YASKAWA AC Drive – V1000

Compact Vector Control Drive

Technical Manual (Preliminary)

Type: CIMR-VU ☐

Model: 200 V Class, Three-Phase Input: 0.1 to 18.5 kW
200 V Class, Single-Phase Input: 0.1 to 5.5 kW
400 V Class, Three-Phase Input: 0.2 to 18.5 kW

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

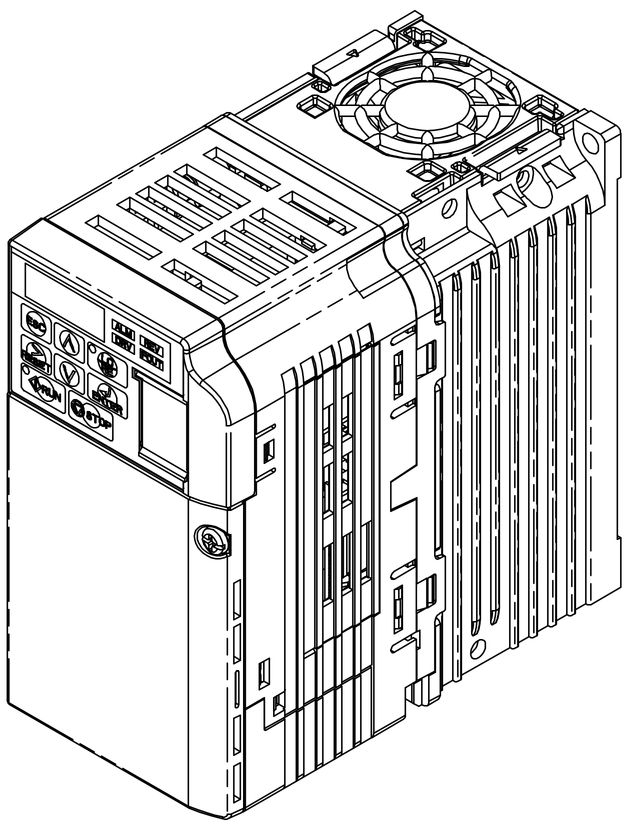


Table of Contents

Preface & General Safety

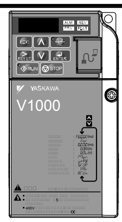
This section provides safety messages pertinent to this product, that, if not heeded, may result in fatality, personal injury, or equipment damage. Yaskawa is not responsible for the consequences of ignoring these instructions.

i.1 Preface

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

◆ Applicable Documentation

The following manuals are available for V1000 series drives:

	V1000 Series AC Drive Installation & Start-Up Manual
	Read this manual first. This manual describes installation, wiring, operation procedures, functions, troubleshooting, maintenance, and inspections to perform before operation.
	V1000 Series AC Drive Technical Manual
	Read this manual for detailed information about parameter usage. Contact a Yaskawa representative to order this manual.
	V1000 Series AC Drive Quick Start Guide
	This guide is packaged together with the product. It contains basic information required to install and wire the drive. This guide provides basic programming and simple set-up and adjustment. Refer to the V1000 Technical Manual for complete descriptions of drive features and functions.

◆ Symbols

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

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

◆ Terms and Abbreviations

TERMS

- **Drive**: Yaskawa V1000 Series Drive
- **PM motor**: Synchronous motor (an abbreviation for IPM motor or SPM motor)
- **IPM motor**: SSR1 Series
- **SPM motor**: Pico motor (SMRA Series)

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

⚠ WARNING
Read and understand this manual before installing, operating or servicing this drive. The drive must be installed according to this manual and local codes. The following conventions are used to indicate safety messages in this manual. Failure to heed these messages could result in serious or possibly even 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! *will 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! *will 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: *will also be indicated by a bold key word embedded in the text followed by an italicized safety message.*

◆ Safety Messages

⚠ DANGER
Heed the safety messages in this manual. Failure to comply will result in death or serious injury. The operating company is responsible for any injuries or equipment damage resulting from failure to heed the warnings in this manual. **Electrical Shock Hazard** **Do not connect or disconnect wiring while the power is on.** Failure to comply will result in death or serious injury. Before servicing, disconnect all power to the equipment. The internal capacitor remains charged even after the power supply is turned off. The charge indicator LED will extinguish when the DC bus voltage is below 50 Vdc. To prevent electric shock, wait at least five minutes after all indicators are OFF and measure the DC bus voltage level to confirm safe level.

WARNING

Sudden Movement Hazard

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

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

When using DriveWorksEZ to create custom programming, the drive I/O terminal functions change from factory settings and the drive will not perform as outlined in this manual.

Unpredictable equipment operation may result in death or serious injury.

Take special note of custom I/O programming in the drive before attempting to operate equipment.

Electrical Shock Hazard

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

Failure to comply could result in death or serious injury.

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

Do not allow unqualified personnel to use equipment.

Failure to comply could result in death or serious injury.

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

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

Failure to comply could result in death or serious injury.

Fire Hazard

Do not use an improper voltage source.

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

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

CAUTION

Crush Hazard

Do not carry the drive by the front cover.

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

NOTICE

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

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

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 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.

Install adequate branch circuit short circuit protection per applicable codes.

Failure to comply could result in damage to the drive.

The drive is suitable for circuits capable of delivering not more than 30,000 RMS symmetrical Amperes, 240 Vac maximum (200V Class) and 480 Vac maximum (400V Class).

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.

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

◆ Drive Label Warnings

Always heed the warning information listed in *Figure i.1* in the position shown in *Figure i.2* .

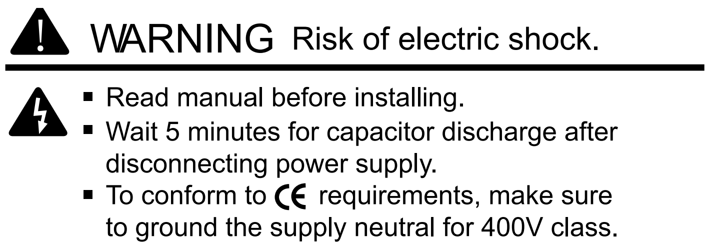


Figure i.1 Warning Information

Figure i.2 Warning Information Position

◆ Warranty Information

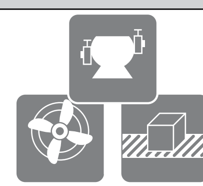
■ Restrictions

The V1000 was not designed or manufactured for use in devices or systems that may directly affect or threaten human lives or health.

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

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

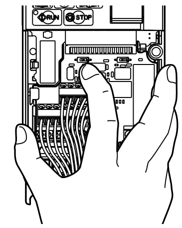
◆ Quick Reference

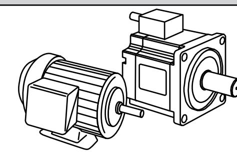
Easily Set Application-Specific Parameters	
Preset parameter defaults are available for many applications. *Refer to Application Presets on page 70*	

Run a Motor of One-Frame Larger Capacity
When using this drive for variable torque loads such as fans and pumps, a motor one frame size larger can be used. *Refer to Drive Duty Mode Selection: C6-01 on page 82*

Know the Details of Safety Measures
The functions listed below affect the safe operation of the drive. Ensure that the settings fit the application requirements prior to operation.
Operation of digital outputs during Auto-tuning. Rotational Auto-tuning allows for normal digital output operation, while non-rotational Auto-tuning does not allow for normal digital output operation.
Safe operations. Run by power on. Parameter setting b1-17.
LOCAL/REMOTE key effective during stop in drive mode. Parameter o2-01.
LED operator stop key priority selection. Parameter o2-02.
Enter press required after changing the keypad frequency reference. Parameter o2-05.

Know the Details of Safety Measures
Operation interlock when program mode is selected. Parameter b1-08.

Replace the Drive	
The removable terminal block with parameter backup function allows the transfer of parameter settings after drive replacement. ***Refer to Replacing the Drive on page 261***	

Drive a Synchronous PM Motor	
The V1000 drive can operate synchronous PM motors. ***Refer to Subchart A3: Operation with Permanent Magnet Motors on page 68***.	

Perform Auto-tuning
Automatic tuning sets motor parameters. ***Refer to Auto-Tuning on page 91***

Check the Maintenance Period Using Drive Monitors
The maintenance period of fans and capacitors can be checked drive monitors. ***Refer to Performance Life Monitors on page 258***.

Drive or Motor Faults are Displayed on a Digital Operator
Refer to Fault Displays, Causes, and Possible Solutions on page 227 and ***Refer to Alarm Codes, Causes, and Possible Solutions on page 236***.

Standards Compliance	
Refer to European Standards on page 346 and ***Refer to UL Standards on page 351***.	c UL US LISTED

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Receiving

This chapter describes the proper inspections to perform after receiving the drive and illustrates the different enclosure types and components.

1.1 Section Safety

CAUTION

Do not carry the drive by the front cover.

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

NOTICE

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

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

A motor connected to a 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 inverter duty and/or the motor service factor is adequate to accommodate the additional heating with the intended operating conditions.

1.2 Model Number and Nameplate Check

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

◆ Nameplate

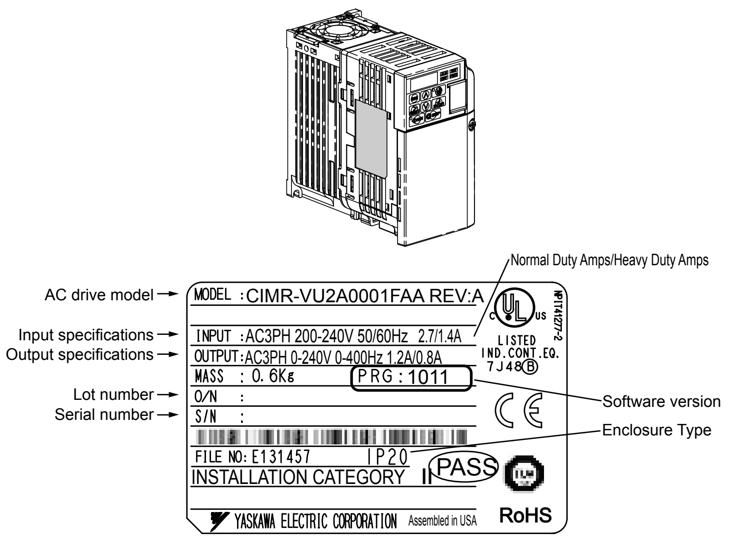
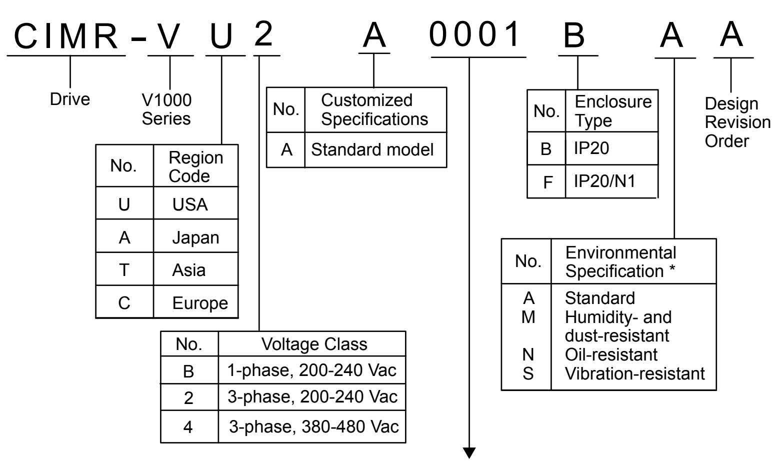


Figure 1.1 Nameplate Information



■ Single-Phase 200 V

Normal Duty		
No.	Max. Motor Capacity kW	Rated Output Current A
0001	0.2	1.2
0002	0.4	1.9
0003	0.75	3.3
0006	1.1	6
0010	2.2	9.6
0012	3.0	12
—	—	—

Heavy Duty		
No.	Max. Motor Capacity kW	Rated Output Current A
0001	0.1	0.8
0002	0.2	1.6
0003	0.4	3
0006	0.75	5
0010	1.5	8
0012	2.2	11
0018	3.7	17.5

Note: CIMR-V□BA0018 is available with a Heavy Duty rating only.

Receiving
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■ Three-Phase 200 V

Normal Duty		
No.	Max. Motor Capacity kW	Rated Output Current A
0001	0.2	1.2
0002	0.4	1.9
0004	0.75	3.5
0006	1.1	6
0010	2.2	9.6
0012	3.0	12
0020	5.5	19.6
0030	7.5	30
0040	11	40
0056	15	56
0069	18.5	69

Heavy Duty		
No.	Max. Motor Capacity kW	Rated Output Current A
0001	0.1	0.8
0002	0.2	1.6
0004	0.4	3
0006	0.75	5
0010	1.5	8
0012	2.2	11
0020	3.7	17.5
0030	5.5	25
0040	7.5	33
0056	11	47
0069	15	60

■ Three-Phase 400 V

Normal Duty		
No.	Max. Motor Capacity kW	Rated Output Current A
0001	0.4	1.2
0002	0.75	2.1
0003	1.5	4.1
0004	2.2	5.4
0005	3.0	6.9
0007	3.7	8.8
0011	5.5	11.1
0018	7.5	17.5
0023	11	23
0031	15	31
0038	18.5	38

Heavy Duty		
No.	Max. Motor Capacity kW	Rated Output Current A
0001	0.2	1.2
0002	0.4	1.8
0003	0.75	3.4
0004	1.5	4.8
0005	2.2	5.5
0007	3.0	7.2
0011	3.7	9.2
0018	5.5	14.8
0023	7.5	18
0031	11	24
0038	15	31

* Drives with these specifications do not guarantee complete protection for the specified environmental condition.

Note: *Refer to Component Names on page 20* for differences regarding enclosure protection types and component descriptions.

1.3 Drive Models and Enclosure Types

The following table describes drive enclosures and models.

Table 1.1 Drive Models and Enclosure Types

Voltage Class	Enclosure Type		
	IP20/Open-Chassis CIMR-V☐	IP20/ NEMA Type 1 CIMR-V☐	
Single-Phase 200 V Class	BA0001B	BA0001F	
	BA0002B	BA0002F	
	BA0003B	BA0003F	
	BA0006B	BA0006F	
	BA0010B	BA0010F	
	BA0012B	BA0012F	
	BA0018B	BA0018F	
Three-Phase 200 V Class	2A0001B	2A0001F	
	2A0002B	2A0002F	
	2A0004B	2A0004F	
	2A0006B	2A0006F	
	2A0010B	2A0010F	
	2A0012B	2A0012F	
	2A0020B	2A0020F	
	2A0030B	2A0030F	
	2A0040B	2A0040F	
	2A0056B	2A0056F	
	2A0069B	2A0069F	
Three-Phase 200 V Class	2A0001B	2A0001F	
	2A0002B	2A0002F	
	2A0004B	2A0004F	
	2A0006B	2A0006F	
	2A0010B	2A0010F	
	2A0012B	2A0012F	
	2A0020B	2A0020F	
	2A0030B	2A0030F	
	2A0040B	2A0040F	
	2A0056B	2A0056F	
	2A0069B	2A0069F	
Three-Phase 200 V Class	2A0001B	2A0001F	
	2A0002B	2A0002F	
	2A0004B	2A0004F	
	2A0006B	2A0006F	
	2A0010B	2A0010F	
	2A0012B	2A0012F	
	2A0020B	2A0020F	
	2A0030B	2A0030F	
	2A0040B	2A0040F	
	2A0056B	2A0056F	
	2A0069B	2A0069F	
	Three-Phase 400 V Class	4A0001B	4A0001F
		4A0002B	4A0002F
4A0004B		4A0004F	
4A0005B		4A0005F	
4A0007B		4A0007F	
4A0009B		4A0009F	
4A0011B		4A0011F	
4A0018B		4A0018F	
4A0023B		4A0023F	
4A0031B		4A0031F	
4A0038B		4A0038F	

TERMS

- Two types of enclosures are offered for V1000 drives.
- IP20/Open-Chassis models are often placed inside a large enclosure panel where the front of the drive is covered to prevent someone from accidentally touching charged components.
- IP20/NEMA Type 1 models mount to an indoor wall and not inside a large enclosure panel.

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1.4 Component Names

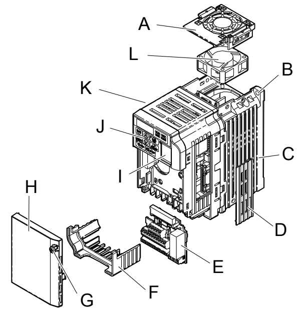
This section illustrates the drive components as they are mentioned in this manual.

Note: *Refer to Operation Instructions on page 95* for a detailed description of digital operator functions. The digital LED operator is not removable.

Note: The number of drive cooling fans varies depending on drive model.

◆ IP20/Open-Chassis

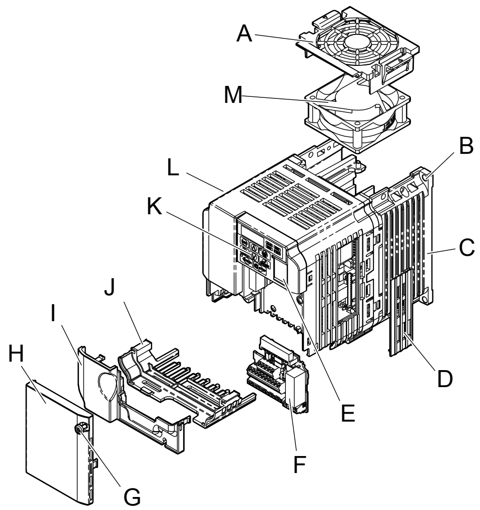
■ Single-phase AC200 V CIMR-V□BA0001B ~ 0003B
Three-phase AC200 V CIMR-V□2A0001B ~ 0006B



A – Fan cover
B – Mounting hole
C – Heatsink
D – Optional 24 V DC power supply connector cover
E – Terminal board *Refer to Control Circuit Terminal Block Functions on page 44*
F – Terminal cover
G – Front cover screw
H – Front cover
I – Comm port
J – LED operator *Refer to Using the Digital LED Operator on page 58*
K – Drive case
L – Cooling fan *Refer to Drive Cooling Fans on page 259*

Figure 1.2 Exploded View of IP20/Open-Chassis Type Components Three-Phase AC200 V CIMR-V□2A0006B

■ Single-Phase AC200 V CIMR-V□BA0006B ~ 0018B
Three-Phase AC200 V CIMR-V□2A0010B ~ 0020B
Three-Phase AC400 V CIMR-V□4A0001B ~ 0011B



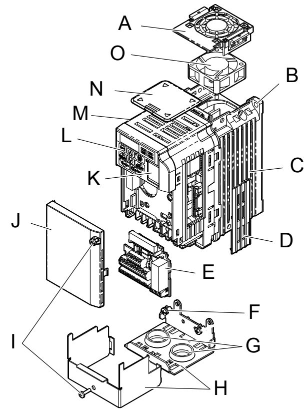
A – Fan cover
B – Mounting hole
C – Heatsink
D – Optional 24 V DC power supply connector cover
E – Comm port
F – Terminal board *Refer to Control Circuit Terminal Block Functions on page 44*
G – Front cover screw
H – Front cover
I – Terminal cover
J – Bottom cover
K – LED operator *Refer to Using the Digital LED Operator on page 58*
L – Case
M – Cooling fan *Refer to Drive Cooling Fans on page 259*

Figure 1.3 Exploded view of IP20/Open-Chassis Type Components Three-Phase AC200 V CIMR-V□2A0012B

Note: CIMR-V□BA0018B is supplied with two built-in cooling fans.

◆ IP20/NEMA Type 1 Enclosure

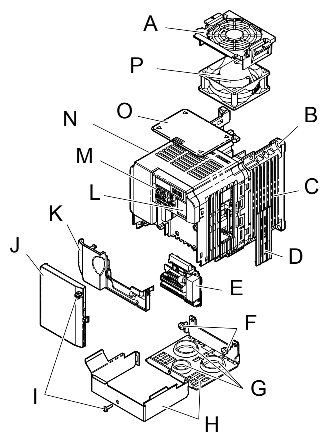
■ Single-phase AC200 V CIMR-V☐BA0001F ~ 0003F
Three-phase AC200 V CIMR-V☐2A0001F ~ 0006F



A – Fan cover
B – Mounting hole
C – Heatsink
D – Optional 24 V DC power supply connector cover
E – Terminal board *Refer to Control Circuit Terminal Block Functions on page 44*
F – Bottom cover screws
G – Rubber bushing
H – Bottom front cover
I – Front cover screws
J – Front cover
K – Comm port
L – LED operator *Refer to Using the Digital LED Operator on page 58*
M – Case
N – Top cover
O – Cooling fan *Refer to Drive Cooling Fans on page 259*

Figure 1.4 Exploded View of IP20/NEMA Type 1 Components
Three-phase AC200 V CIMR-V☐2A00062F

■ Single-phase AC200 V CIMR-V☐BA0006F ~ 0018F
Three-phase AC200 V CIMR-V☐2A0010F ~ 0020F
Three-phase AC400 V CIMR-V☐4A0001F ~ 0011F

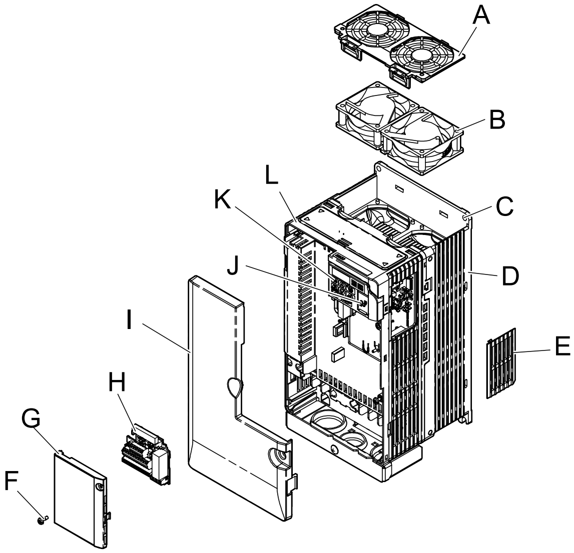


A – Fan cover
B – Mounting hole
C – Heatsink
D – Optional 24 V DC power supply connector cover
E – Terminal board *Refer to Control Circuit Terminal Block Functions on page 44*
F – Cover screws
G – Rubber bushing
H – Bottom cover
I – Front cover screws
J – Front cover
K – Terminal cover
L – Comm port
M – LED operator *Refer to Using the Digital LED Operator on page 58*
N – Case
O – Top cover
P – Cooling fan *Refer to Drive Cooling Fans on page 259*

Figure 1.5 Exploded view of IP20/NEMA Type 1 Components
Three-phase AC200 V CIMR-V☐2A0012F

Note: CIMR-V☐BA0018F is supplied with two built-in cooling fans.

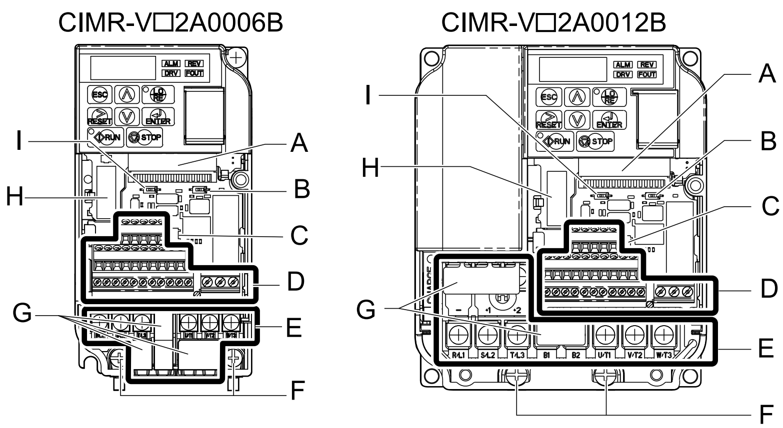
■ Three-phase AC200 V CIMR-V□2A0030F ~ 0069F Three-phase AC400 V CIMR-V□4A00018F ~ 0038F



A – Fan cover
B – Cooling fan *Refer to Drive Cooling Fans on page 259*
C – Mounting Hole
D – Heatsink
E – Cable cover
F – Front cover screws
G – Front cover
H – Terminal board *Refer to Control Circuit Terminal Block Functions on page 44*
I – Terminal cover
J – Comm port
K – LED operator *Refer to Using the Digital LED Operator on page 58*
L – Case

Figure 1.6 Exploded view of IP20/NEMA Type 1 Components Three-phase AC400 V CIMR-V□4A0018F

◆ Front Views



A – Terminal board connector
B – DIP switch S1 *Refer to Terminal A2 Switch on page 50*
C – DIP switch S3 *Refer to Sinking/ Sourcing Mode Switch on page 48*
D – Control circuit terminal *Refer to Control Circuit Wiring on page 44*
E – Main circuit terminal *Refer to Wiring the Main Circuit Terminal on page 43*
F – Ground terminal
G – Terminal cover
H – Option card connector *Refer to Connecting the Option Card on page 277*
I – DIP switch S2 *Refer to MEMOBUS/ Modbus Termination on page 51*

Figure 1.7 Front Views of Drives

2

Mechanical Installation

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

2.1 Section Safety

WARNING

Fire Hazard

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

Failure to comply could result in overheating and fire.

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

CAUTION

Crush Hazard

Do not carry the drive by the front cover.

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

NOTICE

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

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

It may be difficult to perform maintenance on the cooling fans of drives installed in a vertical row inside an enclosure.

Ensure adequate spacing at the top of the drive to perform cooling fan replacement when required.

Operating the drive 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 non-Yaskawa motor. If 100% torque is required continuously at low speed, consider using a special drive or vector motor. Select a motor that is compatible with the required load torque and operating speed range.

Do not operate motors above the maximum rated RPM.

Failure to comply may lead to bearing or other mechanical motor failures.

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 60 Hz, 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.
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.
When using an explosion-proof motor, it must be subject to an explosion-proof test in conjunction with the drive.
This is also applicable when an existing explosion-proof motor is to be operated with the drive. Since the drive itself is not explosion-proof, always install it in a safe place.
Do not use a drive for a single phase motor.
Replace the motor with a three phase motor.
If an oil-lubricated gearbox or speed reducer is used in the power transmission mechanism, oil lubrication will be affected when the motor operates only in the low speed range.
The power transmission mechanism will make noise and experience problems with service life and durability if the motor is operated at a speed higher than 60 Hz.

2.2 Mechanical Installation

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

◆ Installation Environment

To help prolong the optimum performance life of the drive, install the drive in the proper environment. The table below provides description of the appropriate environment for the drive.

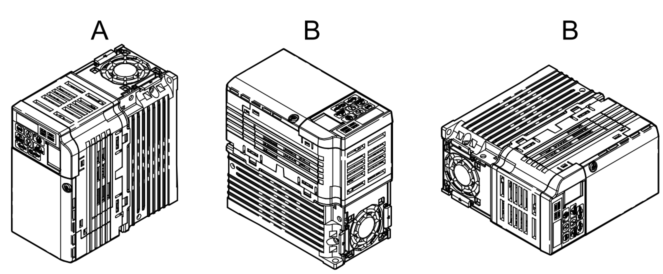
Table 2.1 Installation Environment

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

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

◆ Installation Orientation and Spacing

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

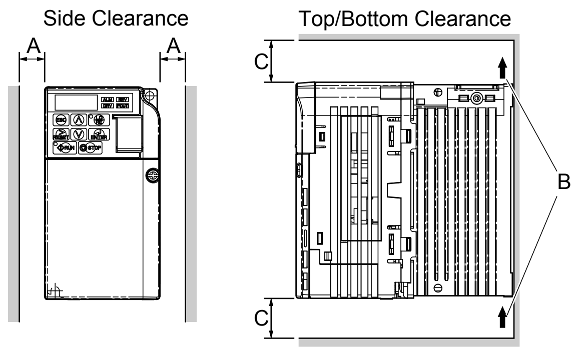


A – Correct **B – Incorrect**

Figure 2.1 Correct Installation Orientation

■ Single Drive Installation

To maintain sufficient space for airflow and wiring, refer to *Figure 2.2* . Install the heatsink against a closed surface to avoid diverting cooling air around the heatsink.



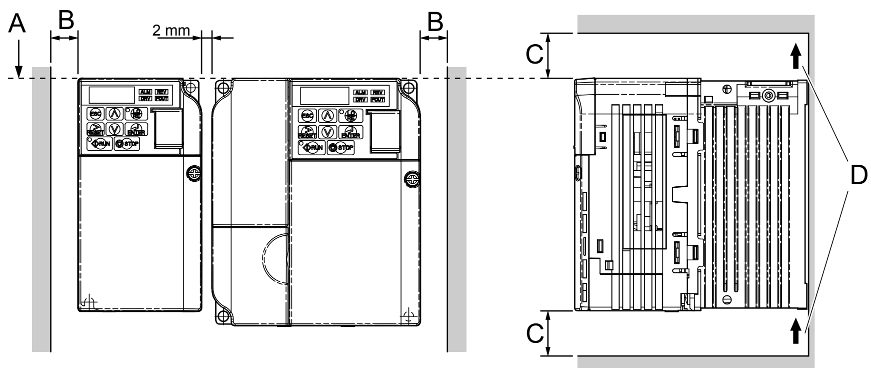
A – 30 mm minimum
B – Airflow direction
C – 100 mm minimum

Figure 2.2 Correct Installation Spacing

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

■ Multiple Drive Installation

When installing multiple drives into the same enclosure panel, mount the drives according to ***Figure 2.2***. When mounting drives with a minimum side-by-side clearance of 2 mm according to ***Figure 2.3***, derating must be considered and parameter L8-35 must be set. ***Refer to Parameter List on page 291***.



A – Line up the tops of the drives.
B – 30 mm minimum
C – 100 mm minimum
D – Airflow direction

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

Note: When installing drives of different sizes into the same enclosure panel, the tops of the drives should line up. Leave space between the top and bottom of stacked drives for cooling fan replacement if required. Using this method, it is possible to replace the cooling fans later.

NOTICE: *When drives with IP20/NEMA Type 1 enclosure are mounted side by side, the top covers of all units must be removed as shown in* ***Figure 2.4***.

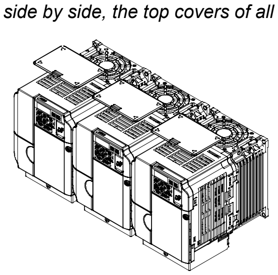


Figure 2.4 IP20/NEMA 1 Side-by-Side Mounting in Enclosure

◆ Removing and Attaching the Protective Covers

Refer to Electrical Installation on page 31, for information regarding the removal and reattachment of protective covers.

◆ Exterior and Mounting Dimensions

The table below matches each drive model with its appropriate drawing.

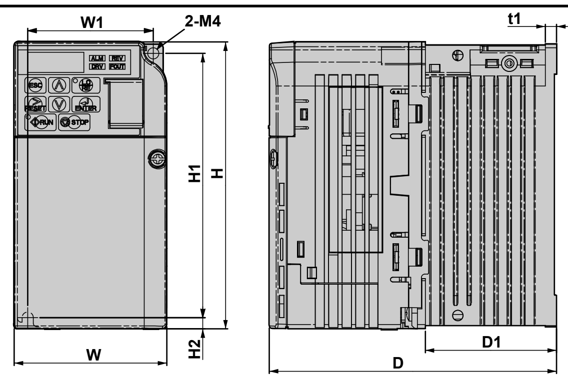
Table 2.2 Drive Models and Types

Protective Design	Drive Model CIMR-V☐ Single-Phase 200 V Class	Drive Model CIMR-V☐ Three-Phase 200 V Class	Drive Model CIMR-V☐ Three-Phase 400 V Class	Page
IP20/Open-Chassis	B☐0001B B☐0002B B☐0003B	2☐0001B 2☐0002B 2☐0004B 2☐0006B	–	28
	B☐0006B B☐0010B B☐0012B B☐0018B	2☐0010B 2☐0012B 2☐0020B	4☐0001B 4☐0002B 4☐0004B 4☐0005B 4☐0007B 4☐0009B 4☐0011B	29
	–	2☐0030B 2☐0040B 2☐0056B 2☐0069B	4☐0018B 4☐0023B 4☐0031B 4☐0038B	30
IP20/NEMA Type 1	B☐0001F B☐0002F B☐0003F	2☐0001F 2☐0002F 2☐0004F 2☐0006F	–	29
	B☐0006F B☐0010F B☐0012F B☐0018F	2☐0010F 2☐0012F 2☐0020F	4☐0001F 4☐0002F 4☐0004F 4☐0005F 4☐0007F 4☐0009F 4☐0011F	30
	–	2☐0030F 2☐0040F 2☐0056F 2☐0069F	4☐0018F 4☐0023F 4☐0031F 4☐0038F	30

Note: *Refer to Specifications on page 279* for information on the amount of heat generated by the drive and appropriate cooling methods.

■ IP20/Open-Chassis Drives

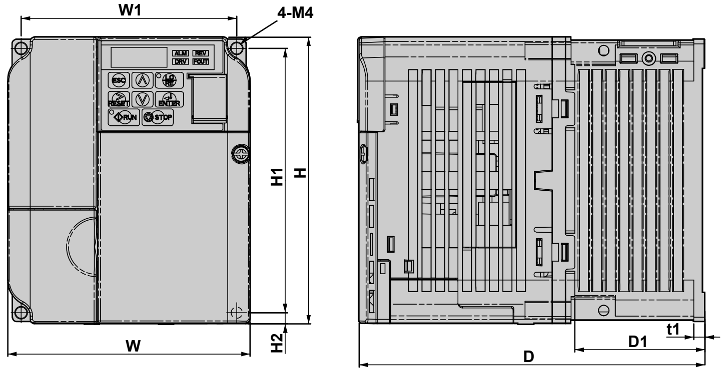
Table 2.3 IP20/Open-Chassis (without an EMC filter)



Voltage Class	Drive Model CIMR-V☐	W1	H1	W	H	D	t1	H2	D1	Weight (lb)
Single-Phase 200 V Class	BA0001B	2.20	4.65	2.68	5.04	2.99	0.12	0.20	0.26	1.32
	BA0002B	2.20	4.65	2.68	5.04	2.99	0.12	0.20	0.26	1.32
	BA0003B	2.20	4.65	2.68	5.04	4.65	0.20	0.20	1.52	2.20
Three-Phase 200 V Class	2A0001B	2.20	4.65	2.68	5.04	2.99	0.12	0.20	2.26	1.32
	2A0002B	2.20	4.65	2.68	5.04	2.99	0.12	0.20	2.26	1.32
	2A0004B	2.20	4.65	2.68	5.04	4.25	0.20	0.20	1.52	1.98
	2A0006B	2.20	4.65	2.68	5.04	5.04	0.20	0.20	2.30	2.43

Dimensions (in) apply to columns W1 through Weight.

Table 2.4 IP20/Open-Chassis (without an EMC filter)

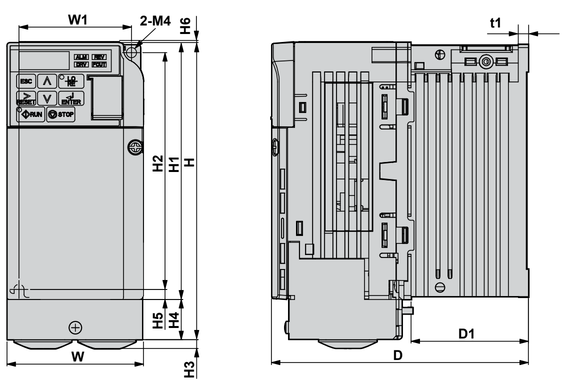


Dimensions

Voltage Class	Drive Model CIMR-V□	Dimensions (in)								
		W1	H1	W	H	D	t1	H2	D1	Weight (lb)
Single-Phase 200 V Class	BA0006B	3.78	4.65	4.25	5.04	5.41	0.20	0.20	2.28	3.7
	BA0010B	3.78	4.65	4.25	5.04	6.06	0.20	0.20	2.28	4.0
	BA0012B	5.04	4.65	5.51	5.04	6.42	0.20	0.20	2.56	5.3
	BA0018B	6.22	4.65	6.69	5.04	7.09	0.20	0.20	2.56	6.6
Three-Phase 200 V Class	2A0010B	3.78	4.65	4.25	5.04	5.08	0.20	0.20	2.28	3.7
	2A0012B	3.78	4.65	4.25	5.04	5.41	0.20	0.20	2.28	3.7
	2A0020B	5.04	4.65	5.51	5.04	5.63	0.20	0.20	2.56	5.3
Three-Phase 400 V Class	4A0001B	3.78	4.65	4.25	5.04	3.19	0.20	0.20	0.39	2.2
	4A0002B	3.78	4.65	4.25	5.04	3.90	0.20	0.20	1.10	2.6
	4A0004B	3.78	4.65	4.25	5.04	5.41	0.20	0.20	2.28	3.7
	4A0005B	3.78	4.65	4.25	5.04	6.06	0.20	0.20	2.28	3.7
	4A0007B	3.78	4.65	4.25	5.04	6.06	0.20	0.20	2.28	3.7
	4A0009B	3.78	4.65	4.25	5.04	6.06	0.20	0.20	2.28	3.7
	4A0011B	5.04	4.65	5.51	5.04	5.63	0.20	0.20	2.56	5.3

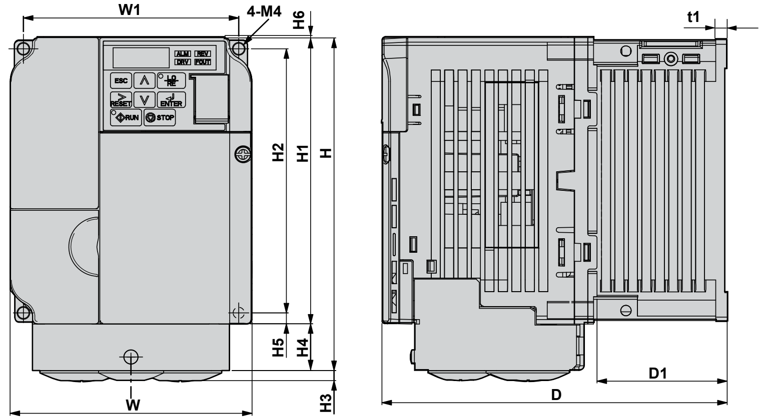
■ IP20/NEMA Type 1 Drives

Table 2.5 IP20/NEMA Type 1 (without an EMC filter)



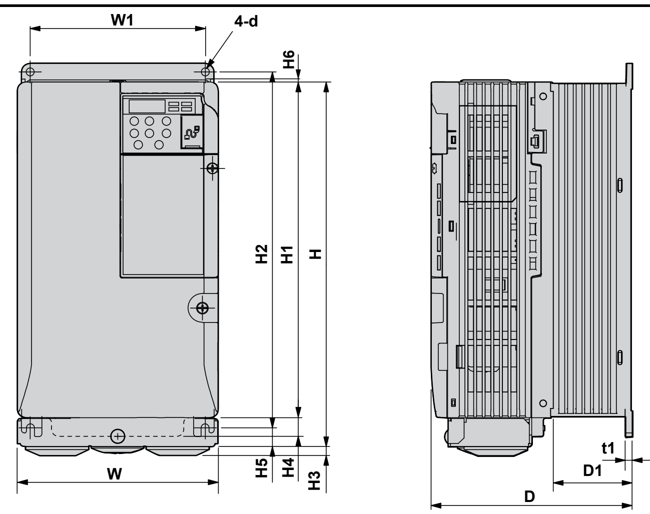
Voltage Class	Drive Model CIMR-V□	Dimensions (in)											
		W1	H2	W	H1	D	t1	H5	D1	H	H4	H3	H6	Weight (lb)
Single-Phase 200 V Class	BA0001F	2.20	4.65	2.68	5.10	2.99	0.12	0.20	0.26	5.89	0.79	0.16	0.06	1.8
	BA0002F	2.20	4.65	2.68	5.10	2.99	0.12	0.20	0.26	5.89	0.79	0.16	0.06	1.8
	BA0003F	2.20	4.65	2.68	5.10	4.65	0.20	0.20	1.54	5.89	0.79	0.16	0.06	2.6
Three-Phase 200 V Class	2A0001F	2.20	4.65	2.68	5.10	2.99	0.12	0.20	0.26	5.89	0.79	0.16	0.06	1.8
	2A0002F	2.20	4.65	2.68	5.10	2.99	0.12	0.20	0.26	5.89	0.79	0.16	0.06	1.8
	2A0004F	2.20	4.65	2.68	5.10	4.25	0.20	0.20	1.54	5.89	0.79	0.16	0.06	2.4
	2A0006F	2.20	4.65	2.68	5.10	5.04	0.20	0.20	2.32	5.89	0.79	0.16	0.06	2.9

Table 2.6 IP20/NEMA Type 1 (without an EMC filter)



Voltage Class	Drive Model CIMR-V☐	Dimensions (in)												
		W1	H2	W	H1	D	t1	H5	D1	H	H4	H3	H6	Weight (lb)
Single-Phase 200 V Class	BA0006F	3.78	4.65	4.25	5.10	5.41	0.20	0.20	2.28	5.89	0.79	0.16	0.06	4.2
	BA0010F	3.78	4.65	4.25	5.10	6.06	0.20	0.20	2.28	5.89	0.79	0.16	0.06	4.4
	BA0012F	5.04	4.65	5.51	5.24	6.42	0.20	0.20	2.56	6.02	0.79	0.19	0.20	5.7
	BA0018F	6.22	1.65	6.69	5.24	7.09	0.20	0.20	2.56	6.73	1.50	0.19	0.20	7.3
Three-Phase 200 V Class	2A0010F	3.78	4.65	4.25	5.10	5.08	0.20	0.20	2.28	5.89	0.79	0.16	0.06	4.2
	2A0012F	3.78	4.65	4.25	5.10	5.41	0.20	0.20	2.28	5.89	0.79	0.16	0.06	4.2
	2A0020F	5.04	4.65	5.51	5.24	5.63	0.20	0.20	2.56	6.02	0.79	0.19	0.20	5.7
Three-Phase 400 V Class	4A0001F	3.78	4.65	4.25	5.10	3.19	0.20	0.20	0.39	5.89	0.79	0.16	0.06	2.6
	4A0002F	3.78	4.65	4.25	5.10	3.90	0.20	0.20	1.10	5.89	0.79	0.16	0.06	3.1
	4A0004F	3.78	4.65	4.25	5.10	5.41	0.20	0.20	2.28	5.89	0.79	0.16	0.06	4.2
	4A0005F	3.78	4.65	4.25	5.10	6.06	0.20	0.20	2.28	5.89	0.79	0.16	0.06	4.2
	4A0007F	3.78	4.65	4.25	5.10	6.06	0.20	0.20	2.28	5.89	0.79	0.16	0.06	4.2
	4A0009F	3.78	4.65	4.25	5.10	6.06	0.20	0.20	2.28	5.89	0.79	0.16	0.06	4.2
	4A0011F	5.04	4.65	5.51	5.24	5.63	0.20	0.20	2.56	6.02	0.79	0.19	0.20	5.7

Table 2.7 IP20/NEMA Type 1 (without an EMC filter)



Voltage Class	Drive Model CIMR-V☐	Dimensions (in)													
		W1	H2	W	H1	D	t1	H5	D1	H	H4	H3	H6	d	Weight (lb)
Three-Phase 200 V Class	2A0030F	4.80	9.76	5.51	9.21	5.51	0.20	0.51	2.17	10.00	0.51	0.24	0.06	M5	8.38
	2A0040F	4.80	9.76	5.51	9.21	5.51	0.20	0.51	2.17	10.00	0.51	0.24	0.06	M5	8.38
	2A0056F	6.30	11.18	7.09	10.63	6.42	0.20	0.51	2.95	11.42	0.59	0.24	0.06	M5	12.13
	2A0069F	7.56	13.23	8.66	12.60	7.36	0.20	0.87	3.07	13.78	0.59	0.28	0.06	M5	20.28
Three-Phase 400 V Class	4A0018F	4.80	9.76	5.51	9.21	5.51	0.20	0.51	2.17	10.00	0.51	0.24	0.06	M5	8.38
	4A0023F	4.80	9.76	5.51	9.21	5.51	0.20	0.51	2.17	10.00	0.51	0.24	0.06	M5	8.38
	4A0031F	6.30	11.18	7.09	10.63	5.63	0.20	0.51	2.17	11.42	0.59	0.24	0.06	M5	11.46
	4A0038F	6.30	11.18	7.09	10.63	6.42	0.20	0.51	2.95	11.42	0.51	0.24	0.06	M5	12.13

3

Electrical Installation

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

3.1 Section Safety

DANGER

Electrical Shock Hazard

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

Failure to comply will result in death or serious injury.

WARNING

Electrical Shock Hazard

Do not operate equipment with covers removed.

Failure to comply could result in death or serious injury.

The diagrams in this section may 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 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 wiring terminals, disconnect all power to the equipment. The internal capacitor remains charged even after the power supply is turned off. The charge indicator LED will extinguish when the DC bus voltage is below 50 Vdc. To prevent electric shock, wait at least five minutes after all indicators are off and measure the DC bus voltage level to confirm 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 improper combustible materials.

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

Attach the drive to metal or other noncombustible material.

Do not use an improper voltage source.

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

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

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.
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 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.

3.2 Standard Connection Diagram

Connect the drive and peripheral devices as shown in *Figure 3.1* . It is possible to run the drive via the digital operator without connecting digital I/O wiring. This section does not discuss drive operation; *Refer to Start-Up Programming & Operation on page 55* for instructions on operating the drive.

NOTICE: *Inadequate branch short circuit protection could result in damage to the drive. Install adequate branch circuit short circuit protection per applicable codes. The drive is suitable for circuits capable of delivering not more than 30,000 RMS symmetrical amperes, 240 Vac maximum (200 V Class) and 480 Vac maximum (400 V Class).*

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 an inverter duty motor. Failure to comply could lead to motor insulation breakdown.*

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

NOTICE: *The minimum load for the multi-function relay output MA-MB-MC is 10 mA. If a circuit requires less than 10 mA (reference value), connect it to a photocoupler output (P1, P2, PC). Improper application of peripheral devices could result in damage to the photocoupler output of the drive.*

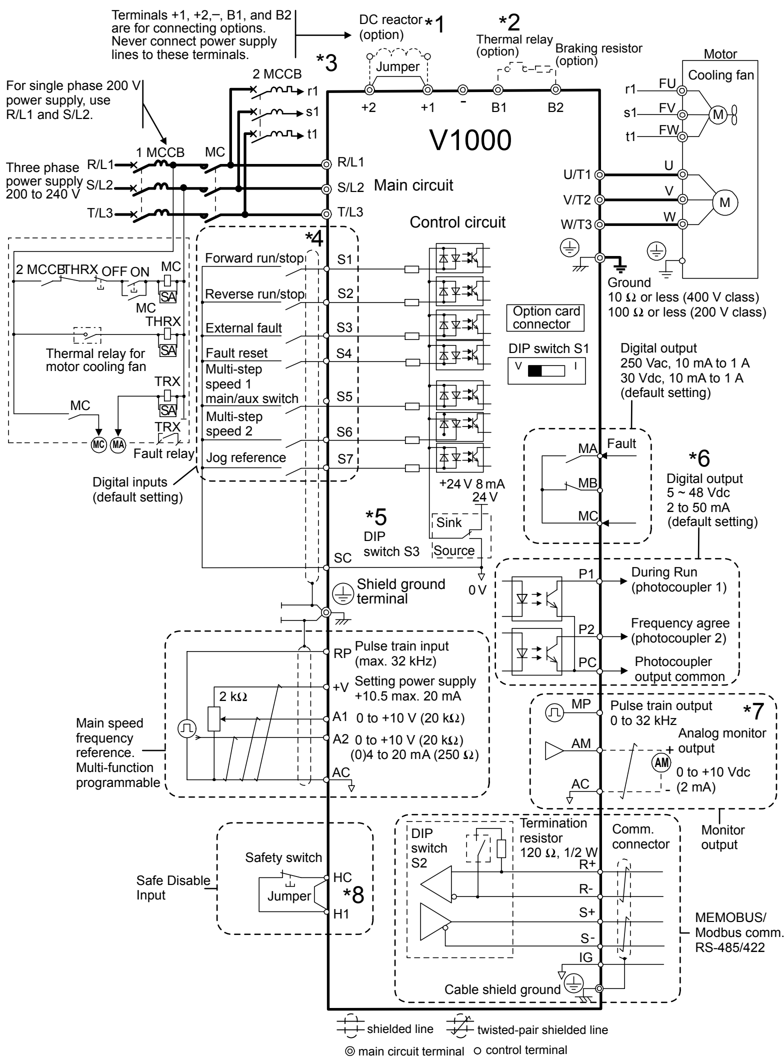


Figure 3.1 Drive Standard Connection Diagram

*1. Remove the jumper when installing an optional DC reactor.
*2. The MC on the input side of the main circuit should open when the thermal relay is triggered.
*3. Self-cooled motors do not require separate cooling fan motor wiring.
*4. Connected using sequence input signal (S1 to S7) from NPN transistor; Default: sink mode (0 V com)
*5. Use only a +24 V internal power supply in sinking mode; the source mode requires an external power supply. *Refer to I/O Connections on page 48*.
*6. Minimum load: 5 Vdc, 10mA (reference value)
*7. Monitor outputs work with devices such as analog frequency meters, ammeters, voltmeters and wattmeters; they are intended for use as a feedback-type of signal.
*8. Disconnect the wire jumper between HC and H1 when utilizing the safety input.

WARNING! *Sudden Movement Hazard. Do not close the wiring for the control circuit unless the multifunction input terminal parameter is properly set (S5 for 3-wire; H1-05 = "0"). Improper sequencing of run/stop circuitry could result in death or serious injury from moving equipment.*

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

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

WARNING! *When the application preset function is executed (or A1-06 is set to any value other than 0) the drive I/O terminal functions change. This may cause unexpected operation and potential damage to equipment or injury.*

Figure 3.2 illustrates an example of a 3-wire sequence.

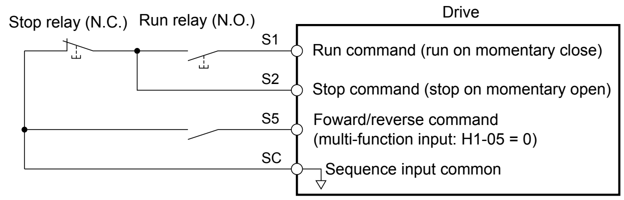


Figure 3.2 3-Wire Sequence

3.3 Main Circuit Connection Diagram

Refer to *Figure 3.3* and *Figure 3.4* for standard drive connection diagrams. Connections may vary based on drive capacity. The main circuit DC power supply powers the control circuit.

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

◆ Single-Phase 200 V Class (CIMR-V☐BA0001 ~ 0012)

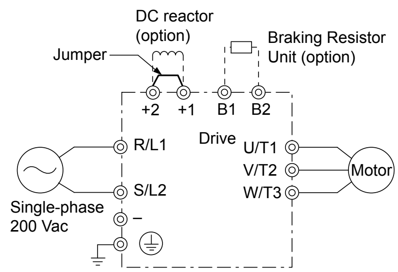


Figure 3.3 Connecting Main Circuit Terminals

NOTICE: *Do not connect T/L3 terminal when using single-phase power supply input. Incorrect wiring may damage the drive.*

◆ Three-Phase 200 V Class (CIMR-V☐2A0001 ~ 0069) Three-Phase 400 V Class (CIMR-V☐4A0001 ~ 0038)

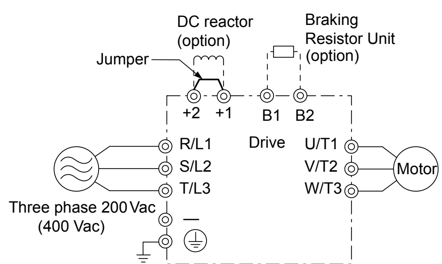


Figure 3.4 Connecting Main Circuit Terminals

3.4 Terminal Block Configuration

The figures in this section provide quick reference and detailed illustrations of the main and control circuit terminal block configurations.

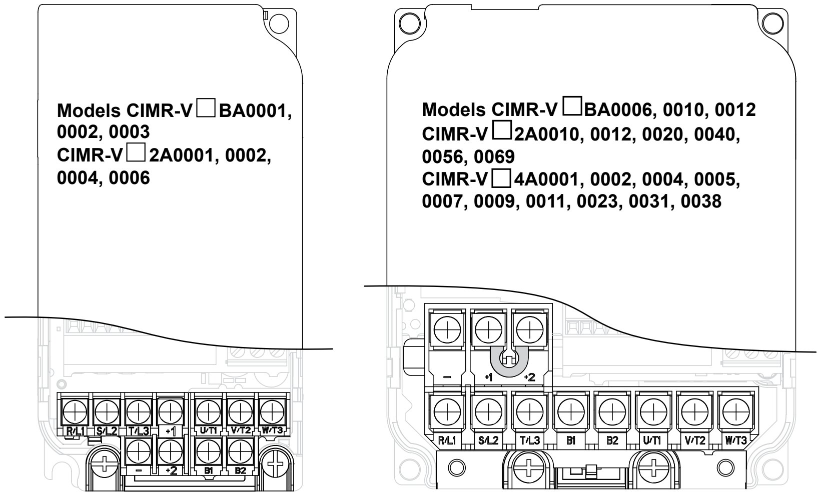


Figure 3.5 Main Circuit Terminal Block Configurations

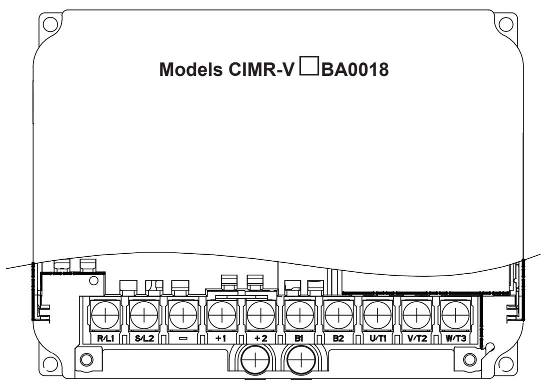


Figure 3.6 Main Circuit Terminal Block Configurations

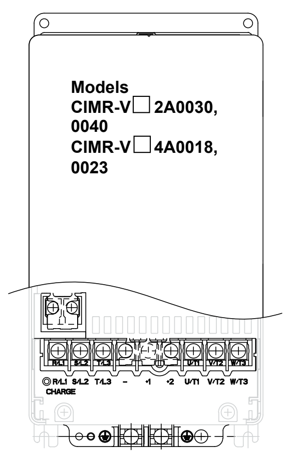


Figure 3.7 Main Circuit Terminal Block Configurations

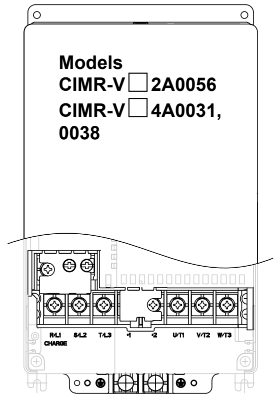


Figure 3.8 Main Circuit Terminal Block Configurations

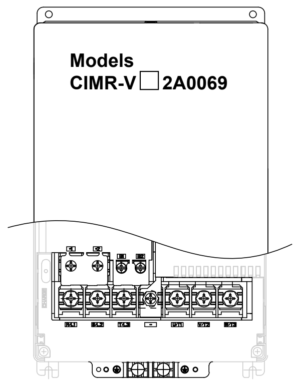


Figure 3.9 Main Circuit Terminal Block Configurations

3.5 Protective Covers

Follow the procedure below to remove the protective covers before wiring the drive and to reattach the covers after wiring is complete.

◆ IP20/Open-Chassis

■ Removing the Protective Covers

1. Loosen the screw that locks the front cover in place to remove.

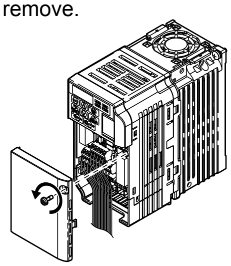


Figure 3.10 Remove the Front Cover on an IP20/Open-Chassis Drive

2. Apply pressure to the tabs on each side of the terminal cover. Pull the terminal cover away from the drive while pushing in on the tabs to pull the cover free.

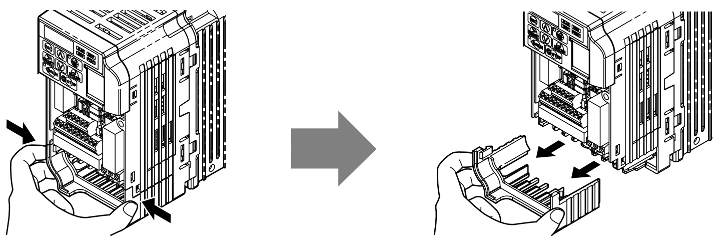


Figure 3.11 Remove the Terminal Cover on an IP20/Open-Chassis Drive

■ Reattaching the Protective Covers

Properly connect all wiring and route power wiring away from control signal wiring. Reattach all protective covers when wiring is complete. Apply only a small amount of pressure to lock the cover back into place.

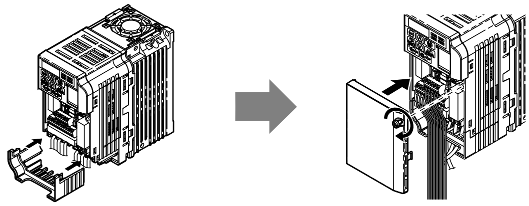


Figure 3.12 Reattach the Protective Covers on an IP20/Open-Chassis Drive

◆ IP20/NEMA Type 1

■ Removing the Protective Covers on an IP20/NEMA Type 1 design

1. Loosen the screw on the front cover to remove the front cover.

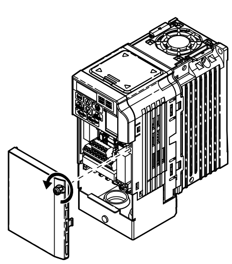


Figure 3.13 Remove the Front Cover on an IP20/NEMA Type 1 Drive

2. Loosen the screw on the terminal cover (*Figure 3.14* , **B**) to remove the terminal cover and expose the conduit bracket (*Figure 3.14* , **A**).

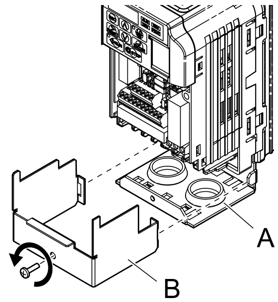


Figure 3.14 Remove the Terminal Cover on an IP20/NEMA Type 1 Drive

3. Loosen two screws attaching the conduit bracket **(** ***Figure 3.15*** **,** ***A*****)** to remove.

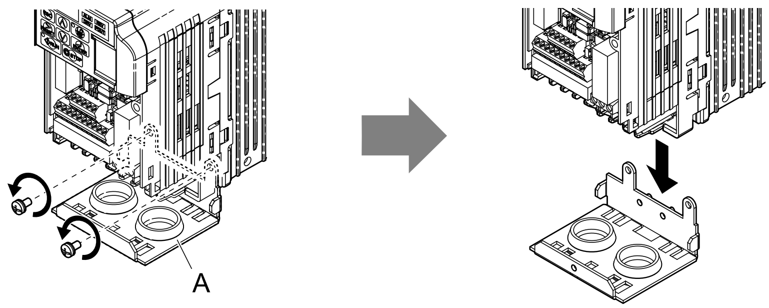
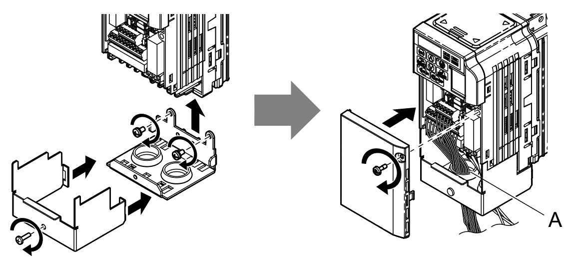


Figure 3.15 Remove the Conduit Bracket on an IP20/Open-Chassis Drive

■ Reattaching the Protective Covers

Pass power wiring and control signal wiring through the exit holes on the bottom of the conduit bracket of the drive. Place power wiring and control signal wiring in separate conduits. Properly connect all wiring after installing the drive and connecting other devices. Reattach all protective covers when wiring is complete.



A – Pass power wiring and control signal wiring through different exit holes at the bottom of the drive.

Figure 3.16 Reattach the Protective Covers and Conduit Bracket on an IP20/NEMA Type 1 Drive

3.6 Main Circuit Wiring

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

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

◆ Main Circuit Terminal Functions

Table 3.1 Main Circuit Terminal Functions

Terminal	Type	Function	Reference
R/L1	Main circuit power supply input	Connects line power to the drive. Drives with single phase 200 V input power use terminals R/L1 and S/L2 only (T/L3 must not be used).	36
S/L2			
T/L3			
U/T1	Drive output	Connects to the motor.	43
V/T2			
W/T3			
B1	Braking resistor	Available for connecting a braking resistor or the braking resistor unit option.	52
B2			
+1	DC reactor connection	These terminals are shorted at shipment. Remove the shorting bar between +1 and +2 when connecting to this terminal.	270
+2			
+1	DC power supply input	For connecting a DC power supply.	-
–			
⏚ (2 terminals)	Ground	Grounding Terminal For 200 V class: 100 Ω or less For 400 V class: 10 Ω or less	43

◆ Wire Gauges and Tightening Torque

Select the appropriate wires and crimp terminals from *Table 3.2* through *Table 3.4* .

Note: **1.** Wire gauge recommendations based on drive continuous current ratings using 75°C 600 Vac vinyl-sheathed wire assuming ambient temperature within 30°C and wiring distance less than 100 m.

2. Terminals +1, +2, –, B1 and B2 are for connecting optional devices such as a DC reactor or braking resistor. Do not connect other non-specified devices to these terminals.

- Consider the amount of voltage drop when selecting wire gauges. Increase the wire gauge when the voltage drop is greater than 2% of motor rated voltage. Ensure the wire gauge is suitable for the terminal block. Use the following formula to calculate the amount of voltage drop:
- Line drop voltage (V) = $\sqrt{3}$ x wire resistance (Ω/km) x wire length (m) x current (A) x 10^{-3}
- Refer to instruction manual TOBPC72060000 for braking unit or braking resistor unit wire gauges.
- *Refer to UL Standards Compliance on page 351* for information on UL compliance.

■ Single-Phase 200 V Class

Table 3.2 Wire Gauge and Torque Specifications

Model CIMR-V☐BA	Terminal	Screw Size	Tightening Torque N•m (lb.in.)	Applicable Gauge mm² (AWG)	Recommended Gauge mm² (AWG)	Line Type
0001 0002 0003	R/L1, S/L2, U/T1, V/T2, W/T3, –, +1, +2, B1, B2, ⏚	M3.5	0.8 to 1.0 (7.1 to 8.9)	0.75 to 2.0 (18 to 14)	2 (14)	Note 1 on page 41
0006	R/L1, S/L2, U/T1, V/T2, W/T3, –, +1, +2, B1, B2, ⏚	M4	1.2 to 1.5 (10.6 to 13.3)	2.0 to 5.5 (14 to 10)	2 (14)	Note 1 on page 41
0010	R/L1, S/L2, U/T1, V/T2, W/T3, ⏚	M4	1.2 to 1.5 (10.6 to 13.3)	2.0 to 5.5 (14 to 10)	3.5 (12)	Note 1 on page 41
	–, +1, +2, B1, B2,	M4	1.2 to 1.5 (10.6 to 13.3)	2.0 to 5.5 (14 to 10)	5.5 (10)	Note 1 on page 41
0012	R/L1, S/L2, U/T1, V/T2, W/T3, –, +1, +2, B1, B2, ⏚	M4	1.2 to 1.5 (10.6 to 13.3)	2.0 to 5.5 (14 to 10)	5.5 (10)	Note 1 on page 41

■ Three-Phase 200 V Class

Table 3.3 Wire Gauge and Torque Specifications

Model CIMR-V☐2A	Terminal	Screw Size	Tightening Torque N•m (lb.in.)	Applicable Gauge mm² (AWG)	Recommended Gauge mm² (AWG)	Line Type
0001 0002 0004 0006	R/L1, S/L2, T/L3, U/T1, V/T2, W/T3, –, +1, +2, B1, B2, ⏚	M3.5	0.8 to 1.0 (7.1 to 8.9)	0.75 to 2.0 (18 to 14)	2 (14)	Note 1 on page 41
0010	R/L1, S/L2, T/L3, U/T1, V/T2, W/T3, –, +1, +2, B1, B2	M4	1.2 to 1.5 (10.6 to 13.3)	2.0 to 5.5 (14 to 10)	2 (14)	Note 1 on page 41
	⏚	M4	1.2 to 1.5 (10.6 to 13.3)	2.0 to 5.5 (14 to 10)	3.5 (12)	Note 1 on page 41
0012	R/L1, S/L2, T/L3, U/T1, V/T2, W/T3, –, +1, +2, B1, B2, ⏚	M4	1.2 to 1.5 (10.6 to 13.3)	2.0 to 5.5 (14 to 10)	3.5 (12)	Note 1 on page 41
0020	R/L1, S/L2, T/L3, U/T1, V/T2, W/T3, –, +1, +2, B1, B2, ⏚	M4	1.2 to 1.5 (10.6 to 13.3)	2.0 to 5.5 (14 to 10)	5.5 (10)	Note 1 on page 41

Model CIMR-V☐2A	Terminal	Screw Size	Tightening Torque N•m (lb.in.)	Applicable Gauge mm^2 (AWG)	Recommended Gauge mm^2 (AWG)	Line Type
0030	R/L1, S/L2, T/L3, U/T1, V/T2, W/T3, -, +1, +2	M4	1.2 to 1.5 (10.6 to 13.3)	5.5 to 14 (10 to 6)	8 (8)	Note 1 on page 41
	B1, B2	M4	1.2 to 1.5 (10.6 to 13.3)	2.0 to 5.5 (14 to 10)	5.5 (10)	Note 1 on page 41
	⏚	M5	2 to 2.5 (17.7 to 22.1)	5.5 to 14 (10 to 6)	8 (8)	Note 1 on page 41
0040	R/L1, S/L2, T/L3, U/T1, V/T2, W/T3, -, +1, +2	M4	1.2 to 1.5 (10.6 to 13.3)	5.5 to 14 (10 to 6)	14 (6)	Note 1 on page 41
	B1, B2	M4	1.2 to 1.5 (10.6 to 13.3)	2.0 to 5.5 (14 to 10)	5.5 (10)	Note 1 on page 41
	⏚	M5	2 to 2.5 (17.7 to 22.1)	5.5 to 14 (10 to 6)	8 (8)	Note 1 on page 41
0056	R/L1, S/L2, T/L3, U/T1, V/T2, W/T3, -, +1, +2	M6	4 to 6 (35.4 to 53.1)	14 to 22 (6 to 4)	22 (4)	Note 1 on page 41
	B1, B2	M5	2 to 2.5 (17.7 to 22.1)	5.5 to 8 (10 to 8)	8 (8)	Note 1 on page 41
	⏚	M6	4 to 6 (35.4 to 53.1)	14 to 22 (6 to 4)	22 (4)	Note 1 on page 41
0069	R/L1, S/L2, T/L3, U/T1, V/T2, W/T3, -, +1, +2	M8	9 to 11 (79.7 to 11.0)	8 to 38 (8 to 2)	38 (2)	Note 1 on page 41
	B1, B2	M5	2 to 2.5 (17.7 to 22.1)	8 to 14 (8 to 6)	14 (6)	Note 1 on page 41
	⏚	M6	4 to 6 (35.4 to 53.1)	8 to 22 (8 to 4)	22 (4)	Note 1 on page 41

■ Three-Phase 400 V Class

Table 3.4 Wire Gauge and Torque Specifications

Model CIMR-V☐4A	Terminal	Screw Size	Tightening Torque N•m (lb.in.)	Applicable Gauge mm^2 (AWG)	Recommended Gauge mm^2 (AWG)	Line Type
0001 0002 0004 0005 0007	R/L1, S/L2, T/L3, U/T1, V/T2, W/T3, –, +1, +2, B1, B2, ⏚	M4	1.2 to 1.5 (10.6 to 13.3)	2.0 to 5.5 (14 to 10)	2 (14)	Note 1 on page 41
0009	R/L1, S/L2, T/L3, U/T1, V/T2, W/T3, –, +1, +2, B1, B2	M4	1.2 to 1.5 (10.6 to 13.3)	2.0 to 5.5 (14 to 10)	2 (14)	Note 1 on page 41
	⏚	M4	1.2 to 1.5 (10.6 to 13.3)	2.0 to 5.5 (14 to 10)	3.5 (12)	Note 1 on page 41
0011	R/L1, S/L2, T/L3, U/T1, V/T2, W/T3, –, +1, +2, B1, B2	M4	1.2 to 1.5 (10.6 to 13.3)	2.0 to 5.5 (14 to 10)	2 (14)	Note 1 on page 41
	⏚	M4	1.2 to 1.5 (10.6 to 13.3)	2.0 to 5.5 (14 to 10)	3.5 (12)	Note 1 on page 41
0018	R/L1, S/L2, T/L3, U/T1, V/T2, W/T3, -, +1, +2	M4	1.2 to 1.5 (10.6 to 13.3)	2.0 to 5.5 (14 to 10)	5.5 (10)	Note 1 on page 41
	B1, B2	M4	1.2 to 1.5 (10.6 to 13.3)	2.0 to 5.5 (14 to 10)	5.5 (10)	Note 1 on page 41
	⏚	M5	2 to 2.5 (17.7 to 22.1)	5.5 to 14 (10 to 6)	5.5 (10)	Note 1 on page 41
0023	R/L1, S/L2, T/L3, U/T1, V/T2, W/T3, -, +1, +2	M4	1.2 to 1.5 (10.6 to 13.3)	5.5 to 14 (10 to 6)	8 (8)	Note 1 on page 41
	B1, B2	M4	1.2 to 1.5 (10.6 to 13.3)	2.0 to 5.5 (14 to 10)	5.5 (10)	Note 1 on page 41
	⏚	M5	2 to 2.5 (17.7 to 22.1)	5.5 to 14 (10 to 6)	5.5 (10)	Note 1 on page 41
0031	R/L1, S/L2, T/L3, U/T1, V/T2, W/T3, -, +1, +2	M5	2 to 2.5 (17.7 to 22.1)	5.5 to 14 (10 to 6)	8 (8)	Note 1 on page 41
	B1, B2	M5	2 to 2.5 (17.7 to 22.1)	5.5 to 8 (10 to 8)	8 (8)	Note 1 on page 41
	⏚	M6	4 to 6 (35.4 to 53.1)	5.5 to 14 (10 to 6)	8 (8)	Note 1 on page 41
0038	R/L1, S/L2, T/L3, U/T1, V/T2, W/T3, -, +1, +2	M5	2 to 2.5 (17.7 to 22.1)	5.5 to 14 (10 to 6)	14 (6)	Note 1 on page 41
	B1, B2	M5	2 to 2.5 (17.7 to 22.1)	5.5 to 8 (10 to 8)	8 (8)	Note 1 on page 41
	⏚	M6	4 to 6 (35.4 to 53.1)	5.5 to 14 (10 to 6)	8 (8)	Note 1 on page 41

◆ Main Circuit Terminal Power Supply and Motor Wiring

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

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

NOTICE: *Do not connect phase-advancing capacitors or LC/RC noise filters to the output circuits. Improper application of noise filters could result in damage to the drive.*

NOTICE: *Do not connect the AC power line to the output motor terminals of the drive. Failure to comply could result in death or serious injury by fire as a result of drive damage from line voltage application to output terminals.*

■ Cable Length Between Drive and Motor

When the cable length between the drive and the motor is too long (especially at low frequency output), note that the cable voltage drop may cause reduced motor torque. Drive output current will increase as the leakage current from the cable increases. An increase in leakage current may trigger an overcurrent situation and weaken the accuracy of the current detection.

Adjust the drive carrier frequency according to the following table. If the motor wiring distance exceeds 100 m because of the system configuration, reduce the ground currents. *Refer to Carrier Frequency Selection: C6-02 on page 82*.

Refer to *Table 3.5* to set the carrier frequency to an appropriate level.

Table 3.5 Cable Length Between Drive and Motor

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

Note: When setting carrier frequency, calculate the cable length as the total distance of wiring to all connected motors when running multiple motors from a single drive.

■ Ground Wiring

Follow the precautions to wire the ground for one drive or a series of drives.

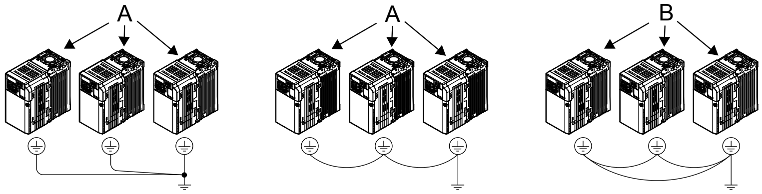
WARNING! *Electrical Shock Hazard. Always use a ground wire that complies with technical standards on electrical equipment and minimize the length of the ground wire. Improper equipment grounding may cause dangerous electrical potentials on equipment chassis, which could result in death or serious injury.*

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

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

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

Refer to *Figure 3.17* when using multiple drives. Do not loop the ground wire.



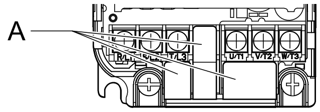
A – Correct **B – Incorrect**

Figure 3.17 Multiple Drive Wiring

■ Wiring the Main Circuit Terminal

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

Note: **1.** A cover placed over the DC Bus and braking circuit terminals prior to shipment helps prevent miswiring. Cut away covers as needed for terminals with a needle-nose pliers.



A – Protective Cover to Prevent Miswiring

2. The ground terminal screw on IP20/NEMA Type 1 holds the protective cover in place.

Main Circuit Connection Diagram

For drive main power circuit connections, refer to *Figure 3.3* and *Figure 3.4* on page *36*.

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

Electrical Installation

3

3.7 Control Circuit Wiring

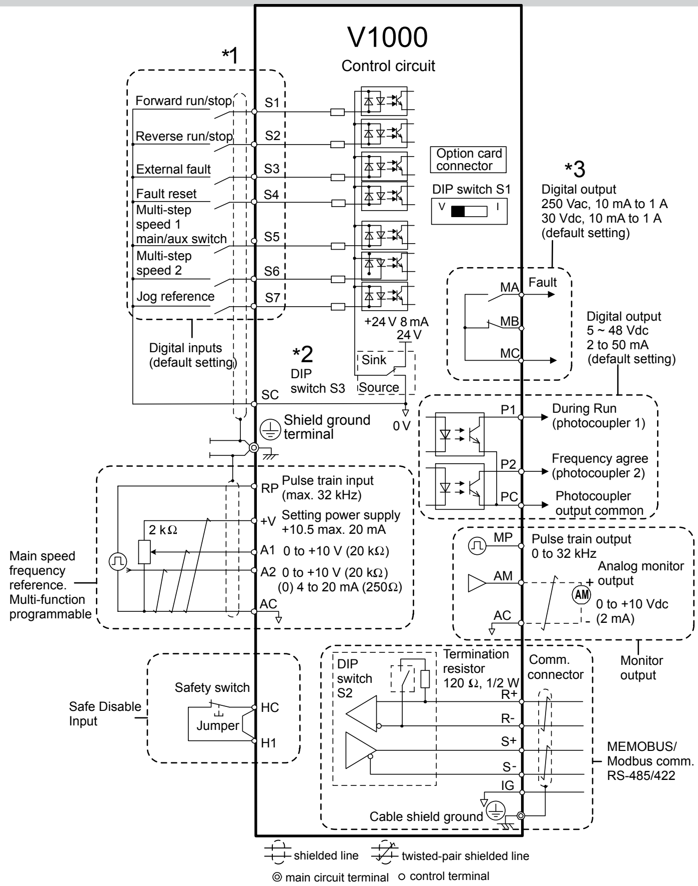


Figure 3.18 Control Circuit Connection Diagram

*1. Connected using sequence input signal (S1 to S7) from NPN transistor; Default: sink mode (0 V com)

*2. Use only a +24 V internal power supply in sinking mode; the source mode requires an external power supply. *Refer to I/O Connections on page 48*.

*3. Minimum load: 5 Vdc, 10mA (reference value)

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

◆ Control Circuit Terminal Block Functions

Drive parameters determine which functions apply to the multi-function digital inputs (S1 to S7), multi-function digital outputs (MA, MB), multi-function pulse inputs and outputs (RP, MP) and multi-function photocoupler outputs (P1, P2). The default is called out next to each terminal.

Refer to ***Figure 3.18*** *on page* ***44*** *.*

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

WARNING! *Confirm the drive I/O signals and external sequence before starting test run. Setting parameter A1-06 may change the I/O terminal function automatically from the factory setting.* ***Refer to Application Presets on page 70****. Failure to comply may result in death or serious injury.*

NOTICE: *Do not switch an input contactor more often than once every 30 minutes. Improper equipment sequencing could shorten useful life of the drive electrolytic capacitors and circuit relays. Normally the drive I/O should be used to stop and start the motor.*

■ Input Terminals

Table 3.6 Control Circuit Input Terminals

Type	No.	Terminal Name (Function)	Function (Signal Level) Default Setting
Multi-Function Digital Inputs	S1	Multi-function input 1 (Closed: Forward run, Open: Stop)	Photocoupler 24 Vdc, 8 mA **Note:** Drive preset to sinking mode. When using source mode, set DIP switch S3 to allow for a 24 Vdc (±10%) external power supply. Refer to page *48*.
	S2	Multi-function input 2 (Closed: Reverse run, Open: Stop)	
	S3	Multi-function input 3 (External fault (N.O.))	
	S4	Multi-function input 4 (Fault reset)	
	S5	Multi-function input 5 (Multi-step speed reference 1)	
	S6	Multi-function input 6 (Multi-step speed reference 2)	
	S7	Multi-function input 7 (Jog reference)	
	SC	Multi-function input common (Control common)	Sequence common
Safety Input	HC	Power supply for safety input command	+24 Vdc (max 10 mA allowed)
	H1	Safety input command	Open: Coast to stop safety input Closed: Normal operation **Note:** Disconnect wire jumper between HC and H1 when using safety input.

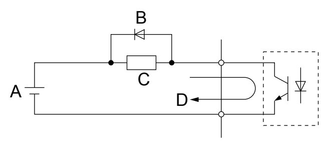
Type	No.	Terminal Name (Function)	Function (Signal Level) Default Setting
Main Frequency Reference Input	RP	Multi-function pulse train input (frequency reference)	Response frequency: 0.5 to 32 kHz (Duty Cycle: 30 to 70%) (High level voltage: 3.5 to 13.2 Vdc) (Low level voltage: 0.0 to 0.8 Vdc) (input impedance: 3 kΩ)
	+V	Analog input power supply	+10.5 Vdc (max allowable current 20 mA)
	A1	Multi-function analog input (frequency reference)	Input voltage 0 to +10 Vdc (20 kΩ) resolution1/1000
	A2	Multi-function analog input (frequency reference)	Input voltage or input current (Selected by DIP switch S1) 0 to +10 Vdc (20 kΩ), Resolution: 1/1000 4 to 20 mA (250 Ω) or 0 to 20 mA (250 Ω), Resolution: 1/500
	AC	Frequency reference common	0 Vdc

■ Output Terminals

Table 3.7 Control Circuit Output Terminals

Type	No.	Terminal Name (Function)	Function (Signal Level)Default Setting
Multi-Function Digital Output	MA	N.O. (fault)	Digital output 30 Vdc, 10 mA to 1 A; 250 Vac, 10 mA to 1 A Minimum load: 5 Vdc, 10 mA (reference value)
	MB	N.C. output (fault)	
	MC	Digital output common	
Multi-Function Photocoupler Output	P1	Photocoupler output 1 (during run)	Photocoupler output 48 Vdc, 2 to 50 mA
	P2	Photocoupler output 2 (Frequency agree)	
	PC	Photocoupler output common	
Monitor Output	MP	Pulse train output (input frequency)	32 kHz (max)
	AM	Analog monitor output	0 to 10 Vdc (2 mA or less) Resolution: 1/1000
	AC	Monitor common	0 V

Connect a suppression diode as shown in *Figure 3.19* when driving a reactive load such as a relay coil. Ensure the diode rating is greater than the circuit voltage.



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

Figure 3.19 Connecting a Suppression Diode

■ Serial Communication Terminals

Table 3.8 Control Circuit Terminals: Serial Communications

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

◆ Removable Terminal Block Configuration

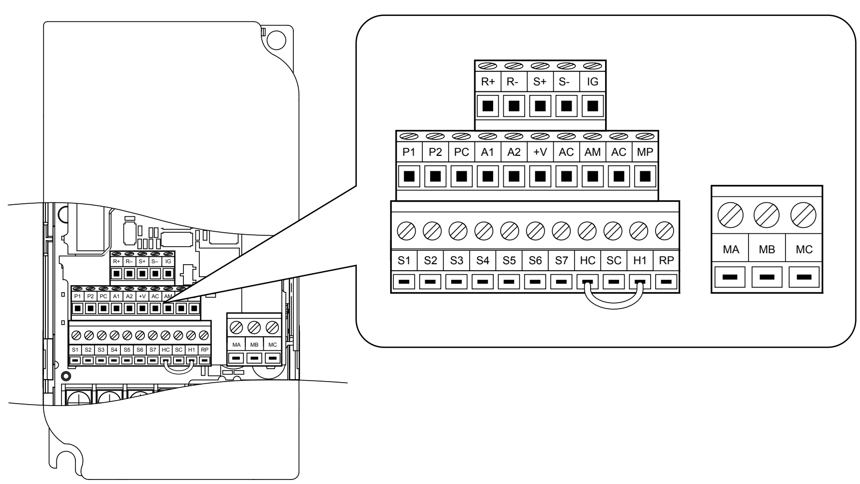


Figure 3.20 Removable Control Circuit Terminal Block
(CIMR-VA□□□□□□□□; CIMR-VU□□□□□□□□□□□)

■ Wire Size and Torque Specifications

Select the appropriate wires and crimp terminals from *Table 3.10*. Crimp a ferrule to signal wiring to improve wiring simplicity and reliability. *Refer to Ferrule Terminal Types and Sizes on page 46*.

Table 3.9 Wire Size and Torque Specifications (Same for All Models)

Terminal	Screw Size	Tightening Torque N•m	Tightening Torque (in-lbs)	Bare Wire Terminal		Ferrule-Type Terminal		Wire Type
				Applicable wire size mm^2 (AWG)	Recomm. mm^2 (AWG)	Applicable wire size mm^2 (AWG)	Recomm. mm^2 (AWG)	
MA, MB, MC	M3	0.5 to 0.6	4.4 to 5.3	Stranded: 0.25 to 1.5 (24 to 16) Single: 0.25 to 1.5 (24 to 16)	0.75 (18)	0.25 to 1.0 (24 to 18)	0.5 (20)	Shielded line, etc.
S1-S7, SC, RP, +V, A1, A2, AC, HC, H1, P1, P2, PC, MP, AM, AC, S+, S-, R+, R-, IG	M2	0.22 to 0.25	1.9 to 2.2	Stranded: 0.25 to 1.0 (24 to 18) Single: 0.25 to 1.5 (24 to 16)	0.75 (18)	0.25 to 0.5 (24 to 20)	0.5 (20)	

■ Ferrule-Type Wire Terminations

Crimp a ferrule to signal wiring to improve wiring simplicity and reliability. Use CRIMPFOX ZA-3, a crimping tool manufactured by PHOENIX CONTACT.

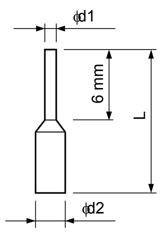


Figure 3.21 Ferrule Dimensions

Table 3.10 Ferrule Terminal Types and Sizes

Size mm^2 (AWG)	Type	L (mm)	d1 (mm)	d2 (mm)	Manufacturer
0.25 (24)	AI 0.25-6YE	10.5	0.8	2	PHOENIX CONTACT
0.34 (22)	AI 0.34-6TQ	10.5	0.8	2	
0.5 (20)	AI 0.5-6WH	12	1.1	2.5	
0.75 (18)	A1 0.75-6GY	12	1.3	2.8	
1.0	AI 1-6RD	12	1.5	3.0	

◆ Wiring Procedure

This section describes the proper procedures and preparations for wiring the terminal board.

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

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

NOTICE: *Separate wiring for digital output terminals MA, MB and MC 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 (UL standard) when connecting to the control terminals. Improper application of peripheral devices could result in drive performance degradation due to improper power supply.*

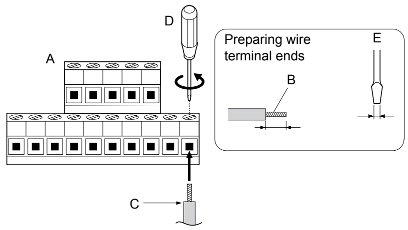
NOTICE: *Insulate shields with tape or shrink tubing to prevent contact with other signal lines and equipment. Improper wiring practices could result in drive or equipment malfunction due to short circuit.*

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 terminal board using *Figure 3.22* as a guide (control circuit terminal block). Be sure to prepare the ends of the control circuit wiring as shown in *Figure 3.23*. *Refer to Wire Gauges and Tightening Torque on page 41* for tightening torque specifications.

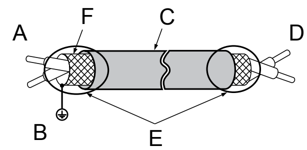
NOTICE: *Do not tighten screws beyond the specified tightening torque. Failure to comply may damage the terminal block.*

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.*



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

Figure 3.22 Terminal Board Wiring Guide

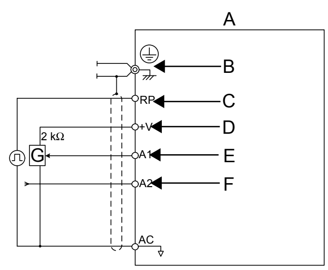


A – Drive side
B – Connect shield to ground terminal of drive.
C – Insulation
D – Control device side
E – Shield sheath (Insulate with tape)
F – Shield

Figure 3.23 Preparing the Ends of Shielded Cables

When setting the frequency by analog reference from an external potentiometer, use shielded twisted-pair wires and ground the shield of twisted-pair wires to the ground terminal of the drive.

NOTICE: *The analog signal lines 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.*



A – Drive
B – Ground terminal (shield connection)
C – (RP) Pulse train (maximum 32 kHz)
D – (+V) Frequency setting power source +10.5 Vdc maximum 20 mA
E – (A1) Main speed frequency reference 0 to +10 Vdc (20 kΩ)
F – (A2) Multi-function analog input 0 to +10 Vdc (20 kΩ) or 4 to 20 mA (250 Ω)/ 0 to 20 mA (250 Ω)
G – Frequency setting potentiometer

Figure 3.24 Wiring the Frequency Reference to the Control Circuit Terminals (External Reference)

3.8 I/O Connections

◆ Sinking/Sourcing Mode Switch

Set the DIP switch S3 on the front of the drive to switch the digital input terminal logic between sinking mode and sourcing mode; the drive is preset to sinking mode.

Table 3.11 Sinking/Sourcing Mode Setting

Set Value	Details
SINK	Sinking Mode (0 V common): factory setting
SOURCE	Sourcing Mode (+24 V common)

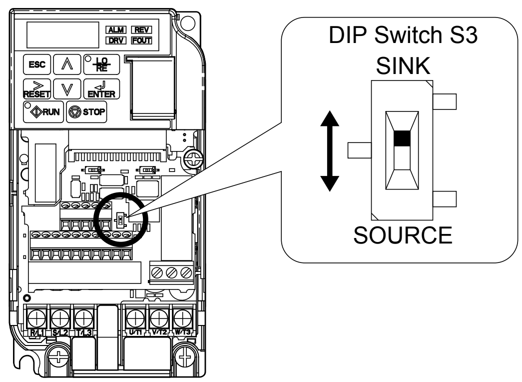


Figure 3.25 DIP Switch S3

■ Transistor Input Signal Using 0 V Common/Sink Mode

When controlling the digital inputs by NPN transistors (0 V common / sinking mode), set the DIP switch S3 to SINK and use the internal 24 V power supply.

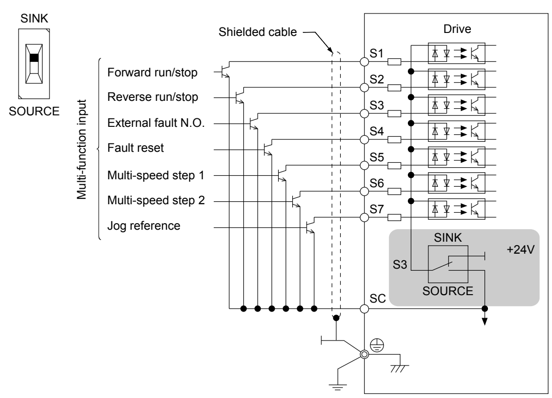


Figure 3.26 Sinking Mode: Sequence from NPN Transistor (0 V Common)

■ Transistor Input Signal Using +24 V Common/Source Mode

When controlling digital inputs by PNP transistors (+24 V common / sourcing mode), set the DIP switch S3 to SOURCE and use an external 24 V power supply.

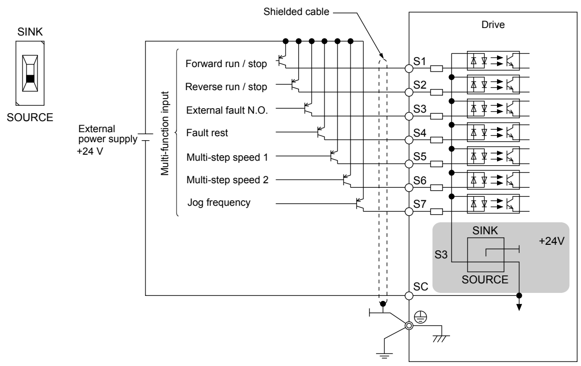


Figure 3.27 Source Mode: Sequence from PNP Transistor (+24 V Common)

3.9 Main Frequency Reference

◆ Terminal A2 Switch

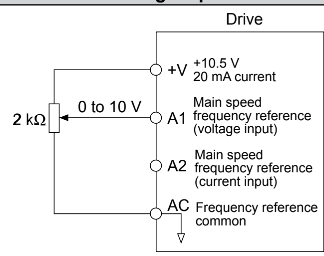
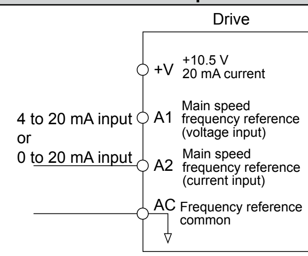
The main frequency reference can either be a voltage or current signal input. For voltage signals both analog inputs, A1 and A2, can be used, for current signals A2 must be used.

To use current input at terminal A2, set the DIP switch S1 to "I" (factory setting) and set parameter H3-09 = “2” or “3” (4-20 mA or 0-20 mA). Set parameter H3-10 = “0” (frequency reference).

Note: If Terminals A1 and A2 are both set for frequency reference (H3-02 = 0 and H3-10 = 0), the addition of both input values builds the frequency reference.

When using input A2 as voltage input, set the DIP switch S1 to “V” (left position) and program parameter H3-09 to “0” (0 to +10 Vdc with lower limit) or “1” (0 to +10 Vdc without lower limit).

Table 3.12 Frequency Reference Configurations

Voltage Input	Current Input
	

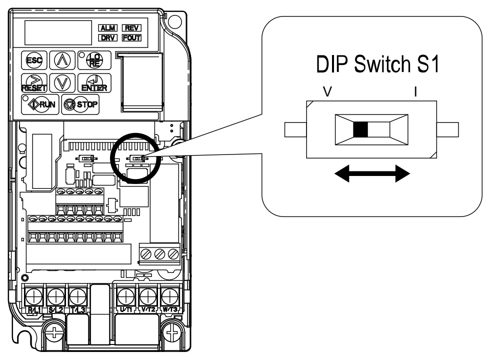


Figure 3.28 DIP Switch S1

Table 3.13 DIP Switch S1 Settings

Setting Value	Description
V (left position)	Voltage input (0 to 10 V)
I (right position)	Current input (4 to 20 mA or 0 to 20 mA): factory setting

Table 3.14 Parameter H3-09 Details

No.	Parameter Name	Description	Setting Range	Default Setting
H3-09	Frequency ref. (current) terminal A2 signal level selection	Selects the signal level for terminal A2. 0: 0 to +10 V, unipolar input (negative frequency reference values are zeroed) 1: 0 to +10 V, bipolar input (negative frequency reference changes the direction) 2: 4 to 20 mA 3: 0 to 20 mA	0 to 3	2

3.10 MEMOBUS/Modbus Termination

DIP switch S2 controls the terminal resistance as shown in the *Figure 3.29* . The OFF position is the default of the terminating resistor switch for MEMOBUS/Modbus communications. Turn the terminal resistor switch ON when the drive is the last drive in a series of slave drives.

Table 3.15 MEMOBUS/Modbus Switch Settings

S2 Position	Description
ON	Internal terminal resistance ON
OFF	Internal terminal resistance OFF (no terminal resistance); default setting

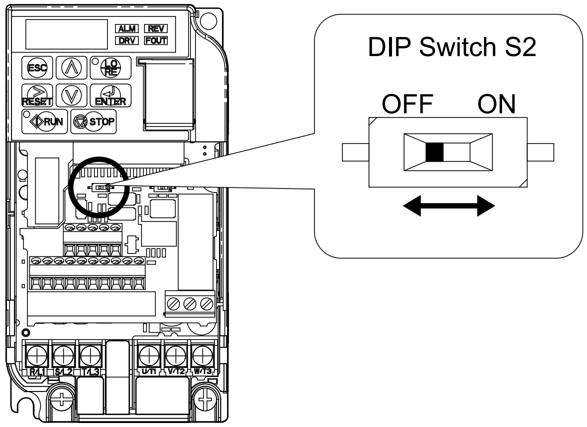


Figure 3.29 DIP Switch S2

Note: Refer to the MEMOBUS/Modbus communications manual for details on MEMOBUS/Modbus.

3.11 Braking Resistor

Dynamic braking (DB) helps bring the motor to a smooth and rapid stop when working with high inertia loads. As the drive lowers the frequency of a motor with high inertia connected, regeneration occurs. This can cause an overvoltage situation when the regenerative energy flows back into the DC bus capacitors. A braking resistor prevents these overvoltage faults.

NOTICE: *Do not allow unqualified personnel to use the product. Failure to comply could result in damage to the drive or braking circuit. Carefully review the braking resistor instruction manual when connecting a braking option to the drive.*

Note: The braking circuit must be sized properly in order to dissipate the power required to decelerate the load in the desired time. Ensure that the braking circuit can dissipate the energy for the set deceleration time prior to running the drive.

Use a thermal overload relay or an over-temperature contact to interrupt input power to the drive in the event the braking resistor overheats.

In the event of a possible thermal overload, the relay will trigger the input contactor and prevent the braking resistor from burning up.

◆ Installation

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

NOTICE: *Connect braking resistors to the drive as shown in the I/O wiring examples. Improperly wiring braking circuits could result in damage to the drive or equipment.*

■ Installation Procedure

1. Disconnect all electrical power to the drive and wait at least five minutes before servicing the drive and any connected components.
2. Remove drive front cover.
3. Use a voltmeter to verify that voltage is disconnected from incoming power terminals and that the DC bus no longer holds a charge.

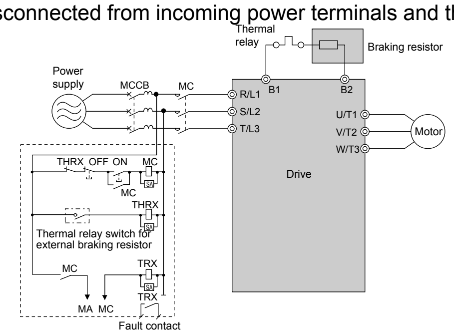


Figure 3.30 Connecting a Braking Resistor

4. Follow manufacturer instructions to connect the resistor unit to the drive using proper wire gauge according to local electrical codes.

   Power leads for the remote mount resistors generate high levels of electrical noise; group these signal leads separately.
5. Mount the resistor unit on a noncombustible surface. Maintain minimum side and top clearances according to resistor manufacturer instructions.

   WARNING! *Fire Hazard. Do not use improper combustible materials. Failure to comply could result in death or serious injury by fire. Attach the drive or braking resistors to metal or other noncombustible material.*
6. Reinstall drive covers and resistor covers, if provided.
7. Set parameter L3-04 = “0” or “3” to disable stall prevention during deceleration.

   Set parameter L8-01= “1” to enable overheat protection when using Yaskawa heatsink mounted braking resistor. Set L8-01 = “0” for other braking resistor types.

   Set parameter L3-04 = “3” to generate the shortest possible deceleration time.

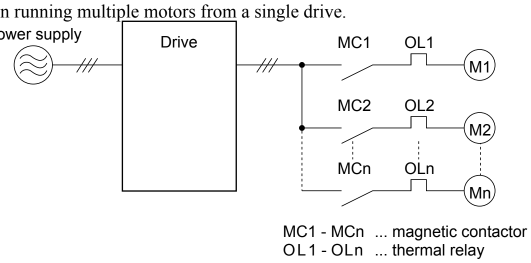
Table 3.16 Braking Resistor Settings

Parameter	Settings
L8-01: Internal Dynamic Braking Resistor Protection selection	0: Disabled. The drive will not provide overheat protection. Supply separate means of overheat protection. 1: Enabled. Braking Resistor is protected from overheat.
L3-04: Stall Prevention During Deceleration <1>	0: Stall prevention disabled.
	3: Stall prevention enabled with a braking resistor. <2>

<1> Select either 0 or 3.
<2> This setting cannot be used in OLV control for PM motor.

8. Operate the system and verify the required deceleration rate is obtained during dynamic braking or stopping.

3.12 Wiring Checklist

☑	No.	Item	Page
		Drive, peripherals, option cards	
☐	1	Check drive model number to ensure receipt of correct model.	*17*
☐	2	Check for correct braking resistors, DC reactors, noise filters, and other peripheral devices.	*52*
☐	3	Check for correct option card model.	*277*
		Installation area and physical setup	
☐	4	Ensure area surrounding the drive complies with specifications.	*26*
		Power supply voltage, output voltage	
☐	5	The voltage from the power supply should fall within the input voltage specification range of the drive.	*83*
☐	6	The voltage rating for the motor should match the drive output specifications.	*17* , *75*
		Main circuit wiring	
☐	7	Confirm proper branch circuit protection exists per National and Local codes.	*34*
☐	8	Properly wire the power supply to drive terminals R/L1, S/L2 and T/L3.	*36*
☐	9	Properly wire the drive and motor together. The motor lines and drive output terminals R/T1, V/T2 and W/T3 should match in order to produce the desired phase order. If the phase order is incorrect, the drive will rotate in the opposite direction.	*42*
☐	10	Use 600 Vac vinyl-sheathed wire for the power supply and motor lines.	*41*
☐	11	Use the correct wire gauges for the main circuit. Refer to ***Table 3.2*** , ***Table 3.3*** , or ***Table 3.4*** .	*41*
		• When using comparatively long motor cable, calculate the amount of voltage drop. $\text{Motor rated voltage (V)} \times 0.02 \geq 3 \times \text{voltage resistance } (\Omega/\text{km}) \times \text{cable length (m)} \times \text{motor rated current (A)} \times 10^{-3}$	*41*
		• If the cable between the drive and motor exceeds 500 m, adjust the carrier frequency (C6-02) accordingly.	*43* , *75*
☐	12	Properly ground the drive. Review page ***43***.	*43*
☐	13	Tightly fasten all terminal screws (control circuit terminals, grounding terminals). Refer to ***Table 3.2*** , ***Table 3.3*** , or ***Table 3.4*** .	*41*
☐	14	Set up overload protection circuits when running multiple motors from a single drive.  **Note:** Close MC1 through MCn before operating the drive.	
☐	15	If using a braking resistor or dynamic braking resistor unit, install a magnetic contactor. Properly install the resistor, and ensure that overload protection shuts off the power supply.	*52*
☐	16	Verify phase advancing capacitors are NOT installed on the output side of the drive.	
		Control circuit wiring	
☐	17	Use twisted-pair cables for all drive control circuit wiring.	*44*
☐	18	Ground the shields of shielded wiring to the GND ⏚ terminal.	*48*
☐	19	If using a 3-wire sequence, properly set parameters for multi-function contact input terminals S1 through S7, and properly wire control circuits.	*35*
☐	20	Properly wire any option cards.	*277*
☐	21	Check for any other wiring mistakes. Only use a multimeter to check wiring.	-
☐	22	Properly fasten the control circuit terminal screws in the drive. Refer to ***Table 3.2*** , ***Table 3.3*** , or ***Table 3.4*** .	*41*
☐	23	Pick up all wire clippings.	
☐	24	Ensure that no frayed wires on the terminal block are touching other terminals or connections.	
☐	25	Properly separate control circuit wiring and main circuit wiring.	
☐	26	Analog signal line wiring should not exceed 10 m.	
☐	27	All other wiring should be less than 50 m.	

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4

Start-Up Programming & Operation

This chapter explains the functions of the LED operator and how to program the drive for initial operation.

4.1 Section Safety

DANGER

Electrical Shock Hazard

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

Failure to comply will result in death or serious injury.

WARNING

Electrical Shock Hazard

Do not operate equipment with covers removed.

Failure to comply could result in death or serious injury.

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

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. The charge indicator LED will extinguish when the DC bus voltage is below 50 Vdc. To prevent electric shock, wait at least five minutes after all indicators are off and measure the DC bus voltage level to confirm safe level.

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 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.
Carefully review instruction manual TOBPC72060000 when connecting a braking option 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.

4.2 Using the Digital LED Operator

Use the LED operator to enter run and stop commands, display data, edit parameters, as well as display fault and alarm information.

◆ Keys, Displays, and LEDs

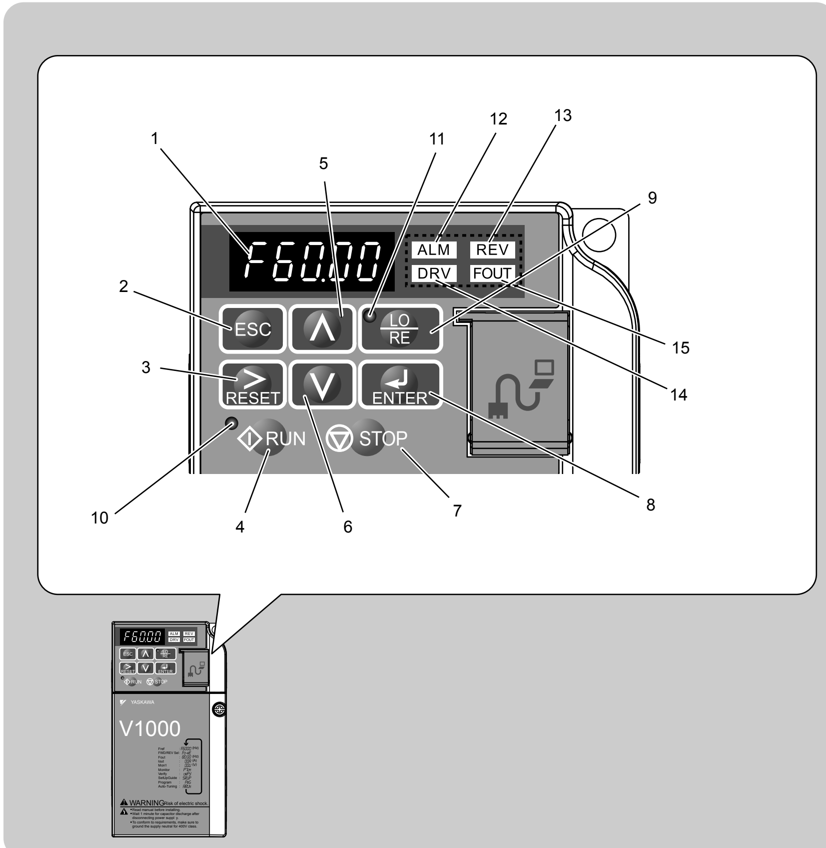


Table 4.1 Keys and Displays on the LED Operator

No.	Display	Name	Function
1	F60.00	Data Display Area	Displays the frequency reference, parameter number, etc.
2	ESC	ESC Key	Returns to the previous menu.
3	> RESET	RESET Key	Moves the cursor to the right. Resets the drive to clear a fault situation.
4	RUN	RUN Key	Starts the drive.
5	∧	Up Arrow Key	Scrolls up to select parameter numbers, setting values, etc.
6	∨	Down Arrow Key	Scrolls down to select parameter numbers, setting values, etc.
7	STOP	STOP Key	Stops the drive. **Note:** Stop priority circuit. A fast-stop is available by pressing the STOP key when the drive detects a danger even if the drive is running by a signal from the multi-function contact input terminal (REMOTE is set). To avoid stoppage by using the STOP key, set o2-02 (STOP Key Function Selection) to 0 (Disabled).
8	ENTER	ENTER Key	Selects all modes, parameters, settings, etc. Selects a menu item to move from one display screen to the next.
9	LO RE	LO/RE Selection Key	Switches drive control between the operator (LOCAL) and the control circuit terminals (REMOTE). **Note:** LOCAL/REMOTE key effective during stop in drive mode. If the digital operator could change from REMOTE to LOCAL by incorrect operation, set o2-01 (LOCAL/REMOTE Key Function Selection) to “0” (disabled) to disable LOCAL/REMOTE key.
10	RUN	RUN Light	Lit while the drive is operating the motor.
11	LO RE	LO/RE Light	Lit while the operator (LOCAL) is selected to run the drive.

No.	Display	Name	Function
12	ALM	ALM LED Light	*Refer to LED Screen Displays on page 59*.
13	REV	REV LED Light	
14	DRV	DRV LED Light	
15	FOUT	FOUT LED Light	

◆ Digital Text Display

Text appears on the LED Operator as shown below. This section explains the meaning of text as it appears on the display screen.

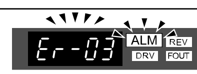
Lit	Flashing
	

Table 4.2 Digital Text Display

Text	LED	Text	LED	Text	LED	Text	LED
0	0	9	9	I	i	R	r
1	1	A	A	J	J	S	S
2	2	B	b	K	K	T	T
3	3	C	C	L	L	U	U
4	4	D	d	M	M <1>	V	u
5	5	E	E	N	n	W	W <1>
6	6	F	F	O	o	X	none
7	7	G	G	P	P	Y	Y
8	8	H	H	Q	q	Z	none

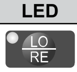
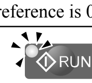
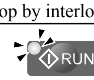
<1> Displayed in two digits.

◆ LED Screen Displays

Display	Lit	Flashing	Off
ALM	When the drive detects a alarm or error	• When an alarm occurs • OPE detected • When a fault or error occurs during Auto-Tuning	Normal state (no fault or alarm)
REV	Motor is rotating in reverse	—	Motor is rotating forward
DRV	Drive Mode Auto-Tuning	When DriveWorksEZ is used <1>	Programming Mode
FOUT	Displays output frequency (Hz)	—	—
As illustrated in this manual			

<1> Refer to the DriveWorksEZ instruction manual for further information.

◆ LO/RE LED and RUN LED Indications

LED	Lit	Flashing	Flashing Quickly <1>	Off
	When run command is selected from LED operator (LOCAL)	—	—	Run command is selected from device other than LED operator (REMOTE)
	During run	• During deceleration to stop • When a run command is input and frequency reference is 0	• During deceleration at a fast-stop. • During deceleration • During stop by interlock operation.	During stop
As shown				

<1> For the difference between “flashing” and “flashing in short intervals” of the RUN LED, refer to *Figure 4.2* , RUN LED and Drive Operation.

Start-Up Programming & Operation

4

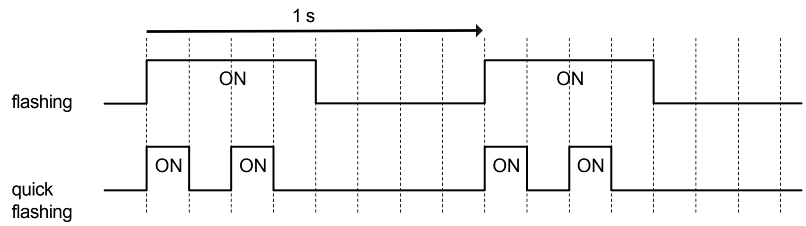


Figure 4.1 RUN LED Status and Meaning

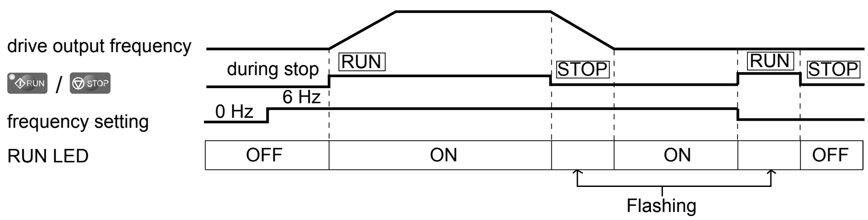


Figure 4.2 RUN LED and Drive Operation

◆ Menu Structure for Digital LED Operator

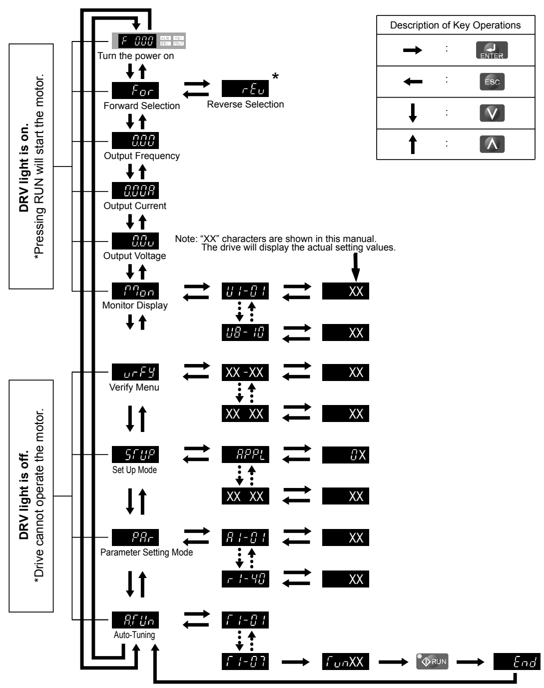


Figure 4.3 Digital LED Operator Screen Structure

* "rEu" can be selected while LOCAL is set.

4.3 The Drive and Programming Modes

The drive functions are divided into two main groups accessible via the Digital LED Operator:

Drive Mode: The Drive mode allows motor operation and parameter monitoring. Parameter settings cannot be changed when accessing functions in the Drive Mode ***(Table 4.2)***.

Programming Mode: The Programming Mode allows access to setup/adjust, verify parameters and Auto-Tuning. The drive prohibits changes in motor operation such as start/stop when the Digital LED Operator is accessing a function in the Programming Mode.

Table 4.2 illustrates the different functions visible as the "Up arrow" is scrolled immediately after powering up the drive.

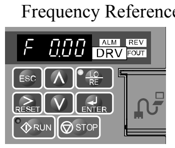
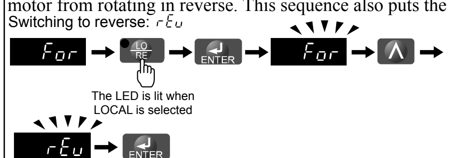
Note: When b1-08 (Run Command Selection while in Programming Mode) is set to 1 (enabled), the drive can run even if the mode is switched to the programming mode. When setting b1-08 to 0 (disabled), the mode cannot be switched to the programming mode while the drive is running.

Table 4.3 Summary of Modes

Mode Group	Description	Key Press	LED Digital Operator Display
Drive Mode Functions (Motor operation and monitoring)	Frequency Reference Display (Initial power-up state)	∧	F 0.00 ALM REV DRV FOUT
	Forward/Reverse	∧	For ALM REV DRV FOUT
	Output Frequency Display	∧	0.00 ALM REV DRV FOUT
	Output Current Display	∧	0.00A ALM REV DRV FOUT
	Output Voltage Reference	∧	0.0u ALM REV DRV FOUT
	Monitor Display	∧	Mon ALM REV DRV FOUT
Programming Mode Functions (Changing parameters)	Verify Function	∧	urFY ALM REV DRV FOUT
	Setup Group Parameters	∧	STUP ALM REV DRV FOUT
	All Parameters	∧	PAr ALM REV DRV FOUT
	Auto-Tuning	∧	AtUn ALM REV DRV FOUT

◆ Navigating the Drive and Programming Modes

The drive is set to operate in Drive Mode when it is first powered up. Switch between display screens by using the ∧ and ∨ keys.

