2-03 =	
TB2-4		Z2-04 =	
TB2-5		Z2-05 =	
TB2-6		Z2-06 =	
TB2-7		Z2-07 =	
TB2-8		Z2-08 =	

◆ Analog Inputs

Terminal	Input Used	Setting Value and Function Name	Memo
A1		H3-02 =	
A2		H3-10 =	

Terminal	Input Used	Setting Value and Function Name	Memo
A3		H3-06 =	

◆ Multi-Function Digital Outputs

Name	Terminal	Output Used	Setting Value and Function Name	Memo
DO-7	TB1-1, 2, 3		Z2-23 =	
DO-8	TB1-4, 5, 6		Z2-24 =	
DO-9	TB1-7, 8, 9		Z2-25 =	
DO-10	TB1-10, 11, 12		Z2-26 =	

◆ Monitor Outputs

Terminal	Output Used	Setting Value and Function Name	Memo
FM		H4-01 =	
AM		H4-04 =	

H.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 Quick Setting Group of parameters.

No.	Name	User Setting
A1-06	**Application Preset**	
b1-03	Stopping Method Selection	
b1-04	Reverse Operation Selection	
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	
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	
b3-07	Output Current 2 during Speed Search (Speed Estimation Type)	
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	
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	
b3-17	Speed Search Restart Current Level	
b3-18	Speed Search Restart Detection Time	
b3-19	Number of Speed Search Restarts	
b3-24	Speed Search Method Selection	
b3-25	Speed Search Wait Time	
b3-27	Start Speed Search Select	
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	
b5-01	PID 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	
b5-06 RUN	PID Output Limit	
b5-07 RUN	PID Offset Adjustment	
b5-08 RUN	PID Primary Delay Time Constant	
b5-09	PID Output Level Selection	
b5-10	PID Output Gain Setting	
b5-11	PID Output Reverse Selection	
b5-12	PID Feedback Loss Detection Selection	
b5-13	PID Feedback Loss Detection Level	
b5-14	PID Feedback Loss Detection Time	
b5-15	PID Sleep Function Start Level	
b5-16	PID Sleep Delay Time	
b5-17	PID Accel/Decel Time	
b5-18	PID Setpoint Selection	
b5-19	PID Setpoint Value	
b5-20	PID Setpoint Scaling	
b5-34 RUN	PID Output Lower Limit	
b5-35 RUN	PID Input Limit	
b5-36	PID Feedback High Detection Level	
b5-37	PID Feedback High Detection Time	
b5-38	PID Setpoint User Display	
b5-39	PID Setpoint Display Digits	
b5-40	Frequency Reference Monitor Content during PID	
b5-46	PID Setpoint Monitor Unit Selection	
b5-47	Reverse Operation Selection 2 by PID Output	
C1-01 RUN	Acceleration Time 1	
C1-02 RUN	Deceleration Time 1	
C1-09	Fast-Stop Time	
C2-01	S-Curve Characteristic at Accel Start	
C2-02	S-Curve Characteristic at Accel End	

H.3 User Setting Table

No.	Name	User Setting
C4-01 RUN	Torque Compensation Gain	
C6-02	Carrier Frequency Selection	
C7-60	Output Voltage Limit Mode Selection	
d1-01 RUN	Frequency Reference 1	
d1-02 RUN	Frequency Reference 2	
d1-03 RUN	Frequency Reference 3	
d1-04 RUN	Frequency Reference 4	
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	
E1-03	V/f Pattern Selection	
E1-05	**Maximum Voltage**	
E2-01	**Motor Rated Current**	
E2-03	Motor No-Load Current	
F6-01	Communications Error Operation Selection	
F6-02	External Fault from Communications Option Detection Selection	
F6-03	External Fault from Communications Option Operation 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 RUN	Terminal A3 Bias Setting	
H3-09	Terminal A2 Signal Level Selection	
H3-10	Terminal A2 Function Selection	
H3-11 RUN	Terminal A2 Gain 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	
L1-01	Motor Overload Protection Selection	
L1-02	Motor Overload Protection Time	
L2-01	Momentary Power Loss Operation Selection	
L2-02	Momentary Power Loss Ride-Thru Time	
L2-03	Momentary Power Loss Minimum Baseblock Time	
L2-05	Undervoltage Detection Level (Uv1)	
L3-02	Stall Prevention Level during Acceleration	
L3-03	Stall Prevention Limit during Acceleration	
L3-04	Stall Prevention Selection during Deceleration	
L3-06	Stall Prevention Level during Run	
L4-01	Speed Agreement Detection Level	
L4-02	Speed Agreement Detection Width	
L4-03	Speed Agreement Detection Level (+/-)	
L4-04	Speed Agreement Detection Width (+/-)	
L4-05	Frequency Reference Loss Detection Selection	
L4-06	Frequency Reference at Reference Loss	
L4-07	Speed Agreement Detection Selection	
L5-01	Number of Auto Restart Attempts	
L5-02	Auto Restart Fault Output Operation Selection	