Power Up	Frequency Reference  Default Setting	This display screen allows the user to monitor and set the frequency reference while the drive is running. ***Refer to The Drive and Programming Modes on page 61***. **Note:** The user can select items to display when the drive is first powered up by setting parameter o1-02.
Drive Mode	∧ ↓↑ ∨	
	Forward/Reverse For DRV	For : Motor rotates forward.
		rEu : Motor rotates in reverse.
		Note: For applications that should not run in reverse (fans, pumps, etc.), set parameter b1-04 = "1" to prohibit the motor from rotating in reverse. This sequence also puts the drive in LOCAL mode. Switching to reverse: rEu 
	∧ ↓↑ ∨	
	Output Frequency Display 0.00 DRV FOUT	Monitors the frequency output by the drive.
	∧ ↓↑ ∨	
	Output Current Display 0.00A DRV	Monitors the output current of the drive.
	∧ ↓↑ ∨	

Drive Mode	Output Voltage Reference (Default setting)	Scroll through o1-01 (User Monitor Selection) until the desired contents appear. ➡ *Refer to Parameter List on page 291*
	∧ ↓↑ ∨	
	Monitor Display	Monitor parameters (U-parameters) are displayed. ➡ *Refer to Drive Status Monitors: U1-01 to U6-19 on page 89*.
Programming Mode	∧ ↓↑ ∨	
	Verify Function	Lists all parameters that have been edited or changed from default settings. ➡ *Refer to Verifying Parameter Changes: Verify Menu on page 63*.
	∧ ↓↑ ∨	
	Setup	A select list of parameters necessary to get the drive operational quickly. ➡ *Refer to The Setup Group within the Programming Mode on page 63*. **Note:** Parameters to be displayed differ depending on the setting of A1-06 (Application Preset). *Refer to Application Presets on page 70*.
	∧ ↓↑ ∨	
	Parameter Setting	Allows the user to access and edit all parameter settings. ➡ *Refer to Parameter List on page 291*.
	∧ ↓↑ ∨	
	Auto-Tuning	Motor parameters are calculated and set automatically. ➡ *Refer to Auto-Tuning on page 91*.
	∧ ↓↑ ∨	
Drive Mode	Frequency Reference	Returns to the frequency reference display screen.

■ 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.

Note: Select "Drive Mode" when running. The mode can be switched to any mode (program mode, etc.) other than drive mode while the drive is stopped. However, the drive cannot be operated in other modes. Return the mode to "Drive Mode" after completing periodic inspection.

Figure 4.4 illustrates changing the default frequency reference of F 0.00 (0 Hz) to F 6.00 (6 Hz) while in Drive Mode. This example assumes the drive is set to LOCAL.

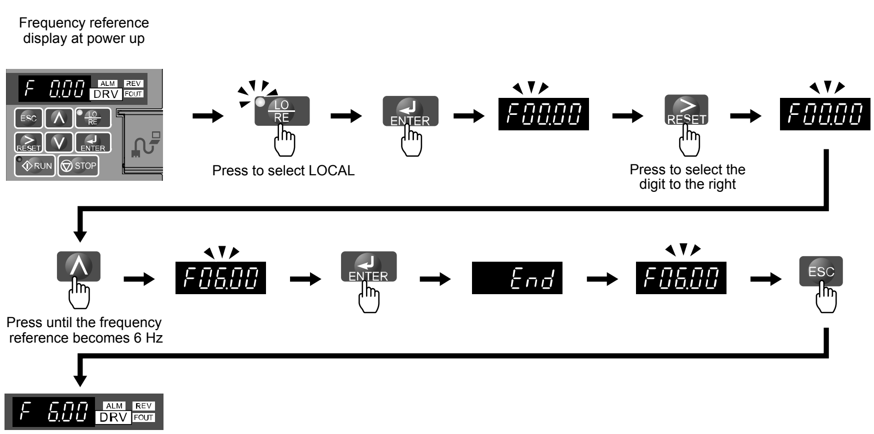


Figure 4.4 Setting the Frequency Reference while in Drive Mode

Note: The drive will not accept a frequency reference set value unless the ENTER key is pressed after the frequency reference is entered. This feature prevents accidental setting of the frequency reference. By setting o2-05 (Frequency Reference Setting Method Selection) to 1 (Enabled), the drive will accept the frequency reference while it is being adjusted on the digital operator.

■ Programming Mode Details

The following actions are possible in the programming mode:
- **Verify Function:** Verify parameter setting changes from original default values.

- **Setup Group:** Access a list of commonly used parameters to simplify setup.
- **Parameter Setting Mode:** Access and edit all parameter settings.
- **Auto-Tuning:** Automatically calculates and sets motor parameters for Open Loop or PM Vector control to optimize the drive for the motor characteristics.

The Setup Group within the Programming Mode

In Setup Group, the user can access the minimum group of parameters required to operate the application.

Note: Setup Group parameters are listed in Appendix B, and indicated with the letter "S" in the Access Level column.

Note: Pressing ***ENTER*** from ***APPL*** navigates to the Application Preset setting display. When the set value is changed, the parameter is changed to the optimum value for each application. It is set to 0 (General-purpose) prior to shipment. *Refer to Application Presets on page 70*.

Figure 4.5 illustrates the keys to press to enter the Setup Group.

In this example, the source of the frequency reference is changed from the control circuit terminals to the LED Operator (i.e., b1-01 is changed from 1 to 0).

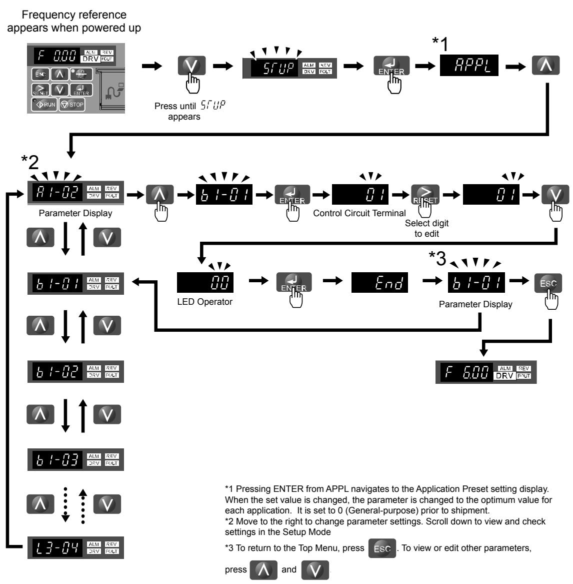


Figure 4.5 Setup Group Example

◆ Changing Parameter Settings or Values

This example explains changing C1-01 (Acceleration Time 1) from 10.0 seconds (default) to 20.0 seconds.

	Step		Display/Result
1.	Turn on the power to the drive. The initial display appears.	➡	F 0.00 DRV
2.	Press the Λ key until the Setup Mode Screen appears.	➡	STUP
3.	Press the ENTER key to view the parameter setting display.	➡	A1-02
4.	Scroll through parameters by pressing the Λ key until C1-01 appears.	➡	C1-01
5.	Press ENTER to view the current setting value (10.0 seconds). (Number farthest to the left flashes)	➡	0010.0
6.	Press RESET until the desired number is selected. ("1" flashes)	➡	0010.0
7.	Press the Λ key and enter 0020.0.	➡	0020.0
8.	Press ENTER and the drive will confirm the change.	➡	End
9.	The display automatically returns to the screen shown in Step 4.	➡	C1-01
10.	Press the ESC key until back at the initial display.	➡	F 0.00 DRV

◆ Verifying Parameter Changes: Verify Menu

The Verify Menu lists edited parameters from the Programming Mode or as a result of Auto-Tuning. The Verify Menu helps determine which settings have been changed, and is particularly useful when replacing a drive. If no settings have been changed and all parameters remain at the original default settings, then the Verify Menu will read nonE . The Verify menu also allows users to access and re-edit edited parameters.

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

The following example is continued from page *63*. Here, parameter C1-01 is accessed using the Verify Menu and is changed again to 20.0 s.

To check the list of edited parameters:

	Step		Display/Result
1.	Turn on the power to the drive. The initial display appears.	→	F 0.00 ALM REV DRV OUT
2.	Press Λ until the display reads, “Verify.”	→	urFY
3.	Press ENTER to enter the list of parameters that have been edited from their original default settings. Scroll through the list by pressing the Λ key.	→	A2-02
4.	Press the Λ key until C1-01 appears.	→	C1-01
5.	Press the ENTER key to access the setting value. (number farthest to the left flashes)	→	0020.0

◆ Switching Between LOCAL and REMOTE

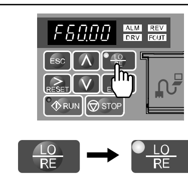
Entering the run command using the LED operator is referred to as LOCAL, while entering the run command from an external device via the control circuit terminals or network option card is referred to as Remote.

WARNING! *Sudden Movement Hazard. The drive may start unexpectedly if the Run command is already applied when switching from LOCAL mode to REMOTE mode when b1-07 = 1, resulting in death or serious injury. Be sure all personnel are clear of rotating machinery and electrical connections prior to switching between LOCAL mode and REMOTE mode.*

There are three ways to switch between LOCAL and REMOTE.

Note: **1.** After selecting LOCAL, LO/RE will remain lit.
2. The drive will not allow the user to switch between LOCAL and REMOTE during run.

■ Using the LO/RE Key on the LED Operator

	Step		Display/Result
1.	Turn on the power to the drive. The initial display appears.	→	F 0.00 ALM REV DRV OUT
2.	Press LO/RE. LO/RE will light up. The drive is now in Local. To set the drive for REMOTE operation, press the LO/RE key again.	→	

■ Using Input Terminals S1 through S7 to Switch between LO/RE

Switch between LOCAL and REMOTE using one of the digital input terminals S1 through S7 (set the corresponding parameter H1-01 through H1-07 to “1”).

Follow the example below to set the digital input terminals.

Note: **1.** For a list of digital input selections, *Refer to Parameter List on page 291*.
2. Setting a multi-function input terminal to a value of 1 disables the LO/RE key on the LED operator.

◆ Parameters Available in the Setup Group

■ Setup Mode (StUP)

StUP

Parameters used for this drive are classified into A to U. To simplify the drive setup, frequently used parameters are selected and input into Setup Mode. StUP

1. To set a parameter, the Setup Mode must be displayed first.
2. If the parameter setting is insufficient, set the parameters in the Parameter Setting Mode.

Note: When parameter A1-02 (Control Method Selection) is changed, some parameter set values are also changed automatically. Execute the A1-02 setting before Auto-tuning.

Table 4.4 lists parameters available in the Setup Group.

Note: This manual also explains other parameters not visible in the Setup Group (A1-06 = 0). Use the “Par” menu in the Programming mode to access parameters not listed in the Setup Group. The Setup Group parameters are shown in *Table 4.4*

Note: Display parameters depend on A1-06. *Refer to Application Presets on page 70*.

Table 4.4 Setup Group Parameters

Parameter	Name	Parameter	Name
A1-02	Control Method Selection	b1-02	Run Command Selection 1
b1-01	Frequency Reference Selection 1	b1-03	Stop Method Selection

Parameter	Name
C1-01	Acceleration Time 1
C1-02	Deceleration Time 1
C6-01	Duty Selection
C6-02	Carrier Frequency Selection
d1-01	Frequency Reference 1
d1-02	Frequency Reference 2
d1-03	Frequency Reference 3
d1-04	Frequency Reference 4
d1-17	Jog Frequency Reference
E1-01	Input Voltage Reference
E1-03	V/f Pattern Selection

Parameter	Name
E1-04	Maximum Output Frequency (FMAX)
E1-05	Maximum Voltage (VMAX)
E1-06	Base Frequency (FA)
E1-09	Minimum Output Frequency (FMIN)
E1-13	Base Voltage (VBASE)
E2-01	Motor Rated Current
E2-04	Number of Motor Poles
E2-11	Motor Rate Capacity
H4-02	Terminal FM Gain Setting
L1-01	Motor Protection Function Selection
L3-04	Stall Prevention Selection during Deceleration

4.4 Start-up Flowcharts

The flowcharts in this section summarize basic steps required to start-up the drive. Use the flowcharts to determine the most appropriate start-up method for a given application. The charts are intended as a quick reference to help familiarize the user with start-up procedures. ***Refer to Basic Drive Setup Adjustments on page 75*** and perform all checks to ensure a proper drive start-up.

Flowchart	Subchart	Objective	Page
A		Basic start-up procedure and motor tuning.	*67*
	A-1	Simple motor set-up with Energy Savings or Speed Search using V/f mode.	*67*
	A-2	High-performance operation using Open Loop Vector (OLV) motor control.	*68*
	A-3	Operation with Permanent Magnet (PM) motors.	*68*
	-	Set-up of drive using application specific selections. ***Refer to Application Presets on page 70***	-

◆ Flowchart A: Basic Start-Up and Motor Tuning

Figure 4.6 , Flowchart A, describes basic start-up sequence for the drive and motor system. This sequence varies slightly depending on application. Use drive default parameter settings in simple applications that do not require high precision.

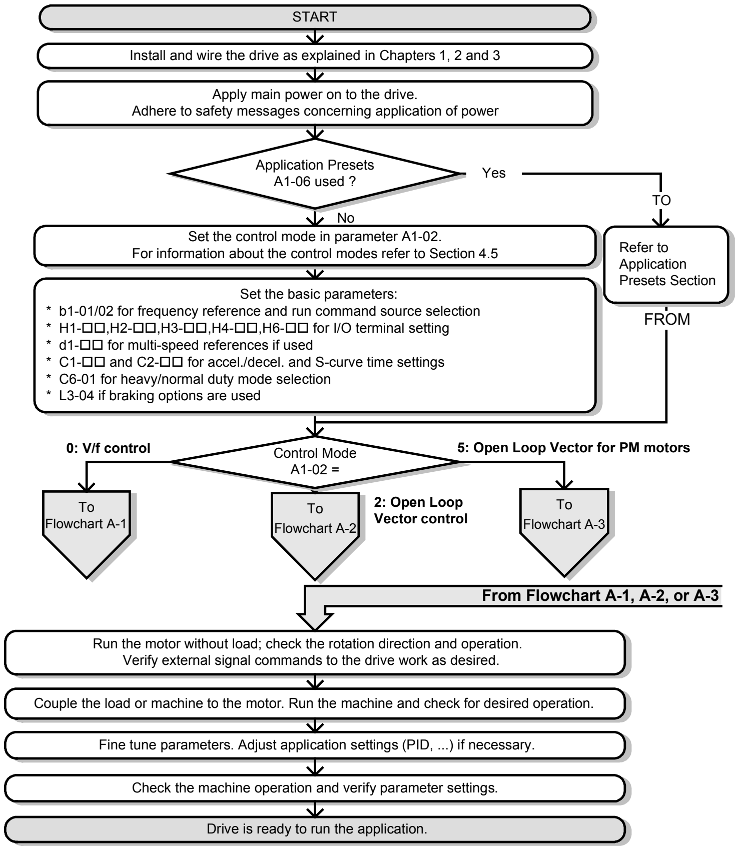


Figure 4.6 Basic Start-Up and Motor Tuning

◆ Subchart A1: Simple Motor Set-Up with Energy Savings or Speed Search using V/f Mode

Figure 4.7 , Flowchart A1, describes simple motor set-up for V/f control. V/f Motor Control is suited for the most basic applications such as fans or pumps. This procedure illustrates using Energy Savings and Speed Estimation Speed Search. V/f control can be used where rotational auto-tuning cannot be performed.

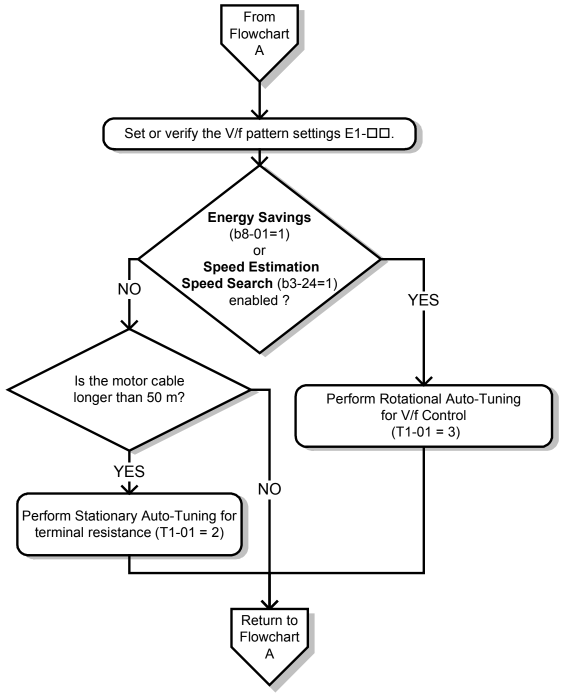


Figure 4.7 Simple Motor Set-Up with Energy Savings or Speed Search Using V/f Mode

◆ Subchart A2: High Performance Operation Using Open Loop Vector Motor Control

Figure 4.8 , Flowchart A2, uses Open Loop Vector Control for high-performance motor operation. This is appropriate for applications requiring high starting torque, torque limits, and improved speed regulation.

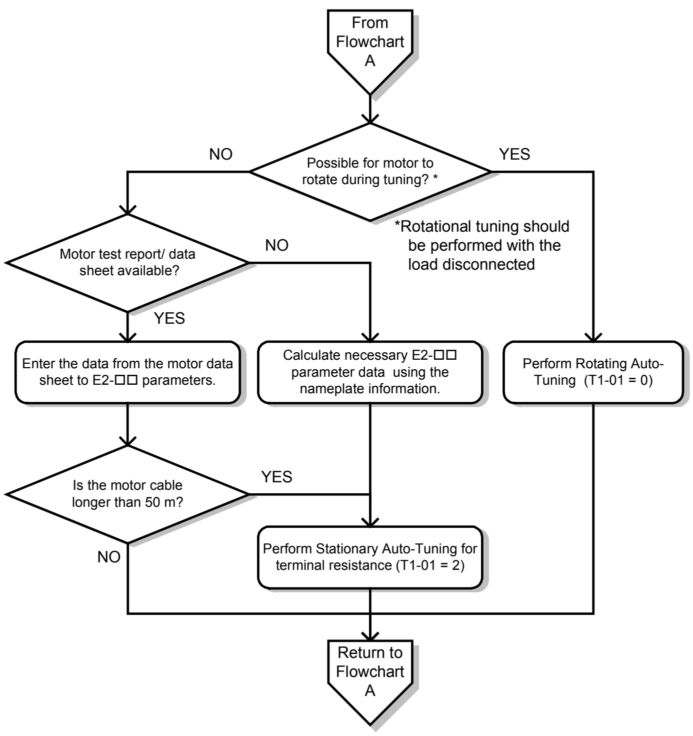


Figure 4.8 Flowchart A2: High Performance Operation Using Open Loop Vector Motor Control

◆ Subchart A3: Operation with Permanent Magnet Motors

Figure 4.9 , Flowchart A3, illustrates tuning for PM motors in Open Loop Vector Control. PM motors can be used for energy savings in reduced or variable torque applications.

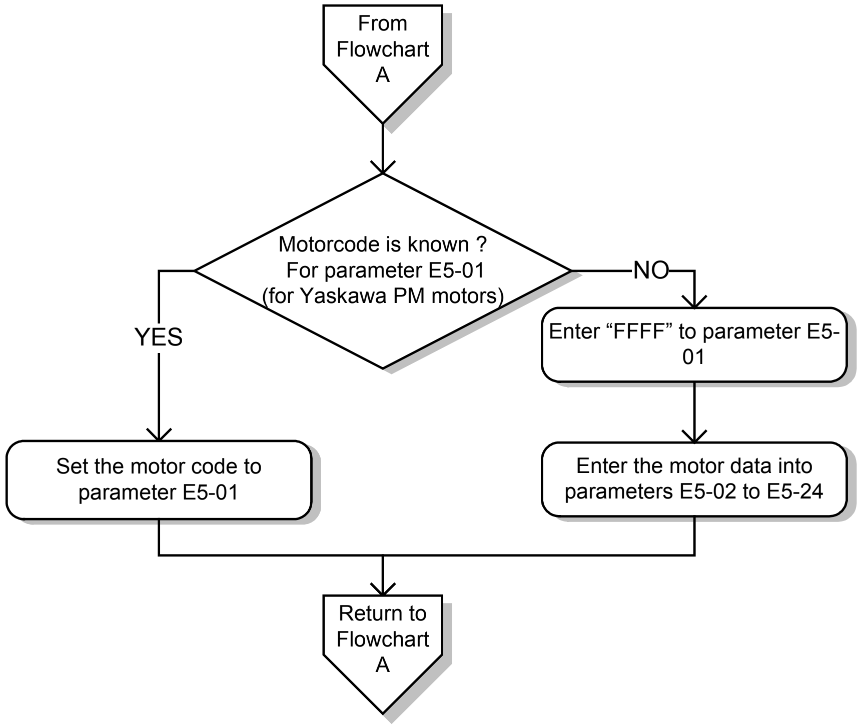


Figure 4.9 Operation with Permanent Magnet Motors

4.5 Application Presets

◆ Application Preset Function (APPL)

APPL

This drive incorporates a function to set the parameters automatically for the applications that are frequently used. Using this Application Preset Function can set or run the drive easily.

1: Water supply pump	2: Conveyor	3: Air supply/exhaust fan
4: AHU (HVAC) fan	5: Compressor	6: Hoist (elevator)
7: Cranes (traverse, traveling)		

Note: For the details of these functions, *Refer to Application Presets on page 70*.

◆ Application Presets: A1-06

The drive features application presets to facilitate the set up of commonly used applications such as a water supply pump, conveyor, exhaust fan, HVAC fan, compressor, hoist, and crane. Selecting one of these presets automatically sets the required parameters to the optimum values and changes the appropriate I/O terminal settings for that specific application.

Verify all I/O signals and external sequences before operating the motor.

Refer to Hoist Application Preset Specifics on page 73 when selecting a hoist application.

Users are able to make further adjustments to these settings using the Setup Mode.

No.	Parameter Name	Setting Range	Default
A1-06	Application Presets	0: General-purpose (A2 parameters are not affected) 1: Water supply pump 2: Conveyor 3: Exhaust fan 4: HVAC fan 5: Air compressor 6: Hoist 7: Crane (hoist, traverse)	0 <1>

<1> All general-purpose parameters are accessible when A1-06 = 0.

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

Perform a 2-wire or 3-wire initialization (A1-03 = 2220 or 3330) on the drive before selecting one of the application presets or before switching between application presets. The initialization process should reset drive parameters before using an application preset.

Save user-edited parameters to a list by setting o2-03 to “1”. This allows for more immediate access a specific list of relevant parameters and saves time scrolling through the parameter menu items.

Set the parameter access level for Preferred Parameters (A1-01 = “1”) to display only the setup parameters.

The parameters listed in the table below are unaffected by drive initialization:

No.	Parameter Name
A1-02 <1>	Control Method Selection
C6-01	Duty Selection
E1-03	V/f Pattern Selection
E5-01	Motor Code Selection (for PM motors)
o2-04	Drive/kVA Selection

<1> The control method set to A1-02 is unaffected when performing a 2-wire or 3-wire initialization, but it automatically changes according to the value set to parameter A1-06.

■ Related Parameters

No.	Parameter Name	Setting Range	Default
A1-01	Access Level Selection	0: Operation only 1: User Parameters (access to a set of parameters selected by the user) 2: Advanced Access Level	2 <1>
A1-03	Initialize Parameters	0: No Initialize 1110: User Initialize (The user must first set user parameter values and then store them using parameter o2-03) 2220: 2-Wire Initialization 3330: 3-Wire Initialization 4440: DriveWorksEZ Initialization 5550: OPE04 Error Reset	0
A2-02 to A2-32	User Parameters, 2 to 32	b1-01 to o2-08	<1>
A2-33	User Parameter Automatic Selection	0: Parameters A2-01 through A2-32 are reserved for the user to create a list of User Parameters. 1: Save history of recently viewed parameters. Recently edited parameters will be saved to A2-17 through A2-32 for quick access.	1 <2>

No.	Parameter Name	Setting Range	Default
o2-03	User Parameter Default Value	0: No Change 1: Set Defaults - Saves current parameter settings as user initialization. 2: Clear All - Clears the currently saved user initialization.	0

<1> Default setting value is dependent on parameter A1-06, Application Selection
<2> Default setting value is dependent on parameter A1-06. This setting value is 0 when A1-06 = 0, and 1 when A1-06 does not = 0.

■ Application Presets

Below is a list of application presets and the values automatically assigned to the parameters as a result of each preset:

Table 4.5 Water Supply Pump Application: Parameters and Settings

No.	Parameter Name	Optimum Setting
A1-02	Control Method Selection	0: V/f control
b1-04	Reverse Operation Selection	1: Reverse prohibited
C1-01	Acceleration Time 1	1.0 s
C1-02	Deceleration Time 1	1.0 s
C6-01	Duty Rating	1: Normal Duty
E1-03	V/f Pattern Selection	0FH
E1-07	Mid Output Frequency (FB)	30.0
E1-08	Mid Output Frequency Voltage (VC)	50.0
L2-01	Momentary Power Loss Operation Selection	1: Enabled
L3-04	Stall Prevention Selection during Deceleration	1: Enabled

Table 4.6 Parameters Automatically Saved as Preferred (A2-01 to A2-16)

No.	Parameter Name	No.	Parameter Name
b1-01	Frequency Reference Selection	E1-08	Mid Output Frequency Voltage (VC)
b1-02	Run Command Selection	E2-01	Motor Rated Current
b1-04	Reverse Operation Selection	H1-05	Multi-Function Digital Input Terminal S5 Function Selection
C1-01	Acceleration Time 1	H1-06	Multi-Function Digital Input Terminal S6 Function Selection
C1-02	Deceleration Time 1	H1-07	Multi-Function Digital Input Terminal S7 Function Selection
E1-03	V/f Pattern Selection	L5-01	Number of Auto Restart Attempts
E1-07	Mid Output Frequency (FB)		

Table 4.7 Conveyor Application: Parameters and Settings

No.	Parameter Name	Optimum Setting
A1-02	Control Method Selection	0: V/f control
C1-01	Acceleration Time 1	3.0 s
C1-02	Deceleration Time 1	3.0 s
C6-01	Duty Rating	0: Heavy Duty
L3-04	Stall Prevention Selection during Deceleration	1: Enabled

Table 4.8 Parameters Automatically Saved as Preferred (A2-01 to A2-16)

No.	Parameter Name	No.	Parameter Name
A1-02	Control Method Selection	C1-02	Deceleration Time 1
b1-01	Frequency Reference Selection	E2-01	Motor Rated Current
b1-02	Run Command Selection	L3-04	Stall Prevention Selection during Deceleration
C1-01	Acceleration Time 1		

Table 4.9 Exhaust Fan Application: Parameters and Settings

No.	Parameter Name	Optimum Setting
A1-02	Control Method Selection	0: V/f control
b1-04	Reverse Operation Selection	1: Reverse Prohibited
C6-01	Duty Selection	1: Normal Duty
E1-03	V/f Pattern Selection	0FH
E1-07	Mid Output Frequency (FB)	30
E1-08	Mid Output Frequency Voltage (VC)	50
L2-01	Momentary Power Loss Operation Selection	1: Enabled
L3-04	Stall Prevention Selection during Deceleration	1: Enabled

Table 4.10 Parameters Automatically Saved as Preferred (A2-01 to A2-16)

No.	Parameter Name	No.	Parameter Name
b1-01	Frequency Reference Selection	E1-07	Mid Output Frequency (FB)
b1-02	Run Command Selection	E1-08	Mid Output Frequency Voltage (VC)
b1-04	Reverse Operation Selection	E2-01	Motor Rated Current
b3-01	Speed Search Selection at Start	H1-05	Multi-Function Digital Input Terminal S5 Function Selection
C1-01	Acceleration Time 1	H1-06	Multi-Function Digital Input Terminal S6 Function Selection
C1-02	Deceleration Time 1	H1-07	Multi-Function Digital Input Terminal S7 Function Selection
E1-03	V/f Pattern Selection	L5-01	Number of Auto Restart Attempts

Table 4.11 HVAC Fan Application: Parameters and Settings

No.	Parameter Name	Optimum Setting
A1-02	Control Method Selection	0: V/f control
b1-04	Reverse Operation Selection	1: Reverse prohibited
C6-01	Duty Rating	1: Normal Duty

No.	Parameter Name	Optimum Setting
C6-02	Carrier Frequency Selection	3: 8.0 kHz
H2-03	Terminals P2 Function Selection (open-collector)	39: Watt Hour Pulse Output
L2-01	Momentary Power Loss Operation Selection	2: CPU Power Active - Drive will restart if power returns prior to control power supply shut down.
L8-03	Overheat Pre-Alarm Operation Selection	4: Derated operation
L8-38	Carrier Frequency Reduction	2: Carrier frequency derating across entire frequency range.

Table 4.12 Parameters Automatically Saved as Preferred (A2-01 to A2-16)

No.	Parameter Name	No.	Parameter Name
b1-01	Frequency Reference Selection	E1-03	V/f Pattern Selection
b1-02	Run Command Selection	E1-04	Max Output Frequency (FMAX)
b1-04	Reverse Operation Selection	E2-01	Motor Rated Current
C1-01	Acceleration Time 1	H3-11	Terminal A2 Gain Setting
C1-02	Deceleration Time 1	H3-12	Frequency Reference (Current) Terminal A2 Input Bias
C6-02	Carrier Frequency Selection	L2-01	Momentary Power Loss Operation Selection
d2-01	Frequency Reference Upper Limit	L8-03	Overheat Pre-Alarm Operation Selection
d2-02	Frequency Reference Lower Limit	o4-12	kWH Monitor Initial Value Selection

Table 4.13 Compressor Application: Parameters and Settings

No.	Parameter Name	Optimum Setting
A1-02	Control Method Selection	0: V/f control
b1-04	Reverse Operation Selection	1: Reverse prohibited
C1-01	Acceleration Time 1	5.0 s
C1-02	Deceleration Time 1	5.0 s
C6-01	Duty Rating	0: Heavy Duty
E1-03	V/f Pattern Selection	0FH
L2-01	Momentary Power Loss Operation Selection	1: Enabled
L3-04	Stall Prevention Selection during Deceleration	1: Enabled

Table 4.14 Parameters Automatically Saved as Preferred (A2-01 to A2-16)

No.	Parameter Name	No.	Parameter Name
b1-01	Frequency Reference Selection	E1-03	V/f Pattern Selection
b1-02	Run Command Selection	E1-07	Mid Output Frequency (FB)
b1-04	Reverse Operation Selection	E1-08	Mid Output Frequency Voltage (VC)
C1-01	Acceleration Time 1	E2-01	Motor Rated Current
C1-02	Deceleration Time 1		

Table 4.15 Crane Application (Hoist): Parameters and Settings

No.	Parameter Name	Optimum Setting
A1-02	Control Method Selection	2: Open Loop Vector Control
b1-01	Frequency Reference Selection	0: Operator
b6-01	Dwell Reference at Start	3.0 Hz
b6-02	Dwell Time at Start	0.3 s
C1-01	Acceleration Time 1	3.0 s
C1-02	Deceleration Time 1	3.0 s
C6-01	Duty Rating	0: Heavy Duty
C6-02	Carrier Frequency Selection	2: 5 kHz
d1-01	Frequency Reference 1	6.0 Hz
d1-02	Frequency Reference 2	30.0 Hz
d1-03	Frequency Reference 3	60.0 Hz
E1-03	V/f Pattern Selection	0FH
H2-02	Terminals P1 Function Selection (open-collector)	37: During frequency output
H2-03	Terminals P2 Function Selection (open-collector)	5: Frequency Detection 2 (FOUT)
L2-03	Momentary Power Loss Minimum Baseblock Time	0.3 s
L3-04	Momentary Power Loss Voltage Recovery Ramp Time	0: Disabled
L4-01	Speed Agreement Detection Level	2.0 Hz
L4-02	Speed Agreement Detection Width	0.0 Hz
L6-01	Torque Detection Selection 1	8: UL3 at RUN -Fault
L6-02	Torque Detection Level 1	5%
L6-03	Torque Detection Time 1	0.5 s
L8-05	Input Phase Loss Protection Selection	1: Enabled
L8-07	Output Phase Loss Protection	1: Enabled
L8-38	Carrier Frequency Reduction	0: Derated when operating at 6 Hz or less
L8-41	Current Alarm Selection	1: Enabled (alarm is output)

Note: A sequence to release the brake is needed when the multi-function output photocoupler P2-PC closes. ***Refer to Hoist Application Preset Specifics on page 73*** for more information.

Note: Perform Auto-Tuning after selecting the Hoist Application Preset.

Table 4.16 Parameters Automatically Saved as Preferred (A2-01 to A2-16)

No.	Parameter Name	No.	Parameter Name
A1-02	Control Method Selection	d1-02	Frequency Reference 2
b1-01	Frequency Reference Selection	d1-03	Frequency Reference 3
b6-01	Dwell Reference at Start	E1-08	Mid Output Frequency Voltage (VC)

No.	Parameter Name	No.	Parameter Name
b6-02	Dwell Time at Start	H2-01	Terminals MA, MB, and MC Function Selection
C1-01	Acceleration Time 1	L1-01	Motor Overload Protection Selection
C1-02	Deceleration Time 1	L4-01	Speed Agreement Detection Level
C6-02	Carrier Frequency Selection	L6-02	Torque Detection Level 1
d1-01	Frequency Reference 1	L6-03	Torque Detection Time 1

Note: Read the instructions listed in *Hoist Application Preset Specifics* on page 73 when using Hoist Application Preset.

Table 4.17 Crane Application (Travel): Parameters and Settings

No.	Parameter Name	Optimum Setting
A1-02	Control Mode	0: V/f control
b1-01	Frequency Reference Selection	0: Operator
C1-01	Acceleration Time 1	3.0 s
C1-02	Deceleration Time 1	3.0 s
C6-01	Duty Cycle	0: Heavy Duty
C6-02	Carrier Frequency Selection	2: 5 kHz
d1-01	Frequency Reference 1	6.0 Hz
d1-02	Frequency Reference 2	30.0 Hz
d1-03	Frequency Reference 3	60.0 Hz
H1-05	Multi-Function Digital Input Terminal S5 Function	3: Multi-Step Speed 1
H1-06	Multi-Function Digital Input Terminal S6 Function	4: Multi-Step Speed 2
H2-02	Terminals P1 Function Selection (open-collector)	37: During frequency output
L3-04	Stall Prevention Selection during Decel	0: Disabled
L8-05	Input Phase Loss Protection Selection	1: Enabled
L8-07	Output Phase Loss Protection	1: Triggered when a single phase is lost
L8-38	Carrier Frequency Reduction	1: Always derated
L8-41	Current Alarm Selection	1: Enabled (alarm output)

Table 4.18 Parameters Automatically Saved as Preferred (A2-01 to A2-16)

No.	Parameter Name	No.	Parameter Name
b1-01	Frequency Reference Selection	d1-03	Frequency Reference 3
C1-01	Acceleration Time 1	E2-01	Motor Rated Current
C1-02	Deceleration Time 1	H1-05	Multi-Function Digital Input Terminal S5 Function
C6-02	Carrier Frequency Selection	H1-06	Multi-Function Digital Input Terminal S6 Function
d1-01	Frequency Reference 1	H2-01	Terminals MA, MB, and MC Function Selection
d1-02	Frequency Reference 2	L1-01	Motor Overload Protection Selection

Note: A sequence to release the brake is needed when the multi-function output photocoupler P2-PC closes. *Refer to Hoist Application Preset Specifics on page 73* for more information.

■ Hoist Application Preset Specifics

This section lists some important points when using the Hoist Application Preset (A1-06 = 6).

Conditions for Opening and Closing the Holding Brake

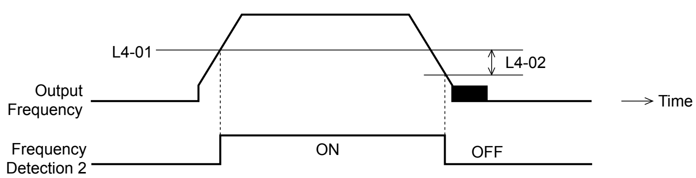
Use an output signal as described below to operate the holding brake in a hoist application.

Make sure that frequency detection is set so that it does not operate during baseblock (L4-07 = “0”). Even when an external baseblock command is present, the output frequency will rise when a run command is entered. If frequency detection were to be enabled during baseblock, (i.e., L4-07 = 1) then the brake would be improperly released. To activate and release the brake using the multi-function output terminals P2-PC, program the drive as shown in the table below:

Brake Open/Close		Brake Activation Level		Control Mode		
Function	Parameter	Signal	Parameter	V/f	OLV	OLV for PM
Frequency Detection 2	L4-07 = 0 H2-03 = 5	Frequency Detection Level Frequency Detection Width	L4-01 = 1.0 to 3.0 Hz <1> L4-02 = 0.0 to 0.5 Hz <2>	O	O	-

<1> This setting range is available when using OLV Control. In V/f Control, set the level as the motor rated slip frequency pulse 0.5 Hz. Not enough motor torque will be created if this value is set too low, and the load may tend to slip. Make sure this value greater than the minimum output frequency and greater than the value of L4-02 as shown in the diagram below. If this value is set too high, there may be a jolt at start.

<2> Adjust Hysteresis for Frequency Detection 2 by changing the frequency detection width (L4-02) between 0.0 and 0.5 Hz. If the load slips during stop, make incremental changes of 0.1 Hz until the load no longer slips.



Sequence Circuit Design for Opening and Closing the Holding Brake

Design the braking sequence as follows:

The brake should release when terminal P2-PC closes in response to the run conditions on the sequence side.

When a fault signal is output, the brake should close. When an up or down command is entered, the brake should release.

Start-Up Programming & Operation 4

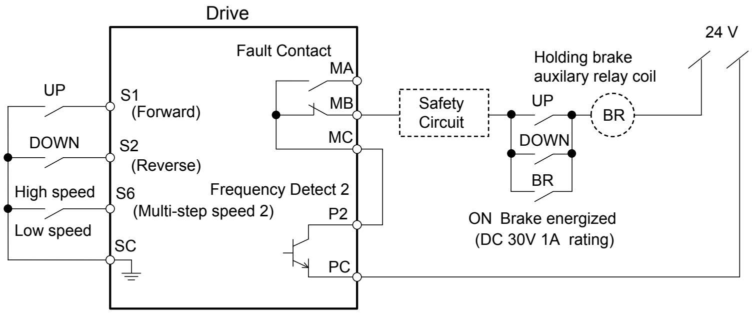


Figure 4.10 Holding Brake Circuit Design

Timechart for Opening and Closing the Holding Brake

A sequence to open and close the holding brake appears in the diagram below.When changing the speed using an analog signal, make sure that the source of the frequency reference is assigned to the control circuit terminals (b1-01 = 1).

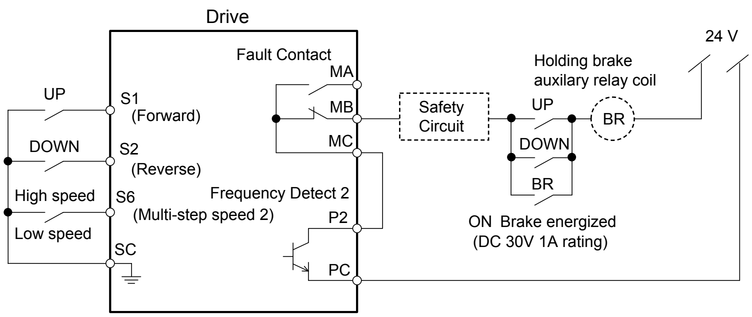


Figure 4.11 Holding Brake Timechart

◆ User Parameters: A2-01 to A2-32

The user can select 32 parameters and set them to parameters A2-01 through A2-32 to save time scrolling through the parameter menu. The list of User Parameters can also track the most recently edited settings and save those parameters to this list.

No.	Parameter Name	Setting range	Default
A2-02 to A2-32	User Parameters, 2 to 32	b1-01 to o2-08	<1>

<1> Default setting value is dependent on parameter A1-06, Application Selection.

■ Detailed Description

To save specific parameters to A2-01 to A2-32, first set the access level to allow access to all parameters (A1-02 = “2”). After selecting the parameters to be saved to A2-01 through A2-32, set the access level to allow access only to the selected list of User Parameters. Set A1-01 to “1” to restrict access so users can only set and reference the specific parameters saved as User Parameters.

◆ User Parameter Automatic Selection: A2-33

A2-33 determines whether parameters that have been edited are saved to the User Parameters (A2-17 to A2-32) for quick, easy access.

No.	Parameter Name	Setting range	Default
A2-33	User Parameter Automatic Selection	0: Do not save history of recently viewed parameters. 1: Save history of recently viewed parameters.	0, 1

■ Detailed Description

0: Do not save history of recently viewed parameters.To manually select the parameters listed in the Preferred Parameter group, set A2-33 to “0”.

1: Save history of recently viewed parameters.

By setting A2-33 to 1, all parameters that were recently edited will be saved to A2-17 through A2-32. A total of 16 parameters are saved in order, with the most recently edited parameter set to A2-17.

4.6 Basic Drive Setup Adjustments

This section explains the basic settings required for initial drive operation. Checking these basic parameter settings during start-up will help to ensure a successful drive start-up.

If more information is required for parameters not listed in this section, *Refer to Parameter List on page 291* as required for a complete listing of drive parameters.

◆ Control Mode Selection: A1-02

■ Available Control Modes

Three motor control modes are available. Select the control mode that best suits the application in which the drive will be used.

Control Mode	Parameter	Main Applications
V/f Control	A1-02 = 0 (default)	• General variable speed applications, particularly useful for running multiple motors from a single drive • When replacing a drive in which parameter settings are unknown.
Open Loop Vector Control	A1-02 = 2	• General variable speed applications • Applications requiring high precision, high speed control.
PM Open Loop Vector Control	A1-02 = 5	Variable torque applications employing permanent magnet motors and energy savings.

◆ Initialize Parameter Values: A1-03

Parameter A1-03 (Initialize Parameters) resets all parameters to the original default values.

Note: Save all changed parameter settings by setting o2-03="1" before initializing the drive. Your settings will be lost if a 2-wire or 3-wire initialization using 2220, or 3330 if performed without first saving user parameters. *Refer to Backing Up Parameter Values: o2-03 on page 96*

■ Different Methods of Drive initialization

1110: Resets all parameters to user-defined default values

A user-initialization resets all parameters to a user-defined set of default values previously saved to the drive. Set parameter o2-03 to "2" to clear those values.

Note: Set o2-03 to "1" to save the current parameter settings and changes for a "user-initialization." After saving all parameter setting changes, parameter o2-03 automatically returns to 0. *Refer to Verifying Parameter Settings and Backing Up Changes on page 96*.

2220: 2-Wire Initialization

Returns all parameters to factory default values for 2-wire control.

3330: 3-Wire Initialization

Returns all parameters to factory default values for 3-wire control.

5550: Uploads Parameter Data from the Removable Control Circuit Terminal Board

Replacing either the removable control circuit terminal board or the drive and applying main power may result in an oPE04 fault. If parameter setting data in the removable control circuit terminal board is correct, set A1-03 to "5550" to upload the data to the drive.

Note: *Refer to Run Command Input Selection: b1-02 on page 77* for more information on a 2-wire and 3-wire sequence.

Note: Initializing the drive for 2-wire sequence (A1-03 = 2220) returns all drive parameters to factory settings. Back up all parameters in the event of accidental initialization. the data with 2-wire sequence returns all the set parameters to the factory settings. *Refer to Backing Up Parameter Values: o2-03 on page 96*

◆ Application Presets: A1-06

The drive features application presets to facilitate the set up of commonly used applications such as a water supply pump, conveyor, exhaust fan, HVAC fan, compressor, hoist, and crane. Selecting one of these presets automatically sets the required parameters to the optimum values and changes the appropriate I/O terminal settings for that specific application. *Refer to Application Presets on page 70*

Verify all I/O signals and external sequences before operating the motor. *Refer to Hoist Application Preset Specifics on page 73* when selecting a hoist application.

Users are able to make further adjustments to these settings using the Setup Mode.

No.	Parameter Name	Setting Range	Default
A1-06	Application Presets	0: General-purpose (A2 parameters are not affected) 1: Water supply pump 2: Conveyor 3: Exhaust fan 4: HVAC fan 5: Air compressor 6: Hoist 7: Crane (hoist, traverse)	0 <1>

<1> All general-purpose parameters are accessible when A1-06 = 0.

◆ DWEZ Function Selection: A1-07

DriveWorksEZ is an independent software package that can be used to operate and monitor the drive with a 2 ms scan. It is fully compatible with all types of serial communication software available on the market.

Setting A1-07 to “1” allows the drive to connect to the DriveWorksEZ software package. When using DriveWorksEZ, be sure to set one of the multi-function terminal inputs for DrivesWorksEZ (H1-☐☐ = “9F”). This drive is ready to communicate with the software when the terminal is open. Set A1-07 to “0” when DriveWorksEZ is not used.

If DriveWorksEZ assigned functions to any multi-function output terminals, those functions stay set after disabling or disconnecting DriveWorksEZ.

No.	Parameter Name	Setting range	Default
A1-07	DriveWorksEZ Function Selection	0: Disabled 1: Enabled 2: Terminal input switch (requires that H1-XX = 9F)	0

◆ Frequency Reference Source: b1-01

This section explains how to assign the frequency reference. Parameters b1-01 and b1-02 can be used to select the source of the run command and the frequency reference independently (e.g., set the reference from the operator and set the run command from the terminals).

■ Frequency Reference from the LED Operator: b1-01 = 0

When b1-01 = 0 the frequency reference will be provided by the LED operator. *Refer to The Drive and Programming Modes on page 61* for information on how to set the frequency reference.

■ Frequency Reference from the Analog Input Terminal: b1-01 = 1

When b1-01 = 1, analog inputs A1 and A2 provide the frequency reference.

Note: Set H3-02 (Terminal A1 Function Selection) to “0” to configure Terminal A1 for the main analog frequency reference.

Using a Single Analog Signal (V or I) as the Frequency Reference

Control Circuit Terminal A1 (Voltage Input):

When entering the main frequency reference with a voltage signal, use the voltage input set up in control circuit terminal A1.

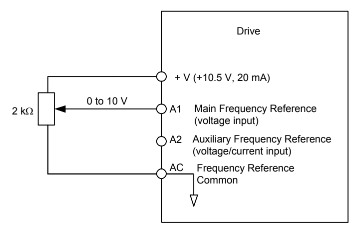


Figure 4.12 Voltage Input for the Main Frequency Reference

Control Circuit Terminal A2 (Voltage/Current Input):

Use control circuit Terminal A2 when supplying the frequency reference with a current signal between 4 to 20 mA. Use the following switch and parameter settings to configure Terminal A2 for 0 to 20 mA or 4 to 20 mA input.

- Set the signal level for analog input A2 to current input (H3-09 = “2” for 4 to 20 mA, H3-09 = “3” for 0 to 20 mA).
- Set the function for analog input A2 to frequency reference (H3-10 = “0”) to command terminal A2 to be a frequency reference.
- Set DIP switch S1 to the I position for a current signal input.

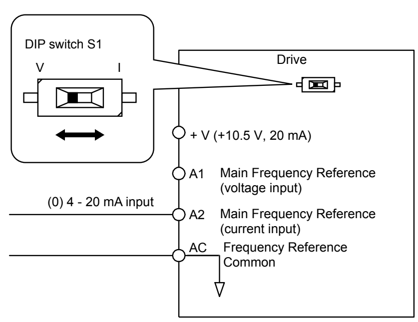


Figure 4.13 Current Input for the Main Frequency Reference

Switching between Main/Auxiliary Frequency References

To configure the frequency reference to switch between analog input A1 and A2 (main/aux frequency switch), use the following setup:

1. Set the frequency reference source to terminals (b1-01 = “1”).
2. Set one of the digital inputs to auxiliary reference 1, H1-☐☐ = “3” (preset for terminal S5).
3. Set input signal type of terminal A2 using dip switch S1 and parameter H3-09.
4. Set the function of analog input A2 to Auxiliary frequency (H3-10 = “3”).

When the digital input assigned in step 2 is off, terminal A1 is the frequency reference input. If it is closed, the A2 input value becomes the frequency reference. The active acceleration / deceleration times are used for the change-over between the values

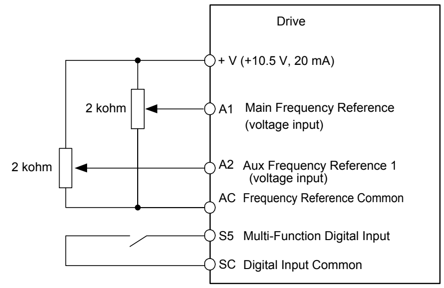


Figure 4.14 Switching between Main/Auxiliary Frequency References

■ Pulse Train Input: b1-01 = 4

Setting b1-04 to 4 programs the drive so that the frequency reference is provided by the pulse train control circuit input terminal RP.

Configuring the Drive for Pulse Train Frequency Reference Input

Setting up the Pulse Input (RP) as frequency reference input:

1. Set the reference source to pulse input (b1-01 = “4”).
2. Set the pulse train input to be the frequency reference by programming parameter H6-01 = “0” and programming the pulse train input gain to 100% (H6-03 = “100”).
3. Set the pulse input scaling (H6-02) to the input frequency value which is equal to the max. frequency reference value.
4. Apply a pulse signal to the input and check that the reference value is the desired value.
5. Readjust the pulse input gain and bias if necessary.

Note: **1.** If the frequency display reaches the maximum desired frequency before the maximum pulse reference signal is applied, increase the pulse train input scaling value (increase H6-02).
2. If the frequency display never reaches the desired maximum with the maximum pulse reference signal applied, decrease the pulse train input scaling value (reduce H6-02)

The pulse input has the following specifications. Ensure the pulse signal meets these specifications:

Pulse Train Input Specifications	
Response Frequency	0.5 to 32 kHz
Duty Cycle	30 to 70%
High Level Voltage	3.5 to 13.2 V
Low Level Voltage	0.0 to 0.8 V
Input Impedance	3 kΩ

◆ Run Command Input Selection: b1-02

This section explains how to assign the run command input.

Parameters b1-01 and b1-02 can be used to select the source of the run command and the frequency reference independently, e.g. set the reference from the operator and set the run command from the terminals.

WARNING! *Sudden Movement Hazard. When the run command is given by turning on the power to the drive, the motor will begin rotating as soon as the drive is powered up. Be sure to take proper precautions if using this setting. Ensure the area around the motor is safe. Failure to comply could result in death or serious injury.*

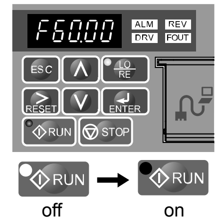
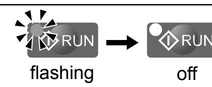
■ Run the Drive at 6 Hz using the Digital LED Operator: b1-02 = 0

To assign the run command to the operator panel, set parameter b1-01 to “0”. This will set up the drive to acknowledge the run command through the LED operator. Initialize the run command using the Run and Stop keys. Upon power up, the drive uses parameter b1-02 to determine the run command location.

The following procedure indicates how to start and stop the drive through the LED operator after parameter b1-02 has been set to 0.

Note:
When b1-02 (Run Command Selection) is not set to 0 (operator), press  to set LOCAL.

Step			Display/Result
1.	Turn on the power to the drive. The initial display appears.	➡	
2.	Set the frequency reference to F6.00 (6 Hz). **Note:** *Refer to Drive Mode Details on page 62* for instructions on how to set the frequency reference.	➡	
3.	Press the  key to start the motor.	➡	

	Step		Display/Result
4.	The motor should accelerate up to 6 Hz while the RUN light is on.	➡	
5.	Press the  key to stop the motor. The RUN light will flash until the motor comes to a complete stop.	➡	

■ Run the Drive using Digital Input Terminals: b1-02 = 1

This setting uses the digital input terminals to enter the run command. The factory setting is a 2-wire sequence.

Using a 2-Wire Sequence

Digital Input Terminals	ON	OFF
S1	Forward Run	Stop
S2	Reverse Run	Stop

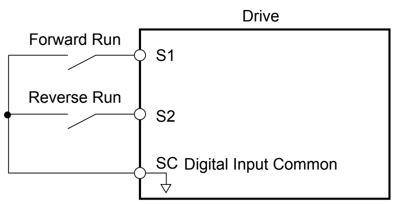


Figure 4.15 Example Wiring Diagram for 2-Wire Sequence

Using a 3-Wire Sequence

When H1-05 (Multi-Function Digital Input Terminal S5 Function Selection) = 0, the functions of terminals S1 and S2 are set to 3-wire sequence, and the multi-function input terminal becomes forward/reverse run command terminal.

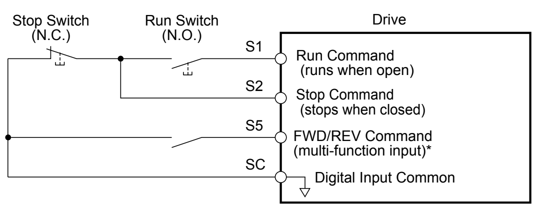


Figure 4.16 Example Wiring Diagram for 3-Wire Sequence Using Terminal S5

*When terminal S5 is open, the motor rotates forward. When closed, the motor rotates in reverse.

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

Note: *Refer to Parameter List on page 291* for a list of digital input functions. After performing a 3-wire initialization (A1-03 = “3”), the drive will automatically assign the forward/reverse command to terminal S5.

CAUTION! *The motor will begin rotating as soon as the power is switched on. Proper precautions must be taken to ensure that the area around the motor is safe prior to powering up the drive. Failure to do so may result in minor or moderate injury.*

Note: Run by Turning on/off the Power Supply. For safety reasons, the drive is initially set up not to accept a run command at power up (b1-17 = "0"). If a run command is issued at power up, the RUN indicator LED will flash quickly. To change this and have the run command issued by the drive, change parameter b1-17 to 1.

◆ Stopping Method Selection: b1-03

When a Stop command is issued, the drive stops the motor using one of four possible methods.

■ Ramp to Stop: b1-03 = 0

When b1-03 = 0, the motor will decelerate to a stop when a stop command is entered. The deceleration time is set by C1-02 (Deceleration Time 1). *Refer to Acceleration/Deceleration: C1-01 to C1-11 on page 80*.

When the output frequency falls below the DC Injection braking start frequency (b2-01) during deceleration, the DC Injection braking current (b2-02) will be activated for the specified DC Injection time at stop (b2-04).

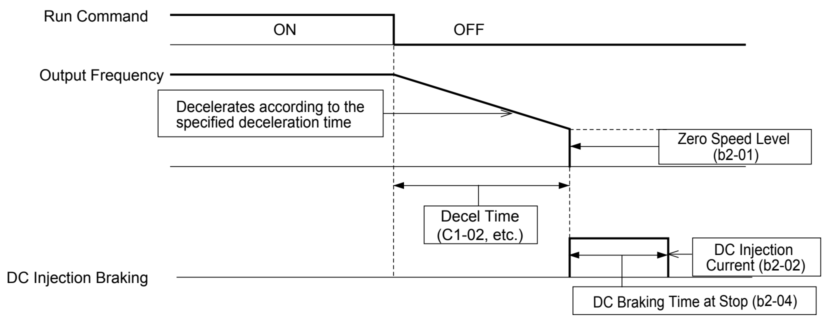


Figure 4.17 Ramp to Stop

Note: Parameter b2-04 is not available if using PM Open Loop Vector. Instead, set the Short Circuit Braking time to b2-13.

■ Coast to Stop: b1-03 = 1

When the run command is removed, the drive will shut off its output and the motor will coast (uncontrolled deceleration). The motor will coast to a stop at the rate determined by the load inertia.

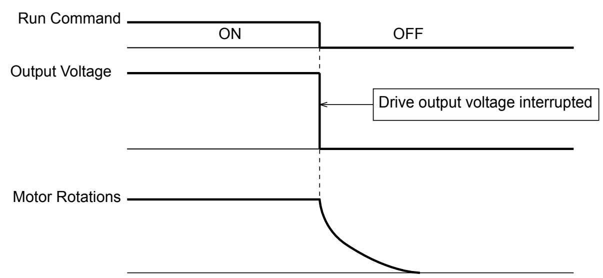


Figure 4.18 Coast to Stop

Note:
1. After entering a stop command, the drive will not accept another run command until the time set to L2-03 (Minimum Baseblock Time) passes.
2. Do not enter another run command until the motor comes to a complete stop. If a run command must be entered before the motor has fully stopped, use DC Injection or Speed Search functions to slow the motor or catch the motor before restarting. For details refer to V1000 Technical Manual.

■ DC Injection Braking to Stop: b1-03 = 2

DC Injection Braking stops a coasting motor without regenerative operation. When the run command is removed, the drive will baseblock (turn off its output) for the minimum baseblock time (L2-03). Once the minimum baseblock time has expired, the drive will inject DC current into the motor windings to lock the motor shaft. The stopping time will be reduced as compared to coast to stop. The level of DC Injection current is set by parameter b2-02 (default = 50%). The time for DC Injection Braking is determined by the value set to b2-04 and by the output frequency at the time the run command is removed.

Note: DC Injection braking cannot be selected as a stopping method in PM Open Loop Vector Control.

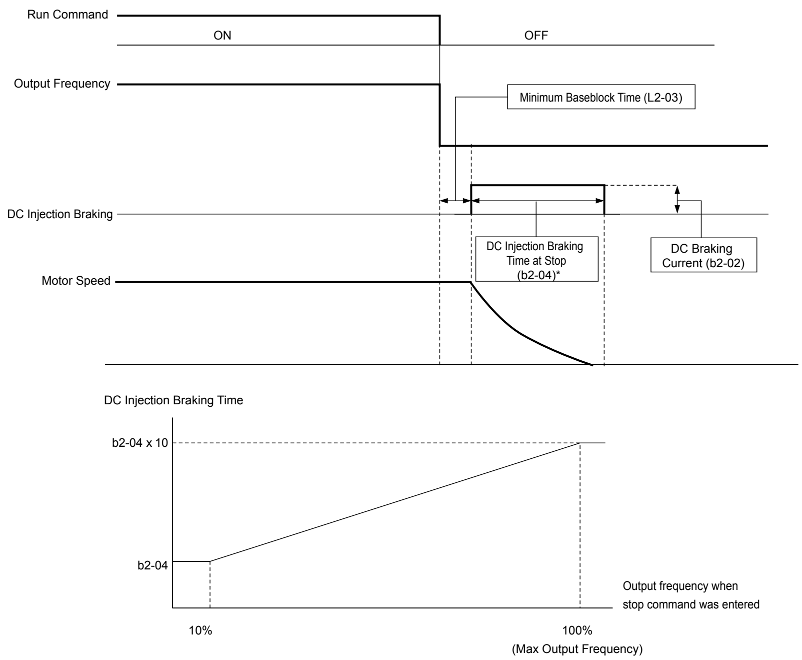


Figure 4.19 DC Injection Braking Stop

*See *Figure 4.18*

Note: Extend baseblock time (L2-03) if overcurrent (OC) occurs on stop command input.

■ Coast to Stop with Timer: Ignoring a Run Command Input within the Deceleration Time: b1-03 = 3

When b1-03 = 3, a stop command interrupts drive output and the motor coasts to stop. The drive will not accept the next run command until time “t” has passed. Time “t” is determined by the output frequency at the moment the stop command was entered and the deceleration time set to the drive according to *Figure 4.20* .

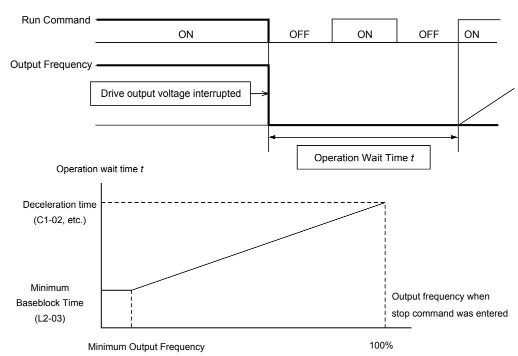


Figure 4.20 Coast to Stop with Timer

◆ Acceleration/Deceleration: C1-01 to C1-11

C1-01 (Acceleration Time 1) sets the time to accelerate from 0 to the maximum output frequency (E1-04). C1-02 (Deceleration Time 1) sets the time to decelerate from maximum output frequency to 0.

No.	Parameter Name	Description	Setting Range	Default
C1-01 <1>	Acceleration Time 1	Sets the time to accelerate from 0 to 100% (maximum output frequency).	0.0 to 6000.0 <2>	10.0 s
C1-02 <1>	Deceleration Time 1	Sets the time to decelerate from 100% (maximum output frequency) to 0%.		

No.	Parameter Name	Description	Setting Range	Default
C1-10	Accel/Decel Time Setting Units	Sets the setting resolution of C1-01 to C1-09. 0: 0.01 s (0.00 to 600.00 s) 1: 0.1 s (0.0 to 6000.0 s)	0, 1	1

<1> The parameter can be changed during run.
<2> The setting range for the acceleration and deceleration times is determined by C1-10 (Accel/Decel Time Setting Units). For example, if the time is set in units of 0.01 s (C1-10 = 0), the setting range becomes 0.00 to 600.00 s

WARNING! *Sudden Movement Hazard. Rapid deceleration may cause the drive to fault on an overvoltage condition, resulting in death or serious injury due to an uncontrolled motor state. Set an acceptable deceleration time in parameter C1-09 when using the Fast-stop feature.*

■ Accel/Decel Time Setting Units

Set the units for the acceleration and deceleration times using parameter C1-10 (default = 1).

Setting	Description
0	Time is set in units of 0.01 s, making the setting range 0.00 to 600.00 seconds.
1	Time is set in units of 0.1 s, making the setting range 0.0 to 6000.0 seconds.

■ Switching Accel/Decel Times with Digital Input Terminals

Up to four different acceleration / deceleration times can be selected using any two digital input terminals S1 through S7.

Program two parameters H1-01 through H1-07 to “07” (Accel/Decel Time 1) and “1A” (Accel/Decel Time 2). The combination of these two inputs activates the acceleration/deceleration times as shown below. As the contacts of the terminals open and close, the following acceleration and deceleration time combinations are possible:

Accel/Decel Time 1 H1-□□ = 7	Accel/Decel Time 2 H1-□□ = 1A	Acceleration Time	Deceleration Time
Open (not selected)	Open (not selected)	C1-01	C1-02
Closed	Open (not selected)	C1-03	C1-04
Open (not selected)	Closed	C1-05	C1-06
Closed	Closed	C1-07	C1-08

■ Automatically Switching Acceleration/Deceleration Times

The drive can automatically switch between acceleration and deceleration times.

When the output frequency reaches the value set to C1-11, the drive will switch acceleration and deceleration times as shown in the figure below. Setting C1-11 to 0.0 Hz disables this function.

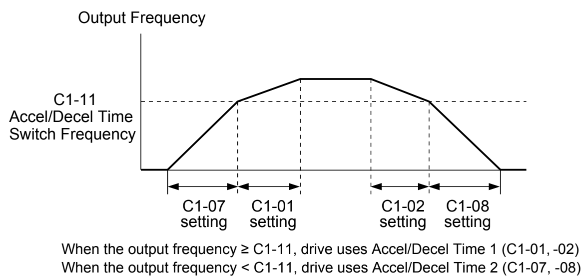


Figure 4.21 Accel/Decel Time Switching Frequency

■ Using S-Curve Characteristics during Acceleration/Deceleration

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

Note: 1. Setting S-curve characteristics will lengthen accel/decel times as follows: Accel Time = Selected Accel Time + (C2-01 + C2-02)/2 Decel Time = Selected Decel Time + (C2-03 + C2-04)/2
2. Set longer S-curve times using PM Open Loop Vector Control.

Setting Example

Figure 4.22 illustrates S-curve characteristics switching between forward and reverse.

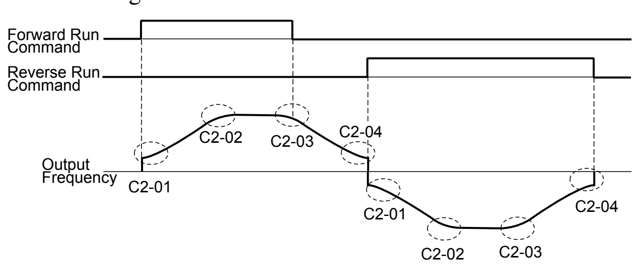


Figure 4.22 S-Curve Characteristics

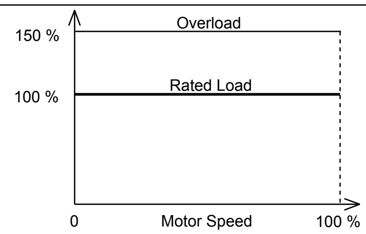
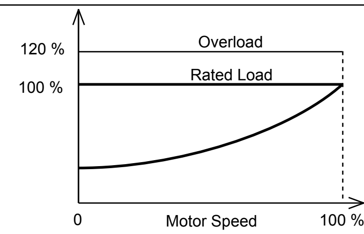
Start-Up Programming & Operation
4

◆ Drive Duty Mode and Carrier Frequency Selection: C6-01 and C6-02

■ Drive Duty Mode Selection: C6-01

The drive has two different duty modes from which to select based on the load characteristics. The drive rated current, overload capacity, carrier frequency, and maximum output frequency will change depending upon the duty mode selection. Use parameter C6-01 (Duty Cycle) to select Heavy Duty (HD) or Normal Duty (ND) for the application. The factory setting is ND. *Refer to Specifications on page 279* for details about the rated current.

HD and ND Mode Selections

Mode	HD Rating	ND Duty Rating
C6-01	0	1
Characteristics		
Application	Use HD Rating is designed applications requiring a high overload tolerance with constant load torque. Such applications include extruders, conveyors and cranes.	Use ND Rating for applications in which the torque requirements drop along with the speed. Examples include fans or pumps where a high overload tolerance is not required.
Overload capability (OL2)	100% continuous, 150% of drive rated current for 60 s	100% continuous, 120% of drive rated current for 60 s
L3-02 Stall Prevention during Acceleration	150%	120%
L3-06 Stall Prevention during Run	150%	120%

Note: By selecting HD/ND motor parameters E2 and E4 are changed to values for the maximum applicable motors.

■ Carrier Frequency Selection: C6-02

Fixed Carrier Frequencies

The carrier frequency can be set using parameter C6-02 as shown in table below.

Parameter	Name	Description	Setting Range	Default
C6-02	Carrier frequency	1 : 2.0 kHz 2 : 5.0 kHz 3 : 8.0 kHz 4 : 10.0 kHz 5 : 12.5 kHz 6 : 15.0 kHz 7: Swing PWM1 8: Swing PWM2 9: Swing PWM3 A: Swing PWM4 F : User defined (C6-03 to C6-05)	1 to F	depends on drive size

Note: Settings 7 through A for parameter C6-02 use a Swing PWM equivalent to a 2 kHz audible noise. This function turns the motor noise into a less obtrusive white noise.

Note: The upper limit for the carrier frequency is determined by drive capacity.

Precautions when setting parameter C6-02:

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

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

Wiring Distance	Up to 50 m	Up to 100 m	Greater than 100 m
C6-02 (Carrier Frequency Selection)	1 to A (15 kHz)	1 to 2, 7 to A (5 kHz)	1, 7 to A (2 kHz)

Note: When using PM Open Loop Vector control with long cable lengths, set the carrier frequency to 2 kHz (C6-02 = “1”). Use V/f control if the motor cable exceeds 100 m.

User Defined and Variable Carrier Frequency

Set parameter C6-02 to “F” to set carrier frequency values between fixed values.

In Open Loop Vector and PM motor control the desired value can be set in parameter C6-03.

In V/f control the carrier frequency can be set up to change linearly with the output frequency. In this case the upper and lower limits for the carrier frequency and the carrier frequency proportional gain (C6-03, C6-04, C6-05) have to be set up as shown *Figure 4.23* .

Note: Set both C6-03 and C6-04 to the same value or set C6-05 to 0 to keep the carrier frequency at a constant level. C6-03 sets the Carrier frequency upper limit.

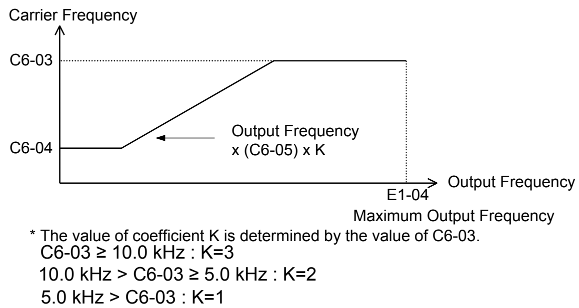


Figure 4.23 Carrier Frequency Changes Relative to Output Frequency

Note: For Open Loop Vector Mode, A1-02 = 2 and OLV for PM the carrier frequency is fixed to a value set by C6-02 or C6-03 if C6-02 is set to F (programmable).

Carrier Frequency Setting Error (oPE11)

A carrier frequency setup error (oPE11) will occur when carrier frequency gain (C6-05) is greater than 6 and C6-03 < C6-04.

Note: *Refer to Troubleshooting Without Fault Display on page 246* for information on operator errors (oPE).

■ Carrier Frequency and Drive Overload Current Level

With C6-01 set to 1, the carrier frequency setting defines drive output current level.

Table 4.19 Current Derating by Carrier Frequency Setting

Single-Phase 200 V			Three-Phase 200 V			Three-Phase 400 V		
Model (Capacity)	Carrier Frequency (kHz)	Output Current (A)	Model (Capacity)	Carrier Frequency (kHz)	Output Current (A)	Model (Capacity)	Carrier Frequency (kHz)	Output Current (A)
B☐0001 0.2 kW/ 0.1 kW	2	1.2	2☐0001 0.2 kW/ 0.1 kW	2	1.2			
	10	0.8		10	0.8			
	15	0.6		15	0.6			
B☐0002 0.4 kW/ 0.2 kW	2	1.9	2☐0002 0.4 kW/ 0.2 kW	2	1.9	4☐0001 0.4 kW/ 0.2 kW	2	1.2
	10	1.6		10	1.6		8	1.2
	15	1.3		15	1.3		15	0.7
B☐0003 0.75 kW/ 0.4 kW	2	3.3	2☐0004 0.75 kW/ 0.4 kW	2	3.3	4☐0002 0.75 kW/ 0.4 kW	2	2.1
	10	3.0		10	3.0		8	1.8
	15	2.4		15	2.4		15	1.1
B☐0006 1.1 kW/ 0.75 kW	2	6.0				4☐0004 1.5 kW/ 0.75 kW	2	4.1
	10	5.0					8	3.4
	15	4.0					15	2.0
			2☐0006 1.1 kW/ 0.75W	2	6.0			
				10	5.0			
				15	4.0			
			2☐0008 1.5 kW/ 1.1 kW	2	8.0			
				8	6.9			
				15	5.5			
B☐0010 2.2 kW/ 1.5W	2	9.6	2☐0010 2.2 kW/ 1.5W	2	9.6	4☐0005 2.2 kW/ 1.5W	2	5.4
	8	8.0		8	8.0		8	4.8
	15	6.4		15	6.4		15	2.9
B☐0012 3.0 kW/ 2.2 kW	2	12.0	2☐0012 3.0 kW/ 2.2 kW	2	12.0	4☐0007 3.0 kW/ 2.2 kW	2	6.9
	8	11.0		8	11.0		8	5.5
	15	8.8		15	8.8		15	3.3
			2☐0018 3.7 kW/ 3.0W	2	17.5	4☐0009 3.7 kW/ 3.0 kW	2	8.8
				8	14.0		8	7.2
				15	11.2		15	4.3
BA0018* —/ 3.7 kW	2	17.5	2☐0020 5.5 kW/ 4.0 kW	2	19.6	4☐0011 5.5 kW/ 4.0 kW	2	11.1
	8	17.5		8	17.5		8	9.2
	15	14.0		15	14.0		15	5.5

* CIMR-V☐BA0018 is available with a Heavy Duty rating only.

◆ Drive Input Voltage Setting: E1-01

Set E1-01 according to the power supply voltage. This setting serves as a base value for certain drive protective functions.

NOTICE: *Set drive input voltage (not motor voltage) in parameter E1-01 for proper function of the protective features of the drive. Failure to comply could result in improper drive operation. Set parameter E1-01 to match the input voltage of the drive.*

Parameter	Name	Description	Setting Range	Default
E1-01	Input Voltage Setting	Set to the nominal voltage of the incoming line. Sets the maximum and base voltage used by preset V/f patterns (E1-03), and adjusts the levels of drive protective features (e.g., overvoltage, braking resistor level, stall prevention, etc.).	200 V Class: 155 to 255 400 V Class: 310 to 510	230 V

■ Input Voltage Setting Value: E1-01

The input voltage level determines the overvoltage detection level and the operation level of the braking transistor as shown in the table below.

Voltage	Setting Value of E1-01	(Approximate Values)				
		OV Detection Level	Braking Transistor Operation Level	UV Detection Level	Desired AC Voltage during KEB	Voltage Level for OV Suppression, Stall Prevention
200 V Class	all settings	410 V	394 V	190 V (single-phase=160 V)	240 V	370 V
400 V Class	setting ≥ 400V	820 V	788 V	380 V	480 V	740 V
	setting < 400V	740 V	708 V	350 V	440 V	660 V

Note: This data is for an internal dynamic braking resistor of 0.1 to 18.5 kW. For larger units, see "Dynamic Braking Resistor Unit for VARISPEED-600 Series, TOBPC72060000."

◆ V/f Pattern Selection: E1-03

Parameter E1-03 is only available when using V/f Control. It allows the user to set the required V/f pattern and drive output voltage. When running a high-speed or special-purpose motor, this function fine tunes the amount of torque required for the load. Select the V/f pattern from 15 fixed V/f patterns or 1 user-programmable V/f pattern.

No.	Parameter Name	Description	Setting Range	Default
E1-03	V/f Pattern Selection	0 to E: Select from 15 preset V/f patterns. F: Custom V/f pattern (allows use of E1-04 through E1-10).	0 to F	F

■ Setting Instructions for Setting a V/f Pattern

1. Set the input voltage for the drive. ***Refer to Drive Input Voltage Setting: E1-01 on page 83***.
2. Select one of the two following V/f patterns:
   - *Select one of the 15 preset V/f patterns (setting = 0 through E)
   - **Select the Custom V/f pattern (setting = F)
3. In case of *, the following parameters are automatically set.

   In case of **, the following parameters are adjustable.

   E1-04 (Max Output Frequency), E1-05 (Max Voltage), E1-06 (Base Frequency), E1-07 (Mid Output Frequency), E1-08 (Mid Output Frequency Voltage), E1-09 (Min Output Frequency), E1-10 (Min Output Frequency Voltage)

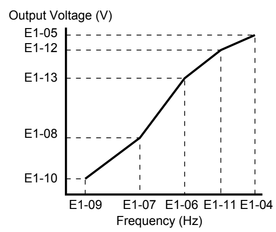


Figure 4.24 V/f Pattern

■ Selecting a Preset V/f Pattern

There are two types of V/f patterns: a method to select one of the 15 presets (set value: 0 to E) and a method to select arbitrary V/f pattern (set value: F). Refer to ***Table 4.20*** .

No.	Parameter Name
E1-04	Maximum Output Frequency (FMAX)
E1-05	Maximum Voltage (VMAX)
E1-06	Base Frequency (FA)
E1-07	Mid Output Frequency (FB)

No.	Parameter Name
E1-08	Mid Output Frequency Voltage (VC)
E1-09	Minimum Output Frequency (FMIN)
E1-10	Minimum Output Frequency Voltage (VMIN)

Note: The default setting for the V/f pattern is for a custom V/f pattern (E1-03 = F).

Table 4.20 V/f Patterns

Setting	Specification	Characteristic	Application
0	50 Hz	Constant torque	For general purpose applications, torque remains constant regardless of speed changes.
1 (F)	60 Hz		
2	60 Hz (with 50 Hz base)		
3	72 Hz (with 60 Hz base)		
4	50 Hz, Heavy Duty 3	Reduced or variable torque	For applications where torque changes with the speed like fans, pumps, and others that require reduced torque relative to the load.
5	50 Hz, Heavy Duty 2		
6	60 Hz, Heavy Duty 3		
7	60 Hz, Heavy Duty 2		
8	50 Hz, mid starting torque	High starting torque	High starting should be selected only when: • Wiring between the drive and motor exceeds 150 m • Large amount of starting torque is required • AC reactor is installed • motor exceeds the largest motor recommended for that drive used
9	50 Hz, high starting torque		
A	60 Hz, mid starting torque		
B	60 Hz, high starting torque		

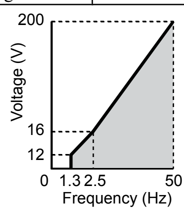
Setting	Specification	Characteristic	Application
C	90 Hz (with 60 Hz base)	Constant output	When operating at speeds greater than 60 Hz motor requires constant voltage. Above 60 Hz, motor operates in constant power range.
D	120 Hz (with 60 Hz base)		
E	180 Hz (with 60 Hz base)		

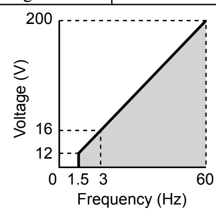
■ V/f Pattern Characteristics

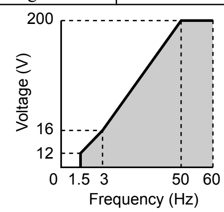
These graphs apply to 200 V class drives; double the values for 400 V class drives.

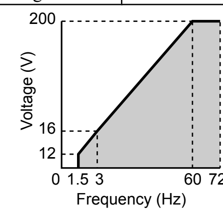
- Constant Torque Characteristics, Settings 0 through 3

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



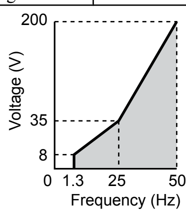


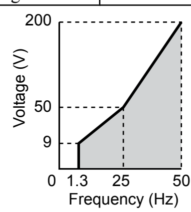


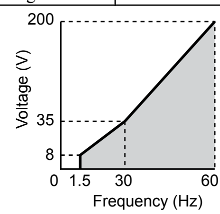


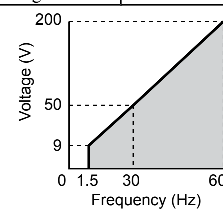
- Reduced Torque Characteristics, Settings 4 through 7

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



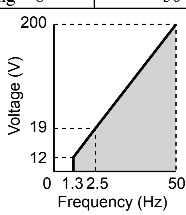


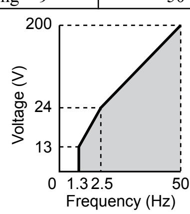


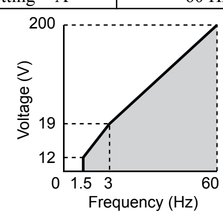


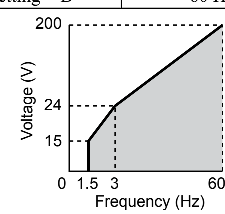
- High Starting Torque Characteristics, Settings 8 through B

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



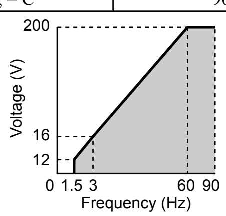


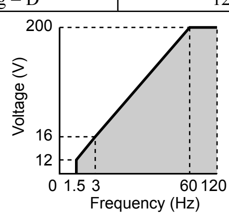


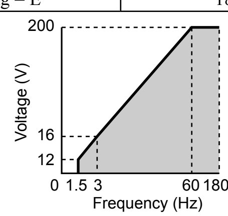


- Constant Output Characteristics, Settings C through F

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







Note: Setting an improper V/f pattern may result in reduced motor torque or increased current (due to over excitation).

◆ Motor Parameters: E2-01 through E2-12 (Manually Entering Parameter Settings)

In Open Loop Vector Control, motor parameters are set automatically during the Auto-Tuning process. Manually set motor parameters if Auto-Tuning cannot be performed. *Refer to Auto-Tuning on page 91* for more information. Refer to *E: Motor Parameters* for a list of motor parameters E2-01 to E2-12.

■ Setting Motor Parameters Manually

The following table provides instructions on how to set motor parameters. Refer to the motor data sheet for the correct motor data.

No.	Parameter Name	Setting Method
E2-01	Motor Rated Current	Sets the motor nameplate full load current in amperes (A).
E2-02	Motor Rated Slip	Calculate and set the motor rated slip based on the rated speed described on the motor nameplate. Motor rated slip = Motor rated frequency [Hz] - Rated speed [r/min] x No. of motor poles / 120.
E2-03	Motor No-Load Current	Set motor no-load current at rated voltage and rated frequency. Contact the motor manufacturer to get the no-load current. This information is not usually written on the motor nameplate. The default no-load current is for a Yaskawa 4-pole motor.
E2-04	Number of Motor Poles	Displayed only when OLV control mode is selected. Set the number of motor poles described on the motor nameplate.

No.	Parameter Name	Setting Method
E2-05	Motor Line-to-Line Resistance	This value is automatically set during Auto-tuning. When regular Auto-Tuning is not possible, contact the motor manufacturer to find out the resistance between lines (T-lead to T-lead). If using the Motor Test Report, calculate resistance between lines as follows: E-Type Insulation: Test Report value for line resistance at 75 °C at 0.92 ohms B-Type Insulation: Test Report value for line resistance at 75 °C at 0.92 ohms F-Type Insulation: Test Report value for line resistance at 115 °C at 0.87 ohms
E2-06	Motor Leakage Inductance	Set the amount of voltage drop due to motor leakage inductance at base frequency and motor rated current. This value should be set when using a high-speed motor or another type of motor that has a relatively small amount of inductance. Contact the motor manufacturer to get the motor leakage inductance, as this information is not usually written on the motor nameplate.
E2-07 <1>	Motor Iron-Core Saturation Coefficient 1	This value is automatically set during rotational Auto-Tuning.
E2-08 <1>	Motor Iron-Core Saturation Coefficient 2	This value is automatically set during rotational Auto-Tuning.
E2-09	Motor Mechanical Loss	Displayed only when using Open Loop Vector Control. It is not necessary to set this parameter, but it may require adjustment under the following circumstances: Large amount of torque loss relative to motor bearings Fan and pump type applications with a large amount of torque loss The amount of mechanical loss will be reflected in the amount of torque compensation.
E2-10	Motor Iron Loss for Torque Compensation	Displayed only when using V/f Control. Increase the motor iron loss in watts in order to increase the accuracy of torque compensation.
E2-11	Motor Rated Output	Sets the motor rated power in kilowatts (kW). This value is automatically set during Auto-Tuning in units of 0.01.
E2-12 <1>	Motor Iron-Core Saturation Coefficient 3	Set to the motor iron saturation coefficient at 130% of magnetic flux. This value is automatically set during rotational Auto-Tuning.

<1> Parameters E2-07 through E2-08 and E2-12 may be difficult to set manually. If Auto-Tuning is not possible, simply leave these settings at the default values.

◆ Digital Outputs H2-01 to H2-03

Parameters H2-01, H2-02 and H2-03 assign functions to digital output terminals MA, MB, MC, P1, and P2. Set these parameters as required by the application. Default values are listed below.

NOTICE: *Do not assign a function that repeats ON/OFF frequently to terminals MA and MB. Failure to comply will reduce the relay contact lifetime. The expected number of relay contact switching times is normally 200,000 times (current 1 A, resistance load).*

No.	Parameter Name	Default
H2-01	Terminal MA, MB and MC Function Selection (relay)	E: Fault
H2-02	Terminal P1 Function Selection (open-collector)	0: During Run
H2-03	Terminal P2 Function Selection (open-collector)	2: Speed Agree 1

Note: The setting range for H2-01 through H2-03 is 0 to 14D. *Refer to Parameter List on page 291* for more information.

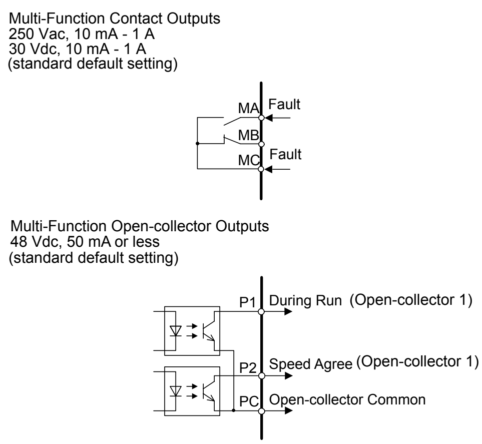


Figure 4.25 Digital Output Connection Diagram

◆ Analog Outputs: H4-01 to H4-03

Group U parameters can be used to observe the drive status (operating conditions) through the LED operator. Analog outputs corresponding to these monitors can be obtained on analog output terminal AM or FM when programmed with parameter group H4. Some Group U monitors are not available as analog outputs.

No.	Parameter Name	Description
H4-01	Multi-Function Analog 1 (Terminal AM Monitor Selection)	Select the data to 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. When using this terminal as a through terminal or when not using it at all, set “000” or “031”.
H4-02 <1>	Multi-Function Analog 1 (Terminal AM Output Gain)	Sets the voltage level gain of multi-function analog output 1 (terminal AM). The bias to be added ranges from 0 to +/- 10% when 10 V is assumed to be 100%.
H4-03 <1>	Multi-Function Analog 1 (Terminal AM Bias Setting)	Sets the voltage level bias for terminal AM. The bias added is 0 to ±10% with a maximum voltage output of 10 V as 100%.

<1> The parameter can be changed during run.

■ Changing Analog Output Settings

The following example illustrates how to program analog output terminal FM to generate a signal proportional to drive output current (monitor U1-03).

Using H4-01 to Display Monitor Contents

	Step		Display/Result
1.	Turn on the power to the drive. The initial display appears.	➡	F 0.00 ALM REV DRV OUT
2.	Press V until the Parameter setting menu is displayed.	➡	PAr
3.	Press ENTER to enter the Parameter setting menu.	➡	A1-01
4.	Press RESET and Λ to select H4-01.	➡	H4-01
5.	Press ENTER to display the value currently set to H4-01.	➡	102
6.	Press RESET and Λ to set the output current (103).	➡	103
7.	Save the setting by pressing ENTER .	➡	End
8.	The display automatically returns to the parameter setting menu.	➡	H4-01
9.	Press the ESC key until back at the Top Screen.	➡	F 0.00 ALM REV DRV OUT

Adjusting the Analog Output Terminal Voltage with H4-02 and H4-03

Note: This example continues from Step 3 in the previous example.

	Step		Display/Result
1.	Select H4-02 or H4-03 by pressing the RESET and Λ keys.	➡	H4-02
2.	Press the ENTER key while the drive is stopped and the following voltage is output for adjustment: output voltage = (10 V x Output Gain (H4-02) + Output Bias (H4-03). Using this output, adjust output gain (H4-02) and output bias (H4-03).	➡	0 100.0

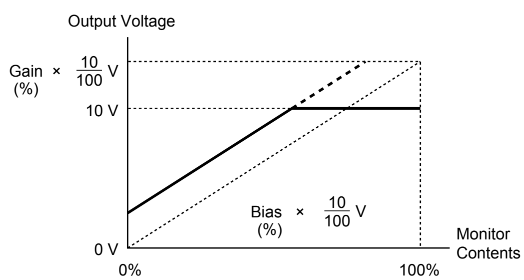


Figure 4.26 Adjusting the Monitor Output

◆ Motor Protection: L1-01 and L1-02

This section explains how to set motor overload protection.

■ Electronic Thermal Motor Protection

The drive has built-in electronic thermal overload protection to detect overload conditions. This protection meets standards set by UL and cUL for motor thermal overload protection. The protective feature is activated when the output current rises above the motor rated current for a specified time. This speed sensitive protective feature interrupts the motor current to protect the motor wiring and windings in the event of overload, eliminating the need for an external overload device. When multiple motors are used with a single drive, separate overload devices are required to properly protect the individual motor branches.

Related Parameters

No.	Parameter Name	Description	Setting Range	Default Setting
E2-01	Motor Rated Current	Sets the motor nameplate full load current in amperes (A). This set value becomes the reference value for motor protection, torque limit, and torque control. This value is automatically set during Auto-Tuning.	10 to 200% of drive rated current Less than 11 kW: 2 digits below the decimal point, 11 kW or more: 1 digit below the decimal point.	Determined by o2-04 and C6-01
E4-01	Motor 2 Rated Current	Sets the motor 2 name plate full load current in amperes (A). This set value becomes the reference value for motor protection, torque limit, and torque control. This value is automatically set during Auto-Tuning.	10 to 200% of drive rated current	Determined by o2-04 and C6-01
L1-01	Motor Overload Protection Selection	Enables or disables motor thermal overload protection (OL1) 0: Disabled 1: Protection for general purpose motor 2: Protection for inverter motor 3: Protection for vector motor 4: Protection for PM variable torque motor	0 to 4 Use L1-13 (Continuous Electrothermal Operation Selection) to select whether electronic thermal value is “held” or “not held” when the power supply is turned off. When connecting several motors to one drive, set “0” (disabled) and install a thermal relay on each motor.	1

No.	Parameter Name	Description	Setting Range	Default Setting
L1-02	Motor Overload Protection Time	Sets the electronic thermal overload protection detection time in the motor overload protection (OL1) function. This setting rarely needs to be changed and should be set in accordance with the overload tolerance of the motor.	0.1 to 5.0	1.0 min

Note: Executing C6-01 (Duty Cycle) changes motor parameters E2 and E4 including motor rated current to the values of the maximum applicable motor.

Digital Outputs (H2-01 through H2-03)

Setting	Function	Description
1F	Motor Overload OL1 Alarm Warning (including OH3)	Closed = When OL1 function is at 90% of its trip point or greater.

Setting Procedure

1. Set E2-01 (Motor Rated Current) and E4-01 (Motor 2 Rated Current) to the motor rated current.

Note: **1.** Values set for the current become the base current for electronic thermal overload protection.
2. These values are automatically set by performing Auto-Tuning.
3. The E4-01 setting is not needed if not using motor 2.

2. Set the proper motor protection level to L1-01.

The ability of the cooling fan to keep an induction motor cool varies by the speed control range. Protection characteristics of the electronic thermal overload protection should be set accordingly. Refer to *Table 4.21* for motor types and overload tolerances.

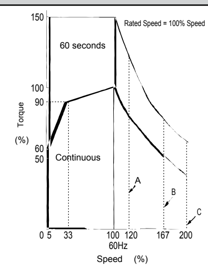
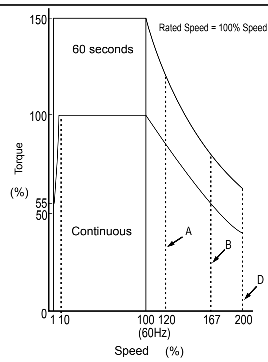
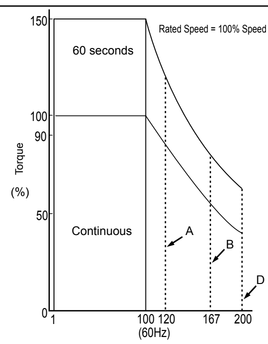
NOTICE: *When connecting multiple motors to one drive, disable the electronic overload protection of the drive (L1-01 = 0) and protect each motor with its own motor thermal overload. Failure to comply could result in improper drive operation.*

NOTICE: *Inadequate motor protection could result in damage to the motor. Configure a motor thermal overload to disconnect main power to the drive when tripped. When using a thermal relay, disable the motor protection function (L1-01 = "0").*

3. Set the motor overcurrent alarm warning level.

When H2-01, H2-02, and H2-03 (Terminal MA, MB, and MC Function selection, Terminal P1 Function Selection, and Terminal P2 Function Selection) are set to 1F motor overload (OL1 alarm warning), a motor overload alarm is enabled. If the electronic thermal value exceeds 90% of the overload detection level, the set output terminal turns on.

Table 4.21 Motor Type and Overload Tolerances

L1-01 Setting	Motor Type	Overload Tolerance	Cooling Fan Capacity	Electrothermal Protection (100% motor overload)
1	General-purpose motor (standard motor)		General purpose motors are designed to operate from line power. The most effective cooling occurs when running at line power specifications.	Operating continuously at less than line power frequency can trigger motor overload protection (OL1). A fault is then output and the motor will coast to stop.
2	Inverter Duty motor (1:10)		Motor designed to effectively self-cool at speeds as low as 6 Hz.	Continuous operation between 6 and 50/60 Hz.
3	Vector motor (1:100)		Motor capable of effective cooling at extremely low speeds (0.6 Hz).	Continuous operation between 0.6 and 60 Hz.

L1-01 Setting	Motor Type	Overload Tolerance	Cooling Fan Capacity	Electrothermal Protection (100% motor overload)
		A: Typical maximum speed for Yaskawa motor frame number 200LJ and greater B: Typical maximum speed for Yaskawa motor frame numbers 160MJ – 180LJ C: Typical maximum speed for Yaskawa motor frame number 132MHJ or less D: Typical maximum speed for Yaskawa motor frame number 132MJ or less		

Notes on Motor Protection

- Motor protection meeting UL and cUL standards is achieved with the motor overload protection time (L1-02) set to factory default setting. Normally, L1-02 (Motor Overload Protection Time) does not require setting. If the motor overload tolerance is clear, set the overload protection time at hot start according to the motor. To detect overload earlier, decrease the setting.

Note: *Figure 4.27* illustrates motor protection operation time characteristics.

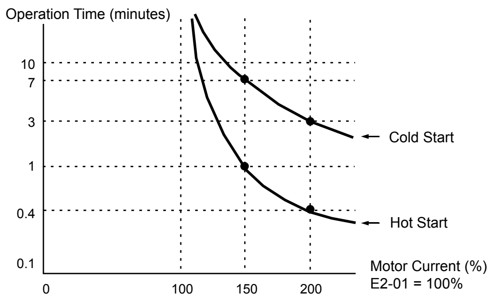


Figure 4.27 Motor Protection Operation

- Disable motor protection (L1-01 = 1) when running multiple motors from the same drive. Attach a thermal relay for each motor to provide overload protection.
- Use L1-13 (Continuous Electrothermal Operation Selection) to select whether the electrothermal value is "held" or "not held" when power supply is turned off. Default setting is 1 (Enabled).
- In the case of a general purpose (standard) motor, the cooling capability is reduced at a low speed. Motor overload protection (OL1) may occur in frequencies lower than motor rated current. Use an exclusive-use or inverter-duty motor to operate the drive at rated current at low frequency.

◆ Drive Status Monitors: U1-01 to U6-19

Parameter group U displays various data regarding the operating status of the drive.

The following example demonstrates viewing output voltage reference (U1-06).

	Step		Display/Result
1.	Turn on the power to the drive. The initial display appears.	➔	
2.	Press  until "Monitor Display" appears.	➔	
3.	Press  to enter the Parameter Setting Screen.	➔	
4.	Press  until U1-06 appears.	➔	
5.	Press  to display the voltage reference. The Output Voltage Reference appears.	➔	

Refer to Parameter List on page 291 for more details about Drive Status Monitors.

Table 4.22 Drive Status Monitors

No.	Parameter Name	Page
U1-01	Frequency Reference	*316*
U1-02	Output Frequency	*316*
U1-03	Output Current	*316*
U1-04	Control Mode	*316*
U1-05	Motor Speed	*316*
U1-06	Output Voltage Reference	*316*
U1-07	DC Bus Voltage	*316*
U1-08	Output Power	*316*
U1-09	Torque Reference	*316*
U1-10	Input Terminal Status	*317*
U1-11	Output Terminal Status	*317*
U1-12	Drive Status	*317*
U1-13	Terminal A1 Input Voltage	*317*
U1-14	Terminal A2 Input Voltage	*317*
U1-16	Output Frequency after SoftStart	*317*
U1-18	oPE Fault	*317*
U1-19	MEMOBUS/Modbus Error Code	*318*
U1-24	Input Pulse Monitor	*318*
U1-25	Software Number (Flash)	*318*
U1-26	Software Number (ROM)	*318*
U2-01	Current Fault	*318*
U2-02	Previous Fault	*318*
U2-03	Frequency Reference at Previous Fault	*318*
U2-04	Output Frequency at Previous Fault	*318*
U2-05	Output Current at Previous Fault	*318*
U2-06	Motor Speed at Previous Fault	*318*
U2-07	Output Voltage at Previous Fault	*318*
U2-08	DC Bus Voltage at Previous Fault	*318*
U2-09	Output Power at Previous Fault	*318*
U2-10	Torque Reference at Previous Fault	*318*
U2-11	Input Terminal Status at Previous Fault	*318*
U2-12	Output Terminal Status at Prev. Fault	*318*
U2-13	Drive Operation Status at Pre. Fault	*318*
U2-14	Cumulative Operation Time at Previous Fault	*318*
U2-15	Soft Starter Speed Reference at Previous Fault	*318*
U2-16	Motor q-Axis Current at Previous Fault	*318*
U2-17	Motor d-Axis Current at Previous Fault	*318*
U3-01	Most Recent Fault	*318*

No.	Parameter Name	Page
U3-02	2nd Most Recent Fault	318
U3-03	3rd Most Recent Fault	318
U3-04	4th Most Recent Fault	318
U3-05	5th Most Recent Fault	318
U3-06	6th Most Recent Fault	318
U3-07	7th Most Recent Fault	318
U3-08	8th Most Recent Fault	318
U3-09	9th Most Recent Fault	318
U3-10	10th Most Recent Fault	318
U3-11	Cumulative Operation Time at Most Recent Fault	318
U3-12	Cumulative Operation Time at 2nd Most Recent Fault	318
U3-13	Cumulative Operation Time at 3rd Most Recent Fault	318
U3-14	Cumulative Operation Time at 4th Most Recent Fault	318
U3-15	Cumulative Operation Time at 5th Most Recent Fault	318
U3-16	Cumulative Operation Time at 6th Most Recent Fault	318
U3-17	Cumulative Operation Time at 7th Most Recent Fault	318
U3-18	Cumulative Operation Time at 8th Most Recent Fault	319
U3-19	Cumulative Operation Time at 9th Most Recent Fault	319
U3-20	Cumulative Operation Time at 10th Most Recent Fault	319
U4-01	Accumulated Operation Time	319
U4-02	Number of Run Commands	319
U4-03	Cooling Fan Operation Time	319
U4-05	Capacitor Maintenance	319
U4-07	IGBT Maintenance	319
U4-08	Heatsink Temperature	319
U4-09	LED Check	319
U4-10	kWH, Lower 4 Digits	319
U4-11	kWH, Upper 5 Digits	319

No.	Parameter Name	Page
U4-13	Peak Hold Current	319
U4-14	Peak Hold Output Frequency	319
U4-16	Motor Overload Estimate (OL1)	319
U4-18	Frequency Reference Selection Results	319
U4-19	Freq. Ref. from MEMOBUS/Modbus Communications	319
U4-20	Option Frequency Reference	319
U4-21	Run Command Selection Results	319
U4-22	MEMOBUS/Modbus Comm. Ref.	319
U4-23	Option Card Reference	319
U5-01	PID Feedback	320
U5-02	PID Input (feedback)	320
U5-03	PID Output	320
U5-04	PID Setpoint	320
U6-01	Torque Reference (Internal)	320
U6-02	Motor Secondary Current (Iq)	320
U6-03	Motor Excitation Current (ld)	320
U6-04	Output of speed control (ASR) (for Simple V/f PG)	320
U6-05	Output voltage reference (Vq)	320
U6-06	Output Voltage Reference (Vd)	320
U6-07	q-axis ACR Output	320
U6-08	d-Axis ACR Output	320
U6-17	Energy Savings Coefficient Calculation Value	320
U6-18	PID Differential Feedback	320
U6-19	PID Adjusted Feedback	320
U6-20	Frequency Ref. Bias (Up/Down 2)	320
U6-21	Offset Frequency	320
U8-□□	Custom Monitors for DriveWorksEZ	320

4.7 Test Run

◆ 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	Ensure the power supply voltage is correct: 200 V class: single-phase 200 to 240 Vac 50/60 Hz 200 V class: 3-phase 200 to 240 Vac 50/60 Hz 400 V class: 3-phase 380 to 480 Vac 50/60 Hz
	Properly wire the power supply input terminals (R/L1, S/L2, T/L3). (for single-phase 200 V class models, wire only R/L1 and S/L2)
	Check for proper grounding of drive and motor.
Drive output terminals and motor terminals	Properly wire drive output terminals U/T1, V/T2, and W/T3 with motor terminals U, V, and W.
Control circuit terminals	Check control circuit terminal connections.
Drive control terminal status	Open all control circuit terminals (off).
Status of the load and connected machinery	Uncouple the motor from the load.

■ Status Display

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

No.	Name	Description
Normal Operation		The data display area displays the frequency reference. DRV flashes.
Fault	 Main circuit low voltage (ex)	Data displayed varies by the type of fault. *Refer to Fault Displays, Causes, and Possible Solutions on page 227* for more information and corrective action. ALM and DRV are lit.

◆ Auto-Tuning

Auto-Tuning automatically sets and tunes parameters required for motor operation.

■ Types of Auto-Tuning

There are three types of Auto-Tuning. *Refer to Auto-Tuning Selection on page 92* to select the best type of Auto-Tuning for the application.

Type	Setting	Application Conditions and Benefits	Control Mode
Rotational Auto-Tuning for V/f Control	T1-01 = 3	Assumes the motor can rotate during the Auto-Tuning process Improves torque compensation, slip compensation, energy savings, and speed search performance	V/f Control
Rotational Auto-Tuning for OLV Control	T1-01 = 0	Assumes the motor can rotate during the Auto-Tuning process Achieves high-performance motor control	Open Loop Vector Control
Stationary Auto-Tuning for V/f and OLV Control Line-to-Line Resistance Only	T1-01 = 2	For use when the motor cable exceeds 50 m The motor cable length has been modified after Auto-Tuning has been previously performed When motor capacity and drive capacity differ	V/f Control, Open Loop Vector Control

Note: Auto-Tuning cannot be performed on permanent magnet motors (IPM, SPM, etc.).

■ Auto-Tuning Selection

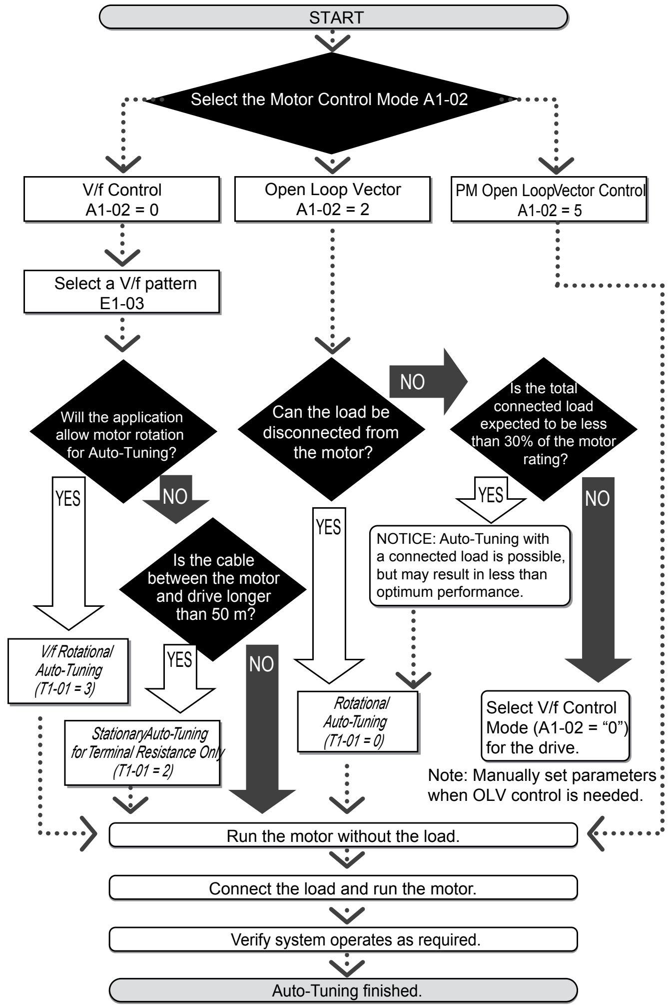


Figure 4.28 Auto-Tuning Selection

■ Before Auto-Tuning the Drive

Check the items below before Auto-Tuning the drive:

Basic Auto-Tuning Preparations

- Auto-Tuning automatically determines the electrical characteristics of the motor. This is fundamentally different from other types of Auto-Tuning features used in servo systems.
- Before auto-tuning, be sure the input supply voltage equals or exceeds the motor rated voltage. Performance can be enhanced by using a motor with a base voltage that is 20 V (40 V for 400 V class models) lower than the input supply voltage. This may be of special importance when operating the motor above 90% of base speed, where high torque precision is required.
- Auto-Tuning is not possible with permanent magnet motors.
- To cancel Auto-Tuning, press the STOP key on the LED operator.
- The next table describes digital input and output terminal status during Auto-Tuning.

Auto-Tuning Type	Digital Input	Digital Output
Auto-Tuning for Energy Savings in V/f Control	Not available	Works the same during normal operation
Rotational-Type Auto-Tuning	Not available	Works the same during normal operation
Auto-Tuning for Resistance between Lines	Not available	Maintains the status at the start of Auto-Tuning

WARNING! *When Auto-Tuning a motor that is used on an application in conjunction with a brake, take special precaution to insure the brake stays applied. Auto-Tuning activates the drive multi-function outputs. Therefore, a brake may be released while the motor is uncoupled from the load, resulting in an unsafe condition. Proper precautions must therefore be taken prior to performing Auto-Tuning.*

Note: It is recommended that Rotational Auto-Tuning be performed with the load disconnected. Failure to comply could result in improper drive operation. If rotational Auto-Tuning is performed for a motor coupled to a load, the motor constants will be inaccurate and the motor may exhibit abnormal operation. Disconnect or decouple the motor from the load.

Rotational Auto-Tuning for V/f Control

- Motor rotates during Auto-Tuning.
- Sets parameters required for torque compensation, slip compensation, energy savings, and speed search.
- Available only when the drive is set for V/f Control.

- Required to perform Estimation-Type Speed Search when using V/f Control.

Rotational Auto-Tuning for Open Loop Vector Control

- Used only when in Open Loop Vector Control.
- Perform only with the motor uncoupled from the load for applications requiring high performance over a wide speed range.
- Disconnect the load before Auto-Tuning the drive and motor. Performing Rotational Auto-Tuning with the load connected will set motor parameters incorrectly, and also be dangerous because irregular motor rotation will occur.
- It is possible to perform Rotational Auto-Tuning with a connected load if the load is less than 30% of the rated load.
- Ensure a motor-mounted brake is fully released.
- Connected machinery should not produce enough power to rotate the motor.

Stationary Auto-Tuning for Terminal Resistance Only

- If the motor cable lead length has been significantly modified after Auto-Tuning has already been performed, perform Stationary Auto-Tuning with the new cables.
- Perform when using motor cables longer than 50 m with V/f Control.

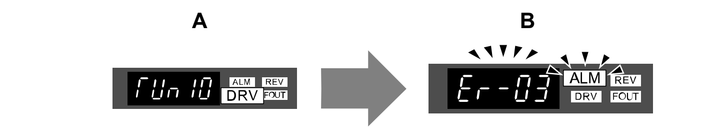
WARNING! *Electrical Shock Hazard. When executing stationary Auto-Tuning for line-to-line resistance only, the motor does not rotate, however, power is applied. Do not touch the motor until Auto-Tuning is completed. Failure to comply may result in injury from electrical shock.*

Note: When auto-tuning a motor that is used on an application in conjunction with a brake, take special precaution to ensure the brake stays applied.

■ Auto-Tuning Fault Codes

Calculation of abnormal measurements or pressing STOP before completion will interrupt Auto-Tuning.

Refer to Auto-Tuning Errors on page 226 for more information.



A – Normal Auto-Tuning Display **B – Auto-Tuning Interrupted**

Figure 4.29 Auto-Tuning Interruption Display

■ Performing Auto-Tuning

The following example illustrates how to perform Rotational Auto-Tuning.

Note: The following example is shown with the drive in Open Loop Vector Control (A1-02 = 2).

Selecting the Type of Auto-Tuning

	Step		Display/Result
1.	Turn on the power to the drive. The initial display appears.	→	F 0.00 ALM REV DRV FOUT
2.	Press the V key until the Auto-Tuning screen appears.	→	AtUn
3.	Press ENTER to begin setting parameters.	→	T1-01
4.	Press ENTER to display the value for T1-01.	→	02
5.	Press > RESET to select the digit to edit.	→	02
6.	Press Λ and set the drive to perform Rotational Auto-Tuning (00).	→	00
7.	Save the setting by pressing ENTER .	→	End
8.	The display automatically returns to the screen shown in Step 3.	→	T1-01
9.	Press the ESC key until back at the Top Screen.	→	F 0.00 ALM REV DRV FOUT

Enter Data from the Motor Nameplate

After selecting the type of Auto-Tuning, enter the required data from the motor nameplate.

Note: These instructions continue from Step 7 in Selecting the Type of Auto-Tuning.

	Step		Display/Result
1.	Press Λ to access the motor output power parameter T1-02.	→	T1-02
2.	Press ENTER to view the default setting.	→	000.40
3.	Press > RESET to select the digit to edit.	→	000.40
4.	Press Λ and enter "0.2." Enter value based on motor nameplate data.	→	000.20

	Step		Display/Result
5.	Press ENTER to save the setting.	➡	End
6.	The display automatically returns to the screen shown in Step 1.	➡	T1-02
7.	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, Motor Poles T1-07, Motor Base Frequency	➡	T1-03 ⋮ T1-07

Note: *Refer to Motor Data for Auto-Tuning on page 94* for the details of each setting.

Note: For stationary Auto-Tuning for line-to-line resistance only, set 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: *Auto-Tuning will not function properly if a holding brake is engaged on the load. Failure to comply could result in improper operation of the drive. Ensure the motor can freely spin before beginning Auto-Tuning.*

NOTICE: *Never perform rotational Auto-Tuning for a motor connected to a load. Failure to comply could result in improper drive operation. If rotational Auto-Tuning is performed for a motor coupled to a load, the motor constants will be inaccurate and the motor may exhibit abnormal operation. Disconnect or decouple the motor from the load.*

Enter the required information from the motor nameplate. Press ∧ to proceed to the Auto-Tuning start screen.

Step			Display/Result
1.	After setting T1-07 as illustrated in the previous section, press ∧ and confirm the display as follows:	➡	TUn10
2.	Press RUN to activate Auto-Tuning. DRV flashes. **Note:** The first digit indicates which motor is undergoing Auto-Tuning (motor 1 or motor 2). The second digit indicates the type of Auto-Tuning being performed.	➡	TUn10 ALM REV DRV FOUT
3.	Auto-Tuning finishes in approximately one to two minutes.	➡	End

■ Motor Data for Auto-Tuning

Table 4.23 Parameters Set During Auto-Tuning

No.	Name	Description	Range	Def.	Control Mode V/f	Control Mode OLV
T1-00	Motor Selection 1/2	Selects which set of motor parameters are set during Auto-Tuning. If motor 2 selection (H1-☐☐ =16) is not selected, this parameter will not be displayed. 1: Motor 1 - E1 to E2 2: Motor 2 - E3 to E4. <1> Enabled when motors 1 and 2 are switched to each other (H1-☐☐ =16). Displayed only when either multi-function contact output H1-01 through H1-07 is set to 16.	1, 2	1	A	A
T1-01	Auto-Tuning Mode Selection	Selects the Auto-Tuning mode. 0: OLV Rotational Auto-Tuning 2: Terminal resistance only, Stationary Auto-Tuning 3: V/f Rotational Auto-Tuning. Only settings 2 and 3 are available when using V/f Control. Only setting 2 is available when using motor 2. Settings 0 and 2 are available when using OLV Control.	0, 2, 3	0 (“2” in V/f mode)	A	A
T1-02	Motor Rated Power	Sets the motor rated output power. A set value that can provide stable control in the open loop control mode ranges from 50 to 100% of the drive rating. In case of motors that operate above base speed, set the value at base speed.	0.00 to 650.00	0.40 kW	A	A
T1-03 <2>	Motor Rated Voltage	Set the motor base voltage according to the information printed on the motor nameplate. In case of motors that operate above base speed, set the value at base speed.	0.0 to 255.5	200.0 V	A	A
T1-04	Motor Rated Current	Enter the motor-rated current as specified on the motor nameplate. For best performance when using OLV select the drive so that the motor represents 50 to 100% of the drive rated current. Enter the current required at base speed for motors with extended speed ranges.	10 to 200% of drive rated current	Det. by o2-04 and C6-01	A	A
T1-05	Motor Base Frequency	Enter the motor base frequency as specified on the motor nameplate. Enter the motor base frequency for extended speed range motors.	0.0 to 400.0	60.0 Hz	A	A
T1-06	Number of Motor Poles	Enter number of motor poles indicated on motor nameplate.	2 to 48	4	A	A
T1-07	Motor Base Speed	Sets the base speed of the motor in revolutions per minute r/min (RPM). Enter the motor base speed for extended speed range motors.	0 to 24000	1750. r/min	A	A
T1-11	Motor Iron Loss	Provides iron loss for determining Energy Saving coefficient. When power is cycled, the value set to E2-10 will appear (the motor iron loss). If T1-02 is changed, an initial value for the motor capacity will appear that is close to the capacity that was changed.	0 to 65535	14W	A	–

<1> Normally not displayed.

<2> Voltage and frequency settings for vector motors and drive motors are often lower than for standard motors. Be sure to enter Auto-Tuning data according to the motor nameplate and motor data sheets. If the no-load voltage and frequency values are shown, enter those values into T1-03 and T1-05.

■ Precision Settings for Auto-Tuning

Basic motor nameplate data can be used to auto-tune a motor. However, improved performance can be achieved by using precise data for base voltage and base frequency. If the base no-load voltage and frequency are known, enter this data when executing auto-tuning to improve performance.

Parameter	Normal Settings	Precision Tuning
T1-03	Enter the motor rated voltage	Enter the no-load voltage when the motor is operating at its rated revolutions per minute
T1-05	Enter the motor base frequency	Enter the no-load frequency when the motor is operating at its rated revolutions per minute

◆ No-Load Operation

This section explains how to operate the drive with the motor uncoupled from the load during a test run.

■ Before Starting the Motor

Check the following items before operation:
- Ensure the area around the motor is safe.
- Set the proper motor rated current to T1-04 to prevent overheating or other damage from motor overload.
- Ensure external emergency stop circuitry is working properly and other safety precautions have been taken.

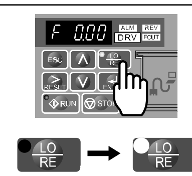
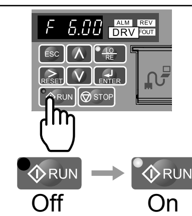
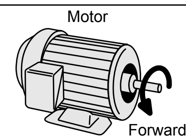
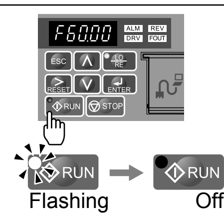
■ During Operation

Check the following items during operation:
- The motor should rotate smoothly (i.e., no abnormal noise or oscillation).
- The motor should accelerate and decelerate smoothly.

■ Operation Instructions

The following example illustrates a procedure to run the drive using the digital operator.

Note: Before starting the motor, set the frequency reference to 6 Hz. ***Refer to The Drive and Programming Modes on page 61*** for instructions.

	Step		Display/Result
1.	Turn on the power to the drive. The initial display appears.	➡	
2.	Press the LO RE key to select LOCAL. The LO/RE LED will turn on.	➡	
3.	Press RUN to give the drive a run command. RUN will light and the motor will rotate at 6 Hz.	➡	
4.	Ensure the motor is rotating in the correct direction and no faults or alarms occur.	➡	
5.	If there is no error in step 4, press ∧ to increase the frequency reference. Increase the frequency in 10 Hz increments verifying smooth operation results at all speeds. For each frequency monitor the drive output current (U1-03) through the LED operator to confirm the current is well below the motor rated current. Example: 6 Hz → 50 Hz/60 Hz. **Note:** ***Refer to Auto-Tuning Errors on page 226*** for help with errors that occur while Auto-Tuning the drive.		
6.	The drive should operate normally. Press STOP to stop the motor. RUN flashes until the motor comes to a complete stop.	➡	

Note: To operate the drive, run (forward/reverse) command and frequency (or multi-step speed) reference are needed. Input these commands and references to the drive.

◆ Operating with the Load Connected

After performing a no-load test run, connect the motor and proceed to run the load.

■ Notes on Connected Machinery

- Clear the area around the motor.

- The motor should come to a complete stop without problems. Connect the machinery.
- Fasten all installation screws properly. Check that the motor and connected machinery are held in place.
- Confirm that the Fast-stop circuit or mechanical safety operate correctly.
- Prepare to press the STOP button in the case of an emergency.

■ Checklist Before Operation

- The motor should rotate in the proper direction.
- The motor should accelerate and decelerate smoothly.
- Check U1-03 to ensure there is not overcurrent.

Note: If the application permits running the load in the reverse direction, try changing motor direction and the frequency reference and watch for abnormal motor oscillation or vibration. Correct the problem if hunting or oscillation occurs or if there are control-related problems.

Refer to Motor Hunting and Oscillation Control Parameters on page 223.

■ Operating the Motor under Loaded Conditions

Test run the application similarly to the no-load test procedure when connecting the machinery to the motor.

◆ Verifying Parameter Settings and Backing Up Changes

Check changes to parameter settings as a result of Auto-Tuning using the Verify function. *Refer to Verifying Parameter Changes: Verify Menu on page 63*.

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

■ Backing Up Parameter Values: o2-03

Performing the following procedure stores all parameters settings to drive memory where they can later be recalled if necessary. Set o2-03 to “1” to save parameter changes. This saves all parameter settings, and then returns o2-03 to 0. The drive can now “recall” the saved parameters by performing a “user-initialization” (A1-03 = 1110).

No.	Parameter Name	Description	Setting Range	Default Setting
o2-03	User Parameter Default Value	Allows storing of parameter settings as a User Initialization Selection. 0: Saved/Not set 1: Set Defaults - Saves current parameter settings as user default settings. 2: Clear All - Clears the currently saved user settings. After saving the user parameter set value, the items of 1110 (User Parameter Initialize) are displayed in A1-03 (User Parameter Default Value).	0 to 2	0
A1-03	Initialize Parameters	Selects a method to initialize the parameters. 0: No Initialize 1110: User Initialize (The user must first program and store desired settings using parameter o2-03) 2220: 2-Wire Initialization (parameter initialized prior to shipment) 3330: 3-Wire Initialization 5550: OPE4 Fault reset	0 to 5550	0

■ Parameter Access Level: A1-01

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

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

No.	Parameter Name	Description	Setting Range	Default
A1-01	Access Level Selection	Selects which parameters are accessible via the digital operator. 0: Operation only (A1-01, -04, and -06 can be set and monitored. U parameters can be monitored) 1: User Parameters (Only those recently changed among application parameters A2-01 to -16 and A2-17 to -32 can be set and monitored) 2: Advanced Access Level (All parameters can be set and monitored)	0 to 2	2
A2-01 to A2-32	Preferred Parameters1 to 32	Parameters selected by the user are stored to the User Parameter menu. This includes recently viewed parameters or parameters specifically selected for quick access. If parameter A2-33 is set to 1, recently viewed parameters will be listed between A2-17 and A2-32. Parameters A2-01 through A2-16 must be manually selected by the user. If A2-33 is set to 0, then recently viewed parameters will not be saved to the User Parameter group. The entire A2 parameter group is now available for manual programming.	b1-01 to o2-08	–
A2-33	Preferred Parameter Automatic Selection	0: Parameters A2-01 through A2-32 are reserved for the user to create a list of User Parameters. 1: Save history of recently viewed parameters. Recently edited parameters will be saved to A2-17 through A2-32 for quick access. The most recently changed parameter is registered in A2-17. The second most recently changed parameter is registered in A2-18.	0, 1	1

■ Password Settings: A1-04, A1-05

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

Note: Parameter A1-05 is hidden from view. To display A1-05, access parameter A1-04 and simultaneously depress the STOP key and the ∧ key.

■ Copy Function (Optional)

Using an option, the parameter setting can be copied to another drive. Storing the modified contents can make restoration easy since the parameters do not have to be set from the beginning if the drive breaks down and must be replaced. For this drive, the following two options can be used:

- Copy unit with USB (USB converter with copy function)
- Drive Wizard (Parameter management tool of PC application software)

Copy Unit with USB

Connect and exclusive-use cable to the communication connector on the drive and use the ON/OFF switch on the copy unit with USB to copy the data

Drive Wizard

Use Drive Wizard to copy the parameter setting to another drive. For details, refer to Help in the Drive Wizard software.

◆ Jog Operation: FJOG/RJOG

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

■ Jog Operation Parameters

No.	Name	Description	Setting Range	Default Setting
d1-17	Jog Frequency Reference	Frequency reference when: “Jog Frequency Reference” is selected via multi-function input terminals. “Jog Frequency Reference” has priority over “Multi-Step Speed Reference 1 to 16." Parameter d1-17 is also the reference for the JOG key on the digital operator, and the multi-function inputs “Forward Jog” and “Reverse Jog.”	0.00 to 400.00	6.00 Hz

■ Selections for Digital Input Terminals S1 to S7 (H1-01 to H1-07)

Setting	Name
12	FJOG Command (ON: rotates forward at the Jog frequency set to d1-17)
13	RJOG Command (ON: rotates in reverse at the Jog frequency set to d1-17)

■ Connection Example for the Jog Function

In this example, H1-07 = 12 and d1-17 = 6.0 Hz.

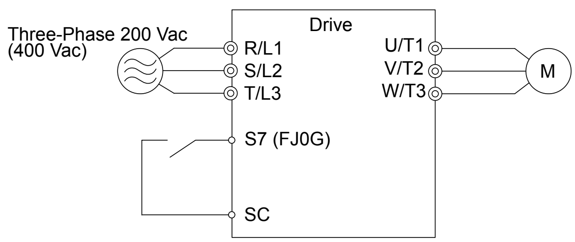


Figure 4.30 Jog Command from External Terminals

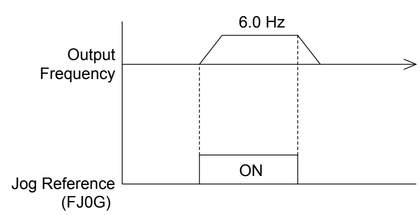


Figure 4.31 Jog Operation Pattern

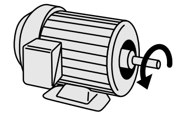
■ Jog Operation Procedures

Set H1-07 (Multi-Function Contact Input Terminal S7 Function Selection) to “12” (FJOG command).

	Step		Display/Result
1.	Turn the power on to the drive. The initial display appears.	➡	F 0.00 ALM REV DRV CUT
2.	Press the V key until the Parameter Setting menu appears.	➡	PAr
3.	Press ENTER to enter the Parameter Setting menu.	➡	A1-01
4.	Press ∧ and > RESET until H1-07 appears. **Note:** Select a parameter between H1-01 and H1-07.	➡	H1-07
5.	Press ENTER and set the value for H1-07.	➡	06
6.	Press ∧ and > RESET until “12” appears on the screen. **Note:** At jog operation in reverse run, set multi-function contact input to 13.	➡	12

Step			Display/Result
7.	Press  ENTER to save the setting.	➡	

To begin rotating the motor:

Step			Display/Result
1.	Turn the power on to the drive. The initial display appears. **Note:** Set the drive to REMOTE.	➡	
2.	With multi-function contact input terminal S7 closed, the motor rotates forwards at 6 Hz. **Note:** No run command is necessary when using the Jog frequency.	➡	Motor 
3.	The drive will stop with terminal S7 open.	➡	

◆ Multi-Step Speed Operation (4-Step Speed)

Select up to 17 preset references (including Jog reference) using five multi-function inputs S3 through S7. Four multi-step references can be selected using two multi-function inputs as illustrated in ***Figure 4.32*** .

■ Multi-Step Speed Operation Parameters

No.	Name	Description
d1-01	Frequency Reference 1	Frequency reference. o1-03 determines the units, with Hz as the default.
d1-02	Frequency Reference 2	Frequency reference when multi-function input “Multi-Step Speed Reference 1" (H1-☐☐ = 3) is on. Setting unit: set by o1-03.
d1-03	Frequency Reference 3	Frequency reference when multi-function input “Multi-Step Speed Reference 2” (H1-☐☐ = 4) is on. Setting unit: set by o1-03.
d1-04	Frequency Reference 4	Frequency reference when multi-function input “Multi-Step Speed Reference 1, 2" (H1-☐☐ = 3 and 4) are both on. Setting unit: set by o1-03.

■ Digital Input

Terminal	Parameter	Setting	Contents
S5	H1-05	3	Multi-Step Speed Reference 1
S6	H1-06	4	Multi-Step Speed Reference 2

■ Wiring Example

Set up external switches SW1 and SW2.

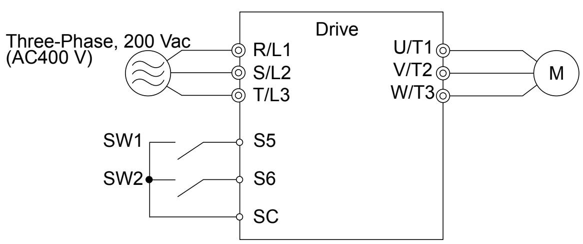


Figure 4.32 Control Terminals for 4 Multi-Step Speeds

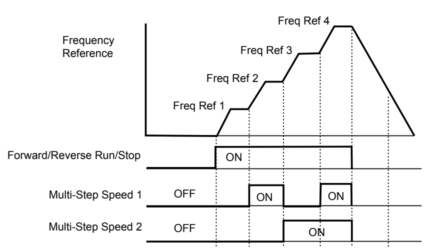
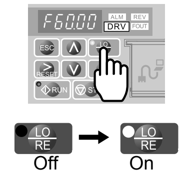
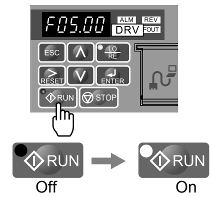
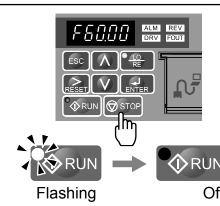


Figure 4.33 4-Step Speed Time Chart

■ Setting Procedure

Step			Display/Result
1.	Turn on the power to the drive. The initial display appears.	➡	
2.	Set the frequencies listed below to the specified parameters: 1. d1-01 = 5 Hz: Step 1 *<1>* 2. d1-02 = 20 Hz: Step 2 *<2>* 3. d1-03 = 50 Hz: Step 3 4. d1-04 = 60 Hz: Step 4		
3.	Press the  ESC key until the initial display appears.		

Step			Display/Result
4.	DRV turns on.	➡	
5.	Press LO/RE to select LOCAL. The LO/RE light will turn on.	➡	
6.	Press RUN to run the motor at 5 Hz. The RUN light will turn on.	➡	
7.	With SW1 closed, the drive runs the motor at Multi-Step Speed 2 (20 Hz).	➡	
8.	With SW1 open and SW2 closed, the drive runs the motor at Multi-Step 3 (50 Hz).	➡	
9.	With both SW1 and SW2 closed, the drive runs the motor at Multi-Step 4 (60 Hz).	➡	
10.	Press STOP to stop the drive. The RUN light will flash until the motor comes to a complete stop.	➡	

<1> When the frequency reference is assigned to the LED operator (b1-01=0), the first step in a multi-step speed sequence comes from d1-01.
<2> Set H3-10 (Multi-function Analog Input (current) Terminal A2 Function Selection) to “F” (not used).

Note: When a run command is input from the control circuit terminal, the frequency reference value is selected as follows: When b1-01 = 0 and the run command is given, the drive uses the frequency set to d1-01. When b1-01 = 1 and the run command is given, the drive uses the frequency reference value input to analog control terminal A1.

Start-Up Programming & Operation

4

4.8 Test Run Checklist

Review the checklist before performing a test run. Check each item that applies.

☑	No.	Checklist	Page
☐	1	Thoroughly read the manual before performing a test run.	
☐	2	Turn the power on.	91
☐	3	Set the voltage for the power supply to E1-01.	83

Check the items that correspond to the control mode being used.

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

☑	No.	Checklist	Page
V/f Control (A1-02 = 0)			
☐	4	Select the best V/f pattern according to the application and motor characteristics. Example: If using a motor with a rated frequency of 60.0 Hz, set E1-03 to “1”.	84
☐	5	Perform Auto-Tuning for Energy Savings if using Energy Saving functions.	91
Open Loop Vector Control (A1-02 = 2)			
☐	6	Uncouple the load from the motor when performing Rotational Auto-Tuning.	91
☐	7	Perform Rotational Auto-Tuning.	93
☐	8	The following data entered during Auto-Tuning should match the information written on the motor nameplate: • motor rated output power (kW) → T1-02 • rated voltage (V) → T1-03 • rated current (A) → T1-04 • base frequency (Hz) → T1-05 • number of motor poles → T1-06 • motor rotations per minutes (r/min) → T1-07	94
PM Open Loop Vector Control (A1-02 = 5)			
☐	9	Set permanent motor parameters E5-01 through E5-24	68

Proceed to the following checklist after checking items 4 through 9.

☑	No.	Checklist	Page
☐	10	The DRV should illuminate after giving a run command.	
☐	11	To give a run command and frequency reference from the LED Digital Operator, press LO/RE to set to LOCAL. The LO/RE key lights while LOCAL is displayed.	64
☐	12	If the motor rotates in the opposite direction during the test run, switch two of the drive output terminals (U/T1, V/T2, W/T3).	91
☐	13	Select the correct duty rating (C6-01) for the application.	82
☐	14	Set the correct values for the motor rated current (E2-01) and the motor protection selection (L1-01) to ensure motor thermal protection.	87
☐	15	If the run command and frequency reference are provided via the control circuit terminals, set the drive for REMOTE and be sure the LO/RE light is out.	64
☐	16	If the control circuit terminals should supply the frequency reference, select the correct voltage input signal level (0 to 10 V) or the correct current input signal level (4 to 20 mA).	64
☐	17	Set the proper voltage to terminal A1. (0 to 10 V)	76
☐	18	Set the proper current to terminal A2. (4 to 20 mA)	76
☐	19	When current input (4 to 20 mA) is used, set H3-09 to “2” (Current Input) and set H3-10 to “0”.	76
☐	20	When current input (4 to 20 mA) is used, switch the drive built-in DIP switch S1 from V-side (OFF) to I-side (ON).	76
☐	21	Set the minimum and maximum frequency references to the desired values. Make the following adjustments if the drive does not operate as expected: • Voltage input, 0 to 10 V: For terminal A1, adjust the frequency reference gain (H3-03) until reaching the desired value (60 Hz). • Current input, 4 to 20 mA: For terminal A2, adjust the current bias (H3-12) until the frequency reference reaches 0.0 Hz. Next adjust the current gain (H3-11) until the frequency reference reaches 60 Hz.	

5

Parameter Details

5.1 A: Initialization

The initialization group contains parameters associated with initial setup of the drive. Parameters involving the display language, access levels, initialization, and password are located in this group.

◆ A1: Initialization

■ A1-01: Parameter Access Level

Allows or restricts access to drive parameters.

No.	Parameter Name	Setting Range	Default
A1-01	Access Level Selection	0: Operation only 1: Preferred Parameters2: Advanced Access Level (A) and Setup Access Level (S)	2

Detailed Description

0: Operation Only

Access is restricted to parameters A1-01, A1-04, A1-06, and all U monitor parameters.

1: Preferred Parameters

Access to only a specific list of parameters set to A2-01 through A2-32.

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

All parameters can be viewed and edited.

- The drive parameters are password protected (A1-04), which prevents access to A1-00 through A1-03, A1-06, and all A2 parameters.
- A digital input is enabled that has been configured as a Program Lockout (H1-□ □ = 1B).
- The display will show “bUSY” when attempting to change a parameter while writing to the drive via serial communications. Access will be restricted from the operator keypad until an enter command is received via the serial communication to finish the serial writing process.

■ A1-02: Control Mode Selection

Selects the Control Method of the drive.

No.	Parameter Name	Setting Range	Default
A1-02	Control Method Selection	0: V/f Control without PG 2: Open Loop Vector5: PM Open Loop Vector	0

Detailed Description

0: V/f Control without PG

- For general-purpose and multiple motor applications.
- For use when the parameter settings are unknown in the drive.

2: Open Loop Vector

- For general, variable-speed applications.
- For applications requiring precise speed control, quick response, and higher torque at low speeds.

5: PM Open Loop Vector

For operating SPM, IPM, and various permanent magnet motors. Takes advantage of Energy Saving features when operating with derated torque.

■ A1-03: Initialization

Resets parameter settings back to their original default values.

No.	Parameter Name	Setting Range	Default
A1-03	Initialize Parameters	0: No Initialize 1110: User Initialize 2220: 2-Wire Initialization 3330: 3-Wire Initialization 5550: OPE04 Reset	0

Detailed Description

1110: User Initialize

The modified Drive parameters are returned to the values selected as user settings. User settings are stored when parameter o2-03 = “1: Set Defaults”.

Note: A “user-initialization” resets all parameters to a user-defined set of default values that were previously saved to the drive. To clear the user-defined default values, set parameter o2-03 to “2”.

2220: 2-Wire Initialization

Resets all parameters back to their original default settings with digital inputs S1 and S2 configured as forward run and reverse run, respectively.

3330: 3-Wire Initialization

The drive parameters are returned to factory default values with digital inputs S1, S2, and S5 configured as run, stop, and forward/reverse respectively.

5550: oPE04 Reset

If parameters on a certain drive have been edited and then a different terminal block is installed with different settings saved in its built-in memory, an oPE04 error will appear on the display screen. To use the parameter settings saved to the terminal block memory, set A1-02 to “5550”.

Note: After initializing the drive, the setting for parameter A1-03 automatically returns to 0.

No.	Parameter Name
A1-02*	Control Method Selection
C6-01	Duty Selection
E1-03	V/f Pattern Selection
E5-01	Motor Code Selection (for PM motors)
E5-02	Motor Rated Capacity (for PM motors)
E5-03	Motor Rated Current (for PM motors)
E5-04	Motor Poles (for PM motors)
E5-05	Motor Armature Resistance (for PM motors)
E5-06	Motor d Axis Inductance (for PM motors)
E5-07	Motor q Axis Inductance (for PM motors)
E5-09	Motor Induction Voltage Constant 1 (for PM motors)
E5-24	Motor Induction Voltage Parameter 2 (for PM motors)
o2-04	Drive/kVA Selection

Note: *Some parameters are unaffected by either the 2-wire or 3-wire initialization. The following parameters will not be reset when parameter A1-03 = 2220 or 3330. Although the control mode in A1-02 is initialized when A1-03 is set to 2220 or 3330, it may change when an application preset is selected. At that time, “APPL” will appear on the display screen, and the most appropriate control mode will be automatically set for the application selected with A1-06.

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

A1-04 is for entering the password when the drive is locked. A1-05 is a hidden parameter used to set the password.

No.	Parameter Name	Setting Range	Default
A1-04	Password	0 to 9999	0
A1-05	Password Setting		

Detailed Explanation

The user can set a password for the drive to restrict access. The password is set to A1-05 and must be entered to A1-04 to unlock parameter access. Until the correct password is entered, the following parameters cannot be viewed or edited: A1-01, A1-02, A1-03, A1-06, and A2-01 through A2-33.

The instructions below demonstrate how to set a new password. Here, the password set is “1234”. An explanation follows on how to enter the password to unlock the parameters.

	Step		Display/Result
	Setting the Password for the Drive		
1.	Turn on the power to the drive. The initial display appears.	⇒	F 0.00 ALM REV DRV OUT
2.	Scroll to the Parameter Setup screen and press ∧ .	⇒	PAr
3.	Scroll to the right by pressing ENTER .	⇒	A1-01
4.	Select the flashing digits by pressing > RESET .	⇒	A1-01
5.	Select A1-04 by pressing ∧ .	⇒	A1-04
6.	Press the STOP key while holding down ∧ at the same time. A1-05 will appear. **Note:** A1-05 is normally hidden, but can be displayed by following the directions listed here.	⇒	A1-05 “05” flashes
7.	Press the ENTER key.	⇒	0000
8.	Use > RESET , ∨ and ∧ to enter the password.	⇒	1234
9.	Press ENTER to save what was entered.	⇒	End
10.	The display automatically returns to the screen shown in step 5.	⇒	A1-04

	Step		Display/Result
	Check to see if A1-02 is locked. Follow the procedure above from step 10.		
1.	Press ∨ to display A1-02.	⇒	A1-02 “02” flashes
2.	Press ENTER to display the value set to A1-02.	⇒	00
3.	Press ∨ and ∧ , making sure that the setting values cannot be changed.		

Step			Display/Result
4.	Press ESC to return to the first screen.	⇒	PAr

Step			Display/Result
	The following procedure shows how to displays the password, continuing from step 4 above.		
1.	Press ENTER to display the screen for parameter setup.	⇒	A1-01
2.	Press RESET to select the flashing digits as shown.	⇒	A1-01 “01 flashes
3.	Press ∧ to scroll to A1-04.	⇒	A1-04
4.	Enter the password “1234”.	⇒	1234
5.	Press ENTER to save the new password.	⇒	End
6.	Screen returns to the parameter display.	⇒	A1-04
7.	Press ∨ and scroll to A1-02.	⇒	A1-02
8.	Press ENTER to display the value set to A1-02.	⇒	00 “0” flashes
9.	Use RESET and ∧ to set the desired value.	⇒	02 Open Loop Vector Control
10.	Press ENTER to save the setting.	⇒	End
11.	The display automatically returns to the parameter display.	⇒	A1-02

Note: Parameter settings may be edited after entering the correct password. Performing a 2-wire or 3-wire initialization resets the password to “0000”. Re-enter the password after drive initialization.

Note: To change the password, enter the new password to parameter A1-05.

■ A1-06: Application Presets

To make it easier to set up the drive for commonly used applications, there are several Application Presets available. By selecting one of these presets, the drive automatically sets the required parameters to their optimal values for that specific application. To further customize these settings, the user can still make changes using the Setup Mode.

No.	Parameter Name	Setting Range	Default
A1-06	Application Presets	0: Disabled 1: Water supply pump 2: Conveyor 3: Exhaust fan 4: HVAC fan 5: Compressor 6: Crane (hoist) 7: Crane (traverse)	0

The next procedure sets the drive for a water supply pump application

A1-06 = 1

By selecting one of the application presets, I/O terminal settings are changed from their default values and assigned functions appropriate for the application that was selected. Verify all I/O signals and external sequences before operating the motor.
When A1-06 = 0, all general-use parameters are accessible.
Perform a 2-wire or 3-wire initialization (A1-03 = 2220 or 3330) on the drive before selecting an Application Preset.

Note: Do not switch between Application Presets without performing a 2-wire or 3-wire initialization (A1-03 = 2220 or 3330) prior to changing the application selected. Drive parameters should be fully reset by the initialization process before using one of the Application Presets.

Note: Parameters edited by the user can be saved to a list by setting o2-03 to 1. This allows for more immediate access a specific list of relevant parameters, and saves time scrolling through the parameter menu items.

Note: To allow only the Setup Parameters to be displayed, set the parameter access level for Preferred Parameters (A1-01 = 1).

The parameters listed in the table below are unaffected when the drive is initialized:

No.	Parameter Name
A1-02*	Control Method Selection
C6-01	Duty Selection
E1-03	V/f Pattern Selection
E5-01	Motor Code Selection (for PM motors)

No.	Parameter Name
o2-04	Drive/kVA Selection

*Although the control method set to A1-02 is unaffected when performing a 2-wire or 3-wire initialization, the drive will automatically change A1-02 according to the value set to parameter A1-06.

Related Parameters

No.	Parameter Name	Setting Range	Default	Page
A1-01	Access Level Selection	0: Operation only 1: Preferred Parameters (access to a set of parameters selected by the user) 2: Advanced Access Level (A) and Setup Access Level (S)	2	-
A1-03	Initialize Parameter	0: No Initialize 1110: User Initialize 2220: 2-Wire Initialization 3330: 3-Wire Initialization 5550: oPE04 Reset	0	-
A2-01 to A2-32	Preferred Parameters 1 to 32	b1-01 to 02-08	Determined by A1-06	-
o2-03	User Parameter Default Value	Allows storing of parameter settings as a User Initialization Selection. 0: No Change 1: Set Defaults - Saves current parameter settings as user initialization. 2: Clear All - Clears the currently saved user initialization.	0	-

Application Presets

Below is a list of Application Presets and the settings automatically assigned to the parameters.

1: Water Supply Pump Application: Parameters and Settings

No.	Name	Optimum Setting
A1-02	Control Method Selection	0: Open Loop Vector
b1-04	Reverse Operation Selection	1: Reverse prohibited
C1-01	Acceleration Time 1	1.0 s
C1-02	Deceleration Time 1	1.0 s
C6-01	Duty Rating	1: Normal Duty
E1-03	V/f Pattern Selection	0FH
E1-07	Mid Output Frequency (FB)	30.0
E1-08	Mid Output Frequency Voltage (VC)	50.0
L2-01	Momentary Power Loss Operation Selection	1: Enabled
L3-04	Stall Prevention Selection during Deceleration	1: Enabled

Parameters below are automatically saved as Preferred Parameters (A2-01 to A2-16):

No.	Parameter Name	No.	Parameter Name
b1-01	Frequency Reference Selection	E1-08	Mid Output Frequency Voltage (VC)
b1-02	Run Command Selection	E2-01	Motor Rated Current
b1-04	Reverse Operation Selection	H1-05	Multi-Function Digital Input Terminal S5 Function Selection
C1-01	Acceleration Time 1	H1-06	Multi-Function Digital Input Terminal S6 Function Selection
C1-02	Deceleration Time 1	H1-07	Multi-Function Digital Input Terminal S7 Function Selection
E1-03	V/f Pattern Selection	L5-01	Number of Auto Restart Attempts
E1-07	Mid Output Frequency (FB)	–	–

2: Conveyor Application Parameters and Settings

No.	Parameter Name	Optimum Setting
A1-02	Control Method Selection	0: Open Loop Vector
C1-01	Acceleration Time 1	3.0 s
C1-02	Deceleration Time 1	3.0 s
C6-01	Duty Rating	0: Heavy Duty
L3-04	Stall Prevention Selection during Deceleration	1: Enabled

Parameters below are automatically saved as Preferred Parameters (A2-01 to A2-16):

No.	Parameter Name	No.	Parameter Name
A1-02	Control Method Selection	C1-02	Deceleration Time 1
b1-01	Frequency Reference Selection	E2-01	Motor Rated Current
b1-02	Run Command Selection	L3-04	Stall Prevention Selection during Deceleration
C1-01	Acceleration Time 1	–	–

3: Exhaust Fan Application: Parameters and Settings

No.	Parameter Name	Optimum Setting
A1-02	Control Method Selection	0: Open Loop Vector
b1-04	Reverse Operation Selection	1: Reverse Prohibited
C6-01	Duty Selection	1: Normal Duty
E1-03	V/f Pattern Selection	0FH
E1-07	Mid Output Frequency (FB)	30.0
E1-08	Mid Output Frequency Voltage (VC)	50.0
L2-01	Momentary Power Loss Operation Selection	1: Enabled
L3-04	Stall Prevention Selection during Deceleration	1: Enabled

Parameters below are automatically saved as Preferred Parameters (A2-01 to A2-16):

No.	Parameter Name	No.	Parameter Name
b1-01	Frequency Reference Selection	E1-07	Mid Output Frequency (FB)

No.	Parameter Name	No.	Parameter Name
b1-02	Run Command Selection	E1-08	Mid Output Frequency Voltage (VC)
b1-04	Reverse Operation Selection	E2-01	Motor Rated Current
b3-01	Speed Search Selection at Start	H1-05	Multi-Function Digital Input Terminal S5 Function Selection
C1-01	Acceleration Time 1	H1-06	Multi-Function Digital Input Terminal S6 Function Selection
C1-02	Deceleration Time 1	H1-07	Multi-Function Digital Input Terminal S7 Function Selection
E1-03	V/f Pattern Selection	L5-01	Number of Auto Restart Attempts

4: HVAC Fan Application: Parameters and Settings

No.	Parameter Name	Optimum Setting
A1-02	Control Method Selection	0: Open Loop Vector
b1-04	Reverse Operation Selection	1: Reverse prohibited
C6-01	Duty Rating	1: Normal Duty
C6-02	Carrier Frequency Selection	3: 8.0 kHz
H2-03	Terminals P2 Function Selection (open-collector)	39: Watt Hour Pulse Output
L2-01	Momentary Power Loss Operation Selection	2: CPU Power Active - Drive will restart if power returns prior to control power supply shut down.
L8-03	Overheat Pre-Alarm Operation Selection	4: Derated operation
L8-38	Carrier Frequency Reduction	2: Carrier frequency derating across entire frequency range.

Parameters below are automatically saved as Preferred Parameters (A2-01 to A2-16):

No.	Parameter Name	No.	Parameter Name
b1-01	Frequency Reference Selection	E1-03	V/f Pattern Selection
b1-02	Run Command Selection	E1-04	Max Output Frequency (FMAX)
b1-04	Reverse Operation Selection	E2-01	Motor Rated Current
C1-01	Acceleration Time 1	H3-11	Terminal A2 Gain Setting
C1-02	Deceleration Time 1	H3-12	Frequency Reference (Current) Terminal A2 Input Bias
C6-02	Carrier Frequency Selection	L2-01	Momentary Power Loss Operation Selection
d2-01	Frequency Reference Upper Limit	L8-03	Overheat Pre-Alarm Operation Selection
d2-02	Frequency Reference Lower Limit	o4-12	kWH Monitor Initial Value Selection

5: Compressor Application: Parameters and Settings

No.	Parameter Name	Optimum Setting
A1-02	Control Method Selection	0: Open Loop Vector
b1-04	Reverse Operation Selection	1: Reverse prohibited
C1-01	Acceleration Time 1	5.0 s
C1-02	Deceleration Time 1	5.0 s
C6-01	Duty Rating	0: Heavy Duty
E1-03	V/f Pattern Selection	0FH
L2-01	Momentary Power Loss Operation Selection	1: Enabled
L3-04	Stall Prevention Selection during Deceleration	1: Enabled

Parameters below are automatically saved as Preferred Parameters (A2-01 to A2-16):

No.	Parameter Name	No.	Parameter Name
b1-01	Frequency Reference Selection	E1-03	V/f Pattern Selection
b1-02	Run Command Selection	E1-07	Mid Output Frequency (FB)
b1-04	Reverse Operation Selection	E1-08	Mid Output Frequency Voltage (VC)
C1-01	Acceleration Time 1	E2-01	Motor Rated Current
C1-02	Deceleration Time 1	-	-

6: Hoist Application: Parameters and Settings

No.	Parameter Name	Optimum Setting
A1-02	Control Method Selection	2: Open Loop Vector Control
b1-01	Frequency Reference Selection	0: Operator
b6-01	Dwell Reference at Start	3.0 Hz
b6-02	Dwell Time at Start	0.3 s
C1-01	Acceleration Time 1	3.0 s
C1-02	Deceleration Time 1	3.0 s
C6-01	Duty Rating	0: Heavy Duty
C6-02	Carrier Frequency Selection	2: 5 kHz
d1-01	Frequency Reference 1	6.0 Hz
d1-02	Frequency Reference 2	30.0 Hz
d1-03	Frequency Reference 3	60.0 Hz
E1-03	V/f Pattern Selection	0FH
H2-02	Terminals P1 Function Selection (open-collector)	37: During frequency output
H2-03	Terminals P2 Function Selection (open-collector)	5: Frequency Detection 2 (FOUT)
L2-03	Momentary Power Loss Minimum Baseblock Time	0.3 s
L3-04	Momentary Power Loss Voltage Recovery Ramp Time	0: Disabled
L4-01	Speed Agreement Detection Level	2.0 Hz
L4-02	Speed Agreement Detection Width	0.0 Hz
L6-01	Torque Detection Selection 1	8: UL3 at RUN - Fault
L6-02	Torque Detection Level 1	5%
L6-03	Torque Detection Time 1	0.5 s
L8-05	Input Phase Loss Protection Selection	1: Enabled

No.	Parameter Name	Optimum Setting
L8-07	Output Phase Loss Protection	1: Enabled
L8-38	Carrier Frequency Reduction	0: Derated when operating at 6 Hz or less
L8-41	Current Alarm Selection	1: Enabled (alarm is output)

Note: **1.** A sequence to release the hold brake is needed for when the multi-function output photocoupler P2-PC closes.
2. Perform Auto-Tuning after selecting the Hoist Application Preset.

Parameters below are automatically saved as Preferred Parameters (A2-01 to A2-16):

No.	Parameter Name	No.	Parameter Name
A1-02	Control Method Selection	d1-02	Frequency Reference 2
b1-01	Frequency Reference Selection	d1-03	Frequency Reference 3
b6-01	Dwell Reference at Start	E1-08	Mid Output Frequency Voltage (VC)
b6-02	Dwell Time at Start	H2-01	Terminals MA, MB, and MC Function Selection
C1-01	Acceleration Time 1	L1-01	Motor Overload Protection Selection
C1-02	Deceleration Time 1	L4-01	Speed Agreement Detection Level
C6-02	Carrier Frequency Selection	L6-02	Torque Detection Level 1
d1-01	Frequency Reference 1	L6-03	Torque Detection Time 1

Note: Read the instructions listed in Notes on Using the Hoist Application Preset when using the Hoist Application Preset.

7: Crane Application: Parameters and Settings

No.	Parameter Name	Optimum Setting
A1-02	Control Mode	0: V/f Control
b1-01	Frequency Reference Selection	0: Operator
C1-01	Acceleration Time 1	3.0 s
C1-02	Deceleration Time 1	3.0 s
C6-01	Duty Cycle	0: Heavy Duty
C6-02	Carrier Frequency Selection	2: 5 kHz
d1-01	Frequency Reference 1	6.0 Hz
d1-02	Frequency Reference 2	30.0 Hz
d1-03	Frequency Reference 3	60.0 Hz
H1-05	Multi-Function Digital Input Terminal S5 Function	3: Multi-Step Speed 1
H1-06	Multi-Function Digital Input Terminal S6 Function	4: Multi-Step Speed 2
H2-02	Terminals P1 Function Selection (open-collector)	37: During frequency output
L3-04	Stall Prevention Selection during Decel	0: Disabled
L8-05	Input Phase Loss Protection Selection	1: Enabled
L8-07	Output Phase Loss Protection	1: Triggered when a single phase is lost
L8-38	Carrier Frequency Reduction	1: Always derated
L8-41	Current Alarm Selection	1: Enabled (alarm output)

Parameters below are automatically saved as Preferred Parameters (A2-01 to A2-16):

No.	Parameter Name	No.	Parameter Name
b1-01	Frequency Reference Selection	d1-03	Frequency Reference 3
C1-01	Acceleration Time 1	E2-01	Motor Rated Current
C1-02	Deceleration Time 1	H1-05	Multi-Function Digital Input Terminal S5 Function
C6-02	Carrier Frequency Selection	H1-06	Multi-Function Digital Input Terminal S6 Function
d1-01	Frequency Reference 1	H2-01	Terminals MA, MB, and MC Function Selection
d1-02	Frequency Reference 2	L1-01	Motor Overload Protection Selection

Note: A sequence to release the hold brake is needed for when the multi-function output photocoupler P2-PC closes.

■ Notes on Using the Hoist Application Preset

This section lists some important points when using the Hoist Application Preset (A1-06 = 6).

Opening and Closing the Holding Brake

Conditions

Use an output signal as described below to operate the holding brake in a hoist application.

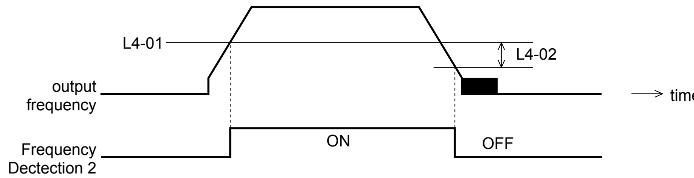
- Set frequency detection so it does not operate during baseblock (L4-07 = 0). Even when an external baseblock command is present, the output frequency will rise when a run command is entered. If frequency detection were to be enabled during baseblock (i.e., if L4-07 = 1), then the brake would be improperly released.

To activate and release the brake using the multi-function output terminals P1-PC, program the drive as shown in the table below:

Brake Open/Close		Brake Activation Level		Control Mode		
Function	Parameter	Signal	Parameter	V/f	OLV	OLV for PM
Frequency Detection 2	L4-07 = 0 H2-02 = 5	Frequency Detection Level Frequency Detection Width	L4-01 = 1.0 to 3.0 Hz*1 L4-02 = 0.0 to 0.5 Hz*2	O	O	–

*1. This is the setting range available when using Open Loop Vector Control. In V/f Control, set the level as the motor rated slip frequency pulse 0.5 Hz. Not enough motor torque will be created if this value is set too low, and the load may tend to slip. Make sure this value is greater than the minimum output frequency and greater than the value of L4-02 as shown in the diagram below. If set too high, however, there may be a jolt at start.

*2. Hysteresis for Frequency Detection 2 can be adjusted by changing the frequency detection width (L4-02) between 0.0 and 0.5 Hz. If the load slips during stop, make incremental changes of 0.1 Hz until the load no longer slips.



Sequence Circuit Design

The braking sequence should be designed as follows:

- The brake should release when terminal P2-PC closes in response to the run conditions on the sequence side
- When a fault signal is output, the brake should close. When an Up or Down command is entered, the brake should release.

Timechart

A sequence to open and close the holding brake appears in the diagram below.

When changing the speed using an analog signal, make sure that the source of the frequency reference is assigned to the control circuit terminals (b1-01 = 1).

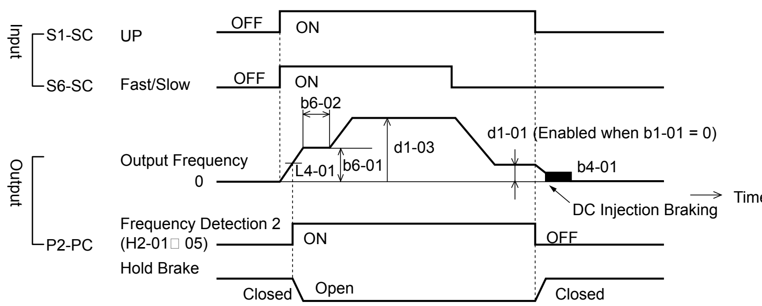


Figure 5.1 Holding Brake Timechart

■ A1-07: DriveWorksEZ Function Selection

DriveWorksEZ is an independent software package that can be used to operate and monitor the drive with a 2 ms scan. It is fully compatible with all types of serial communication software available on the market.

Setting A1-07 to 1 allows the drive to connect to the DriveWorksEZ software package. When using DriveWorksEZ, be sure to set one of the multi-function terminal inputs for DrivesWorksEZ (H1-□□ = 9F). The drive is ready to communicate with the software when the terminal is open. Set A1-07 to “0” when DriveWorksEZ is not used.

Please remember that if DriveWorksEZ assigned functions to the multi-function output terminals (both analog and digital), that the terminals will still be set to those functions even after DriveWorksEZ is disabled or disconnected.

Note: For more information on DriveWorksEZ, contact a Yaskawa representative or the Yaskawa sales department directly.

No.	Parameter Name	Setting Range	Default
A1-07	DriveWorksEZ Function Selection	0: Disabled 1: Enabled 2: Terminal input switch (requires that H1-□□ = 9F)	0

◆ A2: Preferred Parameters

■ A2-01 to A2-32: Preferred Parameters

The user can select 32 parameters and set them to A2-01 through A2-32. This saves time later scrolling through the parameter menu. The list of Preferred Parameters can also be used to keep track of the most recently edited settings, saving those parameters to this list.

No.	Parameter Name	Setting Range	Default
A2-01 to A2-32	Preferred Parameters 1 to 32	b1-01 to o2-08	A1-06

Detailed Description

To save specific parameters to A2-01 to A2-32, the user must first set the access level to allow access to all parameters (A1-02 = 2). After selecting which parameters should be saved and setting those parameters to A2-01 through A2-32, the access level can then be set to allow access only to the selected list of Preferred Parameters. To restrict access so that users can only set and reference the specific parameters saved as Preferred Parameters, set A1-01 to “1”.

■ A2-33: Preferred Parameter Automatic Selection

A2-33 determines whether or not parameters that have been edited are saved to the Preferred Parameters (A2-17 to A2-32) for quick, easy access.

No.	Parameter Name	Setting Range	Default
A2-33	Preferred Parameter Automatic Selection	0: Do not save list of recently view parameters. 1: Save history of recently view parameters.	0, 1

Detailed Description

0: Do not save list of recently view parameters.

To manually select the parameters listed in the Preferred Parameter group, set A2-33 to “0”.

1: Save history of recently view parameters.

By setting A2-33 to 1, all parameters that were recently edited will be automatically saved to A2-17 through A2-32. A total of 16 parameters are saved in order with the most recently edited parameter set to A2-17.

5.2 b: Setup

Application parameters configure the source of the run command, DC Injection Braking, Speed Search, various timer functions, PID control, the Dwell function, Energy Savings and a variety of other application-related settings.

◆ b1: Mode of Operation

■ b1-01: Frequency Reference Selection 1

Use parameter b1-01 to select the source of the frequency reference.

Press ENTER to set the drive to LOCAL and use the operator keypad to enter the frequency reference.

No.	Parameter Name	Setting Range	Default
b1-01	Frequency Reference Selection 1	0: Operator keypad 1: Analog input terminal A1 2: Serial Com - Modbus 3: Option PCB 4: Pulse Input (Terminal RP)	1

Note: If a run command is input to the drive but no corresponding frequency reference is entered, the RUN indicator LED on the digital operator will light and the STOP indicator will flash.

Detailed Description

Setting	Description
0	Operator: Digital preset speed U1-01 or d1-01 to d1-17.
1	Terminals: Analog input terminal A1 (or terminal A2 based on parameter H3-09).
2	Serial Com - Modbus RS-422/485 terminals R+, R-, S+ and S-.
3	Option PCB
4	Pulse Train Input (terminal RP)

0: Operator Keypad

Use the operator keypad to enter the frequency reference. For instructions, see “4.3.2 Drive and Programming Modes” on page 116 in the Users Manual.

Switch between LOCAL and REMOTE modes by pressing ENTER on the operator keypad or by setting b1-01 to “0”. The frequency reference can be viewed from monitor U1-01.

1: Terminals (analog input terminals)

When b1-01 is set to 1, the frequency reference is entered from either control circuit terminal A1 or A2. Terminal A1 is designed to take a voltage input, while terminal A2 can accept either a voltage or current input. Set parameter H3-02 or H3-09 according to how the frequency reference is to be supplied to the drive. For a voltage input, connect a 0 to 10 V source between terminals A1 and AC. For a current input, connect a 4 to 20 mA source between terminals A2 and AC.

- Entering only the main frequency reference:
  Control circuit terminal A1 (voltage input)
  When entering the main frequency reference with a voltage signal, use the voltage input set up in control circuit terminal A1.

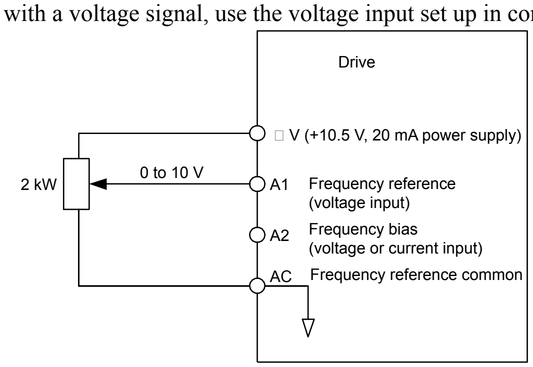


Figure 5.2 Main Frequency Reference Supplied by Voltage Input

Control Circuit Terminal A2 (voltage or current input)

Use control circuit terminal A2 when supplying the frequency reference with a current signal between 4 to 20 mA. To input 0 V to terminal A1, make the following setting changes:

- Set the signal level for multi-function analog input terminal A2 to accept a 4 to 20 mA signal (H3-09 = 2), and the gain for input terminal A2 to 0 (H3-10 = 0)

- For a current signal input, DIP switch S1 must be set to the “I” position. For a voltage signal input, DIP switch S1 must be set to the “V” position.

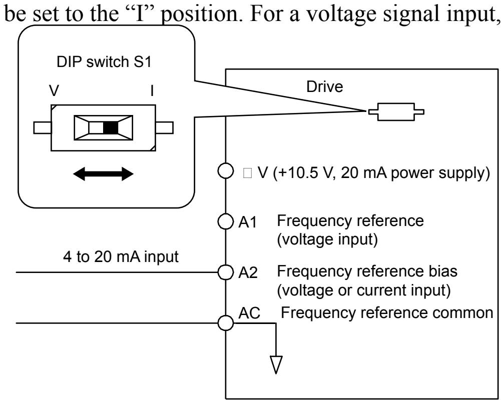
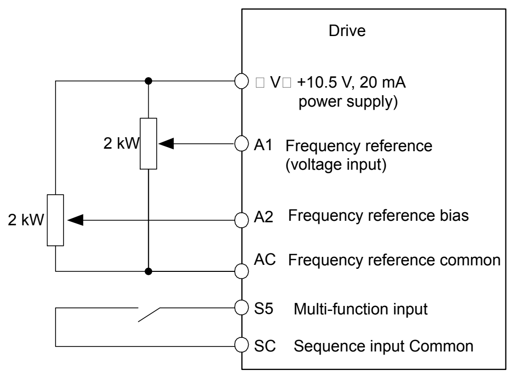


Figure 5.3 Supplying the Frequency Reference with a Current Input

- Switching between Main/Aux Frequency References
  When using the main/aux frequency reference for a two-step speed sequence, input the main frequency reference to terminal A1 and the auxiliary frequency reference to terminal A2. When the multi-function input terminal that has been set for Multi-Step Speed Reference 1 (the default setting for terminal S5) is open, the frequency reference for the drive is supplied by terminal A1. When the contact closes, the frequency reference for the drive changes to terminal A2. When using terminal A2 for an auxiliary frequency reference, set the multi-function analog input terminal A2 function for “Aux Frequency Reference 1” (H3-10 = 2).



Switching between Frequency References

Note: When using multi-function analog input terminal A2 to enter the frequency reference with a voltage signal, the current/voltage DIP switch on the drive needs to be set to voltage. Parameter H3-09 also needs to be set to “1”, which will allows terminal A2 to accept a voltage signal of 0 to 10 V.

2: MEMOBUS Communications

To supply the frequency reference via serial communications, set b1-01 to “2” (Serial Com), and connect the RS-485/422 serial communications cable to terminals R+, R-, S+, and S- on the control I/O terminal block.

3: Option card

Set b1-01 to “3” (Option PCB) and plug a communication option board into the 2CN port on the drive control PCB. Consult the manual supplied with the option board for instructions on integrating the drive with the communication system.

Note: If the frequency reference source is set for an option PCB (b1-01 = 3), but an option board is not installed in 2CN, an OPE05 Operator Programming Error will be displayed on the digital operator and the drive will not run. For more information, see “7.2.2 Alarms and Error Displays” in the instruction manual.

4: Pulse Train Input

Setting b1-01 to 4 tells the drive that the frequency reference will be provided by the Pulse Train input, located at control circuit terminal RP.

Verifying Pulse Train is Working Properly

- With H6-02 (Pulse Train Input Scaling) at its default setting of 1440 Hz, manually rotate the pulse generator and see how much the frequency reference increases.
- If the frequency reference does not reach 60 Hz, check the value of H6-02 (Pulse Train Input Scaling).
- Set the Pulse Train to provide the frequency reference (H6-01 = 0) and put the Pulse Train scaling (H6-02) at 100%.

Pulse Train Input Specifications	
Response Frequency	0.5 to 33 kHz
Heavy Duty	30 to 70%
High Level Voltage	3.5 to 13.2 V
Low Level Voltage	0.0 to 0.8 V
Input Impedance	3 kΩ

■ b1-02: Run Command Selection 1

Parameter b1-02 determines where the run command and stop command are input from.

Parameter Details
5

Note: The run command and the frequency reference can be supplied to the drive using various sources that include the operator, the control circuit terminals, option cards, serial communications, and Pulse Train input. The settings required by the drive to accept each one of these input sources can vary. Be sure to read the directions carefully and make the all appropriate settings.

No.	Name	Description	Default
b1-02	Run Command Selection 1	Selects the run command input source. 0: Operator - RUN and STOP keys on the digital operator. 1: Terminals - Contact closure on terminals S1 or S2. 2: Serial Com - Modbus RS-422/485 terminals R+, R-, S+ and S-. 3: Option PCB.	1

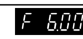
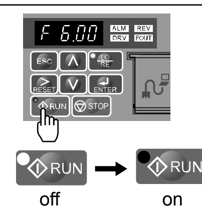
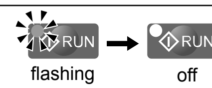
Detailed Description

Available selections for b1-02 include:

Setting	Description
0	Operator: RUN and STOP keys on the LED or LCD operator
1	Terminals: Contact closure on terminals S1 or S2
2	Serial Communications: Modbus RS-422/485 terminals R+, R-, S+ and S-
3	Option PCB

0: Operator

To use the operator to control the drive, press LO/RE or set b1-02 to “0”. This puts the drive in LOCAL mode. In this setting, use the RUN and STOP keys to start and stop the motor.

1.	Turn on the power to the drive. The initial display appears.	⇒	
2.	Set the frequency reference to F6.00 (6 Hz).	⇒	
3.	Press the RUN key to start the motor. The RUN indicator LED will light and the motor will begin rotating at 6 Hz..	⇒	
4.	Press the STOP key to stop the motor. The RUN light will flash until the motor comes to a complete stop.	⇒	

1: Control Circuit Terminal

To issue the run command from the terminals, set b1-02 to “1” and select between 2-wire and 3-wire control operation. The default setting is for 2-wire control.

2-Wire Control

The drive is defaulted for 2-wire operation. In the 2-wire configuration, a closure between S1 and SN is interpreted as a forward run command by the drive. A closure between S2 and SN is interpreted as a reverse run command. If both S1 and S2 are closed, the drive will stop (decelerate to zero speed) and the digital operator will display an external fault alarm (“EF” flashes).

Control Circuit Terminal	ON	OFF
S1	Forward run	Stop
S2	Reverse run	Stop

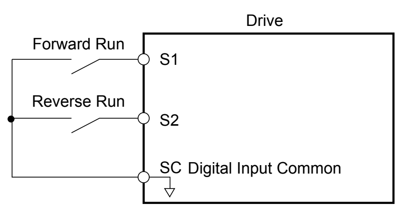
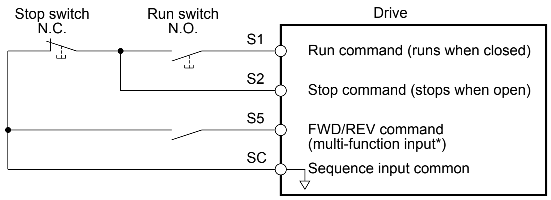


Figure 5.4 2-Wire Control

3-Wire Control

When any of the multi-function digital input parameters (H1-01 through H1-05) are set to 0, terminals S1 and S2 become run and stop, respectively. The multi-function digital input that was set to 0 will function as a forward/reverse input for the drive. When the forward/reverse input is open the drive will run in the forward direction and when the input is closed, the drive will run in reverse.

In 3-wire operation, a momentary closure (> 50 ms) of S1 will cause the drive to run provided that S2 is held closed. The drive will stop any time the S2-SN connection is broken. If the 3-wire configuration is implemented via a 3-wire initialization (A1-03= 3330), then terminal S3 becomes the forward/reverse input.



Note: Forward operation results when S5 is open; Reverse operation results when S5 is closed.

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

Note: For a list multi-function input terminal functions, see "B.3.7 H: Terminal Function Selections" on page 339. When a 3-Wire Initialization is performed using parameter A1-03, the function set to terminal S5 will be automatically reset so that it is assigned the FWD/REV run command.

WARNING! *Sudden Movement Hazard. The motor will begin rotating immediately after the power is switched on. Clear all personnel from rotating machinery and electrical connections prior to switching drive power on. Failure to comply may result in death or serious injury.*

Note: The drive is initially set up not to accept a run command at power up (b1-17 = 0). If a run command is issued at power up, the RUN indicator LED will flash quickly. For the drive to issue the run command, change b1-17 = "1".

3: Option Card

To issue the run command via the communication option board, set b1-02 to "3" and plug a communication option board into the 2CN port on the control PCB. Consult the manual supplied with the option board for instructions on integrating the drive into the communication system.

Note: If b1-01 is set to 3, but an option board is not installed in 2CN, an OPE05 operator programming error will be displayed on the digital operator and the drive will not run.

4: MEMOBUS Communications

To issue a run command via serial communications, set b1-02 to "2" and connect the RS-485/422 serial communication cable to R+, R-, S+, and S- on the removable terminal block. For information, see "H5-01: MEMOBUS" on page xx.

■ b1-03: Stopping Method Selection

Select how the drive stops the motor when a stop command is entered or when the run command is removed. There are four ways to stop.

No.	Name	Description	Setting Range
b1-03	Stopping Method Selection	Selects the stopping method when the run command is removed. 0: Ramp to Stop 1: Coast to Stop 2: DC Injection Braking to Stop 3: Coast with Timer (A new run command is ignored if received before the timer expires)	0 to 3

Note: DC Injection Braking cannot be used to stop the motor in PM Open Loop Vector Control.

Detailed Description

0: Ramp to Stop

When the run command is removed, the drive will decelerate the motor to 0 r/min. The rate of deceleration is determined by the active deceleration time. The default deceleration time is set to parameter C1-02.

When the output frequency has dropped below the DC Injection Start Frequency in b2-01 (default = 0.5 Hz), DC current will be injected in the motor at a level determined by b2-02 (default = 50%). The DC Injection condition will occur for the time specified by b2-04 (default = 0.0) to establish the end point of the ramp. DC Injection can be used to ensure the motor is at 0 r/min prior to the drive shutting off.

The deceleration time is calculated using the following formula:

Stop time = output frequency at stop command/max frequency (E1-04) x deceleration time setting (C1-02, C1-04, C1-06, C1-08)

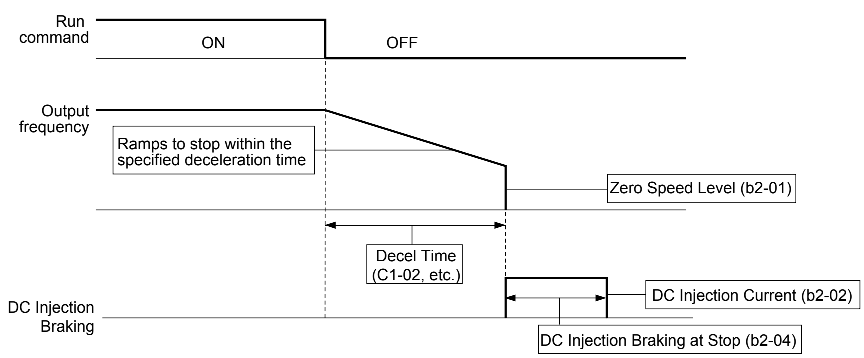


Figure 5.5 Ramp to Stop

Note: If S-curve characteristics are specified by the drive programming, they will add to the total time to stop. Parameter b2-04 is not available if using PM Open Loop Vector. Instead, set the Short Circuit Braking time to b2-13.

1: Coast to Stop

When the run command is removed, the drive will shut off its output and the motor will coast (uncontrolled deceleration). The friction of the driven equipment will eventually overcome any residual inertia of the system and the rotation will stop.

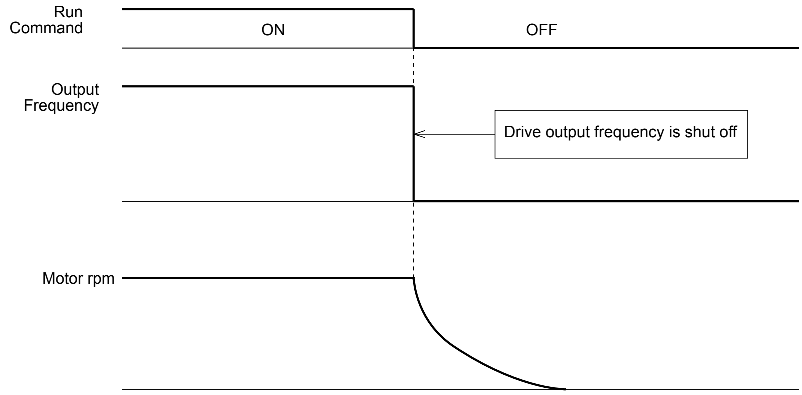


Figure 5.6 Coast to Stop

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 attempt to start the motor up again until it has come to a complete stop. To start the motor back up before it has stopped completely, use DC Injection at start. See parameter b2-03 for more information.

2: DC Injection Braking to Stop

When the run command is removed, the drive will baseblock (turn off its output) for the minimum baseblock time (L2-03). Once the minimum baseblock time has expired, the drive will inject DC current into the motor windings to lock the motor shaft. The stopping time will be reduced as compared to coast to stop. The level of DC Injection current is set by parameter b2-02 (default = 50%). The time for DC Injection Braking is determined by the value set to b2-04 and by the output frequency at the time the run command is removed.

Note: This function is not available when using PM Open Loop Vector. DC Injection Brake Time = (b2-04) x 10 x Output Frequency / max frequency (E1-04)

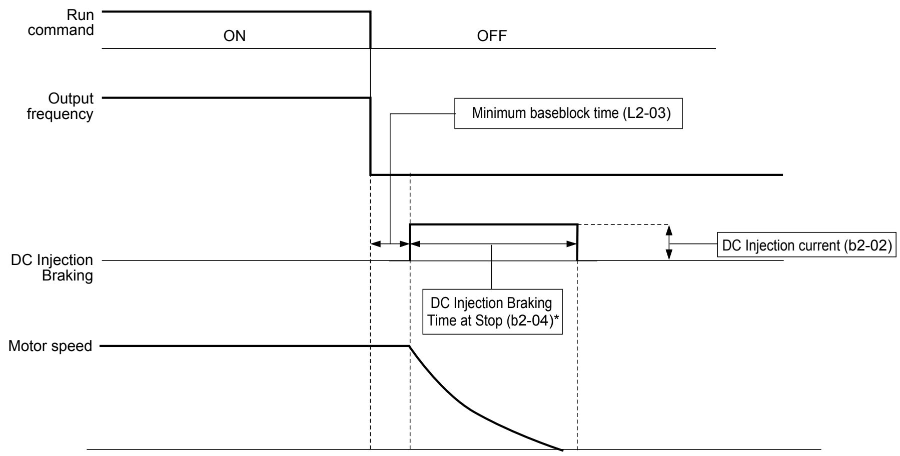
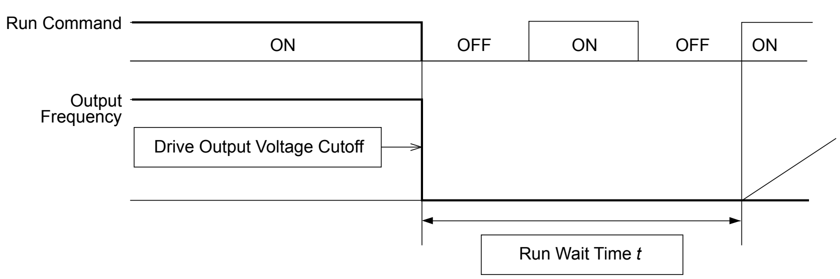


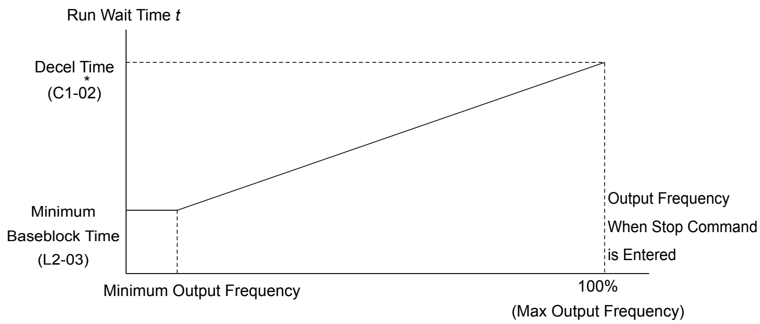
Figure 5.7 DC Injection Braking to Stop

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.

3: Coast to Stop with Timer

When the run command is removed, the drive will turn off its output and the motor will coast to stop. If a run command is input before time t (value of C1-02) expires, the drive will not run and the run command will need to be cycled before operation can occur. The time t (value of C1-02) is determined by the output frequency when the run command is removed and by the active deceleration time.





*This value is C1-02 or the selected deceleration time.

■ b1-04: Reverse Operation Selection

For some applications, reverse motor rotation is not appropriate and may even cause problems (e.g., air handling units, pumps, etc.). Setting parameter b1-04 to 1 will cause the drive to ignore any inputs for reverse operation. .

No.	Name	Setting Range	Default
b1-04	Reverse Operation Selection	Sets the forward rotation of the motor, and if reverse operation is disabled. 0: Reverse enabled. 1: Reverse disabled.	0

Note: The default setting for b1-04 is 0, which allows reverse operation. To prohibit the drive from operating in reverse, set b1-04 to “1”.

■ b1-07: LOCAL/REMOTE Run Selection

When the drive is switched between the LOCAL (operation using the digital operator) to REMOTE (these settings are determined by b1-01 and b1-02), there is the possibility that a run command is already present (i.e., a switch closure between S1 and SN when b1-02 = 1). Parameter b1-07 determines what the drive will do if a run command is still present when switching between LOCAL and REMOTE.

No.	Name	Setting Range	Default
b1-07	LOCAL/REMOTE Run Selection	Determines how the drive will interlock when the source of the run command switches from LOCAL to REMOTE. Note that one of the H1 parameters be set to 2 in order to use this function. 0: Cycle External RUN - If the run command is closed when switching from LOCAL to REMOTE, the drive will not run. The run command must first be shut off and then entered again in order to operate the motor. 1: Accept External Run - If the run command is closed when switching from LOCAL to REMOTE, the drive will run.	0

Detailed Description

0: If the run command is closed when switching from LOCAL or alternative reference to REMOTE, the drive will not run.

The drive ignores an external run command until it is removed and re-instated.

1: If the run command is closed when switching from LOCAL or alternative reference to REMOTE, the drive will run.

The drive accepts a run command if it is already present and immediately begins accelerating to the specified frequency reference.

WARNING! *The drive may start unexpectedly if switching from LOCAL to REMOTE when b1-17 = 1. Clear all personnel away from rotating machinery and electrical connections prior to switching between LOCAL and REMOTE. Failure to comply may cause death or serious injury.*

■ b1-08: Run Command Selection while in Programming Mode

As a safety precaution, the drive will not normally respond to a run input when the digital operator is being used to adjust parameters. If it is necessary to recognize external run commands while programming the drive, set b1-08 to “1”.

No.	Name	Setting Range	Default
b1-08	Run Command Selection while in Programming Mode	0: Disabled - Run command accepted only in the operation menu. 1: Enabled - Run command accepted in all menus.2. Prohibit entering programming mode during run.	0

Note: Refers collectively to the Verify Menu, the Setup Mode, Parameter Settings Mode, and Auto-Tuning.

■ b1-14: Phase Order Selection

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

No.	Name	Setting Range	Default
b1-14	Phase Order Selection	Sets the phase order for drive output terminals U/T1, V/T2 and W/T3. 0: Standard 1: Switch phase order	0

■ b1-15: Frequency Reference Selection 2

Refer to the detailed description for parameter b1-01.

No.	Parameter Name	Setting Range	Default
b1-15	Frequency Reference 2	Selects the frequency reference input source. 0: Operator - Digital preset speed U1-01 or d1-01 to d1-17. 1: Terminals - Analog input terminal A1 (or terminal A2 based on parameter H3-09). 2: Serial Com - Modbus RS-422/485 terminals R+, R-, S+ and S-. 3: Option PCB4: Pulse Input (Terminal RP)	0

■ b1-16: Run Command Source 2

Refer to the detailed description for parameter b1-02.

No.	Parameter Name	Setting Range	Default
b1-16	Run Command Source 2	Selects the run command input source. 0: Operator - RUN and STOP keys on the digital operator. 1: Terminals - Contact closure on terminals S1 or S2. 2: Serial Com - Modbus RS-422/485 terminals R+, R-, S+ and S-. 3: Option PCB	0

■ b1-17: Run Command at Power Up

Determines whether a run command is given as soon as the power to the drive is switched on.

No.	Parameter Name	Setting Range	Default
b1-17	Run Command at Power Up	0: No run command issued at power up 1: Run command given when power is switched on	0

CAUTION! *The motor will begin rotating immediately after the power is switched on. Take proper precautions to ensure the area around the motor is safe prior to powering up the drive. Failure to comply may cause injury.*

Note: The drive is initially set up not to accept a run command at power up (b1-17 = 0). If a run command is issued at power up, the RUN indicator LED will flash quickly. For the drive to issue the run command, change b1-17 = “1”.

◆ b2: DC Injection Braking

These parameters determine how the DC Injection Braking feature operates. Parameters involving the starting frequency, current level, braking time, and motor pre-heat current level are located here.

■ b2-01: DC Injection Braking Start Frequency

Sets the frequency at which DC Injection Braking starts when “Ramp to Stop” is selected as the stopping method (b1-03 = 0). Set in Hz.

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

Detailed Description

Parameter b2-01 sets the output frequency at which the drive begins DC Injection during ramp to stop in order to lock the rotor of the motor and established the end point of the ramp. If b2-01 < E1-09 (Minimum Frequency), then DC Injection begins at at the frequency set to E1-09.

No.	Name	Setting Range	Default
E1-09	Minimum Output Frequency (FMIN)	0.0 to 400.0*	Determined by A1-02 and C1-03. OLV for PM relies on E5-01.

*The upper limit for the setting range is determined by E1-04. E5-01 determines the default value when using PM Open Loop Vector.

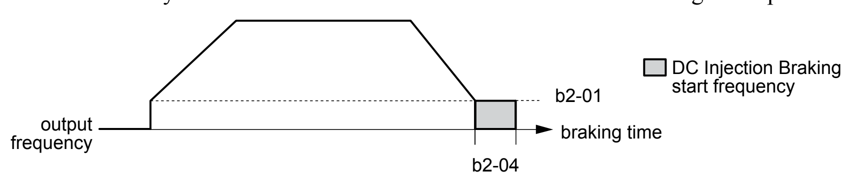


Figure 5.8 DC Injection Braking during Deceleration

■ b2-02: DC Injection Braking Current

Sets the DC Injection Braking current as a percentage of the drive rated current. If set to larger than 50%, the carrier frequency is automatically reduced to 1 kHz.

No.	Parameter Name	Setting Range	Default
b2-02	DC Injection Braking Current	0 to 75	50

Detailed Description

The level of DC Injection Braking current affects the strength of the magnetic field attempting to lock the motor shaft. Increasing the level of current will increase the amount of heat generated by the motor windings, and should only be increased to the level necessary to hold the motor shaft. DC Injection current is set as a percentage of drive rated output current. Find the drive rated output current by looking at the information listed on the drive nameplate.

■ b2-03: DC Injection Braking Time at Start

Sets the time of DC Injection Braking at start in units of 0.01 s, and is used to stop a coasting motor. Disabled when set to 0.00 s.

No.	Parameter Name	Setting Range	Default
b2-03	DC Injection Braking Time at Start	0.00 to 10.00	0.50

Note: When DC Injection Braking cannot be used at start, the motor will likely fault out if Speed Search is not enabled and the motor is allowed to continue rotating.

■ b2-04: DC Injection Braking Time at Stop

This parameter works in combination with b2-01, and sets the DC Injection Braking time at stop in units of 0.01 s. Used to bring the motor to a stop when inertia is causing it to rotate.

No.	Parameter Name	Setting Range	Default
b2-04	DC Injection Braking Time at Stop	0.00 to 10.00	0.50

■ b2-08: Magnetic Flux Compensation Capacity

Sets the magnetic flux compensation as a percentage of the no-load current value (E2-03).

Increases the motor flux when the motor is started up.

No.	Name	Setting Range	Default
b2-08	Magnetic Flux Compensation Capacity	0 to 1000	0

This parameter allows the magnetizing motor flux to be boosted when starting the motor. This parameter will facilitate a quick ramp-up of the torque reference and magnetizing current reference to reduce motor slip during start. A setting of 100% equals motor no-load current E2-03. This flux level will be applied below the minimum output frequency set to E1-09 until the DC Injection time at start (b2-03) expires. This parameter is useful when starting motors that are relatively larger than the drive, due to the requirement for increased magnetizing current. This parameter may also compensate for reduced starting torque due to motor circuit inefficiencies.

■ b2-12: Short Circuit Brake Time at Start

Sets the time for Short-Circuit Brake operation at start in units of 0.01 s. Used when restarting a coasting motor once it has stopped. Disabled when set to 0.00.

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

■ b2-13: Short Circuit Brake Time at Stop

Sets the time for Short-Circuit Brake operation at stop in units of 0.01 s. Used to stop a motor rotating due to inertia. Disabled when set to 0.00.

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

■ b2-15: DC Injection Braking Current 2

Allows the DC Injection Current 1 to flow for the switch time set to b2-16, then switches to DC Injection Current 2. Disabled when set to 0%.

No.	Name	Setting Range	Default
b2-15	DC Injection Braking Current 2	0 to 100	50

◆ b3: Speed Search

The Speed Search function allows the drive to determine the speed of a motor shaft that is being driven by rotational inertia. Speed Search allows the drive to determine the speed of the already rotating motor and begin to ramp the motor to a set speed without first having to bring it to a complete stop. When a momentary loss of supply power occurs, the drive output is turned off. This results in a coasting motor. When power returns, the drive can determine the speed of the coasting motor and start without requiring it to be brought to minimum speed.

Speed Search is performed as follows:

- Enable Power Loss Ride-Thru selection by setting L2-01 to “1” (enabled) or “2” (enabled during CPU operation).
- L5-01 determines the number of times the drive can attempt to restart after a fault occurs.
- To perform Speed Search whenever a run command is entered, set on of the multi-function inputs to External Search Reference 1 or 2 (H1-□ □ = 61 or 62 respectively). Here, Speed Search is performed only when the run command is first entered, and an external command to perform Speed Search is disregarded. Wait at least 2 ms before entering another external Speed Search command.
- To perform Speed Search when baseblock is released, set on of the multi-function inputs to for the baseblock command (H1-□ □ = 8 or 9, N.O. and N.C., respectively).

Note: There are two types of Speed Search available in parameter b3-24: Current Detection Speed Search and Speed Estimation Speed Search. When the Speed Search command is entered through one of the multi-function terminals, the type of Speed Search performed is determined by b3-01. If b3-01 is disabled, then Current Detection Speed Search is performed via one of the remote terminal inputs. If b3-01 is enabled, then Speed Estimation Speed Search is executed. The minimum baseblock time and voltage restoration time (L2-03 and L2-04 respectively) both influence how Speed Search works.

■ b3-01: Speed Search Selection at Start

Enables, disables, and selects the speed search function at start.

No.	Name	Setting Range	Default
b3-01	Speed Search Selection at Start	0: Disabled 1: Enabled	0

The type of Speed Search performed is set to b3-24, while the action to take when a momentary power loss occurs is set to L2-01. When the drive is starting back up after power is restored, the run command needs to be maintained for at least the time set to L2-02 (Momentary Power Loss Ride-Thru Time).

Parameter Details

5

No.	Name	Setting Range	Default
b3-24	Speed Search Method Selection	0: Current Detection Speed Search 1: Speed Estimation Type Speed Search	0
L2-01	Momentary Power Loss Operation Selection	0: Disabled - Drive trips on (UV1) fault when power is lost. 1: Power Loss Ride-Thru Time - Drive will restart if power returns within the time set in L2-02. 2: CPU Power Active - Drive will restart if power returns prior to control power supply shut down.	0

The table below lists the Speed Search methods available.

Speed Search Method	Speed Estimation (b3-01=2, 3)	Current Detection (b3-01=0, 1)
Search Method	Estimates motor speed, then accelerates from that speed up to the specified frequency. Works for both forwards and reverse rotation.	Outputs the frequency when momentary power loss occurs, as well as the maximum frequency and the frequency reference. Caculates the current level relative to those values when Speed Search begins.
External Speed Search	Both External Speed Search 1 and 2 perform the same action, estimating the speed of the motor and then searching for the speed based on that estimated value.	External Speed Search 1: Searches for the speed based on the maximum output frequency. External Speed Search 2: Searches for the motor speed based on the most recent frequency reference.
Application Notes	Not for use when running multiple motors from a single drive or when the drive is a frame size larger than the motor. Cannot be used at speeds greater than 130 Hz.	Sudden acceleration may occur with relatively light loads.

Multi-Function Input Selections (H1-01 to H1-07)

Setting	Description
61	External Search Command 1 Closed: Executes Speed Search from the maximum output frequency (E1-04).
62	External Search Command 2 Closed: Executes Speed Search from the frequency reference.

Detailed Description

Speed Estimation (b3-24 = 1)

In Speed Estimation, the drive first estimates the speed of the motor, then accelerates (or decelerates) to that frequency. To enable Speed Estimation at start, set b3-24 to “1”. To also allow Speed Estimation in reverse, set b3-26 to “1”.

Note: Perform Auto-Tuning before using Speed Estimation Speed Search. Perform Auto-Tuning again if the there is change in the cable length between the drive and motor. Speed Estimation should not be used to search for speeds beyond 130 Hz if the application is running multiple motors from the same drive, or if the motor is considerably smaller than the capacity of the drive. Yaskawa recommends using Current Detection Speed Search instead. Speed Estimation may have trouble finding the actual speed if the motor cable is longer than 50 m. We recommend using Current Detection Speed Search in such situations. Use Current Detection Speed Search instead of Speed Estimation when operating motors small than 0.75 kW. Speed Estimation can end up stopping smaller motors as it attempts to find the speed or figure out what direction the motor is rotating in. When using PM Open Loop Vector Control along with a fairly long motor cable, Yaskawa recommends using Short Circuit Braking instead of Speed Estimation. If attempting to find the speed of a motor coasting faster than 120 Hz when using PM Open Loop Vector Control, Yaskawa recommends using Short Circuit Braking instead of Speed Estimation. shows how the drive operates when performing Speed Search to start the motor and when an external Speed Search command is given via the multi-function input terminals.

Speed Search at Start (b3-24 = 1)

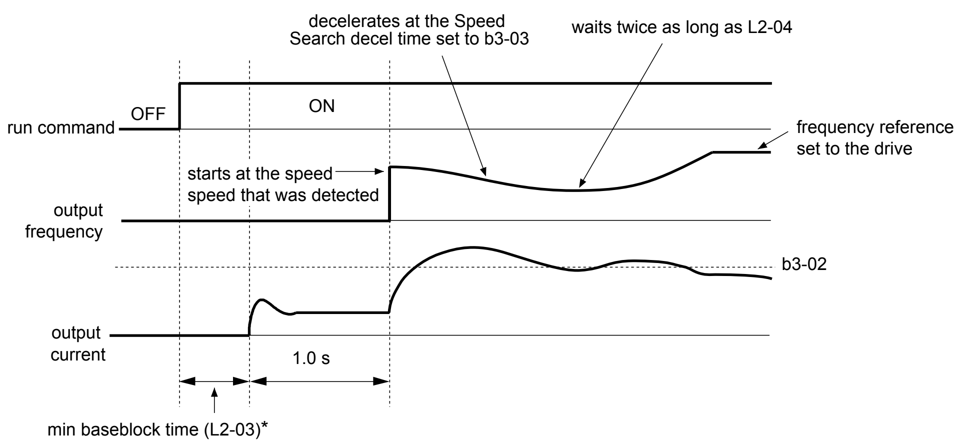


Figure 5.9 Speed Search at Start

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

Note: If the run command is quickly switched off and then back on again when the drive is set to coast to stop following a stop command, Speed Search will operate as shown in the second diagram.

The timechart below demonstrates how the drive operates when power is restored after a momentary power loss.

- Momentary power loss is shorter than the minimum baseblock time (L2-03):

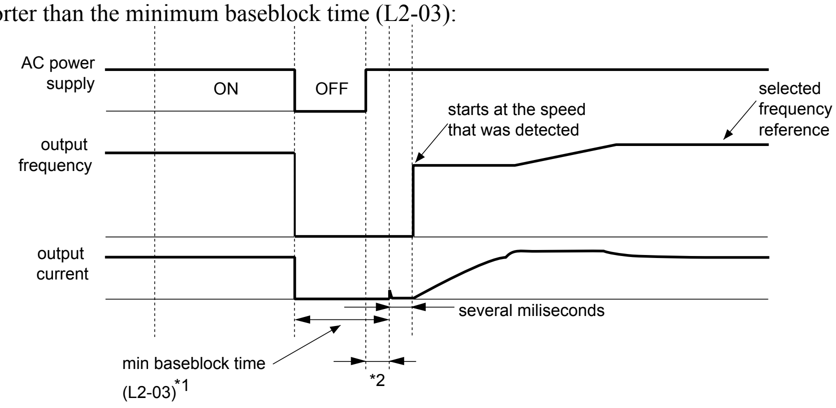


Figure 5.10 Duration of Power Loss < L2-03: Speed Search after Baseblock

*1. Baseblock time may be shortened on account of the output frequency prior to baseblock.

*2. Once AC power is restored, the drive will wait for at least the time set to b3-05.

- Momentary power loss is longer than the minimum baseblock time (L2-03):

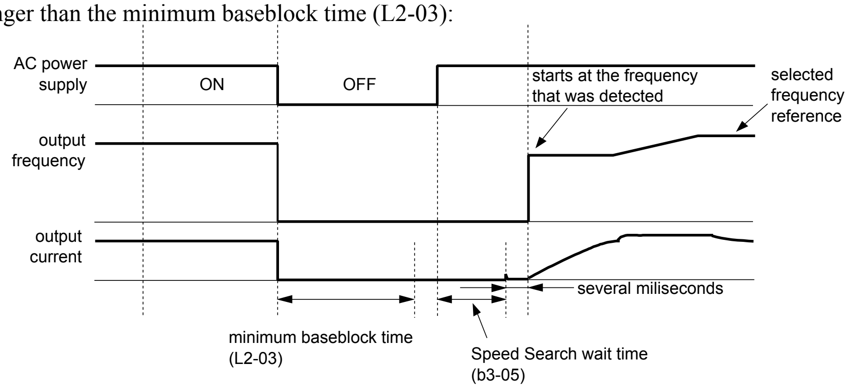


Figure 5.11 Duration of Power Loss > L2-03: Speed Estimation after Baseblock

Note: Speed Search will sometimes operate as shown in the first diagram if the frequency is relatively low just before baseblock or if the duration of power loss is relatively long.

Current Detection Speed Search (b3-24 = 0)

Searches for the motor speed from the maximum frequency and by using the frequency when momentary power loss occurred. Detects speed with the motor current level. Current Detection Speed Search works only in one direction. To enable Current Detection Speed Search, set b3-24 to 0 and b3-01 to 1.

Set the multi-function inputs for “External Speed Search Command 1” or “External Speed Search Command 2” (H1-□□ = 61 or 62). External Speed Search Command 1 looks for the motor speed from the maximum frequency set to E1-04. External Speed Search Command 2 looks for the motor speed by starting from the set frequency and decelerating until the speed of the rotor and the output frequency match.

Note: Increase the voltage recovery ramp time set to L2-04 if a UV1 fault occurs when performing Current Detection Speed Search. Shorten the Speed Search deceleration time set to b3-03 if an OL1 fault occurs while performing Current Detection Speed Search. Increase the minimum baseblock time set to L2-03 if an overcurrent fault occurs when performing Speed Search after power is restored following a momentary power loss. Current Detection Speed Search is not available when using PM Open Loop Vector Control.

The timechart below demonstrates how Speed Serach at start and an external Speed Search command operate.

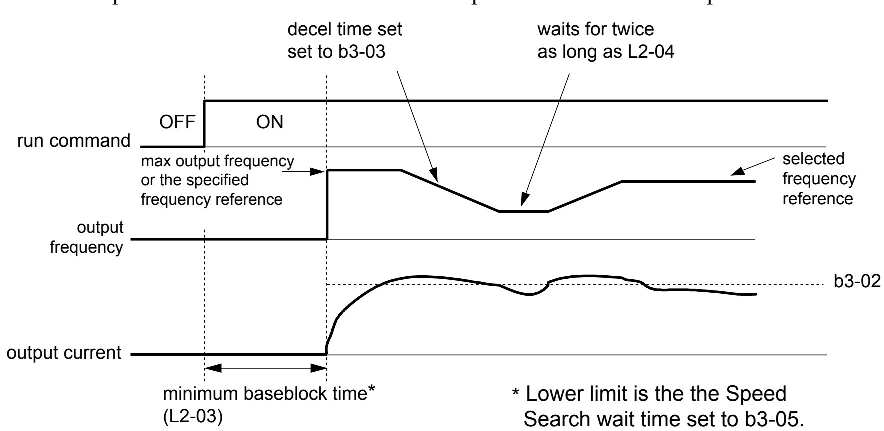


Figure 5.12 Current Detection Speed Search at Start

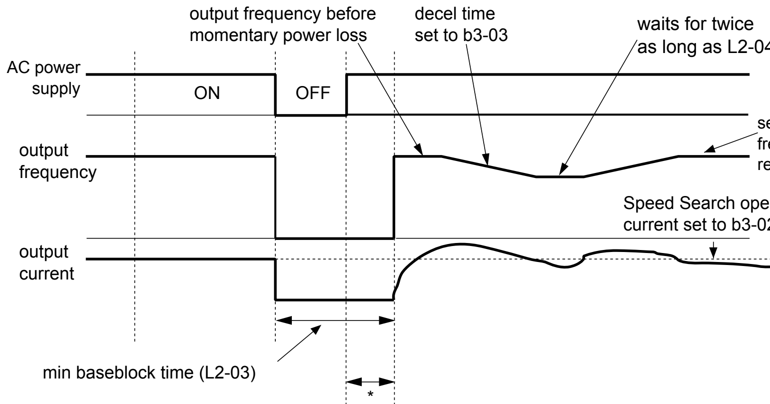
Parameter Details

5

Speed Search for Momentary Power Loss Ride-Thru: Minimum Baseblock Time (b3-01 = 2)

The following timecharts illustrate how Speed Search operates during Momentary Power Loss Ride-Thru.

- If momentary power loss is shorter than the minimum baseblock time



After power is restored, the drive waits to perform Speed Search until the time set to b3-05 has passed.

Note: Power loss is shorter than L2-03: Current Detection Speed Search after Baseblock.

- If momentary power loss is longer than the minimum baseblock time:

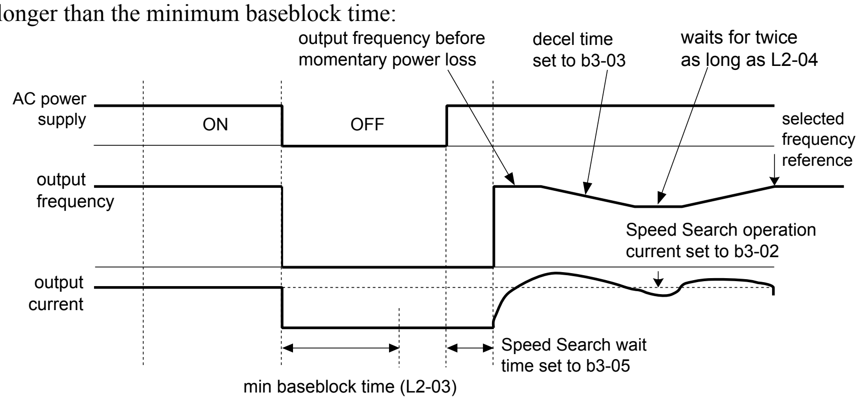


Figure 5.13 Power Loss is Longer than L2-03: Current Detection Speed after Baseblock

Speed Search Settings and Methods		
Settings for b3-01	Speed Search is performed automatically whenever the run command is entered.	Speed Search is performed after a fault restart, external baseblock release command, external Speed Search command, and after momentary power loss.
0	Not possible	Possible
1	Possible	Possible

Note: Default setting is 0.

L2-01 needs to be set to 1 or 2 to enable Speed Search following momentary power loss. To enable Speed Search when performing a fault restart, set L5-01 to any value besides 0.

■ b3-02: Speed Search Deactivation Current

Sets speed search operating current in units of percent with the drive rated current as 100%. Normally there is no need to change this setting. If the drive won't run after a restart, lower this value.

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

Detailed Description

When using the current detection method of Speed Search (b3-01 = 2 or 3), parameter b3-02 sets the current level that will determine when the search is complete and the rotor and output speeds match. When the output frequency is higher than the actual rotor speed the slip causes the current to be high. As the output frequency is lowered, the closer it comes to the rotor speed, the lower the current draw will be. When the output current drops below the level as set in b3-02 (100% = drive rated current) the output frequency stops decreasing and normal operation resumes.

Note: When parameter A1-02 = 0 (V/f control without PG) the factory default setting is 120. When parameter A1-02 = 2 (Open Loop Vector) the factory default setting is 100.

■ b3-03: Speed Search Deceleration Time

Parameter b3-03 sets the deceleration ramp used by the current detection method of Speed Search (b3-01 = 2 or 3) when searching for the motor's rotor speed. Even if Speed Search 2 is selected, for Speed Search at start, the time entered into b3-03 will be the time to decelerate from maximum frequency (E1-04) to minimum frequency (E1-09).

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

Note: Even if Speed Estimation is selected, the drive will still decelerate for as long as it takes to go from the maximum frequency set to E1-04 to the mimimum frequency set to E1-09.

■ b3-05: Speed Search Delay Time

In cases where an output contactor is used between the drive and the motor, extra waiting time is provided after power returns and before Speed Search is performed. This extra time allows for the contactor to operate. When Speed Search at start is used, b3-05 will serve as the lower limit of the minimum baseblock time (L2-03).

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

Note: When using Speed Search at start, the minimum value for the Speed Search Delay Time becomes the same value as the minimum baseblock time set to L2-03.

■ b3-06: Output Current 1 During Speed Search

Sets the coefficients related to motor current for the size of the output current during the beginning of speed search. Rated motor current is set in E2-01 and E4-01. If search speeds are extremely low in the beginning of Speed Search following a long period of baseblock, then increase the setting value (used only in exciatiton search). The output current during Speed Search is automatically limited by the drive rated current. This function is available only when Speed Estimation Speed Search is enabled (b3-24 = 1).

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

Note: If Speed Estimation is not working correctly even after adjusting b3-06, try using Current Detection Speed Search instead.

■ b3-10: Speed Search Detection Compensation Gain

This parameter sets the gain for the frequency at which the drive starts Speed Estimation Speed Search. The drive then starts the motor at this compensated frequency. Available only when Speed Estimation is enabled (b3-24 = 1).

No.	Name	Setting Range	Default
b3-10	Speed Search Detection Compensation Gain	1.00 to 1.20	1.10

Note: Increase this value if overvoltage occurs when performing Speed Search at start after a relatively long period of baseblock.

■ b3-14: Bi-Directional Speed Search Selection

The b3-14 parameter can be used to turn off the bi-directional capabilities of the Speed Estimation form of Speed Search. By turning off the bi-directional capability, the speed search will only try to match the speed in the last known direction.

No.	Parameter Name	Setting Range	Default
b3-14	Bidirectional Speed Search Selection	0: Disabled. Drive uses frequency reference direction. 1: Enable. Drive uses detected direction.	0

■ b3-17: Speed Search Restart Current Level

A large amount of current can end up flowing through the drive if there is a fairly large difference between the estimated frequency and the actual motor speed when performing Speed Estimation. This parameter sets the current level at which Speed Estimation should be retried, thus avoiding overucrrent and overvoltage problems.

Sets the speed search restart operation detection current level as a percentage of the drive rated current.

No.	Parameter Name	Setting Range	Default
b3-17	Speed Search Restart Current Level	0 to 200	150%

■ b3-18: Speed Search Restart Detection Time

Sets the time in seconds for how long it takes for speed search restart to be detected.

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

■ b3-19: Number of Speed Search Restarts

Sets the number of restarts possible for speed search restart operations.

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

■ b3-24: Speed Search Method Selection

Sets the speed search method used at start up and after momentary power loss occurs.

No.	Parameter Name	Setting Range	Default
b3-24	Speed Search Method Selection	0: Current Detection Speed Search 1: Speed Estimation Speed Search	0

Detailed Description

0: Current Detection Speed Search

Current Detection Speed Search looks for the speed of the motor by using the frequency when momentary power loss occured and by using the maximum current. While searching for the speed, it adjusts the output frequency with the current the level, accelerating up to the specified frequency reference.

1: Speed Estimation Speed Search

Speed Estimation starts by first estimating the speed of the motor. Based on that speed, it adjust the frequency with the current level, accelerating up to the specified frequency reference. Speed Estimation works both forwards and in reverse.

Note: For more informatin on Speed Search, *Refer to b3-01: Speed Search Selection at Start on page 117*.

■ b3-25: Speed Search Wait Time

Sets the wait time in units of 0.1 s bewteen Speed Search attempts when using a PM motor.

No.	Parameter Name	Setting Range	Default	Page
b3-25	Speed Search Wait Time	0.0 to 30.0	0.5	–

◆ b4: Delay Timers

The drive has an internal timer function that operates independently from the drive. Delay times can function to get rid of chattering switch noise from sensors.

■ b4-01: Timer Function On-Delay Time

■ b4-02: Timer Function Off-Delay Time

Sets the switching delay for the output in 0.1 s.

No.	Parameter Name	Setting Range	Default
b4-01*	Timer Function On-Delay Time	0.0 to 300.0	0.0
b4-02*	Timer Function Off-Delay Time	0.0 to 300.0	0.0

Enabled when the timer function is set to one of the multi-function inputs (H1-□□) and multi-function outputs (H2-□□).

Detailed Description

A digital input must be programmed to be a timer start input by setting H1-□□ = 18. A digital output must be programmed as a timer output by setting H2-□□ = 12. This should not to be confused with the "Wait to Run Time" in b1-11.

Multi-Function Inputs H1-01 through H1-07

Setting	Function Name	Page
18	Timer Function Input	–

Multi-Function Outputs (H2-01 to H2-03)

Setting	Function Name	Page
12	Timer Function Output	–

When the timer function input closes for longer than the value set in b4-01, the timer output switches on. When the timer function input is open for longer than the value set in b4-02, the timer output function switches off. The following diagram demonstrates the timer function operation.

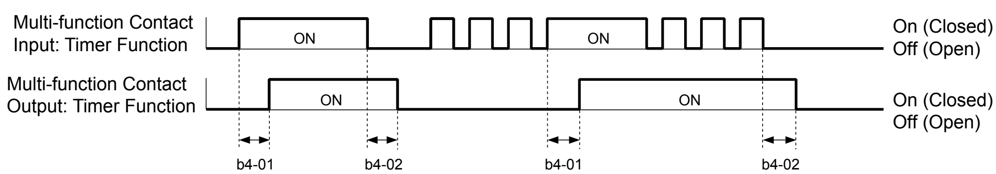


Figure 5.14 Timer Operation

◆ b5: PID Control

The capability to accept an analog signal as feedback for a PID (Proportional + Integral + Derivative) control function is built into the drive. The PID control function provides closed-loop control and regulation of a system variable such as temperature or pressure. A control signal based on the difference (or proportion) between a feedback signal and a desired setpoint is produced. Integration and derivative calculations are then performed on this signal, based upon the PID parameter settings (b5-01 to b5-19), to minimize deviation, for more precise control.

■ P Control

PID refers to the type of action used to control modulating equipment such as valves or dampers. With proportional control, a control signal based on the difference between an actual condition and a desired condition is produced. The difference, such as that between an actual temperature and setpoint is the "error". The inverter adjusts its output signal related directly to the error magnitude.

■ I Control

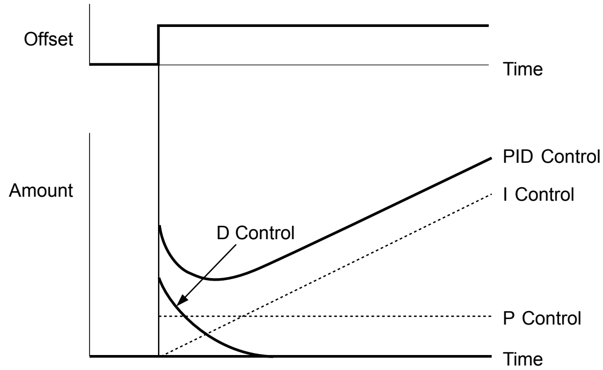
The integral action is designed to minimize offset. An integrating term is used to observe how long the error condition has existed, summing the error over time. Once the system has stabilized, the offset would be minimized.

■ D Control

Overshoot refers to a control loop tendency to overcompensate for an error condition, causing a new error in the opposite direction. Derivative action provides an anticipatory function that exerts a “braking” action on the control loop. When combined, the proportional integral, and derivative actions provide quick response to error, close adherence to the setpoint, and control stability.

■ PID Operation

To better demonstrate how PID input works, the diagram below shows how the output changes as the deviation between the target value and the feedback level are kept constant.



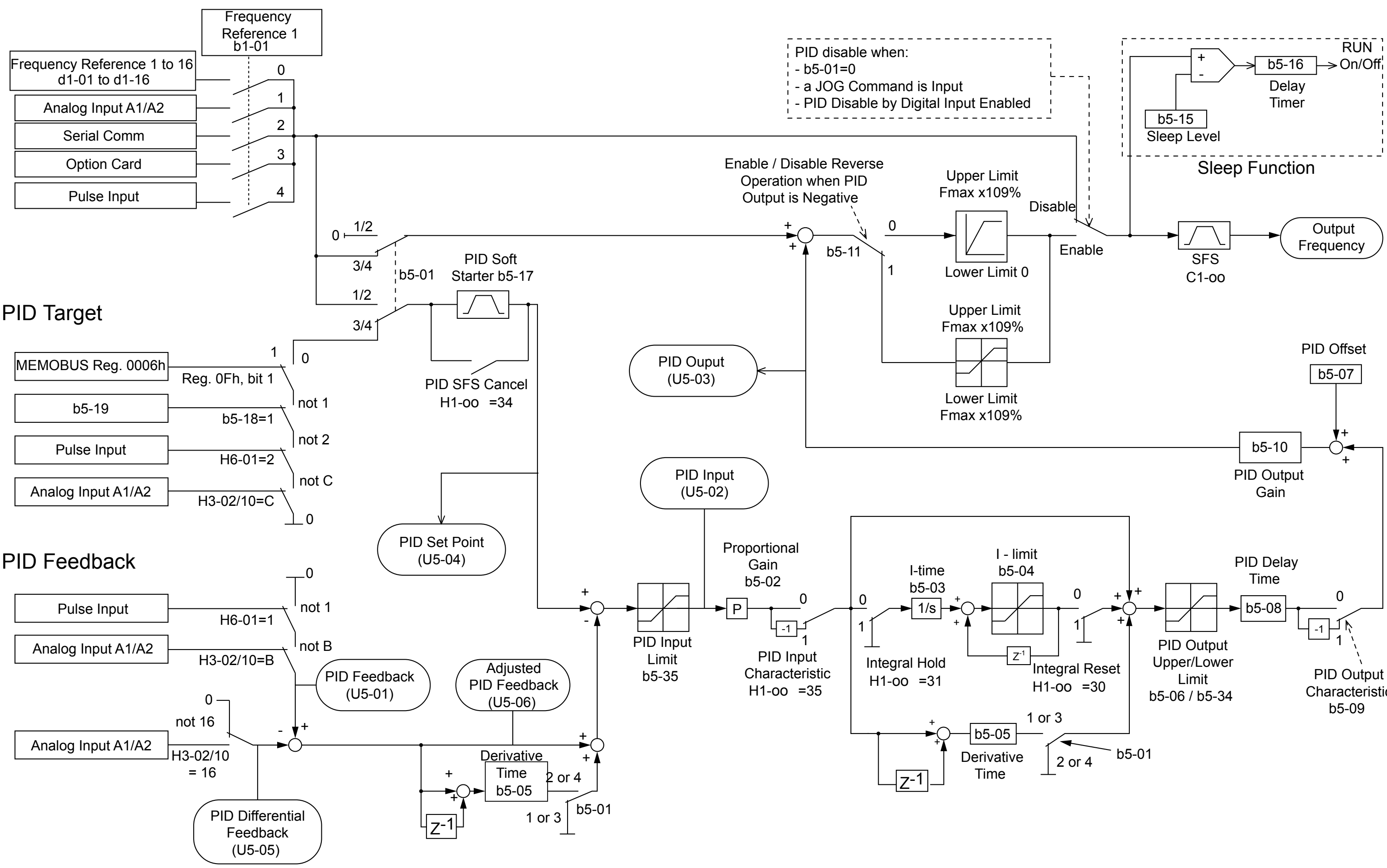
■ Using PID Control

Applications for PID control are listed in the table below.

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 Block Diagram

PID Block Diagram



■ b5-01: PID Function Setting

To enable PID control, select from settings 1 through 4.

No.	Parameter Name	Setting Range	Default
b5-01	PID Function Setting	0: Disabled 1: D = Feedback 2: D = Feed-Forward 3: Frequency reference + PID output (D = Feedback) 4: Frequency reference + PID output (D = Feed-Forward)	0

■ b5-02: Proportional Gain Setting (P)

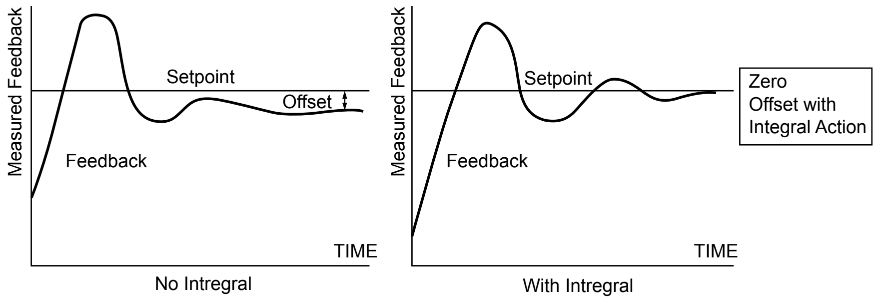
The proportional gain will apply a straight multiplier to the calculated difference (error) between the PID Setpoint and the measured transmitter feedback at terminal A2. A large value will tend to reduce the error but may cause instability (oscillations) if too high. A small value may allow too much offset between the setpoint and feedback.

No.	Parameter Name	Setting Range	Default
b5-02	Proportional Gain Setting (P)	0.00 to 25.00	1.00

■ b5-03: Integral Time Setting (I)

The Integral factor of PID functionality is a time-based gain that can be used to eliminate the error (difference between the setpoint and feedback at steady state). The smaller the integral time set into b5-03, the more aggressive the integral factor will be. To turn off the integral time, set b5-03 = 0.00.

No.	Parameter Name	Setting Range	Default
b5-03	Integral Time Setting (I)	0.0 to 360.0	1.0 s



■ b5-04: Integral Limit Setting

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

No.	Parameter 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. To suppress this oscillation, a limit can be applied to the intrigue factor by programming b5-04.

■ b5-05: Derivative Time (D)

Adjust this parameter to increase the reponsiveness of the system.

No.	Parameter Name	Setting Range	Default
b5-05	Derivative Time	0.00 to 10.00	0.00

Note: Try reducing this derivative time if overshoot occurs. Increase the derivative time to achieve stability faster even if overshoot occurs. Derivative control is disabled when this value is set to 0.00.

■ b5-06: PID Output Limit

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

No.	Parameter Name	Setting Range	Default
b5-06	PID Output Limit	0.0 to 100.0	100.0

■ b5-07: PID Offset Adjustment

Sets the amount of offset of the output of the PID controller. Set as a percentage of the maximum frequency. The offset is summed with the PID output.

No.	Parameter 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 amount of time for the filter on the output of the PID controller.

Normally, change is not required.

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

Note: Effective in preventing oscillation 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 reduces the drives responsiveness.

■ b5-09: PID Output Level Selection

Normally, the output of the PID function causes an increase in motor speed whenever the measured feedback is below the setpoint. This is referred to as “direct acting response.” However, if b5-09 = “1: Reverse Output”, the output of the PID function causes the motor to slow down when the feedback is below the setpoint. This is referred to as “reverse acting response.

No.	Parameter Name	Setting Range	Default
b5-09	PID Output Level Selection	0: Normal Output (direct acting) 1: Reverse Output (reverse acting)	0

■ b5-10: PID Output Gain Setting

Applies a multiplier to the output of the PID function. Using the gain can be helpful when the PID function is used to trim the frequency reference. Increasing b5-10 causes the PID function to have a greater regulating affect on the frequency reference.

No.	Parameter 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 reverse operation is allowed while using PID control (b5-01does not = 0) and the PID output goes negative.

No.	Parameter Name	Setting Range	Default
b5-11	PID Output Reverse Selection	0: Zero Limit (when PID output goes negative, the drive stops) 1: Drive reverses when PID turns negative	0

Note: When reverse operation is prohibited (b1-04 = 1), PID output is limited to 0.

PID Feedback Loss Detection

■ b5-12: PID Feedback Reference Missing Detection Selection

■ b5-13: PID Feedback Loss Detection Level

■ b5-14: PID Feedback Loss Detection Time

The PID Feedback Loss Detection function should be used whenever PID control is enabled. If the feedback signal is lost, the output frequency will rise up to the maximum output frequency.

No.	Parameter Name	Setting Range	Default
b5-12	PID Feedback Reference Missing Detection Selection	0 to 5	0
b5-13	PID Feedback Loss Detection Level	0 to 100	0%
b5-14	PID Feedback Loss Detection Time	0.0 to 25.5	1.0 s

When PID feedback is lost, the following operations may be selected:

Setting	Description
0	Disabled. No detection PID feedback loss.
1	Alarm. Detection PID feedback loss. Continues operating during detection without triggering a fault contact.
2	Fault. A fault is output and the drive coasts to stop.
3	PID Feedback error detection disabled. Multi-function output only, detected during PID control cancel input only.
4	PID Feedback error detection enabled. An alarm is triggered and the drive continues running. Detected only when PID control is canceled.
5	PID Feedback error detection enabled. Fault is triggered and output is shut off. Detected only when PID control is canceled.

Note: Drive continues operating when an alarm is issued. A stop command is automatically issued when fault situation is detected. To cancel PID, set one of the multi-function inputs H1-01through H1-07 to 19.

Detailed Description

- b5-12 = 0: An output will be triggered if the PID feedback value is below the detection level set to b5-13 for the time set in b5-14 when H2-☐☐ = 3E.
- b5-12 = 1: If the PID feedback value falls below the PID feedback loss detection level (b5-13) for longer than the PID feedback loss detection time (b5-14), a “FBL - Feedback Loss” alarm will be displayed drive will continue operation.
- b5-12 = 2: In the same situation described above, a “FBL - Feedback Loss” fault will be displayed and a stop command executed. The motor will coast to stop and a fault relay triggered.
- b5-12 = 3: If the PID feedback value exceeds the PID feedback loss detection level (b5-13) for longer than the PID feedback loss detection time (b5-14), a “FBL - Feedback Loss” alarm will be displayed and the drive will continue operation.
- b5-12 = 4: In the same situation described above, a “FBL - Feedback Loss” fault will be displayed and a stop command executed. The motor will coast to stop and a fault relay triggered.
- b5-12 = 5: When PID feedback loss is detected, “FbH” appears on the operator to indicate excessive PID feedback, and fault output is triggered. The drive will coast to stop.

The following time chart shows what happens when PID feedback is lost.

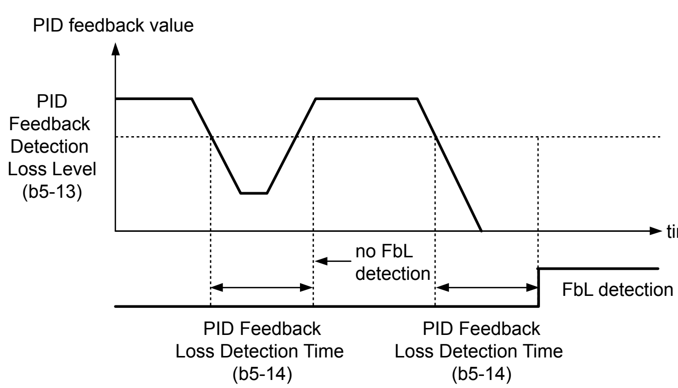


Figure 5.15 PID Feedback Loss Detection

PID Sleep

■ b5-15: PID Sleep Function Start Level

■ b5-16: PID Sleep Delay Time

The PID Sleep function stops the drive when the PID output value falls below the PID Sleep operation level. The drive will resume operating once the PID output value rises above the PID Sleep operation level for the specified time.

No.	Parameter Name	Setting Range	Default
b5-15	PID Sleep Function Start Level	0.0 to 400.0	0.0
b5-16	PID Sleep Delay Time	0.0 to 25.5	0.0

Detailed Description

- If the conditions that triggered the PID Sleep function continue and output fails to rise above the PID Sleep level, the drive will coast to stop.
- If the PID output rises above the PID Sleep level, the drive will automatically be restarted even though the PID Sleep delay time has not fully passed.
- PID Sleep is always enabled, even when PID control is disabled.

Note: Select the stopping method for the drive when PID Sleep is activated.

The figure below illustrates what happens when PID Sleep is triggered.

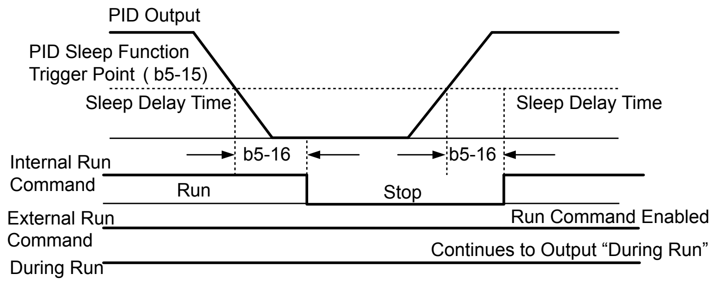


Figure 5.16 PID Sleep

b5-17: PID Accel/Decel Time

This is a soft start function that is applied to the PID setpoint analog input. Instead of having nearly instantaneous changes in signal levels, there is a programmed ramp applied to level changes. When changing setpoints the error can be limited by gradually ramping the setpoint through the use of parameter b5-17.

No.	Parameter Name	Setting Range	Default
b5-17	PID Accel/Decel Time	0 to 255	0

Note: Depending on the settings, resonance with the PID control and hunting in the machinery may occur because the acceleration and deceleration times set to the C1 parameters are allocated after PID control. Parameter b5-17 can be use to prevent such problems. The PID Soft Starter function can also be disabled or enabled by setting one of the multi-function digital inputs to 34.

b5-18: PID Setpoint Selection

b5-19: PID Setpoint Value

No.	Parameter Name	Setting Range	Default
b5-18	PID Setpoint Selection	0: Disabled 1: Enabled	0
b5-19	PID Setpoint Value	0.00 to 100.00	0.00

Sets the PID target value. Use only when b5-18 = 1.

If b5-18 = “0: Disabled”, then the PID Setpoint will either be the Modbus register 06H (provided register 0FH bit 1 is high), or the active frequency reference.

b5-20: PID Setpoint Scaling

Determines the units that the PID setpoint (b5-19) is set in and displayed. Also determines the units for monitors U5-01 and U5-04.