No.	Name	User Setting
L5-03	Time to Continue Making Fault Restarts	
L5-04	Fault Reset Interval Time	
L5-05	Fault Reset Operation Selection	
L6-01	Torque Detection Selection 1	
L6-02	Torque Detection Level 1	
L6-03	Torque Detection Time 1	
L6-13	Motor Underload Protection Selection	
L6-14	Motor Underload Protection Level at Minimum Frequency	
L8-02	Overheat Alarm Level	
L8-05	Input Phase Loss Protection Selection	
L8-06	Input Phase Loss Detection Level	
L8-07	Output Phase Loss Protection	
L8-09	Output Ground Fault Detection Selection	
L8-38	Carrier Frequency Reduction Selection	
n1-01	Hunting Prevention Selection	
n1-02	Hunting Prevention Gain Setting	
n3-13	Overexcitation Deceleration Gain	
o1-01	Drive Mode Unit Motor Selection <1>	
o1-02	User Monitor Selection after Power Up <1>	
o1-03	Digital Operator Display Selection	
o1-09	Frequency Reference Display Units	
o1-10	User-Set Display Units Maximum Value	
o1-11	User-Set Display Units Decimal Display	
o2-04	Drive Model Selection	
o4-03	Cooling Fan Maintenance Operation Time Setting	
o4-11	UB-9 to UB-16 Initialization	
o4-19	Power Unit Price	
S1-01	Stillness Control Selection	
S1-02	Voltage Reduction Rate	
S1-03	Voltage Restoration Level	
S1-04	Voltage Restoration Complete Level	
S1-05	Voltage Restoration Sensitivity Time Constant	
S1-06	Voltage Restoration Time Constant at Impact	
S2-01	Sequence Timer 1 Start Time	
S2-02	Sequence Timer 1 Stop Time	
S2-03	Sequence Timer 1 Day Selection	
S2-04	Sequence Timer 1 Selection	
S2-05	Sequence Timer 1 Reference Source	
S2-06	Sequence Timer 2 Start Time	
S2-07	Sequence Timer 2 Day Selection	
S2-08	Sequence Timer 2 Day Selection	
S2-09	Sequence Timer 2 Selection	
S2-10	Sequence Timer 2 Reference Source	
S2-11	Sequence Timer 3 Start Time	
S2-12	Sequence Timer 3 Stop Time	
S2-13	Sequence Timer 3 Day Selection	
S2-14	Sequence Timer 3 Selection	
S2-15	Sequence Timer 3 Reference Source	
S2-16	Sequence Timer 4 Start Time	

No.	Name	User Setting
S2-17	Sequence Timer 4 Stop Time	
S2-18	Sequence Timer 4 Day Selection	
S2-19	Sequence Timer 4 Selection	
S2-20	Sequence Timer 4 Reference Source	
T1-01	Auto-Tuning Mode Selection	
T1-02	Motor Rated Power	
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 Speed	
T1-11	Motor Iron Loss	
Z1-01 RUN	Initialize	
Z1-02 RUN	Password	
Z1-03 RUN	Password Change	
Z1-05 RUN	Auto Transfer to Bypass Upon Drive Fault	
Z1-06 RUN	Power-Up Mode	
Z1-07 RUN	**Speed Reference Select**	
Z1-08 RUN	**Run Command Select**	
Z1-09 RUN	**HAND Mode Drive Speed Reference**	
Z1-10 RUN	Smoke Purge Preset Frequency Reference	
Z1-11 RUN	2-Motor AND/OR Function Select	
Z1-12 RUN	Run Delay Time	
Z1-13 RUN	Pre-Interlock Run Select	
Z1-14 RUN	Run Delay Frequency Reference	
Z1-15 RUN	Interlock Wait Time	
Z1-24 RUN	Contactor Open Delay Time	
Z1-25 RUN	Contactor Close Delay Time	
Z1-27 RUN	Phase Loss Brownout Voltage Level	
Z1-28 RUN	Phase Loss Brownout Detection Time	

H.3 User Setting Table

No.	Name	User Setting
Z1-29 RUN	Phase Loss Blackout Voltage Level	
Z1-30 RUN	EF0 Fault Delay Time	
Z1-31 RUN	Loss of Load Detection Enable	
Z1-32 RUN	Loss of Load Drive Frequency	
Z1-33 RUN	Loss of Load Drive Output Current	
Z1-34 RUN	Loss of Load Drive Time	
Z1-35 RUN	Loss of Load Bypass Output Current	
Z1-36 RUN	Loss of Load Bypass Time	
Z1-37 RUN	**Set Time**	
Z1-38 RUN	HOA Source Select	
Z1-39 RUN	Drive/Bypass Source Select	
Z1-40	AUTO Transfer Wait Time	
Z1-41	HAND Speed Reference Selection	
Z1-50	Bypass Unbalance Current Detection Level	
Z1-51	Bypass Unbalance Trip Time Detection Level	
Z1-52	Bypass Phase Rotation	
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No.	Name	User Setting
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<1> Available in bypass controller software versions VST800401 and later

<2> This parameter will only appear when BACnet is selected. (Z3-01 = 3)

<4> Available in bypass controller software versions VST800400 and later.

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Revision History

The revision dates and the numbers of the revised manuals appear on the bottom of the back cover.

MANUAL NO.
SIEP YAIZ1D 01B <1>
Revision number
Published in USA June 2015
Date of publication

Date of Publication	Revision Number	Section	Revised Content
April 2023	<4>	All	Added Type 12 Enclosures.
April 2018	<3>	All	Updated documentation to support bypass controller software version VST800401.
May 2017	<2>-1	Preface	Revision: Removed restrictions
December 2016	<2>	Chapter 3	Revision: Wire Gauge and Tightening Torque Specifications
June 2015	<1>	Quick Start Procedure	Revision: Removed procedure
March 2015	-	-	First Edition. This manual supports bypass controller software version VST800299 and drive software version PRG: 6113.

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Z1000U HVAC MATRIX Bypass

Low Harmonic Drive Bypass for HVAC Applications

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SIEPYAIZ1D01

MANUAL NO. SIEP YAIZ1D 01C <4>

Published in USA June 2023