No.	Parameter Name	Setting Range	Default
b5-20	PID Setpoint Scaling	0: 0.01 Hz units 1: 0.01% units (100% of max output frequency) 2: r/min (set the motor poles) 3: User-set display (set using b5-38 and b5-39)	1

b5-34: PID Output Lower Limit

Sets the minimum output possible from the entire PID controller.

No.	Parameter Name	Setting Range	Default
b5-34	PID Output Lower Limit	-100.0 to 100.0	0.00

- Set as a percentage of the maximum frequency (E1-04).
- The lower limit is disabled when set to 0.0%.

b5-35: PID Input Limit

If the input value for PID control is high, the output will also be high. This parameter limits the input value.

No.	Parameter Name	Setting Range	Default
b5-35	PID Input Limit	0 to 1000.0	1000.0

- Set as a percentage of the maximum output frequency (E1-04).
  Acts as a bipolar limit.

■ b5-36: PID Feedback High Detection Level

Determines the level at which a PID feedback alarm occurs. The alarm is triggered when PID feedback exceeds the level specified in b5-36 for longer than the time designated in b5-37. When the alarm is triggered, “FbH” will appear on the operator and the drive will continue running. If the drive is set to trigger a fault, then a fault will be output through one of the multi-function output terminals and a stop command will be issued.

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

- Set as a percentage of the maximum frequency output (E1-04).

■ b5-37: PID Feedback High Detection Time

Determines the time in seconds for the PID feedback level to trigger PID Feedback High detection.

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

■ b5-38: PID Setpoint / User Display

Determines whether or not the PID value is shown when the maximum output frequency is reached. Enabled when b5-20 = 3.

No.	Parameter Name	Setting Range	Default
b5-38	PID Setpoint / User Display	0 to 60000	Determined by b5-20

■ b5-39: PID Setpoint and Display Digits

Determines the number of digits for setting and displaying the PID setpoint. Enabled when b5-20 = 3.

No.	Parameter Name	Setting Range	Default
b5-39	PID Setpoint and Display Digits	0: Integer 1: One decimal places 2: Two decimal places 3: Three decimal places	Determined by b5-20

◆ b6: Dwell Function

■ b6-01/b6-02: Dwell Reference/Time at Start

■ b6-03/b6-04: Dwell Reference/Time at Stop

The reference hold or Dwell function is used to temporarily hold the output frequency at a set reference, for a set time, and then continue to ramp up. This function can be used when driving a permanent magnet motor, or a motor with a heavy starting load. This pause in acceleration allows the magnets in a permanent magnet motor to synchronize with the stator field of the motor, thus reducing traditionally high starting current.

Note: Using the Dwell function requires that the stopping method for the drive be set to “Ramp to Stop” (b1-03 = 0).

No.	Parameter Name	Setting Range	Default
b6-01	Dwell Reference at Start	0.0 to 400.0	0.0 Hz
b6-02	Dwell Time at Start	0.0 to 10.0	0.0 s
b6-03	Dwell Reference at Stop	0.0 to 400.0	0.0 Hz
b6-04	Dwell Time at Stop	0.0 to 10.0	0.0 s

Detailed Description

The figure below illustrates how the Dwell function works.

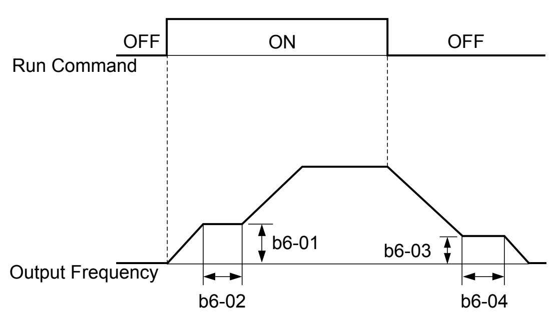


Figure 5.17 Dwell Function at Start and Stop

◆ b8: Energy Saving

The Energy Saving feature improves overall system operating efficiency by operating the motor at its most efficient level. This is accomplished by continuously monitoring the motor load and adjusting the motor terminal voltage so that the motor always operates near its rated slip frequency. A motor is most efficient when operating near rated slip conditions.

Note: Energy Saving is not appropriate for applications where the load may suddenly increase. Such applications should use derated torque.

■ b8-01: Energy Saving Control Selection

Enables the Energy Saving feature.

No.	Parameter Name	Setting Range	Default
b8-01	Energy Saving Control Selection	0: Disabled 1: Enabled	0

■ b8-02: Energy Saving Gain (requires Open Loop Vector)

The output voltage during Energy Saving operation is the product of the normal V/f settings (E1-03 to E1-13) and the Energy Saving gain. The output voltage decreases and recovers according to the Energy Saving control filter time constant b8-03. As the Energy Saving gain increases, the output voltage increases also.

No.	Parameter Name	Setting Range	Default
b8-02	Energy Saving Gain	0.00 to 10.0	0.7

■ b8-03: Energy Saving Control Filter Time Constant (requires Open Loop Vector)

Parameter b8-03 sets the response time for Energy Saving. Although lowering this value allows for a quicker response, instability may result if it is too low.

No.	Parameter Name	Setting Range	Default
b8-03	Energy Saving Control Filter Time Constant	0.00 to 10.00	Determined by o2-04

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

Parameter b8-04 is used to maximize motor efficiency. The default setting depends on the capacity of the drive, but can be adjusted in small amounts while viewing the kW monitor (U1-08) and running the drive to minimize the output kW.

A larger value typically results in less voltage to the motor and less energy consumption, but too large a value will cause the motor to stall.

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

Note: This default value changes if the motor rated capacity set to E2-11 is changed. The Energy Saving coefficient is set automatically when Energy Saving Auto-Tuning is performed (see the section on Auto-Tuning).

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

The Energy Saving function will search out the lowest output voltage in order to achieve minimum output power usage. Parameter b8-05 determines how often the output power (kW) is measured and the output voltage is adjusted.

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

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

Once Energy Savings is enabled and the optimal energy saving coefficient value has been set, the programmer can have the drive further search out the proper voltage to achieve the lowest output power by measuring the output power and making minute changes to the output voltage.

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

Detailed Description

Limits the output voltage to make sure that the output power stays just above the minimum value.

Note: If set too high, the motor may stall with a sudden increase to the load. Disabled when b8-06 = 0. Setting this value to 0 does not disable Energy Saving.

Related Parameters

No.	Parameter Name	Setting Range	Default
E2-02*3	Motor Rated Slip	0.00 to 20.00	*1
E2-11*2	Motor Rated Capacity	0.00 to 650.00 kW	*1

*1. Default setting is determined by drive capacity (o2-04).
*2. Automatically set when Auto-Tuning is performed.
*3. Automatically set when Rotational Auto-Tuning is performed.

5.3 C: Tuning

C parameters control various aspects of how the drive accelerates and decelerates the motor. This includes S-curve, slip compensation, torque compensation and carrier frequency.

◆ C1: Acceleration and Deceleration Times

■ C1-01 to C1-08: Accel/Decel Times 1 to 4

C1-01 (Acceleration Time 1) sets the time to accelerate from 0 to the maximum output frequency (E1-04). C1-02 (Deceleration Time 1) sets the time to decelerate from maximum output frequency to 0. C1-01 and C1-02 are the default active accel/decel settings.

No.	Parameter Name	Setting Range	Default
C1-01	Acceleration Time 1	0.0 to 6000.0*	10.0 s
C1-02	Deceleration Time 1		
C1-03	Acceleration Time 2		
C1-04	Deceleration Time 2		
C1-05	Acceleration Time 3 (Motor 2 Accel Time 1)		
C1-06	Deceleration Time 3 (Motor 2 Decel Time 1)		
C1-07	Acceleration Time 4 (Motor 2 Accel Time 2)		
C1-08	Deceleration Time 4 (Motor 2 Accel Time 2)		

*The setting range for the acceleration and deceleration times is determined by C1-10 (Accel/Decel Time Setting Units). For example, if the time is set in units of 0.01 s (C1-10 = 0), the setting range becomes 0.00 to 600.00 s.

Detailed Description

C1-01 and C1-02 are the factory default active accel/decel "pair". Other accel/decel pairs (C1-03 to C1-08) exist that can be activated by a multi-function digital input (H1-☐☐ = 7 and 1A). Alternatively, the active accel/decel pair can be switched from accel/decel pair 1 (C1-01 and C1-02) to accel/decel pair 4 (C1-07 and C1-08) by a switch over frequency as programmed in parameter C1-11.

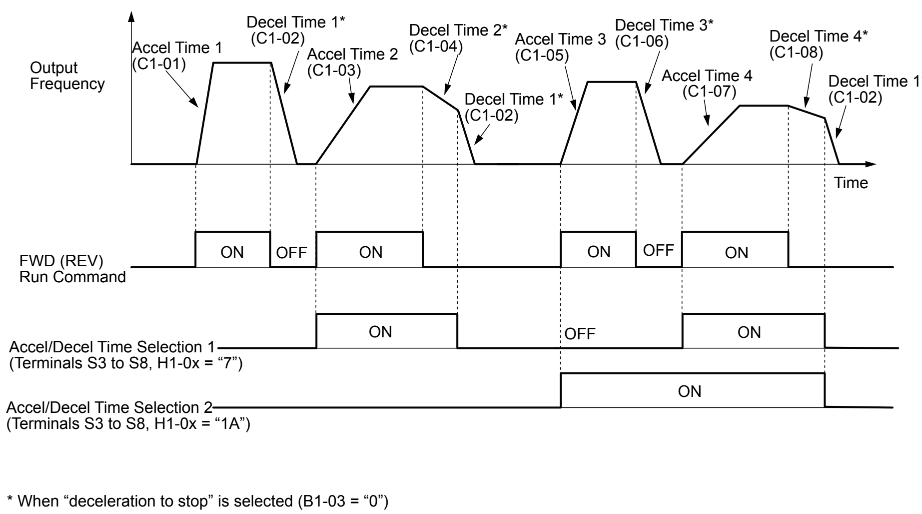


Figure 5.18 Timing Diagram of Accel/Decel Time Change

Ramp to Stop (b1-03 = 0)

Accel/Decel Time Selection 1 Multi-Function Input Setting = "7"	Accel/Decel Time Selection 2 Multi-Function Input Setting = "1A"	Acceleration Time	Deceleration Time
Open or not set	Open or not set	C1-01	C1-02
Closed	Open or not set	C1-03	C1-04
Open or not set	Closed	C1-05	C1-06
Closed	Closed	C1-07	C1-08

■ C1-09: Fast Stop Time

A special deceleration parameter is available for use with emergency or fault operations. Parameter C1-09 will set a special deceleration that can be operated by closing a digital input configured as H1-☐☐ = 15 or H1-☐☐ = 17. A digital input configured as H1-☐☐ = 15 will look for a switch closure before initiating the Fast Stop operation. A digital input configured as H1-☐☐ = 17 will look for the switch opening before initiating the Fast Stop operation.

No.	Parameter Name	Setting Range	Default
C1-09	Fast Stop Time	0.0 to 6000.0*	10.0 s

*Unlike a standard deceleration time, once the Fast Stop operation is initiated even momentarily, the drive cannot be re-operated until the deceleration is complete, the Fast Stop input is cleared, and the run command is cycled.

■ C1-10: Accel/Decel Time Setting Units

Determines the units for the acceleration and deceleration times set to C1-01 through C1-09 using parameter C1-10. If any of the parameters C1-01 to C1-09 are set to 600.1 seconds or more, then C1-10 cannot be set to 0.

No.	Parameter Name	Setting Range	Default
C1-10	Accel/Decel Time Setting Units	0: Sets the accel/decel times in units of 0.01 s, making the setting range 0.00 to 600.00 s. 1: Sets the accel/decel times in units of 0.1 s, making the setting range 0.0 to 6000.0 s.	1

■ C1-11 Accel/Decel Switch Frequency

C1-11 allows the drive to switch automatically between the acceleration and deceleration times set to C1-01/C1-02 and C1-07/C1-08.

No.	Parameter Name	Setting Range	Default
C1-11	Accel/Decel Switch Frequency	0.0 to 400.0	0.0 Hz

Detailed Description

When the output frequency reaches the value set to C1-11, the drive will switch acceleration and deceleration times as shown in the graph below.

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

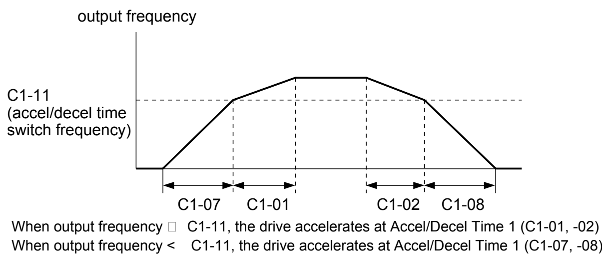


Figure 5.19 Accel/Decel Time Switching Frequency

Acceleration time sets the time necessary for the output frequency to accelerate from 0Hz to maximum output frequency (E1-04). Deceleration time sets the time necessary for the output frequency to decelerate from the maximum output frequency (E1-04) to 0 Hz.

C1-01 and C1-02 make up the default active accel/decel "pair". Other accel/decel pairs (C1-03 to C1-08) exist that can be activated by a multi-function digital input (H1-□□ = 7 and 1A). Alternatively, the active accel/decel pair can be switched from first accel/decel pair (C1-01 and C1-02) to the fourth accel/decel pair (C1-07 and C1-08) by a switch over frequency as programmed in parameter C1-11.

Motor 1 and 2 combinations with Accel/Decel Time 1 are shown in the table below. It is not possible to combine Accel/Decel Time 2 and motor switching at the same time (this would trigger an oPE03 error, indicating a contradictory multi-function input settings).

Table 5.1 Motor Switching and Accel/Decel Time Combinations

Accel/Decel Time 1 (H1-oo = 7)	Output Frequency	Status	Motor 1 Selection	Motor 2 Selection
Open	C1-11 or above	**Accel**	C1-01	C1-05
Open	C1-11 or above	**Decel**	C1-02	C1-06
Open	less than C1-11	**Accel**	C1-07	C1-07
Open	less than C1-11	**Decel**	C1-08	C1-08
Closed	C1-11 or above	**Accel**	C1-03	C1-07
Closed	C1-11 or above	**Decel**	C1-04	C1-08
Closed	less than C1-11	**Accel**	C1-03	C1-07
Closed	less than C1-11	**Decel**	C1-04	C1-08

◆ C2: S-Curve Characteristics

Using S-curve characteristics to smooth acceleration and deceleration minimizes abrupt shock to the load. If a STo fault (Hunting Detection 2) occurs when starting a PM motor, try increasing the value set to C2-01.

■ C2-01 to C2-04: S-Curve Characters

C2-01 through C2-04 set each part of the S-curve.

No.	Parameter Name	Setting Range	Default
C2-01	S-Curve Characteristic at Accel Start	0.00 to 10.00 s	Determined by A1-02
C2-02	S-Curve Characteristic at Accel End		0.20 s
C2-03	S-Curve Characteristic at Decel Start		
C2-04	S-Curve Characteristic at Decel End		0.00 s

The S-curve transition into and out of the active acceleration rate can be programmed independently.

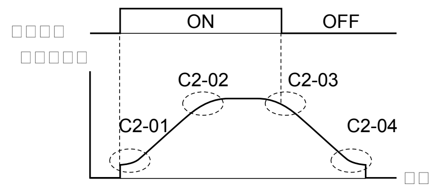


Figure 5.20 S-Curve Characteristics Timing Diagram

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

Detailed Description

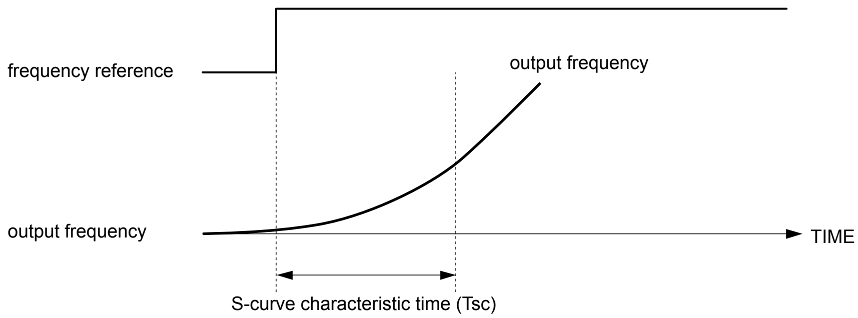


Figure 5.21 S-Curve Characteristic Timing Diagram

Acceleration and deceleration times increase with S-curve characteristics:

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

Actual decel = decel time setting + (C2-03 + C2-04)/2

S-curve characteristics when switching between forward and reverse are shown in the illustration below.

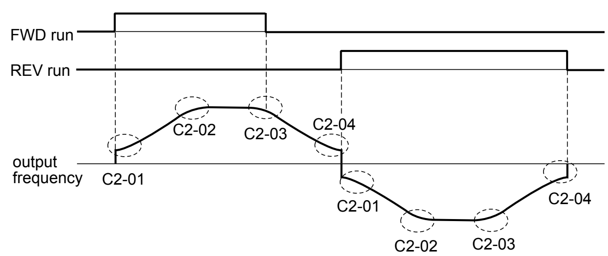


Figure 5.22 S-Curve Timing Diagram - FWD/REV Operation

◆ C3: Slip Compensation

■ C3-01: Slip Compensation Gain

This parameter is used to increase motor speed to account for motor slip by boosting the output frequency. If the speed is lower than the frequency reference, increase C3-01. If the speed is higher than the frequency reference, decrease C3-01. Although this parameter rarely needs to be changed, adjustments might be needed under the following situations:

- If the speed is lower than the frequency reference, increase C3-01.
- If the speed is higher than the frequency reference, decrease C3-01.

No.	Parameter Name	Setting Range	Default
C3-01	Slip Compensation Gain	0.0 to 2.5	Determined by A1-02

Note: Default setting is 0.0 in V/f Control (A1-02 = 0). Default setting is 1.0 in Open Loop Vector Control (A1-02 = 2). This parameter is disabled when using Simple PG in V/f (H6-01 = 3).

■ C3-02: Slip Compensation Primary Delay Time

Adjusts the filter on the output of the slip compensation function. Increase to add stability, decrease to improve response. This parameter rarely needs to be changed from its default setting.

- Decrease the setting when the slip compensation response is too slow.
- Increase this setting when the speed is not stable.

No.	Parameter Name	Setting Range	Default
C3-02	Slip Compensation Primary Delay Time	0 to 10000	Determined by A1-02

Note: When using V/f Control (A1-02 = 0), the default setting becomes 2000 ms. When using Open Loop Vector Control (A1-02 = 2), the default setting becomes 200 ms. This function is not available when using Simple PG in V/f.

C3-03: Slip Compensation Limit

Sets the upper limit for the slip compensation function as a percentage of the motor rated slip (E2-02).

No.	Parameter Name	Setting Range	Default
C3-03	Slip Compensation Limit	0 to 250	200%

Although the slip compensation limit is constant throughout the torque range, the following diagram shows how it works with constant torque.

Note: This parameter is disabled when using Simple PG in V/f Control (H6-01 = 3).

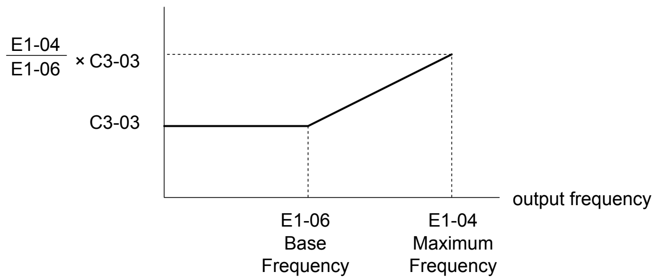


Figure 5.23 Slip Compensation Limit

C3-04: Slip Compensation Selection during Regeneration

When the slip compensation during regeneration function has been activated and regeneration capacity increases momentarily, it might be necessary to use a braking option (braking resistor, braking resistor unit or braking unit.)

Even if enabled, this function does not operate when output frequency is too low.

No.	Parameter Name	Setting Range	Default
C3-04	Slip Compensation Selection during Regeneration	0: Disabled 1: Enabled	0

C3-05: Output Voltage Limit Operation Selection

Determines if the motor flux is automatically reduced when output voltage saturation occurs.

No.	Parameter Name	Setting Range	Default
C3-05	Output Voltage Limit Operation Selection	0: Disabled 1: Enabled	0

C4: Torque Compensation

C4-01: Torque Compensation Gain

C4-02: Torque Compensation Primary Delay Time

The Torque Compensation function compensates for insufficient torque production at start-up and during low speed operation. The drive will detect increases in the motor load by monitoring the output current and compensate by increasing the output voltage. The increased output voltage leads to an increase in usable torque.

Torque Compensation in V/f Control:

The drive calculates the motor primary loss voltage using the terminal resistance value (E2-05) and adjusts the output voltage to compensate insufficient torque at start and during low-speed operation. The compensation voltage is calculated by multiplying the motor primary voltage loss times parameter C4-01.

Torque Compensation in Open Loop Vector Control:

The drive calculates motor excitation current and torque producing current, controlling them separately. Torque compensation affects the torque producing current only. Torque producing current is calculated by multiplying the torque reference times C4-01.

No.	Parameter Name	Setting Range	Default
C4-01	Torque Compensation Gain	0.00 to 2.50	Determined by A1-02
C4-02	Torque Compensation Primary Delay Time	0 to 60000	Determined by A1-02

Detailed Description

Sets amount of gain for torque compensation. This parameter rarely needs to be changed, but adjustment may help in the following situations:

- Increase this setting when using a long motor cable.
- Increase when the motor is significantly smaller than the drive capacity.
- Decrease this setting when motor oscillation occurs.

Note: Adjust the range so that the output current does not exceed the drive's current rating when operating at low speeds.

C4-02 is used to the primary delay time in milliseconds for torque compensation. Although C4-02 rarely needs to be changed, adjustments can be made as follows:

- If the motor vibrates, increase C4-02

Parameter Details

5

- If the motor response is sluggish (and possibly stalls), decrease C4-02.

Note: Auto-Tuning significantly improves drive performance at low speeds.

■ C4-03: Torque Compensation at Forward Start (OLV only)

Sets the amount of torque at start (when rotating forward) as a percentage of the motor rated torque. This parameter may improve the motor performance during start. This feature functions only when starting a motor in the forward direction. Torque reference and motor flux can be ramped up quickly to improve speed response during start. A setting of 0.0 disables this feature.

No.	Parameter Name	Setting Range	Default
C4-03	Torque Compensation at Forward Start	0.0 to 200.0	0.0%

■ C4-04: Torque Compensation at Reverse Start (V/f Control)

This parameter may improve the motor performance during start. This feature functions only when starting a motor in the reverse direction. Torque reference and motor flux can be ramped up quickly to improve speed response during start. A setting of 0.0 disables this feature.

No.	Parameter Name	Setting Range	Default
C4-04	Torque Compensation at Reverse Start	-200.0 to 0.0	0.0%

■ C4-05: Torque Compensation Time Constant (OLV only)

This parameter is the time delay that will be applied to the torque compensation parameters C4-03 and C4-04.

No.	Parameter Name	Setting Range	Default
C4-05	Torque Compensation Time Constant	0 to 200	10 ms

■ C4-06: Torque Compensation Primary Delay Time 2 (V/f Control)

Increase settings when acceleration is complete, or if an overvoltage fault or error occurs with sudden changes in the load. Adjustment is not normally required.

No.	Parameter Name	Setting Range	Default
C4-06	Torque Compensation Primary Delay Time 2	0 to 10000	150 ms

Note: If C4-06 is set to a relatively large value, be sure to also increase the setting in n2-03 (AFR Time Constant 2) proportionally.

◆ C5: ASR

The automatic speed regulator (ASR) provides optimum performance during changes in motor speed or load by using speed feedback.

Note: C5 parameters will appear only when using V/f Conrol (A1-02 = 0) and the Pulse Train function is set to allow Simple PG in V/f (H6-01 = 3).

No.	Parameter Name	Setting Range	Default	Page
A1-02	Control Method Selection	0: V/f Control 2: Open Loop Vector 5: PM Open Loop Vector	0	–
H6-01	Terminal RP Pulse Train Input Function Selection	Selects the function of pulse train terminal RP. 0: Frequency reference 1: PID feedback value 2: PID setpoint value 3: Motor speed when using Simple PG V/f Control (can be set only when using motor 1 in V/f Control)	0	–

The figure below illustrates how speed control works when using Simple PG in V/f.

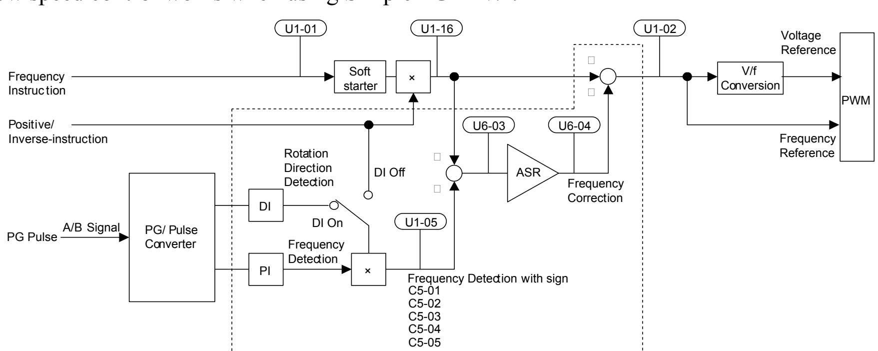


Figure 5.24 Speed Control Using Simple V/f with PG

■ C5-01/C5-03: ASR Proportional Gain 1/2 (Simple PG in V/f)

■ C5-02/C5-04:ASR Integral Time 1/2 (Simple PG in V/f)

C5-01 adjusts the speed in response to speed deviation, and softens the effect of changes in load. Speed response increases as the proportional gain is increased. However, the load may become unstable if the ASR proportional gain is set too high. ASR Proportional Gain 2 is an additional proportional gain adjustment that can be enabled by either a multi-function contact input (H1-□□ = 77) or the ASR switching frequency (C5-07).

C5-02 adjusts the drive’s response time to changes in load. Speed response increases as the integral time is decreased. However, the load may become unstable if the ASR integral time is set too low. ASR Integral Time 2 is an additional integral time adjustment that can be enabled by the ASR switching frequency (C5-07).

No.	Parameter Name	Setting Range	Default
C5-01	ASR Proportional Gain 1 (for Simple PG in V/f)	0.00 to 300.00	0.20
C5-02	ASR Integral Time 1 (for Simple PG in V/f)	0.000 to 10.000	0.200
C5-03	ASR Proportional Gain 2 (for Simple PG in V/f)	0.00 to 300.00	0.02
C5-04	ASR Integral Time 2 (for Simple PG in V/f)	0.000 to 10.000	0.050

Detailed Description

Both the proportional gain P and integral time I for ASR should be set in accordance with the minimum output frequency and the maximum output frequency.

The figure below illustrates how the proportional gain P and integral time I change linearly with motor speed.

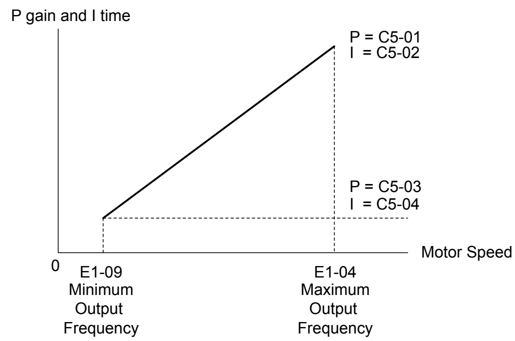


Figure 5.25 Adjusting ASR Proportional Gain and Integral Time

■ C5-05: ASR Limit

Sets ASR frequency compensation limit as a percentage of maximum output frequency (E1-04).

No.	Parameter Name	Setting Range	Default
C5-05	ASR Limit	0.0 to 20.0	5.0%

◆ C6: Carrier Frequency

■ C6-01: Drive Duty Mode Selection

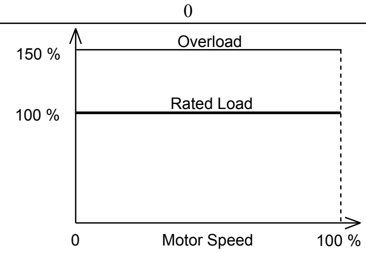
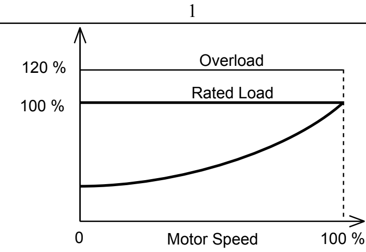
The drive has two different duty modes which must be selected based on the load characteristics. The drives rated current, overload capability and the stall prevention levels during acceleration will change depending on the duty mode selection. Heavy Duty allows over load up to 150% for 1 min, Normal Duty allows up to 120% for 1 min. but therefore the drives rated current is higher. Refer to the Specifications section in this manual for details about the rated current.

No.	Parameter Name	Setting Range	Default
C6-01	Duty Cycle	Selects the load rating for the drive. 0: Heavy Duty, HD (low carrier frequency and constant torque) 1: Normal Duty, ND (high carreir frequency and derated torque)	1

Detailed Description

Set the drive for the type of load using parameter C6-01 (Duty Cycle). The factory setting is Normal Duty

Heavy Duty (HD) vs. Normal Duty (ND) Mode Selections

Mode	Heavy Duty Rating (HD)	Normal Duty Rating (ND)
C6-01	0	1
Characteristics		
Application	Use Heavy Duty Rating is designed applications requiring a high overload tolerance with constant load torque. Such applications include extruders, conveyors and cranes.	Use Normal Duty Rating for applications in which the torque requirements drop along with the speed. Examples include fans or pumps where a high overload tolerance is not required.
Overload capability (OL2)	150% of drive rated current for 60 s	120% of drive rated current for 60 s
L3-02 Stall Prevention during Acceleration	150%	120%

Mode	Heavy Duty Rating (HD)	Normal Duty Rating (ND)
L3-06 Stall Prevention during Run	150%	120%

Setting varies based on the carrier frequency selection (L8-38).

■ C6-02: Carrier Frequency Selection

Parameter C6-02 sets the switching frequency of the drive's output transistors. It can be changed in order to reduce audible noise and also reduce leakage current.

No.	Parameter Name	Setting Range	Default
C6-02	Carrier Frequency Selection	1: 2.0 kHz 2: 5.0 kHz 3: 8.0 kHz 4: 10.0 kHz 5: 12.5 kHz 6: 15.0 kHz 7: Swing PWM1 8: Swing PWM2 9: Swing PWM3 A: Swing PWM4	Determined by the control method (A1-02) and drive capacity (o2-04). Reset when C6-01 is changed.

Note: Swing PWM uses low carrier frequency but by applying special PWM patterns the audible noise of the motor is kept low.

Detailed Description

Use the following guideline to set up the carrier frequency:

Symptom	Remedy
Speed and torque are unstable at low speeds.	Lower the carrier frequency.
Noise from the drive is affecting peripheral devices.	
Excessive leakage current from the drive.	
Wiring between the drive and motor is too long.*	
Motor acoustic noise is too loud.	Increase the carrier frequency or use Swing PWM.
The carrier frequency may need to be lowered if the motor cable is too long. Refer to the table below.	

Wiring Distance	Up to 50 m	Up to 100 m	Greater than 100 m
C6-02 (Carrier Frequency Selection)	0 to 6 (15 kHz)	0 to 4 (10 kHz)	1, 7 to A (2 kHz)

Note: If the motor cable is fairly long when using PM Open Loop Vector, set the carrier frequency to 2 kHz (C6-02 = 1). Switch to V/f Control if the cable is longer than 100 m.

Note: Settings 7 through A use "Swing PWM", equivalent to setting 2 kHz. This function turns the motor noise into less obtrusive white noise. The upper limit for the carrier frequency is determined by drive capacity. A high carrier frequency is fine when using the drive is set for Normal Duty. When setting the carrier frequency higher than the default value with the drive set for Normal Duty, be sure to lower the setting for the drive's output current. For more details on how to lower this setting, please contact Yaskawa.

■ C6-03: Carrier Frequency Upper Limit

■ C6-04: Carrier Frequency Lower Limit

■ C6-05: Carrier Frequency Proportional Gain

The upper and lower limits for the carrier frequency can be set when using V/f Control to operate the drive. To set the upper and lower limits, first make sure that C6-02 = F.

Note: The carrier frequency is can be adjusted only when using V/f Control.

No.	Parameter Name	Setting Range	Default
C6-03*	Carrier Frequency Upper Limit	1.0 kHz to 15.0 kHz	Determined by C6-02
C6-04*	Carrier Frequency Lower Limit	1.0 kHz to 15.0 kHz	
C6-05	Carrier Frequency Proportional Gain	0 to 99	

The default value is determined by the control method (A1-02) as well as the drive capacity (o2-04), and is reinitialized when the value set to C6-01 is changed.

Detailed Description

In V/f Control the carrier frequency can be set up to change linearly with the output frequency. In this case the upper and lower limits for the carrier frequency and the carrier frequency proportional gain (C6-03, C6-04, C6-05) have to be set up like shown *Figure 5.26* .

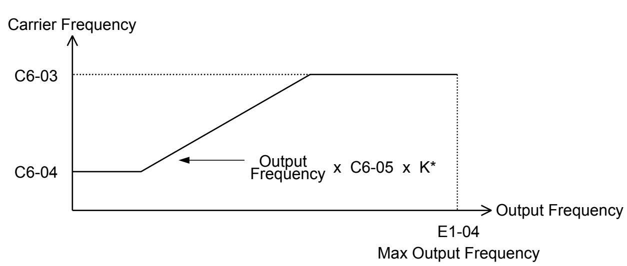


Figure 5.26 Carrier Frequency Changes Relative to Output Frequency

*K is a coefficient determined by the value of C6-03. C6-03 greater than or equal to 10.0 kHz: K=3 10.0 kHz > C6-03 greater than or equal to 5.0 kHz: K=2 5.0 kHz > C6-03: K=1

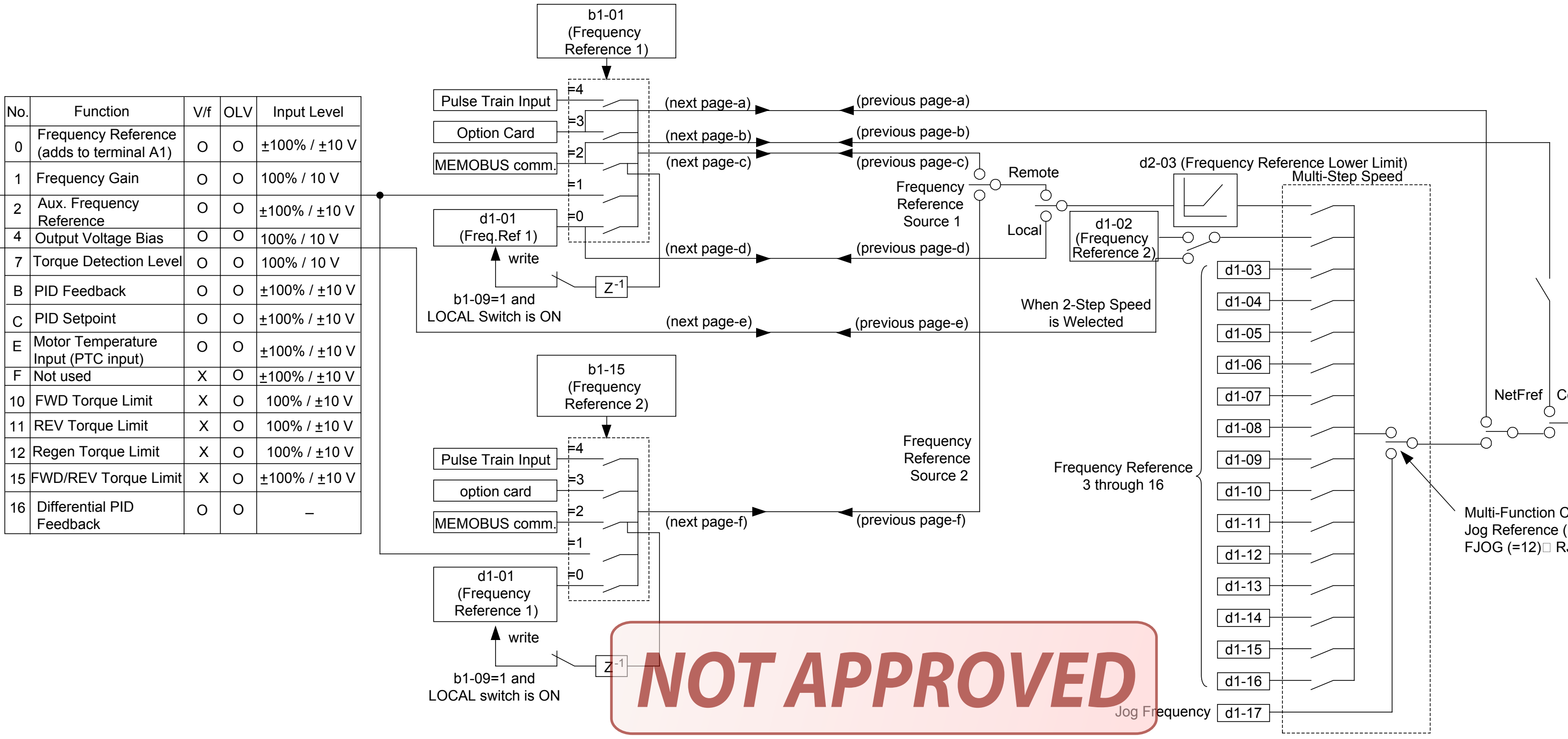
Note: A carrier frequency error (oPE11) will occur when the carrier frequency proportional gain is greater than 6 while C6-03 is less than C6-04.

Table 5.2 Carrier Frequency Default Values

CIMR-V☐	C6-02: Carrier Frequency Selection	C6-03: Carrier Frequency Upper Limit (kHz)
Single-Phase 200 V Class: Normal Duty Rating (ND)		
B0001	7 (Swing PWM1)	2.0
B0002	7 (Swing PWM1)	2.0
B0003	7 (Swing PWM1)	2.0
B0006	7 (Swing PWM1)	2.0
B0010	7 (Swing PWM1)	2.0
B0012	7 (Swing PWM1)	2.0
B0020	7 (Swing PWM1)	2.0
Single-Phase 200 V Class: Heavy Duty Rating (HD)		
B0001	4 (10.0 kHz)	10.0

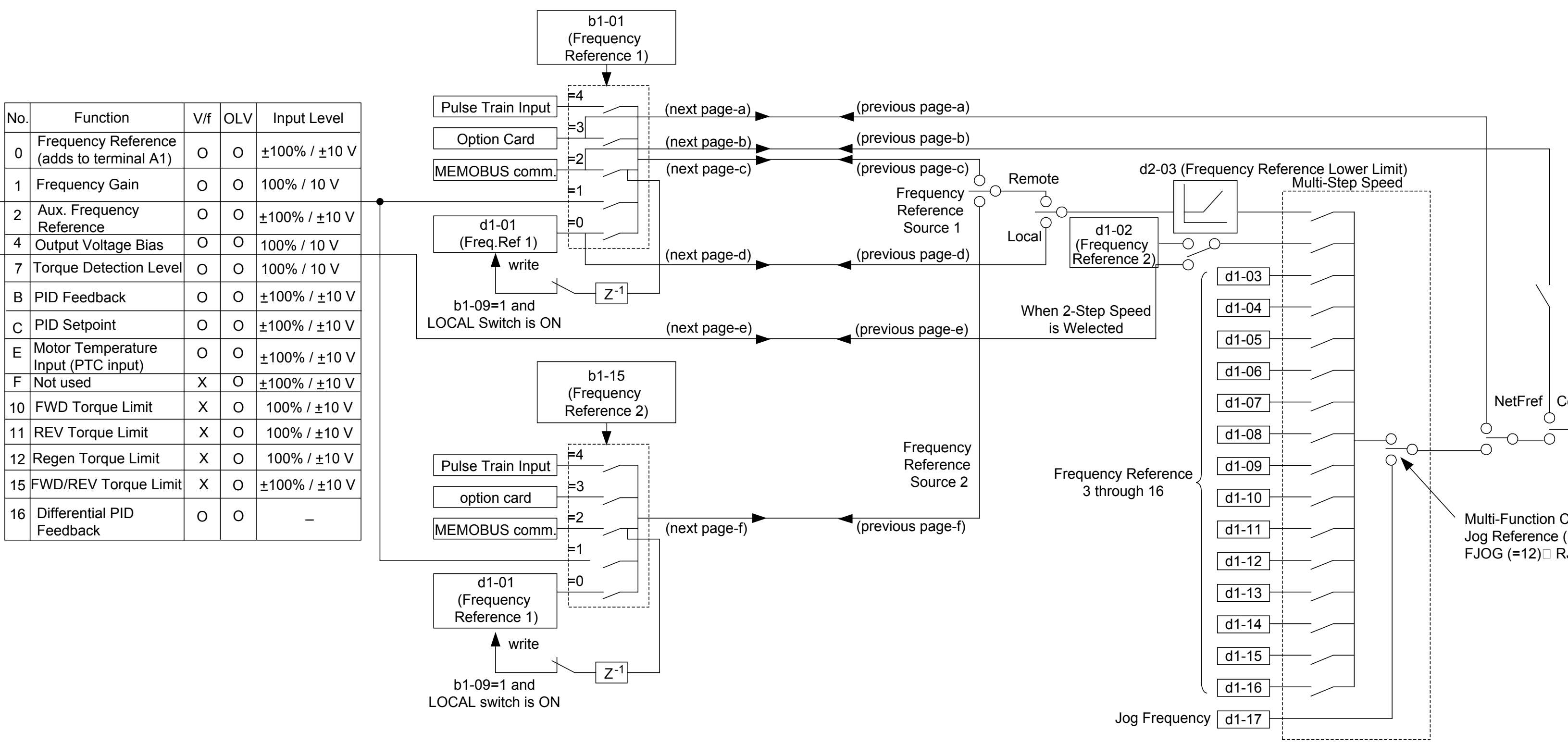
5.4 d: Reference Settings

Sets the various references the drive uses to control the motor. The following figure shows how the various frequency references work.



No.	Function	V/f	OLV	Input Level
0	Frequency Reference (adds to terminal A1)	O	O	±100% / ±10 V
1	Frequency Gain	O	O	100% / 10 V
2	Aux. Frequency Reference	O	O	±100% / ±10 V
4	Output Voltage Bias	O	O	100% / 10 V
7	Torque Detection Level	O	O	100% / 10 V
B	PID Feedback	O	O	±100% / ±10 V
C	PID Setpoint	O	O	±100% / ±10 V
E	Motor Temperature Input (PTC input)	O	O	±100% / ±10 V
F	Not used	X	O	±100% / ±10 V
10	FWD Torque Limit	X	O	100% / ±10 V
11	REV Torque Limit	X	O	100% / ±10 V
12	Regen Torque Limit	X	O	100% / ±10 V
15	FWD/REV Torque Limit	X	O	±100% / ±10 V
16	Differential PID Feedback	O	O	–

Figure 5.27 Frequency Reference Setting Hierarchy



◆ d1: Frequency Reference

■ d1-01 to d1-16: Frequency Reference 1 to 16

■ d1-17: Jog Frequency Reference

Up to 17 preset references (including Jog Reference) can be set through multi-function inputs S3 to S8.

No.	Parameter Name	Setting Range	Default
d1-01 to d1-16	Frequency Reference 1 to 16	0.00 to 400.00*	0.00 Hz
d1-17	Jog Frequency Reference	0.00 to 400.00*	6.00 Hz

Note: The upper limit is determined by the maximum outupt frequency (E1-04) and upper limit for the frequency reference (d2-01).

Detailed Description

To set up 17 separate steps for the speed reference, assign Multi-Step Speed functions to H1-01 to H1-07 (these parameters control the functions set to terminals S1 to S7).

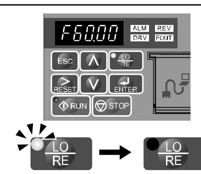
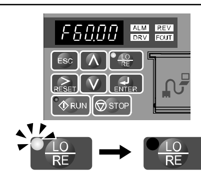
Note: Terminal S5 needs to be set for Multi-Step Speed 1 (H1-05 = 3), and terminal S6 needs to be set for Multi-Speed Step 2 (H1-06 = 4). To have the drive accelerate as shown in the Multi-Step Speed operation shown in this section, parameters need to be changed from their default values as described. Because the Jog Frequency is already assigned to terminal S7 as a default (H1-07 = 6), this setting does not need to be changed.

The drive is defaulted for a 2-step speed operation via the analog input terminals. To enable Multi-Step Speed 1 and 2, set the drive as shown below.

No.	Parameter Name	Setting Range	Default	Page
b1-01	Frequency Reference Selection	0 to 4	1	–
H3-10	Terminal A2 Function Selection	0 to 31	0	–

Procedure

Follow the directions below to set the drive up for Multi-Step Speed operation (allows 17 steps). The example assumes the drive is operating in REMOTE mode using an analog signal.

	Step		Display/Result
1.	Power up the drive. Assign the source of the frequency reference to the LED operator (b1-02 = 1). The run command should already be defaulted to the control circuit terminal (b1-02 = 1). Set multi-function analog input terminal A2 to "Not Used" (H3-10 = F).	⇒	
2.	Set the desired frequencies to d1-01 through d1-16.		
3.	Set the desired Jog Frequency value to d1-17.		
4.	Set multi-function input terminals S3 through S6 for Multi-Step Speed 1 to 4 (H1-03 = 3, H1-04 = 4, H1-05 = 5, H1-06 = 32).		
5.	After setting frequency refrences, press ESC to scroll back to the main screen. The DRV LED should light.	⇒	
6.	Press LO/RE to select REMOTE. The LO/RE light will come on.	⇒	
7.	The drive will run the motor at the frequencies set to parameters d1-01 through d1-17, selecting each frequency reference according to the switching combination of multi-function input terminals S3 through S7. This allows for 17 separate speed steps (including the Jog Frequency).	⇒	

Different frequency references can be given to the drive through various switching combinations of multi-function input terminals S3 through S7. Below is a list of the possible combinations.

Table 5.3 Multi-Step Speed Reference and Terminal Switch Combinations

d1-01 to d1-17	Multi-StepSpeed	Multi-StepSpeed 2	Multi-StepSpeed 3	Multi-StepSpeed 4	Jog Reference	Reference
1	OFF	OFF	OFF	OFF	OFF	Frequency Reference 1 (d1-01)
2	ON	OFF	OFF	OFF	OFF	Frequency Reference 2 (d1-02)
3	OFF	ON	OFF	OFF	OFF	Frequency Reference 3 (d1-03)
4	ON	ON	OFF	OFF	OFF	Frequency Reference 4 (d1-04)
5	OFF	OFF	ON	OFF	OFF	Frequency Reference 5 (d1-05)
6	ON	OFF	ON	OFF	OFF	Frequency Reference 6 (d1-06)
7	OFF	ON	ON	OFF	OFF	Frequency Reference 7 (d1-07)
8	ON	ON	ON	OFF	OFF	Frequency Reference 8 (d1-08)
9	OFF	OFF	OFF	ON	OFF	Frequency Reference 9 (d1-09)
10	ON	OFF	OFF	ON	OFF	Frequency Reference 10 (d1-10)
11	OFF	ON	OFF	ON	OFF	Frequency Reference 11 (d1-11)
12	ON	ON	OFF	ON	OFF	Frequency Reference 12 (d1-12)
13	OFF	OFF	ON	ON	OFF	Frequency Reference 13 (d1-13)
14	ON	OFF	ON	ON	OFF	Frequency Reference 14 (d1-14)
15	OFF	ON	ON	ON	OFF	Frequency Reference 15 (d1-15)
16	ON	ON	ON	ON	OFF	Frequency Reference 16 (d1-16)
17 Jog	–	–	–	–	ON	Jog Frequency Reference (d1-17)*

*The Jog Frequency overrides whatever frequency reference is being used.

Parameter Details 5

Note the following when using the Multi-Step Speed function:

- As shown in the table above, it is possible to use analog inputs in place of Frequency Reference 1 and 2.
- If b1-01 = 1, then the analog input A1 will be used instead of Frequency Reference 1 (d1-01) for the first preset speed.
- If b1-01 = 0 then Frequency Reference 1 (d1-01) will be used.
- When H3-10 = 2, then the value input to terminal A2 will be used as the Multi-Step Speed 2 instead of the value set to parameter d1-02. When H3-10 does not equal 2, then d1-02 becomes the reference for Multi-Step Speed 2.

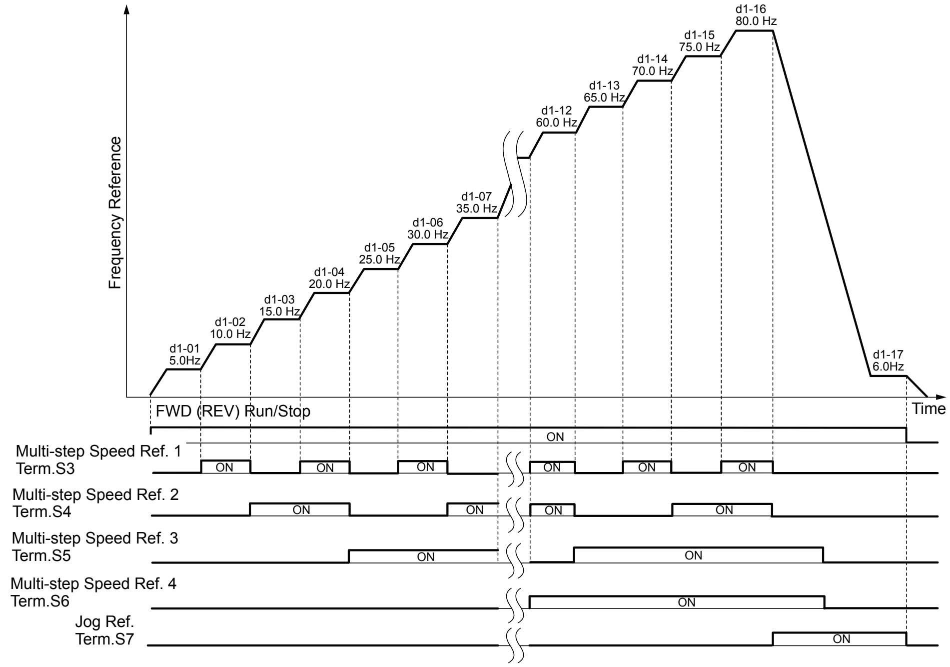


Figure 5.28 Preset Reference Timing Diagram

◆ d2: Frequency Upper/Lower Limits

By entering upper or lower frequency limits, the drive programmer can prevent operation of the Drive above or below levels that may cause resonance and or equipment damage.

■ d2-01: Frequency Reference Upper Limit

Sets the highest frequency that the motor is able to rotate at. This limit applies to all frequency references.

Parameter d2-01 is set as a percentage of the maximum output frequency. Even if the frequency reference is set to a higher value, the drive internal frequency reference will not exceed this value.

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

■ d2-02: Frequency Reference Lower Limit

Sets the lowest frequency that the motor is able to rotate at. This limit applies to all frequency references.

Determines the minimum frequency that the drive can output as a percentage of the maximum output frequency.

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

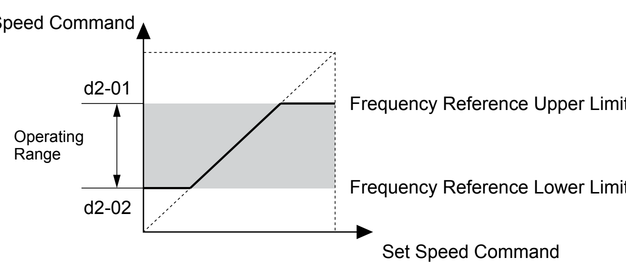


Figure 5.29 Frequency Reference: Upper and Lower Limits

■ d2-03: Master Speed Reference Lower Limit

Unlike frequency reference lower limit (d2-02) which will affect the frequency reference no matter where it is sourced from (i.e., analog input, preset speed, Jog speed, etc.), the frequency reference lower limit (d2-03) sets a low speed threshold that will only affect the analog input (terminals A1 and A2) that is the active master speed frequency.

Set as a percentage of the maximum output frequency.

Note: The lower limits for the Jog frequency, multi-step speed settings, and 2-step speed settings do not change. When lower limits are set to both the frequency reference (d2-02) and the main frequency reference (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

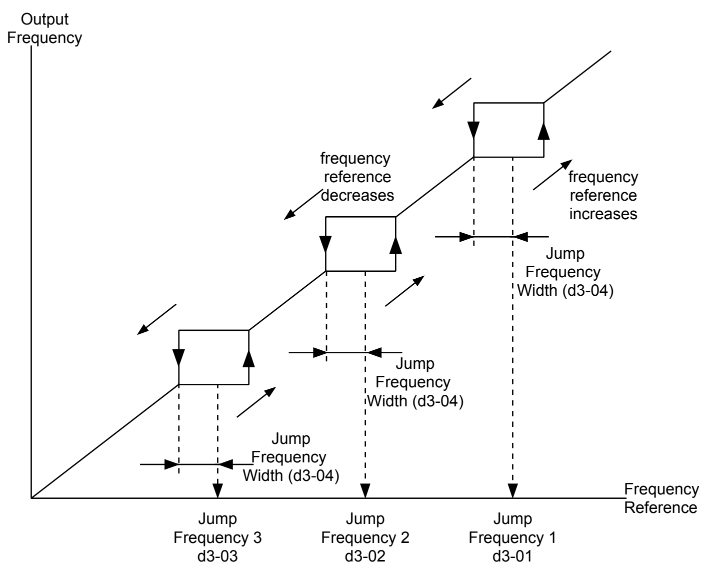
■ d3-04: Jump Frequency Width

In order to avoid continuous operation at a speed that causes resonance in driven machinery, the drive can be programmed with Jump Frequencies that will not allow continued operation within specific frequency ranges. If a speed is commanded that falls within a dead band, or Jump Frequency, the drive will clamp the frequency reference just below the dead band and only accelerate past it when the commanded speed rises above the upper end of the dead band, for increasing references.

No.	Parameter Name	Setting Range	Default
d3-01	Jump Frequency 1	0.0 to 400.0	0.0 Hz
d3-02	Jump Frequency 2		0.0 Hz
d3-03	Jump Frequency 3		0.0 Hz
d3-04	Jump Frequency Width	0.0 to 20.0	1.0 Hz

Detailed Description

The figure below shows the relationship between the Jump Frequency and the output frequency.



Note: The drive will not operate within the specified deadband range for the Jump Frequency. Although the drive quickly accelerates (or decelerates) the motor through the Jump Frequency frequency range, it still maintains the accel/decel times sets to C1-01 and C1-02. When using more than one Jump Frequency, make sure that d3-01 is greater than or equal to d3-02 is greater than or equal to d3-03. Setting parameters d3-01 to d3-03 to 0 essentially disables the Jump Frequency.

◆ d4: Frequency Reference Hold

Determines how bias values affect the frequency reference, and also whether or not the frequency reference is saved when the power is shut off.

■ d4-01: Frequency Reference Hold Function Selection

This function is available when the multi-function inputs “accel/decel ramp hold” or “Up/Down” commands are selected (H1-□□ = A or 10 and 11). Determines whether or not the frequency reference is saved when the power supply is shut off.

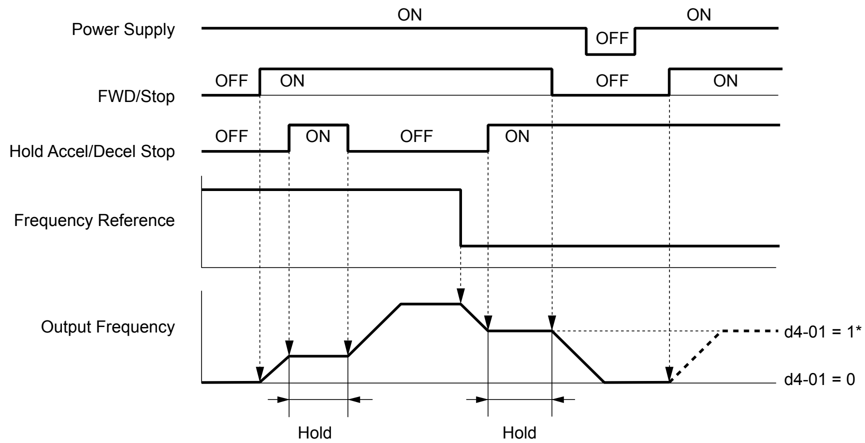
No.	Parameter Name	Setting Range	Default
d4-01	Frequency Reference Hold Function Selection	0, 1	0

Detailed Description

0	Disabled: Starts the motor from 0.

1	Enabled: Starts the motor from the last frequency reference the drive was given before the power was shut off.

Note: Enabled when the multi-function inputs are assigned for “Accel/Decel Ramp Hold” or "Up/Down" (H1-□□ = A or 10 and 11). When d4-01 = 1, the drive will save the frequency reference if the power goes out and then start back up and at that frequency reference as soon as the next Run command is entered. When d4-01 = 1 when the drive is shut off, it will save the frequency reference at that time, then accelerate back up to that frequency the next time the drive is turned back on and a new Run command is issued. To clear the frequency reference that was saved, an Up command or Down command must be entered while the Run command is still off. When d4-01 = 1, the drive will accelerate up to the Up 2 or Down 2 Hold Frequency that was saved befeore the power supply was interrupted the next time the Run command is entered. To reset this frequency, enter a new UP 2 or Down 2 reference while the Run command is still off. Both the Up/Down and Up 2 / Down 2 commands cannot be assigned to the multi-function input terminals at the same time. Doing so will trigger an oPE03 error, which indicates a contradiction set to the multi-function terminals. The drive will no longer be able to decelerate the motor if a Accel/Decel Ramp Hold command is entered during deceleration.



■ d4-03: Frequency Reference Bias Step (Up/Down 2)

Sets the amount to add or subtract from the frequency reference.

No.	Parameter Name	Setting Range	Default
d4-03	Frequency Reference Bias Step (Up/Down 2)	0.00 to 99.99	0.00 Hz

Detailed Description

d4-03 = 0.00

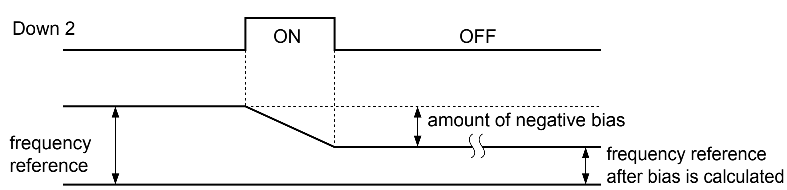
While the Up 2 or Down 2 command is enabled, the bias set to d4-04 will be added (or subtracted) to the frequency reference. Here, the accel/decel times set to the C1 parameters are disregarded.

If d4-03 is set to any value higher than 0.00:

While the terminal assigned to Up 2 or Down 2 is closed, the value set to d4-03 will be added to the speed. After five seconds, the bias value is added (or subtracted) to the frequency reference. This new frequency reference is kept even after the Up 2 or Down 2 command is released. Parameter d4-04 determines the rate at which the drive accelerates or decelerates after the Up 2 or Down 2 command has been added to the frequency reference.

Note: To add a positive bias, when the Up 2 command is enabled (i.e., the switch is closed), it is added to the acceleration rate.

To add a negative bias:



Note: Down 2 is enabled as long as the terminal to which it is assigned is closed. During this time, the value set for Down 2 will be added to the deceleration rate.

■ d4-04: Frequency Reference Accel/Decel(Up/Down 2)

Determines the bias added to the acceleration and deceleration times.

No.	Parameter Name	Setting Range	Default
d4-04	Frequency Reference Accel/Decel (Up/Down 2)	0, 1	0

Detailed Description

0	Adjusts the bias value according to the currently select accel/decel time.
1	Adjusts the bias value by Accel/Decel Time 4 (C1-07 and C1-08).

■ d4-05: Frequency Reference Bias Operation Mode Selection (Up/Down 2)

Determines the frequency reference bias operation when d4-03 is set to 0.00.

No.	Parameter Name	Setting Range	Default
d4-05	Frequency Reference Bias Operation Mode Selection (Up/Down 2)	0, 1	0

Detailed Description

0	Holds the bias value when Up/Down 2 reference is on or off.

1	When the Up 2 reference and Down 2 reference are both on or both off, the frequency reference bias becomes 0. Final reference accelerates or decelerates at the time selected.

Note: Enabled only when d4-03 = 0.

■ d4-06: Frequency Reference Bias (Up/Down 2)

Sets the bias to add or subtract to the frequency reference.

No.	Parameter Name	Setting Range	Default
d4-06	Frequency Reference Bias (Up/Down 2)	-99.9 to 100.0	0.0%

Detailed Description

Set d4-06 as a percentage of the maximum output frequency (E1-04).

The conditions below will disable d4-06:

- When the Up/Down 2 function has not been assigned to the multi-function terminals
- When the frequency reference has been changed (this includes any changes made using the multi-function terminals)
- If d4-03 = 0 Hz and d4-05 = 1 at the same time, then terminals set for the Up 2 and Down 2 functions will both open or both close
- Any changes to the maximum frequency set to E1-04
- Any changes to the digital frequency reference value

■ d4-07: Analog Frequency Reference Fluctuation Limit (Up/Down 2)

This parameter is for handling excessive fluctuation in the frequency reference while the terminal set for Up 2 or Down 2 is closed. If the frequency reference fluctuates passed the level set to d4-07, then the bias value will be held, and the drive will accelerate or decelerate back to the frequency reference. Once Speed Agree is achieved, the bias will be applied again to the frequency reference. Parameter d4-07 is applicable for both an analog frequency reference and when the frequency reference is provided via the Pulse Train input.

No.	Parameter Name	Setting Range	Default
d4-07	Analog Frequency Reference Fluctuation Limit (Up/Down 2)	0.1 to 100.0	1.0%

■ d4-08: Frequency Reference Upper Limit (Up/Down 2)

Parameter d4-08 becomes the upper limit for the bias when d4-08 is greater than d4-06. Set as a percentage of the maximum output frequency (E1-04).

No.	Parameter Name	Setting Range	Default
d4-08	Frequency Reference Upper Limit (Up/Down 2)	0.0 to 100.0	0.0%

■ d4-09: Frequency Reference Lower Limit (Up/Down 2)

Parameter d4-09 becomes the lower limit for the bias when d4-09 is less than d4-06.

No.	Parameter Name	Setting Range	Default
d4-09	Frequency Reference Lower Limit (Up/Down 2)	-99.9 to 0.0	0.0%

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

Parameter Overview

No.	Name	Description	Range	Default
d4-10	Up/Down Frequency Reference Limit Selection	Selects which value is used as frequency reference lower limit if the Up/Down function is used. 0: The lower limit is determined by d2-02 or analog input (H3-02/10 = 0). The higher of both values becomes the reference limit. 1: The lower limit is determined by d2-02.	0 or 1	0

■ d4-11: Bi-Directional Output Selection (YEG Only)

Parameter Overview

No.	Name	Description	Range	Default
d4-11	Bi-directional Output Selection	Enables or disables conversion of frequency reference or PID output value into bi-directional internal frequency reference. 0: Disabled - 0 to 100% reference or PID output: Operation in selected direction 1: Enabled - < 50% reference or PID output: Reverse operation > 50% reference or PID output: Operation in selected direction	0 or 1	0

■ d4-12: Stop Position Gain

Parameter Overview

No.	Name	Description	Range	Default
d4-12	Stop Position Gain	Sets the gain used by the simple positioning stop function to fine adjust the position.	0.50 to 2.55	1.00

◆ d7: Offset Frequencies

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

These parameters are for fine-tuning the frequency reference as needed by machine tool applications. When a multi-function input terminal programmed for an Offset Frequency closes, a bias is added to the frequency reference.

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

Setting	Function Name	Page
44	Offset Frequency 1 Calculations	-
45	Offset Frequency 2 Calculations	-
46	Offset Frequency 3 Calculations	-

Multi-Function Inputs H1-01 to H1-07

Detailed Description

The figure below illustrates how multi-function input terminal settings operate.

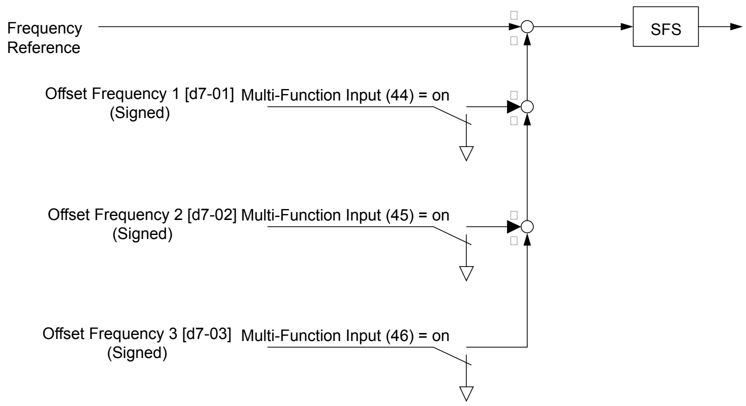


Figure 5.30 Offset Frequency Operation

When two signals from d7-01 through d7-03 differ in sign, the +/- Speed function can be used.

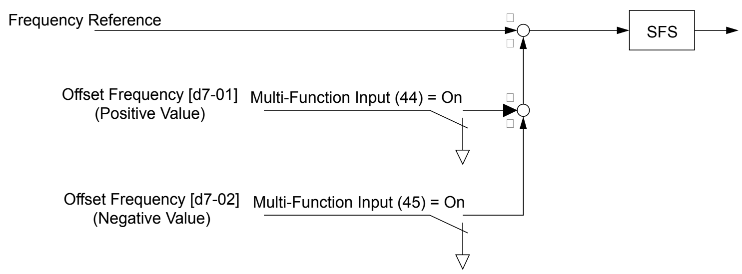


Figure 5.31 Offset Frequency and ± Speed Timing

5.5 E: Motor Parameters

E parameters cover motor related settings.

◆ E1: V/f Characteristics

■ E1-01: Input Voltage Setting

Set the input voltage parameter to the nominal voltage of the connected AC power supply. This parameter adjusts the levels of some protective features of the drive (i.e., overvoltage, Stall Prevention, etc.).

No.	Parameter Name	Setting Range	Default
E1-01	Input Voltage Setting	155 to 255	200 V

Note: The setting range shown here is for 200 V class drives. Double this value when working with 400 V class units.

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

Detailed Description

The input voltage level determines the overvoltage detection level and the operation level of the braking transistor as shown in the table below.

Voltage	Setting Value of E1-01	OV Detection Level (approx.)	BTR Operation Level (approx.)	UV Detection Level (L2-05)	Desired DC Bus Voltage during KEB (L2-11)	Voltage Level for OV Suppression, Stall Prevention (L2-17)
200 V Class	all settings	410 V	394 V	190 V (single phase = 160 V)	240 V	370 V
400 V Class	setting greater than or equal to 400 V	820 V	788 V	380 V	480 V	740 V
	setting < 400 V	740 V	708 V	350 V	440 V	660 V

Note: This data is for an internal dynamic braking resistor of 0.1 to 18.5 kW. For larger units, see “Dynamic Braking Resistor Unit for VARISPEED-600 Series, TOBPC720600000”

■ E1-03: V/f Pattern Selection

■ E1-04 to E1-13

This parameter is only available when using V/f Control. It allows the user to set the V/f pattern and drive input voltage as needed. When running a high-speed or other type of special-purpose motor, this function can be used to fine-tune the amount of torque needed for the load.

No.	Parameter Name	Setting Range	Default
E1-03	V/f Pattern Selection	0 to F	F (user-set)*

*This parameter is not reset when the drive is initialized with A1-03.

Table 5.4 V/f Pattern

Setting	Specification	Characteristic	Application
0	50 Hz	Constant torque	For general purpose applications. Torque remains constant regardless of changes to speed.
1 (F)	60 Hz		
2	60 Hz (with 50 Hz base)		
3	72 Hz (with 60 Hz base)		
4	50 Hz, Heavy Duty 2	Derated torque	For fans, pumps, and other applications that require torque derating relative to the load.
5	50 Hz, Heavy Duty 1		
6	50 Hz, Heavy Duty 1		
7	50 Hz, Heavy Duty 2		
8	50 Hz, mid starting torque	High starting torque	Select high starting torque when: Wiring between the drive and motor exceeds 150 m A large amount of starting torque is required AC Reactor is installed The motor exceeds the largest recommended motor for the drive.
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	When operating at greater than 60 Hz. This requires that constant voltage be application.
D	120 Hz (with 60 Hz base)		
E	180 Hz (with 60 Hz base)		

Detailed Description

The drive operates utilizing a set V/f pattern to determine the appropriate output voltage level for each commanded speed. There are 15 different preset V/f patterns to select from with varying voltage profiles, saturation levels (frequency at which maximum voltage is reached), and maximum frequencies. There are also settings for custom V/f patterns that will allow the programmer to manually set the V/f pattern using parameters E1-04 through E1-10.

Using parameter E1-03, the programmer can select one of the preset V/f patterns or chose between a custom V/f pattern with an upper voltage limit (E1-03 = “F: Custom V/f”).

No.	Name	Setting Range	Default
E1-04	Max Output Frequency (FMAX)	40.0 to 400.0	*2, *3, *4
E1-05	Max Voltage (VMAX)	0.0 to 255.0*1	*2, *3, *4
E1-06	Bass Frequency (FA)	0.0 to 400.0	*2, *3, *4
E1-07	Mid Output Frequency (FB)	0.0 to 400.0	*2, *3
E1-08	Mid Output Frequency Voltage (VC)	0.0 to 255.0 *1	*2, *3
E1-09	Minimum Output Frequency (FMIN)	0.0 to 400.0	*2, *3, *4
E1-10	Minimum Output Frequency Voltage (VMIN)	0.0 to 255.0 *1	*2, *3
E1-11	Mid Output Frequency 2	0.0 to 400.0	0.0 Hz

No.	Name	Setting Range	Default
E1-12	Mid Output Frequency Voltage 2	0.0 to 255.0 *1	0.0 V
E1-13	Base Voltage (VBASE)	0.0 to 255.0 *1	0.0 V

*1. Values shown here are for 200 V class drives. Double the value when using a 400 V class unit.
*2. Default setting is determined by the control mode (value shown here is for V/f Control).
*3. Default setting varies based on the V/f pattern set to E1-03.
*4. When using PM Open Loop Vector, the default setting is determined by the motor code set to E5-01.

Setting Instructions

1. Set the input voltage for the drive. For instructions, see page 133.
2. Choose one of the two following V/f patterns:
Select one of the 15 preset V/f patterns (setting = 0 through E)
Custom V/f pattern (setting = F)
3. When using one of the preset patterns, the parameters listed below are set automatically.
When using a custom V/f pattern, set these parameters as desired:
E1-04 (Max Output Frequency), E1-05 (Max Voltage), E1-06 (Base Frequency), E1-07 (Mid Output Frequency, E1-08 (Mid Output Frequency Voltage), E1-09 (Min Output Frequency), E1-10 (Min Output Frequency Voltage)
4. Settings for the E1 parameters are determined by drive capacity. Drive capacities are divided into the two following ranges:
V/f pattern for 0.1 to 3.7 kW drives
V/f pattern for 5.5 to 18.5 kW drives

The user can select one of 15 preset V/f patterns (setting = 0 through E) or decide to set a customized V/f pattern (setting = F). By selecting one of the 15 presets (settings 0 through E), the drive will automatically set the parameters listed in the table below.

E1-09 less than or equal to E1-07 less than or equal to E1-06 less than or equal to E1-11 less than or equal to E1-04

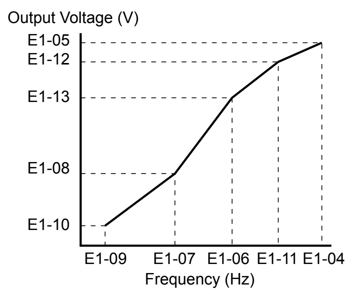


Figure 5.32 V/f Pattern

Note: When the drive is initialized using parameter A1-03, the setting of E1-03 is unaffected but the settings of E1-04 through E1-13 are returned to their default settings.

V/f Patterns for 0.1 to 3.7 kW Drives

The following graphs are for 200 V class drives. Double values when using a 400 V class unit.

Table 5.5 Constant Torque Characteristics, Settings 0 to 3

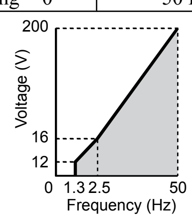
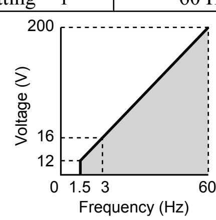
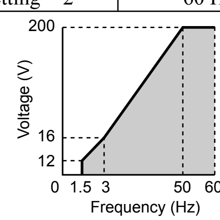
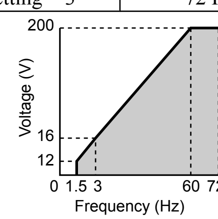
Setting = 0	50 Hz	Setting = 1	60 Hz	Setting = 2	60 Hz	Setting = 3	72 Hz
							

Table 5.6 Derated Torque Characteristics, Settings 4 to 7

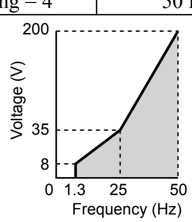
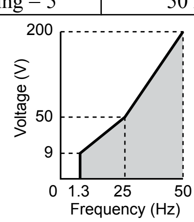
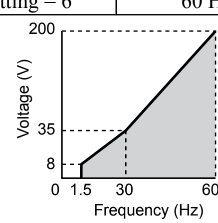
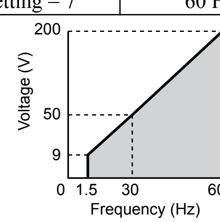
Setting = 4	50 Hz	Setting = 5	50 Hz	Setting = 6	60 Hz	Setting = 7	60 Hz
							

Table 5.7 High Starting Torque, Settings 8 to B

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

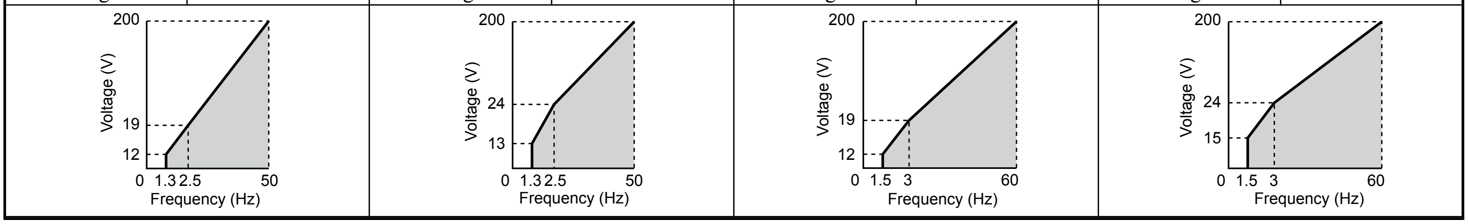
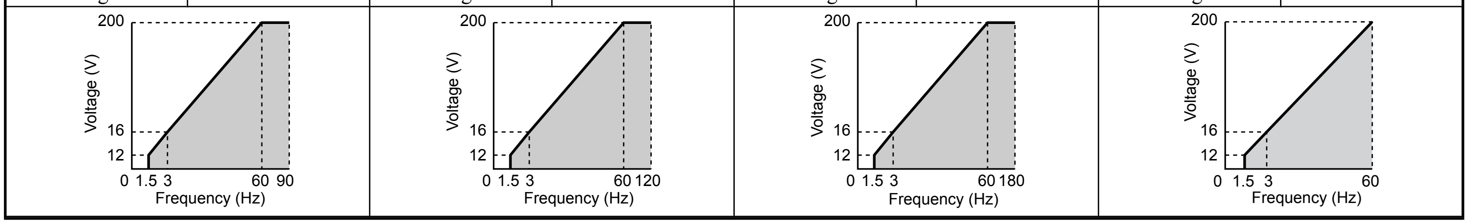


Table 5.8 Rated Output Operation, Settings C to F

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



V/f Patterns for 5.5 to 18.5 kW Drives

The following graphs are for 200 V class drives. Double values when using a 400 V class drive.

Table 5.9 Rated Torque Characteristics, Settings 0 to 3

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

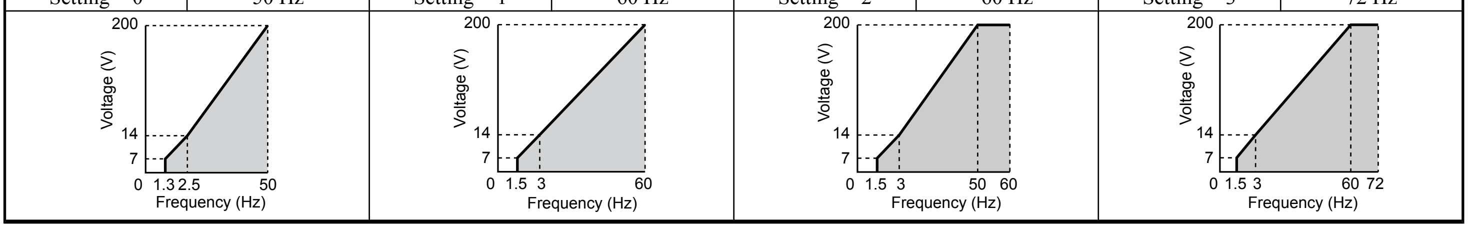


Table 5.10 Derated Torque Characteristics, Settings 4 to 7

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

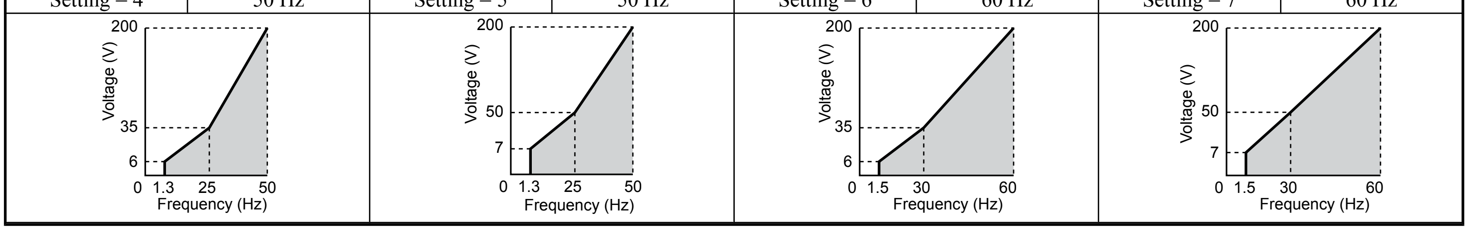


Table 5.11 High Starting Torque, Settings 8 to B

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

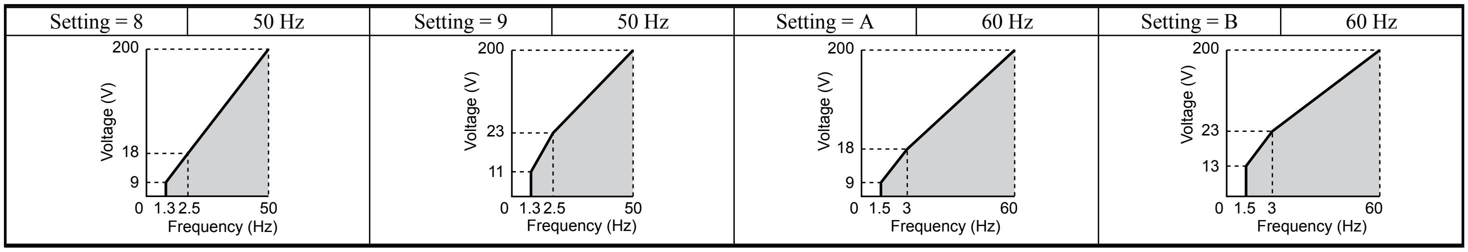
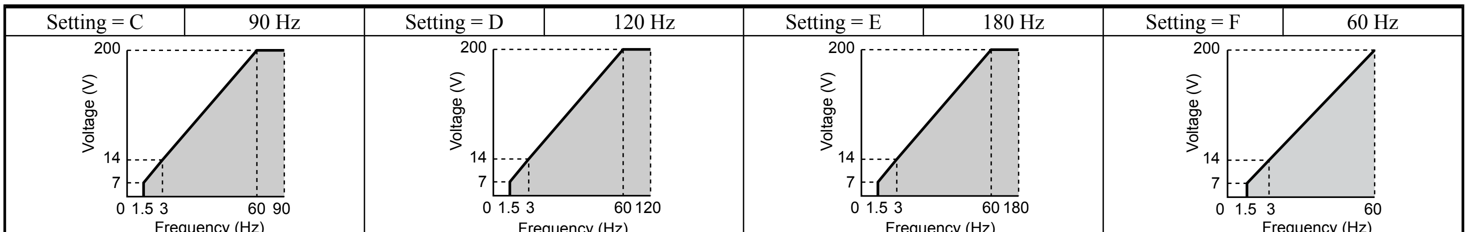


Table 5.12 Constant Output, Settings C to F

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



Note: Increasing the voltage in the V/f pattern increases the available motor torque. However, when setting a custom V/f pattern,increase the voltage gradually while monitoring the motor current, to prevent drive faults as a result of motor over-excitation and motor overheating or excessive vibration

◆ E2: Motor Parameters

These parameters are set automatically when Auto-Tuning is performed for Open Loop Vector Control. If Auto-Tuning is possible, then these parameters can also be set manually.

■ E2-01: Motor Rated Current

The motor rated current parameter E2-01 is used by the drive to protect the motor for proper performance of Open Loop Vector Control (A1-02 = 2). Set E2-01 to the full load amps (FLA) stamped on the motor nameplate. During Auto-Tuning, the technician must enter the motor rated current to parameter T1-04. If Auto-Tuning completes successfully, the value entered into T1-04 will automatically be saved to E2-01.

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

Note: Set the lower and higher digits to the value corresponds to the capacity of the drive: 11 kW or less: Sets the lower 2 digits, 11 kW or higher: Set to the lowest digit

■ E2-02: Motor Rated Slip

Sets the motor rated slip in Hz. This value is automatically set during rotational Auto-Tuning.

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

Calculate the motor rated slip using the information written on the motor nameplate and the formula below:

fs = f - (N x P) / 120

fs: slip frequency (Hz)

f: rated frequency (Hz)

N: rated motor speed (r/min)

P: number of motor poles

■ E2-03: Motor No-Load Current

Set E2-03 to the motor no-load current at rated voltage and rated frequency. If Rotational Auto-Tuning completes successfully, this value is automatically calculated. Consult with the motor manufacturer for the proper value if the no-load current is not stated on the motor nameplate.

No.	Name	Setting Range	Default
E2-03	Motor No-Load Current	Between 0 and [E2-01]	Determined by o2-04

Note: Set the lower and higher digits to the value corresponds to the capacity of the drive: 11 kW or less: Sets the lower 2 digits, 11 kW or higher: Set to the lowest digit

■ E2-04: Number of Motor Poles

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

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

■ E2-05: Motor Line-to-Line Resistance

Sets the line-to-line resistance of the motor's stator winding. If the Auto-tuning completes successfully, this value is automatically calculated. Remember this value must be entered as line-line and not line-neutral.

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

Note: The setting range becomes 0.00 to 130.00 when using less than a 0.2 kW motor.

If Auto-Tuning is not possible, then contact the motor manufacturer to find out the line-to-line resistance. The resistance between lines can also be calculated using the formula below. This data can be obtained from the Motor Test Report.

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

■ E2-06: Motor Leakage Inductance

Sets the voltage drop due to motor leakage inductance as a percentage of motor rated voltage. If Rotational Auto-Tuning completes successfully, then this value is automatically calculated.

No.	Parameter Name	Setting Range	Default
E2-06	Motor Leakage Inductance	0.0 to 40.0	Determined by o2-04

■ E2-07: Motor Iron-Core Saturation Coefficient 1

This parameter sets the motor iron saturation coefficient at 50% of the magnetic flux. If Rotational Auto-Tuning completes successfully, then this value is automatically calculated.

No.	Parameter Name	Setting Range	Default
E2-07	Motor Iron-Core Saturation Coefficient 1	0.00 to 0.50	0.50

■ E2-08: Motor Iron-Core Saturation Coefficient 2

This parameter sets the motor iron saturation coefficient at 75% of the magnetic flux. If Rotational Auto-Tuning completes successfully, then this value is automatically calculated.

No.	Parameter Name	Setting Range	Default
E2-08	Motor Iron-Core Saturation Coefficient 2	E2-07 to 0.75	0.75

■ E2-09: Motor Mechanical Loss

This parameter sets to the motor mechanical loss as a percentage of motor rated power (kW) capacity.

No.	Parameter Name	Setting Range	Default
E2-09	Motor Mechanical Loss	0.0 to 10.0	0.0%

Adjust this setting in the following circumstances:
- When torque loss is large due to motor bearing friction.
- When the torque loss in the load is large.

The setting for the mechanical loss is added to the torque.

■ E2-10: Motor Iron Loss for Torque Compensation

This parameter sets the motor iron loss in watts.

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

■ E2-11: Motor Rated Output

This parameter sets the motor rated power in kW. If rotational Auto-Tuning completes successfully, this value is automatically calculated. Remember that 1 hp = 0.746 kilowatts.

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

■ E2-12: Motor Iron-Core Saturation Coefficient 3

This parameter sets the motor rated power in kW. If rotational Auto-Tuning completes successfully, this value is automatically calculated. Remember that 1 hp = 0.746 kilowatts.

No.	Parameter Name	Setting Range	Default
E2-12	Motor Iron-Core Saturation Coefficient 3	1.30 to 5.00	1.30

◆ E3: V/f Characteristics for Motor 2

The drive has the capability to control two motors independently. A second motor may be selected using a multi-function contact input (H1-□□ = 16). This parameter select the control method for motor 2. The control method for motor 1 is selected via parameter A1-02.

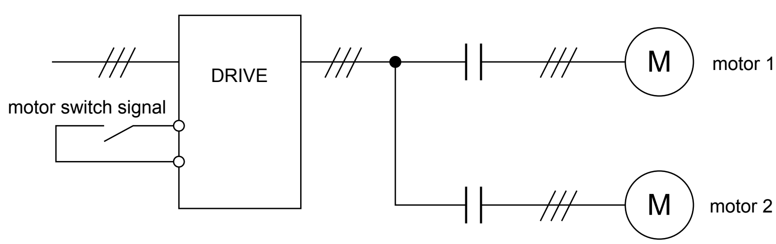


Figure 5.33 Motor Selection

When motor 2 is selected, the following parameters become available:

Table 5.13 Parameters for Motor 2

V/f Pattern 2			
E3-01	Motor 2 Control Method Selection	E3-07	Motor 2 Minimum Output Frequency (FB)
E3-04	Motor 2 Max Voltage (VMAX)	E3-08	Motor 2 Mid Output Frequency Voltage (VC)
E3-05	Motor 2 Max Frequency (FMAX)	E3-09	Motor 2 Minimum Output Frequency (FMIN)
E3-06	Motor 2 Base Frequency (FA)	E3-10	Motor 2 Mid Output Frequency Voltage 2
Motor 2 Settings			
E4-01	Motor 2 Rated Current	E4-08	Motor 2 Motor Iron-Core Saturation Coefficient 2
E4-02	Motor 2 Rated Slip	E4-09	Motor 2 Mechanical Loss
E4-03	Motor 2 Rated No-Load Current	E4-10	Motor 2 Iron Loss
E4-04	Motor 2 Motor Poles	E4-11	Motor 2 Rated Capacity
E4-05	Motor 2 Line-to-Line Resistance	E4-12	Motor 2 Iron-Core Saturation Coefficient 3
E4-06	Motor 2 Leakage Inductance	E4-14	Motor 2 Slip Compensation Gain

V/f Pattern 2			
E4-07	Motor 2 Motor Iron-Core Saturation Coefficient 1	E4-15	Torque Compensation Gain - Motor 2

■ E3-01: Motor 2 Control Method Selection

Selects the control method for motor 2.

No.	Parameter Name	Setting Range	Default
E3-01	Motor 2 Control Method Selection	0: V/f Control 2: Open Loop Vector Control	0

Note: Motor 2 cannot be a permanent magnet motor. The OL1 operation selection set to L1-01 applies to both motor 1 and motor 2.

■ E3-04 to E3-10

The default settings for parameters E3-04 through E3-10 change according to the control method used. The values shown in the table below are the defaults when operating in V/f Control.

No.	Parameter Name	Setting Range	Default
E3-04	Motor 2 Max Output Frequency	40.0 to 400.0	60.0 Hz*2
E3-05	Motor 2 Max Voltage (VMAX)	0.0 to 255.0*1	200.0 V*2
E3-06	Motor 2 Base Frequency (FA)	0.0 to 400.0	60.0 Hz*2
E3-07	Motor 2 Mid Output Frequency (FB)	0.0 to 400.0	3.0 Hz*2
E3-08	Motor 2 Mid Output Frequency Voltage (VC)	0.0 to 255.0 *1	16.0 V*2
E3-09	Motor 2 Minimum Output Frequency (FMIN)	0.0 to 400.0	1.5 Hz*2
E3-10	Motor 2 Minimum Output Frequency Voltage (VMIN)	0.0 to 255.0 *1	9.0 V*2

*1. These values are for 200 V class drives. Double these values when using a 400 V class unit.
*2. The default value is determined by the control method (A1-02). Values listed here are for V/f Control.

To set V/f characteristics in a straight line, set the same values for E3-07 and E3-09. In this case, the setting for E3-08 will be disregarded. Be sure that the four frequencies are set in the following manner or else a fault will occur:

E3-04 (FMAX) greater than or equal to E3-06 (FA) > E3-07 (FB) > E3-09 (FMIN)

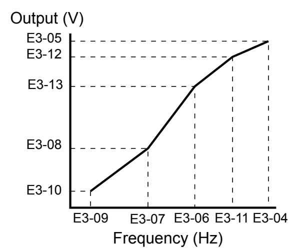


Figure 5.34 V/f Pattern for Motor 2

■ E3-11 to E3-13

These parameters rarely need to be changed. Adjust only when fine-tuning the V/f pattern to maintain constant output.

No.	Parameter Name	Setting Range	Default
E3-11	Motor 2 Mid Output Frequency 2	0.0 to 400.0	0.0 Hz
E3-12	Motor 2 Mid Output Frequency Voltage 2	0.0 to 255.0*1	0.0 Vac
E3-13	Motor 2 Base Voltage (VBASE)	0.0 to 255.0*1	0.0 Vac*2

*1. These values are for 200 V class drives. Double these values when using a 400 V class unit.
*2. This value will be the same as the motor rated voltage set to T1-03 after Auto-Tuning is performed.

◆ E4: Motor 2 Parameters

A single drive is capable of operating two separate motors with different capacities and different V/f characteristics. E4 parameters are for setting up motor 2. In Open Loop Vector Control, E4 parameters are set automatically during the Auto-Tuning process. These parameters may need to be set manually if there is a problem performing Auto-Tuning.

■ E4-01: Motor 2 Rated Current

The motor rated current is used by the drive to protect the motor and for proper control when using Open Loop Vector. The drive calculates this value automatically during the Auto-Tuning process.

No.	Parameter Name	Setting Range	Default
E4-01	Motor 2 Rated Current	Between 10 and 200% of the drive rated current.	Determined by o2-04

Note: Set the lower and higher digits to the value corresponds to the capacity of the drive: 11 kW or less: Sets the lower 2 digits, 11 kW or higher: Set to the lowest digit

■ E4-02: Motor 2 Rated Slip

This parameter sets the motor rated slip frequency in units of 0.01 Hz. The drive calculates this value is automatically during Rotational Auto-Tuning.

For information on calculating the motor rated slip, see the description on E2-02.

No.	Parameter Name	Setting Range	Default
E4-02	Motor 2 Rated Slip	0.00 to 20.00	Determined by o2-04

E4-03: Motor 2 Rated No-Load Current

Sets the magnetizing current of motor 2 as a percentage of the full load current. This value is automatically set during Rotational Auto-Tuning. If Auto-Tuning cannot be performed, contact the motor manufacturer for this information so that it can be entered manually.

No.	Parameter Name	Setting Range	Default
E4-03	Motor 2 Rated No-Load Current	0 to [E4-01]	Determined by o2-04

Note: Set the lower and higher digits to the value corresponds to the capacity of the drive: 11 kW or less: Sets the lower 2 digits, 11 kW or higher: Set to the lowest digit

E4-04: Motor 2 Motor Poles

Sets the number of motor poles for motor 2. This value should be entered during the Auto-Tuning process, after which this parameter will be automatically set.

No.	Parameter Name	Setting Range	Default
E4-04	Motor 2 Motor Poles	2 to 48	4

E4-05: Motor 2 Line-to-Line Resistance

Sets the phase-to-phase resistance of motor 2 in ohms. This value is automatically set when Auto-Tuning is executed.

No.	Parameter Name	Setting Range	Default
E4-05	Motor 2 Line-to-Line Resistance	0.000 to 65.000	Determined by o2-04

Note: The setting range is 0.00 to 130.00 when using a drive capacity of 0.2 kW or less.

E4-05 is the only parameter that is automatically set when Stationary Auto-Tuning is performed (also called, “Auto-Tuning for resistance between lines”). If Auto-Tuning is not possible for some reason, contact the motor manufacturer to find out what the line-to-line resistance is for the motor, then calculate this E4-05 using the appropriate formula below.

- E-type insulation: Multiply 0.92 times the resistance value (W) listed on the Test Report at 75°C.
- B-type insulation: Multiply 0.92 times the resistance value (W) listed on the Test Report at 75°C.
- E-type insulation: Multiply 0.87 times the resistance value (W) listed on the Test Report at 115°C.

E4-06: Motor 2 Leakage Inductance

Sets the voltage drop due to motor leakage inductance as a percentage of rated voltage of motor 2. This value is automatically set during Auto-Tuning.

No.	Parameter Name	Setting Range	Default
E4-06	Motor 2 Leakage Inductance	0.0 to 40.0	Determined by o2-04

E4-07: Motor 2 Motor Iron-Core Saturation Coefficient 1

Set to the motor iron saturation coefficient at 50% of magnetic flux. This value is automatically set during Rotational Auto-Tuning.

No.	Parameter Name	Setting Range	Default
E4-07	Motor 2 Motor Iron-Core Saturation Coefficient 1	0.00 to 0.50	0.50

E4-08: Motor 2 Motor Iron-Core Saturation Coefficient 2

Set to the motor iron saturation coefficient at 75% of magnetic flux. This value is automatically set during Rotational Auto-Tuning.

No.	Parameter Name	Setting Range	Default
E4-08	Motor 2 Motor Iron-Core Saturation Coefficient 2	[E4-07] to 0.75	0.75

E4-09: Motor 2 Mechanical Loss

Sets the motor mechanical loss as a percentage of motor rated power (kW).

No.	Parameter Name	Setting Range	Default
E4-09	Motor 2 Mechanical Loss	0.00 to 10.0	0.0

This parameter seldom needs to be changed, but may need to be adjusted in the following circumstances:

- When there is a large amount of torque loss due to motor bearing friction.
- When there is a large amount of torque loss in a fan or pump application.

E4-10: Motor 2 Iron Loss

Sets the motor iron loss in watts for motor 2.

No.	Parameter Name	Setting Range	Default
E4-10	Motor 2 Iron Loss	0 to 65535	Determined by o2-04

E4-11: Motor 2 Rated Capacity

Sets the motor rated capacity in units of 0.01 kW. This value is automatically set when Auto-Tuning is performed.

No.	Parameter Name	Setting Range	Default
E4-11	Motor 2 Rated Capacity	0.00 to 650.00 kW	Determined by o2-04

E4-12: Motor 2 Iron-Core Saturation Coefficient 3

Set to the motor iron saturation coefficient at 130% of magnetic flux. This value is automatically set during Rotational Auto-Tuning.

No.	Parameter Name	Setting Range	Default
E4-12	Motor 2 Iron-Core Saturation Coefficient 3	1.30 to 5.00	1.30

E4-14: Motor 2 Slip Compensation Gain

Matches the slip compensation gain for motor 1 set to C3-01. Used to increase motor speed to account for motor slip by boosting the output frequency.

No.	Parameter Name	Setting Range	Default
E4-14	Motor 2 Slip Compensation Gain	0.0 to 2.50	Determined by E3-01

Note: The control mode determines the default setting. The value shown here is for V/f Control.

This setting rarely needs to be changed, but adjustment may help under the following conditions:
- Increase this setting if the motor speed is below the desired value.
- Decrease this setting if the motor rotates faster than the desire speed.

E4-15: Motor 2 Torque Compensation Gain

Matches the torque compensation gain for motor 1 set to C4-01. This function magnifies the torque compensation to increase output torque.

No.	Parameter Name	Setting Range	Default
E4-15	Motor 2 Torque Compensation Gain	0.0 to 2.50	1.00

Note: Adjust this parameter so the output current does not exceed the drive rated output curren when operating at low speeds.

- Increase the setting when using a long motor cable.
- When using a motor with a smaller capacity than the drive, increase this setting.
- If the motor begins to vibrate, adjust the value set so that the output current doesn't exceed the drive rated output current when operating at low speeds.

E5: PM Motor Settings

E5-01: PM Motor Code Selection

Set the motor code appropriate for the PM motor being used. Depending on the motor code entered, the drive may be able to automatically set several motor parameters.

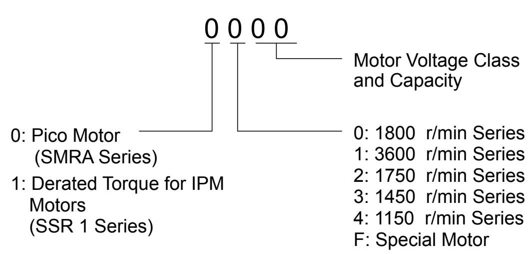
No.	Parameter Name	Setting Range	Default
E5-01	PM Motor Code Selection	0000 to FFFF	Determined by o2-04

Note: This parameter is not reset when the drive is initialized using parameter A1-03. Depending on the motor code, the drive may be able to automatically set several motor parameters. The default setting is for a Yaskawa pico motor with a speed rating of 1800 r/min. Set to "FFFF" when using a specialized or custom motor.

Detailed Description

According to the motor code, the value set for the maximum output frequency becomes the upper limit. Because changing E5-01 will reset all motor parameters according to the new motor code, refrain from making frequent changes to E5-01

Note: Set to "FFFF" when using a specialized or custom motor.



E5-02: Motor Rated Capacity (PM OLV)

Sets the rated capacity of the motor.

No.	Parameter Name	Setting Range	Default
E5-02	Motor Rated Capacity (PM OLV)	0.10 to 18.50	Determined by E5-01

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

E5-03: Motor Rated Current (PM OLV)

Sets the motor rated current in amps.

No.	Parameter Name	Setting Range	Default
E5-03	Motor Rated Current (PM OLV)	10 to 200% of drive rated current	Determined by E5-01

Note: The default value is determined by the motor code set to E5-01. Setting units are determined by drive capacity. 7.5 kW or less: 0.01 A, 11 kW or greater: 0.1 A

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

Sets the number of motor poles.

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

Note: The default value is determined by the motor code set to E5-01. This parameter is not reset when the drive is initialized using A1-03.

■ E5-05: Motor Armature Resistance (PM OLV)

Set the resistance for each motor phase in units of 0.001 W.

No.	Parameter Name	Setting Range	Default
E5-05	Motor Armature Resistance (PM OLV)	0.000 to 65.000	Determined by E5-01

Note: The default value is determined by the motor code set to E5-01. This parameter is not reset when the drive is initialized using A1-03.

■ E5-06: Motor d Axis Inductance (PM OLV)

Sets the d axis inductance in units of 0.01 mH.

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

Note: The default value is determined by the motor code set to E5-01. This parameter is not reset when the drive is initialized using A1-03.

■ E5-07: Motor q Axis Inductance (PM OLV)

Sets the q axis inductance in units of 0.01 mH.

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

Note: The default value is determined by the motor code set to E5-01. This parameter is not reset when the drive is initialized using A1-03.

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

Set the inductance voltage for each motor phase in units of 0.1 mV/(rad/min) [electrical angle]. Set this parameter when using an SSR1 series IPM motor with derated torque or an SST4 series motor with constant torque.

■ E5-24: Motor Induction Voltage Parameter 2 (PM OLV)

Set the inductance voltage for each motor phase in units of 0.1 mV/(r/min) [mechanical angle]. Set this parameter when using an SMRA series pico motor.

Note: Ensure that E5-09 = 0 when setting parameter E5-24.

An alarm will be triggered, however, if both E5-09 and E5-24 are set 0, or if neither parameter is set to 0.

No.	Parameter Name	Setting Range	Default
E5-09	Motor Induction Voltage Constant 1 (PM OLV)	0.0 to 2000.0	Determined by E5-01
E5-24	Motor Induction Voltage Parameter 2 (PM OLV)	0.0 to 2000.0	Determined by E5-01

Note: The default value is determined by the motor code set to E5-01. This parameter is not reset when the drive is initialized using A1-03.

5.6 F: Option Settings

◆ F1: Settings for Simple PG with V/f Control

Although a pulse generator encoder (PG) is not available for V1000, it is equipped with a Pulse Train Input that can be used to improve speed control accuracy. To take advantage of this feature, first set the drive for V/f Control (A1-02 = 0) and then set terminal RP for Simple PG in V/f (H6-01 = 3). For applications operating more than one motor from a single drive, please note that this function is only available for motor 1.

■ F1-02: Operation Selection at PG Open Circuit (PGo)

Sets the stopping method when a PG open circuit fault (PGo) occurs. For a list of stopping methods, see ***Refer to Stopping Methods for PGo, oS, dEv Detection on page 154***.

No.	Parameter Name	Setting Range	Default
F1-02	Operation Selection at PG Open Circuit (PGO)	0 to 3	1

NOTICE: *Setting = 3: Alarm only. This setting offers limited protection to the motor and machinery. Take proper precautions when selecting this setting.*

■ F1-03: Operation Selection at Overspeed

Sets the stopping method when an overspeed (oS) fault occurs.

No.	Parameter Name	Setting Range	Default
F1-03	Operation Selection at Overspeed (for Simple PG V/f)	0 to 3	1

NOTICE: *Setting = 3: Alarm only. This setting offers limited protection to the motor and machinery. Take proper precautions when selecting this setting.*

■ F1-04: Operation Selection at Deviation

Sets the stopping method when a speed deviation (dEv) fault occurs.

No.	Parameter Name	Setting Range	Default
F1-04	Operation Selection at Deviation (for Simple PG V/f Control)	0 to 3	3

Note: The drive is set to continue operating when dEv is detected (F1-04 = 3).

Table 5.14 Stopping Methods for PGo, oS, dEv Detection

Setting	Description
0	Ramp to Stop (uses the decleration time set to C1-02)
1	Coast to Stop
2	Fast Stop (uses the Fast Stop time set to C1-09)
3	Alarm only

■ F1-08: Overspeed Detection Level

■ F1-09: Overspeed Detection Delay Time

F1-08 is set as a percentage of the maximum output frequency and determines the level at which oS is detected.

F1-09 determines the time it takes for oS to be detected after the motor speed exceeds the detection level set to F1-08.

No.	Parameter Name	Setting Range	Default
F1-08	Overspeed Detection Level	0 to 120	115%
F1-09	Overspeed Detection Delay Time	0.0 to 2.0	1.0

■ F1-10: Excessive Speed Deviation Detection Level

■ F1-11: Excessive Speed Deviation Detection Delay Time

Configures the speed deviation fault (dEv) detection. dEv fault will occur if the speed deviation is greater than the F1-10 setting for a time longer than F1-11. F1-10 is set as a percentage of the maximum output frequency (E1-04). Speed deviation is the difference between actual motor speed and the frequency reference command.

No.	Parameter Name	Setting Range	Default
F1-10	Excessive Speed Deviation Detection Level	0 to 50	10%
F1-11	Excessive Speed Deviation Detection Delay Time	0.0 to 10.0	0.5 s

■ F1-14: PG Open-Circuit Detection Time

Sets the time required to detect PGo.

No.	Parameter Name	Setting Range	Default
F1-14	PG Open-Circuit Detection Time	0.0 to 10.0	2.0 s

◆ F6 and F7: Serial Communications Option Card Settings

■ F6-01: Communications Error Option Selection

Parameter Overview

No.	Name	Description	Range	Default
F6-01	Communications Error Operation Selection	Selects the operation after a communications error occurred. 0: Ramp to stop using current accel/decel time 1: Coast to stop 2: Fast Stop using C1-09 3: Alarm only	0 to 3	1

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

Parameter Overview

No.	Name	Description	Range	Default
F6-02	External Fault from Comm. Option Selection	Sets when an external fault from a comm option is detected. 0: Always detected 1: Detection during Run only	0 or 1	0

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

Parameter Overview

No.	Name	Description	Range	Default
F6-03	External Fault from Comm. Option Operation Selection	Selects the operation after an external fault set by a communications option (EF0). 0: Ramp to stop using current accel/decel time 1: Coast to stop 2: Fast Stop using C1-09 3: Alarm only	0 to 3	1

■ F6-04: Trace Sampling Rate

Parameter Overview

No.	Name	Description	Range	Default
F6-04	Trace Sampling Rate	-	0.0 to 5.0	2.0 s

■ F6-10: CC-Link Node Address

Parameter Overview

No.	Name	Description	Range	Default
F6-10	CC-Link Node Address	Sets the node address if a CC-Link option card is installed	0 to 63	0

■ F6-11: CC-Link Communication Speed

Parameter Overview

No.	Name	Description	Range	Default
F6-11	CC-Link Communication Speed	0: 156 Kbps 1: 625 Kbps 2: 2.5 Mbps 3: 5 Mbps 4: 10 Mbps	0 to 4	0

■ F6-14: BUS Error Auto Reset

Parameter Overview

No.	Name	Description	Range	Default
F6-14	BUS Error Auto Reset	Selects if a BUS fault can be automatically reset.	0 or 1	0

■ F6-20: DeviceNet MAC Address

Parameter Overview

No.	Name	Description	Range	Default
F6-20	DeviceNet MAC Address	Selects the drives MAC address for DeviceNet	0 to 63	0

■ F6-21: DeviceNet Communication Speed

Parameter Overview

No.	Name	Description	Range	Default
F6-21	DeviceNet Communication Speed	0: 125 kbps 1: 250 kbps 2: 500 kbps 3: Detect automatically	0 to 3	3

F6-22: DeviceNet PCA Setting

Parameter Overview

No.	Name	Description	Range	Default
F6-22	DeviceNet PCA Setting	I/O Polled Consuming Assembly Data Instance	0 to 255	0

F6-23: DeviceNet PPA Setting

Parameter Overview

No.	Name	Description	Range	Default
F6-23	DeviceNet PPA Setting	I/O Polled Producing Assembly Data Instance	0 to 255	0

F6-24: DeviceNet Idle Mode Fault Detection

Parameter Overview

No.	Name	Description	Range	Default
F6-24	DeviceNet Idle Mode Fault Detection	Selects if a fault is detected during communication idle mode. 0: Disabled 1: Enabled	0 or 1	0

F6-30: PROFIBUS Node Address

Parameter Overview

No.	Name	Description	Range	Default
F6-30	PROFIBUS Node Address	Sets the node address for a PROFIBUS option.	0 to 125	0

F6-31: PROFIBUS Clear Mode Selection

Parameter Overview

No.	Name	Description	Range	Default
F6-31	PROFIBUS Clear Mode Selection	Selects the operation when a "Clear Mode" command is received. 0: Resets back to zero. 1: Maintains the previous value.	0 or 1	0

F6-32: PROFIBUS Map Selection

Parameter Overview

No.	Name	Description	Range	Default
F6-32	PROFIBUS Map Selection	0: PPO Type 1: Conventional	0 or 1	0

F6-36: CANopen Node ID Selection

Parameter Overview

No.	Name	Description	Range	Default
F6-36	CANopen Node ID Selection	Sets the Node ID for a CANopen option	0 to 127	99

F6-37: CANopen Communication Speed

Parameter Overview

No.	Name	Description	Range	Default
F6-37	CANopen Communication Speed	0: Auto-adjust 1: 10kbps 2: 20 kbps 3: 50 kbps 4: 125 kbps 5: 250 kbps 6: 500 kbps 7: 800 kbps 8: 1 Mbps	0 to 8	6

F6-40: CompoNet Node ID

Parameter Overview

No.	Name	Description	Range	Default
F6-40	CompoNet Node ID	Sets the Node ID for a CompoNet option.	0 to 63	0

F6-41: CompoNet Speed

Parameter Overview

No.	Name	Description	Range	Default
F6-41	CompoNet Speed	0: 93.75 kbit/s 1: Reserved 2: 1.5 Mbit/s 3: 3 Mbit/s 4: 4 Mbit/s5-25 5: Reserved	0 to 255	0

■ F7-01 to F7-04: Ethernet IP Address 1 to 4

Parameter Overview

No.	Name	Description	Range	Default
F7-01	Ethernet IP Address 1	Combining these parameters like F7-01.F7-02.F7-03.F7-04 sets the Ethernet IP address. Example: (192.168.1.10)	0 to 255	0
F7-02	Ethernet IP Address 2		0 to 255	0
F7-03	Ethernet IP Address 3		0 to 255	0
F7-04	Ethernet IP Address 4		0 to 255	0

■ F7-05 to F7-08: Subnet Mask 1 to 4

Parameter Overview

No.	Name	Description	Range	Default
F7-05	Subnet Mask 1	Combining these parameters like F7-05.F7-06.F7-07.F7-08 sets the Ethernet Subnet Mask. Example: (255.255.255.0)	0 to 255	0
F7-06	Subnet Mask 2		0 to 255	0
F7-07	Subnet Mask 3		0 to 255	0
F7-08	Subnet Mask 4		0 to 255	0

■ F7-09 to F7-12: Gateway Address 1 to 4

Parameter Overview

No.	Name	Description	Range	Default
F7-09	Gateway Address 1	Combining these parameters like F7-09.F7-10.F7-11.F7-12 sets the Ethernet Gateway Address. Example: (192.168.1.1)	0 to 255	0
F7-10	Gateway Address 2		0 to 255	0
F7-11	Gateway Address 3		0 to 255	0
F7-12	Gateway Address 4		0 to 255	0

■ F7-13: Dress Mode at Startup

Parameter Overview

No.	Name	Description	Range	Default
F7-13	Dress Mode at Startup	Selects how the Ethernet IP address is set. 0:User defined 1:BOOTP 2:DHCP	0 to 2	0

■ F7-14: Security Password

Parameter Overview

No.	Name	Description	Range	Default
F7-14	Security Password	Sets the password required for setup changes via the network. 0: No password required 1 - 9999: 4 digit password	0 to 9999	0

■ F7-15: Duplex Mode Selection

Parameter Overview

No.	Name	Description	Range	Default
F7-15	Duplex Mode Selection	0:Auto Negotiate 1:Half Duplex forced 2:Full Duplex forced	0 to 2	0

■ F7-18: Communication Speed Selection

Parameter Overview

No.	Name	Description	Range	Default
F7-18	Communication Speed Selection	0:Auto Negotiate 10:10 Mbps speed setting 100:100Mbps Speed Setting	0, 10, 100	0

■ F7-19: Web Page Access

Parameter Overview

No.	Name	Description	Range	Default
F7-19	Web Page Access	Selects the mode for modification on the Ethernet option board Web page settings. 0: All access 1: Only during stop 2: Never	0 to 2	0

■ F7-20: Gateway Selection

Parameter Overview

No.	Name	Description	Range	Default
F7-20	Gateway Selection	0: Gateway not used 1: Use Gateway	0 or 1	1

■ F7-21: Communication Loss Time Out

Parameter Overview

No.	Name	Description	Range	Default
F7-21	Communication Loss Time Out	Multiplier for communication loss detection timeout value.	0 to 300	0

5.7 H: Terminal Functions

H parameters are used to assign functions to the external terminals.

◆ H1: Multi-Function Contact Inputs

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

These parameters assign functions to the seven multi-function contact inputs located at terminals S1 through S7. Settings 0 to 9F determine the type of input for each terminal.

Note: If not using an input terminal or if using the through-mode, set that terminal to “F”.

No.	Parameter Name	Setting Range	Default
H1-01	Multi-Function Digital Input Terminal S1 Function Selection	1 to 9F	40: Forward Run Command (2-wire sequence)
H1-02	Multi-Function Digital Input Terminal S2 Function Selection	1 to 9F	41: Reverse Run Command (2-wire sequence)
H1-03	Multi-Function Digital Input Terminal S3 Function Selection	0 to 9F	24: External Fault (user selection possible)
H1-04	Multi-Function Digital Input Terminal S4 Function Selection	0 to 9F	14: Fault Reset Closed: Allows the drive to run again after the fault is cleared and the run command is removed
H1-05	Multi-Function Digital Input Terminal S5 Function Selection	0 to 9F	3 (0)*: Multi-Step Speed Reference 1
H1-06	Multi-Function Digital Input Terminal S6 Function Selection	0 to 9F	4 (3)*: Multi-Step Speed Reference 2
H1-07	Multi-Function Digital Input Terminal S7 Function Selection	0 to 9F	6 (4)*: Jog Reference Selection Takes priority over other multi-step speed references 1 through 16

*Number appearing in parenthesis is the default value after performing a 3-wire initialization.

Table 5.15 Multi-Function Contact Input Settings

Setting	Function	Page	Setting	Function	Page
0	3-Wire Sequence	–	4	Multi-Step Speed Reference 2	–
1	LOCAL/REMOTE Selection	–	5	Multi-Step Speed Reference 2	–
2	Option/Drive Selection	–	6	Jog Reference Selection	–
3	Multi-Step Speed Reference 1	–	7	Accel/Decel Time 1	–
8	Baseblock Command (N.O.)	–	40	Forward Run Command (2-wire sequence)	–
9	Baseblock Command (N.C.)	–	41	Reverse Run Command (2-wire sequence)	–
A	Accel/Decel Ramp Hold	–	42	Run Command (2-wire sequence 2)	–
B	Drive Overheat Alarm (OH2)	–	43	FWD/REV Command (2-wire sequence 2)	–
C	Terminal A2 Enable	–	44	Offset Frequency 1 Addition	–
F	Not used	–	45	Offset Frequency 2 Addition	–
10	Up Command	–	46	Offset Frequency 3 Addition	–
11	Down Command	–	60	DC Injection Braking Command	–
12	Forward Jog	–	61	External Search Command 1	–
13	Reverse Jog	–	62	External Search Command 2	–
14	Fault Reset	–	65	KEB Ride-Thru (N.C.)	–
15	Fast-Stop (N.O.)	–	66	KEB Ride-Thru (N.O.)	–
16	Motor 2 Selection	–	67	Communications Test Mode	–
17	Fast-stop (N.C.)	–	68	High-Slip Braking	–
18	Timer Function	–	6A	Drive Enable	–
19	PID Disable	–	75	Up 2 Command	–
1A	Accel/Decel Time Selection 2	–	76	Down 2 Command	–
1B	Program Lockout	–	7A	KEB Ride-Thru 2 (N.C.)	–
1E	Reference Sample Hold	–	7B	KEB Ride-Thru 2 (N.O.)	–
20 to 2F	External Fault	–	7C	Short-Circuit Braking (N.O.)	–
30	PID Integral Reset	–	7D	Short-Circuit Braking (N.C.)	–
31	PID Integral Hold	–	7E	Forward/Reverse Detection (Simple PG in V/f)	–
32	Multi-Step Speed Reference 4	–	90 to 96	DriveWorksEZ Digital Input 1 to 7	–
34	PID Soft Starter	–	9F	DriveWorksEZ Digital Input 9F	–
35	PID Input Switch	–			

Detailed Description

Setting 0: 3-Wire Sequence

When one of the digital inputs (S3 to S7) is programmed for 3-wire control, that input becomes a forward/reverse directional input. Whenever the input is open, the drive will be set for forward rotation of the motor shaft. If the input it closed, then the motor shaft will rotate in the reverse direction whenever a there is a run command entered.

Note: The run and stop commands are allotted to terminals S1 and S2.

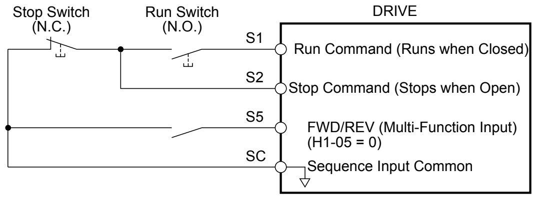


Figure 5.35 3-Wire Sequence Wiring Diagram

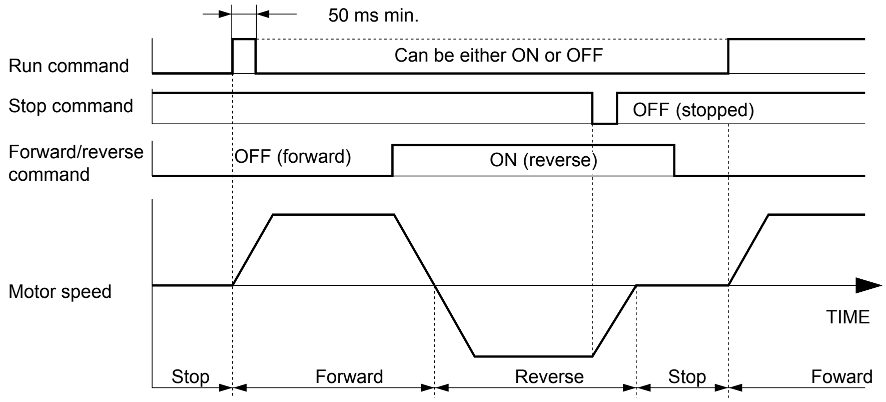


Figure 5.36 3-Wire Sequence

WARNING! *Sudden Movement Hazard. The drive may start unexpectedly if the run command is already applied when programming 3-wire control. Set b1-17 to "0" and set terminal S5 for a 3-wire sequence (H1-05 = 0). Failure to comply could result in death or serious injury from moving equipment.*

WARNING! *Sudden Movement Hazard. The motor will begin rotating when the power is turne on. may start unexpectedly if the run command is already applied when programming 3-wire control. Set b1-17 to "0" and set terminal S5 for a 3-wire sequence (H1-05 = 0). Failure to comply could result in death or serious injury from moving equipment.*

Note: When terminal S1 set for the run command closes, the drive will start operating the motor after 50 ms. If the Run command is not given at power up (b1-17 = 0), the LED will flash briefly when the power supply is cycled to indicate that protective functions are operating. Set b1-17to 1 to allow for the Run command to be given when the drive is first powered on.

Setting 1: LOCAL/REMOTE Selection

When the Run command is assigned to the LED operator, this setting is called LOCAL. When the Run command is entered from one of the control circuit terminals or from an upper controller sequence, this is referred to as REMOTE. This setting allows the input terminal to determine if the drive will run in LOCAL mode or REMOTE mode.

Status	Description
Open	LOCAL: Operation according to frequency reference and Run command from digital operator.
Closed	REMOTE: Operation according to frequency reference and Run command set by parameters b1-01 and b1-02, respectively.

Note: If one of the multi-function input terminals is set to for LOCAL/REMOTE, then the LO/RE key on the operator will be disabled. The drive cannot switch between LOCAL and REMOTE during run. When the drive is set to LOCAL, the LO/RE LED will light.

Setting 2: Option/Drive Selection

The Option/Drive Selection function allows the user to select the source for the Run command and frequency references between either the drive's terminals or an optional communication board. When a digital input is programmed for the Option/Drive Selection function (H1-☐☐ = 2), that input will function as shown in the following table:.

Input Selection Status	Source of Run Command and Frequency Reference
Open	b1-01, b1-02
Closed	b1-15, b1-16

Setting 3 to 5: Multi-Speed Reference 1 to 3

Setting 6: Jog Frequency Reference Selection

The drive can be programmed to utilize digital inputs to change between 16 presets speeds and a Jog speed. It is a two-step process to set the drive up for preset speeds. ***Refer to d1-01 to d1-16: Frequency Reference 1 to 16 on page 138***

No.	Parameter Name	Setting Range	Default
d1-01	Frequency Reference 1 (when the source of the frequency reference is assigned to the operator)	0.00 to 400.00	0.00 Hz
d1-02 to d1-16	Frequency Reference 2 to 16		0.00 Hz
d1-17	Jog Frequency Reference		6.00 Hz

When a digital input configured as Jog Frequency Reference (H1-☐☐ = 6) is closed, the active frequency reference will be the setting of parameter d1-17 (Jog Frequency Reference). Closure of this digital input alone will not initiate a Jog motion, it will only change the frequency reference. An active Run command is necessary for the drive to operate at the Jog frequency reference. To change to the Jog frequency reference and provide a Run command with a single input, refer to digital input settings 12 and 13.

Note: The Jog frequency reference overrides other frequency references.

Setting 7: Accel/Decel Time Selection 1

When any of the multi-function contact input selections (H1-01 to H1-06) are set to 7 and 1A, up to four acceleration and deceleration times can then be selected by opening and closing the appropriate accel/decel time selection commands (terminals 3 to 8). ***Refer to C1-01 to C1-08: Accel/Decel Times 1 to 4 on page 130***.

Setting 8: External Baseblock, N.O.

Setting 9: External Baseblock, N.C.

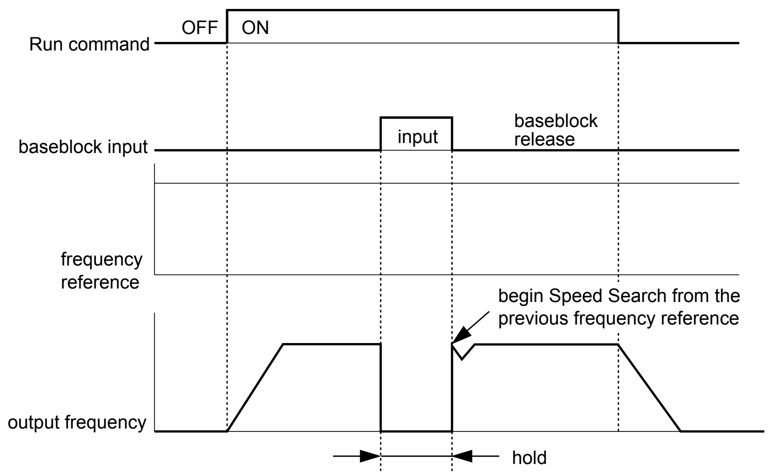
Settings of 8 and 9 assign the baseblock command to the external terminals. When the drive is commanded into baseblock, gating of the output transistor stops and output voltage/frequency drops to 0 (i.e., the motor coasts). During this time, the alarm “bb” flashes will flash on the LED operator to indicate baseblock. For more information on alarms, see “5.2. Alarms and Errors” in the V1000 Basic Manual. When baseblock ends, the drive performs Speed Search to get the motor running again.

Status	Description
Open	Normal operation
Closed	Interrupt output (baseblock)

Setting 9 (instead of 8) reverses the table above: baseblock will execute when the terminal is open.

The drive has two ways to find the speed of the motor: Current Detection Speed Search and Speed Estimation. The method used when the baseblock input is removed is determined by b3-24.

NOTICE: *Do not use the baseblock excessively with hoist-type applications. Failure to comply will result in sudden motor coasting when the baseblock command is entered, causing the load to slip.*



External Baseblock Characteristics

Function A: Accel/Decel Ramp Hold

The Accel/Decel Ramp Hold function will clamp (“hold”) the speed of the output frequency whenever a digital input that has been programmed for it (H1-☐☐ = A) is closed. All acceleration or deceleration will cease, and the drive will hold the current speed. Once the input is opened again, acceleration or deceleration resumes.

If the Accel/Decel Ramp Hold function is enabled (d4-01 = 1), the drive will save the output frequency to memory whenever the Ramp Hold input is closed. When the interrupted power is restored and a new Run command is entered, the frequency reference becomes the frequency reference that was saved (provided that the Accel/Decel Ramp Hold input is still closed).

No.	Parameter Name	Setting Range	Default
d4-01	Frequency Reference Hold Function Selection	0: Disabled. Drive starts the motor with a frequency reference of 0 if the power is interrupted. 1: Enabled. Drive starts the motor at the frequency reference that was saved just before the power went out.	0

Function B: Drive Overheat Alarm (OH2)

Triggers an OH2 alarm when the contact closes. Because this is an alarm, drive operation is not affected.

For more information on alarms, see “5.2. Alarms and Errors” in the V1000 Basic Manual.

Function C: Terminal A2 Enable

Causes the input to analog input terminals A1 and A2 to be ignored unless the contact is closed.

For more information on multi-function analog input settings, ***Refer to H3-01: Terminal A1 Signal Level Selection on page 178***

Status	Description
Open	Disables terminals A1, A2
Closed	Enables terminals A1, A2

No.	Parameter Name	Setting Range	Default
H3-09*	Terminal A2 Signal Level Selection	0: 0 to +10 V (with lower limit) 1: 10 to 10 V (no lower limit) 2: 4 to 20 mA (9 bit input) 3: 0 to 20 mA	2

Parameter Details

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

*1. When using terminal A2, make sure DIP switch S1 is set appropriately for the type of input used (current or voltage).
*2. By tuning the gain and bias levels, an input of less than 5 V can be treated as a negative value.

Function F: Not Used

Any digital input that is not used or is used as through-put should be set to F. This way drive operation will not be affected by the switch, whether it is open or closed.

Setting 10: Up Command

Setting 11: Down Command

Using two digital inputs, the drive can operate with the same type of functionality as a motor operated potentiometer (MOP). One digital input can be programmed as the Up input (H1-0x= 10) to increase the frequency reference, and another digital input can be programmed as the Down input (H1-0x= 11) to decrease the frequency reference. To use these functions, the source of the frequencyr reference must be assigned to the terminals (b1-02 = 1).

Status	Description
Open	Maintain the present frequency reference (no effect)
Closed	Increase or decrease the frequency reference

An opE03 error will occur under the following conditions, indicating that there is a contradictory setting among the functions assigned to terminals S1 to S7:

- The Up function cannot be programmed without also programming the Down function (or vice-versa)
- UP/DOWN function is assigned to the terminals while the Accel/Decel Ramp Hold function is also programmed into other digital inputs

For more information on alarms, see “5.2. Alarms and Errors” in the V1000 Basic Manual.

No.	Parameter Name	Setting Range	Default	Page
d2-01	Frequency Reference Upper Limit	0.0 to 110.0	100.0%	–
d2-02	Frequency Reference Lower Limit	0.0 to 110.0	0.0%	–
d2-03	Master Speed Reference Lower Limit	0.0 to 110.0	0.0%	–
E1-04	Max Output Frequency (FMAX)	40.0 to 400.0*	60.0 Hz*	–

When using PM Open Loop Vector Control, these settings will change according to the motor code set to E5-01.

Note: Once the Up/Down functions are programmed, the preset speeds are disabled and the analog frequency reference input becomes a potential frequency reference lower limit. The lower limits for Up/Down are the greater of the analog frequency reference and the programmed frequency reference lower limit (d2-03). The upper limit will be d2-01 (Frequency Reference Upper Limit).Once a Run command is issued the drive will accelerate immediately to the lower limit. When Up/Down functions are not used, the upper limit is the maximum output frequency (E1-04).The status of the d4-01 parameter will affect the performance of the drive after power is cycled to the drive and a fresh Run command is issued. If d4-01= “0: Disabled”, the Run command will cause the drive to ramp to the frequency reference lower limit. However, if d4-01= “1: Enabled”, the Run command will cause the drive to ramp to the last frequency referenced by the Up/Down function before the Run command was removed and the power cycled. Even if d4-01= “1: Enabled”, the previous frequency reference can be reset to the frequency reference lower limit automatically by closing either the Up or Down input without having a Run command active.

No.	Parameter Name	Setting Range	Default	Page
d4-01	Frequency Reference Hold Function Selection	0: Disabled. Drive starts the motor with a frequency reference of 0 if the power is interrupted. 1: Enabled. Drive starts the motor at the frequency reference that was saved just before the power went out.	0	–

Below is an example of drive operation when the Up function is assigned to terminal S3 and the Down function to terminal S4.

No.	Parameter Name	Setting
H1-03	Multi-Function Digital Input Terminal S3 Function Selection	10: Up Command
H1-04	Multi-Function Digital Input Terminal S3 Function Selection	11: Down Command

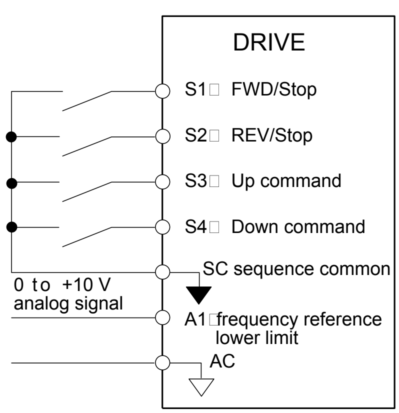
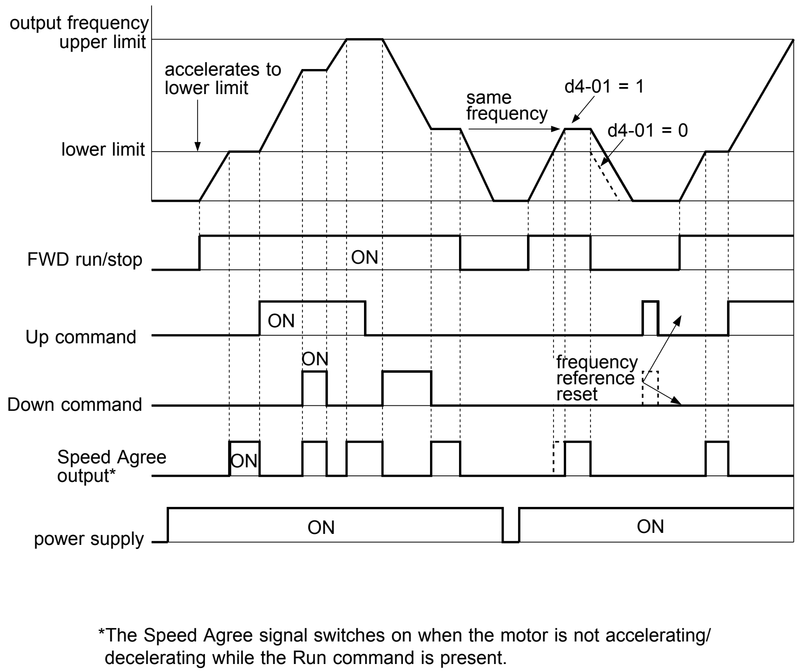


Figure 5.37 Up/Down Functions and Terminal Assignments



*1. The frequency matching signal (Speed Agree) turns on when the motor is not accelerating/decelerating while the Run command is on.
*2. The frequency reference can be reset by entering the Up or Down commands while the drive is stopped.

Up/Down Command Operation

Setting 12: FJOG Reference

Setting 13: RJOG Reference

Overview

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

Setting	Description
12	Forward Jog (Closed: Forward run at the frequency reference set to d1-17)
13	Reverse Jog (Closed: Reverse run at the frequency reference set to d1-17)

No.	Parameter Name	Setting Range	Default	Page
d1-17	Jog Frequency Reference	0.00 to 400.00*	6.00 Hz	–

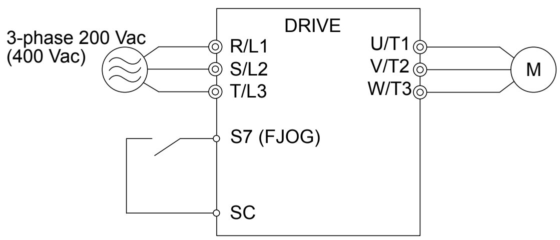
*Parameter d1-17 becomes the frequency reference when Jog is activated.

The setting range for E5-01 changes if using PM Open Loop Vector.

Note: The Forward Jog and Reverse Jog commands override all other frequency references. However, if the drive is set to prohibit reverse rotation (b1-04 = 1), then activating Reverse Jog will have no effect. If both the Forward Jog and Reverse Jog are input simultaneously for 500 ms or more, an external fault will occur and the drive will stop using the method set by b1-03.

Detailed Description

Below is an example of the Jog function when H1-07 = 12 and d1-17 = 6.00 Hz.



Jog Operation Using Terminals

Parameter Details

5

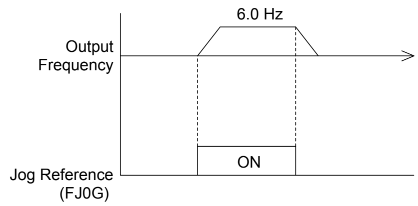
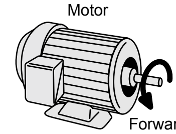


Figure 5.38 Jog Sequence

Setting Up the Jog Function

This example shows how terminal S7 (H1-07) activates the Forward Jog function.

	Procedure		Display/Result
1.	Turn on the power to the drive.	⇒	F 0.00 ALM REV DRV CUT
2.	Press V until the parameter setting screen is displayed.	⇒	PAr
3.	Press ENTER to enter the list of parameters.	⇒	A1-01
4.	Press ENTER to enter the list of parameters.	⇒	A1-01
5.	Use the > RESET and Λ keys to scroll to parameter H1-07 (Multi-Function Digital Input Terminal S7 Function Selection). **Note:** selecting any parameter between H1-01 to H1-07 will produce the same result.	⇒	H1-07
6.	Press ENTER to display the setting value for H1-07.	⇒	06
7.	Use the Λ and > RESET keys to set 12 (the setting value for Forward Jog.) **Note:** set 13 for Reverse Jog.	⇒	12
8.	Press ENTER to save the settings.	⇒	End

	Procedure		Display/Result
1.	Turn on the power to the drive, making sure the drive is set to REMOTE	⇒	F 0.00 ALM REV DRV CUT F00.00
2.	Close terminal S7 and run the drive at 6.00 Hz. **Note:** when the Jog reference is input, there is no need to enter a run command.	⇒	
3.	Open terminal S7 to stop the drive.		

Setting 14: Fault Reset

Whenever the drive detects a fault condition, the fault output contact will close and the drive's output will shut off. The motor then coasts to stop (specific stopping methods can be selected for some faults such as L1-04 for motor overheat). Once the run command is removed, the fault can be cleared by either the RESET key on the digital operator or by closing a digital input configured as a Fault Reset (H1-☐☐ = 14).

Note: Fault reset commands are ignored as long as the Run command is present. To reset a fault, first remove the Run command. For more information on alarms, see "5.2. Alarms and Errors" in the V1000 Basic Manual.

Setting 15: Fast Stop, N.O.

Setting 17: Fast Stop, N.C.

The Fast Stop function operates much like an emergency stop input to the drive. While in the run mode, if a Fast Stop is input to the drive, the drive will decelerate to a stop with the deceleration time determined by C1-09 (Fast Stop Time).

- To trigger the Fast Stop function with a N.O. switch, set 15
- To trigger the Fast Stop function with a N.C. switch, set 16

The drive will not run from either the terminals or the digital operator while the Fast Stop is being input. To restart the drive, the Fast Stop input must be removed and the Run command must be cycled.

No.	Parameter Name	Setting Range	Default	Page
C1-09	Fast Stop Time	0.0 to 6000.0	10.0 s	–

The Fast Stop feature is also available as one of the stopping methods for when a fault is detected.Therefore, be sure to set an acceptable deceleration time in parameter C1-09 when using the Fast Stop feature.

Note: The setting range of C1-09 is dependent on C1-10 Accel/Decel Time Setting Unit.

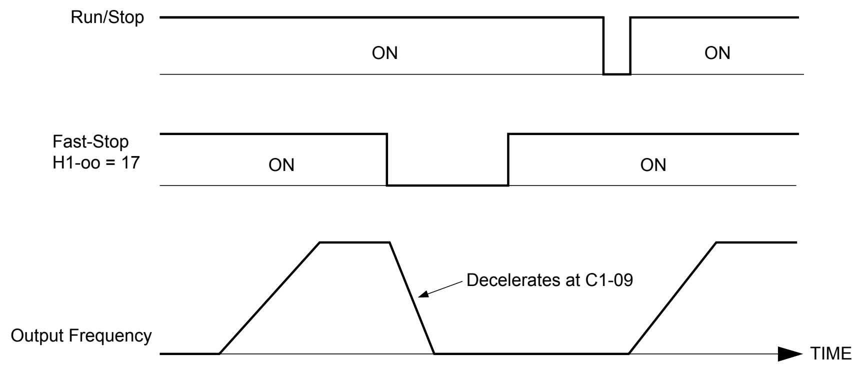


Figure 5.39 Fast Stop Sequence

NOTICE: *Rapid deceleration can trigger an overvoltage fault. When faulted, the drive output shuts off, allowing the motor to coast. The result is an uncontrolled motor state. Therefore, be sure to set an acceptable deceleration time in parameter C1-09 when using the Fast Stop feature*

Setting 16: Motor 2 Selection

The drive has the capability to control 2 different motors independently. Motor 2 may be selected by closing the multi-function contact input programmed for motor 2 selection (H1-☐☐ = 16). When motor 2 is selected, E3 and E4 parameters set the V/f pattern, control method, and motor specifications.

Acceleration and deceleration times for motor 2 can be set to parameters C1-05 through C1-08.

Setting 18: Timer Function

The Timer Function works independently from the drive. For Timer operation, a digital input must be configured for a Timer Function start (H1-☐☐ = 18), a digital output must be configured as a Timer Function output (H2-☐☐ = 12), and the Timer Function On-Delay and Off-Delay parameters (b4-01 and b4-02, respectively) must be programmed.

Table 5.16 Related Parameters

No.	Name	Setting Range	Default	Page
b4-01	Timer Function On-Delay Time	0.0 to 300.0	0.0 s	–
b4-02	Timer Function Off-Delay Time	0.0 to 300.0	0.0 s	–

Once the applicable parameter are programmed the Timer Function start digital input must be closed at least as long as the setting of b4-01 before the Timer Function output will close. The Timer Function input must be open for at least as long as the setting of b4-02 before the Timer Function output will re-open.

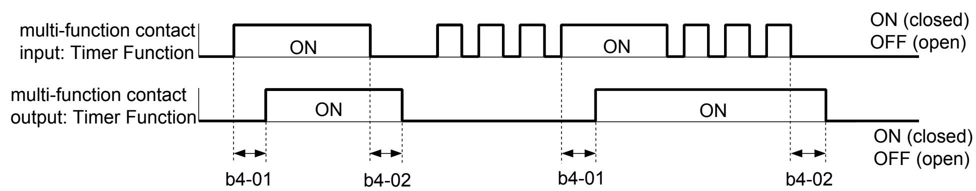


Figure 5.40 Timer Function Timechart

Note: For more information on the Timer Function, *Refer to b4: Delay Timers on page 122*.

Setting 19: PID Control Cancel

When the PID Function has been enabled by b5-01 (PID Mode Selection), it can be indefinitely disabled by closing a digital input configured as a PID Disable (H1-☐☐ = 19). When disabled, the drive operates as a standard drive that does not have PID enabled.

No.	Parameter Name	Setting Range	Default	Page
b5-01	PID Function Setting	0: Disabled 1: D = Feedback 2: D = Feed-Forward 3: Freq. Ref. + PID output (D = Feedback) 4: Freq. Ref. + PID output (D = Feed-Forward)	0	–

Setting 1A: Multi-Acceleration/Deceleration

When any of the multi-function contact input selections (H1-01 to H1-07) are set to "7" and "1A", up to four accel/decel times can then be selected by opening or closing the appropriate accel/decel time selection commands (terminals S1 to S7). For more information on accel/decel times, *Refer to C1: Acceleration and Deceleration Times on page 130*.

Setting 1B: Program Lockout

A Program Lockout digital input will allow changing of parameter values when the input is closed but prevent changing of any drive parameter value except the frequency reference when it is open. Parameter values can be viewed even when a Program Lockout is active.

Status	Description
Open	Parameters settings are locked and cannot be changed.

Parameter Details
5

Status	Description
Closed	Parameter settings can be changed.

Setting 1E: Analog Frequency Reference Sample / Hold

This function allows the user to sample an analog signal being input to A1, A2, or A3 and change the frequency reference to the sampled level. Once the digital input that is configured for the Analog Frequency Reference Sample / Hold function is held for at least 100 ms, the drive reads the analog input and changes the frequency reference to the newly sampled speed.

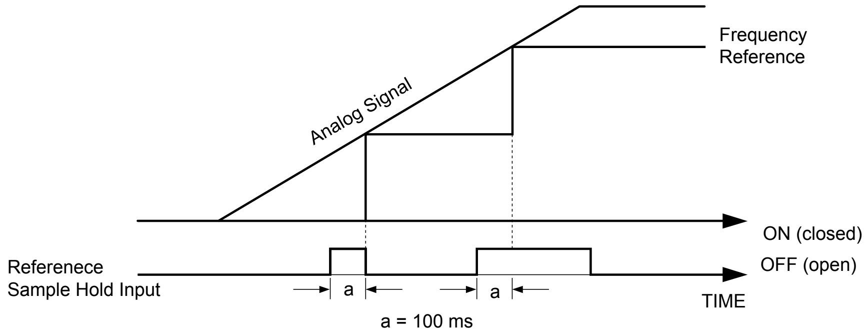


Figure 5.41 Analog Frequency Reference Sample/Hold

- The following functions cannot be programmed to a multi-function input terminal the same time as the Analog Frequency Reference Sample / Hold function. Doing so will cause an oPE03 error.
  - ♦ Hold Accel/Decel Stop (setting: A)
  - ♦ Up command, Down command (setting: 10, 11)
  - ♦ Offset Frequency (setting: 44 to 46)
  - ♦ Up or Down functions (setting: 75, 76)
- The analog frequency reference that has been sampled by this function will be cleared if the power is shut off.
- When the power is shut off and the sampled analog frequency reference is cleared, the frequency reference is reset to 0.
- Remember that the digital input must be held for at least 100 ms. If the digital input is not held for at least 100 ms, the analog input will not be sampled.

Setting 20 to 2F: External Fault

By using the External Fault function, the drive can be stopped when problems occur with external devices.

To use the external fault function, set one of the multi-function digital inputs to any value between 20 to 2F. The operator will display EF□ where □ is the number of the terminal (terminal S□) to which the external fault signal is assigned.

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

Select the value to be set in H1-01 to H1-06 from a combination of any of the following three conditions:
- Signal input level from peripheral devices
- External fault detection method
- Operation after external fault detection

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

Setting	Terminal Status*1		Detection Method*2		Stopping Method			
	N.O.	N.C.	Always Detected	Detected during Run	Ramp to Stop (fault)	Coast to Stop (fault)	Fast Stop (fault)	Alarm Only (continue running)
20	O		O		O			
21		O	O		O			
22	O			O	O			
23		O		O	O			
24	O		O			O		
25		O	O			O		
26	O			O		O		
27		O		O		O		
28	O		O				O	
29		O	O				O	
2A	O			O			O	
2B		O		O			O	
2C	O		O					O
2D		O	O					O
2E	O			O				O
2F		O		O				O

*1. Determine the terminal status for each fault: whether the terminal is normally open or normally closed.
*2. Determine whether detection for each fault should be enabled only during run or always detected.

- Always Detected: Detection enabled as soon as the drive is powered up
- Detection during Run: Detection enabled only during run.

Setting 30: PID Integral Reset

By configuring one of the digital inputs as an Integral Reset Input, (H1-0☐ = 30), the value of the integral component of PID control can be reset to 0 whenever the configured input is closed. The integral component of PID control will be held at 0 as long as the configured digital input is held closed.

Note: For more informatin on PID control, *Refer to b5: PID Control on page 122*.

Setting 31: PID Integral Hold

By configuring a digital input for Integral Hold (H1-0☐ = 31), the value of the integral component of the PID control can be forced to clamp at the value it was at when the input is closed. The integral component of the PID control returns to accumulating the error when the digital input is open again.

Holding the integral value can be useful during periods when the error can build up naturally, such

Note: For more informatin on PID control, *Refer to b5: PID Control on page 122*.

Function 32: Multi-Step Speed 4

For more details, see the descriptions for setting functions 3, 4, and 5 on page *160*.

Function 34: PID SFS Cancel

By configuring a digital input as a PID SFS Cancel input (H1-0☐ = 34), the operator will be able to use a contact closure to remove the acceleration and deceleration times that are applied to changes in the PID setpoint by the b5-17 parameter. If the digital input configured as PID SFS Cancel is closed, the PID setpoint accel/decel set to b5-17 will be disregarded.

Note: For more informatin on PID control, *Refer to b5: PID Control on page 122*.

Function 35: PID Input Level Selection

When using the PID Function built into the drive, the set point that has been selected is compared with the feedback that was measured. The difference is called the error. The proportional and integral function are applied to this error. For some applications it may be appropriate to invert the input to the PID block. This can be accomplished by setting one of the digital inputs up as an Input Level Selection (H1-0☐ = 35). When the terminal for the input level is closed, the error will be inverted before it is passed to the PID block.

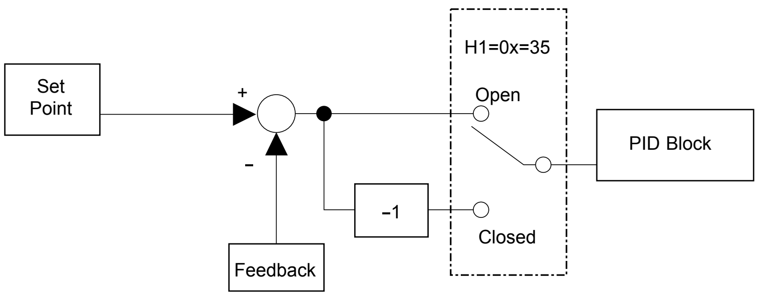


Figure 5.42 PID Input Characteristics

Setting 40: Forward Run Command (2-Wire Sequence)

Setting 41: Reverse Run Command (2-Wire Sequence)

Assigns a 2-wire sequence to the input terminals so that a forward or reverse Run command is issued when the contacts close.

Control Circuit Terminal	Closed	Open
S1	Forward Run	Stop
S2	Reverse Run	Stop

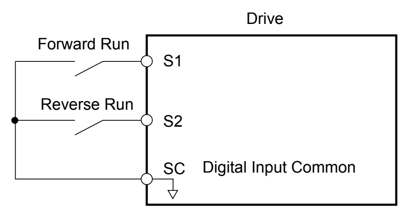


Figure 5.43 2-Wire Sequence Wiring Diagram

Note: Settings 42 and 43 cannot be simultaneously set to the multi-function input terminals.

Setting 42: 2-Wire Sequence 2 (Run Command)

Setting 43: 2-Wire Sequence 2 (Forward/Reverse Command 2)

Sets up a 2-wire sequence to the input terminals. One of the terminals executes the Run command when closed, while the other determines the direction of the Run command: forward when closed, reverse when open.

Note: Settings 40 and 41 cannot be simultaneously set to the multi-function input terminals.

Setting 44: Offset Frequency 1 Addition

Setting 45: Offset Frequency 2 Addition

Setting 46: Offset Frequency 3 Addition

Operates much the same as a bias. When the input is switched on, the value set to d7-01, d7-02, and d7-03 are added to the frequency reference.

Note: For more information, *Refer to d7: Offset Frequencies on page 143*.

Setting 60: DC Injection Braking

When a DC Injection Braking command is input while the drive is stopped, DC Injection Braking operation is activated. When a Run command or a Jog command is input, DC Injection Braking is released to start operation (Jog operation has priority).

The diagram below illustrates the DC Injection Braking function.

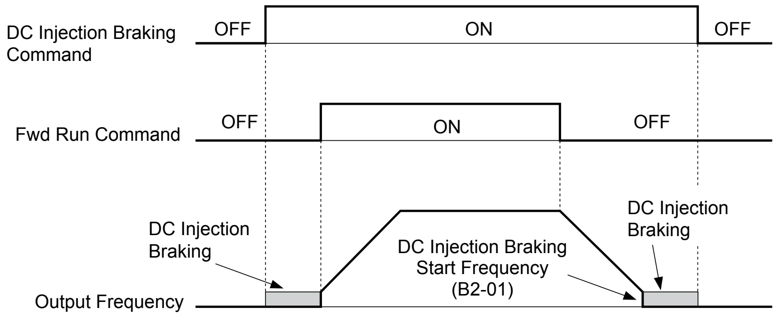


Figure 5.44 DC Injection Braking Input Timing Diagram

Setting 61: Speed Search 1

Setting 62: Speed Search 2

The speed search function detects the actual speed of a coasting motor and restarts it smoothly from that speed. It is useful for getting the application going after momentary power loss, and finding the speed of an idling fan.

No.	Parameter Name	Setting Range	Default	Page
b3-01	Speed Search Selection at Start	0: Enabled 1: Disabled	Determined by A1-02	–
b3-24	Speed Search Method Selection	0: Current Detection Type 1: Speed Estimation	0	–

When the Speed Search method is set for Current Detection Speed Search (b3-24 = 0), then the input terminal set for Speed Search 1 (H1-☐☐ = 60) will begin looking for the motor speed from the maximum output frequency when enabled. Speed Search 2 (H1-☐☐ = 61) instead starts looking for the motor speed starting at the frequency reference. When an input terminal set to 60 or 61 closes, Speed Search is performed regardless of whether b3-01 is enabled or not.

Note: Operator error oPE03 will result if both Speed Search 1 and Speed Search 2 are set to the input terminals at the same time. Only one may be selected. If baseblock occurs, Speed Search cannot begin until the minimum baseblock time set to L2-03 passes. Speed Search 1 and Speed Search 2 will function the same when using Current Detection Speed Search (b21-24 = 1).

Setting 65: KEB Ride-Thru 1, N.C.

Setting 66: KEB Ride-Thru 2, N.O.

The Kinetic Energy Braking (KEB) control circuit attempts to maintain the DC bus voltage at an optimum level [1.35 x ~ input voltage (E1-01)] during momentary power loss, by using load inertia to regenerate voltage back to the DC bus. The drive decelerates at the Fast Stop rate set to C1-09 until power is restored, or until the time runs out and an undervoltage fault (UV) occurs. The larger the inertia, the longer the deceleration rate can be extended. If the inertia is small, then the drive must decelerate quickly to regenerate voltage back to the DC bus, and thus the ride-through time is shorter.

No.	Parameter Name	Setting Range	Default	Page
E1-01	Input Voltage Setting	155 to 255 *1	200 V *1	–
L2-06	KEB Deceleration Time	0.0 to 200.0	0.0 s	–
L2-07	Momentary Power Loss Ride-Thru Time	0.0 to 25.5	0.0 s *2	–

*1. This value is for a 200 V class drive. Double the value when using 400 V class units.

*2. When set to 0.0, the drive accelerates up to speed at the acceleration rate set to C1-01 to 08.

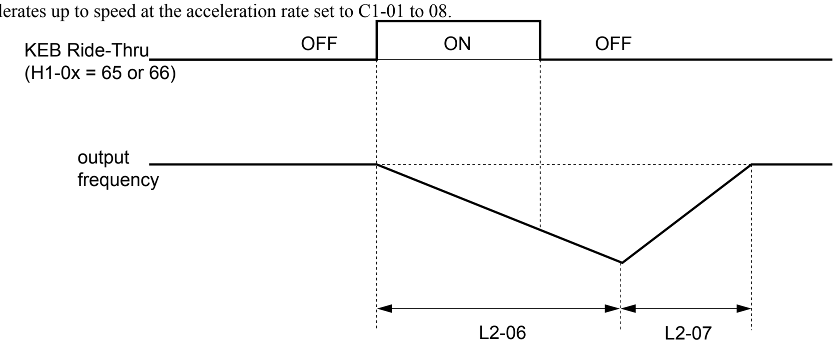


Figure 5.45 KEB Ride-Thru Timing Diagram

Setting 67: Communication Test Mode

The drive has a built-in function for self-diagnosing the serial communications operation. The test involves wiring the send and receive terminals of the RS-485/422 port together. The drive transmits data and then confirms the communications are received normally.

Setting 68: High Slip Braking

If the load inertia is large the High Slip Braking function can be used to shorten the deceleration time compared to simply coasting to stop. The High Slip Braking function manipulates the output frequency while monitoring the output current and DC bus to create a large slip condition. It consumes regenerative energy created as the motor slows, and this energy is consumed in the motor windings. This slip is then used to slow the motor until it stops.

The result is a relatively quick way of stopping the motor.

Setting 6A: Drive Enable

A digital input configured as a Drive Enable input (H1-0□ = 6A) will prevent the drive from executing a Run command until the input is closed. When the Drive Enable input is open, the digital operator will display “dnE to indicate that the drive is disabled. If a Run command is closed prior to the Drive Enable input being closed, then the drive will not run until the Run command is cycled. If the Drive Enable input is opened while the drive is running, the drive will stop using the method set by parameter b1-03.”

No.	Parameter Name	Setting Range	Default	Page
b1-03	Stopping Method Selection	0: Ramp to Stop 1: Coast to Stop 2: DC Injection Braking to Stop 3: Coast with Timer	0	–

Note: DC Injection Braking is not possible in PM Open Loop Vector.

Setting 75: Up 2

Setting 76: Down 2

These functions raise or lower the frequency reference when the terminals close. For more information, refer to *Table 5.17* .

Settings for Terminals S1 to S7	Closed	Open
75: Up 2	Increases or decreases the frequency reference	No change (maintains present speed)
76: Down 2		

Note: Set the Up 2 and Down 2 functions as a pair. This function requires that the source of the Run command be assigned to the control circuit terminals (b1-02 = 1).

Table 5.17 Up 2 and Down 2

<table>
<tr><th>Function</th><th>Frequency Reference</th><th>d4-03 Frequency Reference Bias Step (Up/Down 2)</th><th>d4-05 Frequency Reference Bias Operation Mode Selection (Up/Down 2)</th><th>d4-01 Frequency Hold Function</th><th>Operation</th><th>Frequency Saved</th></tr>
<tr><td>1</td><td rowspan="3">Multi-Step Speed Reference</td><td rowspan="3">0</td><td rowspan="2">0</td><td>0</td><td rowspan="2">Accelerates while the Up 2 function is closed, decelerates while Down 2 is closed, holds the output frequency from the Up 2 or Down 2 functions until the frequency reference is changed. Operates with the frequency reference in all other situations</td><td>Not saved</td></tr>
<tr><td>2</td><td>1</td><td>After the output frequency is held for 5 s, the value sampled with the Multi-Step Speed reference during Hold is set as the frequency reference, and d4-06 is reset to 0.</td></tr>
<tr><td>3</td><td>1</td><td>--</td><td>Accelerates while the Up 2 function is closed, decelerates while Down 2 is closed. Otherwise operates by the frequency reference</td><td>Not saved</td></tr>
<tr><td>4</td><td rowspan="2">Multi-Step Speed Reference</td><td rowspan="2">0</td><td rowspan="2">--</td><td>0</td><td rowspan="2">When the Up 2 is enabled, drive accelerates up to the frequency reference plus d4-03. When Down 2 is enabled, drive decelerates down to the frequency reference minus d4-03. Holds the frequency after Speed Agree is reached, otherwise follows the frequency reference.</td><td>Not saved</td></tr>
<tr><td>5</td><td>1</td><td>After the output frequency is held for 5 s, the value sampled with the Multi-Step Speed reference during Hold is set as the frequency reference, and d4-06 is reset to 0.</td></tr>
<tr><td>6</td><td rowspan="2">Other (analog communications, etc.)</td><td rowspan="2">0</td><td rowspan="2">0</td><td>0</td><td rowspan="2">While Up 2 is closed, drive accelerates. While Down 2 is closed, the drive decelerates. In both situations, though, the drive will hold the bias until Speed Agree is reached if the change in the frequency during accel/decel is greater than the analog frequency fluctuation limit. When Up 2 or Down 2 is enabled, drive holds the bias until the frequency reference changes. Otherwise uses the frequency reference.</td><td>Not saved</td></tr>
<tr><td>7</td><td>1</td><td>After the output frequency is held for 5 s, the value sampled during Hold is set to d4-06. The frequency reference cannot be overwritten, so only the bias is saved.</td></tr>
<tr><td>8</td><td rowspan="3">Other: Analog, Comm., etc.</td><td>0</td><td>1</td><td>--</td><td>When the Up 2 is enabled, drive accelerates up to the frequency reference plus d4-03. When Down 2 is enabled, drive decelerates down to the frequency reference minus d4-03. In both situations, though, the drive will clear the bias until Speed Agree is reached if the change in the frequency during accel/decel is greater than d4-07.</td><td>Not saved</td></tr>
<tr><td>9</td><td rowspan="2">¼0</td><td rowspan="2">--</td><td>0</td><td rowspan="2">When the Up 2 is enabled, drive accelerates up to the frequency reference plus d4-03. When Down 2 is enabled, drive decelerates down to the frequency reference minus d4-03. Holds the frequency after Speed Agree is reached, otherwise follows the frequency reference.</td><td>Not saved</td></tr>
<tr><td>10</td><td>1</td><td>After the output frequency is held for 5 s, the value sampled during Hold is set to d4-06. The frequency reference cannot be overwritten, so only the bias is saved.</td></tr>
</table>

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

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

For details on KEB Ride-Thru 1, see page 168.

KEB Ride-Thru 2 adjusts the deceleration rate using load inertia data and regenerative power for smooth deceleration. This requires that the motor and load inertia ration be set to L3-25, as well as the motor acceleration time caculated from inertia calculations be set to L3-24.

Setting 7C: Short Circuit Braking, N.O.

Setting 7D: Short Circuit Braking, N.C.

Short Circuit Braking commands (both the N.O. and N.C. terminal settings) are for use with PM Open Loop Vector only.

Status	Description
Open	Normal operation
Closed	Short-Circuit Braking

Setting 7E: Forward Reverse Detection (Simple PG in V/f)

Status	Description
Open	Forward
Closed	Reverse

Assigns the direction of speed feedback to one of the multi-function terminals using the Pulse Train Input.

Setting 90 to 96: DriveWorksEZ Digital Input 1 to 7

Setting 9F: DriveWorksEZ Function Disable (requires A1-07 = 2)

This function is for use with DriveWorksEZ. Contact Yaskawa for more information on DriveWorksEZ.

◆ H2: Multi-Function Outputs

■ H2-01: Terminal MA, MB, and MC Function Selection

■ H2-02: Terminal P1 Function Selection

■ H2-03: Terminal P2 Function Selection

The drive has three multi-function output terminals. Set parameters H2-01 to H2-03 between 0 and 192 to assign functions to these terminals. Default values are listed in the table below.

No.	Parameter Name	Setting Range	Default
H2-01	Terminal MA, MB and MC Function Selection (relay)	0 to 192	E: Fault Closes when a fault occurs (excluding CPF00, CPF01).
H2-02	Terminal P1 Function Selection (open-collector)	0 to 192	0: During RunCloses when the Run command is present or when there is voltage output.
H2-03	Terminal P2 Function Selection (open-collector)	0 to 192	2: Speed Agree 1 (detection width set to L4-02)

Note: If not using an input terminal or if using it in the through-mode, be sure to set that terminal to “F”.

Below is a circuit diagram for the multi-function output terminals.

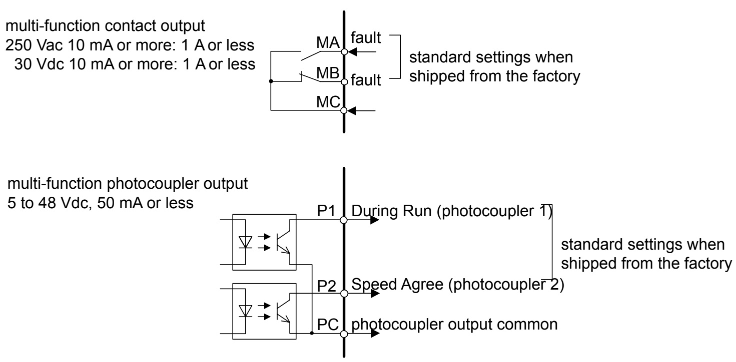


Figure 5.46 Multi-Function Output Circuit Diagram

Table 5.18 Multi-Function Output Terminal Settings

Setting	Function	Page	Setting	Function	Page
0	During Run	–	19	Torque Detection 2 (N.C.)	–
1	Zero Speed	–	1A	Reverse Direction	–
2	Fref/Fout Agree 1	–	1B	Baseblock 2	–
3	Fref/Fset Agree 1	–	1C	Motor 2 Selection	–
4	Frequency (FOUT) Detection 1	–	1E	Restart Enabled	–
5	Frequency (FOUT) Detection 2	–	1F	Overload OL1 (OL1 Alarm)	–
6	Drive Ready	–	20	OH Pre alarm	–
7	DC Bus Undervoltage	–	22	Mechanical Weakening (N.O.)	–
8	During Baseblock	–	30	During Torque Limit	–
9	Option Reference	–	37	During Frequency Output	–
A	Local/Remote	–	38	Drive Enable	–
B	Torque Detection 1 (N.O.)	–	39	Watt Hour Pulse Output	–

Setting	Function	Page	Setting	Function	Page
C	Loss of Reference	–	3C	Drive Mode	–
D	Braking Resistor Fault	–	3D	Speed Search	–
E	Fault	–	3E	PID Feedback Loss	–
F	Not used	–	3F	PID Feedback Fault	–
10	Alarm	–	4A	KEB Operation	–
11	Reset Command Active	–	4B	Short-Circuit Brake	–
12	Timer Output	–	4C	During Fast-stop	–
13	Fref/Fout Agree 2	–	4D	OH Pre-alarm Time Limit	–
14	Fref/Fset Agree 2	–	90	DriveWorksEZ Digital Output 1	–
15	Frequency Detection 3	–	91	DriveWorksEZ Digital Output 2	–
16	Frequency Detection 4	–	92	DriveWorksEZ Digital Output 3	–
17	Torque Detection 1 (N.C.)	–	100 to 192H	H2 Parameter Functions Reversed Output Switching of 0 to 92	–
18	Torque Detection 2 (N.O.)	–	–	–	–

Detailed Description

Setting 0: During Run

Closes whenever the Run command is provided and the drive is outputting voltage. This includes deceleration and DC Injection Braking.

Status	Description
Open	Drive is stopped
Closed	During run (which includes anytime their is a voltage output)

Setting 37: During Frequency Output

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

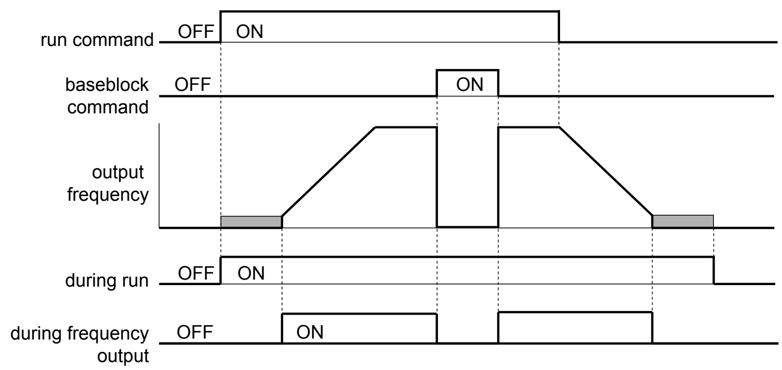


Figure 5.47 During Run Timing Diagram

Setting 1: Zero Speed

Terminal closes whenever the output frequency falls below the minimum output frequency set to E1-09.

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

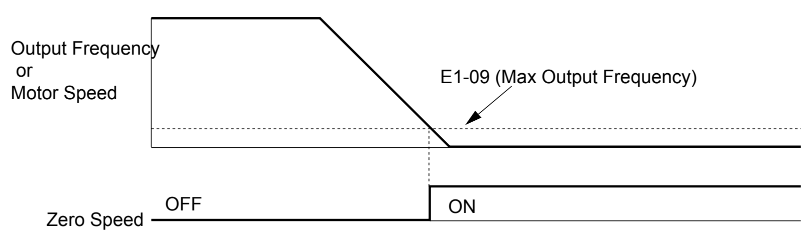


Figure 5.48 Zero-Speed Timechart

Setting 2: Speed Agree 1

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

Status	Description
Open	Output frequency does not match the frequency reference while the drive is running
Closed	Output frequency is within the Speed Agree Width (L4-02) set for the frequency reference

Setting 3: User-Set Speed Agree 1

Closes whenever the actual output frequency 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 does not match the frequency reference while the drive is running
Closed	Output frequency and the frequency reference are both equal to L4-01 ± hysteresis for L4-02

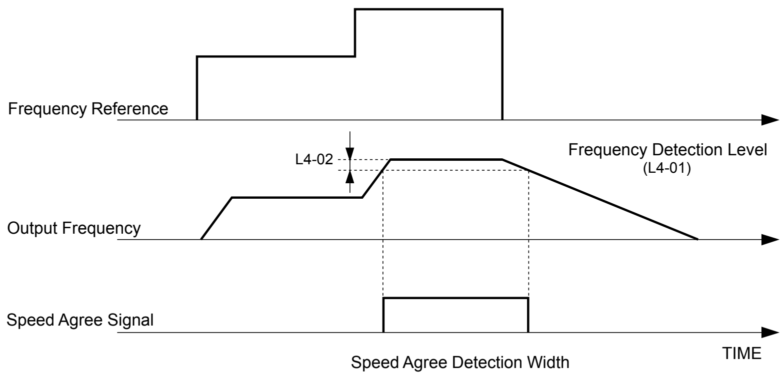


Figure 5.49 User-Set Speed Agree Timing Diagram

Setting 4: Frequency Detection 1

Output closes whenever the output frequency is equal to or below the value of the programmed Speed Agreement Level (L4-01). The Speed Agreement Width (L4-02) is the hysteresis to Frequency Detection 1.

Status	Description
Open	Drive is stopped or the condition described below is not true
Closed	Frequency Detection 1 > (+L4-01 greater than or equal to output frequency greater than or equal to -L4-01, L4-02)

Note: The terminal opens when the output for Frequency Detection 1 reaches the level set to L4-01. Frequency Detection 1 can also be used when the motor is rotating in reverse.

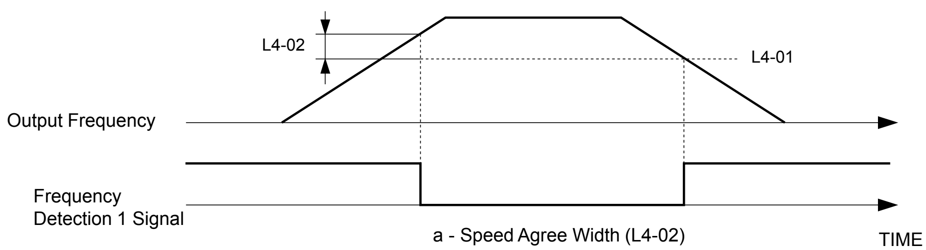


Figure 5.50 Frequency Detection 1 Timing Diagram

Setting 5: Frequency Detection 2

Output closes whenever the output frequency is equal to or above the value of the programmed Speed Agreement Level (L4-01). The Speed Agreement Width (L4-02) is the hysteresis to Frequency Detection 2.

Status	Description
Open	Drive is stopped or the condition described below is not true
Closed	Frequency Detection 1 > (+L4-01 greater than or equal to output frequency greater than or equal to -L4-01, L4-02)

No.	Parameter Name	Setting Range	Default	Page
L4-01	Frequency Detection Level	0.0 to 400.0	0.0 Hz	–
L4-02	Frequency Detection Width	0.0 to 20.0	2.0 Hz	–

Note: The output terminal set for Frequency Detection 2 will close when the output frequency falls below the level set to L4-01 minus the Speed Agree detection width set to L4-02. Frequency Detection 2 can also be used when the motor is rotating in reverse.

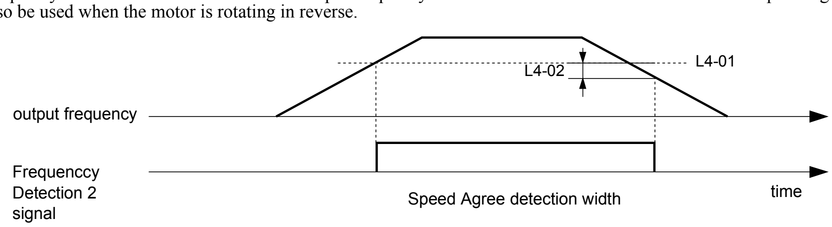


Figure 5.51 Frequency Detection 2 Timing Diagram

Setting 6: Drive Ready

Output closes whenever the drive is not in a fault state and not being programmed. If b1-08 = 1: Enabled", a drive that is in an active Run state that is also being programmed will have the Drive Ready output closed.

Status	Description
Open	Processing: Drive is powering up, initializing parameter settings, dealing with a fault situation, or in the Programming Mode.
Closed	Drive ready: In the Drive Mode with no fault situation. Drive can begin running the motor.

No.	Parameter Name	Setting Range	Default	Page
b1-08	Run Command Selection during Program*	0: Disabled - Run command accepted only in the operation menu. 1: Enabled - Run command accepted in all menus (except when b1-02 = 0). 2: Operation not possible. Cannot enter the Programming mode* because the Programming Mode cannot be accessed during run.	0	–

*"Programming mode" refers to when the drive is in the Setup mode, the Parameter Settings mode, performing Auto-Tuning, or the user is viewing the Verify Menu.

Setting 7: DC Bus Undervoltage

Output closes whenever the main circuit DC bus voltage or control circuit power supply drop below their respective trip level. The undervoltage trip level is determined by L2-05. An open soft charge contactor answer back signal will also cause the DC Bus Undervoltage output 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.

No.	Parameter Name	Setting Range	Default	Page
L2-05	Undervoltage Detection Level (UV)	150 to 210 *2	*1 **Note:** Reset when E1-01 is changed	–

*1. Default setting is determined by the drive capacity set to o2-04.

*2. This value is for a 200 V class drive. Double this value when using a 400 V class unit.

Setting 8: During Baseblock

Output closes to indicate that the drive is in baseblocked state. While baseblock is executed, output transistors are prevented from firing.

Status	Description
Open	Drive is not in a baseblock state.
Closed	Baseblock is being executed (there is no output voltage at this time).

Setting 9: Operator Reference

Output closes when the frequency reference is being sourced from the operator.

Status	Description
Open	Frequency reference is provided from the control circuit terminals or via serial communications.
Closed	Frequency reference is being sourced from the digital operator.

Setting A: LOCAL/REMOTE Operation

Output closes when the Run command is being sourced from the operator.

Status	Description
Open	Run command is provided from the control circuit terminals or via serial communications.
Closed	Run command is being sourced from the digital operator.

Setting B: Torque Detection 1, N.O.

Setting 17: Torque Detection 1, N.C.

Setting 18: Torque Detection 2, N.O.

Setting 19: Torque Detection 2, N.C.

Theses functions tie a digital output to the overtorque/undertorque sensing capabilities of the drive. The digital output switches whenever the output current falls above or below the specified levels for the specified time period.

Select the type of torque detection and assign it to one of the multi-function output terminals (H2-01 to H2-03 = B, 17, 18, 19). Set the torque detection level to L6-01 for Torque Detection 1 or to L6-04 for Torque Detection 2.

Setting	Status	Description
B	Closed	Output current/torque exceeds the torque value set in parameter L6-02 for longer than the time specified in parameter L6-03.
17	Open	Output current/torque exceeds the value set in parameter L6-02 for more time than is set in parameter L6-03.
18	Closed	Output current/torque exceeds the value set in parameter L6-05 for more time than is set in parameter L6-06.
19	Open	Output current/torque exceeds the value set in parameter L6-05 for more time than is set in parameter L6-06.

Note: The torque detection function has a built-in hysteresis of 10% of the drive rated output current. The torque detection function is based on 100% of the drive rated output current when using V/f Control or PM Open Loop Vector. In general Open Loop Vector Control, torque detection is based on 100% of the motor rated torque.

Parameters related to torque detection appear in the table below.

No.	Parameter Name	Setting Range	Default	Page
L6-01 L6-04	Torque Detection Selection 1, 2	0: Disabled 1: OL4 at Speed Agree - Alarm (Overtorque Detection only active during Speed Agree and Operation continues after detection). 2: OL4 at RUN - Alarm (Overtorque Detection is always active and operation continues after detection). 3: OL4 at Speed Agree - Fault (Overtorque Detection only active during Speed Agree and drive output will shut down on an OL4 fault). 4: OL4 at RUN - Fault (Overtorque Detection is always active and drive output will shut down on an OL4 fault). 5: UL4 at Speed Agree - Alarm (Undertorque Detection is only active during Speed Agree and operation continues after detection). 6: UL4 at RUN - Alarm (Undertorque Detection is always active and operation continues after detection). 7: UL4 at Speed Agree - Fault (Undertorque Detection only active during Speed Agree and drive output will shut down on an OL4 fault). 8: UL4 at RUN - Fault (Undertorque Detection is always active and drive output will shut down on an OL4 fault).	0	–
L6-02	Torque Detection Level 1	0 to 300	150%	–
L6-03	Torque Detection Time 1	0.0 to 10.0	0.1 s	–

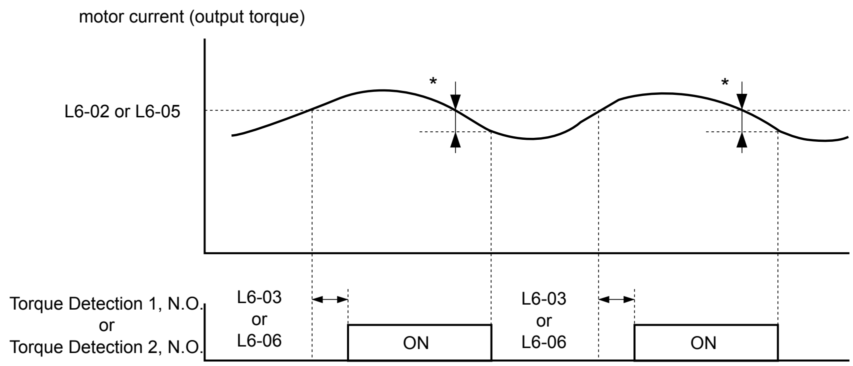


Figure 5.52 Overtorque Detection Timing Diagram

To cancel an overtorque situation, the current level must fall below about 10% of drive rated output torque (or motor rated torque).

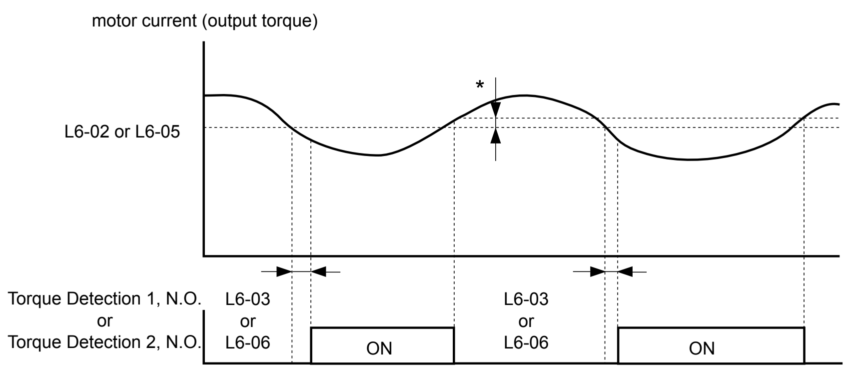


Figure 5.53 Undertorque Detection Timing Diagram

To cancel an undertorque situation, the current level must rise above about 10% of drive minimum output torque (or motor minimum torque).

Setting C: Loss of Reference

The Loss of Reference configured digital output will close when the drive has detected a loss of the analog frequency reference. The frequency reference is considered lost when the voltage level drops 90% in 0.4 seconds. Parameter L4-05 determines the drive’s reaction to a loss of reference state in addition to turning on the Loss of Reference digital output.

The frequency references to which the Loss of Reference function applies are:

- Analog frequency reference input via terminal A1
- Analog frequency reference input via terminal A2

No.	Parameter Name	Setting Range	Default	Page
L4-05	Frequency Reference Loss Detection Selection	0: Stop - Drive will stop. 1: Run at the value saved to L4-06	0	–
L4-06	Frequency Reference at Reference Loss	0.0 to 100.0	80.0%	–

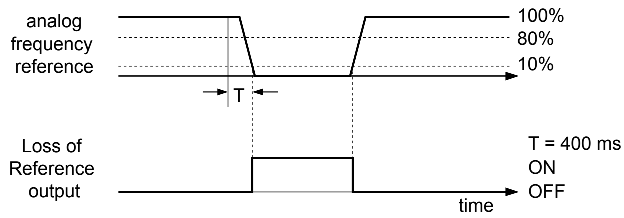


Figure 5.54 Loss of Reference Function

Setting D: Dynamic Braking Resistor Overheat

When the dynamic braking resistor (DB) overheats or the braking transistor is in a fault condition, the DB Overheat configured digital output will close.

Setting E: Fault

The Fault configured digital output will close whenever the drive experiences a fault (this excludes faults CPF00 and CPF01).

Setting F: Not Used

Use this setting when the terminal is not used or when using the terminal as a through-put.

Setting 10: Minor Fault

Output closes when a minor fault condition is present.

Note: For more information on alarms, see "5.2. Alarms and Errors" in the V1000 Basic Manual.

Setting 11: During Fault Reset

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

Note: For more information on alarms, see "5.2. Alarms and Errors" in the V1000 Basic Manual.

Setting 12: Timer Output

Used in conjunction with a multi-function digital input programmed for the timer function. Output closes after the input closes and the time set to b1-04 pass.

Note: For more information on the various timer functions, *Refer to b4: Delay Timers on page 122*

Setting 13: Speed Agree 2

Output closes whenever the output frequency is equal to or below the value of the programmed Speed Agree Level. The Speed Agree Width (L4-04) is the hysteresis to Frequency Detection 2.

Status	Description
Closed	Output currents matches the frequency reference +/- L4-04

No.	Parameter Name	Setting Range	Default	Page
L4-04	Speed Agreement Detection Width (+/-)	0.0 to 20.0	2.0 Hz	–

Setting 14: User Speed Agree 2

Output closes whenever the actual output frequency and the frequency reference are within the Speed Agree Width (L4-04) of the specified Speed Agree Level (L4-03). User Speed Agree 2 output is direction sensitive according to the direction programmed in L4-03.

Status	Description
Open	Output frequency and the frequency reference do not match (or the drive is stopped).
Closed	Output currents matches the frequency reference +/- L4-04

No.	Parameter Name	Setting Range	Default	Page
L4-04	Speed Agreement Detection Width (+/-)	0.0 to 20.0	2.0 Hz	–

Setting 15: Frequency Detection 3

Output will be closed whenever the output frequency is equal to or below the value of the specified Speed Agree Level (L4-03). The Speed Agree Width (L4-04) is the hysteresis to the Frequency Detection 3 function. Whenever the output frequency approaches the Speed Agree Level while accelerating, it will need to be equal to or exceed the Speed Agree Level (L4-03) plus the Speed Agree Width (L4-04) before the Frequency Detection 3 output will be activated.

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

Note: During acceleration, the terminal set for Frequency Detection 3 will close if the output frequency is greater than the frequency detection level (L4-03) and the frequency detection width (L4-04). During deceleration, the terminal set for Frequency Detection 3 will close as long as the output frequency is less than the frequency detection level (L4-03). The output for Frequency Detection 3 is direction sensitive according to the direction programmed in L4-03.

Setting 16: Frequency Detection 4

Output closes whenever the output frequency is equal to or above the value of the specified Speed Agree Level (L4-03). The Speed Agree Width (L4-04) is the hysteresis to the Frequency Detection 4 function.

No.	Parameter Name	Setting Range	Default	Page
L4-03	Speed Agreement Detection Level (+/-)	-400.0 to 400.0	0.0 Hz	–

No.	Parameter Name	Setting Range	Default	Page
L4-04	Speed Agreement Detection Width (+/-)	0.0 to 20.0	2.0 Hz	–

Note: During acceleration, the terminal set for Frequency Detection 4 will close if the output frequency is greater than the frequency detection level (L4-03) and the frequency detection width (L4-04). During deceleration, the terminal set for Frequency Detection 4 will close as long as the output frequency is less than the frequency detection level (L4-03). The output for Frequency Detection 4 is direction sensitive according to the direction programmed in L4-03.

Setting 1A: During Reverse

The During Reverse digital output will close and remain closed whenever the drive is turning the motor in the reverse direction.

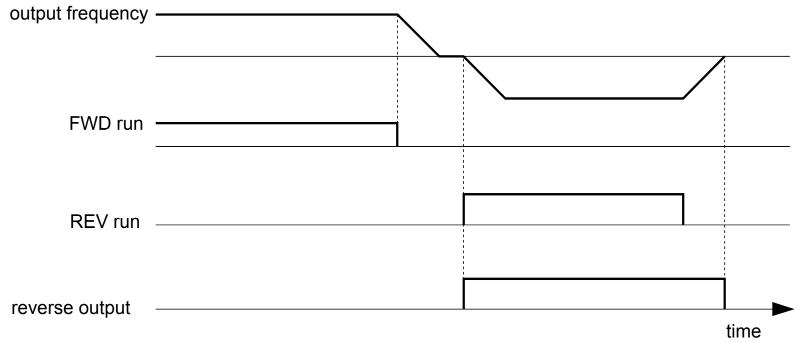


Figure 5.55 Reverse Direction Timing Diagram

Setting 1B: Baseblock, N.C.

Output opens only when the drive is in a baseblocked state.

Setting 1C: Motor 2 Selected

Output closes whenever a multi-function input programmed for motor 2 selection (H1-0x = 16) is closed.

Setting 1E: Restart Enabled

Depending on the setting of parameter L5-01, the drive may be configured to automatically attempt to restart itself after certain faults. The Restart Enabled output will be closed once the restarts begin and will remain closed until a successful restart is accomplished or the number of Auto Restart attempts as specified by L5-01 is reached.

No.	Parameter Name	Setting Range	Default	Page
L5-01	Number of Auto Restart Attempts	0 to 10	0 times	–

Setting 1F: Overload Alarm oL1

The oL1 fault function is designed to protect the motor. It estimates the motor's winding temperature based on the output current, output frequency, and time. An Overload Alarm oL1 digital output will close whenever 90% of the programmed oL1 time is exceeded.

Status	Description
Open	Motor winding temperature is less than 90% of the specified temperature.
Closed	Motor winding temperature has exceeded 90% of the protection level.

Setting 20: OH Prealarm

Output closes whenever the heatsink temperature reaches the level specified by parameter L8-02. Parameter L8-03 will determine how the drive responds when it reaches the OH Prealarm level, in addition to closing the configured digital output.

Status	Description
Open	Heatsink is cooler than the overheat temperature.
Closed	Heatsink has exceeded the overheat level set to L8-02.

No.	Parameter Name	Setting Range	Default	Page
L8-02	Overheat Alarm Level	50 to 130	Determined by o2-04	–

Setting 22: Mechanical Weakening Detection

Output closes when mechanical weakening is detected.

Setting 30: During Torque Limit (Current Limit)

When the torque reference reaches the torque limit set in L7-01 to L7-04, the output programmed for During Torque Limit closes. This setting is only valid when using Open Loop Vector Control (A1-02 = 2).

No.	Parameter Name	Setting Range	Default	Page
L7-01	Forward Torque Limit	0 to 300	200%	–
L7-02	Reverse Torque Limit			–
L7-03	Forward Regenerative Torque Limit			–
L7-04	Reverse Regenerative Torque Limit			–

Setting 37: During Frequency Output

Output closes whenever the Run command is provided and the drive is outputting frequency. This does not include baseblock, DC Injection, Short Circuit Braking, and Initial Excitation.

Status	Description
Open	Drive is stopped or is performing DC Injection, Short Circuit Braking, or Initial Excitation.
Closed	Drive is producing a frequency output

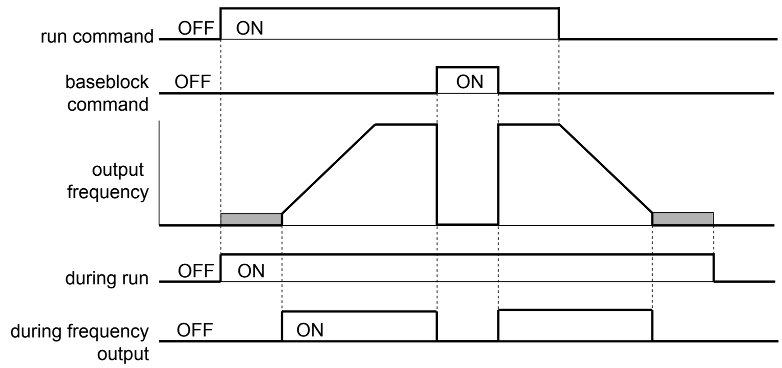


Figure 5.56 Timing Diagram During Frequency Output

Setting 38: Drive Enabled

A Drive Enable digital output will reflect the status of a digital input configured as a Drive Enable input (H1-0x = 6A). If the Drive Enable digital input is closed then the Drive Enabled digital output will also close.

Setting 39: Watt Hour Pulse Output

Outputs a pulse to indicate the watt hour. Set H2-06 to specify the units. Output terminal closes every 200 ms.

No.	Parameter Name	Setting Range	Default	Page
H2-06	Watt Hour Output Unit Selection	0: 0.1 kWH units 1: 1 kWH units 2: 10 kWH units 3: 100 kWH units 4: 1000 kWH units	0	–

Setting 3C: REMOTE/LOCAL Switch

Output terminal closes while the drive is set for LOCAL, and opens when in REMOTE.

Status	Description
Open	REMOTE
Closed	LOCAL

Setting 3D: During Speed Search

Output terminal closes while Speed Search is being performed.

Setting 3E: PID Feedback Loss

Output terminal closes when a the PID feedback signal is lost. Works for both pulse input and analog input PID signals. For PID loss to be detected, set the loss level to b5-13 and the detection time to b5-14.

No.	Parameter Name	Setting Range	Default	Page
b5-13	PID Feedback Loss Detection Level	0 to 100	0%	–
b5-14	PID Feedback Loss Detection Time	0.0 to 25.5	1.0 s	–

Note: For details on a PID, ***b5: PID Control***.

Setting 3F: PID Feedback High Fault

Output terminal closes when a the PID feedback signal is too high for too long. Works for both pulse input and analog input PID signals. To detect an excessively high PID signal, set the detection level to b5-36 and the detection time to b5-37.

No.	Parameter Name	Setting Range	Default	Page
b5-36	PID Feedback High Detection Level	0 to 100	100%	–
b5-37	PID Feedback High Level Detection Time	0.0 to 25.5	1.0 s	–

Note: For details on a PID, ***b5: PID Control***.

Setting 4A: During KEB Operation

Output terminals closes while KEB is being performed.

Setting 4B: During Short Circuit Braking

Closes the output terminal while Short Circuit Braking is being executed.

Setting 4C: During Fast Stop

Output terminal closes when a Fast Stop is being executed.

Setting 4D: oH Pre-Alarm Time Limit

Output terminals closes when then overheat prealarm continues passed the allowable time.

Setting 90 to 92: DriveWorksEZ Digital Output 1 to 3

For use with DriveWorksEZ.

Setting 100 to 192: Reverse Switching for Functions 0 to 92

Reverses the switching status of the specified terminal and function. Set as 1□□, where the last two digits specify the setting number of the function to be reversed.

Example: To reverse the output for “8: During Baseblock”, set “108”. To reverse the output for “14A: During KEB,” set 14A.

■ H2-06: Watt Hour Output Unit Selection

When one of the multi-function terminals is set output the number of watt hours (H2-01 to H2-03 = 39), parameter H2-06 determines the units for the output signal. Outputs a signal every 200 ms.

No.	Parameter Name	Setting Range	Default	Page
H2-06	Watt Hour Output Unit Selection	0: 0.1 kWH units 1: 1 kWH units 2: 10 kWH units 3: 100 kWH units 4: 1000 kWH units	0	–

◆ H3: Multi-Function Analog Input Terminals

V1000 is equipped with 2 multi-function analog input terminals, A1 and A2. The user can assign functions to these terminals by setting parameters H3-02 and H3-10 between 0 and 31.

No.	Parameter Name	Setting Range	Default
H3-02	Terminal A1 Function Selection	0 to 31	0
H3-10	Terminal A2 Function Selection	0 to 31	0

■ Multi-Function Analog Input Terminal Settings

Setting	Function	Page	Setting	Function	Page
0	Frequency Bias (A1)	–	F	Not used (use this setting if the terminal is not used or is used as a pass-through terminal)	–
1	Frequency Gain	–	10	FWD Torque Limit	–
2	Auxiliary Frequency Reference (used as a second frequency reference)	–	11	REV Torque Limit	–
4	Output Voltage Bias	–	12	Regenerative Torque Limit	–
7	Overtorque/Undertorque Detection Level	–	15	FWD/REV Torque Limit	–
B	PID Feedback	–	16	Differential PID Feedback	–
C	PID Set Point	–	30	DriveWorksEZ Analog Input 1	–
E	Motor Temperature (PTC input)	–	31	DriveWorksEZ Analog Input 2	–

Analog input levels are set using the H3 parameters described below.

■ H3-01: Terminal A1 Signal Level Selection

The A1 analog input can accept either a 0 to 10 Vdc or -10 to +10 Vdc signal as a reference.

No.	Parameter Name	Setting Range	Default
H3-01	Terminal A1 Signal Level Selection	0 to 1	0

Note: When set to “1”, the user can have an input of less than 5 V can be treated as a negative value by tuning the gain and bias levels.

■ H3-02: Terminal A1 Function Selection

Determines the function assigned to analog output terminal A1.

No.	Parameter Name	Setting Range	Default
H3-02	Terminal A1 Function Selection	0 to 31	0

Note: If not using an input terminal or if using it in the through-mode, be sure to set that terminal to “F”.

■ H3-03: Terminal A1 Gain Setting

■ H3-04: Terminal A1 Bias Setting

In order to have the drive properly interpret an analog input, it may be necessary to apply a gain and/or a bias to the signal. The analog inputs have a resolution of 10 bits (1024 steps).

No.	Parameter 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%

Detailed Description

Using the factory default settings for the analog input’s gain and bias, the 0 to 10 Vdc or the -10 to +10 Vdc signal at the analog input will yield a 0 to 100% frequency reference span.

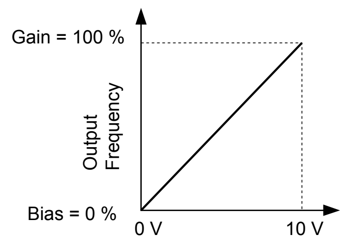


Figure 5.57 Output Frequency as Commanded via Analog Input

If a different span of analog input signal is desirable, it will be necessary to adjust the gain, the bias, or both to allow the analog input level to generate the desired frequency command. Adjustment of the gain setting will change the frequency reference that is equivalent to the maximum analog input (10 Vdc). If, for instance, the gain is increased to 200%, then 10 Vdc will be equivalent to a 200% frequency reference and 5 Vac will be equivalent to a 100% frequency reference. Since the drive output is limited by the maximum frequency parameter (E1-04), 0 to 5 Vdc will now be equivalent to 0 - 100% frequency reference span.

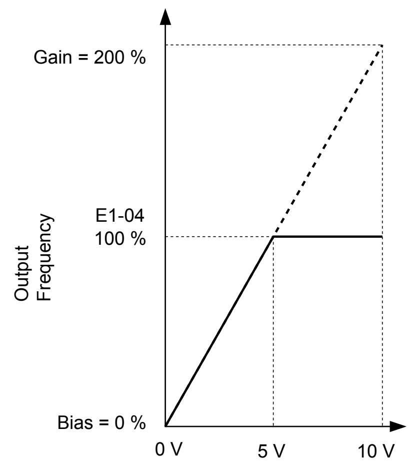


Figure 5.58 Output Frequency Using Analog Input with Increased Gain

Adjustment of the bias setting will likewise adjust the frequency reference that is equivalent to the minimum analog input level (0 Vdc). If, for instance, the bias is set to -25%, then 0 Vdc will be equivalent to a -25% frequency reference. Since the minimum frequency reference is 0% an analog input of 2.5 to 10 Vdc will now be equivalent to 0 - 100% speed command span.

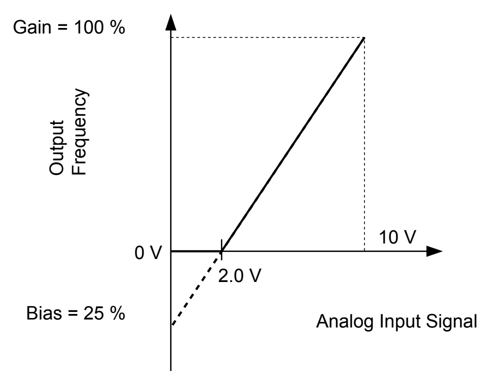


Figure 5.59 Output Frequency Using Analog Input with Reduced Gain

As a further example, for an inverse-acting frequency reference, set the bias= 100% and the gain = 0%. The minimum analog input level (0 Vdc) will produce a 100% frequency reference and the maximum analog input level (10 Vdc) will produce a 0% frequency reference.

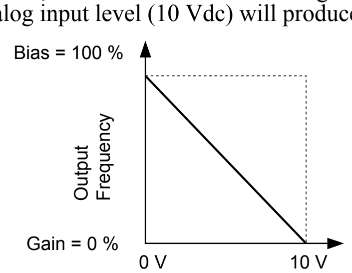


Figure 5.60 Output Frequency with Inverted Gain and Bias Settings

■ H3-09: Terminal A2 Signal Level Selection

Parameter H3-09 assigns the signal level for input signal connected to multi-function analog input terminal A2. Below is a list of settings and corresponding signal levels. Be sure to also set DIP switch S1 accordingly for a voltage input or current input.

0: 0 to +10 V, with lower limit

1: 0 to +10 V, no lower limit

2: 4 to 20 mA

3: 0 to 20 mA

For instructions on how to set DIP switch S1, review section 3.9 in the V1000 Basic Manual.

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

■ H3-10: Terminal A2 Function Selection

Determines which function is assigned to multi-function analog input terminal A2.

No.	Parameter Name	Setting Range	Default
H3-10	Terminal A2 Function Selection	0 to 31	0

■ Multi-Function Analog Input Terminal Settings and Functions

This section describes the various functions that can be assigned to terminal A2 by setting H3-10.

Setting 0: Adds to Terminal A1

By setting analog input to 0, the level of the analog input will be summed with the level of the frequency reference analog input A1.

Setting 1: Frequency Gain

The analog output level will correspond to the chosen frequency reference input, whether it is input via the operator keypad, analog input, serial communication, option board, or pulse input. Setting 100% will be equivalent to the maximum output frequency of the drive.

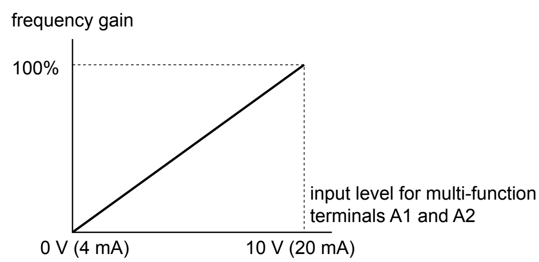


Figure 5.61 Input for Frequency Reference Gain 1

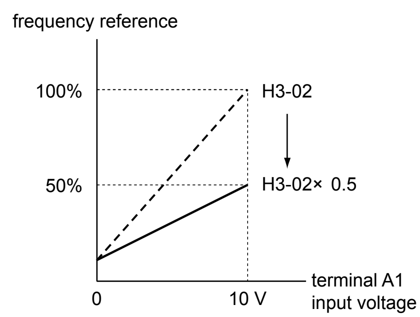


Figure 5.62 Setting Bias Levels for the Output Frequency

Setting 2: Aux Reference

Sets the analog input toe act as an auxiliary speed reference. Input level is a percentage of the drive's maximum output frequency set to E1-04.

Setting 4: Voltage Bias

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

Setting 7: Overtorque Level

Overtorque level sets the overtorque/undertorque detection level using the analog input. This works with Torque Detection Selection 1 (L6-01) and will take the place of the torque detection level set to L6-02. For general OpenLoop Vector Control, this function is based on 100% of the motor rated torque. For V/f Control and PM Open Loop Vector, this function is based on 100% of the drive rated current.

Setting B: PID Feedback

Configuring the analog input as PID feedback is a requirement of setting the drive up for PID operation.

Note: For details on PID control, *Refer to b5: PID Control on page 122*.

Setting C: PID Set Point

Setting the analog input to PID set point allows the analog input level to be the PID set point as a percentage of maximum output frequency (E1-04). The frequency reference selected in parameter b1-01 no long becomes the PID set point.

Setting E: Motor Temperature

In addition to or in place of the oL1 (motor overload) fault of the drive, it is possible to use a PTC (Positive Temperature Coefficient) thermistor for motor insulation protection. The PTC thermistors are built into the windings of some motors and will vary their resistance based on temperature. For details, see .

Setting F: Not Used

Use this setting when the terminal is not used or when using the terminal as a through-put.

Setting 10: Forward Torque Limit

Setting 11: Reverse Torque Limit

Setting 12: Regeneration Torque Limit

Torque limit can be independently set by the analog input programmed for the proper motoring condition (quadrants 1, 2, 3, and 4) as a percentage of motor rated torque. Available only when using Open Loop Vector Control.

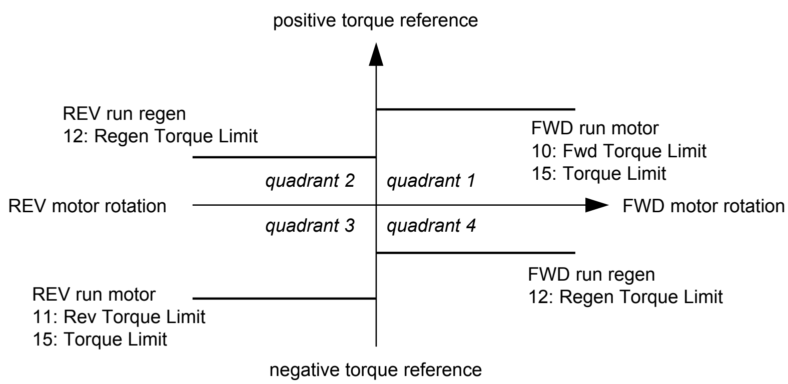


Figure 5.63 Analog Input Torque Limit

Setting 15: Torque Limit

Torque limit can be set by the analog input programmed torque limit for forward and reverse motoring conditions (quadrants 1 and 3) as a percentage of motor rated torque. This function is available only when using Open Loop Vector Control.

Setting 16: Differential PID Feedback

Setting 30: DriveWorksEZ Analog Input 1

Setting 31: DriveWorksEZ Analog Input 2

■ H3-11: Terminal A2 Gain Setting

■ H3-12: Frequency Reference (Current) Terminal A2 Input Bias

An analog input filter can be used to prevent erratic drive control when a “noisy” analog reference is used. Parameter H3-12 sets the time constant for a first order filter that will be applied to both the A1, A2, and A3 analog inputs. The drive operation becomes more stable the longer the time programmed, but it becomes less responsive to rapidly changing analog signals.

No.	Parameter Name	Setting Range	Default
H3-11	Terminal A2 Gain Setting	-999.9 to 999.9	100.0%
H3-12	Frequency Reference (Current) Terminal A2 Input Bias	-999.9 to 999.9	0.0%

■ H3-13: Analog Input Filter Time Constant

Sets the primary delay filter time constant for terminals A1 and A2.

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

◆ H4: Multi-Function Analog Output Terminals

These parameters assign an output to multi-function analog output terminal AM for monitoring a specific aspect of drive performance.

■ H4-01: Multi-Function Analog 1 (Terminal AM Monitor Selection)

Select the data to be output through multi-function analog output terminal AM. Set the desired monitor parameter to the digits available in U□-□□.

Example: Enter “103” for U1-03.

No.	Parameter Name	Setting Range	Default
H4-01	Multi-Function Analog 1 (Terminal AM Monitor Selection)	000 to 999	102

Note: If terminal AM is not used or is used as a through-put, then set H4-01 to 000 or 031.For information on available monitors and settings, *U1: Status Monitors*.

■ H4-02: Multi-Function Analog 1 (Terminal AM Output Gain)

■ H4-03: Multi-Function Analog 1 (Terminal AM Output Bias)

Sets the gain and bias of the voltage level output from terminal AM.

No.	Parameter Name	Setting Range	Default
H4-02	Multi-Function Analog 1 (Terminal AM Output Gain)	-999.9 to 999.9	100.0%
H4-03	Multi-Function Analog 1 (Terminal AM Output Bias)	-999.9 to 999.9	0.0%

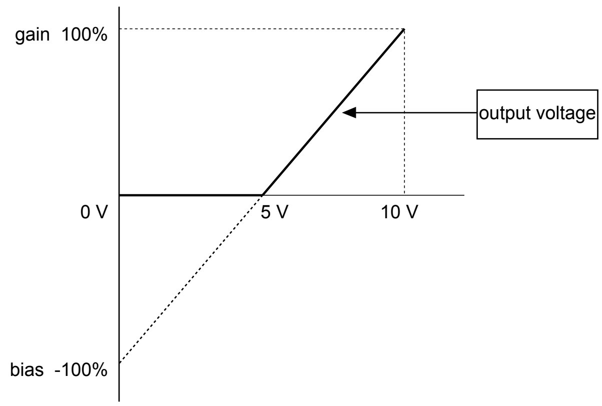


Figure 5.64 Analog Output Gain/Bias Setting

◆ H5: MEMOBUS/Modbus Serial Communication

Serial communication can be performed with programmable logic controllers (PLCs) or similar devices using the MEMOBUS/Modbus protocol.

■ H5-01: Drive Node Address

Parameter Overview

No.	Name	Description	Range	Default
H5-01	Drive Node Address	Selects drive station node number (address) for MEMOBUS/Modbus terminals R+, R-, S+, S-. Cycle power for the setting to take effect.	0 to 20 H	1F

■ H5-02: Communication Speed Selection

Parameter Overview

No.	Name	Description	Range	Default
H5-02	Communication Speed Selection	Selects the baud rate for MEMOBUS/Modbus terminals R+, R-, S+ and S-. Cycle power for the setting to take effect. 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	0 to 8	3

■ H5-03: Communication Parity Selection

Parameter Overview

No.	Name	Description	Range	Default
H5-03	Communication Parity Selection	Selects the communication parity for MEMOBUS/Modbus terminals R+, R-, S+ and S-. Cycle power for the setting to take effect. 0: No parity 1: Even parity 2: Odd parity	0 to 2	0

■ H5-04: Stopping Method after Communication Error

Parameter Overview

No.	Name	Description	Range	Default
H5-04	Stopping Method after Communication Error	Selects the stopping method when a communication time-out fault (CE) is detected. 0: Ramp to stop 1: Coast to stop 2: Fast-stop 3: Alarm only	0 to 3	3

■ H5-05: Communication Fault Detection Selection

Parameter Overview

No.	Name	Description	Range	Default
H5-05	Communication Fault Detection Selection	Enables or disables the communications time-out fault (CE) detection. 0: Disabled 1: Enabled - If communication is lost for more than two seconds, a CE fault will occur.	0,1	1

■ H5-06: Drive Transmit Wait Time

Parameter Overview

No.	Name	Description	Range	Default
H5-06	Drive Transmit Wait Time	Set the wait time between receiving and sending data.	5 to 65	5

■ H5-07: RTS Control Selection

Parameter Overview

No.	Name	Description	Range	Default
H5-07	RTS Control Selection	Selects "request to send" (RTS) control: 0: Disabled - RTS is always on. 1: Enabled - RTS turns on only when sending.	0,1	1

■ H5-09: CE Detection Time

Parameter Overview

No.	Name	Description	Range	Default
H5-09	CE Detection Time	Sets the time required to detect a communications error. Adjustment may be need when networking several drives.	0.0 to 10.0 s	2.0

■ H5-10: Unit Selection for MEMOBUS/Modbus Register 0025H

Parameter Overview

No.	Name	Description	Range	Default
H5-10	Unit Selection for MEMOBUS/Modbus Register 0025H	Selects the units used for MEMOBUS/Modbus register 0025H (Output Voltage Reference Monitor). 0: 0.1 V units 1: 1 V units	0, 1	0

■ H5-11: Communications ENTER Function Selection

Parameter Overview

No.	Name	Description	Range	Default
H5-11	Communications ENTER Function Selection	Select the function for the enter command that saves parameter data to the drive. 0: Parameter changes are activated when ENTER command is entered. 1: Parameter changes are activated immediately without ENTER command (compatible with Varispeed VS606-V7).	0, 1	1

■ H5-12: Run Command Method Selection

Parameter Overview

No.	Name	Description	Range	Default
H5-12	Run Command Method Selection	0: FWD/STOP, REV/STOP Method 1: RUN/STOP, FWD/REV Method	0, 1	0

◆ H6: Pulse Train Input/Output

The drive has the ability to receive and output a single-ended pulse train. The pulse train input and output is not quadrature and therefore cannot be used to sense or transmit direction (phase) information. Please pay attention to the wiring diagrams in the Basic Manual to avoid potential damage to the drive and external circuitry. Proper circuit impedance must be used to avoid either an unrecognizable pulse train signal or a high current condition that could damage equipment.

The input, which can handle up to a 32 kHz signal, is scalable and can be programmed for frequency reference and PID functions. To use the pulse input as the frequency reference, set b1-01 = 4 and H6-01 = 0. For PID functions, set H6-01 = 1 for PID feedback or H6-01 = 2 for PID setpoint.

Speed feedback control is possible when using V/f Control by setting H6-01 to 3. For more information, refer to the description of the C5 parameters.

The output monitor, which can be used in sinking or sourcing installations, is also scalable up to a 32 kHz frequency and can be programmed to be proportional to the drive's monitors relating to frequency, speed, and the PID functions. To program the output, set the appropriate U1 monitor number in H6-06. The monitor can also be sychronized in phase with the drive's T1-phase output frequency by setting H6-06 = 2 and H6-07 = 0.

■ H6-01: (Terminal RP) Pulse Train Input Function Selection

Selects the function of pulse train (terminal RP).

This parameter selects the function of the pulse train terminal RP. If pulse train is to be used as the frequency reference (H6-01 = 0) parameter b1-01 must be set to "4: Pulse Input."

No.	Parameter Name	Setting Range	Default
H6-01	(Terminal RP) Pulse Train Input Function Selection	0: Frequency reference 1: PID feedback value 2: PID setpoint value 3: Simple PG V/f control mode (can be set only when using motor 1 in the V/f control mode)	0

■ H6-02: Pulse Train Input Scaling

Pulse train input scaling parameter sets the number of pulses (in Hz) that is equal to the maximum output frequency E1-04.

No.	Parameter Name	Setting Range	Default
H6-02	Pulse Train Input Scaling	1000 to 32000	1440 Hz

■ H6-03: Pulse Train Input Gain

Pulse train input gain sets the output level with the pulse train input is at 100% as a percentage of maximum output frequency (E1-04).

No.	Parameter Name	Setting Range	Default
H6-03	Pulse Train Input Gain	0.0 to 1000.0	100.0%

■ H6-04: Pulse Train Input Bias

Pulse train input bias sets the output level when the pulse train input is 0 Hz as a percentage of maximum output frequency (E1-04).

No.	Parameter Name	Setting Range	Default
H6-04	Pulse Train Input Bias	-100.0 to 100.0	0.0%

■ H6-05: Pulse Train Input Filter Time

Sets the pulse train input filter time constant in seconds.

No.	Parameter Name	Setting Range	Default
H6-05	Pulse Train Input Filter Time	0.00 to 2.00	0.10 s

■ H6-06: Pulse Train Input Monitor Selection

Selects the pulse train monitor output terminal MP function (value of the □□ part of monitor U1-□□). See Appendix A for a complete list of monitors.

No.	Parameter Name	Setting Range	Default
H6-06	Pulse Train Input Monitor Selection	000, 031, 101, 102, 105, 116, 501, 502, 801 to 809	102

■ H6-07: Pulse Train Input Monitor Scaling

Pulse train monitor scaling sets the number of output pulses when the monitor is 100% (in Hz). Set H6-06 to 102 and H6-07 to 0 to make the pulse train monitor output synchronous to the output frequency.

No.	Parameter Name	Setting Range	Default
H6-07	Pulse Train Input Monitor Scaling	0 to 32000	1440 Hz

5.8 L: Protection Functions

◆ L1: Motor Protection Functions

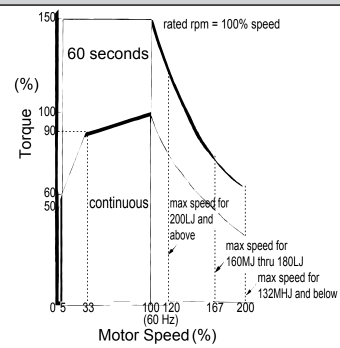
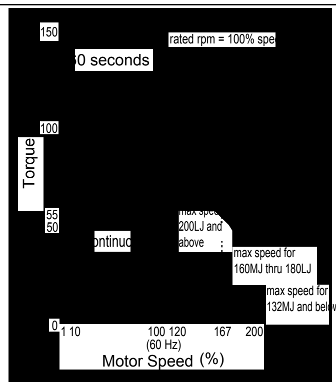
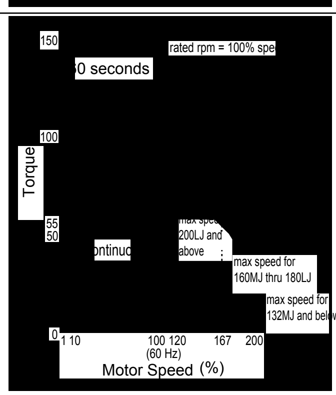
The drive has an electronic overload protection function that protects the motor from overheating.

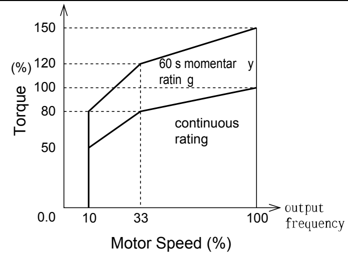
■ L1-01: Motor Protection Function Selection

Set the overload protection function in L1-01 according to the motor being used. The cooling ability of an induction motor varies with the motor type, so the electronic thermal protection characteristics must be consequently adjusted.

No.	Name	Setting Range	Default	Page
L1-01	Motor Overload Protection Selection	0 to 4	Determined by A1-02.	–

The table below shows the overload characteristics for each type of motor.

L1-01 Setting	Motor Type	Overload Characteristics	Cooling Ability	Eletrothermal Operation (100% motor OL)
1	General-purpose motor (standard motor)		Motor designed to operate from line power. Most effective at cooling the motor when running at line power specifications (check the specifications for line power in your area).	Operating continuously at less then frequency provided by line power can trigger motor overload protection (OL1). A fault is then output and the motor will coast to stop.
2	Inverter-Drive Dedicated Motor (constant torque, 1:10)		Motor is designed to effectively cool itself even at low speeds (as lower as 6 Hz).	Continuous operation at 6 Hz to 50/60 Hz.
3	Vector Motor (1:100)		Motor is designed to effectively cool itself at ultra-low speeds (about 0.6 Hz).	Continuous operation at 0.6 Hz to 50/60 Hz.

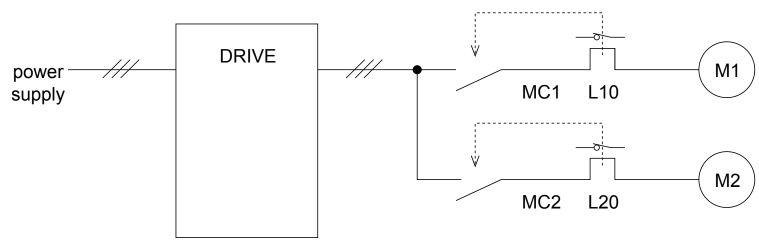
L1-01 Setting	Motor Type	Overload Characteristics	Cooling Ability	Eletrothermal Operation (100% motor OL)
4	PM Derated Torque Motor		Pico motor is designed with a heatsink running from the flange to the enclosure. IPM motors for derated torque have the most effective cooling design.	Because this motor is designed for derated torque applications, the load needs to be limited at low speeds.

Setting Descriptions

- L1-01 = 1
  Set to “1” when using a general-purpose motor (standard motor). Because the motor is self-cooled, this setting lowers the overload tolerance as the motor speeds up. The drive appropriately adjusts the electrothermal trigger point according to the motor overload characteristics, protecting the motor from overheat throughout the entire speed range.
- L1-01 = 2
  Use this setting when operating a inverter drive dedicated motor with a torque ratio of 1:10. Here, the drive runs the motor so that it produces constant torque from 10% up to 100% speed. Slower speeds require torque derating.
- L1-01 = 3
  Use this setting when operating a inverter drive dedicated motor with a torque ratio of 1:100. Here, the drive runs the motor so that is produces constant torque from 1% up to 100% speed. Slower speeds require torque derating.
- L1-01 = 4
  This setting is for operating a PM motor. IPM motors for derated torque have a self-cooling design, so the overload tolerance drops as motor slows. Electrothermal operation is triggered in accordance with the motor overload characteristics, providing overheat protection across the entire speed range.

Note: Select a method to protect the motor from overheat by setting L1-01 between 1 and 4 when running a single motor from the drive. An external thermal relay is not needed.

NOTICE: *Protect each motor with individual thermal overloads when multiple motors are connected to one drive. Failure to comply could result in improper drive operation. Disable the electronic overload protection of the drive (L1-01= “0: Disabled”) and protect each motor with its own motor thermal overload.*



MC1, MC2: magnetic contactors
L10, L20: thermal relays

Figure 5.65 Example of Protection Circuit Design for Multiple Motors)

■ L1-02: Motor Overload Protection Time

Sets the time it takes the drive to detect motor overheat due to overload. This setting rarely requires adjustment, but should correlate with the motor overload tolerance protection time for performing a hot start.

No.	Name	Setting Range	Default	Page
L1-02	Motor Overload Protection Time	0.1 to 5.0	1.0 min	–

- Sets the operation time for electrothermal protection. This setting rarely needs to be changed.
- Defaulted to operate allow 150% overload operation for one minute.

- Below is an example of the electrothermal protection operation time using a general-purpose motor operating at 60 Hz with L1-02 set to 1 minute.

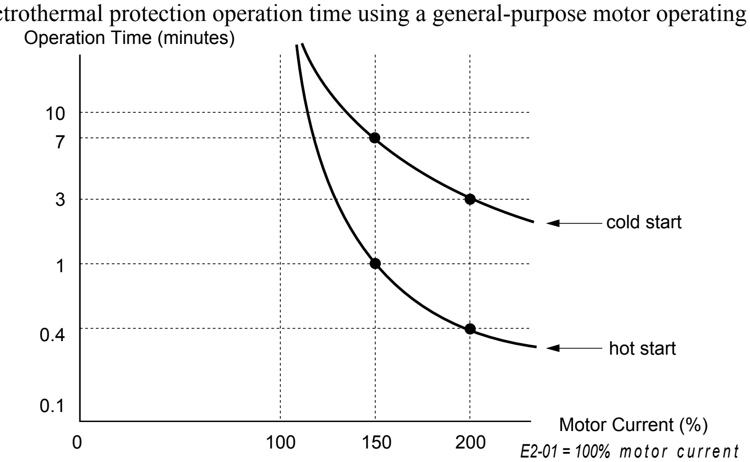


Figure 5.66 Motor Protection Operation Time

Note: When the motor protection function is enabled (L1-01 is not set to 0), an OL1 alarm can be output through one of the multi-function outputs by setting H2-01 to 1F. The output will close when the alarm is triggered at 90% overload.

■ L1-03: Motor Overheat Alarm Operation Selection L1-04: Motor Overheat Fault Operation Selection L1-05: Motor Temperature Input Filter Time

The motor is protected from overheat by using a PTC thermistor embedded in the motor stator windings.

No.	Name	Setting Range	Default	Page
L1-03	Motor Overheat Alarm Operation Selection	0 to 3	3	–
L1-04	Motor Overheat Fault Operation Selection	0 to 2	1	–
L1-05	Motor Temperature Input Filter Time	0.00 to 10.00	0.20 sec	–

Detailed Description

L1-03 and L1-04 determine how the motor is protected from overheat. Alarm OH3 and fault OH4 can be set to appear on the LED or LCD operator by setting the motor temperature input filter time constant to parameter L1-04.

- L1-03 Settings

Setting	Description
0	Ramp to Stop
1	Coast to Stop
2	Fast Stop (stops at the deceleration time set to C1-09)
3	Alarm Only (“oH3” flashes on the operator)

- L1-04 Settings

Setting	Description
0	Ramp to Stop
1	Coast to Stop
2	Fast Stop (stops at the deceleration time set to C1-09)

- Example Using PTC Thermistor

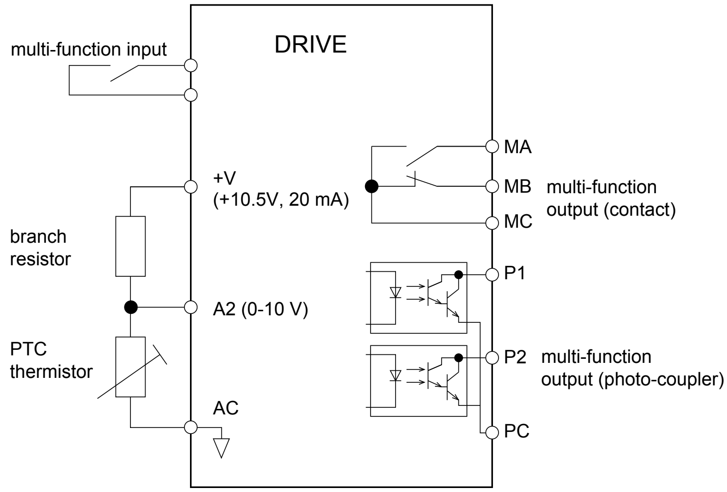


Figure 5.67 Setting Up Motor Overheat Protection

Note: When using terminal A2, set DIP switch S1 to the voltage side.

Parameter Details

5

PTC Thermistor Characteristics

The following diagram shows the characteristics of temperature and resistance on the PTC thermistor.

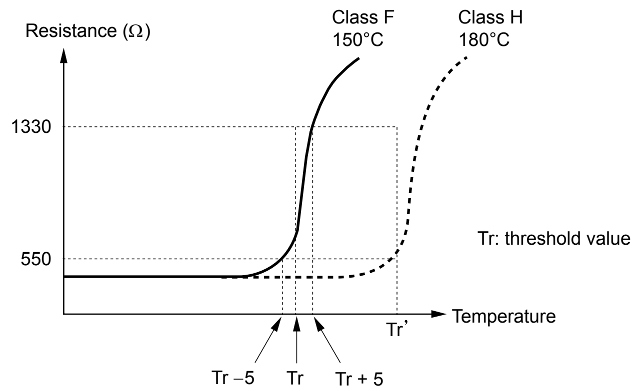


Figure 5.68 PTC Thermistor Temperature: Resistance

- Operation Selection and Setting Method

  Set the analog input terminal for motor temperature input (H3-1 = E), and connect a PTC thermistor as shown in Fig 6.42. Although OH3 or OH4 will appear on the operator when the motor overheats, the drive is defaulted to continue running when OH3 occurs, and to not output a fault. If OH4 occurs, a fault signal will be output and the drive will come to a stop. Depending on the application, the conditions for OH3 can be set to L1-03, and the conditions for OH4 to L1-04.

  When protection operation produces abnormal amounts of noise, try increasing the value set to parameter L1-05.

■ L1-13: Continuous Electrothermal Operation Selection

Parameter Overview

No.	Name	Description	Range	Default
L1-13	Continuous Electrothermal Operation Selection	Determines whether to hold the electrothermal value when the power supply is interrupted. 0: Disabled 1: Enabled	0 to 1	1

◆ L2: Momentary Power Loss Ridethru

■ L2-01: Momentary Power Loss Operation Selection

■ L2-02: Momentary Power Loss Ridethru Time

When a momentary power loss occurs, the drive can be set to automatically return to the operation it was performing when the power went out based on certain conditions.

No.	Name	Setting Range	Default	Page
L2-01	Momentary Power Loss Operation Selection	0 to 2	0	–
L2-02	Momentary Power Loss Ride-Thru Time	0.0 to 25.5	Determined by o2-04.	–

Detailed Description

Three operations are possible when a momentary power loss occurs. The table below lists the selections available for parameter L2-01.

Setting	Description
0*	Disabled - Drive trips on (UV1) fault when power is lost.
1	Power Loss Ride-Thru Time: Drive will restart if power returns within the time set in L2-02.*
2	CPU Power Active: Drive will restart if power returns prior to control power supply shut down.

*Default Setting

- L2-01 = 0 (disabled)

  If power is not restored within 15 ms, a UV1 alarm will result and the drive will come to stop.

- L2-01 = 1 (enabled)

  When a momentary power loss occurs, the drive will attempt to restart and perform Speed Search if power is restored within the period of time set to L2-02. If power is not restored within the time set to L2-02, then a UV1 alarm will result.

  Note: The amount of time the drive is capable of recovering after a power loss is determined by the capacity of the drive. Drive capacity determines the upper limit for L2-02. A Momentary Power Loss Unit is available to allow for a longer momentary power loss ride through time in a 0.4 to 7.5 kW drive (200 or 400 V class). This option makes it possible to continue running after up to 2 seconds of power loss.

- L2-01 = 2

  Drive will restart as long as the CPU still has power. This allows for a longer ride-thru time than setting L2-01 to 1.

  Note: When L2-01 is set to 1 or 2, be sure that the magnetic contactor to the power supply as well as the control signal is still maintained even when the power goes out. “UV1” 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.

■ L2-03: Momentary Power Loss Minimum Baseblock Time

Sets the minimum baseblock time when power is restored following a momentary power loss. This determines the time is takes for the leftover voltage in the motor to dissipate. Increase this setting if overcurrent or overvoltage occur at the beginning of Speed Search. If L2-03 > L2-02, then the drive will restart after the time set to L2-03 passes following a momentary loss in power.

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

Note: Increase this setting if overcurrent occurs at the beginning of Speed Search or DC Injection Braking.

■ L2-04: Momentary Power Loss Voltage Recovery Ramp Time

No.	Name	Setting Range	Default	Page
L2-04	Momentary Power Loss Voltage Recovery Ramp Time	0.0 to 5.0 s	Determined by o2-04	–

- Sets the time it takes for the output voltage to be restored from 0 to the maximum voltage.

■ L2-05: Undervoltage Detection Level

No.	Name	Setting Range	Default	Page
L2-05	Undervoltage Detection Level	150 to 210 V/200 V class 300 to 420 V/400 V class	190 V 380 V* Determined by o2-04	–

*This value is initialized when E1-01 is changed.
- This setting rarely needs to be changed.
- Determines the voltage level in the DC bus that is considered to be UV. Uses externals terminal +1 and -.
- When setting L2-05 lower than the default setting, be sure to install an AC reactor option to the input side of the power supply to prevent damage to drive circuitry.

■ KEB Function

KEB (Kinetic Energy Back-Up) decelerates the motor using regenerative energy when power loss has been detected. By keeping the DC bus voltage at a constant level, KEB Ride-Thru allows the drive to continue running without interrupting the output power during momentary power loss. Once power is restored, the drive smoothly returns to the same operational state before the power loss occurred.

Operation Selection and Setting Method

To set KEB Ride-Thru the input terminals, enter 65 or 66 (N.C. and N.O. respectively) to one of the H1 parameters. To set KEB Ride-Thru 2, enter 7A or 7B (again, N.C. and N.O. respectively) to one of the H1 parameters. As shown in *Figure 5.68* , an auxiliary switch for the magnetic contactor should be set between the power supply and the terminal set to KEB Ride-Thru. The drive can be set to trigger KEB when the magnetic contactor opens or closes. Depending on the specifications, set the input auxiliary switch to be N.O. or N.C.

Note: To properly use the KEB function, make sure that the drive is set so that the run command does not switch off when momentary power loss occurs. If the run command is switched off, the drive will not accelerate back to speed when the power is restored.

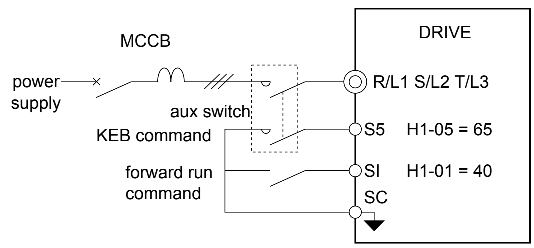


Figure 5.69 KEB Function

KEB Ride-Thru 1

When KEB Ride-Thru 1 has been set to one of the multi-function input terminals, the drive will decelerate at the time set to L2-06. If KEB Ride-Thru is switched off after about 50 ms, the drive will then begin to accelerate again for the time set to L2-07. Use this function to enable KEB Ride-Thru with multiple motors running from the same drive.

Note: Although KEB operation will still begin even if the voltage level in the DC bus is below the value specified in L2-05 prior to KEB Ride-Thru 1, the drive will accelerate back up to speed if the KEB is switched off after approximately 50 ms. Make sure the KEB Ride-Thru 1 is operating properly. This function requires a breaking resistor.

KEB Ride-Thru 2

When KEB Ride-Thru 2 is entered through one of the multi-function input terminals, the drive will decelerate while maintaining the DC bus voltage at the level specified in L3-16. If KEB Ride-Thru 2 is switched off after about 50 ms, then once power is restored the drive will accelerate back up to the speed it was at prior to the power loss. Use this function to have the drive decelerate by KEB only.

Note: Although KEB operation will still begin even if the voltage level in the DC bus is below the value specified in L2-05 prior to KEB Ride-Thru 2, the drive will accelerate back up to speed if the KEB is switched off after approximately 50 ms. Make sure the KEB Ride-Thru 2 is operating properly.

■ L2-06: KEB Deceleration Time

No.	Name	Setting Range	Default	Page
L2-06	KEB Deceleration Time	0.0 to 200.0	0.0 s	–

Sets the time to decelerate from the maximum frequency down to zero speed after KEB Ride-Thru 1 has been entered to one of the multi-function input.

■ L2-07: Momentary Power Loss Ride-Thru Time

No.	Name	Setting Range	Default	Page
L2-07	Momentary Power Loss Ride-Thru Time	0.0 to 25.5	0.0 s	–

Sets the acceleration time to reaccelerate back up to the specified frequency following the momentary power loss occurs that triggered the KEB function. When set to 0, the drive will accelerate back up to speed according to parameters C1-01 through C1-08.

■ L2-08: Minimum Frequency Gain at KEB Start

No.	Name	Setting Range	Default	Page
L2-08	Minimum Frequency Gain at KEB Start	0 to 300	100%	–

The output frequency is reduced in steps when KEB Ride-Thru 1 begins. Set the rate of this decrease as a percentage using the following formula:

Amount of reduction = Slip frequency prior to KEB x (L_2-08) x 2

■ L2-11: Desired DC Bus Voltage during KEB

Sets the desired voltage in the DC bus when KEB is operating.

No.	Name	Setting Range	Default	Page
L2-11	Desired DC Bus Voltage during KEB	150 to 400 *1	240%*3	–

*1. Double this value when using a 400 V class unit.
*2. This value is initialized when E1-01 is changed.
*3. This value is reset its default setting when the control mode is changed (A1-02). The value shown here is for Open Loop Vector Control.

- This setting rarely needs to be changed.
- Sets the level of voltage suppression in the DC bus when KEB Ride-Thru 2 is operating.

Adjustment to KEB Ride-Thru 2 can be made by changing the gain in the DC bus voltage (L3-20), gain calculations for deceleration (L3-21), inertia calculations for the motor acceleration time (L3-24), and the load inertia ratio (L3-25). For more information, refer to *L3: Stall Prevention*

◆ L3: Stall Prevention

"Stalling" occurs when the motor is unable to keep up with the frequency reference, and falls too far behind the normal the amount of slip. This makes it impossible to decelerate or accelerate. The drive can prevent the motor from stalling and still reach the desired speed without the user needing to change the acceleration or deceleration time settings.

■ L3-01: Stall Prevention Selection during Acceleration

■ L3-02: Stall Prevention Level during Acceleration

■ L3-03: Stall Prevention Limit during Acceleration

No.	Name	Setting Range	Default	Page
L3-01	Stall Prevention Selection during Acceleration	0 to 2*1	1	–
L3-02	Stall Prevention Level during Acceleration	0 to 150*2	*2	–
L3-03	Stall Prevention Limit during Acceleration	0 to 100	50%	–
L3-22	Deceleration Time at Stall Prevention during Acceleration	0.0 to 6000.0	0.0 s	–

*1. Setting range in PM Open Loop Vector is 0 and 1. When enabled, the drive will stop accelerating if the level set to L3-02 is reached, then decelerate briefly for 100 ms. Acceleration begins again after the current value is restored.
*2. The upper limit is determined by the duty rating and the carrier frequency derating selection (C6-01 and L8-38 respectively).

Overview

Stall Prevention during acceleration is used when the motor loses speed during acceleration due to a relatively large load. It prevents overcurrent and motor overload (OL1) from resulting.

Detailed Description

Setting	Description
0	Disabled: Motor accelerates at active acceleration rate.
1	General Purpose: When output current exceeds L3-02 level, acceleration stops. Acceleration will continue when the output current level falls below the L3-02 level.
2	Intelligent: The active acceleration rate is ignored. Acceleration is completed in the shortest amount of time without exceeding the current value set in L3-02.

- L3-01 = 0
  The drive may not be able to perform acceleration within the specified time if the acceleration time setting is too short.
- L3-01 = 1
  Enables Stall Prevention during acceleration.

■ Timechart

The figure below shows the frequency characteristics when L3-01 is set to 1.

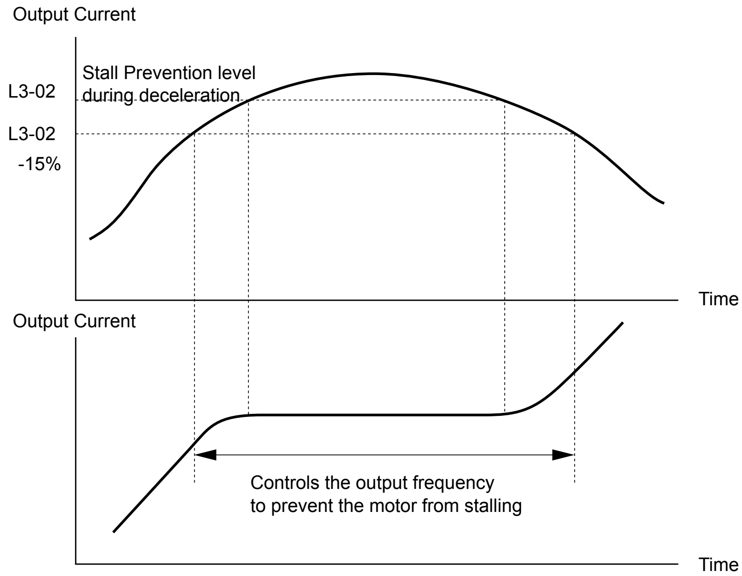


Figure 5.70 Timechart for Stall Prevention during Acceleration

■ Setting Notes

- If stalling occurs with L3-02 set to its default value when using a motor that is relatively small compared to the drive, try lowering L3-02.
- When operating the motor within a constant output range, L3-02 is automatically reduced to prevent speed loss. L3-03 limits the degree to which L3-02 is reduced while attempting to maintain constant output.
- Set as a percentage of the drive rated current.

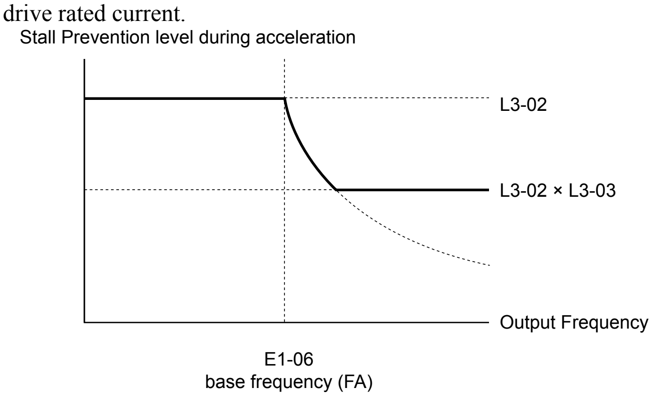
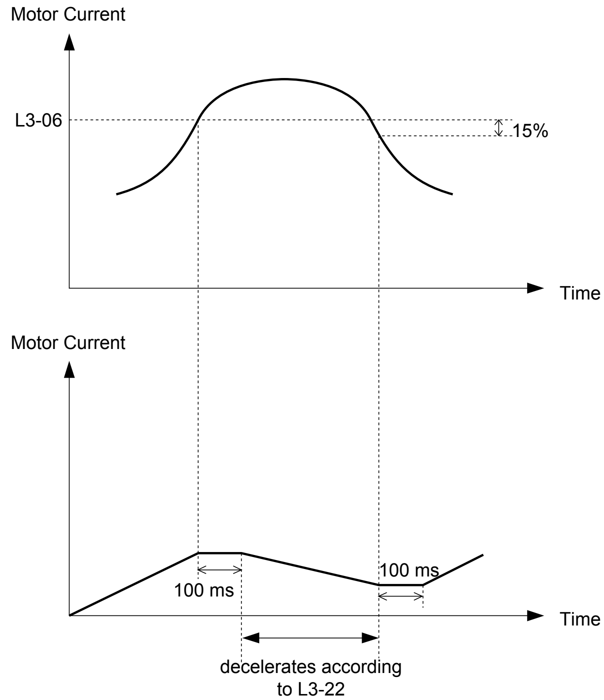


Figure 5.71 Stall Prevention Level and Limit during Acceleration

- If operation exceeds the Stall Prevention level set to L3-02 for more than 100 ms when using PM Open Loop Vector Control, then the drive will respond by briefly decelerating for the time specified in L3-22. Acceleration will resume once the Stall Prevention level falls below L3-02 for 100 ms.



■ L3-22: Deceleration Time at Stall Prevention during Acceleration

Sets the brief deceleration time for when stalling occurs while accelerating a PM motor. When set to 0, this function is disabled and the drive will decelerate at a normal rate when stalling occurs.

Note: The function is available only in Open Loop Vector Control Mode for PM motors.

- L3-01 = 2

  Ignores the acceleration time that has been set and instead accelerates as quickly as possible without the motor stalling.

  Accelerates at the optimal level without exceeding the Stall Prevention level set for acceleration (L3-02).

■ L3-04: Stall Prevention Selection during Deceleration

No.	Name	Setting Range	Default	Page
L3-04	Stall Prevention Selection during Deceleration	0 to 4	1	–

Stall Prevention during deceleration keeps the deceleration rate smooth while keeping the voltage in the DC bus from tripping an OV fault.

Detailed Description

Settings for L3-04 and their meanings appear in the table below.

Setting	Description
0	Disabled (drive decelerates at the active deceleration rate)
1*	General Purpose (no braking resistor)
2	Intelligent
3	Stall Prevention with Braking Resistor
4	Overexciation Deceleration

*Default Setting

Note: Settings 3 and 4 are not available when using a PM motor.

- L3-04 = 1

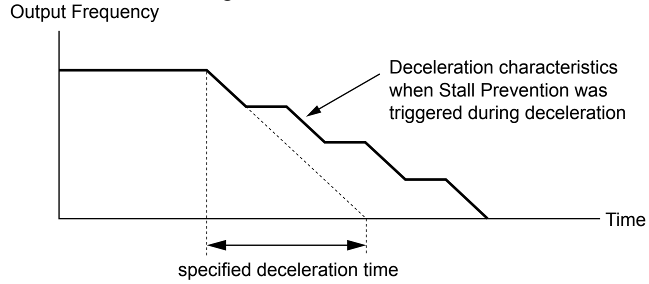
  This setting enables Stall Prevention during deceleration.

Briefly stops deceleration and maintains the output frequency when the DC bus voltage exceeds the Stall Prevention level listed on the previous page. Begins decelerating again at the specified deceleration time once the voltage in the DC bus drops below the Stall Prevention level. Stall Prevention may be triggered repeatedly to avoid an overvoltage fault, and is useful when attempting to decelerate a load at a rate beyond what the drive is capable of.

Drive Voltage		Stall Prevention Level during Deceleration
200 V class		VDC = 380 V
400 V class	E1-01 greater than or equal to 400 V	VDC = 760 V
	E1-01 < 400 V	VDC = 660 V

Note: Set L3-04 to “0” or “3” when using a Dynamic Braking Resistor or some other braking option. If Stall Prevention during deceleration is enabled, it will be triggered before the braking resistor option can operate.

- The figure below illustrates how Stall Prevention works during deceleration.



Note: When Stall Prevention is activated during deceleration, it might take slightly longer to decelerate than the specified deceleration time. As this may not be appropriate in conveyors or other such applications where positioning is a concern, you may want to consider using a braking resistor option instead.

- L3-04 = 2

  Drive automatically adjusts Stall Prevention levels for optimum performance.

  It suppresses the DC bus voltage, preventing the motor from stalling during deceleration while still maintaining the desired voltage levels specified in L3-17. Here, the deceleration time is disregarded. When the frequency is relatively high, the drive will decelerate the motor slowly, increasing the speed only as the frequency level drops. This function is affected by other parameters that include the DC bus voltage adjustment gain (L3-20), the deceleration rate calculations gain (L3-21), inertia calculations for the motor deceleration time (L3-24), and the load inertia ratio (L3-25).

  Note: Refrain from using this function in conveyors and other applications in which the stopping position is a concern. Yaskawa recommends using a braking option instead.

- L3-04 = 3

  Enables the Stall Prevention function while using a braking resistor.

  Use this setting if overvoltage occurs with L3-04 disabled when using a braking resistor. This makes it possible to reduce the deceleration time.

- L3-04 = 4

  Enables Overexcitation Deceleration.

  Overexcitation (increasing the motor flux) can shorten the deceleration time faster than disabling Stall Prevention during deceleration (L3-04 = 0). Repetitive overexcitation, however, can result in motor overload (OL1). In such situations, either shorten the deceleration time setting or consider using a braking resistor.

  Note: Because the flux level that allows for overexcitation varies based on the flux saturation characteristics of the motor, set the proper overexcitation level by adjusting the excitation gain in parameter n3-13. Motor characteristics and inertia of the machine influence the deceleration time during overexcitation deceleration.

■ L3-05: Stall Prevention Selection during Run

■ L3-06: Stall Prevention Level during Run

Stall Prevention during run allows the drive to operate at a continuous speed with a constant frequency output. It prevents speed loss or overload (OL1) that would otherwise occur due to an increase in the load.

No.	Name	Setting Range	Default	Page
L3-05	Stall Prevention Selection during Run	0 to 2	1	–
L3-06	Stall Prevention Level during Run	30 to 150*	Determined by C6-01 and L8-38.	–

*The upper limit for this setting is determined by C6-01 and L8-38. This setting rarely needs to be changed.

Note: This function is not available in V/f Control. When used in Open Loop Vector for PG motors, it functions much the same as the torque limit.

Detailed Description

Settings for L3-05 appear in the table below:

Setting	Description
0	Disabled: Drive runs a set frequency. A heavy load may cause a fault.
1	Decelerates at Decel Time 1 (C1-02)
2	Decelerates at Decel Time 2 (C1-04)

- L3-05 = 0

  Disabled. Drive runs a set frequency. A heavy load may cause the drive to trip on an OC or OL fault.

- L3-05 = 1

  In order to avoid stalling during heavy loading, the drive will decelerate at Decel Time 1 (C1-02) if the output current exceeds the level set by L3-06. Once the current level drops below the L3-06 level for 100 ms, the drive will accelerate back to its frequency reference at the active acceleration rate.

- L3-05 = 2

  Same as setting 1 except the drive decelerates at Decel Time 2 (C1-04). When output frequency is 6Hz or less, stall prevention during run is disabled regardless of the setting in L3-05.

■ L3-23: Automatic Reduction Function Selection for Stall Prevention during Run

No.	Name	Setting Range	Default	Page
L3-23	Automatic Reduction Function Selection for Stall Prevention during Run	0: Disabled 1: Enabled	0	–

Note: When L3-23 = 0, the Stall Prevention level during run becomes the value set to L3-06. When L3-23 = 1, the Stall Prevention level during run is automatically reduced in the constant output range. The lower limit value becomes 40% of L3-06.

■ L3-11: OV Suppression Function Selection

Suppresses voltage in the DC bus to prevent an OV fault from occurring when a regenerative load is added.

Parameter Details

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No.	Name	Setting Range	Default	Page
L3-11	OV Suppression Function Selection	0: Disabled 1: Enabled*	0	–

*Motor speed will exceed the frequency reference when overvoltage suppression is triggered from an increase in a regenerative load. Consequently, overvoltage suppression is not appropriate in applications that require a perfect match between the frequency reference and the actual motor speed. Disable overvoltage suppression when using a braking resistor. Overvoltage may still occur if there is a sudden increase to a regenerative load.

- L3-11 = 1 (enabled)

  When there in an increase to a regenerative load, this function prevents overvoltage from resulting by increasing the output frequency. It suppresses the DC bus voltage as well as keeps it within the desired level set to L3-17. Be aware that the motor can speed up while OV suppression is operating. This function is helpful in punch press applications, in addition to motoring and regenerative applications that involve repetitive crank movement. Overvoltage suppression is adjusted with other parameters, including DC bus voltage gain (L3-20), deceleration rate calculations gain (L3-21), inertia calculations for motor acceleration time (L3-24), and the load inertia ratio (L3-25).

Note: Not for use with applications in where the motor speed and frequency reference must be exactly the same. Disable this settings when using a braking resistor. Overvoltage may occur even when this function is enabled if there is a sudden increase to a regenerative load. This function is enabled only when operating just below the maximum frequency reference and there is an increase to a regenerative load.

■ L3-17: Overvoltage Suppression and Deceleration Stall and Desired DC Bus Voltage during Motor Stall

No.	Name	Setting Range	Default	Page
L3-17	Overvoltage Suppression and Deceleration Stall and Desired DC Bus Voltage during Motor Stall	150 to 400*1	370 V*1*2	–

*1. Double this value when using a 400 V class unit.

*2. This value is initialized when E1-01 is changed.

Note: This parameter is enabled when overvoltage suppression selection is also enabled (L3-11 = 1), and also when Stall Prevention during deceleration is set for automatic adjustment (L3-04 = 2). This setting rarely needs to be changed.

■ L3-20: Main Circuit Voltage Adjustment Gain

Determines the proportional gain for suppressing DC voltage to the desire levels (L3-11 = 1) when KEB Ride-Thru 2 or automatic adjustments for Stall Prevention during deceleration is enabled.

No.	Name	Setting Range	Default	Page
L3-20	Main Circuit Voltage Adjustment Gain	0.00 to 5.00	1.00	–

Note: If overvoltage or undervoltage (UV1) occurs at the beginning of deceleration while KEB Ride-Thru 2 is enabled or while intelligent, automatic adjustment is set for Stall Prevention during deceleration, try increasing this setting slowly in increments of 0.1. If this setting is too high, then a fair amount of speed or torque ripple can result. If overvoltage suppression is enabled (L3-11 = 1) and there is a sudden increase in a regenerative load, overvoltage may still result. To counteract this problem, try increasing this setting in increments of 0.1. Note that a fair amount of speed or current ripple may result if set too high.

■ L3-21: Accel/Decel Rate Calculation Gain

Determines the proportional gain used in calculating acceleration and deceleration in order to keep DC bus voltage within the desired range when overvoltage supression is enabled (L3-11 = 1) for KEB Ride-Thru 2 and intelligent Stall Prevention during deceleration (L3-04 = 2).

No.	Name	Setting Range	Default	Page
L3-21	Accel/Decel Rate Calculation Gain	0.00 to 200.00	1.00*	–

*Reset to its default value when the control mode is changed (A1-02). The value shown here is for Open Loop Vector Control.

Note: The gain for the acceleration calculations may need to be reduced in small increments of 0.05 if there is a fairly large speed or current ripple during KEB Ride-Thru 2 or when using the automatic, intelligent adjustment feature in Stall Prevention during deceleration. Small reductions in the acceleration gain can also help solve problems with overvoltage and overcurrent. Be careful not to decrease this setting too much, as that may result in too slow of a response in controlling DC bus voltage and may also slow deceleration times beyond optimal levels. Increase this setting in small increments of 0.1 if overvoltage occurs as a result of a regenerative load when overvoltage suppression is enabled (L3-11 = 1). If there is a fairly large speed ripple when overvoltage suppression is enabled, then slowly decrease L3-21 in increments of 0.05.

■ L3-24: Motor Acceleration Time for Inertia Calculations

Sets the time it takes to accelerate the motor from stop to the maximum speed at motor rated torque.

This parameter should be set when using KEB Ride-Thru 2, automatic adjustment for optimal Stall Prevention during deceleration (L2-04 = 2), or the overvoltage suppression function (L3-11 = 1).

No.	Name	Setting Range	Default	Page
L3-24	Motor Acceleration Time for Inertia Calculations	0.001 to 10.000	Determined by o2-04, E2-11, and E5-01	–

Note: Parameter o2-04 is defaulted for a Yaskawa standard 4-pole motor. During Auto-Tuning, o2-04 will be initialized to a Yaskawa standard 4-pole motor if parameter E2-11 is changed. This value changes based on the motor code set to E5-01 when using the Open Loop Vector Control Mode for PM motors.

Calculations are made as follows:

J: GD2/4

P: Rated output

$$ta = 2\pi \cdot J\ [Kgm^2] \cdot Nr\ [r/min] / [60 T_{100}\ (Nm)]$$

To solve for T_{100}:

$$T_{100} = 60\ P[kW] \times 103 / [2\pi \cdot Nr\ (r/min)]$$

■ L3-25: Load Inertia Ratio

Determines the ratio between the rotor inertia and the load. Set this parameter when using KEB Ride-Thru 2, when optimizing Stall Prevention during deceleration (L2-04 = 2), and when using the overvoltage suppression function (L3-11 = 1).

No.	Name	Setting Range	Default	Page
L3-25	Load Inertia Ratio	0.0 to 1000.0	1.0	–

Note: When set incorrectly, a fairly large current ripple can result during KEB Ride-Thru 2 and while automatic adjustments are made for Stall Prevention during deceleration (L3-11 = 1). Other possible faults such as OV, UV1, and OC may also occur. load inertia = machine inertia (motor shaft calculated value) / rotor inertia

◆ L4: Frequency Detection

Sets the output signal for a series of functions assigned to the multi-function output terminals that determine frequency agree, user-set frequency agree, frequency detection, and so on.

■ L4-01: Speed Agreement Detection Level

■ L4-02: Speed Agreement Detection Width

L4-01 and L4-02 allow the user to set the Speed Agreement specifications when Frequency Detection 1, Frequency Detection 2, or User-Selected Frequency Agree 1 are assigned to the multi-function terminals.

For more information, ***Refer to H2: Multi-Function Outputs on page 170***.

■ L4-03: Speed Agreement Detection Level (+/-)

■ L4-04: Speed Agreement Detection Width (+/-)

L4-03 and L4-04 allow the user to set the Speed Agreement specifications when Frequency Agree 2, Frequency Detection 3, Frequency Detection 4, or User-Selected Frequency Agree 2 are assigned to the multi-function terminals.

For more information, ***Refer to H2: Multi-Function Outputs on page 170***.

■ L4-05: Frequency Reference Loss Detection Selection

■ L4-06: Frequency Reference at Reference Loss

No.	Name	Setting Range	Default	Page
L4-05	Frequency Reference Loss Detection Selection	0: Drive will stop. 1: Continue running at L4-06.	0	–
L4-06	Frequency Reference at Reference Loss	0.0 to 100.0	80.0 %	–

- The frequency reference is considered “lost” when it is entered from an external source, and suddenly falls below 90% for more than 400 ms.
- If L4-05 = 1, the drive will not stop when the frequency reference is lost, but will instead operate at the value set to L4-06. The drive will switch back to the main frequency reference once it is restored.
- To have a fault output trigger when the frequency reference is lose, set H2-01, H2-02, or H2-03 to “C”.

Note: Frequency reference loss detection: analog reference supplied via terminal A1 can be supplied from terminal A2 by setting H3-10 to 0.

■ L4-07: Frequency Detection Conditions

Parameter Overview

No.	Name	Description	Range	Default
L4-07	Frequency Detection Conditions	0: No detection during baseblock. 1: Detection always enabled.	0 to 1	0

◆ L5: Fault Restart

The drive performs a self-diagnostic check if a fault occurs during operation. If the problem has been taken care of, the drive performs Speed Search (b3-24) and starts back up again. This is referred to as a Fault Restart.

■ L5-01: Number of Auto Restart Attempts

■ L5-02: Auto Restart Operation Selection

No.	Name	Setting Range	Default	Page
L5-01	Number of Auto Restart Attempts	0 to 10	0	–
L5-02	Auto Restart Operation Selection	0: No output 1: Output	0	–

The user can set the number of times that the drive may attempt to restart itself. When the drive faults out, it can attempt to restart after the minimum baseblock time has passed plus 5 ms. Each time that the drive clears the fault and attempts to restart is counted in the number of fault restarts. Even if the number of fault restarts is set to L5-01, protection operation will be triggered if the fault situation continues as the drive attempts to restart itself. The drive can attempt to restart itself following the faults listed below. Other protection functions are available for other faults not included in this list.

- OC (Overcurrent) RH (Braking Resistor)

- GF (Ground Fault) RR (Braking Transistor)
- PUF (DC Bus Fuse) OL1 (Motor Overload)
- OV (DC Bus Overvoltage) OL2 (Drive Overload)
- UV1 (DC Bus Undervoltage) OH1 (Overheat)
- PF (Input Phase Loss) OL3 (Overtorque 1)
- LF (Output Open Phase) OL4 (Overtorque 2)

When undervoltage in the DC bus is set to allow for Power Loss Ride-Thru (L2-01 = 1 or 2).

Note: To output a signal during fault restart, set H2-01, H2-02, or H2-03 to 1E. The number of fault restarts is reset back to 0 when: The drive operates normally for ten minutes following a fault restart. A fault is cleared manually after protective functions were triggered. The power supply is cycled.

NOTICE: *Do not use the fault restart function in hoist applications.*

L5-04: Fault Reset Interval Time

Determines the amount of time to wait between attempts to restart the drive.

This function is enabled by setting L5-05 to 1.

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

L5-05: Fault Reset Operation Selection

No.	Name	Setting Range	Default	Page
L5-05	Fault Reset Operation Selection	Keeps track of how many times the drive attempted to restart after a fault occurred. 0: Uses the method available in G7. 1: Uses the method available in V7.	0	–

L6: Torque Detection

This function outputs an alarm signal using multi-function output terminals MA-MC, P1-PC, and P2-PC when the load is too heavy (overtorque) on the machine side, or suddenly becomes too light (undertorque).

L6-01/L6-04: Torque Detection Selection 1/2

L6-02/L6-05: Torque Detection Level 1/2

L6-03/L6-06: Torque Detection Time 1/2

No.	Name	Setting Range	Default	Page
L6-01	Torque Detection Selection 1	0: Disabled 1: OL3 at Speed Agree - Alarm (Overtorque Detection only active during Speed Agree and Operation continues after detection). 2: OL3 at RUN - Alarm (Overtorque Detection is always active and operation continues after detection). 3: OL3 at Speed Agree - Fault (Overtorque Detection only active during Speed Agree and drive output will shut down on an OL3 fault). 4: OL3 at RUN - Fault (Overtorque Detection is always active and drive output will shut down on an OL3 fault). 5: UL3 at Speed Agree - Alarm (Undertorque Detection is only active during Speed Agree and operation continues after detection). 6: UL3 at RUN - Alarm (Undertorque Detection is always active and operation continues after detection). 7: UL3 at Speed Agree - Fault (Undertorque Detection only active during Speed Agree and drive output will shut down on an OL3 fault). 8: UL3 at RUN - Fault (Undertorque Detection is always active and drive output will shut down on an OL3 fault).	0	–
L6-02	Torque Detection Level 1	0 to 300	150%	–
L6-03	Torque Detection Time 1	0.0 to 10.0	0.1 s	–
L6-04	Torque Detection Selection 2	Same as L6-01	0	–
L6-05	Torque Detection Level 2	0 to 300	150%	–
L6-06	Torque Detection Time 2	0.0 to 10.0	0.1 s	–

Detailed Description

This function is used to detect torque levels in order to check for overtorque or undertorque. When enabled, the following selection can be assigned to the multi-function output terminals (H2-01, H2-02, and H2-03).

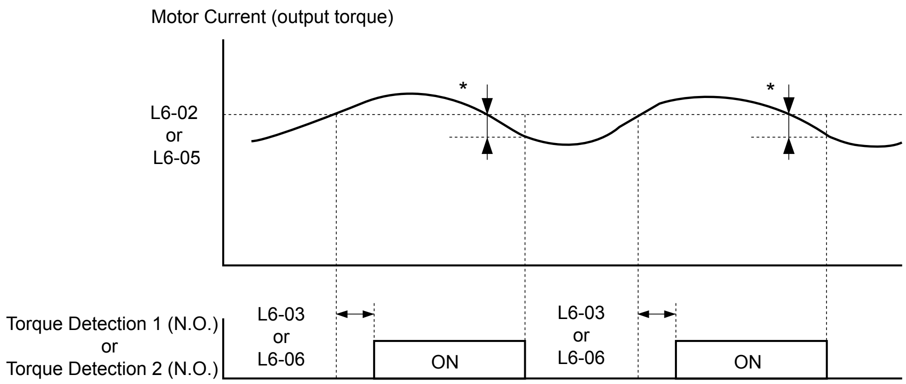
Setting	Status	Description
B	Closed	Output current/torque exceeds the torque value set in parameter L6-02 for longer than the time specified in parameter L6-03.
17	Open	Output current/torque exceeds the value set in parameter L6-02 for more time than is set in parameter L6-03.
18	Closed	Output current/torque exceeds the value set in parameter L6-05 for more time than is set in parameter L6-06.
19	Open	Output current/torque exceeds the value set in parameter L6-05 for more time than is set in parameter L6-06

Note: The torque detection function uses a hysteresis of about 10% of the drive rated output current. The torque detection level in V/f Control is 100% of the drive rated output current. In Open Loop Vector, it is defined as 100% of the motor rated torque.

NOTICE: *When overtorque occurs, the drive may stop due to overcurrent or overload (OL1). To prevent this, the drive should quickly detect overtorque situations. Problems with undertorque can result in a torn belt, a pump shutting off, or other similar trouble.*

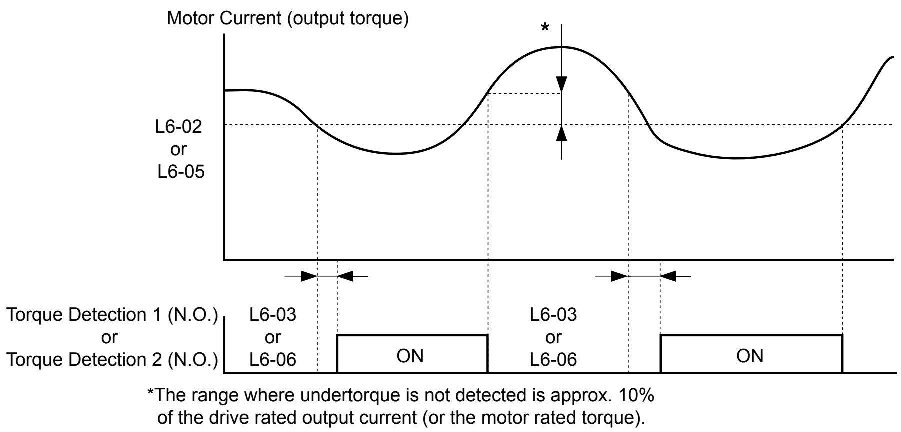
Below is a timechart for overtorque and undertorque detection.

- Overtorque Detection



Note: Torque detection is not active in about 10% of the drive rated output current (or motor rated torque).

- Undertorque Detection



Note: Torque detection is not active in about 10% of the drive rated output current (or motor rated torque).

■ L6-08: Mechanical Weakening Detection Operation

The following settings are available for L6-08:

0: Mechanical Weakening Detection disabled.

1: Continue running if the speed (signed) is greater than L6-09 (alarm only).

2: Continue running if the speed (not signed) is greater than L6-09 (alarm only).

3: Interrupt drive output when the motor speed (signed) is greater than L6-09 (protection operation).

4: Interrupt drive output when the motor speed (not signed) is greater than L6-09 (protection operation).

5: Continue running if the speed (signed) is less than L6-09 (alarm only).

6: Continue running if the speed (not signed) is less than L6-09 (alarm only).

7: Interrupt drive output when the motor speed (signed) is less than L6-09 (protection operation).

8: Interrupt drive output when the motor speed (not signed) is less than L6-09 (protection operation).

Note: This output signal is switched on when one of the multi-function outputs is set for mechanical weakening detection (H2-□□ = 22).

■ L6-09: Mechanical Weakening Detection Speed Level

Sets the speed at which mechanical weakening operates. Uses Torque Detection 1 when determining the torque (L6-01 to L6-03). If the absolute value selection is set to L6-08, then negative numbers are treated as positive numbers.

■ L6-10: Mechanical Weakening Detection Time

Sets the time permitted for the situation selected in parameter L6-08 to arise before mechanical weakening is detected.

■ L6-11: Mechanical Weakening Detection Start Time

Mechanical weakening detection is triggered when the cumulative operation time (U4-01) exceeds this value.

◆ L7: Torque Limit

The torque limit function is available only when in the Open Loop Vector Mode. Set torque limit to protect the connect machinery.

■ L7-01/L7-02: Forward/Reverse Torque Limit

■ L7-03/L7-04: Forward/Reverse Regenerative Torque Limit

No.	Name	Setting Range	Default	Page
L7-01	Forward Torque Limit	0 to 300	200	–
L7-02	Reverse Torque Limit	0 to 300	200	–
L7-03	Forward Regenerative Torque Limit	0 to 300	200	–
L7-04	Reverse Regenerative Torque Limit	0 to 300	200	–

Note: If the multi-function analog input is programmed for "10: Forward Torque Limit", "11: Reverse Torque Limit", "12: Regen Torque Limit", or "15: FWD/REV Torque Limit", the drive uses the lower value of either L7-01 through L7-04, or analog input torque limit.

■ L7-06: Torque Limit Integral Time Constant

Sets the integral time constant for the torque limit.

No.	Name	Setting Range	Default	Page
L7-06	Torque Limit Integral Time Constant	5 to 10000	200 ms	–

Note: Reduce this setting in order to allow for a large change in frequency as determined by the torque limit when using integral control with the torque limit.

■ L7-07: Torque Limit Control Method Selection during Accel/Decel

Selects the method of torque limit controls during acceleration and deceleration.

No.	Name	Setting Range	Default	Page
L7-07	Torque Limit Control Method Selection during Accel/Decel	0: Proportional Control (uses integral control at fixed speeds). 1: Integral Control	0	–

Note: This setting rarely needs to be changed. Set this parameter to 1 (Integral Control) to give torque control priority when accelerating in applications using the torque limit feature. Be aware that when the torque limit is triggered, the acceleration time may increase and motor speed may differ slightly more than usual from the exact frequency reference.

◆ L8: Hardware Protection

■ L8-01: Internal Dynamic Braking Resistor Protection Selection (ERF type)

This parameter selects the dynamic braking resistor protection only when using the 3% duty cycle heatsink mount Yaskawa braking resistor. This parameter does not enable or disable the general dynamic braking function of the Drive. Do not adjust this parameter when using any other braking resistors.

■ L8-02: Overheat Alarm Level

■ L8-03: Overheat Pre-Alarm Operation Selection

The drive is capable of warning the operator of an impending heatsink over-temperature fault via an OH pre-alarm. The level at which the pre-alarm will activate is determined by the setting of parameter L8-02. Measurement of the heatsink temperature is done with several strategically mounted thermistors. The drive will fault (OH2) if any of the heatsink thermistors measure a temperature in excess of the setting of L8-02. When an OH2 fault occurs, one of the action below can be set to L8-03:
- Ramp to stop at the selected deceleration time (L8-03 = 0)
- Coast to stop (L8-03 = 1)
- Fast Stop (L8-03 = 2: Fast Stop)
- Continue operating but display an OH alarm (L8-03 = 3: Alarm only)
- Continue operating but derate the frequency reference (L8-03 = 4: Derated Operation)

When an output terminal is set to for the OH prealarm (H2-01 = 20), the switch will close when the heatsink temperature rises above L8-02, regardless of the value set to L8-03.

■ L8-05: Input Phase Loss Protection Selection

Selects the detection of input current phase loss, power supply voltage imbalance, or main circuit electrostatic capacitor deterioration.

Phase loss detection for the input power supply is disabled when:
- a stop command has been issued
- the magnetic contactor has interrupted the power supply
- a CPU A/D conversion fault occurs
- the drive is decelerating
- output current is less than or equal to 30% of the drive rated current

■ L8-07: Output Phase Loss Protection

The output phase loss detection circuit monitors the DCCT and is triggered when one or more of the output phases are lost. If an output phase loss (LF) fault occurs, and the motor coasts to stop.

■ L8-09: Output Ground Fault Detection Selection

Enables and disables the drive's output ground fault detection. Drive coasts to stop when a ground fault is detected.

■ L8-10: Heatsink Cooling Fan Operation Selection

■ L8-11: Heatsink Cooling Fan Operation Delay Time

Parameters L8-10 and L8-11 allow the drive programmer to customize the heatsink cooling fan operation. Parameter L8-10 determines whether the cooling fans are always on whenever the drive is powered (L8-10 = “1: Fan Always On”) or if the cooling fans are only on when the drive is in a run condition (L8-10 = “0: Fan On-Run Mode”).

Parameter L8-11 is a delayed off for the cooling fan if L8-10 = “0: Fan On-Run Mode”. When the cooling fans are set to turn off when the run command is removed, parameter L8-11 will cause the fans to continue cooling the drive for the amount of time programmed into L8-11 after the run command is actually removed. The drive can be programmed to allow the cooling fan to run for up to 5 minutes (factory default) after the run command is removed.

Both parameters are intended to extend fan life while still providing sufficient cooling for proper drive operation.

■ L8-12: Ambient Temperature Setting

Set parameter L8-12 to the temperature of the area in which the drive is mounted. This value is used during fault detection and for maintenance.

■ L8-15: OL2 Characteristics Selection at Low Speeds

At very low speeds (6 Hz and below) and very high current levels it can be possible to damage output transistors. Therefore the default setting of L8-15 is set to shorten the time before an OL2 fault will occur when operating at low speed with a relatively heavy load (L8-15 = “1: Enabled”).

■ L8-18: Software CLA Selection

The Software CLA (software current limit level) is a drive protection function that will limit the drive's output current. The drive limits the output current by reducing the output frequency whenever the current exceeds 110% of the drive rated current. If the current level drops below the Software CLA level, then normal operation will continue.

If the software current limit is disabled (L8-18 = “0: Disabled”), the drive may trip on an OC fault if the load is prohibitively large or the acceleration is too short. For proper drive protection and operation leave the Software CLA function enabled.

■ L8-19: Frequency Reduction Rate during OH Pre-Alarm

Specifies how much to derate the frequency reference when L8-03 is set to 4 and an OH prealarm is output.

■ L8-29: Current Unbalance Detection (LF2)

This function is available only when using PM Open Loop Vector.

Issues a stop command when the output current becomes unbalanced as a result of a damaged photocoupler or output phase loss. Set to 0 to disable this function.

■ L8-35: Side-by-Side Installation Selection

Sets the type of installation. Default setting is for a standard type of set up. For a fully enclosed motor compliant with NEMA type 1 specifications, set this parameter to “2”. Set to “1” when taking advantage of Yaskawa’s Side-by-Side installation.

■ L8-38: Carrier Frequency Reduction

Specifies the degree of reduction for the carrier frequency at low speeds for IGBT protection. There is no carrier frequency reduction when L8-38 is set to 0. Set to “1” to derate the carrier frequency when operating at less than 6 Hz and during overload.

To always have a derated carrier frequency, set L8-38 to 2.

■ L8-40: Low Carrier Frequency Time

Sets the amount of time the drive will operate with a reduced carrier frequency. The carrier frequency derating function during run is disabled when this parameter is set to 0.00 s.

■ L8-41: Current Alarm Selection

Allows or restricts an alarm from being triggered when the relative output current rises above 150%. Disabled when set to 0 (no output).

5.9 n: Special Adjustments

The n parameters handle a variety of specialized adjustments and functions, including Hunting Prevention, ASR Control, High Slip Braking, resistance between motor lines, and PM motor control functions.

◆ n1: Hunting Prevention

Hunting Prevention keeps the drive from hunting as a result of the carrier frequency, low inertia, and operating with a light load. It is available in V/f Control only.

■ n1-01: Hunting Prevention Selection

Enables or disables the Hunting Prevention function.

Note: This function is available only when using V/f Control. Hunting Prevention should be disabled when drive response is need over suppressing motor oscillation. This function can also be disabled without any problems in applications with high inertia loads or relatively heavy loads.

No.	Parameter Name	Setting Range	Default
n1-01	Hunting Prevention Selection	0: Disabled 1: Enabled	1

■ n1-02: Hunting Prevention Gain Setting

Sets the gain for the Hunting Prevention Function.

No.	Parameter Name	Setting Range	Default
n1-02	Hunting Prevention Gain Setting	0.00 to 2.50	1.00

Normally, n1-02 does not need to be changed, but adjustment may help under the following conditions:
- 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.

Note: An overly large Hunting Prevention Gain (n1-02) may cause the motor to stall.

■ n1-03: Hunting Prevention Time Constant

Determines how responsive the Hunting Prevention function is (affects the primary delay time for Hunting Prevention).

No.	Parameter Name	Setting Range	Default
n1-03	Hunting Prevention Time Constant	0 to 500	Determined by o2-04

■ n1-05: Hunting Prevention Gain while in Reverse

This parameter is the same as n1-02 except that it is for when the motor rotating in reverse. See the description of n1-02 for setting instructions.

Note: When set to 0, n1-02 is enabled even when the drive is operating in reverse.

No.	Parameter Name	Setting Range	Default
n1-05	Hunting Prevention Gain while in Reverse	0.00 to 2.50	0.00

◆ n2: AFR Tuning

These parameter are used to achieve speed stability by calculating changes in the torque current feedback and then compensating the output frequency.

Note: The drive comes equipped with Speed Feedback Detection, and therefore an external device for detecting the speed is not necessary

■ n2-01: Speed Feedback Detection Control (AFR) Gain

Sets the internal speed feedback detection control gain in the AFR. Normally there is no need to adjust n2-01 from the default setting. Make adjustments in the following cases:
- If hunting occurs, increase the set value.
- If response is low, decrease the set value.

Note: Adjust the setting by 0.05 units at a time while checking the response.

■ n2-02: Speed Feedback Detection Control (AFR) Time Constant 1

■ n2-03: Speed Feedback Detection Control (AFR) Time Constant 2

Sets the time constant to determine the rate of change for the AFR.

Note: If hunting occurs, increase the set value. If response is low, decrease the set value. Increase the setting of n2-03 if overvoltage (OV) failures occur at the completion of acceleration or when the load changes radically. Parameter n2-02 cannot be set higher than n2-03 or an oPE08 error will result. If you increase the gain for Hunting Prevention (n1-02), be sure to also proportionally increase the torque compensation delay time constant set to C4-02. If you increase the time constant for Hunting Prevention (n1-03), be sure to also proportionally increase the value set to C4-06 (Torque Compensation Delay Time Constant 2).

No.	Parameter Name	Setting Range	Default
n2-02	Speed Feedback Detection Control (AFR) Time Constant 1	0 to 2000	50 ms
n2-03	Speed Feedback Detection Control (AFR) Time Constant 2	0 to 2000	750 ms

◆ n3: High Slip Braking

High Slip Braking (HSB) is a method of decreasing the stopping time of a load without using dynamic braking. The regenerated energy of the decelerating load is dissipated in the motor windings through increased motor slipping. Because of the increased temperature of the motor windings, there is a limitation on the occurrence of HSB usage (~5% duty cycle).

The deceleration time is disregarded during HSB.

Braking time varies based on the load inertia and motor characteristics.

Note: High Slip Braking is only possible when using V/f Control. Due to the increased temperature created in the motor windings, there is a limitation on the occurrence of HSB usage. When a HSB command is given, it is not possible to restart the drive until the motor is stopped and the Run command is cycled.

■ n3-01: High Slip Braking Deceleration Frequency Width

Sets how aggressively the drive decreases the output frequency as it stops the motor using high slip braking (HSB).

No.	Parameter Name	Setting Range	Default
n3-01	High Slip Braking Deceleration Frequency Width	1 to 20	5%

■ n3-02: High Slip Braking Current Limit

Sets the maximum current to be output during an HSB stop as a percentage of motor rated current (E2-01). Make sure that this value does not exceed 150% of the drive's current rating.

No.	Parameter Name	Setting Range	Default
n3-02	High Slip Braking Current Limit	100 to 200	150%

■ n3-03: High Slip Braking Dwell Time at Stop

Sets the time that the output frequency should remain constant with the minimum output frequency set to E1-09.

Note: Possible only when using V/f Control. Enabled only during High Slip Braking.

No.	Parameter Name	Setting Range	Default
n3-03	High Slip Braking Dwell Time at Stop	0.0 to 10.0	1.0 s

■ n3-04: High Slip Braking Overload Time

Sets the time required for an HSB overload fault (OL7) to occur when the drive output frequency does not change for some reason during an HSB stop.

The overload fault oL1 is not affected by n3-04.

No.	Parameter Name	Setting Range	Default
n3-04	High Slip Braking Overload Time	30 to 1200	40 s

■ n3-13: Overexcitation Deceleration Gain

Improves the ability of the drive to perform linear deceleration when L3-04 = 4. Increase the gain to shorten the deceleration time.

- Returns to the normal values after ramp to stop, re-acceleration, and stop (DB, BB).
- To improve the breaking power of overexcitation, increase the gain by 1.25 to 1.30.
  The optimum setting for n3-04 depends on the motor flux saturation characteristics.
  Parameters n3-13, n3-21, and n3-23 are enabled only when using V/f Control or Open Loop Vector Control.
  The drive decelerates at the specified time.
  This function allows the drive to abandoned deceleration and start accelerating back up to a specified speed.

No.	Parameter Name	Setting Range	Default
n3-13	Overexcitation Deceleration Gain	1.00 to 1.40	1.10

■ n3-21: Overslip Suppression Current Level

If overcurrent, OL1, or OL2 occur during overslip deceleration, reduce the overslip suppression current level. Set as a percentage of the drive rated current.

No.	Parameter Name	Setting Range	Default
n3-21	Overslip Suppression Current Level	0 to 150	100%

Note: If the motor current exceeds the overexcitation supression current level set to n3-21 during overexcitation deceleration, then try returning the setting to what they were before. The problem is the result of flux saturation in the motor. Another possible solution is to try reducing the overexcitation gain set to n3-13.

■ n3-23: Overexcitation Operation Selection

Set this parameter to determine whether overexcitation can work in only one direction or not. This is helpful for having overexcitation apply only when motoring or only during regeneration. Because the flux level increases by the gain set by n3-13 during the overexcitation operation, regenerative energy is consumed in the motor. This allows enough regen torque to be output that a braking resistor is not needed.

Note: Operating the drive with overexcitation can trigger oL1. If overvoltage continues to occur even with this function enabled, try using a braking resistor instead. Disabled this function when using a braking resistor.

No.	Parameter Name	Setting Range	Default
n3-23	Overexcitation Operation Selection	0 to 2	0

0	Disabled
1	Enabled only when rotating forwards

Parameter Details

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2	Enabled only when rotating in reverse

◆ n6: Line-to-Line Motor Resistance Online Tuning

For tuning the line-to-line motor resistance online.

No.	Parameter Name	Setting Range	Default
n6-01	Line-to-Line Motor Resistance Online Tuning	0: Disabled 1: Enabled	1

◆ n8: PM Motor Control

These parameters are available when using the special Open Loop Vector Control designed for permanent magnet motors.

■ n8-45: Speed Feedback Detection Control Gain (PM OLV)

Sets the gain for internal speed feedback detection control. Although this setting rarely needs to be changed, adjustment may be necessary under the following conditions:
- Increase this setting if motor oscillation occurs.
- Decrease this setting when there is a fair amount of speed fluctuation due to the load.
- Lower this setting in increments of 0.05 to decrease how responsive the drive is.

No.	Parameter Name	Setting Range	Default
n8-45	Speed Feedback Detection Control Gain (PM OLV)	0.00 to 10.00	0.80

■ n8-47: Pull-In Current Compensation Time Constant (PM OLV)

Sets the gain in units of 0.1 seconds to compensate for the phase margin.

Although this setting rarely needs to be changed, adjustment may be necessary under the following conditions:
- Increase this setting when it takes too long for the reference value for the Pull-In Current to match the target value.
- Decrease this setting if motor oscillation occurs.

No.	Parameter Name	Setting Range	Default
n8-47	Pull-In Current Compensation Time Constant (PM OLV)	0.0 to 100.0 s	5.0 s

■ n8-48: Pull-In Current (PM OLV)

Tells the drive the amount of current to be provided to the motor during no load operation at a constant speed. Set as a percentage of the motor rated current.

Increase this setting when hunting occurs while running at a constant speed.
- If the motor is unstable when operating at constant speeds, then slightly increase this setting.
- If there is too much current when drive a light load at a constant speed, then raise this level slightly.

No.	Parameter Name	Setting Range	Default
n8-48	Pull-In Current (PM OLV)	20 to 200%	Determined by E5-01

■ n8-49: d Axis Current for High Efficiency Control (for PM)

Sets the amount of d axis current when using Energy Saving control as a percentage of the motor rated current. For IPM motors only.

Although this setting seldom needs to be changed, please note the following:
- If motor operation is unstable when driving heavy loads, try lowering this setting.
- If motor parameters (E5) have been changed, this value will be reset to 0.

No.	Parameter Name	Setting Range	Default
n8-49	d Axis Current for High Efficiency Control (for PM)	-200.0 to 0.0%	Determined by E5-01

■ n8-51: Acceleration Time Pull-In Current (for PM OLV)

Sets the pull-in current during acceleration as a percentage of the motor rated current (E5-03). Set to a high value when more starting torque is needed.

Adjustments to this setting may help in the following situations:
- Increase this setting when a large amount of starting torque is required.
- Lower this setting if there is excessive current during acceleration.

No.	Parameter Name	Setting Range	Default
n8-51	Acceleration Time Pull-In Current	0 to 200%	Determined by E5-01

■ n8-54: Voltage Error Compensation Time Constant

Parameter Overview

No.	Name	Description	Range	Default
n8-54	Voltage Error Compensation Ttime Constant	Sets the time constant for voltage error compensation. Adjust the value when: • hunting occurs at low speed • hunting occurs with sudden load changes. Increase in steps of 0.1 or disable the compensation by setting n8-45 to 0. • oscillations occur at start. Increase the value in steps of 0.1.	0.00 to 10.00	1.00

■ n8-55: Load Inertia (PM OLV)

Adjust appropriately for the inertia of the connected machinery. If this value is set too low, the motor may not start very smoothly, and a STo fault (Pull-Out Detection 2) might occur. Try adjusting this parameter from the beginning.

0: The inertia ratio between the motor and the load just less than 1:10. There is a sizable current ripple.

1: The inertia ratio between the motor and the load is 1:10 to 1:30. When set to 0, STo occurs as a result of the load impact and sudden acceleration or deceleration.

2: The inertia ratio between the motor and the load is 1:30 to 1:50. When set to 1, STo occurs as a result of the load impact and sudden acceleration or deceleration.

3: The inertia ratio between the motor and the load is greater than 1:50. When set to 1, STo occurs as a result of the load impact and sudden acceleration or deceleration.

No.	Parameter Name	Setting Range	Default
n8-55	Load Inertia (PM OLV)	0 to 3	0

■ n8-62: Output Voltage Limit

Parameter Overview

No.	Name	Description	Range	Default
n8-62	Output Voltage Limit	Sets the limit for the output voltage. Adjustment is normally needed only if the input voltage is below the n8-62 set value. In this case set n8-62 to the input voltage.	0.0 to 230.0	200 Vac

Parameter Details

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5.10 o: Operator Related Settings

These parameters concern the various functions and features of the operator.

◆ o1: Display Settings and Selections

There parameters determine how data is displayed on the operator screen.

■ o1-01: Drive Mode Unit Monitor Selection

Selects which monitor will be displayed in the operation menu upon power-up when o1-02 = 4. Press the up arrow key four times and select the desired monitor.

No.	Parameter Name	Setting Range	Default
o1-01	Drive Mode Unit Monitor Selection	104 to 621 (U1-04 to U6-21*)	106 (U1-06)

*U2-□□ and U3-□□ parameters cannot be selected.

Detailed Description

To select a monitor, set the three numeric digits that make up that monitor, in other words, enter the □-□□ part of U□-□□. For more information, *Refer to U1: Status Monitors on page 214*.

The following example explains how to set U4-03 (Cooling Fan Operation Time) to be displayed when the drive is first powered up.

Step			Display/Result
1.	Power up the drive.	⇒	F 0.00 ALM REV DRV OUT
2.	Press the V key until the parameter settings screen appears.	⇒	PAr
3.	Press ENTER to enter the parameter settings menu.	⇒	A1-01
4.	Scroll to o1-01 by pressing RESET and Λ.	⇒	o1-01
5.	Press RESET and Λ to set "403".	⇒	403
6.	Press ENTER to save the setting.	⇒	End
7.	The screen display will automatically return to step 4.	⇒	o1-01
8.	Press ESC until the display returns to the first screen.	⇒	F 0.00 ALM REV DRV OUT

■ o1-02: User Monitor Selection After Power Up

Selects which monitor will be displayed upon power-up. Defaulted to show the frequency reference when the drive is first turned on.

No.	Parameter Name	Setting Range	Default
o1-02	User Monitor Selection After Power Up	1: Frequency Reference (U1-01) 2: Forward/Reverse 3: Output Frequency (U1-02) 4: Output Current (U1-03) 5: User Monitor (set by o1-01)	1

■ o1-03: Digital Operator Display Selection

Parameter o1-03 allows the programmer to change the units used in the speed monitors and when some speed parameters are displayed.

No.	Parameter Name	Setting Range	Default
o1-03	Digital Operator Display Selection	0: 0.01 Hz1: 0.01% (100% = E1-04) 2: r/min (enter the number of motor poles) 3: User-set	0

The o1-03 parameter will change the units of the following parameters along with o1-10 and o1-11.

No.	Parameter Name
U1-01	Frequency Reference
U1-02	Output Frequency
U1-05	Motor Speed
U1-16	Output Frequency after Soft Start
d1-01 to d1-17	Frequency Reference 1 to 17

Detailed Description

- To display the frequency reference as a percent rather than hertz, set o1-03 to 1.
- To display the reference in r/min, set o1-03 to 2. The drive will calculate the revolutions per minute from the maximum output frequency and the number of motor poles. Motor pole data should be set to parameters E2-04, E4-04, and E5-04.

- To display the revolutions of the machine (r/min) or the line speed (m/min), set o1-03 to 3, and then set parameters o1-10 and o1-11.

■ o1-10: Frequency Reference Setting and User-Set Display

Determines how values are set and displayed when operating at the max output frequency.

No.	Parameter Name	Setting Range	Default
o1-10	Frequency Reference Setting and User-Set Display	1 to 60000: User-set display □□□□□ o1-10□□□□□□□□□ □□ □ □□ 5□□□□	Determined by o1-03

■ o1-11: Frequency Reference Setting / Decimal Display

Sets the number of digits for setting and displaying the frequency reference.

No.	Parameter Name	Setting Range	Default
o1-11	Frequency Reference Setting / Decimal Display	0: No decimal point. 1: Set to one decimal point. 2: Set to the second decimal point. 3: Set to the third decimal point.	Determined by o1-03

◆ o2: Operator Key Selections

These parameters determine the functions assigned to the operator keys.

■ o2-01: LOCAL/REMOTE Key Function Selection

Parameter o2-01 determines whether the LOCAL/REMOTE switch on the digital operator will be enabled and will switch between keypad operation and the sources specified by the b1-01 and b1-02 parameters when the drive is stopped.

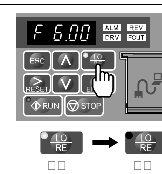
No.	Parameter Name	Setting Range	Default
o2-01	LOCAL/REMOTE Key Function Selection	0: Disabled 1: Enabled	1

Note: When LOCAL has been selected, the LO/RE indicator light is on. The user cannot switch between LOCAL/REMOTE while the drive is running the motor.

Detailed Description

There are three different ways to switch between LOCAL and REMOTE.

- Switching between LOCAL and REMOTE using the LO/RE key:

	Step		Display/Result
1.	Power up the drive. DRV should be lit.	⇒	F 0.00 ALM REV DRV FOUT
2.	If DRV is not lit, press the LO/RE key. Press LO/RE again to put the drive back into REMOTE mode.	⇒	

- Switching between LOCAL and REMOTE with an input terminal (S1 through S7):

Note: For more details on multi-function input settings, *Refer to H1: Multi-Function Contact Inputs on page 159*. Taking the steps described here will disable the LO/RE key on the operator keypad.

	Step		Display/Result
1.	Power up the drive.	⇒	F 0.00 ALM REV DRV FOUT
2.	Press the ∨ key until the parameter settings screen appears.	⇒	PAr
3.	Press ENTER to enter the parameter settings menu.	⇒	A1-01
4.	Scroll to H1-05 (or any parameter between H1-05 and H1-07) by pressing ∧ and > RESET.	⇒	H1-05
5.	Press ENTER to display the value set to H1-05	⇒	03
6.	Press > RESET to select the flashing digit.	⇒	03
7.	Press ∨ to set “01” (LOCAL/REMOTE).	⇒	01
8.	Press ENTER to save the setting.	⇒	End
9.	The display will return to the screen shown in step 4.	⇒	H1-05

Step			Display/Result
10.	Press  until the display returns to the first screen.	⇒	

- Switch between LOCAL and REMOTE using parameters b1-01 and b1-02:
  This method can be used to issue the frequency reference from the operator keypad and the Run command from the control terminals.

■ o2-02: STOP Key Function Selection

The STOP key is enabled during Auto Run as a default, which enables the STOP key on the digital operator even if b1-02 has assigned the Run command to be given from a remote source (i.e., not from the operator). In effect, the STOP key becomes an alternative stop input. Once the drive has been stopped by the STOP key, it can be restarted by cycling the external Run command. If o2-02 = “0: Disabled”, then pressing the STOP key while the drive is set for REMOTE will have no effect.

No.	Parameter Name	Setting Range	Default
o2-02	STOP Key Function Selection	0: Disabled 1: Enabled	1

■ o2-03: User Parameter Default Value

The drive gives the option of configuring any and all of the programming parameters and then saving the parameters as “User Initialization Values”. After configuring the drive, set parameter o2-03 = “1: Set Defaults” to save the parameters to the User Initialization memory. Once this has been done, the “Initialize Parameters” parameter (A1-03) will offer the choice of “1110: User Initialize”. Choosing A1-03 = “1110: User Initialized”, will reset all modified parameters back to what they were the last time they were saved using o2-03.

No.	Parameter Name	Setting Range	Default
o2-03	User Parameter Default Value	0: No Change 1: Set Defaults - Saves current parameter settings as user initialization. A1-03 now allows selecting <1110> for user initialization and returns o2-03 to 0. 2: Clear All - Clears the currently saved user initialization. A1-03 no longer allows selecting <1110> and returns o2-03 to 0.	0

■ o2-04: Drive/kVA Selection

Parameter o2-04 matches the control board to the drive hardware. Proper setting of o2-04 is important so that the control board can provide proper protection for the drive hardware. This parameter is configured at the factory and does not normally require adjustment in the field. It is available primarily to accommodate control board replacement in the event of damage.

No.	Parameter Name	Setting Range	Default
o2-04	Drive/kVA Selection	Sets the kVA of the drive. This parameter only needs to be set when installing a new control board. Do not change for any other reason.	Determined by o2-04

Note: The default settings for some parameters are determined by the capacity of the drive set to o2-04.

An oPE04 error will occur if someone attempts to install a removable terminal board and control board to drive that has a different capacity from the capacity saved to memory of those boards. The oPE04 error indicates that the terminal board doesn’t match the control board. To reset oPE04, the drive needs to be initialized by using parameter A1-03. To reset the oPE04 error without initializing any parameter settings, set 5550 to A1-03. Otherwise, initialize the entire drive with a 2-wire or a 3-wire initialization (settings 2220 and 3330 respectively).

Note: Drive performance will suffer If the correct drive capacity is not set to o2-04, and protective functions will fail to operate properly.

■ o2-05: Frequency Reference Setting Method Selection

Determines if the ENTER key must be used to input a frequency reference from the digital operator.

No.	Parameter Name	Setting Range	Default
o2-05	Frequency Reference Setting Method Selection	0: ENTER key required. 1: ENTER not required.	0

The default setting of the Frequency Reference Setting Method parameter (o2-05 = “1: Enabled”) dictates that when setting a frequency reference via the digital operator (LOCAL), it is not necessary to press the “ENTER” key before the drive will begin to accelerate or decelerate to the new set speed. When o2-05 = “1: Enabled”, the frequency reference is stored to memory five seconds after the up arrow or down arrow keys are released.

■ o2-06: Operation Selection when Digital Operator is Disconnected

Determines if the drive will stop when the LCD operator is removed in LOCAL mode or with b1-02 set to 0.

No.	Parameter Name	Setting Range	Default
o2-06	Operator is Disconnect Operation	0: Disabled. Drive does not stop when the digital operator is removed. 1: Enabled. The drive will fault (OPR) and coast to stop when the digital operator is removed.	0

Note: An LCD operator is available as an option. This setting is not applicable to the standard LED operator that comes with the drive.

■ o2-07: Motor Direction at Power Up when Using Operator

Determines the direction the motor will rotate after the drive is powered up when the Run command is set to be given from the LED operator.

No.	Parameter Name	Setting Range	Default
o2-07	Motor Direction at Power Up when Using Operator	0: Forward 1: Reverse	0

Note: This parameter is available only when the Run command is set to be given from the LED operator (b1-02 = 0).

o2-09: Initialization Specification Selection

This parameter sets the regional specifications for the drive and should not be changed.

o4: Maintenance Period

o4-01: Accumulated Operation Time Setting

o4-02: Accumulated Operation Time Selection

Displays the cummlative operation time of the drive and allows the user to set when the drive should indicate the need for maintenance. Specify in o4-01 whether the drive should keep track of how long it is powered up, or if it should only keep track of the time that it is running the motor. If any parts are replaced, be sure to reset o4-01 back to 0. The user can monitor the amount of time passed by viewing U4-01.

No.	Parameter Name	Setting Range	Default	Page
o4-01	Accumulated Operation Time Setting	Sets the starting value for the cumulative operation time of the drive.	0 H	–
o4-02	Accumulated Operation Time Selection	0: Logs operation time from power-on 1: Logs operation time from the point the run command is issued	0	–
U4-01	Accumulated Operation Time	0 to 99999	–	–

Note: It is considered to be “during run” whenever the run command is present (even if the motor is not rotating) and also whenever there is voltage output from the drive.

o4-03: Cooling Fan Maintenance Setting

Sets the units to be used when keeping track of how long the cooling fan has been operating. The user can check the amount of time passed by viewing U4-04. Be sure to reset this parameter back to 0 if the cooling fan is replaced.

No.	Parameter Name	Setting Range	Default	Page
o4-03	Cooling Fan Maintenance Setting (Operation Time)	0 to 9999	0H	–
U4-03	Cooling Fan Operation Time	0 to 99999 (value resets if time exceeds 99999)	–	–
U4-04	Cooling Fan Maintenance	Display units: % 90% = Maintenance Period	–	–

Note: Required maintenance times will depend on the environment the drive is used in.

o4-05: Capacitor Maintenance Setting

Sets the units to be used when keeping track of how long the electrolytic capacitors have been operating. The user can check the amount of time passed by viewing U4-05. This paramaeter is set as a percentage of the total expected performance life. Be sure to reset this value back to 0 if the main circuit is replaced.

No.	Parameter Name	Setting Range	Default	Page
o4-05	Capacitor Maintenance Setting	0 to 150	0%	–
U4-05	Capacitor Maintenance	Display units: % 90% = Maintenance Period	–	–

Note: Required maintenance times will depend on the environment the drive is used in.

o4-07: Inrush Prevention Relay Maintenance Setting

Resets the counter used for parameter U4-06 back 0.

No.	Parameter Name	Setting Range	Default	Page
o4-07	Inrush Prevention Relay Maintenance Setting	0 to 150	0%	–
U4-06	Inrush Prevention Relay Maintenance	Display units: % 90% = Maintenance Period	–	–

Note: Required maintenance times will depend on the environment the drive is used in.

o4-09: IGBT Maintenance Setting

Resets the counter used for parameter U4-07 back to 0.

No.	Parameter Name	Setting Range	Default	Page
o4-09	IGBT Maintenance Setting	0 to 150	0%	–
U4-07	IGBT Maintenance	Display units: % 50% = Maintenance Period	–	–

Note: Required maintenance times will depend on the environment the drive is used in.

o4-11: U2, U3 Initial Value Selection

This parameter is used to reset the values for the fault history and fault trace (U2-□□ and U3-□□).

No.	Parameter Name	Setting Range	Default	Page
o4-11	U2, U3 Initial Value Selection	0: Saves the value for U2-□□ (Fault Trace) and U3-□□ (Fault History). 1: Resets the values for U2-□□ (Fault Trace) and U3-□□ (Fault History).	0	–

o4-12: kWH Monitor Initial Value Selection

Saves the values of monitor parameters U4-10 and U4-11. This value is not reset when the power to the drive is cycled. To manually set this value back to 0, set o4-12 to 1.

Below is an example of how o4-12 displays kilowatt hours when viewing U4-10 and U4-11.

Example: “12345678.9 KWH” indicates that U4-10: 678.9 KWH U4-11: 12345 MWH

Note: No analog monitor output is available.

No.	Parameter Name	Setting Range	Default	Page
o4-12	kWH Monitor Initial Value Selection	0: Saves the values of monitor parameters U4-10 and U4-11. 1: Resets monitor parameters U4-10 and U4-11 back to default settings.	0	–
U4-10	kWH, Lower 4 Digits	Display units: kWH	–	–
U4-11	kWH, Upper 5 Digits	Display units: kWH	–	–

■ o4-13: Motor rpm Reset

Resets the value displayed in U4-02, which keeps track of the number of motor revolutions per minute. This count is not reset when the power is shut off, but can be manually reset to 0 by setting o4-13 to 1.

No.	Parameter Name	Setting Range	Default	Page
o4-13	Motor rpm Reset	0: Maintain the current r/min. 1: Reset the number of motor revolutions to 0.	0	–
U4-02	Number of Run Commands	Displays the number of times the run command was entered. Reset the number of run commands using parameter o4-13. A maximum of 65535 run commands are counted, after which the value is reset to 0.	–	–

◆ q: DriveWorksEZ Parameters

■ q1-01 to q6-07: Reserve for use by DriveWorksEZ

These parameters are reserved for use with DriveWorksEZ. Refer to the DriveWorksEZ manual for more information.

◆ r: DriveWorksEZ Connection Parameters

■ r1-01 to r1-40: DriveWorksEZ Connection Parameters

These parameters are reserved for use with DriveWorksEZ. Refer to the DriveWorksEZ manual for more information.

5.11 Auto-Tuning

Auto-Tuning automatically sets and tunes parameters required for motor operation.

◆ Types of Auto-Tuning

There are three types of Auto-Tuning. *Refer to Auto-Tuning Selection on page 92* to select the best type of Auto-Tuning for the application.

Type	Setting	Application Conditions and Benefits	Control Mode
Rotational Auto-Tuning for V/f Control	T1-01 = 3	Assumes the motor can rotate during the Auto-Tuning process. Improves torque compensation, slip compensation, energy savings, and speed search performance.	V/f Control
Rotational Auto-Tuning for OLV Control	T1-01 = 0	Assumes the motor can rotate during the Auto-Tuning process Achieves high-performance motor control	Open Loop Vector Control
Stationary Auto-Tuning for V/f and OLV Control Line-to-Line Resistance Only	T1-01 = 2	For use when the motor cable exceeds 50 m The motor cable length has been modified after Auto-Tuning has been previously performed When motor capacity and drive capacity differ	V/f Control, Open Loop Vector Control

Note: Auto-Tuning cannot be performed on permanent magnet motors (IPM, SPM, etc.).

◆ Auto-Tuning Selection

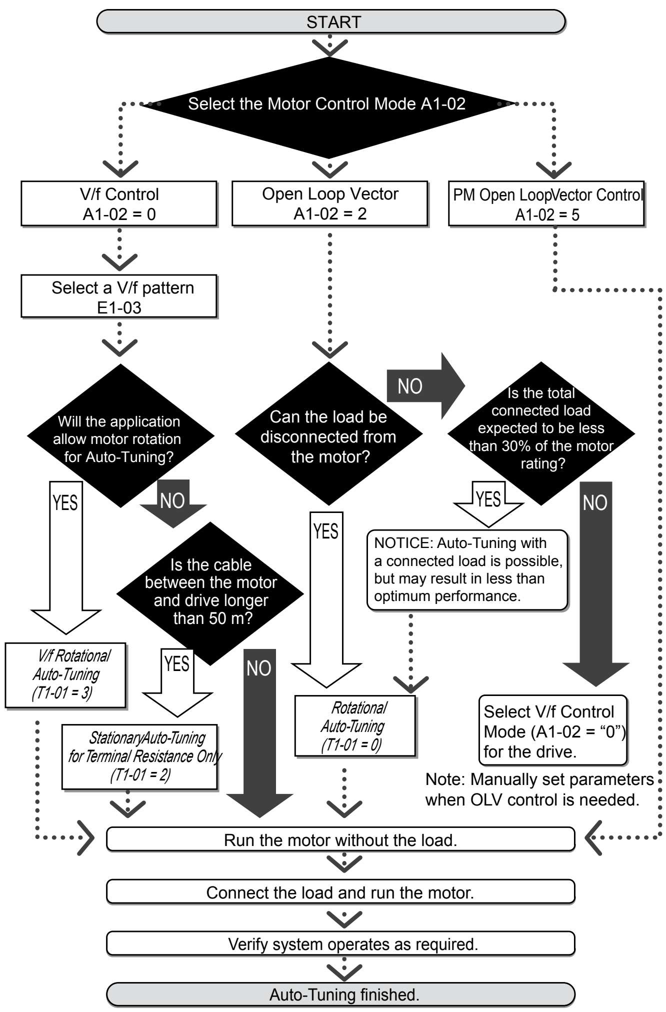


Figure 5.72

◆ Before Auto-Tuning the Drive

Check the items below before Auto-Tuning the drive:

Basic Auto-Tuning Preparations

- Auto-Tuning automatically determines the electrical characteristics of the motor. This is fundamentally different from other types of Auto-Tuning features used in servo systems.
- Before auto-tuning, be sure the input supply voltage equals or exceeds the motor rated voltage. Performance can be enhanced by using a motor with a base voltage that is 20 V (40 V for 400 V class models) lower than the input supply voltage. This may be of special importance when operating the motor above 90% of base speed, where high torque precision is required.
- Auto-Tuning is not possible with permanent magnet motors.
- To cancel Auto-Tuning, press the STOP key on the LED operator.
- The next table describes digital input and output terminal status during Auto-Tuning.

Auto-Tuning Type	Digital Input	Digital Output
Auto-Tuning for Energy Savings in V/f Control	Not available	Works the same during normal operation
Rotational-Type Auto-Tuning	Not available	Works the same during normal operation
Auto-Tuning for Resistance between Lines	Not available	Maintains the status at the start of Auto-Tuning

WARNING! *When Auto-Tuning a motor that is used on an application in conjunction with a brake, take special precaution to insure the brake stays applied. Auto-Tuning activates the drive multi-function outputs per the table below. Therefore, a brake may be released while the motor is uncoupled from the load, resulting in an unsafe condition. Proper precautions must therefore be taken prior to performing Auto-Tuning.*

Note: It is recommended that Rotational Auto-Tuning be performed with the load disconnected. Failure to comply could result in improper drive operation. If rotational Auto-Tuning is performed for a motor coupled to a load, the motor constants will be inaccurate and the motor may exhibit abnormal operation. Disconnect or decouple the motor from the load.

Rotational Auto-Tuning for V/f Control

- Motor rotates during Auto-Tuning.
- Sets parameters required for torque compensation, slip compensation, energy savings, and speed search.
- Available only when the drive is set for V/f Control.
- Required to perform Estimation-Type Speed Search when using V/f Control.

Rotational Auto-Tuning for Open Loop Vector Control

- Used only when in Open Loop Vector Control.
- Perform only with the motor uncoupled from the load for applications requiring high performance over a wide speed range.
- Disconnect the load before Auto-Tuning the drive and motor. Performing Rotational Auto-Tuning with the load connected will set motor parameters incorrectly, and also be dangerous because irregular motor rotation will occur.
- It is possible to perform Rotational Auto-Tuning with a connected load if the load is less than 30% of the rated load.
- Ensure a motor-mounted brake is fully released.
- Connected machinery should not produce enough power to rotate the motor.

Stationary Auto-Tuning for Terminal Resistance Only

- If the motor cable lead length has been significantly modified after Auto-Tuning has already been performed, perform Stationary Auto-Tuning with the new cables.
- Perform when using motor cables longer than 50 m with V/f Control.

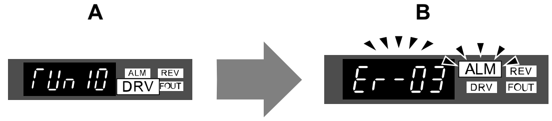
WARNING! *Electrical Shock Hazard. When executing stationary Auto-Tuning for line-to-line resistance only, the motor does not rotate, however, power is applied. Do not touch the motor until Auto-Tuning is completed. Failure to comply may result in injury from electrical shock.*

Note: When auto-tuning a motor that is used on an application in conjunction with a brake, take special precaution to ensure the brake stays applied.

◆ Auto-Tuning Fault Codes

Calculation of abnormal measurements or pressing STOP before completion will interrupt Auto-Tuning.

A B



A – Normal Auto-Tuning Display B – Auto-Tuning Interrupted

Figure 5.73 Auto-Tuning Interruption Display

◆ Performing Auto-Tuning

The following example illustrates how to perform Rotational Auto-Tuning.

Note: The following example is shown with the drive in Open Loop Vector Control (A1-02 = 2).

Selecting the Type of Auto-Tuning

Step			Display/Result
1.	Turn on the power to the drive. The initial display appears.	⇒	
2.	Press the V key until the Auto-Tuning screen appears.	⇒	

Step			Display/Result
3.	Press ENTER to begin setting parameters.	⇒	T1-01
4.	Press ENTER to display the value for T1-01.	⇒	02
5.	Press RESET to select the digit to edit.	⇒	02
6.	Press ∧ and set the drive to perform Rotational Auto-Tuning (00).	⇒	00
7.	Save the setting by pressing ENTER .	⇒	End
8.	The display automatically returns to the screen shown in Step 3.	⇒	T1-01
9.	Press the ESC key until back at the Top Screen.	⇒	F 0.00 DRV

■ Enter Data from the Motor Nameplate

After selecting the type of Auto-Tuning, enter the required data from the motor nameplate.

Note: These instructions continue from Step 7 in Selecting the Type of Auto-Tuning.

Step			Display/Result
1.	Press ∧ to access the motor output power parameter T1-02.	⇒	T1-02
2.	Press ENTER to view the default setting.	⇒	000.40
3.	Press RESET to select the digit to edit.	⇒	000.40
4.	Press ∧ and enter “0.2.” Enter value based on motor nameplate data.	⇒	000.20
5.	Press ENTER to save the setting.	⇒	End
6.	The display automatically returns to the screen shown in Step 1.	⇒	T1-02
7.	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, Motor Poles ; T1-07, Motor Base Frequency	⇒	T1-03 ⋮ T1-07

Note: For the details of each setting, *Refer to Motor Data for Auto-Tuning on page 94*. For stationary Auto-Tuning for line-to-line resistance only, set 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: *Auto-Tuning will not function properly if a holding brake is engaged on the load. Failure to comply could result in improper operation of the drive. Ensure the motor can freely spin before beginning Auto-Tuning.*

NOTICE: *Never perform rotational Auto-Tuning for a motor connected to a load. Failure to comply could result in improper drive operation. If rotational Auto-Tuning is performed for a motor coupled to a load, the motor constants will be inaccurate and the motor may exhibit abnormal operation. Disconnect or decouple the motor from the load.*

Enter the required information from the motor nameplate. Press ∧ to proceed to the Auto-Tuning start screen.

Step			Display/Result
1.	After setting T1-07 as illustrated in the previous section, press ∧ and confirm the display is as follows:	⇒	TUn10
2.	Press RUN to activate Auto-Tuning. DRV flashes. **Note:** The first digit indicates which motor is undergoing Auto-Tuning (motor 1 or motor 2). The second digit indicates the type of Auto-Tuning being performed.	⇒	TUn10 DRV
3.	Auto-Tuning finishes in approximately one to two minutes.	⇒	End

◆ Motor Data for Auto-Tuning

Table 5.19 Parameters Set During Auto-Tuning

No.	Name	Description	Range	Def.
T1-00	Motor Selection 1/2	Selects which set of motor parameters are set during Auto-Tuning. If motor 2 selection (H1-□□=16) is not selected, this parameter will not be displayed. 1: Motor 1 - E1 to E22: Motor 2 - E3 to E4. Enabled when motors 1 and 2 are switched to each other (H1-□□=16). Displayed only when either multi-function contact output H1-01 through H1-07 is set to 16.	1, 2	1
T1-	Auto-Tuning Mode Selection	Selects the Auto-Tuning mode. 0: OLV Rotational Auto-Tuning 2: Terminal resistance only, Stationary Auto-Tuning 3: V/f Rotational Auto-Tuning. Only settings 2 and 3 are available when using V/f Control. Only setting 2 is available when using motor 2. Settings 0 and 2 are available when using OLV Control.	0, 2, 3	0 ("2" in V/f mode)
T1-02	Motor Rated Power	Sets the motor rated output power. A set value that can provide stable control in the open loop control mode ranges from 50 to 100% of the drive rating. In case of motors that operate above base speed, set the value at base speed.	0.00 to 650.00	0.40 kW
T1-03	Motor Rated Voltage	Set the motor base voltage according to the information printed on the motor nameplate. In case of motors that operate above base speed, set the value at base speed.	0.0 to 255.5	200.0 V
T1-04	Motor Rated Current	Enter the motor-rated current as specified on the motor nameplate. For best performance when using OLV select the drive so that the motor represents 50 to 100% of the drive rated current. Enter the current required at base speed for motors with extended speed ranges.	10 to 200% of drive rated current	Det. by o2-04 and C6-01
T1-05	Motor Base Frequency	Enter the motor base frequency as specified on the motor nameplate. Enter the motor base frequency for extended speed range motors.	0.0 to 400.0	60.0 Hz
T1-06	Number of Motor Poles	Enter number of motor poles indicated on motor nameplate.	2 to 48	4
T1-07	Motor Base Speed	Sets the base speed of the motor in revolutions per minute r/min (RPM). Enter the motor base speed for extended speed range motors.	0 to 24000	1750. r/min
T1-11	Motor Iron Loss	Provides iron loss for determining Energy Saving coefficient. When power is cycled, the value set to E2-10 will appear (the motor iron loss). If T1-02 is changed, an initial value for the motor capacity will appear that is close to the capacity that was changed.	0 to 65535	14W

◆ Precision Settings for Auto-Tuning

Basic motor nameplate data can be used to auto-tune a motor. However, improved performance can be achieved by using precise data for base voltage and base frequency. If the base no-load voltage and frequency are known, enter this data when executing auto-tuning to improve performance.

Parameter	Normal Settings	Precision Tuning
T1-03	Enter the motor rated voltage	Enter the no-load voltage when the motor is operating at its rated revolutions per minute
T1-05	Enter the motor base frequency	Enter the no-load frequency when the motor is operating at its rated revolutions per minute

◆ No-Load Operation

This section explains how to operate the drive with the motor uncoupled from the load during a test run.

■ Before Starting the Motor

Check the following items before operation:

- Ensure the area around the motor is safe.
- Set the proper motor rated current to T1-04 to prevent overheating or other damage from motor overload.
- Ensure external emergency stop circuitry is working properly and other safety precautions have been taken.

■ During Operation

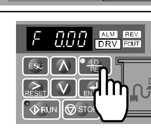
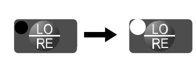
Check the following items during operation:

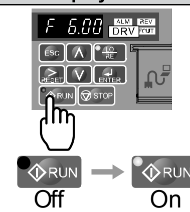
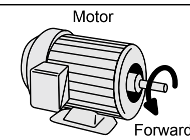
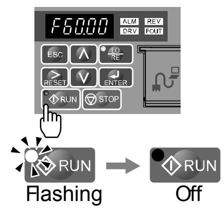
- The motor should rotate smoothly (i.e., no abnormal noise or oscillation).
- The motor should accelerate and decelerate smoothly.

■ Operation Instructions

The following example illustrates a procedure to run the drive using the digital operator.

Note: Before starting the motor, set the frequency reference to 6 Hz.

	Step		Display/Result
1.	Turn on the power to the drive. The initial display appears.	⇒	
2.	Press the  key to select LOCAL. The LO/RE LED will turn on.	⇒	 

Step			Display/Result
3.	Press  to give the drive a run command. RUN will light and the motor will rotate at 6 Hz.	⇒	
4.	Ensure the motor is rotating in the correct direction and no faults or alarms occur.	⇒	
5.	If there is no error in step 4, press  to increase the frequency reference. Increase the frequency in 10 Hz increments verifying smooth operation results at all speeds. For each frequency monitor the drive output current (U1-03) through the LED operator to confirm the current is well below the motor rated current. Example: 6 Hz → 50 Hz/60 Hz.		
6.	The drive should operate normally. Press  to stop the motor. RUN flashes until the motor comes to a complete stop.	⇒	

Note: To operate the drive, run (forward/reverse) command and frequency (or multi-step speed) reference are needed. Input these commands and references to the drive.

◆ Operating with the Load Connected

After performing a no-load test run, connect the motor and proceed to run the load.

■ Notes on Connected Machinery

- Clear the area around the motor.
- The motor should come to a complete stop without problems. Connect the machinery.
- Fasten all installation screws properly. Check that the motor and connected machinery are held in place.
- Confirm that the Fast-stop circuit or mechanical safety operate correctly.
- Prepare to press the STOP button in the case of an emergency.

■ Checklist Before Operation

- The motor should rotate in the proper direction.
- The motor should accelerate and decelerate smoothly.
- Check U1-03 to ensure there is not overcurrent.

If the application permits running the load in the reverse direction, try changing motor direction and the frequency reference and watch for abnormal motor oscillation or vibration. Correct the problem if hunting or oscillation occurs or if there are control-related problems.

■ Operating the Motor under Loaded Conditions

Test run the application similarly to the no-load test procedure when connecting the machinery to the motor.

5.12 U: Monitor Parameters

Monitor parameters let the user view various aspects of drive performance as it is displayed on the operator screen.

◆ U1: Status Monitors

The following monitors display drive status. The data displayed when viewing the parameters below can also be output from terminal AM by assigning the specific monitor parameter number to H4-01. This is done by setting the numeric parts of U□-□□ to H4-01. For more information, ***Refer to H4: Multi-Function Analog Output Terminals on page 181***.

No.	Name	Description	Analog Output Level	Unit
U1-01	Frequency Reference	Monitors the frequency	10 V: Max frequency	0.01Hz
U1-02	Output Frequency	Displays the output voltage. Display units are determined by o1-03.	10 V: Max frequency	0.01Hz
U1-03	Output Current	Displays the output current.	10 V: Drive rated current	0.01A
U1-04	Control Mode	Control method set in A1-02. 0: V/f without PG 2: Open Loop Vector (OLV) 5: PM Open Loop Vector (PM)	No output signal available	–
U1-05	Motor Speed	Displays the motor speed feedback. Display units are determined by o1-03.	10 V: Maximum speed	0.01Hz
U1-06	Output Voltage Reference	Displays the output voltage.	10 V: 200 Vrms (400 Vrms)	0.1 V
U1-07	DC Bus Voltage	Displays the DC bus voltage.	10 V: 400 V (800 V)	1 V
U1-08	Output Power	Displays the output voltage (this value is determined internally).	10 V: Drive capacity (kW) (max. motor capacity allowed)	–
U1-09	Torque Reference	Monitor of internal torque reference value for Open Loop Vector (OLV) control	10 V: Motor rated torque	–
U1-10	Input Terminal Status	Displays the input terminal status. U1-09=0000000 1: FWD run command (terminal S1 enabled) 1: REV run command (terminal S2 enabled) 1: Multi-Function Digital Input 1 (terminal S3 enabled) 1: Multi-Function Digital Input 2 (terminal S4 enabled) 1: Multi-Function Digital Input 3 (terminal S5 enabled) 1: Multi-Function Digital Input 4 (terminal S6 enabled) 1: Multi-Function Digital Input 5 (terminal S7 enabled)	No output signal available	–
U1-11	Output Terminal Status	Displays the output terminal status. U1-11=000 1: Multi-Function Digital Output (fault) (terminal MA/MB-MC) 1: Multi-Function Digital Output 1 (terminal P1) enabled 1: Multi-Function Digital Output 2 (terminal P2) enabled	No output signal available	–

No.	Name	Description	Analog Output Level	Unit
U1-12	Drive Status	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 output signal available	–
U1-13	Terminal A1 Input Voltage	Displays the analog input A1 input level. 100% when the input is 10 V	10 V: 100%	0.1%
U1-14	Terminal A2 Input Voltage	Displays the analog input A2 input level. 100% when the input is 10 V / 20 mA	10 V: 100%	0.1%
U1-16	Output Frequency after Soft Start	Displays the output frequency including ramp times, S-curves. Units are determined by o1-03.	10 V: Max frequency	0.01Hz
U1-18	OPE Fault Parameter	Displays the parameter number for oPE☐☐or Err (operator error) where the error occurred.	No output signal available	–
U1-19	MEMOBUS/Modbus Error Code	Displays the contents of a MEMOBUS/Modbus error. U1-18=00000000 1: CRC Error 1: Data Length Error Not Used (Normally 0) 1: Parity Error 1: Overrun Error 1: Framing Error 1: Timed Out Not Used (Normally 0)	No output signal available	–
U1-24	Input Pulse Monitor	Displays the Pulse Train input RP frequency.	32000	–
U1-25	Software No. (Flash)	Yaskawa Flash ID	No signal output available	–
U1-26	Software No. (ROM)	Yaskawa ROM ID	No signal output available	–

Set the lower and higher digits to the value corresponds to the capacity of the drive:11 kW or less: Sets the lower 2 digits11 kW or higher: Set to the lowest digit

◆ U2: Fault Trace

These monitor parameters are used to view the status of various drive aspects when a fault occurs. This information is helpful for finding out why a fault occurred.

No.	Name	Description	Analog Output Level	Unit
U2-01	Current Fault	Display of the current fault.	No signal output avail.	–
U2-02	Previous Fault	Display of the previous fault.	No signal output avail.	–
U2-03	Frequency Reference at Previous Fault	Displays the frequency reference at the previous fault.	No signal output avail.	0.01Hz
U2-04	Output Frequency at Previous Fault	Displays the output frequency at the previous fault.	No signal output avail.	0.01Hz
U2-05	Output Current at Previous Fault	Displays the output current at the previous fault.	No signal output avail.	
U2-06	Motor Speed at Previous Fault	Displays the motor speed at the previous fault.	No signal output avail.	0.01 Hz
U2-07	Output Voltage at Previous Fault	Displays the output voltage at the previous fault.	No signal output avail.	0.1 V
U2-08	DC Bus Voltage at Previous Fault	Displays the DC bus voltage at the previous fault.	No signal output avail.	1 V
U2-09	Output Power at Previous Fault	Displays the output power at the previous fault.	No signal output avail.	0.1 kW
U2-10	Torque Reference at Previous Fault	Displays the torque reference at the previous fault.	No signal output avail.	0.1%
U2-11	Input Terminal Status at Previous Fault	Displays the input terminal status at the previous fault. Displayed as in U1-10.	No signal output avail.	–
U2-12	Output Terminal Status at Previous Fault	Displays the output status at the previous fault. Displays the same status displayed in U1-11.	No signal output available	–
U2-13	Drive Operation Status at Previous Fault	Displays the operation status of the drive at the previous fault. Displays the same status displayed in U1-12.	No signal output available	–
U2-14	Cumulative Operation Time at Previous Fault	Displays the cumulative operation time at the previous fault.	No signal output available	1 H
U2-15	Soft Starter Speed Reference at Previous Fault	Displays the speed reference for the soft starter at the previous fault.	No signal output available	0.01%
U2-16	Motor q-Axis Current at Previous Fault	Displays the q-axis current for the motor at the previous fault.	No signal output avail.	0.10%

No.	Name	Description	Analog Output Level	Unit
U2-17	Motor d-Axis Current at Previous Fault	Displays the d-axis current for the motor at the previous fault.	No signal output avail.	0.10%

Note: Two digits for 11kW or less, one digit for larger units.

◆ U3: Fault History

These parameters display faults that have a occurred during operation and when they occurred.

No.	Name	Description	Analog Output Level	Unit
U3-01	Most Recent Fault	Displays the most recent fault.	No signal output avail.	–
U3-02	2nd Most Recent Fault	Displays the second most recent fault.	No signal output avail.	–
U3-03	3rd Most Recent Fault	Displays the third most recent fault.	No signal output avail.	–
U3-04	4th Most Recent Fault	Displays the fourth most recent fault.	No signal output available	–
U3-05	5th Most Recent Fault	Displays the fifth most recent fault.	No signal output available	–
U3-06	6th Most Recent Fault	Displays the sixth most recent fault.	No signal output available	–
U3-07	7th Most Recent Fault	Displays the seventh most recent fault.	No signal output available	–
U3-08	8th Most Recent Fault	Displays the eighth most recent fault.	No signal output available	–
U3-09	9th Most Recent Fault	Displays the ninth most recent fault.	No signal output available	–
U3-10	10th Most Recent Fault	Displays the tenth most recent fault.	No signal output available	–
U3-11	Cumulative Operation Time at Most Recent Fault	Displays the cumulative operation time at the most recent fault.	No signal output available	1 h
U3-12	Cumulative Operation Time at 2nd Most Recent Fault	Displays the cumulative operation time at the second most recent fault.	No signal output available	1 h
U3-13	Cumulative Operation Time at 3rd Most Recent Fault	Displays the cumulative operation time at the third most recent fault.	No signal output available	1 h
U3-14	Cumulative Operation Time at 4th Most Recent Fault	Displays the cumulative operation time at the fourth most recent fault.	No signal output available	1 h
U3-15	Cumulative Operation Time at 5th Most Recent Fault	Displays the cumulative operation time at the fifth most recent fault.	No signal output available	1 h
U3-16	Cumulative Operation Time at 6th Most Recent Fault	Displays the cumulative operation time at the sixth most recent fault.	No signal output available	1 h
U3-17	Cumulative Operation Time at 7th Most Recent Fault	Displays the cumulative operation time at the seventh most recent fault.	No signal output available	1 h
U3-18	Cumulative Operation Time at 8th Most Recent Fault	Displays the cumulative operation time at the eighth most recent fault.	No signal output available	1 h
U3-19	Cumulative Operation Time at 9th Most Recent Fault	Displays the cumulative operation time at the ninth most recent fault.	No signal output available	1 h
U3-20	Cumulative Operation Time at 10th Most Recent Fault	Displays the cumulative operation time at the tenth most recent fault.	No signal output available	1 h

◆ U4: Maintenance Monitors

Maintenance monitors are used to indicate when various components require replacement.

No.	Name	Description	Analog Output Level	Unit
U4-01	Accumulated Operation Time	Displays the cumulative operation time of the drive. The value for the cumulative operation time counter can be set 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 avail.	1 h
U4-02	Number of Run Commands	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 avail.	
U4-03	Cooling Fan Operation Time	Displays the cumulative operation time of the cooling fan. The default value for the fan operation time is set to parameter o4-03. This value will reset to 0 and start counting again after reaching 65535.	No signal output avail.	1H
U4-05	Capacitor Maintenance	Displays main circuit capacitor usage time in percent of their expected performance life. Parameter o4-06 resets this monitor.	No signal output avail.	1%
U4-07	IGBT Maintenance	Displays IGBT usage time as a percent of expected performance life. One of the multi-function contact outputs can be set to close when the value reaches 50% (H2-☐☐ = 2F), triggering an alarm. One of the multi-function contact outputs can be set to close when the value reaches 90% (H2-☐☐ = 10), triggering an alarm. Parameter o4-09 resets this monitor.	No signal output avail.	1%
U4-09	LED Check	Lights all segments of the LED to verify that the display is working properly.	No signal output avail.	–
U4-10	kWH, Lower 4 Digits	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 kWhU4-11: 12345 MWh Analog monitor: No output signal available.	No signal output avail.	kWh
U4-11	kWH, Upper 5 Digits			MWh
U4-13	Peak Hold Current	Displays the peak hold current during run.	10 V: Motor rated current	0.01A
U4-14	Peak Hold Output Frequency	Displays the output frequency when operating at the peak hold current.	10 V: Max frequency	0.01Hz
U4-16	Motor Overload Estimate (OL1)	100% = OL1 detection level	100% = OL1 detection level	0.1%

No.	Name	Description	Analog Output Level	Unit
U4-18	Frequency Reference Source Selection	Displays the source for the frequency reference as XY-nn. X: indicates which reference is used: 1 = Reference 1 (b1-01) 2 = Reference 2 (b1-15) Y-nn: indicates the reference source 0-01 = Operator (d1-01) 1-01 = Analog (terminal A1) 1-02 = Analog (terminal A2) 2-02 to 17 = Multi-step speed (d1-02 to 17) 3-01 = MEMOBUS/Modbus comm. 4-01 = Option 5-01 = Pulse Input 6-01 = CASE 7-01 = DWEZ		–
U4-19	Frequency Reference from MEMOBUS/Modbus Comm.	Displays the frequency reference provided by MEMOBUS/Modbus (decimal)		–
U4-20	Option Frequency Reference	Displays the frequency reference input by an option card (decimal).		–
U4-21	Run Command Source Selection	Displays the source for the Run command as XY-nn. X: Indicates which Run source is used: 1 = Reference 1 (b1-02) 2 = Reference 2 (b1-16) Y: Input power supply data 0 = Operator 1 = External terminals 2 = Not used 3 = MEMOBUS/Modbus communications 4 = Option 5 = Not used 6 = CASE7 = DWEZ 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 the soft charge bypass contactor after the power is switched on (UV or UV1 flashes after 10 seconds). 04: Waiting for “Run Command Prohibited” time period to end. 05: Fast-stop (digital input (H1-☐☐ = 15), operator) 06: b1-17 (run command given at power-up). 07: During Baseblock while coast to stop with timer 08: Frequency reference is below minimal reference during base block 09: Waiting for Enter command		–
U4-22	MEMOBUS/Modbus Communications Reference	Displays the drive control data set by MEMOBUS/Modbus communications register No. 0001H as a 4 digit hexadecimal number.		–
U4-23	Option Card Reference	Displays drive control data set by an option card as a 4 digit hexadecimal number.		–

◆ U5: Application Monitors

These monitors display various aspects of PID control, and can output data via analog output terminal AM. Set the monitor parameter data to be output by entering the last two digits of U5-☐☐ to H4-01. For more information, ***Refer to H4: Multi-Function Analog Output Terminals on page 181***.

No.	Name	Description	Analog Output Level	Unit
U5-01	PID Feedback	Displays the PID feedback value in.	10V: 100% (max. freq.)	0.01%
U5-02	PID Input	Displays the amount of PID input (deviation between PID target and feedback).		0.01%
U5-03	PID Output	Displays PID control output.		0.01%
U5-04	PID Setpoint	Displays the PID setpoint.		0.01%
U5-05	PID differential feedback	Displays the 2nd PID feedback value if differential feedback is used.		0.01%
U5-06	PID Adjusted Feedback	Displays the subtraction value of both feedback values if differential feedback is used.		0.01%

◆ U6: Control Monitors

The drive can U6 monitor parameters via multi-function analog output terminal AM. Select the monitor for output to H4-01. Enter 6☐☐, where the last two digits of U6-☐☐ indicate the U6 monitor parameter for output. For more information, ***Refer to H4: Multi-Function Analog Output Terminals on page 181***.

No.	Name	Description	Analog Output Level	Unit
U6-01	Motor Secondary Current (Iq)	Displays the value of the motor secondary current (Iq).	10 V: Motor rated secondary current	0.1%
U6-02	Motor Excitation Current (ld)	Displays the value calculated for the motor excitation current (Id) as a percentage of the motor rated secondary current (Iq).	10 V: Motor rated secondary current	0.1%
U6-03	ASR Input	Displays the ASR input value if Simple PG is used in V/f control.	10V: 100% (max. freq.)	0.1%
U6-04	ASR Output	Displays the ASR output value if Simple PG is used in V/f control.	10V: 100% (max. freq.)	0.1%
U6-05	Output voltage reference (Vq)	Output voltage reference (Vq). (q-axis)	10 V: 200 V (400 V)	0.1 Vac
U6-06	Output Voltage Reference (Vd)	Output voltage reference (Vd). (d-axis)	10 V: 200 V (400 V)	0.1 Vac
U6-07	q-axis ACR Output	Displays the current control (ACR) output of for the motor secondary current (Iq).	10 V: 100%	0.1%
U6-08	d-Axis ACR Output	Displays the current control (ACR) output of for the motor excitation current (Id).	10 V: 100%	0.1%
U6-20	Frequency Reference Bias (Up/Down 2)	Displays the bias value used to adjust the frequency reference.	10 V: max. frequency	0.1%
U6-21	Offset Frequency	Displays the frequency added to the main frequency reference.	10 V: max. frequency	0.1%

◆ U8: DriveWorksEZ Monitors

These parameters are reserved for use with DriveWorksEZ.

No.	Name	Description	Analog Output Level	Unit
U8-01	–	Reserved for DriveWorksEZ, Monitor 1.	–	0.01%
U8-02	–	Reserved for DriveWorksEZ, Monitor 2.	–	0.01%
U8-03	–	Reserved for DriveWorksEZ, Monitor 3.	–	0.01%
U8-04	–	Reserved for DriveWorksEZ, Monitor 4.	–	0.01%
U8-05	–	Reserved for DriveWorksEZ, Monitor 5.	–	0.01%
U8-06	–	Reserved for DriveWorksEZ, Monitor 6.	–	0.01%
U8-07	–	Reserved for DriveWorksEZ, Monitor 7.	–	0.01%
U8-08	–	Reserved for DriveWorksEZ, Monitor 8.	–	0.01%
U8-09	–	Reserved for DriveWorksEZ, Monitor 9.	–	0.01%
U8-10	–	Reserved for DriveWorksEZ, Monitor 10.	–	0.01%

6

Troubleshooting

This chapter provides descriptions of the drive faults, alarms, errors, related displays, and possible solutions. This chapter can also serve as a reference guide for tuning the drive during a trial run.

6.1 Section Safety

DANGER

Electrical Shock Hazard

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

Failure to comply will result in death or serious injury.

WARNING

Electrical Shock Hazard

Do not operate equipment with covers removed.

Failure to comply could result in death or serious injury.

The diagrams in this section may 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 wiring terminals, disconnect all power to the equipment. The internal capacitor remains charged even after the drive input power is turned off. The charge indicator LED will extinguish when the DC bus voltage is below 50 Vdc. To prevent electric shock, wait at least five minutes after all indicators are off and measure the DC bus voltage level to confirm safe level.

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 drive input power before applying power.

Do not use improper combustible materials.

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

Attach the drive to metal or other noncombustible material.

NOTICE
Observe proper electrostatic discharge procedures (ESD) when handling the drive and circuit boards.
Failure to comply may result in ESD damage to the drive circuitry.
Never connect or disconnect the motor from the drive while the drive is outputting voltage.
Improper equipment sequencing could result in damage to the drive.
Do not use unshielded cable for control wiring.
Failure to comply may cause electrical interference resulting in poor system performance. Use shielded twisted-pair wires and ground the shield to the ground terminal of the drive.
Do not allow unqualified personnel to use the product.
Failure to comply could result in damage to the drive or braking circuit.
Carefully review instruction manual TOBPC72060000 when connecting a braking option 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 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, or other faults that occur while performing a trial run. Refer to the section below that corresponds to the motor control method used.

Note: This section describes parameters that are commonly edited. Consult Yaskawa for more information on detailed settings and fine-tuning the drive.

◆ V/f Motor Control Method Tuning

Table 6.1 Parameters for Tuning the Drive in V/f Motor Control Method

Problem	Parameter No.	Countermeasure	Default Value	Suggested Setting
• Motor hunting and oscillation at speeds between 10 and 40 Hz	Hunting Prevention Gain (n1-02)	• If insufficient motor torque relative to the size of the load causes hunting, reduce the setting. • When motor hunting and oscillation occur with a light load, increase the setting.	1.00	0.50 to 2.00
• Motor noise • Motor hunting and oscillation at speeds up to 40 Hz	Carrier Frequency Selection (C6-02)	• If the motor noise is too loud, increase the carrier frequency. • When motor hunting and oscillation occur at speeds up to 40 Hz, lower the carrier frequency. • The default setting for the carrier frequency depends on the drive capacity (o2-04) and the Drive Duty Selection (C6-01).	7 (Swing PWM 1)	1 to A
• Poor torque or speed response • Motor hunting and oscillation	Torque Compensation Primary Delay Time (C4-02)	• If motor torque and speed response are too slow, decrease the setting. • If motor hunting and oscillation occur, increase the setting.	200 ms <1>	100 to 1000 ms
• Poor motor torque at speeds below 10 Hz • Motor hunting and oscillation	Torque Compensation Gain (C4-01)	• If motor torque is insufficient at speeds below 10 Hz, increase the setting. • If motor hunting and oscillation with a relatively light load, decrease the setting.	1.00	0.50 to 1.50
• Poor motor torque at low speeds • Poor motor instability at motor start	Mid Output Voltage A (E1-08) Minimum Output Voltage (E1-10)	• If torque is insufficient at speeds below 10 Hz, increase the setting. • If motor instability occurs at motor start, decrease the setting. **Note:** The recommended setting value is for 200 V class drives. Double this value when using a 400 V class drive.	E1-08: 16.0 VE1-10: 12.0 V	Initial value ±5 V
• Poor speed precision	Slip Compensation Gain (C3-01)	• After setting the motor-rated torque (E2-01), motor-rated slip (E2-02) and motor no-load current (E2-03), adjust the slip compensation gain (C3-01).	-	0.5 to 1.5

<1> Default settings change when the Control Method is changed (A1-02) or a different V/f pattern is selected using parameter E1-03. The default setting shown is for V/f Control.

Note: Use slip compensation to improve speed precision in V/f Control. First make sure that the proper values have been set for the motor rated current to E2-01, motor rated slip (E2-02), and motor no-load current (E2-03). Next, adjust the slip compensation gain set to C3-01 so that it is between 0.5 to 1.5.

◆ Open Loop Vector (OLV) Motor Control Method Tuning

Table 6.2 Parameters for Tuning the Drive in OLV Motor Control Method

Problem	Parameter No.	Countermeasure	Default Value	Suggested Setting
• Poor motor torque and speed response • Control motor hunting and oscillation at speeds between 10 and 40 Hz.	AFR Gain (n2-01)	• If motor torque and speed response are too slow, gradually decrease the setting by 0.05. • If motor hunting and oscillation occur, gradually increase the setting by 0.05.	1.00	0.50 to 2.00
• Poor motor torque and speed response • Control motor hunting and oscillation at speeds between 10 and 40 Hz.	AFR Time Constant 1 (n2-02)	• To improve motor torque speed response, gradually reduce this setting by 10 ms and check the performance. • If motor hunting and oscillation occur as a result of load inertia, gradually increase the setting by 50 ms and check the performance. **Note:** Ensure that n2-02 ≤ n2-03. When making adjustments to n2-02, set C4-02 (Torque Compensation Primary Delay Time Constant 1) accordingly.	50 ms	50 to 2000 ms
• Overvoltage trips when accelerating, decelerating, or during sudden speed or load changes.	AFR Time Constant 2 (n2-03)	• If overvoltage trips occur, gradually increase this setting by 50 ms. • If response is slow, gradually reduce this setting by 10 ms. **Note:** Ensure that n2-02 ≤ n2-03. When making adjustments to n2-03, increase the value of C4-06 (Torque Compensation Primary Delay Time 2) proportionally.	750 ms	750 to 2000 ms
• Poor motor torque and speed response • Motor hunting and oscillation.	Torque Compensation Primary Delay Time Constant 1 (C4-02)	• To improve motor torque speed response, gradually reduce this setting by 2 ms and check the performance. • If motor hunting and oscillation occur, gradually increase this setting by 10 ms. **Note:** Ensure that C4-02 ≤ C4-06. When making adjustments to C4-02, increase n2-02 (AFR Time Constant) proportionally.	20 ms <1>	20 to 100 ms
• Overvoltage trips when accelerating, decelerating, or during sudden speed or load changes	Torque Compensation Primary Delay Time Constant 2 (C4-06)	• If overvoltage trips occur, gradually increase this setting by 10 ms and check the performance. • If response is slow, gradually reduce this setting by 2 ms and check the performance. **Note:** Ensure that C4-02 ≤ C4-06. When changing C4-06 (Torque Compensation Primary Delay Time Constant 2), increase the value of n2-03 proportionally.	150 ms	150 to 750 ms
• Poor speed response and stability	Slip Compensation Primary Delay Time Constant (C3-02)	• If response is slow, gradually decrease the setting by 10 ms. • If speed is unstable, gradually increase the setting by 10 ms.	200 ms <1>	100 to 500 ms
• Poor speed precision	Slip Compensation Gain (C3-01)	• If speed is too slow, gradually increase the setting by 0.1 ms. • If speed is too fast, gradually decrease the setting by 0.1 ms.	1.0 <1>	0.5 to 1.5
• Motor noise • Control motor hunting and oscillation occur at speeds below 10 Hz.	Carrier Frequency Selection (C6-02)	• If there is too much motor noise, the carrier frequency is too high. • If motor hunting and oscillation occur at low speeds, reduce the carrier frequency. • The default setting for the carrier frequency depends on the drive capacity (o2-04) and Drive Duty Selection (C6-01).	7 (Swing PWM 1)	0 to the default setting

Problem	Parameter No.	Countermeasure	Default Value	Suggested Setting
• Poor motor torque at low speeds • Poor speed response • Motor instability at motor start.	Mid Output Voltage A (E1-08) Minimum Output Voltage (E1-10)	• If motor torque and speed response are too slow, increase the setting. • If the motor exhibits excessive instability at start-up, reduce the setting. **Note:** The default value is for 200 V class units. Double this value when using a 400 V class drive. When working with a relatively light load, increasing this value too much can create an excessively high of a torque reference.	E1-08: 12.0 V <1> E1-10: 2.5 V <1>	Initial ±2 V

<1> Default settings change when the Control Method is changed (A1-02) or a different V/f pattern is selected using parameter E1-03. The default setting shown is for V/f Control.

When using OLV Motor Control, leave the torque compensation gain (C4-01) at its default setting of 1.00. To increase speed precision during regeneration in OLV Motor Control, enable slip compensation during regeneration (C3-04 = “1”).

◆ Motor Hunting and Oscillation Control Parameters

In addition to the parameters discussed in *V/f Pattern Selection: E1-03*, the following parameters indirectly affect motor hunting and oscillation.

Table 6.3 Parameters that Affect Control Performance in Applications

Name (Parameter No.)	Application
Dwell Function (b6-01 through b6-04)	Prevents motor speed loss by maintaining the output frequency when working with heavy loads or when there is powerful backlash on the machine side.
Accel/Decel Time (C1-01 through C1-11)	Adjusting accel and decel times will affect the torque presented to the motor during acceleration or deceleration.
S-Curve Characteristics (C2-01 through C2-04)	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, L3-11)	• Prevents motor speed loss and overvoltage. Used when the load is too heavy and also during sudden acceleration/deceleration. • Adjustment is not normally required because Stall Prevention is enabled as a default. Disable Stall Prevention during deceleration (L3-04 = “0”) when using a braking resistor.
Torque Limits (L7-01 through L7-04, L7-06, L7-07)	• Sets the maximum torque for Open Loop Vector Control. • Ensure that the drive capacity is greater than the motor capacity when increasing this setting. Be careful when reducing this value because motor speed loss may occur with heavy loads.

6.3 Drive Alarms, Faults, and Errors

◆ Types of Alarms, Faults, and Errors

Check the LED operator for information about possible faults if the drive or motor fails to operate. *Refer to Using the Digital LED Operator on page 58*.

If problems occur that are not covered in this manual, contact the nearest Yaskawa representative with the following information:

- Drive model
- Software version
- Date of purchase
- Description of the problem

Table 6.4 contains descriptions of the various types of alarms, faults, and errors that may occur while operating the drive.

Contact Yaskawa in the event of drive failure.

Table 6.4 Types of Alarms, Faults, and Errors

Type	Drive Responses to Alarms, Faults, and Errors
Faults	When the drive detects a fault: • The digital operator displays text that indicates 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. • Depending on the setting, the drive and motor may stop via different methods than listed. • If a digital output is programmed for fault output (H2-☐☐ = E), it will close if a fault occurs. • When the drive detects a fault, it will remain inoperable until that fault has been reset. *Refer to Fault Reset Methods on page 245*.
Minor Faults and Alarms	When the drive detects an alarm or a minor fault: • The digital operator displays text that indicates the specific alarm or minor fault and the ALM indicator LED flashes. • The motor does not stop. • One of the multi-function contact outputs closes if set to be tripped by a minor fault (H2-☐☐ = 10), but not by an alarm. • The digital operator displays text indicating a specific alarm and ALM indicator LED flashes. • Remove the cause of an alarm or minor fault to automatically reset.
Operation Errors	When parameter settings conflict with one another or do not match hardware settings (such as with an option card), it results in an operation error. When the drive detects an operation error: • The digital operator displays text that indicates the specific error. • Multi-function contact outputs do not operate. • When the drive detects an operation error, it will not operate the motor until the error has been reset. Correct the settings that caused the operation error to reset.
Tuning Errors	Tuning errors occur while performing Auto-Tuning. When the drive detects a tuning error: • The digital operator 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

When the drive detects a fault, the ALM indicator LEDs remain lit without flashing. If the LEDs flash, the drive has detected a minor fault or alarm. *Refer to Minor Faults and Alarms on page 225* for more information. An overvoltage situation trips both faults and minor faults, therefore it is important to note whether the LEDs remain lit or if the LEDs flash.

LED Operator Display		Name	Page
bUS	bUS	Option Communication Error	227
CE	CE	MEMOBUS/Modbus Communication Error	227
CF	CF	Control Fault	227
CoF	CoF	Current Offset Fault	227
CPF02	CPF02	A/D Conversion Error	227
CPF03	CPF03	PWM Data Fault	227
CPF06	CPF06	Drive specification mismatch during Terminal Board or Control Board replacement	227
CPF07	CPF07	Terminal Board Communication Fault	228
CPF08	CPF08	EEPROM Serial Communications Fault	228
CPF11	CPF11	RAM Fault	228
CPF12	CPF12	FLASH Memory Fault	228
CPF13	CPF13	Watchdog Circuit Exception	228
CPF14	CPF14	Control Circuit Fault	228
CPF16	CPF16	Clock Fault	228
CPF17	CPF17	Timing Fault	228
CPF18	CPF18	Control Circuit Fault	228
CPF19	CPF19	Control Circuit Fault	228

LED Operator Display		Name	Page
CPF20 or CPF21	CPF20or CPF21	RAM Fault	228
		FLASH Memory Fault	228
		Watchdog Circuit Exception	228
		Clock Fault	228
oH3	oH3	Motor Overheat 1 (PTC input)	231
oH4	oH4	Motor Overheat 2 (PTC input)	231
oL1	oL1	Motor Overload	232
oL2	oL2	Drive Overload	232
oL3	oL3	Overtorque Detection 1	232
oL4	oL4	Overtorque Detection 2	232
oL5	oL5	Mechanical Weakening Detection 1	232
oL7	oL7	High Slip Braking OL	233
oPr	oPr	Operator Connection Fault	233
CPF22	CPF22	A/D Conversion Error	228
CPF23	CPF23	PWM Feedback Data Fault	228
CPF24	CPF24	Drive Capacity Signal Fault	228
dEv	dEv	Excessive Speed Deviation(for Simple V/f with PG)	229
EF0	EF0	Option Card External Fault	229
EF1 to EF7	EF1 to EF7	External Fault (input terminal S1 to S7)	229

LED Operator Display		Name	Page
FbH	FbH	Excessive PID Feedback	229
FbL	FbL	PID Feedback Loss	229
GF	GF	Ground Fault	229
LF	LF	Output Phase Loss	230
LF2	LF2	Output Open Phase	230
oC	oC	Overcurrent	230
oFA00	oFA00	Option Card Fault (port A)	231
oH	oH	Heatsink Overheat	231
oH1	oH1	Heatsink Overheat	231
PGo	PGo	PG Disconnect(for Simple V/f with PG)	234
rH	rH	Dynamic Braking Resistor	234
rr	rr	Dynamic Braking Transistor	234

LED Operator Display		Name	Page
SEr	SEr	Too Many Speed Search Restarts	234
STO	STO	Pull-Out Detection	234
UL3	UL3	Undertorque Detection 1	234
UL4	UL4	Undertorque Detection 2	235
UL5	UL5	Mechanical Weakening Detection 2	235
Uv1	Uv1	Undervoltage	235
Uv2	Uv2	Control Power Supply Undervoltage	235
Uv3	Uv3	Soft Charge Circuit Fault	235
oS	oS	Overspeed(for Simple V/f with PG)	233
ov	ov	Overvoltage	233
PF	PF	Input Phase Loss	233

Note: If faults CPF11 through CPF19 occur, the LED operator will display CPF00 or CPF11.

■ Minor Faults and Alarms

When a minor fault or alarm occurs, the ALM LED flashes and the text display shows an alarm code. A fault has occurred if the text remains lit and does not flash. *Refer to Alarm Detection on page 236*. An overvoltage situation, for example, can trigger both faults and minor faults. It is therefore important to note whether the LEDs remain lit or if the LEDs flash.

Table 6.5 Minor Fault and Alarm Displays

LED Operator Display		Name	Minor Fault Output (H2-□□ = 10)	Page
bb	bb	Drive Baseblock	No output	236
bUS	bUS	Option Card Communications Error	YES	236
CALL	CALL	Serial Communication Transmission Error	YES	236
CE	CE	MEMOBUS/Modbus Communication Error	YES	236
dEv	dEv	Excessive Speed Deviation (for Simple V/f with PG)	YES	236
dnE	dnE	Drive Disabled	YES	237
EF	EF	Run Command Input Error	YES	237
EF0	EF0	Option Card External Fault	YES	237
EF1 to EF7	EF1 to EF7	External Fault (input terminal S1 to S7)	YES	237
FbH	FbH	Excessive PID Feedback	YES	237
FbL	FbL	PID Feedback Loss	YES	237
Hbb	Hbb	Hardwire Baseblock Signal Input	YES	238
HbbF	HbbF	Hardwire Baseblock Signal Input	YES	238
SE	SE	MEMOBUS/Modbus Test Mode Fault	YES	
oL5	oL5	Mechanical Weakening Detection 1	YES	232
UL5	UL5	Mechanical Weakening Detection 2	YES	235
dWAL	dWAL	DriveWorksEZ Alarm	YES	229
HCA	HCA	Current Alarm	YES	238
oH	oH	Heatsink Overheat	YES	238
oH2	oH2	Drive Overheat	YES	238
oH3	oH3	Motor Overheat	YES	238
oL3	oL3	Overtorque 1	YES	238
oL4	oL4	Overtorque 2	YES	239
oS	oS	Overspeed (for Simple V/f with PG)	YES	239
ov	ov	Overvoltage	YES	239
PASS	PASS	MEMOBUS/Modbus Test Mode Complete	No output	239
PGo	PGo	PG Disconnect (for Simple V/f with PG)	YES	239
rUn	rUn	During Run 2, Motor Switch Command Input	YES	239
rUnC	rUnC	Run Command Reset	YES	239
UL3	UL3	Undertorque 1	YES	239
UL4	UL4	Undertorque 2	YES	240
Uv	Uv	Undervoltage	YES	240

■ Operation Errors

Table 6.6 Operation Error Displays

LED Operator Display		Name	Page
oPE01	oPE01	Drive kVA Setting Error	241
oPE02	oPE02	Parameter Setting Range Error	241
oPE03	oPE03	Multi-Function Input Setting Error	241
oPE04	oPE04	Terminal Board Mismatch Error	241

LED Operator Display		Name	Page
oPE05	oPE05	Run Command Selection Error	241
oPE07	oPE07	Multi-Function Analog Input Selection Error	241
oPE08	oPE08	Parameter Selection Error	242
oPE09	oPE09	PID Control Selection Error	242

LED Operator Display		Name	Page
oPE10	oPE10	V/f Data Setting Error	242
oPE11	oPE11	Carrier Frequency Setting Error	242
oPE13	oPE13	Pulse Train Monitor Selection Error	242

■ Auto-Tuning Errors

Table 6.7 Auto-Tuning Error Displays

LED Operator Display		Name	Page
Er-01	Er-01	Motor Data Error	243
Er-02	Er-02	Alarm	243
Er-03	Er-03	STOP button Input	243
Er-04	Er-04	Line-to-Line Resistance Error	243
Er-05	Er-05	No-Load Current Error	243
Er-08	Er-08	Rated Slip Error	243

LED Operator Display		Name	Page
Er-09	Er-09	Acceleration Error	243
Er-11	Er-11	Motor Speed Error	243
Er-12	Er-12	Current Detection Error	243
End1	End1	Excessive V/f Setting	244
End2	End2	Motor Iron Core Saturation Coefficient Error	244
End3	End3	Rated Current Setting Alarm	244

6.4 Fault Detection

◆ Fault Displays, Causes, and Possible Solutions

Table 6.8 Detailed Fault Displays, Causes, and Possible Solutions

LED Operator Display		Fault Name
bUS	bUS	Option Communication Error • After establishing initial communication, the connection was lost. • Only detected when the run command frequency reference is assigned to an option card.
Cause		**Possible Solution**
No signal received from the PLC.		• Check for faulty wiring. • Correct the wiring. • Check for loose wiring and short circuits. Repair as needed.
The communication cable is faulty or a short circuit exists.		
A communications data error occurred due to noise.		• Check the various options available to minimize the effects of noise. • Counteract noise in control circuit, main circuit, and ground wiring. • Ensure that other equipment such as switches or relays do not cause noise and use surge suppressors if required. • Use cables recommended by Yaskawa or another type of shielded line. Ground the shield on the controller side or on the drive input power side. • Separate all wiring for communications devices from drive input power lines. Install a noise filter to the input side of the drive input power.
The option card is damaged.		• Replace the option card if there are no problems with the wiring and the error continues to occur.
The option card is not properly connected to the drive.		• The connector pins on the option card are not properly lined up with the connector pins on the drive. • Reinstall the option card.
LED Operator Display		**Fault Name**
CE	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 a short circuit exists.		• Check for faulty wiring. • Correct the wiring. • Check for loose wiring and short circuits. Repair as needed.
A communications data error occurred due to noise.		• Check the various options available to minimize the effects of noise. • Counteract noise in control circuit, main circuit, and ground wiring. • Use Yaskawa-recommended cables, or another type of shielded line. Ground the shield on the controller side or on the drive input power side. • Ensure that other equipment such as switches or relays do not cause noise and use surge suppressors if required. • Separate all wiring for communications devices from drive input power lines. Install a noise filter to the input side of the drive input power.
LED Operator Display		**Fault Name**
CF	CF	Control Fault A torque limit was reached continuously for three seconds or longer during a ramp to stop while in Open Loop Vector Control.
Cause		**Possible Solution**
Motor parameters are not set properly.		Check the motor parameter settings and repeat Auto-Tuning.
Torque limit is too low.		Set the torque limit to the most appropriate setting (L7-01 through L7-04).
Load inertia is too big.		• Adjust the deceleration time (C1-02, -04, -06, -08). • Set the frequency to the minimum value and interrupt the run command when the drive finishes decelerating.
LED Operator Display		**Fault Name**
CoF	CoF	Current Offset Fault There is a problem with the current detection circuit or the drive attempted to start a coasting PM motor.
Cause		**Possible Solution**
While the drive automatically adjusted the current offset, the calculated value exceeded the allowable setting range. This problem may occur when attempting to restart a coasting PM motor.		Enable Speed Search at start (b3-01 = 1). Use the multi-function terminals to execute External Speed Search 1 and 2 (H1-☐☐ = 61 or 62). **Note:** When using a PM motor, both External Speed Search 1 and 2 perform the same operation.
The drive attempted to write parameter values when the drive input power was shut off (use communications option card).		Reinitialize the drive (A1-03).
LED Operator Display		**Fault Name**
CPF02	CPF02	A/D Conversion Error An A/D conversion error occurred.
Cause		**Possible Solution**
Control circuit is damaged.		Cycle power to the drive.If the problem continues, replace the drive.
Control circuit terminals have shorted out (+V, AC).		• Check for wiring errors along the control circuit terminals. • Correct the wiring. Check the resistance of the speed potentiometer and related wiring.
Control terminal input current has exceeded allowable levels.		• Check the input current. • Reduce the current input to control circuit terminal (+V) to 20 mA.
LED Operator Display		**Fault Name**
CPF03	CPF03	PWM Data Error There is a problem with the PWM data.
Cause		**Possible Solution**
Drive hardware is damaged.		Replace the drive.
LED Operator Display		**Fault Name**
CPF06	CPF06	EEPROM Data Error There is an error in the data saved to EEPROM.
Cause		**Possible Solution**
Control circuit is damaged.		Cycle power to the drive.If the problem continues, replace the drive.

The drive attempted to write parameter values when the drive input power was shut off (use communications option card).		Reinitialize the drive (A1-03).
LED Operator Display		**Fault Name**
CPF07	CPF07	Terminal Board Communications Error
		A communication error occurred at the terminal board.
Cause		**Possible Solution**
There is a fault connection between the terminal board and control board.		Turn the power off and reconnect the control circuit terminals.
LED Operator Display		**Fault Name**
CPF08	CPF08	EEPROM Serial Communication Fault
		EEPROM communications are not functioning properly.
Cause		**Possible Solution**
Terminal board or control board is not connected properly.		Turn the power off and check the control terminal connections.
LED Operator Display		**Fault Name**
CPF11	CPF11	RAM Fault
Cause		**Possible Solution**
Hardware is damaged.		Replace the drive.
LED Operator Display		**Fault Name**
CPF12	CPF12	FLASH Memory Fault
		Problem with the ROM (FLASH memory).
Cause		**Possible Solution**
Hardware is damaged.		Replace the drive.
LED Operator Display		**Fault Name**
CPF13	CPF13	Watchdog Circuit Exception
		Self-diagnostics problem.
Cause		**Possible Solution**
Hardware is damaged.		Replace the drive.
LED Operator Display		**Fault Name**
CPF14	CPF14	Control Circuit Fault
		CPU error (CPU operates incorrectly due to noise, etc.)
Cause		**Possible Solution**
Hardware is damaged.		Replace the drive.
LED Operator Display		**Fault Name**
CPF16	CPF16	Clock Fault
		Standard clock error.
Cause		**Possible Solution**
Hardware is damaged.		Replace the drive.
LED Operator Display		**Fault Name**
CPF17	CPF17	Timing Fault
		A timing error occurred during an internal process.
Cause		**Possible Solution**
Hardware is damaged.		Replace the drive.
LED Operator Display		**Fault Name**
CPF18	CPF18	Control Circuit Fault
		CPU error (CPU operates incorrectly due to noise, etc.)
Cause		**Possible Solution**
Hardware is damaged.		Replace the drive.
LED Operator Display		**Fault Name**
CPF19	CPF19	Control Circuit Fault
		CPU error (CPU operates incorrectly due to noise, etc.)
Cause		**Possible Solution**
Hardware is damaged.		Replace the drive.
LED Operator Display		**Fault Name**
CPF20 or CPF21	CPF20 or CPF21	One of the following faults occurred: RAM fault, FLASH memory error, watchdog circuit exception, clock error
		• RAM fault. • FLASH memory error (ROM error). • Watchdog circuit exception (self-diagnostic error). • Clock error.
Cause		**Possible Solution**
Hardware is damaged.		Replace the drive.
LED Operator Display		**Fault Name**
CPF22	CPF22	A/D Conversion Fault
		A/D conversion error.
Cause		**Possible Solution**
Control circuit is damaged.		• Cycle power to the drive. ***Refer to Diagnosing and Resetting Faults on page 245***. • If the problem continues, replace the drive.
LED Operator Display		**Fault Name**
CPF23	CPF23	PWM Feedback Fault
		PWM feedback error.
Cause		**Possible Solution**
Hardware is damaged.		Replace the drive.
LED Operator Display		**Fault Name**
CPF24	CPF24	Drive Capacity Signal Fault
		Entered a capacity that does not exist. (Checked when the drive is powered up.)

Cause		Possible Solution
Hardware is damaged.		Replace the drive.
LED Operator Display		**Fault Name**
dEv	dEv	Speed Deviation (for Simple V/f with PG)
		According to the pulse input (RP), the speed deviation is greater than the setting in F1-10 for longer than the time set to F1-11.
Cause		**Possible Solution**
Load is too heavy.		Reduce the load.
Acceleration and deceleration times are set too short.		Increase the acceleration and deceleration times (C1-01 through C1-08).
The load is locked up.		Check the machine.
Parameters are not set appropriately.		Check the settings of parameters F1-10 and F1-11.
Motor brake engaged.		Ensure the motor brake releases properly.
LED Operator Display		**Fault Name**
dWFL	dWFL	DriveWorksEZ Fault
dWAL	dWAL	DriveWorksEZ Program Error Output
Cause		**Possible Solution**
DriveWorksEZ program output a fault.		• Correct whatever caused the fault to occur.
LED Operator Display		**Fault Name**
EF0	EF0	Option Card External Fault
		An external fault condition is present.
Cause		**Possible Solution**
An external fault was received from the PLC with F6-03 = 3 “alarm only” (the drive continued to run after external fault).		• 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.
LED Operator Display		**Fault Name**
EF1	EF1	External Fault (input terminal S1)
		External fault at multi-function input terminal S1.
EF2	EF2	External Fault (input terminal S2)
		External fault at multi-function input terminal S2.
EF3	EF3	External Fault (input terminal S3)
		External fault at multi-function input terminal S3.
EF4	EF4	External Fault (input terminal S4)
		External fault at multi-function input terminal S4.
EF5	EF5	External Fault (input terminal S5)
		External fault at multi-function input terminal S5.
EF6	EF6	External Fault (input terminal S6)
		External fault at multi-function input terminal S6.
EF7	EF7	External Fault (input terminal S7)
		External fault at multi-function input terminal S7.
Cause		**Possible Solution**
An external device has tripped an alarm function.		Remove the cause of the external fault and reset the fault.
Wiring is incorrect.		• Ensure the signal lines have been connected properly to the terminals assigned for external fault detection (H1-□□ = 20 to 2F). • Reconnect the signal line.
Incorrect setting of multi-function contact inputs.		• Check if the unused terminals set for H1-□□ = 20 to 2F (External Fault). • Change the terminal settings.
LED Operator Display		**Fault Name**
Err	Err	EEPROM Write Error
		Data does not match the EEPROM being written to.
Cause		**Possible Solution**
-		• Press the ENTER button. • Correct the parameter settings. • Cycle power to the drive. ***Refer to Diagnosing and Resetting Faults on page 245***.
LED Operator Display		**Fault Name**
FbH	FbH	Excessive PID Feedback
		PID feedback input is greater than the level set b5-36 for longer than the time set to b5-37. To enable fault detection, set b5-12 = “2” or “5”.
Cause		**Possible Solution**
Parameters are not set appropriately.		Check the settings of parameters b5-36 and b5-37.
Wiring for PID feedback is incorrect.		Correct the wiring.
There is a problem with the feedback sensor.		• Check the sensor on the control side. • Replace the sensor if damaged.
LED Operator Display		**Fault Name**
FbL	FbL	PID Feedback Loss
		This fault occurs when PID Feedback Loss Detection is programmed to fault (b5-12 = 2) and the PID Feedback < PID Feedback Loss Detection Level (b5-13) for the PID Feedback Loss Detection Time (b5-14).
Cause		**Possible Solution**
Parameters are not set appropriately.		Check the settings of parameters b5-13 and b5-14.
Wiring for PID feedback is incorrect.		Correct the wiring.
There is a problem with the feedback sensor.		Check the sensor on the controller side.If damaged, replace the sensor.
LED Operator Display		**Fault Name**
GF	GF	Ground Fault
		• Current shorted to ground exceeded 50% of rated current on output side of the drive. • Setting L8-09 to 1 enables ground fault detection in models 5.5 kW or larger.

Cause		Possible Solution
Motor insulation is damaged.		• Check the insulation resistance of the motor. • Replace the motor.
A damaged motor cable is creating a short circuit.		• Check the motor cable. • Remove the short circuit and turn the power back on. • Check the resistance between the cable and the ground terminal ⏚ . • Replace the cable.
The leakage current at the drive output is too high.		• Reduce the carrier frequency. • Reduce the amount of stray capacitance.
The drive started to run during Current Offset Fault or while coasting to a stop.		• The value set exceeds the allowable setting range while the drive automatically adjusts the current offset (this happens only attempting to restart a PM motor that is coasting to stop). • Enable Speed Search at start (b3-01 = 1). • Perform Speed Search 1 or 2 (H1-xx = 61 or 62) via one of the external terminals. **Note:** Speed Search 1 and 2 are the same when using PM OLV.
Hardware problem.		• Replace the drive.
LED Operator Display		**Fault Name**
LF	LF	Output Phase Loss • Phase loss on the output side of the drive. • Phase Loss Detection is enabled when L8-07 is set to “1” or “2”.
Cause		**Possible Solution**
The output cable is disconnected.		• Check for wiring errors and ensure the output cable is connected properly. • 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 Size and Torque Specifications on page 46***.
The motor being used is less than 5% of the drive rated current.		Check the drive and motor capacities.
An output transistor is damaged.		Replace the drive.
A single phase motor is being used.		The drive being used cannot operate a single phase motor.
LED Operator Display		**Fault Name**
LF2	LF2	Output current imbalance One or more of the phases in the output current is 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 on the output side of the drive are loose.		Apply the tightening torque specified in this manual to fasten the terminals. ***Refer to Wire Size and Torque Specifications on page 46***.
No signal displays from the gate driver board.		Replace the drive. Contact Yaskawa for assistance.
Motor impedance or motor phases are uneven.		• Measure the line-to-line resistance for each motor phase. Ensure all values are the same. • Replace the motor. Contact Yaskawa for assistance.
LED Operator Display		**Fault Name**
oC	oC	Overcurrent Drive sensors have detected an output current greater than the specified overcurrent level.
Cause		**Possible Solution**
The motor has been damaged due to overheating or the motor insulation is damaged.		Check the insulation resistance. Replace the motor.
One of the motor cables has shorted out or there is a grounding problem.		• Check the motor cables. • Remove the short circuit and power the drive back up. • 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 unit if the current value exceeds the rated current of the drive. • 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 the right amount of torque cannot be set, make the following changes: • Increase the acceleration time (C1-01, -03, -05, -07) • Increase the S-curve characteristics (C2-01 through C2-04) • Increase the capacity of the drive.
The drive is attempting to operate a specialized motor or a motor larger than the maximum size allowed.		• Check the motor capacity. • Ensure that the rated capacity of the drive is greater than or equal to the capacity rating found on the motor nameplate.
Magnetic contactor (MC) on the output side of the drive has turned on or off.		Set up the operation sequence so that the MC is not tripped while the drive is outputting current.
V/f setting is not operating as expected.		• Check the ratios between the voltage and frequency. • Set parameter E1-04 through E1-10 appropriately. Set E3-04 through E3-10 when using a second motor. • Lower the voltage if it is too high relative to the frequency.
Excessive torque compensation.		• Check the amount of torque compensation. • Reduce the torque compensation gain (C4-01) until there is no speed loss and less current.
Drive fails to operate properly due to noise interference.		• Review the possible solutions provided for handling noise interference. • Review the section on handling noise interference and check the control circuit lines, main circuit lines and ground wiring.
Overexcitation gain is set too high.		• Check if fault occurs simultaneously to overexcitation function operation. • Consider motor flux saturation and reduce the value of n3-13 (Overexcitation Deceleration Gain).
Run command applied while motor was coasting.		• Enable Speed Search at start (b3-01 = “1”). • Program the Speed Search command input through one of the multi-function contact input terminals (H1-□□ = “61” or “62”).
The wrong motor code has been entered for PM Open Loop Vector (Yaskawa motors only).		Enter the correct motor code to E5-01 to indicate that a PM motor is connected.

The motor control method and motor do not match.		Check which motor control method the drive is set to (A1-02). • For IM motors, set A1-02 = “0” or “2”. • For PM motors, set A1-02 = “5”.
The motor cable is too long		Use a larger drive.
LED Operator Display		**Fault Name**
oFA00	oFA00	Option Card Fault (Port A) The option card is incompatible with the drive.
Cause		**Possible Solution**
The option card is incompatible with the drive.		Use a compatible option card.
LED Operator Display		**Fault Name**
oFA01	oFA01	Option Card Fault (Port A) Replace the option card.
Cause		**Possible Solution**
The option card is not connected properly to the drive.		Turn the power off and reconnect the option card.
LED Operator Display		**Fault Name**
oFA03	oFA03	Option Card Fault (port A) Option card self-diagnostic error
oFA04	oFA04	Option Card Fault (port A) An error occurred attempting to write to the option card memory.
oFA30 thru oFA43	oFA30 thru oFA43	Option Card Fault (port A) Communication ID error
Cause		**Possible Solution**
Option card or hardware is damaged.		Replace the option card. Contact Yaskawa for consultation.
LED Operator Display		**Fault Name**
oH	oH	Heatsink Overheat The temperature of the heatsink exceeded the value set to L8-02 (90-100°C). 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).
Internal cooling fan is stopped.		• Replace the cooling fan. ***Refer to Cooling Fan Replacement on page 259***. • After replacing the drive, reset the cooling fan maintenance parameter (o4-03 = “0”).
LED Operator Display		**Fault Name**
oH1	oH1	Overheat 1 (Heatsink Overheat) The temperature of the heatsink has exceeded the value set to L8-02 (100-110°C). Default value for L8-02 is determined by drive capacity (o2-04).
Cause		**Possible Solution**
Surrounding temperature is too hot.		• 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.
The internal cooling fan has reached its performance life or has malfunctioned.		• Check the maintenance time for the cooling fan (U4-04). • If U4-04 exceeds 90%, replace the cooling fan. ***Refer to Cooling Fan Replacement on page 259***. • After replacing fan, reset the fan maintenance time (o4-03 = “0”).
Current flowing to control circuit terminal +V exceeded the tolerance level.		• Check the current level of the terminal. • Set the current to the control circuit terminal to be 20 mA or less.

LED Operator Display		**Fault Name**
oH3	oH3	Motor Overheat Alarm (PTC Input) • The motor overheat signal to analog input terminal A1 or A2 exceeded the alarm detection level. • Detection requires multi-function analog input H3-02 or H3-10 be set to “E”.
Cause		**Possible Solution**
Motor has overheated		• Check the size of the load, the accel/decel times and the cycle times. • Decrease the load. • Increase the acceleration and deceleration times (C1-01 through C1-08).
		• Adjust the preset V/f pattern (E1-04 through E1-10). This will mainly involve reducing E1-08 and E1-10. • Be careful not to lower E1-08 and E1-10 excessively, as this reduces load tolerance at low speeds.
		• Check the motor-rated current. • Enter the motor-rated current as indicated on the motor nameplate (E2-01). • Ensure the motor cooling system is operating normally. • Repair or replace the motor cooling system.
LED Operator Display		**Fault Name**
oH4	oH4	Motor Overheat Fault (PTC Input) • The motor overheat signal to analog input terminal A1 or A2 exceeded the alarm detection level. • Detection requires that multi-function analog input H3-02 or H3-10 = “E”.

Cause	Possible Solution
Motor has overheated.	• Check the size of the load, the accel/decel times and the cycle times. • Decrease the load. • Increase the acceleration and deceleration times (C1-01 through C1-08). • Adjust the preset V/f pattern (E1-04 through E1-10). This will mainly involve reducing E1-08 and E1-10. Be careful not to lower E1-08 and E1-10 excessively because this reduces load tolerance at low speeds • Check the motor-rated current. • Enter the motor-rated current as indicated on the motor nameplate (E2-01). • Ensure the motor cooling system is operating normally. • Repair or replace the motor cooling system.
LED Operator Display	**Fault Name**
oL1 — oL1	Motor Overload
	The electrothermal sensor tripped overload protection.
Cause	**Possible Solution**
Load is too heavy.	Reduce the load.
Cycle times are too short during acceleration and deceleration.	Increase the acceleration and deceleration times (C1-01 through C1-08).
• Drive overloaded at low speeds. • Overload may occur at low speeds when using a general-purpose motor, even if operating within the rated current limitation.	• Reduce the load. • Increase the speed. • If the drive is supposed to operate at low speeds, either increase the motor capacity or use a motor specifically designed to operate with the drive.
Although a special type of motor is being used, the motor protection selection is set for a general-purpose motor (L1-01 = 1).	Set L1-01 = “2”.
Voltage is too high for the V/f characteristics.	• Adjust the user set V/f patterns (E1-04 through E1-10). Parameters E1-08 and E1-10 may need to be reduced. • If E1-08 and E1-10 are set too high, there may be very little load tolerance at low speed.
The wrong motor-rated current is set to E2-01.	• Check the motor-rated current. • Enter the value written on the motor nameplate to parameter E2-01.
The maximum frequency for the drive input power is set too low.	• Check the rated frequency indicated on the motor nameplate. • Enter the rated frequency to E1-06 (Base Frequency).
Multiple motors are running off the same drive.	Disable the Motor Protection function (L1-01 = “0”) and 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 value set to L1-01 (Motor Protection Function). • 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).
Overexcitation current is enabled.	• Overexcitation is a potential serious danger to the motor. • Reduce the excitation deceleration gain (n3-13). • Set L3-04 (Stall Prevention during Deceleration) to a value other than 4. • Disable overexcitation (n3-23 = “0”).
Speed Search related parameters are not set to the proper values.	• Check values set to Speed Search related parameters. • Adjust the Speed Search current and Speed Search deceleration times (b3-02 and b3-03 respectively). • After Auto-Tuning, enable Speed Estimation Type Search (b3-24 = “1”).
Output current fluctuation due to input phase loss	Check the power supply for phase loss.
LED Operator Display	**Fault Name**
oL2 — oL2	Drive Overload
	The thermal sensor of the drive triggered overload protection.
Cause	**Possible Solution**
Load is too heavy.	Reduce the load.
Cycle times are too short during acceleration and deceleration.	Increase the settings for the acceleration and deceleration times (C1-01 through C1-08).
Voltage is too high for the V/f characteristics.	• Adjust the preset V/f pattern (E1-04 through E1-10). This will mainly involve reducing E1-08 and E1-10. • Be careful not to lower E1-08 and E1-10 excessively because this reduces load tolerance at low speeds.
Drive capacity is too small.	Replace the drive with a larger model.
Overload occurred when operating at low speeds.	• Reduce the load when operating at low speeds. • Replace the drive with a model that is one frame size larger. • Lower the carrier frequency (C6-02).
Excessive torque compensation.	Reduce the torque compensation gain (C4-01) until there is no speed loss but less current.
Speed Search related parameters are not set correctly.	• Check the settings for all Speed Search related parameters. • Adjust the current used during Speed Search and the Speed Search deceleration time (b3-03 and b3-02 respectively). • After Auto-Tuning the drive, enable the Speed Search Estimation Type (b3-24 = “1”).
Output current fluctuation due to input phase loss	Check the power supply for phase loss.
LED Operator Display	**Fault Name**
oL3 — oL3	Overtorque Detection 1
	The current has exceeded the value set for torque detection (L6-02) for longer than the allowable time (L6-03).
Cause	**Possible Solution**
Parameter settings are not appropriate for the type of load.	Check the settings of 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 load. Remove the cause of the fault.
LED Operator Display	**Fault Name**
oL4 — oL4	Overtorque Detection 2
	The current has exceeded the value set for Overtorque Detection 2 (L6-05) for longer than the allowable time (L6-06).
Cause	**Possible Solution**
Parameter settings are not appropriate for the type of load.	Check the settings of parameters L6-05 and L6-06.

There is a fault on the machine side (e.g., the machine is locked up).		Check the status of the load.Remove the cause of the fault.
LED Operator Display		**Fault Name**
oL7	oL7	High-Slip Braking OL The output frequency stayed constant for longer than the time set in n3-04 during High-slip Braking.
Cause		**Possible Solution**
Excessive load inertia. Motor is driven by the load. Something on the load side is restricting deceleration.		• Reduce deceleration times using parameters C1-02, -04, -06 and -08 in applications that do not use High-slip Braking. • Use a braking resistor to shorten deceleration time.
The overload time during High-slip Braking during is too short.		• Increase parameter n3-04 (High-slip Braking Overload Time). • Install a thermal relay and increase the parameter setting of n3-04 to the maximum value.
LED Operator Display		**Fault Name**
oPr	oPr	Digital Operator Connection Fault • The LCD operator has been disconnected from the drive. **Note:** An oPr fault will occur when all of the following conditions are true: • Output is interrupted when the operator is disconnected (o2-06 = 1). • The run command is assigned to the LCD operator (b1-02 = 0 and LOCAL has been selected).
Cause		**Possible Solution**
LCD operator is not properly connected to the drive.		• Check the connection between the LCD operator and the drive. • Replace the cable if damaged. • Turn off the drive input power and disconnect the LCD operator. Next reconnect the operator and turn the drive input power back on.
LED Operator Display		**Fault Name**
oS	oS	Overspeed (Simple V/f with PG) Pulse input (RP) indicates that motor speed feedback exceeded F1-08 setting.
Cause		**Possible Solution**
Overshoot or undershoot is occurring.		• Adjust the gain by using the pulse train input parameters (H6-02 through H6-05). • Increase the settings for C5-01 (Speed Control Proportional Gain 1) and reduce C5-02 (Speed Control Integral Time 1).
Incorrect PG pulse settings.		Set the H6-02 (Pulse Train Input Scaling) = 100%, the number of pulses during maximum motor revolutions.
Inappropriate parameter settings.		Check the setting for the overspeed detection level and the overspeed detection time (F1-08 and F1-09).
LED Operator Display		**Fault Name**
ov	ov	Overvoltage Voltage in the DC bus has exceeded the overvoltage detection level. • For 200 V class: approximately 410 V • For 400 V class: approximately 820 V (740 V when E1-01 is less than 400)
Cause		**Possible Solution**
Deceleration time is too short and regenerative energy flows from the motor into the drive.		• Increase the deceleration time (C1-02, -04, -06, -08). • Install a braking resistor or a dynamic braking resistor unit. • Enable stall prevention during deceleration (L3-04 = “1”). Stall prevention is enabled as the default setting.
Acceleration time is too short.		• Check if sudden drive acceleration triggers an overvoltage alarm. • Increase the acceleration time. • Use longer S-curve acceleration and deceleration times.
Excessive braking load.		The braking torque was too high, causing regenerative energy to charge the DC bus. Reduce the braking torque, use a braking option, or lengthen decel time.
Surge voltage entering from the drive input power.		Install a DC reactor. **Note:** Voltage surge can result from thyristor convertor and phase advancing capacitor using same drive main input power supply.
Ground fault in the output circuit causing the DC bus capacitor to overcharge.		• Check the motor wiring for ground faults. • Correct grounding shorts and turn the power back on.
Improper Setting of Speed Search related parameters. (Includes Speed Search after a momentary power loss and after a fault restart.)		• Check the settings for Speed Search related parameters. • Enable Speed Search Retry function (b3-19 greater than or equal to 1 to 10). • Adjust the current level during Speed Search and the deceleration time (b3-02 and b3-03 respectively). • Perform Line-to-Line Resistance Auto-Tuning and then enable Speed Estimation Type Speed Search (b3-24 = “1”).
Excessive regeneration when overshoot occurs after acceleration.		• Enable the Overvoltage Suppression function (L3-11 = “1”). • Lengthen the S-curve at acceleration end.
Drive input power voltage is too high.		• Check the voltage. • Lower drive input power voltage within the limits listed in the specifications.
The dynamic braking transistor is damaged.		Replace the drive.
The braking transistor is wired incorrectly.		• Check braking transistor wiring for errors. • Properly rewire the braking resistor device.
Drive fails to operate properly due to noise interference.		• Review the list of possible solutions provided for controlling noise. • Review the section on handling noise interference and check the control circuit lines, main circuit lines and ground wiring.
Load inertia has been set incorrectly.		• Check the load inertia settings when using KEB, overvoltage suppression or Stall Prevention during deceleration. • Adjust L3-25 (Load Inertia Ratio) in accordance with the load.
Braking function is being used in PM Open Loop Vector Control.		Connect a braking resistor.
Motor hunting occurs.		• Adjust the parameters that control hunting. • Set the hunting prevention gain (n1-02). • Adjust the AFR time constant (n2-02 and n2-03) when in OLV Control. • Use parameters n8-45 (PM Speed Feedback Detection Suppression Gain) and n8-47 (Pull-In Current Compensation Time Constant).
LED Operator Display		**Fault Name**
PF	PF	Input Phase Loss Drive input power has an open phase or has a large imbalance of voltage between phases. Detected when L8-05 = 1 (enabled).
Cause		**Possible Solution**
There is phase loss in the drive input power.		• Check for wiring errors in the main circuit drive input power. • Correct the wiring.

There is loose wiring in the drive input power terminals.		• Ensure the terminals are tightened properly. • Apply the tightening torque specified in this manual to fasten the terminals. *Refer to Wire Gauges and Tightening Torque on page 41*
There is excessive fluctuation in the drive input power voltage.		• Check the voltage from the drive input power. • Review the possible solutions for stabilizing the drive input power. • Disable Input Phase Loss Detection (L8-05 = "0"). PF is detected if DC bus ripple is too high. If it is disabled, there is no fault but the ripple is still too high, thereby the capacitors are stressed more and lose lifetime.
There is poor balance between voltage phases.		• Stabilize drive input power or disable phase loss detection.
The main circuit capacitors are worn.		• Check the maintenance time for the capacitors (U4-05). • Replace the drive if U4-05 is greater than 90%.
		• Check for anything wrong with the drive input power. • If nothing is wrong with the drive input power, try the following solutions if the alarm continues: • Disable Input Phase Loss Protection selection (L8-05 = "0"). PF is detected if DC bus ripple is too high. If it is disabled, there is no fault but the ripple is still too high, thereby the capacitors are stressed more and lose lifetime. • Replace the drive.
LED Operator Display		**Fault Name**
PGo	PGo	PG Disconnect (for Simple V/f with PG)
		No PG pulses are received for longer than the time set to F1-14.
Cause		**Possible Solution**
Pulse input (RP) is disconnected.		Reconnect the pulse input (RP).
Pulse input (RP) wiring is wrong.		Correct the wiring.
Motor brake engaged.		Ensure the motor brake releases properly.
LED Operator Display		**Fault Name**
rH	rH	Braking Resistor Overheat
		Braking resistor protection was triggered. Fault detection is enabled when L8-01 = 1 (disabled as a default).
Cause		**Possible Solution**
Deceleration time is too short and excessive regenerative energy is flowing back into the drive.		• Check the load, deceleration time and speed. • Reduce the load. • Increase the acceleration and deceleration times (C1-01 through C1-08). • Replace the braking option with a larger device that can handle the power that is discharged.
Excessive braking inertia.		Recalculate braking load and braking power. Then try reducing the braking load and checking the braking resistor settings and improve braking capacity.
The proper braking resistor has not been installed.		• Check the specifications and conditions for the braking resistor device. • Select the optimal braking resistor.
Note: The magnitude of the braking load trips the braking resistor overheat alarm, NOT the surface temperature. Using the braking resistor more frequently than its rating trips the alarm even when the braking resistor surface is not very hot.		
LED Operator Display		**Fault Name**
rr	rr	Dynamic Braking Transistor
		The built-in dynamic braking transistor failed.
Cause		**Possible Solution**
The braking transistor is damaged.		• Cycle power to the drive and check if the fault reoccurs. *Refer to Diagnosing and Resetting Faults on page 245*. • Replace the drive if the fault continues.
The control circuit is damaged.		
LED Operator Display		**Fault Name**
SEr	SEr	Too Many Speed Search Restarts
		The number of speed search restarts exceeded the number set to b3-19.
Cause		**Possible Solution**
Speed Search parameters are set to the wrong values.		• Reduce the detection compensation gain during Speed Search (b3-10). • Increase the current level when attempting Speed Search (b3-17). • Increase the detection time during Speed Search (b3-18). • Repeat Auto-Tuning.
The motor is coasting in the opposite direction of the run command.		Enable Bi-directional Speed Search (b3-14 = "1").
LED Operator Display		**Fault Name**
STO	STO	Pull-Out Detection
		Motor pull-out has occurred.
Cause		**Possible Solution**
The wrong motor code has been set (Yaskawa motors only).		• Enter the correct motor code for the PM being used into E5-01. • For special-purpose motors, enter the correct data to all E5 parameters according to the Test Report provided for the motor.
Load is too heavy.		• Increase the value set to n8-55 (Load Inertia for PM). • Increase the value set to n8-51 (Pull-In Current during Accel/Decel for PM). • Reduce the load. • Increase the motor or drive capacity.
Load inertia is too heavy.		Increase n8-55 (Load Inertia for PM).
Acceleration and deceleration times are too short.		• Increase the acceleration and deceleration times (C1-01 through C1-08). • Increase the S-curve acceleration and deceleration times (C2-01).
LED Operator Display		**Fault Name**
UL3	UL3	Undervoltage 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 type of 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.

LED Operator Display		Fault Name
UL4	UL4	Undertorque Detection 2
		The current has fallen below the minimum value set for torque detection (L6-05) for longer than the allowable time (L6-06).
Cause		**Possible Solution**
Parameter settings are not appropriate for the type of load.		Check the settings of parameters L6-05 and L6-06.
There is a fault on the machine side.		Check the load for any problems.
LED Operator Display		**Fault Name**
UL5	UL5	Mechanical Weakening Detection 2
		The operation conditions matched the conditions set to L6-08.
Cause		**Possible Solution**
Undertorque was detected and matched the condition of mechanical loss detection operation selection (L6-08).		Check the load side for any problems.
LED Operator Display		**Fault Name**
Uv1	Uv1	DC Bus Undervoltage
		One of the following conditions occurred while the drive was stopped: • Voltage in the DC bus fell below the undervoltage detection level (L2-05). • For 200 V class: approximately 190 V (160 V for single phase drives) • For 400 V class: approximately 380 V (350 V when E1-01 is less then 400) The fault is output only if L2-01 = 0 or L2-01 = 1 and the DC bus voltage is under L1-05 for longer than L2-02.
Cause		**Possible Solution**
Input power phase loss.		• The main circuit drive input power is wired incorrectly. • Correct the wiring.
One of the drive input power wiring terminals is loose.		• Ensure there are no loose terminals. • Apply the tightening torque specified in this manual to fasten the terminals. *Refer to Wire Size and Torque Specifications on page 46*
There is a problem with the voltage from the drive input power.		• Check the voltage. • Correct the voltage to within range listed in drive input power specifications.
The power has been interrupted.		Correct the drive input power.
Drive internal circuitry has become worn.		• Check the maintenance time for the capacitors (U4-05). • Replace the drive if U4-05 exceeds 90%.
The drive input power transformer is not large enough and voltage drops after switching on power.		Check the capacity of the drive input power transformer.
Air inside the drive is too hot.		Check the drive internal temperature.
Problem with the CHARGE indicator.		Replace the drive.
LED Operator Display		**Fault Name**
Uv2	Uv2	Control Power Supply Voltage Fault
		Voltage is too low for the control drive input power.
Cause		**Possible Solution**
L2-02 changed from its default value in drive that is 7.5 kW or smaller without installing a Momentary Power Loss Ride-Thru.		Correct parameter L2-02 setting or install optional Momentary Power Loss Ride-Thru unit.
The wiring for the control power supply is damaged.		• Cycle power to the drive. Check if the fault reoccurs. • Replace the drive if the fault continues to occur.
Internal circuitry is damaged.		• Cycle power to the drive. Check if the fault reoccurs. • Replace the drive if the fault continues to occur.
LED Operator Display		**Fault Name**
Uv3	Uv3	Undervoltage 3 (Inrush Prevention Circuit Fault)
		The inrush prevention circuit has failed.
Cause		**Possible Solution**
The contactor on the inrush prevention circuit is damaged.		• Cycle power to the drive. Check if the fault reoccurs. • Replace the drive if the fault continues to occur. • Check monitor U4-06 for the performance life of the inrush prevention circuit. • Replace the drive if U4-06 exceeds 90%.

6.5 Alarm Detection

Alarms are drive protection functions that do not operate the fault contact. The drive will return to original status when the cause of the alarm has been removed.

During an alarm condition, the Digital Operator display flashes and an alarm output is generated at the multi-function outputs (H2-01 to H2-03), if programmed.

Investigate the cause of the alarm and refer to *Table 6.9* for the appropriate action.

◆ Alarm Codes, Causes, and Possible Solutions

Table 6.9 Alarm Codes, Causes, and Possible Solutions

LED Operator Display		**Minor Fault Name**	
bb	bb	Baseblock	
		Drive output interrupted as indicated by an external baseblock signal.	
Cause		**Possible Solutions**	**Minor Fault (H2-□□ = 10)**
External baseblock signal entered via multi-function input terminal (S1 to S7).		Check external sequence and baseblock signal input timing.	No output
LED Operator Display		**Minor Fault Name**	
bUS	bUS	Option Communication Error	
		• After initial communication was established, the connection was lost. • Assign a run command frequency reference to the option card.	
Cause		**Possible Solutions**	**Minor Fault (H2-□□ = 10)**
Connection is broken or master controller stopped communicating.		• Check for faulty wiring. • Correct the wiring. • Repair ground wiring or disconnected cables.	YES
Option card is damaged.		If there are no problems with the wiring and the fault continues to occur, replace the option card.	YES
The option card is not properly connected to the drive.		• The connector pins on the option card are not properly lined up with the connector pins on the drive. • Reinstall the option card.	YES
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 cables recommended by Yaskawa, or another type of shielded line. The shield should be grounded on the controller side or on the drive input power side. • All wiring for communications devices should be separated from drive input power lines. Install a noise filter to the input side of the drive input power.	YES
LED Operator Display		**Minor Fault Name**	
CALL	CALL	Serial Communication Transmission Error	
		Communication has not yet been established.	
Cause		**Possible Solutions**	**Minor Fault (H2-□□ = 10)**
Communications wiring is faulty, there is a short circuit, or something is not connected properly.		• Check for wiring errors. • Correct the wiring. • Remove and ground shorts and reconnect loose wires.	YES
Programming error on the master side.		Check communications at start-up and correct programming errors.	YES
Communications circuitry is damaged.		• Perform a self-diagnostics check. • Replace the drive if the fault continues to occurs.	YES
Terminal resistance setting is incorrect.		The terminal slave drive must have the internal terminal resistance switch set correctly. Place DIP switch S2 to the ON position. *Refer to on page Not a Valid XREF!!!*.	YES
LED Operator Display		**Minor Fault Name**	
CE	CE	MEMOBUS/Modbus Communication Error	
		Control data was not received correctly for two seconds.	
Cause		**Possible Solutions**	**Minor Fault (H2-□□ = 10)**
A data error occurred due to noise.		• Check options available to minimize the effects of noise. • Counteract noise in the control circuit wiring, main circuit lines and ground wiring. • Reduce noise on the controller side. • Use surge absorbers on magnetic contactors or other equipment causing the disturbance. • Use cables recommended by Yaskawa or another type of shielded line. The shield should be grounded on the controller side or on the drive input power side. • Separate all wiring for communications devices from drive input power lines. Install a noise filter to the input side of the drive input power.	YES
Communication protocol is incompatible.		• Check the H5 parameter settings as well as the protocol setting in the controller. • Ensure settings are compatible.	YES
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 (H5-09).	YES
Incompatible PLC software settings or there is a hardware problem.		• Check the PLC. • Remove the cause of the error on the controller side.	YES
Communications cable is disconnected or damaged.		• Check the connector for a signal through the cable. • Replace the communications cable.	YES
LED Operator Display		**Minor Fault Name**	
dEu	dEv	Speed Deviation (for Simple V/f with PG)	
		According to the pulse input (RP), the speed deviation is greater than the setting in F1-10 for a time longer than the setting in F1-11.	

Cause		Possible Solutions	Minor Fault Output (H2-□□ = 10)
Load is too heavy		Reduce the load.	YES
Acceleration and deceleration times are set too short.		Increase the acceleration and deceleration times (C1-01 through C1-08).	YES
The load is locked up.		Check the machine.	YES
Parameter settings are inappropriate.		Check the settings of parameters F1-10 and F1-11.	YES
The motor brake engaged.		Ensure the brake releases properly.	YES
LED Operator Display		**Minor Fault Name**	
dnE	dnE	Drive Disabled	
Cause		**Possible Solutions**	**Minor Fault Output (H2-□□ = 10)**
“Drive Enable” is set to a multi-function contact input (H1-□□ = 6A) and that signal was switched off.		Check the operation sequence.	YES
LED Operator Display		**Minor Fault Name**	
EF	EF	Forward/Reverse Run Command Input Error	
		Both forward run and reverse run closed simultaneously for over 0.5 s.	
Cause		**Possible Solutions**	**Minor Fault Output (H2-□□ = 10)**
Sequence error		Check the forward and reverse command sequence and correct the problem. **Note:** When minor fault EF detected, motor ramps to stop.	YES
LED Operator Display		**Minor Fault Name**	
EF0	EF0	Option Card External Fault	
		An external fault condition is present.	
Cause		**Possible Solutions**	**Minor Fault Output (H2-□□ = 10)**
An external fault was received from the PLC with F6-03 = 3 (causing the drive to continue running when an external fault occurs).		• Remove the cause of the external fault. • Remove the external fault input from the PLC.	YES
There is a problem with the PLC program.		Check the PLC program and correct problems.	YES
LED Operator Display		**Minor Fault Name**	
EF1	EF1	External fault (input terminal S1)	
		External fault at multi-function input terminal S1.	
EF2	EF2	External fault (input terminal S2)	
		External fault at multi-function input terminal S2.	
EF3	EF3	External fault (input terminal S3)	
		External fault at multi-function input terminal S3.	
EF4	EF4	External fault (input terminal S4)	
		External fault at multi-function input terminal S4.	
EF5	EF5	External fault (input terminal S5)	
		External fault at multi-function input terminal S5.	
EF6	EF6	External fault (input terminal S6)	
		External fault at multi-function input terminal S6.	
EF7	EF7	External fault (input terminal S7)	
		External fault at multi-function input terminal S7.	
Cause		**Possible Solutions**	**Minor Fault Output (H2-□□ = 10)**
An external device has tripped an alarm function.		Remove the cause of the external fault and reset the multi-function input value.	YES
Wiring is incorrect.		• Ensure the signal lines have been connected properly to the terminals assigned for external fault detection (H1-□□ = 20 to 2F). • Reconnect the signal line.	YES
Multi-function contact inputs are set incorrectly.		• Check if the unused terminals have been set for H1-□□ = 20 to 2F (External Fault). • Change the terminal settings.	YES
LED Operator Display		**Minor Fault Name**	
FbH	FbH	Excessive PID Feedback	
		The PID feedback input is higher than the level set in b5-36 for longer than the time set in b5-37, and b5-12 is set to 1 or 4.	
Cause		**Possible Solutions**	**Minor Fault Output (H2-□□ = 10)**
Parameters settings for b5-36 and b5-37 are incorrect.		Check parameters b5-36 and b5-37.	YES
PID feedback wiring is faulty.		Correct the wiring.	YES
Feedback sensor has malfunctioned.		Check the sensor and replace it if damaged.	YES
Feedback input circuit is damaged.		Replace the drive.	YES
LED Operator Display		**Minor Fault Name**	
FbL	FbL	PID Feedback Loss	
		The PID feedback input is lower than the level set in b5-13 for longer than the time set in b5-14, and b5-12 is set to 1 or 4.	
Cause		**Possible Solutions**	**Minor Fault Output (H2-□□ = 10)**
Parameters settings for b5-13 and b5-14 are incorrect.		Check parameters b5-13 and b5-14.	YES
PID feedback wiring is faulty.		Correct the wiring.	YES
Feedback sensor has malfunctioned.		Check the sensor and replace it if damaged.	YES
Feedback input circuit is damaged.		Replace the drive.	YES
LED Operator Display		**Minor Fault Name**	

Hbb	Hbb	Hardwire Baseblock Signal Input Hardwire Baseblock input signal open.	
Cause		**Possible Solutions**	**Minor Fault Output (H2-□□ = 10)**
Internally, both Hardwire Baseblock channels are broken.		Replace the drive.	YES
There is no signal at terminal H1.		Check the wiring of terminal H1. Check if the PLC signal is set correctly.	YES
LED Operator Display		**Minor Fault Name**	
HbbF	HbbF	Hardwire Baseblock Signal Input One of the baseblock channels is damaged.	
Cause		**Possible Solutions**	**Minor Fault Output (H2-□□ = 10)**
One of the baseblock channels is faulty.		Replace the drive.	YES
LED Operator Display		**Minor Fault Name**	
HCA	HCA	Current Alarm Drive current exceeded overcurrent warning level (150% of the rated current).	
Cause		**Possible Solutions**	**Minor Fault Output (H2-□□ = 10)**
Load is too heavy.		• Measure the current flowing through the motor. • Reduce the load or increase the capacity of the drive.	YES
Acceleration and deceleration times are too short.		• Calculate the torque required during acceleration and for the inertia moment. • If the torque level is not right for the load, take the following steps: • Increase the acceleration and deceleration times (C1-01 through C1-08). • Increase the capacity of the drive.	YES
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.	YES
The current level increased due to Speed Search after a momentary power loss or while attempting to perform a fault restart.		The alarm will appear only briefly. There is no need to take action to prevent the alarm from occurring in such instances.	YES
LED Operator Display		**Minor Fault Name**	
oH	oH	Heatsink Overheat The temperature exceeded the maximum allowable value.	
Cause		**Possible Solutions**	**Minor Fault Output (H2-□□ = 10)**
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.	YES
Internal cooling fan has stopped.		• Replace the cooling fan. ***Refer to Cooling Fan Replacement on page 259***. • After replacing the drive, reset the cooling fan maintenance parameter to (o4-03 = “0”).	YES
Airflow around the drive is restricted.		• Provide proper installation space around the drive as indicated in the manual. Refer to ***Figure 2.1*** on page ***26***. • Allow for the specified space and ensure that there is sufficient circulation around the control panel.	YES
		• Check for dust or foreign materials clogging cooling fan. • Clear debris caught in the fan that restricts air circulation.	YES
LED Operator Display		**Minor Fault Name**	
oH2	oH2	Drive Overheat Warning “Drive Overheat Warning” was input to a multi-function input terminal, S1 through S7 (H1-□□	
Cause		**Possible Solutions**	**Minor Fault Output (H2-□□ = 10)**
An external device triggered and overheat warning in the drive.		• Search for the device that tripped the overheat warning. • Solving the problem will clear the warning.	YES
LED Operator Display		**Minor Fault Name**	
oH3	oH3	Motor Overheat The motor overheat signal entered to a multi-function analog input terminal exceeded the alarm level (H3-02 or H13-10 = E).	
Cause		**Possible Solutions**	**Minor Fault Output (H2-□□ = 10)**
Motor thermostat wiring is fault (PTC input).		Repair the PTC input wiring.	YES
There is a fault on the machine side (e.g., the machine is locked up).		• Check the status of the machine. • Remove the cause of the fault.	
Motor has overheated.		• Check the load size, accel/decel times, and cycle times. • Decrease the load. • Increase accel and decel times (C1-01 to C1-08). • Adjust the preset V/f pattern (E1-04 through E1-10). This will mainly involve reducing E1-08 and E1-10. **Note:** Do not lower E1-08 and E1-10 excessively, because this reduces 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.	YES
LED Operator Display		**Minor Fault Name**	
oL3	oL3	Overtorque 1 Drive output current (or torque in OLV) was greater than L6-02 for longer than the time set in L6-03.	

Cause	Possible Solutions	Minor Fault Output (H2-□□ = 10)
Inappropriate parameter settings.	Check parameters L6-02 and L6-03.	YES
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.	YES
LED Operator Display	**Minor Fault Name**	
oL4	Overtorque 2 Drive output current (or torque in OLV) was greater than L6-05 for longer than the time set in L6-06.	
Cause	**Possible Solutions**	**Minor Fault Output (H2-□□ = 10)**
Parameter settings are not appropriate.	Check parameters L6-05 and L6-06.	YES
There is a fault on the machine side (e.g., the machine is locked up).	• Check the status of the machine being used. • Remove the cause of the fault.	YES
LED Operator Display	**Minor Fault Name**	
oS	Overspeed (for Simple V/f with PG) Pulse input (RP) indicates that motor speed feedback exceeded F1-08 setting.	
Cause	**Possible Solutions**	**Minor Fault Output (H2-□□ = 10)**
Overshoot or undershoot is occurring.	• Adjust the gain by using the pulse train input parameters (H6-02 through H6-05). • Adjust the speed feedback accuracy. • Increase the settings for C5-01 (Speed Control Proportional Gain 1) and reduce C5-02 (Speed Control Integral Time 1).	YES
PG pulse settings are incorrect.	Set the H6-02 (Pulse Train Input Scaling) = 100%, the number of pulses during maximum motor revolutions.	YES
Parameter settings are inappropriate.	Check the setting for the overspeed detection level and the overspeed detection time (F1-08 and F1-09).	YES
LED Operator Display	**Minor Fault Name**	
ov	DC Bus Overvoltage The DC bus voltage exceeded the trip point. For 200 V class: approximately 410 V For 400 V class: approximately 820 V (740 V when E1-01 < 400)	
Cause	**Possible Solutions**	**Minor Fault Output (H2-□□ = 10)**
Surge voltage present in the drive input power.	• Install a DC reactor or an AC reactor. • Voltage surge can result from a thyristor convertor and a phase advancing capacitor operating on the same drive input power system.	YES
• The motor has short-circuited. • Ground current has over-charged the main circuit capacitors via the drive input power.	• Check the motor power cable, relay terminals and motor terminal box for short circuits. • Correct grounding shorts and turn the power back on.	YES
Noise interference causes the drive to operate incorrectly.	• Review possible solutions for handling noise interference. • Review section on handling noise interference and check control circuit lines, main circuit lines and ground wiring. • If the magnetic contactor is identified as a source of noise, install a surge protector to the MC coil.	YES
	Set number of fault restarts (L5-01) to a value other than 0.	YES
LED Operator Display	**Minor Fault Name**	
PASS	MEMOBUS/Modbus Comm. Test Mode Complete	
Cause	**Possible Solutions**	**Minor Fault Output (H2-□□ = 10)**
MEMOBUS/Modbus test has finished normally.	This verifies that the test was successful.	No output
LED Operator Display	**Minor Fault Name**	
PGo	PG Disconnect (for Simple V/f with PG) Detected when no PG pulses received for a time longer than setting in F1-14.	
Cause	**Possible Solutions**	**Minor Fault Output (H2-□□ = 10)**
Pulse input (RP) is disconnected.	Reconnect the pulse input (RP).	YES
Pulse input (RP) wiring is wrong.	Correct the wiring.	YES
Motor brake is engaged.	Ensure the brake releases properly	YES
LED Operator Display	**Minor Fault Name**	
rUn	Motor Switch during Run A command to switch motors was entered during run.	
Cause	**Possible Solutions**	**Minor Fault Output (H2-□□ = 10)**
A motor switch command was entered during run.	Change the operation pattern so that the motor switch command is entered while the drive is stopped.	YES
LED Operator Display	**Minor Fault Name**	
rUnC	Fault Reset when Run Command Entered Fault reset was being executed when a run command was entered.	
Cause	**Possible Solutions**	**Minor Fault Output (H2-□□ = 10)**
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 card during fault reset. • Turn off the run command.	YES
LED Operator Display	**Minor Fault Name**	
UL3	Undertorque Detection 1 Drive output current (or torque in OLV) less than L6-02 for longer than L6-03 time.	

<table>
<tr><th colspan="2">Cause</th><th>Possible Solutions</th><th>Minor Fault Output (H2-□□ = 10)</th></tr>
<tr><td colspan="2">Inappropriate parameter settings.</td><td>Check parameters L6-02 and L6-03.</td><td>YES</td></tr>
<tr><td colspan="2">Load has dropped or decreased significantly.</td><td>Check for broken parts in the transmission system.</td><td>YES</td></tr>
<tr><th colspan="2">LED Operator Display</th><th colspan="2">Minor Fault Name</th></tr>
<tr><td rowspan="2">UL4</td><td rowspan="2">UL4</td><td colspan="2">Undertorque Detection 2</td></tr>
<tr><td colspan="2">Drive output current (or torque in OLV) less than L6-05 for longer than L6-06 time.</td></tr>
<tr><th colspan="2">Cause</th><th>Possible Solutions</th><th>Minor Fault Output (H2-□□ = 10)</th></tr>
<tr><td colspan="2">Inappropriate parameter settings.</td><td>Check parameters L6-05 and L6-06.</td><td>YES</td></tr>
<tr><td colspan="2">The load has dropped or decreased significantly.</td><td>Check for broken parts in the transmission system.</td><td>YES</td></tr>
<tr><th colspan="2">LED Operator Display</th><th colspan="2">Minor Fault Name</th></tr>
<tr><td rowspan="2">Uv</td><td rowspan="2">Uv</td><td colspan="2">Undervoltage</td></tr>
<tr><td colspan="2">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 open.
• 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.</td></tr>
<tr><th colspan="2">Cause</th><th>Possible Solutions</th><th>Minor Fault Output (H2-□□ = 10)</th></tr>
<tr><td colspan="2">Phase loss in the drive input power.</td><td>Check for wiring errors in the main circuit drive input power. Correct the wiring.</td><td>YES</td></tr>
<tr><td colspan="2">Loose wiring in the drive input power terminals.</td><td>• Ensure the terminals have been properly tightened.
• Apply the tightening torque specified in this manual to fasten the terminals. ***Refer to Wire Gauges and Tightening Torque on page 41***</td><td>YES</td></tr>
<tr><td colspan="2">There is a problem with the drive input power voltage.</td><td>• Check the voltage.
• Lower the voltage of the drive input power so that it is within the limits listed in the specifications.</td><td>YES</td></tr>
<tr><td colspan="2">Drive internal circuitry is worn.</td><td>• Check the maintenance time for the capacitors (U4-05).
• Replace the drive if U4-05 exceeds 90%.</td><td>YES</td></tr>
<tr><td colspan="2">The drive input power transformer is not large enough and voltage drops when the power is switched on.</td><td>• Check for a tripped alarm when the magnetic contactor, line breaker and leakage breaker are turned on.
• Check the capacity of the drive input power transformer.</td><td>YES</td></tr>
<tr><td colspan="2">Air inside the drive is too hot.</td><td>• Check the temperature inside the drive.</td><td>YES</td></tr>
<tr><td colspan="2">The CHARGE indicator light is broken or disconnected.</td><td>• Replace the drive.</td><td>YES</td></tr>
</table>

6.6 Operator Programming Errors

An Operator Programming Error (oPE) occurs when an inappropriate parameter is set or an individual parameter setting is inappropriate.

The drive will not operate until the parameter is set correctly; however, no alarm or fault outputs will occur. If an oPE occurs, investigate the cause and refer to *Table 6.10* for the appropriate action. When oPE error is displayed, press the ENTER button to display U1-34 (oPE fault constant). This monitor displays the parameter causing the oPE error.

◆ oPE Codes, Causes, and Possible Solutions

Table 6.10 oPE Codes, Causes, and Possible Solutions

LED Operator Display		Error Name
oPE01	oPE01	Drive Capacity Setting Fault Drive capacity and then value set to o2-04 do not match.
Cause		**Possible Solutions**
The drive capacity setting (o2-04) and the actual capacity of the drive are not the same.		Correct the value set to o2-04.
LED Operator Display		**Error Name**
oPE02	oPE02	Parameter Range Setting Error Use U1-18 to find which parameters were set outside the setting range.
Cause		**Possible Solutions**
Parameters were set outside the possible setting range.		Set parameters to the proper values.
Note: Other errors are given precedence over oPE02 when multiple errors occur at the same time.		
LED Operator Display		**Error Name**
oPE03	oPE03	Multi-Function Input Selection Error A contradictory setting is assigned to multi-function contact inputs H1-01 through to H1-07.
Cause		**Possible Solutions**
• The same function is assigned to two multi-function inputs. • Excludes “Not used” and “External Fault.”		• Ensure all multi-function inputs are assigned to different functions. • Re-enter the multi-function settings to ensure this does not occur.
The Up command was set but the Down command was not, or vice versa (settings 10 vs. 11). The Up 2 command was set but the Down 2 command was not, or vice versa (settings 75 vs. 76).		Correctly set functions that need to be enabled in combination with other functions.
Run command for a 2-wire sequence was set, but forward/reverse command for a 2-wire sequence was not. “Drive Enable” is set to a multi-function contact input (H1-01 = 6A or H1-02 = 6A).		Correctly set functions that need to be enabled in combination with other functions.
Two of the following functions are set at the same time: • Up / Down Command (10 vs. 11) • Up 2 / Down 2 Command (75 vs. 76) • Hold Accel/Decel Stop (A) • Analog Frequency Reference Sample / Hold (1E) • Offset Frequency 1, 2, 3 Calculations (44, 45, 46)		• Check if contradictory settings have been assigned to the multi-function input terminals at the same time. • Correct setting errors.
The Up/Down command (10, 11) is enabled at the same time as PID control (b5-01).		Disable control PID (b5-01 = “0”) or disable the Up/Down command.
One of the following settings at the multi-function input terminals: • External Search Command 1 and External Search Command 2 (61 vs. 62) • Fast-Stop N.O. and Fast-Stop N.C. (15 vs. 17) • KEB for Momentary Power Loss and High Slip Braking (65, 66, 7A, 7B vs. 68) • Motor Switch Command and Accel/Decel Time 2 (16 vs. 1A) • KEB Command 1 and KEB Command 2 (65, 66 vs. 7A, 7B) • FWD Run Command (or REV) and FWD/REV Run Command (2-wire) (40, 41 vs. 42, 43) • External DB Command and Drive Enable (60 vs. 6A)) • Motor Switch Command and UP2/DOWN2 Command (16 vs. 75, 76)		Check for contradictory settings assigned to the multi-function input terminals at the same time.Correct setting errors.
One of the following settings was entered while H1-□□ = 2 (Alternative Reference): • b1-15 = 4 (Pulse Train Input) and H6-01 (Pulse Train Input Function Selection) not = 0 (Frequency Reference) • b1-15 or b1-16 set to 3 but no option card connected • Although b1-15 = 1 (Analog Input) and H3-02 or H3-10 are set to 0 (Frequency Bias). H2-□□ = 38 (Drive Enabled) but H1-□□ is not set to 6A (Drive Enable). H1-□□ = 7E (Direction Detection) although H6-01 is not set to 3 (Simple V/f with PG).		Correct the settings for the multi-function input terminal parameters.
LED Operator Display		**Error Name**
oPE04	oPE04	Initialization required.
Cause		**Possible Solutions**
The drive, control board, or terminal board has been replaced and the parameter settings between the control board and the terminal board no longer match.		To load the parameter settings to the drive that are stored in the terminal board, set A1-03 to 5550.Initialize parameters after drive replacement by setting A1-03 to 1110 or 2220.
LED Operator Display		**Error Name**
oPE05	oPE05	Run Command Selection Error The Run command selection parameter b1-02 is set to 3 but no option board is installed.
Cause		**Possible Solutions**
Frequency reference is assigned to an option card (b1-01 = 3) that is not connected to the drive. The Run command is assigned to an option card (b1-02 = 3) that is not connected to the drive.		Reconnect the option card to the drive.
Frequency reference is assigned to the pulse train input (b1-01 = 4), but terminal RP is not set for pulse train input (H6-01 is greater than 0).		Set H6-01 to “0”.
LED Operator Display		**Error Name**
oPE07	oPE07	Multi-Function Analog Input Selection Error A contradictory setting is assigned to multi-function analog inputs H3-02 through to H3-10 and PID functions conflict.
Cause		**Possible Solutions**
H3-02 and H3-10 are set to the same value.		Change the settings to H3-02 and H3-10 so that functions no longer conflict. **Note:** Both 0 (primary analog frequency reference) and F (Not Used) can be set to H3-02 and H3-10 at the same time.

The following simultaneous contradictory settings:H3-02 or H3-10 = B (PID Feedback) H6-01 (Pulse Train Input) = 1 (PID Feedback)		Disable one of the PID selections.
The following simultaneous contradictory settings: H3-02 or H3-10 = C (PID Target Value) H6-01 = 2 (pulse train input sets the PID target value)		
The following simultaneous contradictory settings: H3-02 or H3-10 = C (PID Target Value) b5-18 = 1 (enables b5-19 as the target PID value)		
The following simultaneous contradictory settings: H6-01 or H3-10 = C (PID Target Value) b5-18 = 1 (enables b5-19 as the target PID value)		
LED Operator Display		**Error Name**
oPE08	oPE08	Parameter Selection Error
		A function has been set that cannot be used in the motor control method selected.
Cause		**Possible Solutions**
Attempted to use a function in the V/f motor control method that is only possible in Open Loop Vector Control.		Check the motor control method and the functions available.
Simple V/f with PG was enabled while not in V/f Control (H6-01 = 3).		To use Simple V/f with PG, ensure the motor control method has been set to V/f Control (A1-02 = “0”).
In Open Loop Vector Control, n2-02 is greater than n2-03		Correct parameter settings so that n2-02 is less than n2-03.
In Open Loop Vector Control, C4-02 is greater than C4-06		Correct parameter settings so that C4-02 is less than C4-06.
In PM Open Loop Vector Control, parameters E5-02 to E5-07 are set to 0.		• Set the correct motor code in accordance with the motor being used (E5-01). • When using a special-purpose motor, set E5-☐☐ in accordance with the Test Report provided.
The following conditions are true in PM Open Loop Vector Control: • E5-03 does not equal 0 • E5-09 and E5-24 are both equal to 0, or neither equals 0		• Set E5-09 or E5-24 to the correct value, and set the other to “0”. • Set the motor-rated current for PM to “0” (E5-03).
Note: Use U1-18 to find which parameters are set outside the specified setting range. Other errors are given precedence over OPE08 when multiple errors occur at the same time.		
LED Operator Display		**Error Name**
oPE09	oPE09	PID Control Selection Fault
		PID control function selection is incorrect. Requires that PID control is enabled (b5-01 = 1 to 4).
Cause		**Possible Solutions**
The following simultaneous contradictory settings: • b5-15 not 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 another value besides 0. • Set the stopping method to coast to stop or ramp to stop (b1-03 = “0” or “1”).
LED Operator Display		**Error Name**
oPE10	oPE10	V/f Data Setting Error
		The following setting errors have occurred where: E1-04 is greater than or equal to E1-06 is greater than or equal to E1-07 is greater than or equal to E1-09. Or the following setting errors have occurred: E3-04 is greater than or equal to E3-06 is greater than or equal to E3-07 is greater than or equal to E3-09.
Cause		**Possible Solutions**
—		Correct the settings for E1-04, -06, -07 and -09 (or E-04, -06, -07, -09 for motor 2).
LED Operator Display		**Error Name**
oPE11	oPE11	Carrier Frequency Setting Error
		Correct the setting for the carrier frequency.
Cause		**Possible Solutions**
The following simultaneous contradictory settings: C6-05 is greater than 6 and C6-04 is greater than C6-03 (carrier frequency lower limit is greater than the upper limit). If C6-05 is less than or equal to 6, the drive operates at C6-03.		Correct the parameter settings.
Upper and lower limits between C6-02 and C6-05 contradict each other.		
LED Operator Display		**Error Name**
oPE13	oPE13	Pulse Monitor Selection Error
		Incorrect setting of monitor selection for Pulse Train (H6-06).
Cause		**Possible Solutions**
Scaling for the Pulse Train monitor is set to 0 (H6-07 = 0) while H6-06 is not set to 101, 102, 105, or 116.		Change scaling for the Pulse Train monitor or set H6-06 to 101, 102, 105, or 116.

6.7 Auto-Tuning Fault Detection

Auto-Tuning faults are shown below. When the following faults are detected, the fault is displayed on the Digital Operator and the motor coasts to a stop. No fault or alarm outputs will occur

◆ Auto-Tuning Codes, Causes, and Possible Solutions

Table 6.11 Auto-Tuning Codes, Causes, and Possible Solutions

LED Operator Display		Error Name
Er-01	Er-01	Motor Data Error
Cause		**Possible Solutions**
Motor data or data entered during Auto-Tuning incorrect.		• Check that the motor data entered to the T1 parameters match the information written on the motor nameplate input before Auto-Tuning. • Start Auto-Tuning over again and enter the correct information.
Motor output 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 output and no-load current settings (T1-04 and E2-03) do not match.This data is required only when Auto-Tuning for Open Loop Vector Control or when performing Stationary Auto-Tuning.		• Check the motor-rated current and no-load current. • Correct the settings of parameters T1-04 and E2-03.
Base frequency and base motor rotations (T1-05 and T1-07) do not match.		Set T1-05 and T1-07 to the correct value.
LED Operator Display		**Error Name**
Er-02	Er-02	Minor Fault
Cause		**Possible Solutions**
Motor data entered during Auto-Tuning was incorrect.		• Motor data entered to the T1 parameters does not match the information written on the motor nameplate. Enter the correct data. • Start Auto-Tuning over again and enter the correct information.
The wiring is faulty.		• Check the wiring and correct defective connections. • Check around the machine. • Check the load.
Load is too heavy.		
LED Operator Display		**Error Name**
Er-03	Er-03	STOP Button Input
Cause		**Possible Solutions**
Auto-Tuning canceled by pressing STOP button.		Auto-Tuning did not complete properly and will have to be performed again.
LED Operator Display		**Error Name**
Er-04	Er-04	Line-to-Line Resistance Error
Cause		**Possible Solutions**
Motor data entered during Auto-Tuning was incorrect.		• Motor data entered to the T1 parameters does not match the information written on the motor nameplate. Enter the correct data. • Start Auto-Tuning over again and enter the correct information.
Auto-Tuning did not complete within designated time frame.		• Check and correct faulty motor wiring. • Disconnect the motor from machine and perform Rotational Auto-Tuning.
Drive-calculated values outside parameter setting range.		
LED Operator Display		**Error Name**
Er-05	Er-05	No-Load Current Error
Cause		**Possible Solutions**
Motor data entered during Auto-Tuning was incorrect.		• Motor data entered to the T1 parameters does not match the information written on the motor nameplate. Enter the correct data. • Restart Auto-Tuning and enter the correct information.
Auto-Tuning did not complete within designated time frame.		• Check and correct faulty motor wiring. • Disconnect the motor from machine and perform Rotational Auto-Tuning.
Drive-calculated values outside parameter setting range.		
LED Operator Display		**Error Name**
Er-08	Er-08	Rated Slip Error
Cause		**Possible Solutions**
Motor data entered during Auto-Tuning was incorrect.		• Motor data entered to the T1 parameters does not match the information written on the motor nameplate. Enter the correct data. • Restart Auto-Tuning and enter the correct information.
Auto-Tuning did not complete within designated time frame.		• Check and correct faulty motor wiring. • Disconnect the motor from machine and perform Auto-Tuning.
Values calculated by the drive are outside the allowable parameter setting ranges.		
LED Operator Display		**Error Name**
Er-09	Er-09	Acceleration Error (detected only during Rotational Auto-Tuning)
Cause		**Possible Solutions**
The motor did not accelerate for the specified acceleration time.		• Increase the acceleration time (C1-01). • Check if it is possible to disconnect the machine from the motor.
Torque limit when motoring is too low (L7-01 and L7-02).		• Check the settings of parameters L7-01 and L7-02). • Increase the setting.
LED Operator Display		**Error Name**
Er-11	Er-11	Motor Speed Fault (detected only when Auto-Tuning is enabled)
Cause		**Possible Solutions**
Torque reference is too high. (Enabled in OLV only.)		• Increase the acceleration time (C1-01). • Disconnect the machine from the motor, if possible.
LED Operator Display		**Error Name**
Er-12	Er-12	Current Detection Error

<table>
<tr><th colspan="2">Cause</th><th>Possible Solutions</th></tr>
<tr><td colspan="2">One of the motor phases is missing (U/T1, V/T2, W/T3).</td><td>Check motor wiring and correct problems.</td></tr>
<tr><td colspan="2">Current exceeded the current rating of the drive.</td><td rowspan="2">• Check the motor wiring for a short between motor lines.
• If a magnetic contactor is used between motors, ensure it is on.
• Replace the drive.</td></tr>
<tr><td colspan="2">The current is too low.</td></tr>
<tr><td colspan="2">Attempted Auto-Tuning without motor connected to the drive.</td><td>Connect the motor and perform Auto-Tuning.</td></tr>
<tr><td colspan="2">Current detection signal error.</td><td>Replace the drive.</td></tr>
<tr><th colspan="2">LED Operator Display</th><th>Error Name</th></tr>
<tr><td>End1</td><td>End1</td><td>Excessive V/f Setting. Detected only during Rotational Auto-Tuning, and displayed after Auto-Tuning is complete.</td></tr>
<tr><th colspan="2">Cause</th><th>Possible Solutions</th></tr>
<tr><td colspan="2">The torque reference exceeded 20% during Auto-Tuning.</td><td rowspan="2">• Before Auto-Tuning the drive, verify the information written on the motor nameplate and enter that data to T1-03 through T1-05.
• Enter proper information to parameters T1-03 to T1-05 and repeat Auto-Tuning.
• If possible, disconnect the motor from the load and perform Auto-Tuning.</td></tr>
<tr><td colspan="2">The results from Auto-Tuning the no-load current exceeded 80%.</td></tr>
<tr><th colspan="2">LED Operator Display</th><th>Error Name</th></tr>
<tr><td>End2</td><td>End2</td><td>Motor Iron-Core Saturation Coefficient. Detected only during Rotational Auto-Tuning and displayed after Auto-Tuning is complete.</td></tr>
<tr><th colspan="2">Cause</th><th>Possible Solutions</th></tr>
<tr><td colspan="2">Motor data entered during Auto-Tuning was incorrect.</td><td>• Motor data entered to the T1 parameters does not match the information written on the motor nameplate.
• Restart Auto-Tuning and enter the correct information.</td></tr>
<tr><td colspan="2">Auto-Tuning calculated values outside the parameter setting range, assigning the iron-core saturation coefficient (E2-07, -08) a temporary value.</td><td>• Check and correct faulty motor wiring.
• Disconnect the motor from machine and perform Rotational Auto-Tuning.</td></tr>
<tr><th colspan="2">LED Operator Display</th><th>Error Name</th></tr>
<tr><td>End3</td><td>End3</td><td>Rated Current Setting Alarm (displayed after Auto-Tuning is complete)</td></tr>
<tr><th colspan="2">Cause</th><th>Possible Solutions</th></tr>
<tr><td colspan="2">• The motor line-to-line resistance and the motor-rated current are not consistent with one another.
• The correct current rating printed on the nameplate was not entered into T1-04.</td><td>• Check the setting of parameter T1-04.
• Check the motor data and repeat Auto-Tuning.</td></tr>
</table>

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.

◆ 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. 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.

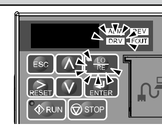
Note: To find out what faults were triggered, check U2-02 (Fault History). Information on drive status when the fault occurred such as the frequency, current and voltage, can be found in U2-03 through U2-17. ***Refer to Viewing Fault Trace Data after Fault on page 245*** for information on how to view fault trace data.

Note: When the fault continues to be displayed after cycling power, remove the cause of the fault and reset.

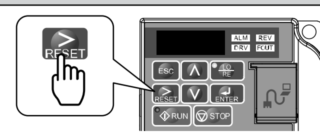
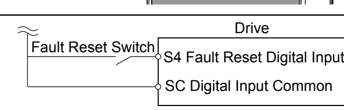
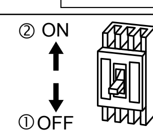
◆ If the drive still has power after a fault occurs

1. Look at the LED operator for information on the fault that occurred.
2. ***Refer to Fault Displays, Causes, and Possible Solutions on page 227***
3. Reset the fault. ***Refer to Fault Reset Methods on page 245***.

◆ Viewing Fault Trace Data after Fault

	Step		Display/Result
1.	Turn on the drive input power. The first screen displays.	➡	
2.	Press  until the monitor screen is displayed.	➡	
3.	Press  to display the parameter setting screen.	➡	
4.	Press  and > until U2-02 (Fault History) is displayed.	➡	
5.	Press  to view most recent fault (here, oC).	➡	
6.	Press  to view drive status information when fault occurred.		
7.	Parameters U2-03 through U2-17 help determine cause of fault.	➡	

◆ Fault Reset Methods

After the Fault Occurs	Procedure	
Fix the cause of the fault, restart the drive, and reset the fault	Press the RESET button on the digital operator	
Resetting via Fault Reset Digital Input S4	Close then open the fault signal digital input via terminal S4. S4 is set fault reset as default (H1-04 = 12)	
If the above methods do not reset the fault, turn off the drive main power supply. Reapply power after LED operator display is out.		

6.9 Troubleshooting Without Fault Display

This section is for troubleshooting problems that do not trip an alarm or fault.

◆ Cannot Change Parameter Settings

Cause	Possible Solutions
The drive is running the motor (i.e., the Run command is present).	• Stop the drive and switch over to the Programming Mode. • Most parameters cannot be edited during run.
The Access Level is set to restrict access to parameter settings.	• Set the Access Level to allow parameters to be edited (A1-02 = 2).
The operator is not in the Parameter Setup Mode (the LED screen will display “PAr”).	• See what mode the LED parameter is current set for. • Parameters cannot be edited when in the Setup Mode (“STUP”). Switch modes so that “PAr” appears on the screen.
A multi-function contact input terminal is set to allow or restrict parameter editing (H1-01 through H1-10 = 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: • Display parameter A1-04. Press the  button while pressing  at the same time. Parameter A1-05 will appear. • Set a new password to parameter A1-05.
Undervoltage was detected.	• Check the drive input power voltage by looking at the DC bus voltage (U1-07). • Check all main circuit wiring.

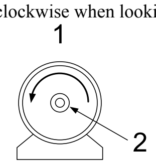
◆ Motor Does Not Rotate Properly after Pressing RUN Button or After Entering External Run Command

■ Motor Does Not Rotate

Cause	Possible Solutions
The drive is not in the Drive Mode.	• Check if the DRV light on the LED operator is lit. • Enter the Drive Mode to begin operating the motor. *Refer to The Drive and Programming Modes on page 61*.
The LO/RE button 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 the LO/RE button. • If o2-01 is set to 0, then the LO/RE button will be disabled.
Auto-Tuning has just completed.	• When Auto-Tuning has completed, 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 LED operator to enter the Drive Mode. *Refer to The Drive and Programming Modes on page 61*.
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: LED/LCD operator 1: Control circuit terminal (default setting) 2: MEMOBUS/Modbus communications 3: Option card
One of the Safety Inputs is open.	• Check for a short-circuit between terminals H1 and HC. • See if one of the Safety Inputs is open. • Correct any faulty wiring.
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: LED operator 1: Control circuit terminal (default setting) 2: MEMOBUS/Modbus communications 3: Option card 4: Pulse train input (RP)
The terminal set to accept the main speed reference is set to the incorrect voltage and/or current.	Check DIP switch S1. Next assign the correct input level to terminal A2 (H3-09). *Refer to Terminal A2 Switch on page 50*.
Selection for the sink/source mode is incorrect.	Check DIP switch S3. *Refer to Sinking/Sourcing Mode Switch on page 48*.
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 or A2 is set for frequency reference gain (H3-02/10 = 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.
The STOP button was pressed when the drive was started from a REMOTE source.	• When the STOP button is pressed, the drive will decelerate to stop. • Switch off the run command and then re-enter a run command. • The STOP button is disabled when o2-02 is set to 0.

Cause	Possible Solutions
Motor is not producing enough torque in the V/f motor control method.	• Ensure the selected V/f pattern corresponds with the characteristics of the motor being used. • Set the correct V/f pattern to E1-03. • When E1-03 = F, increase both the minimum and mid output frequency voltages (E1-08, E1-10).
	Increase the frequency reference so that it is higher than the minimum frequency reference (E1-09).
	Perform Line-to-Line Resistance Auto-Tuning when using particularly long motor cables.
	Increase the torque compensation gain (C4-01).
Motor is not producing enough torque in Open Loop Vector Control.	• Execute Rotational Auto-Tuning. • If the motor cables are replaced with longer cables after Rotational Auto-Tuning was performed, Auto-Tuning may need to be repeated due to voltage drop across the line.
	• Check if the torque limit parameters have been set too low (L7-01 through L7-04). • Reset the torque limit back to its default setting (200%).
	Increase both the minimum and mid output frequency voltages (E1-08 and E-10).
The drive is set for both 2-wire and 3-wire sequence at the same time.	• The drive is set for a 3-wire sequence when one of parameters H1-03 through H1-07 is set to 0. • If the drive is supposed to be set up for a 2-wire sequence, then ensure parameters H1-03 through H1-07 are not set to 0. • If the drive is supposed to be set up for a 3-wire sequence, then H1-□□ must be set to 0. Refer to *Table 6.2* for additional information.

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 the corresponding motor terminals U, V, and W.
The forward direction for the motor is set-up incorrectly.	Typically, forward is designated as being counterclockwise when looking from the motor shaft (refer to the 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 the drive to allow the motor to rotate in reverse (b1-04 = "0").
A Reverse run signal has not been entered, although 3-wire sequence is selected.	• Make sure that one of the input terminals S3 to S7 used for the 3-wire sequence has been set for reverse.

Motor is Too Hot

Cause	Possible Solutions
The load is too heavy.	If the load is too heavy for the motor, the motor will overheat as it exceeds its rated torque value for an extended period of time. Keep in mind that the motor also has a short-term overload rating in addition to the possible solutions provided below: • Reduce the load. • Increase the acceleration and deceleration times. • Check the values set for the motor protection (L1-01, L1-02) as well as the motor rated current (E2-01). • Increase motor capacity.
The air around the motor is too hot.	• Check the ambient temperature. • Cool the area until it is within the specified temperature range.
The drive is operating in a vector control mode but Auto-Tuning has not yet been performed.	• Perform Auto-Tuning. • Calculate the motor value and reset the motor parameters. • Change the motor control method to V/f Control (A1-02 = "0").
Insufficient voltage tolerance between motor phases.	When the motor is connected to terminals U/T1, V/T2, and W/T3, voltage surges occur between the motor coils and drive switching. Normally, surges can reach up to three times the drive input power supply voltage (600 V for 200 V class, and 1200 V for 400 V class). • Use a motor with voltage tolerance higher than the max voltage surge. • Use a motor designed to work specifically with a drive when using a 400 V class unit. • Install an AC reactor on the output side of the drive.
The motor fan has stopped or is clogged.	Check the motor fan.

Drive Does Not Allow Selection of Rotational Auto-Tuning

Cause	Possible Solutions
The drive is in the incorrect motor control method for Rotational Auto-Tuning.	• Check if the drive is set to V/f Control by accident (A1-02 = 0). • Change the motor control method to Open Loop Vector Control (A1-02 = "2").

■ Motor Hunting Occurs at Low Speeds

Cause	Possible Solutions
Excessive load inertia in Open Loop Vector Control.	• Excess load inertia can cause motor hunting in Open Loop Vector Control due to slow motor response. • Increase the speed feedback detection control time constant (n2-02) from its default value of 50 ms to an appropriate level between 200 and 1000 ms. Adjust this setting in combination with n2-03 (Feedback Detection Control Time Constant 2).

■ Overvoltage Occurs When Running at a Constant Speed

Cause	Possible Solutions
Excessive load inertia in Open Loop Vector Control.	• Loads with a lot of inertia (fans, etc.) can trigger an overvoltage fault when operating in Open Loop Vector Control. • Switch to the V/f motor control method. • Adjust the values set for the speed feedback detection control time constant (n2-02, n2-03).

■ Motor Stalls During Acceleration or With Large Loads

Cause	Possible Solutions
Load is too heavy.	Take the following steps to resolve the problem: • Reduce the load. • Increase the acceleration time. • Increase motor capacity. • 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.

■ Motor Will Not Accelerate or the Acceleration Time is Too Long

Cause	Possible Solutions
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 or A2 (H3-03, H3-11).
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.
	Check if the mechanical brake is fully releasing as it should.
The torque limit function is operating in Open Loop Vector Control.	• Check the torque limit setting. It may be too low. (L7-01 through L7-04). • Reset the torque limit to its default value (200%).
Acceleration time has been set too long.	Check if the acceleration time parameters have been set too long (C1-01, -03, -05, -07).
Motor characteristics and drive parameter settings are incompatible with one another in V/f Control.	• Select the correct V/f pattern so that it matches the characteristics of the motor being used. • Check E1-03 (V/f Pattern Selection).
The right combination of motor characteristics have not been set in Open Loop Vector Control.	Execute Rotational Auto-Tuning.
Incorrect frequency reference setting.	• Check the multi-function analog input settings. • Check if multi-function analog input terminal A1 or A2 is set for frequency gain (H3-02 or H3-10 = “1”). If so, the frequency reference will be 0 if there is no voltage (current) input provided. • Ensure H3-02 and H3-10 are set to the proper values. • Ensure the analog input value is set to the right value (U1-13, U1-14).
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 will take a fair amount of time. • 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.
Although the drive is operating in Open Loop Vector motor control method, Auto-Tuning has not been performed.	• Perform Auto-Tuning. • Calculate motor data and reset motor parameters. • Switch to the V/f motor control method (A1-02 = “0”).
Drive reached the limitations of the V/f motor control method.	• The motor cable may be long enough (over 50 m) to require Auto-Tuning for line-to-line resistance. Also be aware that V/f Control is comparatively limited when it comes to producing torque at low speeds. • Consider switching to Open Loop Vector Control.

■ Drive Frequency Reference Differs from the Controller Frequency Reference Command

Cause	Possible Solutions
The analog input frequency gain and bias are set to incorrect values.	• Check the frequency reference terminal input gain level assigned to terminals A1 and A2, as well as the frequency reference input bias to terminal A1 and A2 (parameters H3-03, H3-04, and H3-12). • Set these parameters to the appropriate values.
A frequency bias signal is being entered via analog input terminals A1 or A2.	• If multi-function analog input terminals A1 and A2 are set for frequency reference (H3-02 = 0 and H3-10 = 0), the addition of both signals builds the frequency reference. • Ensure that H3-02 and H3-10 are set appropriately. • Check the input level set for terminals A1 and A2 (U1-13, U1-14).

■ Poor Speed Control Accuracy

Cause	Possible Solutions
Drive reached the slip compensation limit.	• Check the slip compensation limit (C3-03). • Increase the value set to C3-03.

Cause	Possible Solutions
Motor-rated voltage is set too high in Open Loop Vector Control.	• The input voltage for the drive determines the maximum output voltage. A drive with an input of 200 Vac can only output a maximum of 200 Vac. Open Loop Vector Control sometimes calculates an output voltage reference value that exceeds the maximum drive output voltage level, resulting in a loss of speed control accuracy. • Use a motor with a lower voltage rating (a vector control motor). • Increase the input power voltage.
Auto-Tuning did not complete properly for Open Loop Vector Control.	• Perform Auto-Tuning again.

■ Deceleration Takes Too Long With Dynamic Braking Enabled

Cause	Possible Solutions
L3-04 is set incorrectly.	• Check the Stall Prevention Level during deceleration (L3-04). • If a braking resistor option has been installed, disable Stall Prevention during deceleration (L3-04 = “0”).
The deceleration time is set too long.	Set deceleration to more appropriate time (C1-02, C1-04, C1-06, C1-08).
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.
Reaching the torque limit.	• Check the settings for the torque limit (L7-01 through L7-04). • If the torque limit is enabled, deceleration might take longer than expected because the drive cannot output more torque than the limit setting. Ensure the torque limit is set to a large enough value. • Increase the torque limit setting.
	• If multi-function analog input terminal A1 or A2 is set to torque limit (H3-02 or H3-10 equals 10, 11, 12, or 15), ensure that the analog input levels are set to the correct levels. • Ensure H3-02 and H3-10 are set to the right levels. • Ensure the analog input is set to the correct value.
Load exceeded the internal torque limit determined by the drive rated current.	Switch to a larger capacity drive.

■ Motor Hunting Occurs When Operating With a Light Load

Cause	Possible Solutions
Carrier frequency is too high.	Lower the carrier frequency setting C6-02.
Large V/f setting value at low speeds triggers overexcitation.	• Select the proper V/f pattern (E1-03). • Use parameters E1-04 through E1-10 to set the V/f pattern in relation to the load characteristics.
The maximum output frequency and the base frequency reference are not set properly in relationship to each other.	Set the proper values for the maximum output frequency and base frequency (E1-04, E1-06).
Hunting Prevention is disabled (V/f control only).	• Enable Hunting Prevention by setting n1-01 = “1”. • (OLV only) Increase the speed feedback detection control gain and time constant (n2-01, n2-02).

■ Load Falls When Brake is Applied (Hoist-Type Applications)

Cause	Possible Solutions
The timing for the brake to close and release is not set properly.	Use frequency reference detection for closing and releasing the brake. • At start: Release the brake after creating enough torque. • At stop: Close the brake when the motor still produces torque. Make the following setting changes to hold the brake: • Set the frequency detection inactive during baseblock (L4-07 = 0). • Multi-function contact output terminal will switch on when the output frequency is greater than the frequency detection level set in L4-01. Set L4-01 between 1.0 and 3.0 Hz. • Slipping may occur when stopping because hysteresis is used in Frequency Reference 2 (where the frequency agree setting in L4-02 is 2.0 Hz). To prevent this, change the setting to 0.1 Hz. • Do not use the multi-function contact output setting “During Run” (H2-01 = 0) for the brake signal.
Insufficient DC Injection Braking.	Increase the amount of DC Injection Braking (b2-02).

■ Noise From Drive or Output Lines 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.

■ Ground Fault Circuit Interrupter (GFCI) Trips During Run

Cause	Possible Solutions
Excessive leakage current trips MCCB.	• Increase the GFCE 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. • Install a noise filter or reactor on the output side of the drive.

■ Connected Machinery Vibrates When Motor Rotates

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.

Unexpected Noise from Connected Machinery

Cause	Possible Solutions
The carrier frequency is at the resonant frequency of the connected machinery.	Adjust the carrier frequency using parameters C6-02 through C6-05.
The drive output frequency is the same as the resonant frequency of the connected machinery.	• Adjust the parameters used for the Jump Frequency function (d3-01 through d3-04) to skip the problem-causing bandwidth. • Place the motor on a rubber pad to reduce vibration.

Note: The drive may have trouble assessing the status of the load due to white noise generated when using Swing PWM (C6-02 = 7 to A, or 7 if set for Normal Duty).

■ Oscillation or Hunting

Cause	Possible Solutions
Insufficient tuning in Open Loop Vector Control.	Adjust the following parameters in the order listed to get better gain. An increase in gain should be followed with an increase in the primary delay time constant. • C4-02 (Torque Compensation Primary Delay Time) • n2-01 (Speed Feedback Detection Control [AFR] Time Constant 1) • C3-02 (Slip Compensation Primary Delay Time) The response for torque compensation and slip compensation will drop as the time constant is increased.
Auto-Tuning has not yet been performed (required for Open Loop Vector Control).	Perform Auto-Tuning. Set motor parameters after calculating the proper values. Change the motor control method to V/f Control (A1-02 = “0”).
Insufficient tuning in Open Loop Vector Control.	Adjust the following parameters in the order listed to get better gain. An increase in gain should be followed with an increase in the primary delay time constant. • C4-02 (Torque Compensation Primary Delay Time) • n2-02 (AFR Time Constant 1) • n1-02 (Hunting Prevention Gain Setting) The response for torque compensation and slip compensation will drop as the time constant is increased.
Gain is too low when using PID control.	Check the period of oscillation and adjust P, I, and D settings accordingly.
The frequency reference is assigned to an external source.	• Ensure that noise is not affecting the signal lines. • Separate main circuit wiring and control circuit wiring. • Use twisted-pair cables or shielded wiring for the control circuit. • Increase the analog input time filter constant (H3-13).
The cable between the drive and motor is too long.	• Perform Auto-Tuning. • Reduce the length of the cable.

■ PID output fault

Cause	Possible Solutions
No PID feedback input.	• Check the multi-function analog input terminal settings. • Set multi-function analog input terminal A1 or A2 for PID feedback (H3-02 or H3-10 = “B”). • A signal input to the terminal selection for PID feedback is necessary. • 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 H3-03/11 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”).

■ Insufficient Motor Torque

Cause	Possible Solutions
Auto-Tuning has not yet been performed (required for OLV Control).	Perform Auto-Tuning.
The control mode was changed after performing Auto-Tuning.	Perform Auto-Tuning again.
Only Line-to-Line Resistance Auto-Tuning was performed.	Perform Rotational Auto-Tuning.

■ Motor Rotates After the Drive Output is Shut Off

Cause	Possible Solutions
Low DC Injection Braking and the drive cannot decelerate properly.	• Adjust the DC Injection braking settings. • Increase the value of b2-02 (DC Injection Braking Current). • Increase the b2-04 (DC Injection Braking Time at Stop).

■ OV or Speed Loss Occurs When Starting into a Rotating Load

Cause	Possible Solutions
The load is already rotating when the drive is trying to start it.	• Stop the motor using DC Injection braking. Restart the motor. • Increase the value of b2-03 (DC Injection Braking Time at start). • Enable Speed Search at start (b3-01 = “1”). • Set a multi-function input terminal for external Speed Search command (H1-□□=“61” or “62” during restart). *Figure 4.17* on *79*.

■ 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 through d3-03). • Enabling the Jump Frequency prevents the drive from outputting the frequencies specified in the Jump Frequency range.

Cause	Possible Solutions
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).

■ Buzzing Sound from Motor at 2 kHz

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 automatically reduces and causes a whining or buzzing sound. • If the sound is coming from the motor, disable carrier frequency derating (L8-38 = “0”). • Disabling the automatic carrier frequency derating increases the chances of an overload fault (oL2). Switch to a larger capacity motor if oL2 faults occur too frequently.

■ Unstable Motor Speed when Using PM or IPM

Cause	Possible Solutions
The motor code for PM (E5-01) is set incorrectly. (Yaskawa motors only)	Set parameter E5-01 in accordance with the motor being used.
The drive is operating at less than 10% of the speed reference.	Consult with Yaskawa about using a different type of motor when attempting to operate at 10% of the speed reference.
Motor hunting occurs.	Set and carefully adjust the following parameters in the order listed: • n8-45 (Speed Feedback Detection Suppression Gain) • n8-55 (Load Inertia for PM Motors) • C4-02 (Torque Compensation Primary Delay Time)
Hunting occurs at start.	Increase the S-curve time at the start of acceleration (C2-01).
Too much current is flowing through the drive.	• If using a PM motor, set the correct motor code to E5-01. • If using a specialized motor, set parameter E5-xx to the correct value according to the Motor Test Report.

■ Motor Does Not Operate When the RUN Button on the Digital Operator is Pressed

Cause	Possible Solutions
The LOCAL/REMOTE mode is not selected properly.	Press the LOCAL/REMOTE button to switch. The LO/RE LED should be on for LOCAL mode.
The drive is not in drive mode.	A run command will not be issued. Exit to the drive mode and cycle the run command.
The frequency reference is too low.	• If the frequency reference is set below the frequency set in E1-09 (Minimum Output Frequency), the drive will not operate. • Raise the frequency reference to at least the minimum output frequency.

■ Motor Does Not Operate When an External Run Command is Input

Cause	Possible Solutions
The LOCAL/REMOTE mode is not selected properly.	Press the LOCAL/REMOTE button to switch. The LO/RE LED should be off for REMOTE mode.
The drive is not in Drive Mode.	A run command will not be issued. Exit to the Drive mode and cycle the run command.
The frequency reference is too low.	• If the frequency reference is set below the frequency set in E1-09 (Minimum Output Frequency), the drive will not operate. • Raise the frequency reference to at least the minimum output frequency.

■ Motor Stops During Acceleration or When a Load is Connected

Cause	Possible Solution
• The load is too heavy. • The limit of motor response may be reached during rapid acceleration. This may be a result of improper stall prevention or automatic torque boost function adjustment. (L3-01 = 2)	Increase the acceleration time (C1-01) or reduce the motor load. Also, consider increasing the motor size and/or drive size.

■ Motor Rotates in One Direction Only

Cause	Possible Solution
"Reverse run prohibited" is selected. If b1-04 (Reverse Prohibit Operation) is set to 1 (reverse run prohibited), the drive will not accept a reverse run command.	Set b1-04 = “0” to allow reverse run operation.

■ Motor Operates at a Higher Speed than the Speed Command

Cause	Possible Solution
PID is enabled. If the PID mode is enabled (b5-01 = 1 to 4), the drive output frequency will change to regulate the process variable to the target setpoint. The PID can command a speed up to maximum output frequency (E1-04).	If PID operation is not target, disable PID by setting b5-01 = “0”.

■ Poor Speed Control Accuracy Above Base Speed in Open-Loop Vector Motor Control Method

Cause	Possible Solution
The maximum output voltage of the drive is determined by its input voltage. Vector control uses voltage to control the currents within the motor. If the vector control voltage reference value exceeds the drive output voltage capability, the speed control accuracy will decrease because the motor currents cannot be properly controlled.	Use a motor with a lower rated voltage compared to the input voltage, or change to flux vector control.

■ Peripheral Devices Affected by Drive Operation

Cause	Possible Solutions
Radio frequency interference may be generated by drive output PWM waveform.	• Change the Carrier Frequency Selection (C6-02) to lower the carrier frequency. This will help to reduce the amount of transistor switching noise. • Install an Input Noise Filter at the input power terminals. • Install an Output Noise Filter at the motor terminals. • Use conduit. Metal can shield electrical noise. • Ground the drive and motor. • Separate main circuit wiring from control wiring.

■ Ground Fault Interrupter Activates When Drive is Running

Cause	Possible Solutions
The output of the drive is a series of high frequency pulses (PWM), so there is a certain amount of leakage current. This may cause the ground fault interrupter to operate and cut off the drive input power.	• Change to a ground fault interrupter with a higher leakage current detection level (such as, a sensitivity current of 200 mA or greater per Unit, with an operating time of 0.1 s or more), or one that incorporates high-frequency countermeasures. • Change the Carrier Frequency Selection (C6-02) to lower the carrier frequency. **Note:** Leakage current increases in proportion to cable length.

7

Periodic Inspection & Maintenance

This chapter describes the periodic inspection and maintenance of the drive to ensure that it receives the proper care to maintain overall performance.

7.1 Section Safety

DANGER

Electrical Shock Hazard

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

Failure to comply will result in death or serious injury.

WARNING

Electrical Shock Hazard

Do not operate equipment with covers removed.

Failure to comply could result in death or serious injury.

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

Always ground the motor-side grounding terminal.

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

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

Failure to comply could result in death or serious injury.

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

Failure to comply could result in death or serious injury.

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

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

Failure to comply could result in death or serious injury.

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

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

Failure to comply could result in death or serious injury.

Before wiring terminals, disconnect all power to the equipment. The internal capacitor remains charged even after the power supply is turned off. The charge indicator LED will extinguish when the DC bus voltage is below 50 Vdc. To prevent electric shock, wait at least five minutes after all indicators are off and measure the DC bus voltage level to confirm safe level.

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 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.
Carefully review instruction manual TOBPC72060000 when connecting a braking option 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.

7.2 Inspection

Power electronics have limited life and may exhibit changed 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, semi-conductors, 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 3 months 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.

WARNING! *Electrical Shock Hazard. Do not connect or disconnect wiring while the power is on. Failure to comply can result in serious personal injury. Before servicing the drive, disconnect all power to the equipment. The internal capacitor remains charged even after the power supply is turned off. The charge indicator LED will extinguish when the DC bus voltage is below 50 Vdc. To prevent electric shock, wait at least five minutes after all indicators are OFF and measure the DC bus voltage level to confirm safe level.*

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 excessive load • Loose connections • Check for dirty heatsink or motor • Ambient temperature	
Cooling	• Inspect drive cooling fan operation.	• Check for clogged or dirty fan. • Check fan operation drive parameter.	
Environment	• Verify the drive environment complies with the specifications listed in the Installation section of this manual.	• 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 excessive load. • Check the motor parameter settings of the drive.	
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. Periodic inspections should generally be checked every 3-6 months; however, the drive may require more frequent inspection due to poor environments or 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 connect or disconnect wiring while the power is on. Failure to comply can result in serious personal injury. Before servicing the drive, disconnect all power to the equipment. The internal capacitor remains charged even after the power supply is turned off. The charge indicator LED will extinguish when the DC bus voltage is below 50 Vdc. To prevent electric shock, wait at least five minutes after all indicators are OFF and measure the DC bus voltage level to confirm safe level.*

Table 7.2 Periodic Inspection Checklist

Inspection Area	Inspection Points	Corrective Action	Checked
Main Circuit Periodic Inspection			
General	• Overall check of the main power circuit and ground terminals	Take appropriate actions (e.g., tightening loose connections).	
	• 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 present. Replace components if cleaning is not possible. • Use dry air to clear away foreign matter. Use a pressure of 39.2 x 10^4 to 58.8 x 10^4 Pa (4 - 6 kg •cm^2).	
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.	

Inspection Area	Inspection Points	Corrective Action	Checked
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 over or under voltage conditions. • Replace damaged removable relays contactors or circuit board.	
Braking Resistors	• Inspect for discoloration of heat stress on or around resistors.	• Minor discoloration may be acceptable. • If discoloration exists check for loose connections.	
Electrolytic (bus) Capacitors	• Inspect for leakage, discoloration, or cracks. • Inspect the relief valve for swelling, rupture, or leakage.	• The drive has few serviceable parts and may require complete drive replacement.	
Diodes and IGBTs	• Inspect for accumulation of dust or other foreign particles on components.	• Use dry air to clear away foreign matter. • Use a pressure of: 39.2 x 10^4 to 58.8 x 10^4 Pa (4 - 6 kg •cm^2).	
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. • Check for tightness.	• 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.	
Printed Circuit Boards	• Inspect for unusual discoloration, burning or strange odor, noticeable rust or corrosion, proper seating of connectors, dust, oil, or other contamination.	• Re-seat loose connectors. • Replace PCBs if wiping or vacuuming with anti-static vacuum cannot clean the PCB. • Do not use solvents on PCBs. • Use dry air to clear away foreign matter. Use a pressure of 39.2 x 10^4 to 58.8 x 10^4 Pa (4 - 6 kg •cm^2). • The drive has few serviceable parts and may require complete drive replacement.	
Cooling System Periodic Inspection			
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 259*** for information on cleaning or replacing the cooling fan.	
Heatsink	• Inspect for dust or other foreign material collected on the surface.	• Use dry air to clear away foreign matter. • Use a pressure of 39.2 x 10^4 to 58.8 x 10^4 Pa (4 - 6 kg•cm^2).	
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.	
LED Periodic Inspection			
LEDs	• Make sure the LED lights correctly. • Make sure various components operate properly. • Inspect for dust or other foreign material that may have collected on surrounding components.	• Contact your Yaskawa representative if there is any trouble with the LED or keypad. • Clean the LED.	

Note: Periodic inspections should be performed every one or two years. The drive, however, may require more frequent inspection due to poor environments or rigorous use.

7.3 Periodic Maintenance

The drive has various "maintenance monitors". 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 the following maintenance periods.

- Cooling Fan
- Electrolytic Capacitors (Main Circuit)
- Inrush fuse
- IGBT

◆ 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	10 years
Electrolytic Capacitors (Main Circuit)	10 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 40° C • Load factor: 80% maximum • Operation time: 24 hours a day*

■ Performance Life 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 LED digital operator 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 256 for more details.

Table 7.4 Performance Life Monitors Used for Component Replacement

Parameter	Component	Contents
U4-03	Cooling Fan	Displays the accumulated operation time of the cooling fan, from 0 to 99999 hours. This value is automatically reset to 0 once it reaches 999999.
U4-04		Displays the accumulated cooling fan operation time as a percentage of the specified maintenance period (displayed in percent %).
U4-05	Main Circuit (DC bus) Electrolytic 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.
U4-07	IGBT	Displays the percentage of the maintenance period reached by the IGBTs.

■ Related Drive Parameters

Table 7.5 Maintenance Parameter Settings

Parameter	Parameter Name	Control Mode		
	Operator Display	V/f	Open Loop Vector	Open Loop Vector for PM
o4-03	Cooling Fan Maintenance Setting (Operation Time)	A	A	A
o4-05	Capacitor Maintenance Setting	A	A	A
o4-07	Inrush Prevention Relay (pre-charge) Maintenance Setting	A	A	A
o4-09	IGBT Maintenance Setting	A	A	A

NOTICE: *After replacing parts, reset the appropriate maintenance parameters (o4-03, o4-05, o4-07, and o4-09) to 0. If these parameters are not reset, the function will continue to count down the performance life of the new replaced components.*

7.4 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 your Yaskawa representative or supplier to order replacement cooling fans as required.

Some drive models have multiple cooling fans.

For drives with multiple cooling fans, replace all the fans when performing maintenance to ensure maximum useful product life.

◆ Cooling Fan Replacement

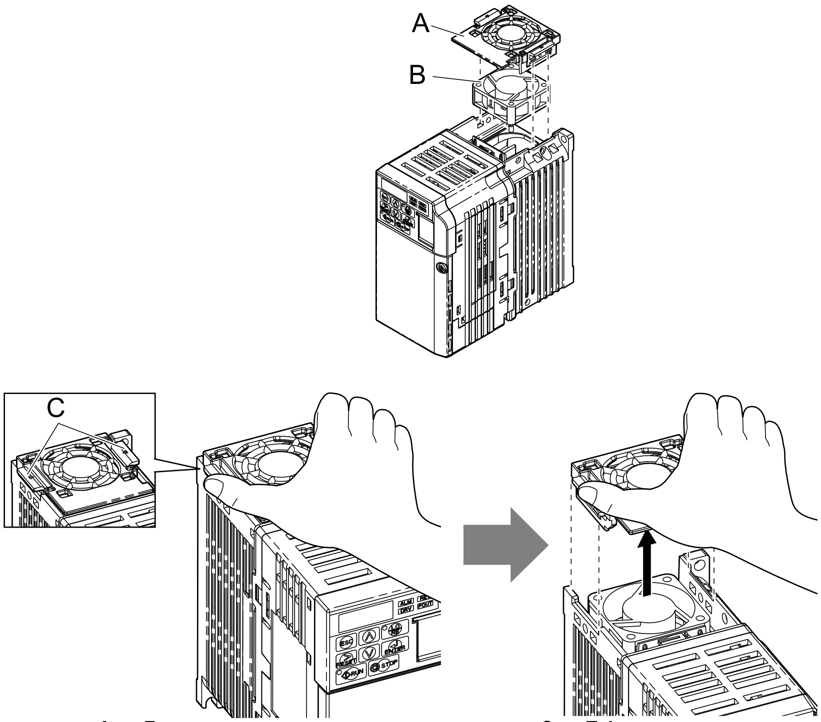
The cooling fan is installed on the top of the drive. The cooling fan can easily be replaced without tools or removal of the drive or enclosure parts.

WARNING! *Electrical Shock Hazard. Do not connect or disconnect wiring while the power is on. Failure to comply can result in serious personal injury. Before servicing the drive, disconnect all power to the equipment. The internal capacitor remains charged even after the power supply is turned off. The charge indicator LED will extinguish when the DC bus voltage is below 50 Vdc. To prevent electric shock, wait at least five minutes after all indicators are OFF and measure the DC bus voltage level to confirm safe level.*

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.*

■ Removing the Cooling Fan

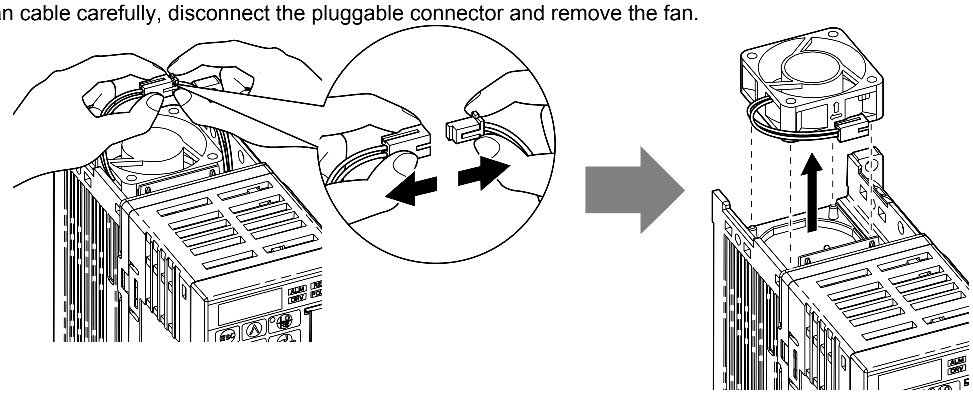
1. Depress the right and left sides of the fan cover tabs and pull upward. Remove the fan cover from the top of the drive. The figure illustrates a drive with a single cooling fan.



A – Fan cover
B – Cooling fan
C – Tab

Figure 7.1 Remove the Cooling Fan Cover

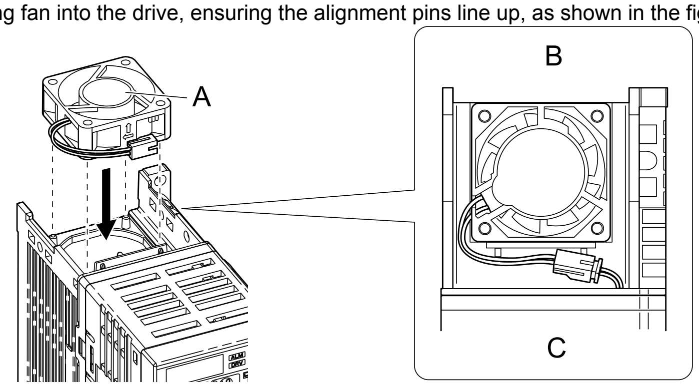
2. Remove the fan cable carefully, disconnect the pluggable connector and remove the fan.



■ Installing the Cooling Fan

NOTICE: *Prevent Equipment Damage. Follow cooling fan replacement instructions. Improper cooling fan replacement could result in the damage to equipment. When installing the replacement cooling fan into the drive, make sure the fan is facing upwards. To ensure maximum useful product life, replace all cooling fans when performing maintenance.*

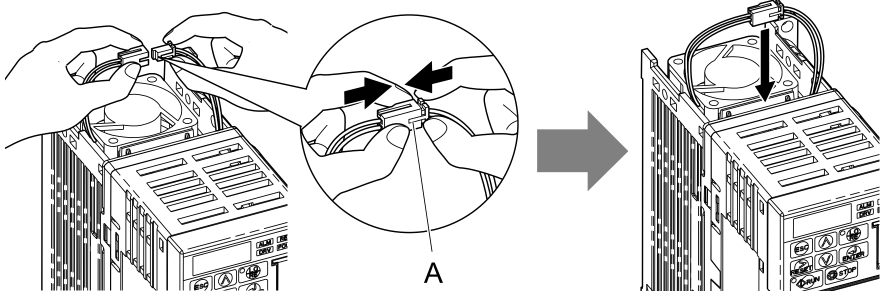
1. Install the replacement cooling fan into the drive, ensuring the alignment pins line up, as shown in the figure below:



A – Label facing up
B – Back
C – Front

Figure 7.2 Cooling Fan Orientation

2. Ensure the connectors are properly connected and place the cable back into the recess of the drive.



A – Push the connectors together so no space remains between them.

Figure 7.3 Connectors

3. Align the left and right cover tabs to install the fan cover back on the top of the drive.

Note: Ensure that the left and right tabs are locked back into place.

7.5 Drive Replacement

◆ Serviceable Parts

The drive contains few serviceable parts. The following parts are considered replacement parts on the drive:

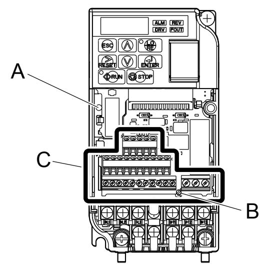
- Main control board and I/O Terminal board I/O PCBs.
- Cooling fan(s)
- Front cover

Replace the drive if the main power circuitry is damaged. Contact your local Yaskawa representative before replacing parts if the drive is still under warranty. Yaskawa reserves the right to replace or repair the drive according to Yaskawa warranty policy.

WARNING! *Electrical Shock Hazard. Do not connect or disconnect wiring while the power is on. Failure to comply can result in serious personal injury. Before servicing the drive, disconnect all power to the equipment. The internal capacitor remains charged even after the power supply is turned off. The charge indicator LED will extinguish when the DC bus voltage is below 50 Vdc. To prevent electric shock, wait at least five minutes after all indicators are OFF and measure the DC bus voltage level to confirm safe level.*

◆ Terminal Board Overview

The drive has a modular I/O terminal block that facilitates quick drive replacement. The terminal board contains on-board memory that stores all drive parameter settings and allows the parameters to be saved and transferred to the replacement drive by disconnecting the terminal board from the damaged drive then reconnecting the terminal board to the replacement drive. There is no need to manually reprogram the replacement drive.



A – Charge LED
B – Terminal Board Screw
C – Removable Terminal Board

Figure 7.4 Terminal Board

◆ Replacing the Drive

WARNING! *Electrical Shock Hazard. Never connect or disconnect wiring, remove connectors or option cards, or replace the cooling fan while the power is on. Failure to comply may result in serious injury. Before servicing, disconnect all power to the equipment. The internal capacitor remains charged even after the power supply is turned off.*

WARNING! *Electrical Shock Hazard. Do not allow unqualified personnel to perform work on the drive. Failure to comply could result in serious injury. Installation, maintenance, inspection and servicing must be performed only by authorized personnel familiar with installation, adjustment and maintenance of AC drives.*

NOTICE: *Damage to Equipment. 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.*

1. Loosen the screw on the front of the drive and remove the front cover.

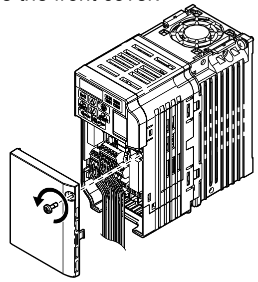


Figure 7.5 Remove Front Cover

2. Pull the pin on the ground terminal out of the removable terminal block.

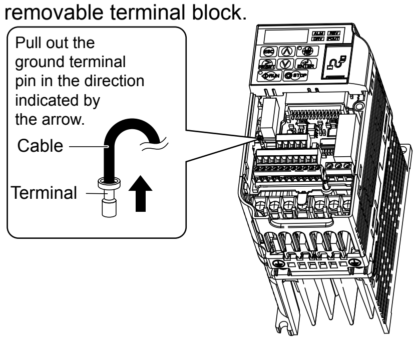


Figure 7.6 Depress Plastic Tab

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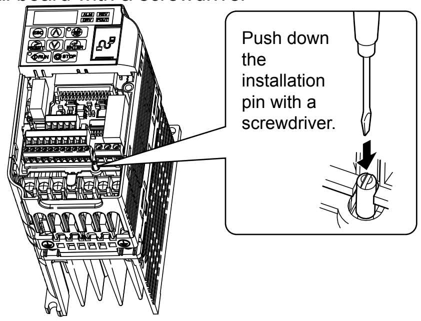
3. Push down the installation pin on the terminal board with a screwdriver



4. While holding down the installation pin from step 3, slide the removable terminal block in the direction of the arrows in *Figure 7.7* .

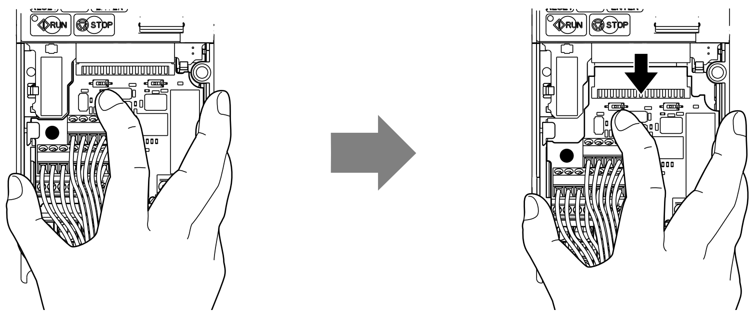


Figure 7.7 Removing the Terminal Board

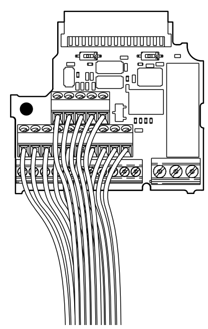


Figure 7.8 Removable Terminal Board disconnected from the drive

■ Terminal Board Replacement

1. Replace the removable terminal block on the drive according to *Figure 7.9*

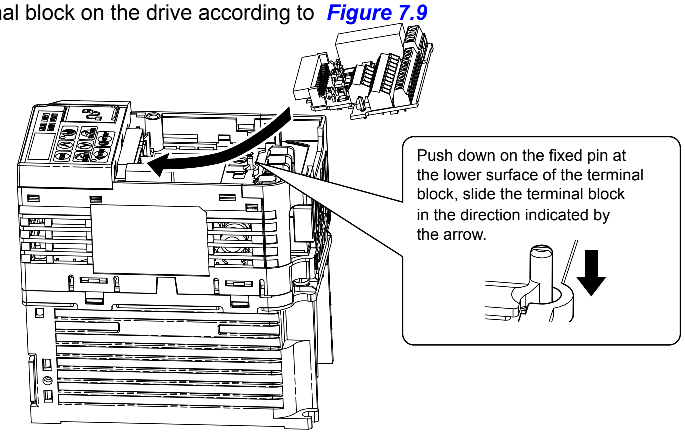


Figure 7.9 Terminal Board Replacement

2. Ensure the terminal block is firmly fastened to the connector.

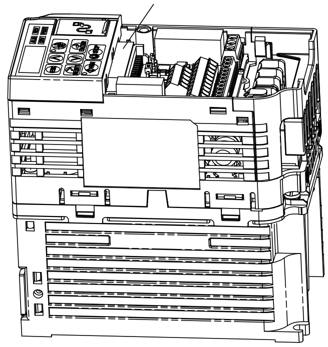


Figure 7.10 Terminal Board Installed

◆ Details on Terminal Board (TB) or Control Board (CNT) Replacement

The drive Terminal Board retains drive parameter settings to significantly improve the ease of drive replacement. Refer to *Figure 7.11* for a flowchart to assist in board replacement. When replacing the drive, or changing the Control Board or Terminal Board, the following error codes may be encountered upon application of power:

- **oPE04** Drive parameter settings need to be initialized or uploaded from the TB.
- **CPF06** Drive specification does not match the replaced drive.
- **oPE01** Drive parameter o2-04 kVA requires setting.

Procedural Notes:

1. When replacing the drive, control board or terminal board, make sure to confirm the kVA setting, parameter o2-04 is correct upon initial power-up.
2. Perform an initialization (via parameter A1-03) to obtain the desired parameter settings.
3. In cases where a previously programmed terminal board is retained, initializing the drive with a setting of A1-03 = 5550 may be desired to program the drive with previously programmed settings (settings used prior to replacing the drive or control board).

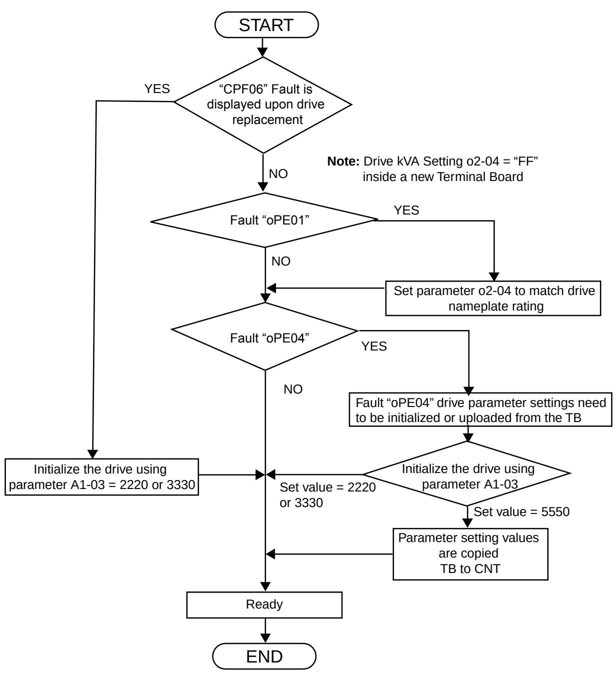


Figure 7.11 Troubleshooting Terminal Board or Control Board Replacement

Periodic Inspection & Maintenance

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8

Peripheral Devices & Options

This chapter explains the installation of available peripheral devices and options for the drive.

8.1 Section Safety

DANGER

Electrical Shock Hazard

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

Failure to comply will result in death or serious injury.

Disconnect all power to the drive, wait at least five minutes after all indicators are off, measure the DC bus voltage to confirm safe level, and check for unsafe voltages before servicing to prevent electric shock. 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.

WARNING

Electrical Shock Hazard

Do not operate equipment with covers removed.

Failure to comply could result in death or serious injury.

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

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

Failure to comply could result in death or serious injury.

WARNING

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. The charge indicator LED will extinguish when the DC bus voltage is below 50 Vdc. To prevent electric shock, wait at least five minutes after all indicators are off and measure the DC bus voltage level to confirm safe level.

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.

Always ground the motor-side grounding terminal.

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

WARNING

Do not change wiring or remove option cards while power is running through the drive.

Failure to comply could result in death or serious injury.

Disconnect all power to the drive and check for unsafe voltages before servicing.

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.

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.

8.2 Peripheral Devices

The following table of peripheral devices lists the names of the various devices/options available for Yaskawa drives. Contact Yaskawa or your Yaskawa agent to order these peripheral devices.

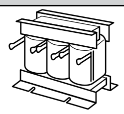
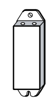
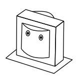
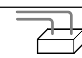
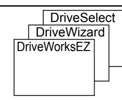
- **Peripheral Device Selection**: Refer to Yaskawa catalog for EMC filter selection and part numbers.
- **Peripheral Device Installation**: Refer to option manual for option installation instructions.

Table 8.1 Available Peripheral Devices

Name	Name
Surge Protector	DIN Rail Attachments
DC Reactor	NEMA Type 1 Kit
AC Reactor	DriveWizard
Single-Phase 200 V Reactor	Connection Cable for Engineering Tools
Braking Resistor	DriveWorksEZ
Heatsink External Mounting Attachment (Side-by-Side)	

The following table lists some of the available peripheral devices found in the previous table along with a picture of the device to help identify and describe situations that may require each device.

Table 8.2 Specific Peripheral Devices and Purposes

Device		Purpose	Device		Purpose
	AC Reactor	Protects the drive when the power supply is too large. Required for power supplies greater than 600 kVA.		Braking resistor	For uses requiring dynamic braking.
	DC Reactor	Harmonic suppression.		Surge protector	Suppresses surge voltage.
		Improves the power factor of the power supply.		Software Engineering Tools	Software for selecting drive capacity, customizing and programming the drive.

8.3 Connecting Peripheral Devices

Figure 8.1 illustrates how the drive and motor connect together with various peripheral devices.

- Refer to peripheral device option manual for detailed installation instructions.

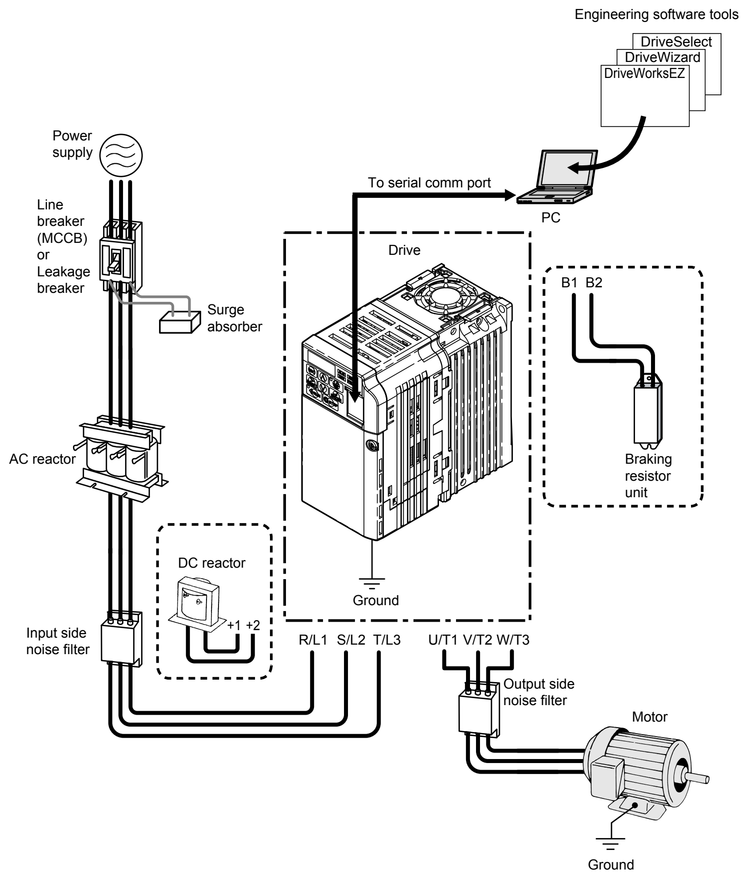


Figure 8.1 Connecting Peripheral Devices

8.4 Installing Peripheral Devices

This section describes the proper steps and precautions to take when installing or connecting various peripheral devices to the drive.

- Refer to peripheral device manual for detailed installation instructions.

NOTICE: *Use a class 2 power supply (UL standard) when connecting to the control terminals. Improper application of peripheral devices could result in drive performance degradation due to improper power supply.*

◆ Installing a Molded Case Circuit Breaker (MCCB)

Install an MCCB for line protection between the power supply and the main circuit power supply input terminals R/L1, S/L2 and T/L3. This protects the main circuit and devices wired to the main circuit while also providing overload protection.

Consider the following when selecting and installing an MCCB:

- The capacity of the MCCB should be 1.5 to 2 times the rated output current of the drive. Use an MCCB keep the drive from faulting out instead of using overheat protection (150% for one minute at the rated output current).
- If several drives are connected to one MCCB or an MCCB is shared with other equipment, use a sequence that shuts the power OFF when errors are output by using magnetic contactor (MC) as shown the following figure.
- Install a 400/200 V transformer when using a 400 V class power supply input.

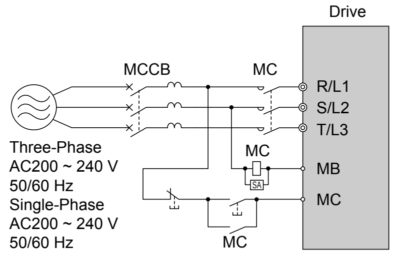


Figure 8.2 Connecting an MCCB (for Three-Phase 200 V Class)

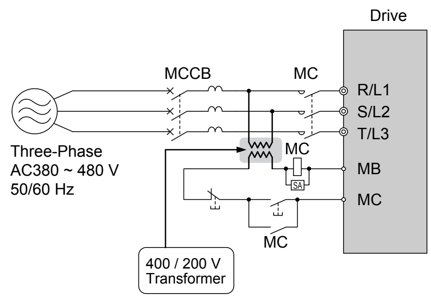


Figure 8.3 Connecting an MCCB (for Three-Phase 400 V Class)

WARNING! *Electrical Shock Hazard. Disconnect the MCCB and MC before wiring terminals. Failure to comply may result in serious injury or death.*

◆ Installing a Leakage Breaker

Drive outputs generate high-frequency leakage current as a result of high-speed switching. Install a Ground Fault Circuit Interrupter (GFCI) on the input side of the drive to switch off potentially harmful leakage current.

Factors in determining leakage current:

- Size of the AC drive
- AC drive carrier frequency
- Motor cable type and length
- EMI/RFI filter

In order to safely protect the drive system, select a breaker that senses all types of current (AC and DC) and high frequency currents

Note: Choose a GFCI designed specifically for an AC drive. The operation time should be at least 0.1 second with sensitivity amperage of at least 200 mA per drive. The output waveform of the drive may cause the leakage current to increase. This may, in turn, cause the leakage breaker to malfunction. Take the following steps to correct the problem:
• Increase the sensitivity amperage.
• Lower the carrier frequency.

◆ Installing a Magnetic Contactor

■ Disconnecting the Power Supply

The drive can be shut off in the case of a fault in external equipment such as braking resistors through use of a Magnetic Contactor (MC).

NOTICE: *Install the MC on the input side of the drive when the drive should not automatically restart after power loss. To get the full performance life out of the electrolytic capacitors and circuit relays, refrain from switching the MC more than once every 30 minutes. Frequent use can damage the drive. Use the drive to stop and start the motor.*

■ Protecting the Braking Resistor or Braking Resistor Unit

Use an MC on the input side of the drive to protect a braking resistor or braking resistor unit from overheat or fire.

WARNING! *Fire Hazard. When using a braking unit, use a thermal relay on the braking resistors and configure a fault contact output for the braking resistor unit to disconnect drive main power via an input contactor. Inadequate braking circuit protection could result in death or serious injury by fire from overheating resistors.*

◆ Connecting an AC or DC Reactor

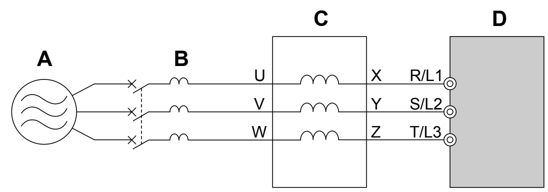
AC and DC reactors suppress surges in current and improve the power factor on the input side of the drive.

To better suppress harmonic current, use an AC reactor and DC reactor together.

Use a DC reactor or AC reactor or both:
- To suppress harmonic current or improve the power factor of the power supply.
- When using an advancing capacitor switch.
- With a large capacity power supply transformer (over 600 kVA).

Note: Use an AC or DC reactor when also connecting a thyristor converter (such as a DC drive) to the same power supply system, regardless of the conditions of the power supply.

■ Connecting an AC Reactor

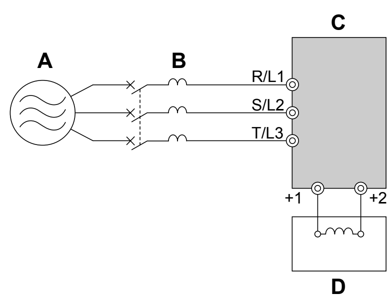


A – Power supply
B – MCCB
C – AC reactor
D – Drive

Figure 8.4 Connecting an AC Reactor

■ Connecting a DC Reactor

Ensure the jumper between terminals +1 and +2 (terminals are jumpered for shipment) is removed when connecting a DC reactor. The jumper must be installed if no DC reactor is used. Refer to ***Figure 8.5*** for an example of DC reactor wiring.



A – Power supply
B – MCCB
C – Drive
D – DC reactor

Figure 8.5 Connecting a DC Reactor

◆ Connecting a Surge Protector

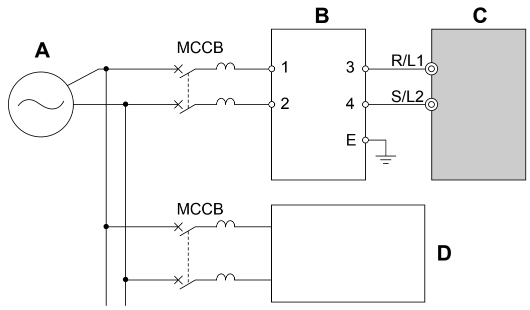
A surge protector suppresses surge voltage generated from switching an inductive load near the drive. Inductive loads include magnetic contactors, relays, valves, solenoids and brakes. Always use a surge protector or diode when operating with an inductive load.

Note: Never connect a surge protector to the drive output.

◆ Connecting a Noise Filter

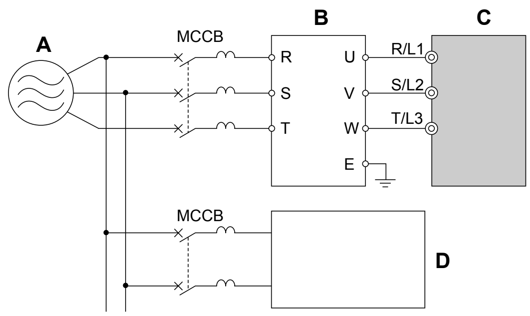
■ Input-Side Noise Filter

Drive outputs generate noise as a result of high-speed switching. This noise flows from inside the drive back toward the power supply, possible affecting other equipment. Installing a noise filter to the input side of the drive can reduce the amount of noise flowing back into the power supply. This also prevents noise from entering the drive from the power supply.
- Use a noise filter specifically designed for AC drives.
- Install the noise filter as close as possible to the drive.



A – Power supply
B – Input-side noise filter Model: LNFD-□□
C – Drive
D – Other control device

Figure 8.6 Input-Side Noise Filter (Single-Phase 200 V)



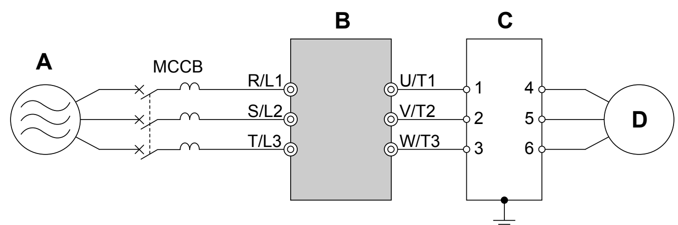
A – Power supply
B – Input-side noise filter Model: LNFD-□□
C – Drive
D – Other control device

Figure 8.7 Input-Side Noise Filter (Three-Phase 200/400 V)

■ Output-Side Noise Filter

A noise filter on the output side of the drive reduces inductive noise and radiated noise. *Figure 8.8* illustrates an example of output-side noise filter wiring.

NOTICE: *Do not connect phase-advancing capacitors or LC/RC noise filters to the output circuits. Improper application of noise filters could result in damage to the drive.*



A – Power supply
B – Drive
C – Output-side noise filter
D – Motor

Figure 8.8 Output-Side Noise Filter

TERMS

Radiated noise:

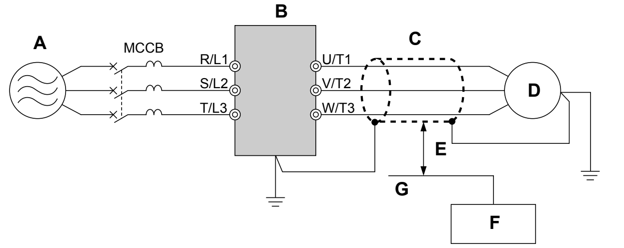
- Electromagnetic waves radiated from the drive and cables create noise throughout the radio bandwidth that can affect devices.

Induced noise:

- Noise generated by electromagnetic induction can affect the signal line and may cause the controller to malfunction.

Preventing Induced Noise

Use a noise filter on the output side or use shielded cables. Lay the cables at least 30 cm away from the signal line to prevent induced noise.



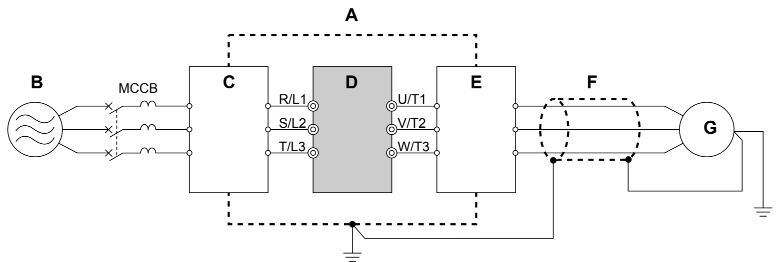
A – Power supply
B – Drive
C – Shielded motor cable
D – Motor
E – Separate at least 30 cm
F – Controller
G – Signal line

Figure 8.9 Preventing Induced Noise

Reducing Radiated/Radio Frequency Noise

The drive, input lines, and output lines generate radio frequency noise. Use noise filters on input and output sides and install the drive in a metal enclosure panel to reduce radio frequency noise.

Note: The cable running between the drive and motor should be as short as possible.



A – Metal enclosure
B – Power supply
C – Noise filter
D – Drive
E – Noise filter
F – Shielded motor cable
G – Motor

Figure 8.10 Reducing Radio Frequency Noise

◆ EMC Filter Installation

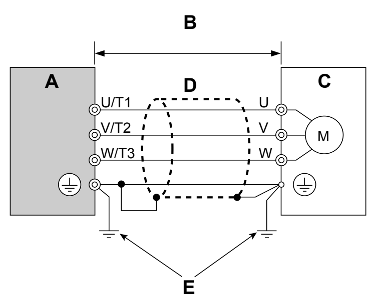
This drive is tested according to European standards EN61800-3 and it complies with the EMC guidelines. The following conditions must be met to ensure continued compliance with guidelines.

- **EMC Filter Selection**: Refer to Yaskawa catalog for EMC filter selection and part numbers.
- **EMC Filter Installation**: Refer to option manual for option installation instructions.

■ Installation Method

Verify the following installation conditions to ensure that other devices and machinery used in combination with this drive also comply with EMC guidelines.

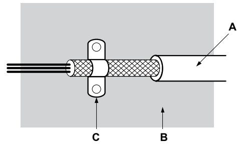
1. Install an EMC noise filter to the input side specified by Yaskawa for compliance with European standards.
2. Place the drive and EMC noise filter in the same enclosure.
3. Use braided shield cable for the drive and motor wiring or run the wiring through a metal conduit.
4. Keep wiring as short as possible. Ground the shield on both the drive side and the motor side (*Figure 8.11*).



A – Drive
B – 20 m max cable length between drive and motor
C – Motor
D – Metal conduit
E – Ground wire should be as short as possible.

Figure 8.11 Installation Method

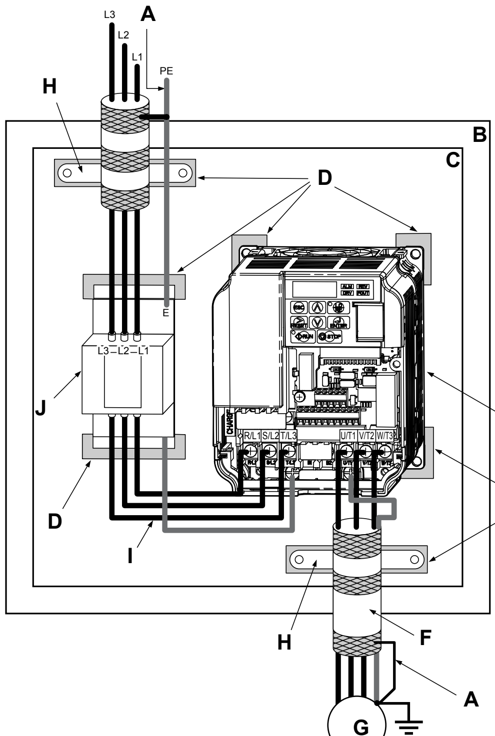
5. Ground the largest possible surface area of the shield to the metal conduit when using braided shield cable. Yaskawa recommends using a cable clamp (*Figure 8.12*).



A – Braided shield cable
B – Metal panel
C – Cable clamp (conductive)

Figure 8.12 Ground Area

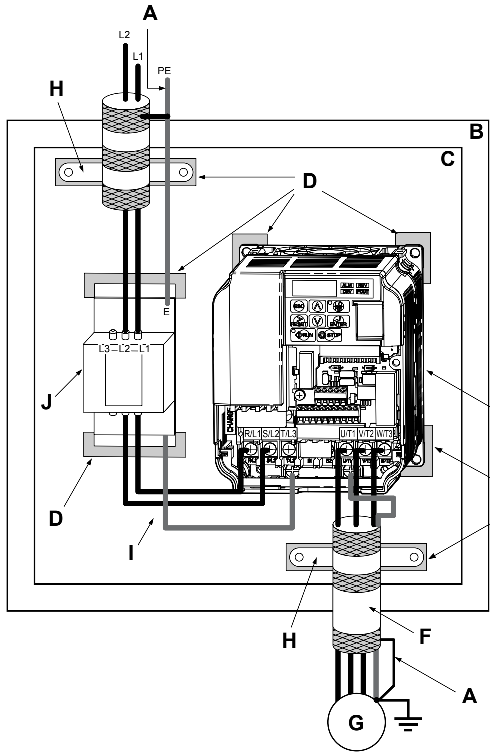
Three-Phase 200 V / 400 V Class



A – Ground the cable shield
B – Enclosure panel
C – Metal plate
D – Grounding surface (remove any paint or sealant)
E – Drive
F – Motor cable (braided shield cable, max. 20 m)
G – Motor
H – Cable clamp
I – Max. distance between drive and noise filter
J – EMC noise filter

Figure 8.13 EMC Filter and Drive Installation for CE Compliance (Three-Phase 200 V / 400 V Class)

Single-Phase 200 V Class



A – Ground the cable shield
B – Enclosure panel
C – Metal plate
D – Grounding surface (remove any paint or sealant)
E – Drive
F – Motor cable (braided shield cable, max. 20 m)
G – Motor
H – Cable clamp
I – Max. distance between drive and noise filter
J – EMC noise filter

Figure 8.14 EMC Filter and Drive Installation for CE Compliance (Single-Phase 200 V Class)

◆ Installing a Motor Thermal Overload (OL) Relay on the Drive Output

Motor thermal overload relays protect the motor by disconnecting power lines to the motor due to a motor overload condition.

Install a motor thermal overload relay between the drive and motor:
- When operating multiple motors on a single AC drive.
- When using a power line bypass to operate the motor directly from the power line.

It is not necessary to install a motor thermal overload relay when operating a single motor from a single AC drive. The AC drive has UL recognized electronic motor overload protection built into the drive software.

Note: Disable the motor protection function (L1-0 1 = “0”) when using an external motor thermal overload relay. The relay should shut off main power on the input side of the main circuit when triggered.

Special application precautions should be considered when using motor thermal overload relays on the output of AC drives. The following may occur if a motor thermal OL relay is connected to the output of an AC drive (between the drive and the motor) when the carrier frequency is high and the wiring between the motor and the drive is long:
- Thermal relay nuisance trips occur.
- The thermal relay may be damaged due to excessive heat loss.

Some considerations involving AC drives and use of thermal overload relays:

1. Low speed motor operation
2. Use of multiple motors on a single AC drive
3. Motor cable length greater than 50 meters (164 feet)
4. Voltage boost and high torque V/f pattern settings
5. Nuisance tripping resulting from high AC drive carrier frequency

■ General Precautions to Prevent Tripping of Motor Thermal Overload Relays

Low Speed Operation and Motor Thermal OL Relays

Generally, thermal relays are applied on general-purpose motors. When general-purpose motors are driven by AC drives, the motor current is approximately 5 ~ 10% greater than if driven by the commercial power supply. In addition, the cooling capacity of a motor with a shaft-driven fan decreases when operating at low speeds. Even if the load current is within the motor rated value, motor overheating may occur. A thermal relay cannot effectively protect the motor due to the reduction of cooling at low speeds. For this reason, apply the UL-recognized electronic thermal overload protection function built into the drive whenever possible.

UL recognized electronic thermal overload function of the drive: Speed-dependent heat characteristics are simulated using data from standard motors and force-ventilated motors. The motor is protected from overload using this function.

Using One Drive with Multiple Motors

Turn off the electronic thermal overload function. Please refer to the appropriate product instruction manual to determine which parameter disables this function.

The UL recognized electronic thermal overload function of the drive cannot be applied when using multiple motors on one drive. The electronic thermal function is calculated using the output current of the drive. Individual motor currents cannot be determined using the output current of the drive. Therefore, a thermal relay is required for each motor connected to the drive.

Wiring Length Greater Than 50 meters (164 feet)

When motor wiring is longer than 164 feet (50 meters), nuisance tripping of the thermal relay may occur if a high carrier frequency is used. Due to increased high frequency leakage current the thermal relay element may overheat due to surface skin effect. Therefore, reduce the carrier frequency.

The following should be considered for long motor cable length applications:

1. For a single motor drive, use the electronic thermal overload function of the drive (thermal relay not required).

2. For multiple motor drives:

Lower the carrier frequency according to *Figure 8.15* or correct the motor thermal OL relay adjustment according to *Table 8.3* .

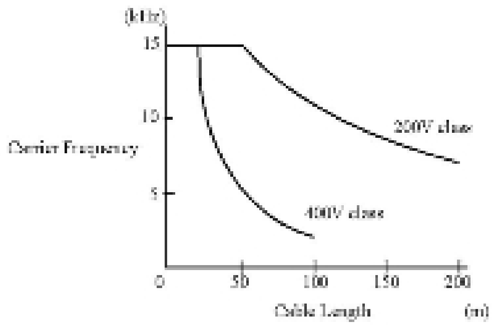


Figure 8.15 Criteria for Setting Carrier Frequency

Voltage Boost and High Torque V/f Pattern Settings

The V/f pattern and voltage boost settings may impact motor heating. Improperly adjusted V/f patterns or torque compensation settings may cause over-excitation of the motor, resulting in additional motor heating. Unintentional triggering of the overload device may also occur. Therefore, do not use high starting torque V/f patterns or use excessive voltage boost settings unless absolutely necessary.

Correcting Nuisance Tripping Resulting from High AC Drive Carrier Frequency

Thermal overload element heating is influenced by carrier frequency and lead length. Current waveforms generated by PWM drives tend to create additional temperature rise in overload relays. Therefore, it may be necessary to increase the trip level setting by the factors listed in *Table 8.3* when encountering nuisance triggering of the relay. Confirm an actual overload condition is not present prior to increasing the trigger level.

WARNING! *Risk of Fire. Confirm an actual motor overload condition is not present prior to increasing the thermal OL trip setting. Check local electrical codes before making adjustments to motor thermal overload settings.*

Example: A thermal OL relay with an adjustment range of 1.1 to 1.6 A is used with a drive working with 8 kHz carrier frequency. The motor rated current is 1.2 A. The overload trip level may be corrected to: 1.2 A x 1.21 = 1.45 A

Table 8.3 shows recommended correction factors for the motor protection device trigger level based on adjustment range and carrier frequency of the drive.

Table 8.3 Motor Protection Device Correction Factors

Adjustment Range / Rated Current	Drive Carrier Frequency Setting (KHz)							
	2	4	6	8	10	12	14	16
3.2 to 50 A	1.07	1.12	1.16	1.18	1.19	1.21	1.22	1.23
0.5 to 2.5 A	1.08	1.13	1.17	1.21	1.24	1.26	1.28	1.29
0.32 to 0.4 A	1.09	1.15	1.21	1.25	1.29	1.33	1.35	1.37
0.16 to 0.25 A	1.10	1.17	1.24	1.28	1.33	1.38	1.42	1.46

System Component Compatibility

Thoroughly review the application requirements to ensure compatibility of the selected components (motor, speed range, application speed-torque requirements).

8.5 Communication Options

Table 8.4 gives detailed information about the available option cards that allow Yaskawa drives to connect to various communications networks. Consult the table to determine which option cards may be necessary for a given environment. Contact Yaskawa or your Yaskawa agent to order option cards.

- **Option Card Selection**: Refer to Yaskawa catalog for option card selection and part numbers.
- **Option Card Installation**: Refer to option card manual for option card installation instructions.

Table 8.4 Available Option Cards

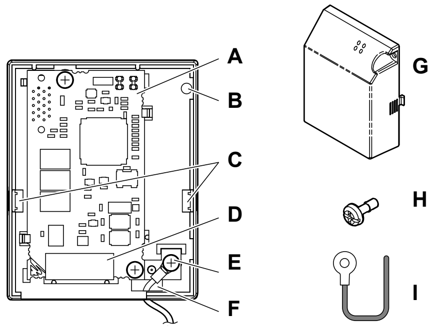
Option Card	Model	Function	Manual
CC-Link	SI-C3/V	Allows the drive to connect to a CC-Link network. A host controller starts and stops the drive and allows the user to edit and reference parameter settings (output frequency, output current, etc.) over the network.	Contact Yaskawa

8.6 Connecting an Option Card

The drive can communicate with other devices through a specially designed option card. The following section describes how to install an option card. Refer to option card manual for detailed installation instructions.

Note: *Refer to Available Option Cards on page 276* for a list of option cards for use with this product.

◆ Verifying Option Card and Product Type



A – Option card
B – Option card cover installation screw holes
C – Tabs for mounting front cover
D – Comm. connector (CN1)
E – Ground lead connection
F – Wire through-hole
G – Option card cover
H – Cover screw
I – Ground lead

Figure 8.16 Option Card

◆ Connecting the Option Card

1. Loosen the screw on the front cover of the drive to remove the cover.

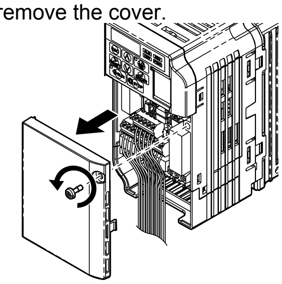
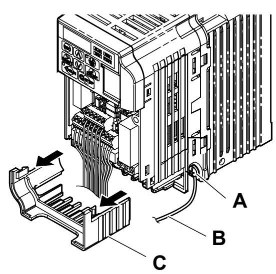


Figure 8.17 Remove Cover

2. Remove the terminal cover. Connect the lead from the option card to the drive ground terminal.



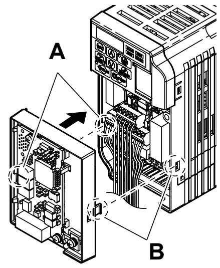
A – Ground terminal
B – Ground lead
C – Terminal cover

Figure 8.18 Connect Lead

3. Reattach the terminal cover.
4. Attach the option card to the drive.

Peripheral Devices & Options

8



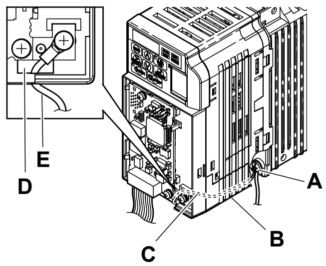
A – Line up the tab with the mounting hole. **B – Line up the tab with the mounting hole.**

Figure 8.19 Attach Option Card

Note: Gently pack wires to fit behind the left and right side of the cover into the provided recess.

5. Connect the lead from the drive ground terminal to the same terminal as the option card lead.

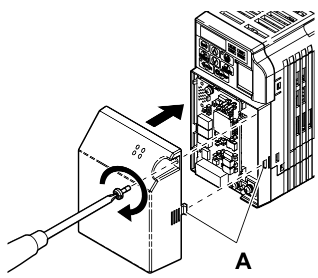
The option card lead should exit through the holes provided on the underside of the drive as it gets routed passed the ground terminal.



A – Drive ground terminal
B – Route the lead wire on the inside of the lower cover.
C – Ground lead
D – Ground lead through-hole
E – Ground lead

Figure 8.20 Lead Wire Connection

6. Reattach the option card cover.



A – Align the tab with the mounting hole.

Figure 8.21 Reattach Cover

Appendix: A

Specifications

A.1 Heavy Duty and Normal Duty Ratings

The capacity of the drive is based on two types of load characteristics: Heavy Duty (HD) and Normal Duty (ND).

Refer to *Table A.1* for the differences between HD and ND. Specifications for capacity ratings appear are listed on the following pages.

Table A.1 Selecting the Appropriate Load Rating

Setting Parameter C6-01	Rated Output Current	Overload Tolerance	Carrier Frequency
0: Heavy Duty	HD Rating (varies by model <1>)	150% rated output current for 60 s	2-15 kHz (varies by model)
1: Normal Duty (default)	ND Rating (varies by model <1>)	120% rated output current for 60 s (varies by model <1>)	2 kHz, Swing PWM

<1> The following pages list information on rating changes based on drive model.

TERMS

HD and ND

- HD refers to applications requiring constant torque output, while ND refers to applications with variable torque needs.
- The drive allows the user to select HD or ND torque depending on the application. Fans, pumps, and blowers should use ND (C6-01 = “1”), and other applications generally use HD (C6-01 = “0”).

Swing PWM

- Swing PWM equivalent to a 2 kHz audible noise. This function turns the motor noise into a less obtrusive white noise.

Note: Differences between HD ratings and ND ratings for the drive include rated input and output current, overload capacity, carrier frequency, and current limit. The default setting is for ND (C6-01=1).

A.2 Single/Three-Phase 200 V Class Drive

Table A.2 Power Ratings

Item				Specification						
Three-Phase: CIMR-V□2A				0001	0002	0004	0006	0010	0012	0020
Single-Phase: CIMR-V□BA <1>				0001	0002	0003	0006	0010	0012	0018
Maximum Motor Size Allowed (HP) <2>			ND Rating	0.13	0.25	0.5/0.75	1.0/1.5	2.0/3.0	3.0	5.5 <8>
			HD Rating	0.13	0.25	0.5/0.75	0.75/1.0	1.5/2.0	3.0	3.7
Input	Input Current (A) <3>	Three Phase	ND Rating	1.1	1.9	3.9	7.3	10.8	13.9	24.0
			HD Rating	0.7	1.5	2.9	5.8	7.5	11.0	18.9
		Single Phase	ND Rating	2.0	3.6	7.3	13.8	20.2	24.0	–
			HD Rating	1.4	2.8	5.5	11.0	14.1	20.6	35.0
Output	Rated Output Capacity (kVA) <4>		ND Rating	0.5	0.7	1.3	2.3	3.7	4.6	7.5
			HD Rating	0.3	0.6	1.1	1.9	3.0	4.2	6.7
	Output Current (A)		ND Rating <5>	1.2	1.9	3.5 (3.3)	6.0	9.6	12.0	19.6
			HD Rating	0.8 <6>	1.6 <6>	3.0 <6>	5.0 <6>	8. <7>	11.0 <7>	17.5 <7>
	Overload Tolerance			ND Rating: 120% of rated output current for 1 minute HD Rating: 150% of rated output current for 1 minute (Derating may be required for applications that start and stop frequently)						
	Carrier Frequency			2 kHz (user-set, 2 to 15 kHz)						
	Max Output Voltage (V)			Three-phase power: Three-phase 200 to 240 V Single-phase power: Three-phase 200 to 240 V (both proportional to input voltage)						
	Max Output Frequency (Hz)			400 Hz (user-adjustable)						
Power Supply	Rated Voltage Rated Frequency			Three-phase power: Three-phase 200 to 240 V 50/60 Hz Single-phase power: 200 to 240 V 50/60 Hz						
	Allowable Voltage Fluctuation			-15 to 10%						
	Allowable Frequency Fluctuation			±5%						
Harmonic Countermeasures		DC Reactor		Optional						
Heat Generation (W)		ThreePhase	ND Rating	13.0	17.1	29.4	44.7	77.5	91.7	145.0
			HD Rating	11.6	16.7	27.6	43.3	78.6	100.7	153.8
		SinglePhase	ND Rating	13.5	17.3	29.0	49.5	81.5	98.4	–
			HD Rating	11.7	16.8	27.6	50.5	80.7	104.8	161.9

<1> Drives with single-phase power supply inputs output three-phase power, and cannot run a single-phase motor.
<2> The motor capacity (HP) refers to a NEC rated 4-pole motor. The rated output current of the drive output amps should be equal to or greater than the motor rated current.
<3> Input current rating varies depending on the power supply transformer, input reactor, wiring connections, and power supply impedance.
<4> Rated motor capacity is calculated with a rated output voltage of 230 V.
<5> Carrier frequency is set to 2 kHz. Current derating is required in order to raise the carrier frequency.
<6> Carrier frequency is set to 10 kHz. Current derating is required in order to raise the carrier frequency.
<7> Carrier frequency is set to 8 kHz. Current derating is required in order to raise the carrier frequency.
<8> CIMR-V□BA0020 only. CIMR-V□BA0018 is available with a Heavy Duty rating only.

Table A.3 Power Ratings Continued

Item				Specification			
Three-Phase: CIMR-V□2A				0030	0040	0056	0069
Single-Phase: CIMR-V□BA <1>				-	-	-	-
Maximum Motor Size Allowed (HP) <2>			ND Rating	10.1	14.8	20.1	24.8
			HD Rating	7.4	10.1	14.8	20.1
Input	Input Current (A) <3>	Three-Phase	ND Rating	34.7	50.9	69.4	85.6
			HD Rating	26.0	35.4	51.9	70.8
		Single-Phase	ND Rating	-	-	-	-
			HD Rating	-	-	-	-
Output	Rated Output Capacity (kVA) <4>		ND Rating	11.4	15.2	21.3	26.3
			HD Rating	9.5	12.6	17.9	22.9
	Output Current (A)		ND Rating <5>	30.0	40.0	56.0	69.0
			HD Rating	25.0 <7>	33.0 <7>	47. <7>	60.0 <7>
	Overload Tolerance			ND Rating: 120% of rated output current for 1 minute HD Rating: 150% of rated output current for 1 minute (Derating may be required for applications that start and stop frequently)			
	Carrier Frequency			2 kHz (user-set, 2 to 15 kHz)			
	Max Output Voltage (V)			Three-phase power: Three-phase 200 to 240 V Single-phase power: Three-phase 200 to 240 V (both proportional to input voltage)			
	Max Output Frequency (Hz)			400 Hz (user-adjustable)			
Power Supply	Rated Voltage Rated Frequency			Three-phase power: Three-phase 200 to 240 V 50/60 Hz Single-phase power: 200 to 240 V 50/60 Hz			
	Allowable Voltage Fluctuation			-15 to 10%			
	Allowable Frequency Fluctuation			±5%			
Harmonic Countermeasures	DC Reactor			Optional			

Item			Specification			
Three-Phase: CIMR-V☐2A			0030	0040	0056	0069
Single-Phase: CIMR-V☐BA <1>			-	-	-	-
Heat Generation (W)	Three Phase	ND Rating	-	-	-	-
		HD Rating	335.3	379.5	509.7	646.2
	Single Phase	ND Rating	303.7	321.3	465.2	589.1
		HD Rating	-	-	-	-

<1> Drives with single-phase power supply inputs output three-phase power, and cannot run a single-phase motor.
<2> The motor capacity (kW) refers to a Yaskawa 4-pole motor. The rated output current of the drive output amps should be equal to or greater than the motor rated current.
<3> Input current rating varies depending on the power supply transformer, input reactor, wiring connections, and power supply impedance.
<4> Rated motor capacity is calculated with a rated output voltage of 220 V.
<5> Carrier frequency is set to 2 kHz. Current derating is required in order to raise the carrier frequency.
<7> Carrier frequency is set to 8 kHz. Current derating is required in order to raise the carrier frequency.

Note: Differences between HD ratings and ND ratings for the drive include rated input and output current, overload capacity, carrier frequency, current limit, and maximum output frequency. Set parameter C6-01 to “O” for HD or “1” for ND (default).

A.3 Three-Phase 400 V Class Drives

Table A.4 Power Ratings

Item			Specification						
CIMR-V□4A			0001	0002	0004	0005	0007	0009	0011
Maximum Applicable Motor Capacity (HP) <1>		ND Rating	0.25	0.5/0.75/1.0	1.5/2.0	3.0	3.0	5.0	7.5
		HD Rating	0.25	0.5/0.75	1.0/1.5/2.0	3.0	3.0	5.0	5.0
Input	Input Current (A) <2>	ND Rating	1.2	2.1	4.3	5.9	8.1	9.4	14.0
		HD Rating	1.2	1.8	3.2	4.4	6.0	8.2	10.4
Output	Output Current (kVA) <3>	ND Rating <4>	0.9	1.6	3.1	4.1	5.3	6.7	8.5
		HD Rating <5>	0.9	1.4	2.6	3.7	4.2	5.5	7.0
	Output Current (A)	ND Rating <4>	1.2	2.1	4.1	5.4	6.9	8.8	11.1
		HD Rating <5>	1.2	1.8	3.4	4.8	5.5	7.2	9.2
	Overload Tolerance		ND Rating: 120% of rated output current for 60 s HD Rating: 150% of rated output current for 60 s (Derating may be required for applications that start and stop frequently)						
	Carrier Frequency <3>		2 kHz (user-adjustable from 2 to 15 kHz)						
	Maximum Output Voltage (V)		Three-phase: @380 to 480 V (proportional to input voltage)						
	Maximum Output Frequency (Hz)		400 Hz (user-adjustable)						
Power Supply	Rated Voltage Rated Frequency		Three-phase: 380 to 480 V 50/60 Hz						
	Allowable Voltage Fluctuation		-15 to 10%						
	Allowable Frequency Fluctuation		±5%						
Harmonic Countermeasures		DC Reactor	Optional						
Heat Generation (W)		ND Rating	19.6	32.4	47.3	66.3	87.0	95.1	127.7
		HD Rating	30.6	43.8	60.2	96.9	111.7	117.5	148.7

<1> The motor capacity (HP) refers to a NEC 4-pole motor. The rated output current of the drive output amps should be equal to or greater than the motor rated current.
<2> Input current rating varies depending on the power supply transformer, input reactor, wiring conditions, and power supply impedance.
<3> Rated motor capacity is calculated with a rated output voltage of 460 V.
<4> Carrier frequency is set to 2 kHz. Current derating is required in order to raise the carrier frequency.
<5> Carrier frequency is set to 8 kHz. Current derating is required in order to raise the carrier frequency.

Table A.5 Power Ratings Continued

Item			Specification			
CIMR-V□4A			0018	0023	0031	0038
Maximum Applicable Motor Capacity (HP) <1>		ND Rating	10.1	14.8	20.1	24.8
		HD Rating	7.4	10.1	14.8	20.1
Input	Input Current (A) <2>	ND Rating	20.0	24.0	38.0	44.0
		HD Rating	15.0	20.0	29.0	39.0
Output	Output Current (kVA) <3>	ND Rating <4>	13.3	17.5	23.6	29.0
		HD Rating <5>	11.3	13.7	18.3	23.6
	Output Current (A)	ND Rating <4>	17.5	23.0	31.0	38.0
		HD Rating <5>	14.8	18.0	24.0	31.0
	Overload Tolerance		ND Rating: 120% of rated output current for 60 s HD Rating: 150% of rated output current for 60 s (Derating may be required for applications that start and stop frequently)			
	Carrier Frequency <3>		2 kHz (user-adjustable from 2 to 15 kHz)			
	Maximum Output Voltage (V)		Three-phase: @380 to 480 V (proportional to input voltage)			
	Maximum Output Frequency (Hz)		400 Hz (user-adjustable)			
Power Supply	Rated Voltage Rated Frequency		Three-phase: 380 to 480 V 50/60 Hz			
	Allowable Voltage Fluctuation		-15 to 10%			
	Allowable Frequency Fluctuation		±5%			
Harmonic Countermeasures		DC Reactor	Optional			
Heat Generation (W)		ND Rating	261.3	321.1	433.6	475.0
		HD Rating	228.7	285.2	372.8	445.7

<1> The motor capacity (kW) refers to a Yaskawa 4-pole motor. The rated output current of the drive output amps should be equal to or greater than the motor rated current.
<2> .Input current rating varies depending on the power supply transformer, input reactor, wiring conditions, and power supply impedance.
<3> Rated motor capacity is calculated with a rated output voltage of 440 V.
<4> Carrier frequency is set to 2 kHz. Current derating is required in order to raise the carrier frequency.
<5> Carrier frequency is set to 8 kHz. Current derating is required in order to raise the carrier frequency.

Note: Differences between Heavy Duty ratings and Normal Duty ratings for the drive include rated input and output current, overload capacity, carrier frequency, current limit, and maximum output frequency. Set parameter C6-01 to “0” for Heavy Duty ratings or “2” for Normal Duty ratings. The default is Normal Duty (C6-01 = 1).

A.4 Drive Specifications

Note: Perform rotational Auto-Tuning to obtain OLV performance specifications.

Note: For optimum performance life of the drive, install the drive in an environment that meets the environmental conditions.

Item		Specification
Control Characteristics	Control Method	The following control methods are available: Open Loop Vector Control (current vector), V/f Control, and PM Open Loop Vector for (for use with SPM and IPM)
	Frequency Control Range	0.01 to 400 Hz
	Frequency Accuracy	Digital input: within ±0.01% of the max output frequency (-10 to +50 °C) Analog input: within ±0.5% of the max output frequency (25°C ±10 °C)
	Frequency Setting Resolution	Digital inputs: 0.01 Hz Analog inputs: 1/1000 of maximum output frequency
	Output Frequency Resolution	1/220 of maximum output frequency
	Frequency Setting Signal	Main frequency reference: 0 to +10 Vdc (20 kΩ), 4 to 20 mA (250 Ω), 0 to 20 mA (250 Ω) Main speed reference: Pulse Train Input (max 33 kHz)
	Starting Torque	200%/0.5 Hz (Open Loop Vector Control, HD rating, IM of 3.7 kW or smaller), 50%/6 Hz (PM Open Loop Vector Control)
	Speed Control Range	1:100 (Open Loop Vector Control), 1:40 (V/f Control), 1:10 (PM Open Loop Vector Control)
	Speed Control Accuracy	0.2% in Open Loop Vector Control <1>
	Speed Response	5 Hz (20 °C ±10 °C) in Open Loop Vector Control (excludes temperature fluctuation when performing Rotational Auto-Tuning)
	Torque Limit	Open Loop Vector Control only. Adjustable in 4 quadrants.
	Accel/Decel Time	0.00 to 6000.0 s (allows four separate settings for accel and decel)
	Braking Torque	Instantaneous Average Decel Torque <2> : 0.1/0.2 kW: over 150%, 0.4/0.75 kW: over 100%, 1.5 kW: over 50%, 2.2 kW and above: over 20% Continuous Regen Torque: 20%, 125% with a Braking Resistor Unit <3> : (10% ED) 10 s with an internal braking resistor.
	V/f Characteristics	Preset V/f patterns and user-set program available.
	Drive Functions	Momentary Power Loss Ride-Thru, Speed Search, Overtorque Detection, Torque Limit, Multi-Step Speed (17 steps max), Accel/Decel Time Switch, S-Curve Accel/Decel, 3-Wire Sequence, Rotational Auto-Tuning, Stationary Auto-Tuning of Line-to-Line Resistance, Dwell, Cooling Fan ON/OFF, Slip Compensation, Torque Compensation, Frequency Jump, Frequency Reference Upper/Lower Limit, DC Injection Braking (start and stop), High Slip Braking, PID Control (with Slip Function), Energy Saving, MEMOBUS (RS-485/422 Max 115.2 kbps), Fault Reset, Parameter Copy.
Protection Functions	Motor Protection Momentary	Motor overheat protection via output current sensor
	Overcurrent Protection	Drives stops when output exceeds 200% of the rated current (Heavy Duty)
	Overload Protection	A stop command will be entered after operating at 150% for 60 s (Heavy Duty) <4>
	Low Voltage Protection	Drive stops when DC bus voltage falls below the levels indicated: <5> 190 V (3-phase 200 V), 160 V (single-phase 200 V), 380 V (3-phase 400 V), 350 V (3-phase 380 V)
	Momentary Power Loss Ride-Thru	3 selections available: Ridethru disabled (stops after 15 ms), time base of 0.5 s, and continue running until power is restored. <6>
	Heatsink Overheat Protection	Protected by thermistor
	Braking Resistor Overheat Protection	Overheat sensor for braking resistor (Optional ERF-type, 3% ED)
	Stall Prevention	Stall prevention is available during acceleration, deceleration, and during run. Separate settings for each type of stall prevention determine the current level at which stall prevention is triggered.
	Cooling Fan Failure Protection	Circuit protection (“fan-lock” sensor)
	Ground Protection	Electronic circuit protection (triggered by the same levels as momentary current protection) <7>
	DC Bus Charge LED	Remains lit until DC bus voltage falls below 50 V
Environment	Storage/Installation Area	Indoors
	Ambient Temperature	-10 to +40 °C (wall-mounted enclosure) -10 to +50 °C (open chassis)
	Humidity	95 RH% or less with no condensation
	Storage Temperature	-20 to +60 °C allowed for short-term transport of the product
	Altitude	1000 m or less
	Shock, Impact	10 to 20 Hz: 9.8 m/S 2 20 to 55 Hz: 5.9 m/S 2
	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 • harmful gases and liquids • excessive vibration • chlorides • direct sunlight
	Orientation	Install the drive vertically to maintain maximum cooling effects
Safety Regulations and Standards		UL508C, EN954-1 Cat. 3 <>
Protective Enclosure		Open chassis (IP20) Wall-mounted enclosure (NEMA Type 1): available as an option

Item	Specification
Cooling Method	CIMR-VBU0001 to 0006: self-cooled CIMR-VABU0010 to 0012: cooling fan CIMR-VA2U0001 to 0004: self-cooled CIMR-VA2U0006 to 0069: cooling fan CIMR-VA4U0001 to 0004: self-cooled CIMR-VA4U0005 to 0038: cooling fan

<1> Speed control accuracy varies somewhat according to the type of motor and drive settings. Contact Yaskawa for more information.
<2> Instantaneous average deceleration torque refers to the torque required to decelerate the motor (uncoupled from the load) from 60 Hz in the shortest time.
<3> Ensure that Stall Prevention Selection during Deceleration is disabled (L3-04 = 0) or set to 3 when using a braking resistor or the Braking Resistor Unit. The default setting for the stall prevention function will interfere with the braking resistor.
<4> Overload protection may be triggered when operating with 150% of the rated output current if the output frequency is less than 6 Hz.
<5> Parameter settings allow up to 150 V.
<6> A Momentary Power Loss Ridethru Unit is required for 200/400V class drives 7.5 kW and less if the application needs to continue running during a momentary power loss up to 2 seconds.
<7> Ground protection cannot be provided under the following circumstances when a ground fault is likely in the motor windings during run: Low ground resistance for the motor cable and terminal block; low ground resistance for the motor cable and terminal block; or the drive is powered up from a ground short.
<8> Drive output is interrupted in less than 1 ms after the safety input is activated.

A.5 Drive Watts Loss Data

Table A.6 Watts Loss 200 V Class Single-Phase Models

Drive Duty	Fc (kHz)	Model Number CIMR-V☐	Rated Amps (A)	Heatsink Loss (W)	Interior Unit Loss (W)	Total Loss (W)
HD	8	BA0001	0.8	28.7	15.5	44.2
		BA0002	1.6	38.8	21.9	60.7
		BA0003	3.0	52.0	29.5	81.5
		BA0006	5.0	80.6	43.9	124.5
		BA0010	8.0	4.7	12.5	17.2
		BA0012	11.0	7.2	13.7	20.9
		BA0020	17.5	14.0	18.6	32.6
	2	BA0001	0.8	3.0	7.1	10.1
		BA0002	1.6	6.0	8.4	14.4
		BA0003	3.0	12.6	10.6	23.2
		BA0006	5.0	28.7	15.5	44.2
		BA0010	8.0	38.8	21.9	60.7
		BA0012	11.0	52.0	29.5	81.5
		BA0020	17.5	80.6	43.9	124.5
ND	2	BA0001	1.2	4.7	12.5	17.2
		BA0002	1.9	7.2	13.7	20.9
		BA0003	3.2	14.0	18.6	32.6
		BA0006	6.0	35.6	25.6	61.2
		BA0010	9.6	48.6	34.5	83.1
		BA0012	12.0	57.9	42.6	100.5

Table A.7 Watts Loss 200 V Class Three-Phase Models

Drive Duty	Fc (kHz)	Model Number CIMR-V☐	Rated Amps (A)	Heatsink Loss (W)	Interior Unit Loss (W)	Total Loss (W)
HD	8	2A0001	0.8	4.3	7.3	11.6
		2A0002	1.6	7.9	8.8	16.7
		2A0004	3.0	16.1	11.6	27.7
		2A0006	5.0	27.4	15.9	43.3
		2A0010	8.0	54.8	23.8	78.6
		2A0012	11.0	70.7	29.9	100.6
		2A0020	17.5	110.5	43.3	153.8
	2	2A0001	0.8	3.0	7.0	10.0
		2A0002	1.6	6.0	8.3	14.3
		2A0004	3.0	12.6	10.6	23.2
		2A0006	5.0	21.1	14.3	35.4
		2A0010	8.0	38.8	19.8	58.6
		2A0012	11.0	52.0	25.3	77.3
		2A0020	17.5	80.6	35.8	116.4
ND	2	2A0001	1.2	4.7	11.9	16.6
		2A0002	1.9	7.2	13.5	20.7
		2A0004	3.5	15.1	17.7	32.8
		2A0006	6.0	26.2	21.4	47.6
		2A0010	9.6	48.6	30.5	79.1
		2A0012	12.0	57.9	35.9	93.8
		2A0020	19.6	93.3	53.0	146.3

Table A.8 Watts Loss 400 V Class Three-Phase Models

Drive Duty	Fc (kHz)	Model Number CIMR-V☐	Rated Amps (A)	Heatsink Loss (W)	Interior Unit Loss (W)	Total Loss (W)
HD	8	4A0001	1.2	19.2	11.5	30.7
		4A0002	1.8	28.9	14.8	43.7
		4A0004	3.4	42.3	17.9	60.2
		4A0005	4.8	70.7	26.2	96.9
		4A0007	5.5	81.0	30.7	111.7
		4A0009	7.2	84.6	32.9	117.5
		4A0011	9.2	107.2	41.5	148.7
	2	4A0001	1.2	8.2	8.6	16.8
		4A0002	1.8	13.0	10.9	23.9
		4A0004	3.4	21.3	12.6	33.9
		4A0005	4.8	32.8	16.8	49.6
		4A0007	5.5	38.2	20.0	58.2
		4A0009	7.2	44.3	22.8	67.1
		4A0011	9.2	57.6	29.1	86.7

Drive Duty	Fc (kHz)	Model Number CIMR-V□	Rated Amps (A)	Heatsink Loss (W)	Interior Unit Loss (W)	Total Loss (W)
ND	2	4A0001	1.2	8.2	14.4	22.6
		4A0002	2.1	15.5	18.4	33.9
		4A0004	4.1	26.4	21.2	47.6
		4A0005	5.4	37.5	25.7	63.2
		4A0007	6.9	49.7	32.4	82.1
		4A0009	8.8	55.7	36.0	91.7
		4A0011	11.1	71.9	51.7	123.6

A.6 Drive Derating Data

The drive can be operated at above rated temperature, altitude and default carrier frequency by derating the drive capacity. For example, a 10 amp continuous rated drive may be operated at higher temperatures if it is only used to supply 8 amps continuous.

◆ Carrier Frequency Derating

As the carrier frequency of the drive is increased above the factory setting the drive capacity should be derated according to *Figure A.1* .

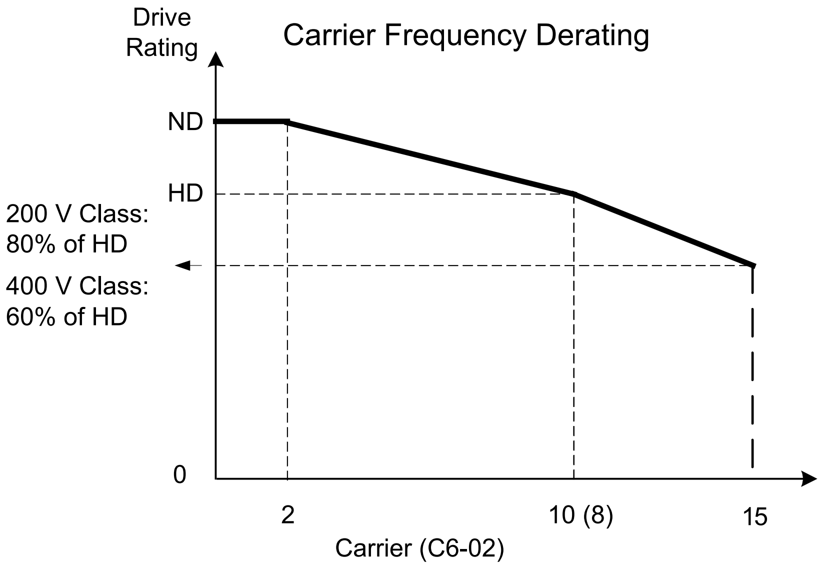


Figure A.1 Carrier Frequency Derating

◆ Temperature Derating

As the ambient temperature for the drive is increased above the drive specification the drive should be derated. Additionally parameter L8-35 Side-by-Side Selection on page *288* should be set according to enclosure type and mounting method as illustrated in *Figure A.2* on page *288*.

■ Output Current Derating Due to Ambient Temperature

If the ambient temperature is above the drive specification or if drives are side-by-side mounted in a cabinet, the parameters L8-12 and L8-35 must be set according to the installation conditions. The output current is derated as shown in *Figure A.2* .

No.	Name	Description	Range	Def.
L8-12	Ambient Temperature Setting	Adjust the drive overload (OL2) protection level when the drive is installed in an environment that exceeds its ambient temperature rating.	40 to 60	40 °C
L8-35	Side-by-Side Selection	0: Disabled (standard installation) 1: Side-by-Side installation 2: IP20/NEMA Type 1 3: Finless/Fin Outside installation	0 to 2	0

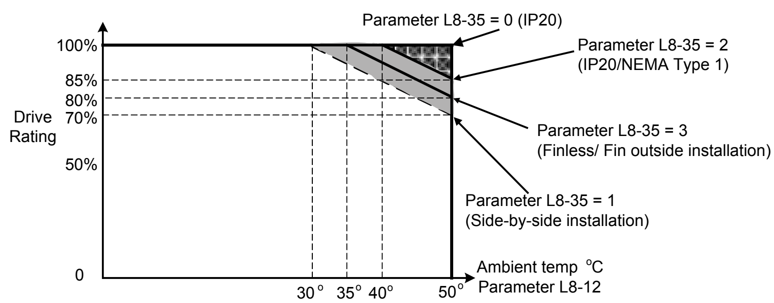


Figure A.2 Ambient Temperature and Installation Method Derating

◆ Altitude Derating

Yaskawa recommends referencing two standards when considering altitude derating. These standards are:

- **ANSI/IEEE C 37.40:** Service Conditions and Definitions for High Voltage Fuses, Distributor Enclosed Single Pole Air Switches and Accessories
- **IEC 282-1.2:** High Voltage Fuse

■ Drive Derating

Power conversion equipment must be de-rated above a certain altitude (usually 1000 meters). Equipment that depends on air for its insulating and cooling medium has a higher temperature rise and a lower dielectric strength value when operated at altitudes higher than 1000 meters (3300 feet). Application of the correct de-rating factors is necessary to prevent drive failure.

The effect of high altitudes may eventually result in thermal damage to the power semi-conductors and related components (reduced effectiveness of the heat sinks) as well as lower dielectric withstand capabilities. High altitude de-rating is, therefore, an important consideration during the initial application of the drive. *Figure A.3* is provided as a quick reference to aid in derating the drive above specified altitude.

Note: This derate applies only to the inverter. However, if the inverter is placed in a pressurized cabinet so that the internal pressure is maintained at the value of atmospheric pressure at 3300 ft. then there is no need for derate. **Example:** Heatsink is exposed to the outside and is not under positive pressure in an enclosed cabinet with forced air cooling or an air-conditioning system. In such a case, derating is required.

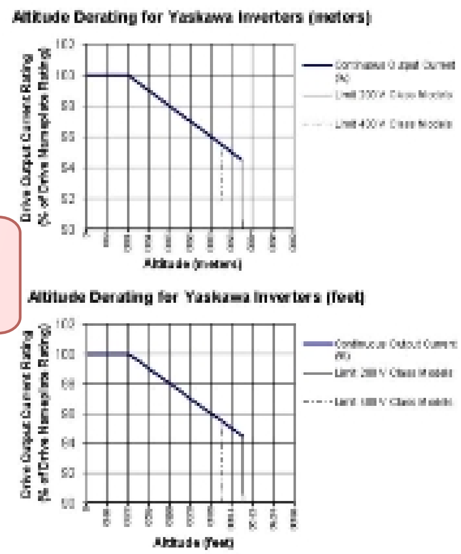


Figure A.3 Altitude Derating for Yaskawa Drives

■ Motor Derating

Consult the motor manufacturer for the applicable altitude de-rating factor before applying the motor. As a general guideline, consult the NEMA standard MG 1-14.04 (Operation of AC and DC Fractional- and Integral-HP Motors and Generators at Altitudes Above 3,300 feet (1000 meters). However, the motor manufacturer's specific de-rating data is always preferable.

Specifications

A

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Appendix: B

Parameter List

This chapter contains a full listing of all parameters and settings available in the drive.

B.1 Parameter Groups

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B.2 Parameter Table

◆ A: Initialization Parameters

The A parameter group creates the operating environment for the drive. This includes the parameter Access Level, Motor Control Method, Password, User Parameters and more.

No.	Name	Description	Range	Def.	Control Mode			Addr. Hex	Pg.
					V/f	OLV	PM		
A1: Initialization Parameters Use A1 parameters to configure the basic environment for drive operation.									
A1-01 <22> <16>	Access Level Selection	Selects which parameters are accessible via the digital operator. 0: Operation only 1: User Parameters (access to a set of parameters selected by the user) 2: Advanced Access Level	0 to 2	2	A	A	A	101H	—
A1-02	Control Method Selection	Selects the Control Method of the drive. 0: V/f Control without PG 2: Open Loop Vector (OLV) 5: PM Open Loop Vector (PM) Note: Does not return to the default setting when the drive is initialized.	0, 2, 5	0	S	S	S	102	75
A1-03	Initialize Parameters	Resets all parameters to factory default settings. (Initializes the drive then returns A1-03 to 0) 0: No Initialize 1110: User Initialize (First set user parameter values must be stored using parameter o2-03) 2220: 2-Wire Initialization 3330: 3-Wire Initialization 5550: OPE04 Error Reset	0 to 3330	0	A	A	A	103	—
			The following parameters are not reset when the performing initialization: A1-00, A1-02, A1-07, and all U2 and U3 monitors.						
A1-04	Password 1	When the value set into A1-04 does not match the value set into A1-05, parameters A1-01 thru A1-03, A1-06, and A2-01 thru A2-32 cannot be changed.	0 to 9999	0	A	A	A	104	—
A1-05	Password 2		0 to 9999	0	A	A	A	105	—
			This parameter is hidden from view. To access A1-05, first display A1-04. Then press the STOP key while holding down the up arrow key. Parameter A1-05 will appear.						—
A1-06	Application Preset	Sets parameters that are commonly used in certain applications to A2-01 through A2-16 for easier access. 0: General-purpose (A2 parameters are not affected) 1: Water supply pump 2: Conveyor 3: Exhaust fan 4: HVAC fan 5: Air compressor 6: Crane (Hoist) 7: Crane (Travelling)	0 to 7	0	A	A	A	127	—
A1-07	DriveWorksEZ Function Selection	0: Disabled 1: Enabled 2: Multi-function input (enabled when H1-☐☐ = 9F)	0 to 2	0	A	A	A		—
A2: User Parameters Use A2 parameters to program the drive.									
A2-01 to A2-32	User Parameters, 1 to 32	Parameters that were recently edited are listed here. The user can also select parameters to appear here for quick access. Parameters will be stored here for quick access when A1-01 = 1.	b1-01 to o2-08	-- <16>	A	A	A	106 to 125	—
A2-33	User Parameter Automatic Selection	0: Parameters A2-01 through A2-32 are reserved for the user to create a list of User Parameters. 1: Save history of recently viewed parameters. Recently edited parameters will be saved to A2-17 through A2-32 for quick access.	0, 1	1 <4>	A	A	A	126	—

<4> Default setting value is dependent on parameter A1-06. This setting value is 0 when A1-06 = 0, and 1 when A1-06 does not = 0.
<16> Default setting value is dependent on parameter A1-06, Application Selection.
<22> Parameter can be changed during run.

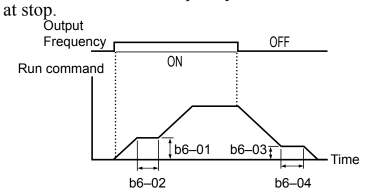
◆ b: Application

Application parameters configure the Run Command Source, DC Injection Braking, Speed Search, Timer functions, PID control, the Dwell function, Energy Savings and a variety of other application-related settings.

No.	Name	Description	Range	Def.	Control Mode			Addr. Hex	Pg.
					V/f	OLV	PM		
b1: Operation Mode Selection Use b1 parameters to configure the operation mode.									
b1-01	Frequency Reference Selection 1	Selects the frequency reference input source. 0: Operator - Digital preset speed d1-01 to d1-17. 1: Terminals - Analog input terminal A1 or A2. 2: Memobus communications 3: Option PCB 4: Pulse Input (Terminal RP)	0 to 4	1	S	S	S	180	76
b1-02	Run Command Selection 1	Selects the run command input source. 0: Operator - RUN and STOP keys on the digital operator. 1: Digital input terminals S1 to S7 2: Memobus communications 3: Option PCB.	0 to 3	1	S	S	S	181	77

No.	Name	Description	Range	Def.	Control Mode			Addr. Hex	Pg.
					V/f	OL V	PM		
b1-03	Stopping Method Selection	Selects the stopping method when the run command is removed. 0: Ramp to Stop 1: Coast to Stop 2: DC Injection Braking to Stop 3: Coast with Timer (A new run command is ignored if received before the timer expires)	0 to 3	0	S	S	S	182	78
			DC Injection Braking at Stop cannot be selected when using Open Loop Vector for PM motors.						
b1-04	Reverse Operation Selection	Permits or prohibits reverse operation. 0: Reverse enabled. 1: Reverse disabled.	0, 1	0	A	A	A	183	—
b1-07	Local/Remote Run Selection	Determines the operation when the Run command source is switched from LOCAL to REMOTE or between Run source 1 and 2 while an external Run command is active at the new source. 0: External Run command has to be cycled at the new source to be activated. 1: External Run command at new source is accepted immediately.	0, 1	0	A	A	A	186	—
b1-08	Run Command Selection while in Programming Mode	0: Run command accepted only in the operation menu. 1: Run command accepted in all menus. 2: Prohibit entering programming mode during Run	0 to 2	0	A	A	A	187	—
b1-14	Phase Order Selection	Sets the phase order for drive output terminals U/T1, V/T2 and W/T3. 0: Standard 1: Switch phase order	0, 1	0	A	A	A	1C3	—
b1-15	Frequency Reference 2	Selects the frequency reference input source.0: Operator - Digital preset speed d1-01 to d1-17. 1: Terminals - Analog input terminal A1 or A2 2: Memobus communications 3: Option PCB 4: Pulse Input (Terminal RP)	0 to 4	0	A	A	A	1C4	—
b1-16	Run Command Source 2	Selects the run command input source. 0: Operator - RUN and STOP keys on the digital operator. 1: Digital input terminals S1 to S7 2: Memobus communications 3: Option PCB	0 to 3	0	A	A	A	1C5	—
b1-17	Run Command at Power Up	Determines the operation when a Run command is active at power up of the drive. 0: Run command not issued, needs to be cycled 1: Run command issued, motor operation start	0, 1	0	A	A	A	1C6	—
b2: DC Injection Braking Use b2 parameters to configure DC Injection Braking operation									
b2-01	DC Injection Braking Start Frequency	Sets the frequency at which DC Injection Braking starts when Ramp to Stop (b1-03 = 0) is selected. If b2-01< E1-09, DC Injection Braking starts at E1-09.	0.0 to 10.0	0.5 Hz	A	A	A	189	—
b2-02	DC Injection Braking Current	Sets the DC Injection Braking current as a percentage of the drive rated current.	0 to 75	50%	A	A	–	18A	—
b2-03	DC Injection Braking Time/DC Excitation Time at Start	Sets DC Injection Braking time at start. Disabled when set to 0.00 seconds.	0.00 to 10.00	0.00 s <1>	A	A	–	18B	—
b2-04	DC Injection Braking Time at Stop	Sets DC Injection Braking time at stop. When b1-03 = 2, actual DC Injection time is calculated as follows: (b2-04) x 10 x (Output Freq) / (E1-04). When b1-03 = 0, this parameter sets the amount of DC Injection time applied to the motor at the end of the decel ramp or High Slip Braking. Disabled when set to 0.00.	0.00 to 10.00	0.50 s	A	A	–	18C	—
b2-08	Magnetic Flux Compensation Capacity	Sets the magnetic flux compensation as a percentage of the no-load current value (E2-03).	0 to 1000	0%	–	A	–	190	—
b2-12	Short Circuit Brake Time at Start	Sets the time for Short-Circuit Brake operation at start. Disabled when set to 0.00. <32>	0.00 to 25.50	0.00 s	–	–	A	1BA	—
b2-13	Short Circuit Brake Time at Stop	Sets Short-Circuit Brake operation time at stop. Used to stop a motor rotating due to inertia. Disabled when set to 0.00 seconds. <32>	0.00 to 25.50	0.50 s	–	–	A	1BB	—
b3: Speed Search Use B3 parameters to configure Speed Search function operation.									
b3-01	Speed Search Selection	Enables/disables speed search function at start.0: Disabled - Speed Search is not automatically performed at start. 1: Enabled - Speed Search is automatically performed at start.	0 to 1	0	A	A	A	191	—
b3-02	Speed Search Deactivation Current	Sets the current level at which the speed is assumed to be detected and Speed Search is ended. Set in percent of the drive rated current.	0 to 200	120 <2>	A	A	–	192	—
b3-03	Speed Search Deceleration Time	Sets the time constant used to reduce the output frequency during speed search. Related to a change from max. output frequency to 0.	0.1 to 10.0	2.0 s	A	A	–	193	—
b3-05	Speed Search Delay Time	Delays the speed search operation after a momentary power loss to allow time for an external output contactor to close.	0.0 to 100	0.2 s	A	A	A	195	—
b3-06	Output Current 1 during Speed Search	Sets the current injected to the motor at the beginning of Estimation type Speed Search. Set as a factor to the motor rated current.	0.0 to 2.0	<12>	A	A	–	196	—
b3-10	Speed Search Detection Compensation Gain	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.	1.00 to 1.20	1.05	A	A	–	19A	—
b3-14	Bi-Directional Speed Search Selection	Selects if Speed Search detects the motor rotation direction during speed search. 0: Disabled–Frequency reference direction used 1: Enabled–Detected direction used	0, 1	0	A	A	–	19E	—
b3-17	Speed Search Restart Current Level	Sets the speed search restart current level in percentage of the drive rated current.	0 to 200	150%	A	A	–	1F0	—
b3-18	Speed Search Restart Detection Time	Sets the time in seconds for speed search restart to be detected.	0.00 to 1.00	0.10 s	A	A	–	1F1	—
b3-19	Number of Speed Search Restarts	Sets the number of restarts possible for speed search restart operations.	0 to 10	3	A	A	–	1F2	—
b3-24	Speed Search Method Selection	Sets the Speed Search detection mode. 0: Current Detection Type 1: Speed Estimation Type	0, 1	0	A	A	–	1C0	—
b3-25	Speed Search Retry Interval Time	Sets the wait time before Speed Search restarts.	0 to 30.0	0.5 s	A	A	A	1C8	—

No.	Name	Description	Range	Def.	Control Mode			Addr. Hex	Pg.
					V/f	OL V	PM		
b4: Timer Function Use b4 parameters to configure timer function operation.									
b4-01	Timer Function On-Delay Time	Used in conjunction with a multi-function digital input (H1-□□ = 18) and a multi-function digital output (H2-□□ = 12) programmed for the timer function. This sets the amount of time between digital input closure and digital output activation.	0.0 to 300.0	0.0 s	A	A	A	1A3	—
b4-02	Timer Function Off-Delay Time	Used in conjunction with a multi-function digital input (H1-□□ = 18) and a multi-function digital output programmed for the timer function. This sets the amount of time the output remains activated after the digital input is opened.	0.0 to 300.0	0.0 s	A	A	A	1A4	—
b5: PID Control Use b5 parameters to configure the PID control drive function.									
b5-01	PID Function Setting	Sets the PID control mode. 0: Disabled 1: Enable (Deviation is D-controlled) 2: Enable (Feedback is D-controlled) 3: Enable (Deviation is D-controlled, PID output added to Freq. Ref.) 4: Enable (Feedback is D-controlled, PID output added to Freq. Ref.)	0 to 4	0	A	A	A	1A5	—
b5-02 <22>	Proportional Gain Setting (P)	Sets the proportional gain of the PID controller. A setting of 0.00 disables P control.	0.00 to 25.00	1.00	A	A	A	1A6	—
b5-03 <22>	Integral Time Setting (I)	Sets the integral time for the PID controller. A setting of 0.0 s disables integral control.	0.0 to 360.0	1.0 s	A	A	A	1A7	—
b5-04 <22>	Integral Limit Setting	Sets the maximum output possible from the integrator.	0.0 to 100.0	100.0%	A	A	A	1A8	—
b5-05 <22>	Derivative Time (D)	Sets D control derivative time. A setting of 0.00 s disables derivative control.	0.00 to 10.00	0.00 s	A	A	A	1A9	—
b5-06 <22>	PID Output Limit	Sets the maximum output possible from the entire PID controller.	0.0 to 100.0	100.0%	A	A	A	1AA	—
b5-07 <22>	PID Offset Adjustment	Applies an offset to the PID controller output.	-100.0 to +100.0	0.0%	A	A	A	1AB	—
b5-08 <22>	PID Primary Delay Time Constant	Sets the amount of time for the filter on the output of the PID controller.	0.00 to 10.00	0.00 s	A	A	A	1AC	—
b5-09	PID Output Level Selection	Sets the PID controller output direction. 0: Normal Output (direct acting) 1: Reverse Output (reverse acting)	0, 1	0	A	A	A	1AD	—
b5-10	PID Output Gain Setting	Sets the gain applied to the PID output.	0.00 to 25.00	1.00	A	A	A	1AE	—
b5-11	PID Output Reverse Selection	Sets the drive operation with negative PID output. 0: Drive stops with negative PID output 1: Rotation direction reverses with negative PID output. When using setting 1 make sure, reverse operation is permitted by parameter b1-04.	0, 1	0	A	A	A	1AF	—
b5-12	PID Feedback Reference Missing Detection Selection	Configures the PID feedback loss detection. 0: Disabled. 1: Feedback loss detected when PID enabled. Alarm output, operation is continued without triggering a fault contact. 2: Feedback loss detected when PID enabled. Fault output, operation is stopped and a fault contact is triggered. 3: Feedback loss detection even when PID is disabled by digital input. No alarm/fault output. "PID feedback loss" digital output is switched. 4: PID Feedback error detection even when PID is disabled by digital input. An alarm is triggered and the drive continues to run. 5: PID Feedback error detection even when PID is disabled by digital input. Fault is triggered and output is shut off.	0 to 5	0	A	A	A	1B0	—
b5-13	PID Feedback Loss Detection Level	Sets the PID feedback loss detection level.	0 to 100	0%	A	A	A	1B1	—
b5-14	PID Feedback Loss Detection Time	Sets the PID feedback loss detection delay time in terms of seconds.	0.0 to 25.5	1.0 s	A	A	A	1B2	—
b5-15	PID Sleep Function Start Level	Sets the sleep function start frequency. **Note:** Also enabled when PID is not active.	0.0 to 400.0	0.0 Hz	A	A	A	1B3	—
b5-16	PID Sleep Delay Time	Sets the sleep function delay time in units of 0.1 seconds.	0.0 to 25.5	0.0 s	A	A	A	1B4	—
b5-17	PID Accel/Decel Time	Applies an accel/decel time to the PID setpoint reference.	0 to 255	0 s	A	A	A	1B5	—
b5-18	PID Setpoint Selection	Selects b5-19 as PID setpoint value. 0: Disabled 1: Enabled, b5-19 becomes PID target	0, 1	0	A	A	A	1DC	—
b5-19	PID Setpoint Value	Sets the PID target value when b5-18 = 1.	0.00 to 100.00	0.00%	A	A	A	1DD	—
b5-20	PID Setpoint Scaling	Sets the units for b5-19, and for parameter monitors U5-01 (PID Feedback) and U5-04 (PID Setpoint). 0: 0.01Hz units 1: 0.01% units (100% = max output frequency) 2: r/min (motor pole number must be set up) 3: User-set (set to b5-38 and b5-39)	0 to 3	1	A	A	A	1E2	—
b5-34 <22>	PID Output Lower Limit	Sets the minimum output possible from the PID controller.	-100.0 to +100.0	0.00%	A	A	A	19F	—
b5-35 <22>	PID Input Limit	Limits the PID control input (deviation signal). Acts as a bipolar limit.	0 to 1000.0	1000.0 %	A	A	A	1A0	—
b5-36	PID Feedback High Detection Level	Sets the PID feedback high detection level.	0 to 100	100%	A	A	A	1A1	—
b5-37	PID Feedback High Level Detection Time	Sets the PID feedback high level detection delay time.	0.0 to 25.5	1.0 s	A	A	A	1A2	—
b5-38	PID Setpoint / User Display	0 to 60000: User-Set Display if b5-20=3Set the numbers displayed by designating the maximum PID target.	1 to 60000	<5>	A	A	A	1FE	—
b5-39	PID Setpoint Display Digits	Sets the number of digits the PID setpoint. 0: No decimal places 1: One decimal places 2: Two decimal places 3: Three decimal places	0 to 3	<5>	A	A	A	1FF	—

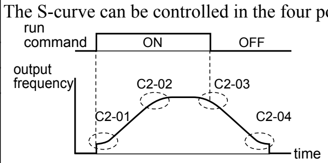
No.	Name	Description	Range	Def.	Control Mode			Addr. Hex	Pg.
					V/f	OLV	PM		
b6: Dwell Function Use b6 parameters to configure dwell function operation.									
b6-01	Dwell Reference at Start	The Dwell function is used to temporarily hold the frequency when driving a motor with a heavy load. Parameters b6-01 and b6-02 set the frequency to hold and the time to maintain that frequency at start. Parameters b6-03 and b6-04 set the frequency to hold and the time to maintain that frequency at stop.	0.0 to 400.0	0.0 Hz	A	A	A	1B6	—
b6-02	Dwell Time at Start		0.0 to 10.0	0.0 s	A	A	A	1B7	—
b6-03	Dwell Frequency at Stop		0.0 to 400.0	0.0 Hz	A	A	A	1B8	—
b6-04	Dwell Time at Stop		0.0 to 10.0	0.0 s	A	A	A	1B9	—
b8: Energy Saving Use b8 parameters to configure the energy saving/conservation drive function.									
b8-01	Energy Saving Control Selection	Selects the Energy Savings function. 0: Disabled 1: Enabled (set b8-04)	0, 1	0	A	A	–	1CC	—
b8-02 <22>	Energy Saving Gain	Sets energy savings control gain when in Open Loop Vector (OLV) control mode.	0.0 to 10.0	0.7	–	A	–	1CD	—
b8-03 <22>	Energy Saving Control Filter Time Constant	Sets energy saving control filter time constant when in Open Loop Vector control.	0.00 to 10.00	0.50	–	A	–	1CE	—
b8-04	Energy Saving Coefficient Value	Sets the Energy Saving coefficient and is used to fine adjustments in V/f Control.	0.0 to 655.00	<57>	A	–	–	1CF	—
b8-05	Power Detection Filter Time	Sets a filter time for the Power Detection used by Energy Savings in V/f Control.	0 to 2000	20 ms	A	–	–	1D0	—
b8-06	Search Operation Voltage Limit	Sets the limit for the voltage search operation performed by Energy Savings in V/f Control. Set as a percentage of the motor base voltage. Disabled when set to 0%.	0 to 100	0%	A	–	–	1D1	—

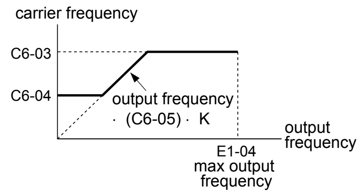
<1> Default setting value is dependent on parameter A1-02, Control Method Selection. The value shown is for A1-02 = 2-OLV control.
<2> Default setting value is dependent on parameter A1-02, Control Method Selection. The value shown is for A1-02 = 0-V/f Control.
<5> Default setting is dependent on parameter b5-20, PID Setpoint Scaling.
<12> Default setting value is dependent on parameter o2-04, Drive/kVA Selection.
<14> Default setting value is dependent on parameter o2-09, Initialization Spec. Selection.
<22> Parameter can be changed during run.
<32> A coasting motor may require a braking resistor circuit to bring the motor to a stop in the required time.
<33> Increase the setting value in increments of 0.1 when estimating the minimum output frequency for a motor coasting at high speed while attempting Speed-Estimation Type Speed Search.
<34> Increase this value if an OV overvoltage fault occurs when performing Speed Search at start.
<57> Default setting value is dependent on parameter o2-04, Drive/kVA Selection and C6-01, Drive Duty Selection.

◆ C: Tuning

C parameters are used to adjust the acceleration and deceleration times, S-curves, slip- and torque compensation functions and carrier frequency selections.

No.	Name	Description	Range	Def.	Control Mode			Addr. Hex	Pg.
					V/f	OLV	PM		
C1: Acceleration and Deceleration Times Use C1 parameters to configure motor acceleration and deceleration.									
C1-01 <22>	Acceleration Time 1	Sets the time to accelerate from 0 to maximum frequency.	0.0 to 6000.0 <6>	10.0 s	S	S	S	200	81
C1-02 <22>	Deceleration Time 1	Sets the time to decelerate from maximum frequency to 0.	0.0 to 6000.0 <6>	10.0 s	S	S	S	201	81
C1-03 <22>	Acceleration Time 2	Sets the time to accelerate from 0 to maximum frequency when Accel/Decel times 2 are selected by a digital input.	0.0 to 6000.0 <6>	10.0 s	A	A	A	202	—
C1-04 <22>	Deceleration Time 2	Sets the time to decelerate from maximum frequency to 0 when Accel/Decel times 2 are selected by a digital input.	0.0 to 6000.0 <6>	10.0 s	A	A	A	203	—
C1-05 <22>	Acceleration Time 3 (Motor 2 Accel Time 1)	Sets the time to accelerate from 0 to maximum frequency when Accel/Decel times 3 are selected by a digital input.	0.0 to 6000.0 <6>	10.0 s	A	A	A	204	—
C1-06 <22>	Deceleration Time 3 (Motor 2 Decel Time 1)	Sets the time to decelerate from maximum frequency to 0 when Accel/Decel times 3 are selected by a digital input.	0.0 to 6000.0 <6>	10.0 s	A	A	A	205	—
C1-07 <22>	Acceleration Time 4 (Motor 2 Accel Time 2)	Sets the time to accelerate from 0 to maximum frequency when Accel/Decel times 4 are selected by a digital input.	0.0 to 6000.0 <6>	10.0 s	A	A	A	206	—
C1-08	Deceleration Time 4 (Motor 2 Decel Time 2)	Sets the time to decelerate from maximum frequency to 0 when Accel/Decel times 4 are selected by a digital input.	0.0 to 6000.0 <6>	10.0 s	A	A	A	207	—
C1-09	Fast-Stop Time	Sets the time to decelerate from maximum frequency to 0 for the multi-function input fast-stop function. **Note:** This parameter is also used by selecting "Fast-Stop" as a Stop Method when a fault is detected.	0.0 to 6000.0 <6>	10.0 s	A	A	A	208	—
C1-10	Accel/Decel Time Setting Units	Sets the resolution of C1-01 to C1-09. 0: 0.01 s (0.00 to 600.00 s) 1: 0.1 s (0.0 to 6000.0 s)	0, 1	1	A	A	A	209	—
C1-11	Accel/Decel Time Switching Frequency	Sets the frequency for automatic acceleration/deceleration switching. Below set frequency: Accel/Decel Time 4 Above set frequency: Accel/Decel Time 1 The multi-function input "Accel/Decel Time 1" or "Accel/Decel Time 2" take priority.	0.0 to 400.0 Hz	0.0 Hz	A	A	A	20A	—

No.	Name	Description	Range	Def.	Control Mode V/f	Control Mode OLV	Control Mode PM	Addr. Hex	Pg.
C2: S-Curve Characteristics Use C2 parameters to configure S-curve operation.									
C2-01	S-Curve Characteristic at Accel Start	The S-curve can be controlled in the four points shown below.  S-curve is used to further soften the starting and stopping ramp. The longer the S-curve time, the softer the starting and stopping ramp.	0.00 to 10.00	0.20 s <2>	A	A	A	20B	—
C2-02	S-Curve Characteristic at Accel End		0.00 to 10.0	0.20 s	A	A	A	20C	—
C2-03	S-Curve Characteristic at Decel Start		0.00 to 10.0	0.20 s	A	A	A	20D	—
C2-04	S-Curve Characteristic at Decel End		0.00 to 10.0	0.00 s	A	A	A	20E	—
C3: Slip Compensation Use C3 parameters to configure the slip compensation function.									
C3-01 <22>	Slip Compensation Gain	Sets the slip compensation gain. Decides for what amount the output frequency is boosted in order to compensate the slip. **Note:** Adjustment is not normally required.	0.0 to 2.5	0.0 <2>	A	A	–	20F	—
C3-02	Slip Compensation Primary Delay Time	Adjusts the slip compensation function delay time. Decrease the setting when the slip compensation response is too slow, increase it when the speed is not stable. Disabled when Simple V/f Control with PG (H6-01 = 3) is used.	0 to 10000	2000 ms <2>	A	A	–	210	—
C3-03	Slip Compensation Limit	Sets the slip compensation upper limit. Set as a percentage of motor rated slip (E2-02). Disabled when Simple V/f Control with PG (H6-01 = 3) is used.	0 to 250	200%	A	A	–	211	—
C3-04	Slip Compensation Selection during Regeneration	Selects slip compensation during regenerative operation. 0: Disabled 1: Enabled Using the Slip Compensation function during regeneration may require a braking option to handle momentary increasing regenerative energy.	0, 1	0	A	A	–	212	—
C3-05	Output Voltage Limit Operation Selection	Selects if the motor magnetic flux is reduced during output voltage saturation. 0: Disabled 1: Enabled	0, 1	0 <2>	–	A	–	213	—
C4: Torque Compensation Use C4 parameters to configure Torque Compensation function.									
C4-01 <23>	Torque Compensation Gain	V/f control: Sets the gain for the automatic torque (voltage) boost function and helps to produce better starting torque. Increase this setting when using a long motor cable or when the motor is significantly smaller than the drive capacity. Decrease this setting when motor oscillation occurs. Set the value so that the current at low speed does not exceeds the drives rated current. Open Loop Vector: Sets the torque compensation function gain. Normally no change is required.	0.00 to 2.50	1.00	A	A	A	215	—
C4-02	Torque Compensation Primary Delay Time	Sets the torque compensation filter time. Increase this setting when motor oscillation occurs. Reduce the setting if there is not enough response from the motor.	0 to 60000	200 ms <1>	A	A	A	216	—
C4-03	Torque Compensation at Forward Start	Sets torque compensation at forward start as a percentage of motor torque.	0.0 to 200.0	0.0%	–	A	–	217	—
C4-04	Torque Compensation at Reverse Start	Sets torque compensation at reverse start as a percentage of motor torque.	-200.0 to 0.0	0.0%	–	A	–	218	—
C4-05	Torque Compensation Time Constant	Sets the time constant for torque compensation at forward start and reverse start (C4-03 and C4-04). The filter is disabled if the time is set to 4 ms or less.	0 to 200	10 ms	–	A	–	219	—
C4-06	Torque Compensation Primary Delay Time 2	Sets the torque compensation time 2. When an OV fault occurs with sudden load changes or at the and of an acceleration, increase the setting. **Note:** Adjustment is not normally required. If adjusted then AFR time 2 (n2-03) should be adjusted too.	0 to 10000	150 ms	–	A	–	21AH	—
C5: Speed Control (ASR) Use C5 parameters to configure the Automatic Speed Regulator (ASR). C5 parameters are available only when using V/f with Simple PG (H6-01 = 3).									
C5-01 <22>	ASR Proportional Gain 1	Sets the proportional gain of the speed control loop (ASR).	0.00 to 300.00	0.20	A	–	–	21B	—
C5-02 <22>	ASR Integral Time 1	Sets the integral time of the speed control loop (ASR).	0.000 to 10.000	0.200 s	A			21C	—
C5-03 <22>	ASR Proportional Gain 2	Sets the speed control gain 2 of the speed control loop (ASR).	0.00 to 300.00	0.02	A	–	–	21D	—
C5-04 <22>	ASR Integral Time 2	Sets the integral time 2 of the speed control loop (ASR).	0.000 to 10.000	0.050 s	A	–	–	21E	—
C5-05 <22>	ASR Limit	Sets the upper limit for the speed control loop (ASR) as a percentage of the maximum output frequency (E1-04).	0.0 to 20.0	5.0%	A			21F	—
C6: Carrier Frequency Use C6 parameters to configure the carrier frequency drive settings.									
C6-01	Normal/Heavy Duty Selection	Selects the load rating for the drive. 0: Heavy Duty (HD) for constant torque applications. 1: Normal Duty (ND) for variable torque applications. This setting affects the Rated output current and overload tolerance of the drive.	0, 1	1	S	S	S	223	82
C6-02	Carrier Frequency Selection	Selects the carrier frequency 1 : 2.0 kHz 2 : 5.0 kHz 3 : 8.0 kHz 4 : 10.0 kHz 5 : 12.5 kHz 6 : 15.0 kHz 7 : Swing PWM1 (Audible sound 1) 8 : Swing PWM2 (Audible sound 2) 9 : Swing PWM3 (Audible sound 3) A : Swing PWM4 (Audible sound 4) B to E: No setting possible F : User defined (determined by C6-03 through C6-05)	1 to F	<3>	S	S	S	224	82

No.	Name	Description	Range	Def.	Control Mode V/f	Control Mode OLV	Control Mode PM	Addr. Hex	Pg.
C6-03	Carrier Frequency Upper Limit	Open Loop Vector: C6-03 defines the fixed carrier frequency if C6-02 = F.	1.0 to 15.0	<8>	A	A	A	225	—
C6-04	Carrier Frequency Lower Limit	V/f control: C6-03 and C6-04 set upper and lower limits for the carrier frequency.  The coefficient K depends on C6-03: C6-03 ≥ 10.0 kHz: K = 3 10.0 kHz > C6-03 ≥ 5.0 kHz: K = 2 5.0 kHz > C6-03: K = 1 When C6-05 ≤ 6, C6-04 is disabled (makes the carrier frequency C6-03 value).	0.4 to 15.0	<8>	A	-	-	226	—
C6-05	Carrier Frequency Proportional Gain	Sets the relationship of output frequency to carrier frequency when C6-02 = F.	00 to 99	<8>	A	-	-	227	—

<1> Default setting value is dependent on parameter A1-02, Control Method Selection. The value shown is for A1-02 = 2-OLV control.
<2> Default setting value is dependent on parameter A1-02, Control Method Selection. The value shown is for A1-02 = 0-V/f Control.
<3> Default setting value is dependent on parameters o2-04, Drive/kVA Selection, A1-02, Control Method Selection and C6-01, Normal/Heavy Duty selection. 351.
<6> Setting range value is dependent on parameter C1-10, Accel/Decel Time Setting Units. When C1-10 = 0 (units of 0.01 seconds), the setting range becomes 0.00 to 600.00 seconds.
<8> Default setting value is dependent on parameter C6-02, Carrier Frequency Selection.
<22> Parameter can be changed during run.
<23> Parameter cannot be changed during run when parameter A1-02 = 5-PM OLV Control.

◆ d: References

Reference parameters are used to set the various frequency reference values during operation.

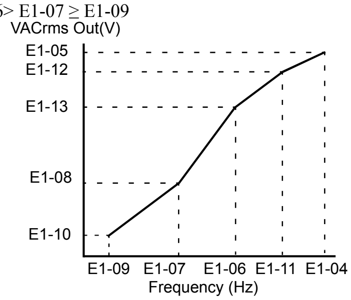
No.	Name	Description	Range	Def.	Control Mode V/f	Control Mode OLV	Control Mode PM	Addr. Hex	Pg.
		d1: Frequency Reference Use d1 parameters to configure the drive frequency reference.							
d1-01 <22>	Frequency Reference 1	Frequency reference	0.00 to 400.00 Hz <11> <19>	0.00 Hz	S	S	S	280	76
d1-02 <22>	Frequency Reference 2	Frequency reference when digital input "Multi-Step Speed Reference 1" (H1-☐☐ = 3) is on.		0.00 Hz	S	S	S	281	76
d1-03 <22>	Frequency Reference 3	Frequency reference when digital input "Multi-Step Speed Reference 2" (H1-☐☐ = 4) is on.		0.00 Hz	S	S	S	282	76
d1-04 <22>	Frequency Reference 4	Frequency reference when digital inputs "Multi-Step Speed Reference 1, 2" (H1-☐☐ = 3 and 4) are on.		0.00 Hz	S	S	S	283	76
d1-05 <22>	Frequency Reference 5	Frequency reference when digital input "Multi-Step Speed Reference 3" (H1-☐☐ = 5) is on.		0.00 Hz	A	A	A	284	—
d1-06 <22>	Frequency Reference 6	Frequency reference when digital inputs "Multi-Step Speed Reference 1, 3 " (H1-☐☐ = 3 and 5) are on.		0.00 Hz	A	A	A	285	—
d1-07 <22>	Frequency Reference 7	Frequency reference when digital inputs "Multi-Step Speed Reference 2, 3" (H1-☐☐ = 4 and 5) are on.		0.00 Hz	A	A	A	286	—
d1-08 <22>	Frequency Reference 8	Frequency reference when multi-function input "Multi-Step speed reference 1, 2, 3" (H1-☐☐ = 3, 4, 5) are on.		0.00 Hz	A	A	A	287	—
d1-09 <22>	Frequency Reference 9	Frequency reference when multi-function input "Multi-Step Speed Reference 4" (H1-☐☐ = 32) is on.		0.00 Hz	A	A	A	288	—
d1-10 <22>	Frequency Reference 10	Frequency reference when digital input "Multi-Step Speed Reference 1, 4" (H1-☐☐ = 3 and 32) are on.		0.00 Hz	A	A	A	28B	—
d1-11 <22>	Frequency Reference 11	Frequency reference when digital inputs "Multi-Step Speed Reference 2, 4" (H1-☐☐ = 4 and 32) are on.		0.00 Hz	A	A	A	28C	—
d1-13 <22>	Frequency Reference 13	Frequency reference when digital inputs "Multi-Step Speed Reference 3, 4" (H1-☐☐ = 5 and 32) are on.		0.00 Hz	A	A	A	28E	—
d1-14 <22>	Frequency Reference 14	Frequency reference when digital inputs "Multi-Step Speed Reference 1, 3, 4" (H1-☐☐ = 3, 5, 32) are on.		0.00 Hz	A	A	A	28F	—
d1-15 <22>	Frequency Reference 15	Frequency reference when digital inputs "Multi-Step Speed Reference 2, 3, 4" (H1-☐☐ = 4, 5, 32) are on.		0.00 Hz	A	A	A	290	—
d1-16 <22>	Frequency Reference 16	Frequency reference when digital inputs "Multi-Step Speed Reference 1, 2, 3, 4" (H1-☐☐ = 3, 4, 5, 32) are on.		0.00 Hz	A	A	A	291	—
d1-17 <22>	Jog Frequency Reference	Frequency reference when digital inputs "Jog Frequency Reference", "Forward Jog" or "Reverse Jog." are on. "Jog Frequency Reference" has priority over "Multi-Step Speed Reference 1 to 16".		6.00 Hz	S	S	S	292	76
		d2: Frequency Upper and Lower Limits Use d2 parameters to configure the frequency reference limits.							
d2-01	Frequency Reference Upper Limit	Sets the frequency reference upper limit as a percentage of maximum output frequency (E1-04). Output speed is limited to this value even if the frequency reference is higher. This limit applies to all frequency reference sources.	0.0 to 110.0	100.0%	A	A	A	289	—
d2-02	Frequency Reference Lower Limit	Sets the frequency reference lower limit as a percentage of maximum output frequency (E1-04). Output speed is limited to this value even if the frequency reference is lower. This limit applies to all frequency reference sources.	0.0 to 110.0	0.0%	A	A	A	28A	—

No.	Name	Description	Range	Def.	Control Mode V/f	Control Mode OLV	Control Mode PM	Addr. Hex	Pg.
d2-03	Master Speed Reference Lower Limit	Sets the minimum frequency reference lower limit if the frequency reference is input using an analog input. Set as a percentage of maximum output frequency (E1-04). The higher of both values d2-01 and d2-03 will be the lower limit.	0.0 to 110.0	0.0%	A	A	A	293	—
d3: Jump Frequency Use d3 parameters to configure the drive Jump Frequency settings.									
d3-01	Jump Frequency 1	d3-01 to d3-04 allow programming of three prohibited frequency reference points for eliminating problems with resonant vibration of the motor / machine. This feature does not eliminate the selected frequency values, but accelerates and decelerates the motor through the prohibited bandwidth.The parameters must be according to the rule; d3-01 ≥ d3-02 ≥ d3-03.	0.0 to 400.0	0.0 Hz	A	A	A	294	—
d3-02	Jump Frequency 2			0.0 Hz	A	A	A	295	—
d3-03	Jump Frequency 3			0.0 Hz	A	A	A	296	—
d3-04	Jump Frequency Width	This parameter sets the dead-band width around each selected prohibited frequency reference point. The bandwidth becomes the designated Jump frequency, plus or minus d3-04.	0.0 to 20.0	1.0 Hz	A	A	A	297	—
d4: Frequency Reference Hold Use d4 parameters to configure the drive frequency reference hold function.									
d4-01	Frequency Reference Hold Function Selection	This parameter is used to hold the last frequency reference in U1-01 (d1-01) when power is removed. 0: Disabled 1: Enabled This function is available when the multi-function inputs “accel/decel ramp hold” or “up/down” commands are selected (H1-□□ = A or 10 and 11).	0, 1	0	A	A	A	298	—
d4-03 <22>	Frequency Reference Bias Step (Up/Down 2)	Sets the bias added to the frequency reference when the Up/Down 2 digital inputs are set. When set to 0.00 Hz, the bias value is increased or decreased according to d4-04. When greater than 0.0 Hz, the bias value d4-03 is added or subtracted to/from the frequency reference. The acceleration or deceleration rate is ultimately determined by d4-04.	0.00 to 99.99Hz	0.00 Hz	A	A	A	2AA	—
d4-04 <22>	Frequency Reference Accel/Decel (Up/Down 2)	0: Adjusts the bias value according to the currently selected accel/decel time. 1: Adjusts the bias value by Accel/Decel Time 4 (C1-07 and C1-08).	0, 1	0	A	A	A	2AB	—
d4-05 <22>	Frequency Reference Bias Operation Mode Selection (Up/Down 2)	0: Holds the bias value when Up/Down 2 reference is on or off. 1: When the Up 2 reference and Down 2 reference are both on or both off, the applied bias becomes 0. Currently selected accel/ decel. times are used. Enabled only when d4-03 = 0.	0, 1	0	A	A	A	2AC	—
d4-06	Frequency Reference Bias (Up/Down 2)	The Up/Down 2 bias value is saved in d4-06 once the frequency reference is adjusted. It is limited by d4-08 and d4-09. The bias can be set by the user, but will be disabled under the following conditions: • When none of the digital inputs are assigned to Up2/Down2 commands. • When the frequency reference source has been changed (including multi-step speed). • When both d4-03 = 0 and d4-05 = 1 and the Up 2 / Down 2 commands are both on or both off. • When the max output frequency E1-04 has changed.	-99.9 to +100.0	0.0%	A	A	A	2AD	—
d4-07 <22>	Analog Frequency Reference Fluctuation Limit (Up/Down 2)	• When during Up2/Down2 the frequency reference value from analog or pulse input changes for more than the level set in d4-07, the bias value is hold and the reference is changed to the new value. • After the speed reaches the frequency reference the bias hold is released. (Works with frequency reference from analog or pulse input only)	0.1 to +100.0	1.0%	A	A	A	2AE	—
d4-08 <22>	Frequency Reference Bias Upper Limit (Up/Down 2)	Sets the upper limit for d4-06 in percent of the maximum output frequency E1-04.	0.1 to 100.0	0.0%	A	A	A	2AF	—
d4-09 <22>	Frequency Reference Bias Lower Limit (Up/Down 2)	Sets the lower limit for d4-06 in percent of the maximum output frequency E1-04.	-99.9 to 0.0	0.0%	A	A	A	2B0	—
d4-10	Up/Down Frequency Reference Limit Selection	Selects which value is used as frequency reference lower limit if the Up/Down function is used. 0: The lower limit is determined by d2-02 or analog input (H3-02/10 = 0). The higher of both values becomes the reference limit. 1: The lower limit is determined by d2-02.	0 or 1	0	A	A	A	2B6	—
d4-12	Stop Position Gain	Sets the gain used by the simple positioning stop function to fine adjust the position. Refer to the V1000 Technical Manual for details.	0.50 to 2.55	1.00	A	A	A	2B8	
d7: Offset Frequency Use d7 parameters to set the offset frequency.									
d7-01 <22>	Offset Frequency 1	Added to the frequency reference when the digital input “Frequency Offset 1” (H1-□□ = 44) is switched on.	-100.0 to +100.0	0.0%	A	A	A	2B2	—
d7-02 <22>	Offset Frequency 2	Added to the frequency reference when the digital input “Frequency Offset 2” (H1-□□ = 45) is switched on.	-100.0 to +100.0	0.0%	A	A	A	2B3	—
d7-03 <22>	Offset Frequency 3	Added to the frequency reference when the digital input “Frequency Offset 3” (H1-□□ = 46) is switched on.	-100.0 to +100.0	0.0%	A	A	A	2B4	—

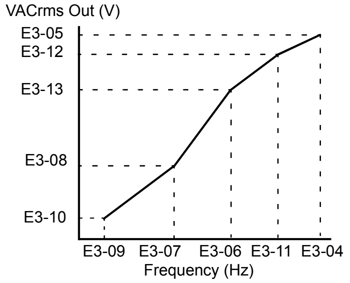
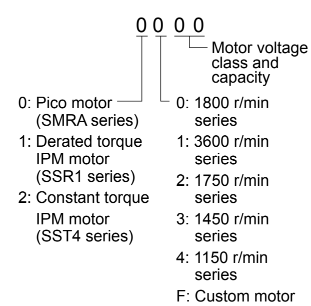
<11> Default setting value is dependent on parameter o1-03, Digital Operator Display Selection.
<19> Range upper limit is dependent on parameters E1-04, Maximum Output Frequency, and d2-01, Frequency Reference Upper Limit.
<22> Parameter can be changed during run.

◆ E: Motor Parameters

No.	Name	Description	Range	Def.	Control Mode			Addr. Hex	Pg.
					V/f	OLV	PM		
E1: V/f Pattern Characteristics Use E1 parameters to set V/f characteristics for the motor.									
E1-01 <24>	Input Voltage Setting	This parameter must be set to the power supply voltage. It sets the maximum and base voltage used by preset V/f patterns (E1-03 = 0 to E) and adjusts levels used by certain functions. **WARNING!** Drive input voltage (not motor voltage) must be set in E1-01 for the protective features of the drive to function properly. failure to do so may result in equipment damage and/or death or personal injury.	155 to 255	230 V	S	S	S	300	83
E1-03	V/f Pattern Selection	Selects a preset V/f pattern. 0: 50 Hz Constant torque 1 1: 60 Hz Constant torque 2 2: 60 Hz Constant torque 3 (50 Hz base) 3: 72 Hz Constant torque 4 (60 Hz base) 4: 50 Hz Variable torque 1 5: 50 Hz Variable torque 2 6: 60 Hz Variable torque 3 7: 60 Hz Variable torque 4 8: 50 Hz High starting torque 1 9: 50 Hz High starting torque 2 A: 60 Hz High starting torque 3 B: 60 Hz High starting torque 4 C: 90 Hz (60 Hz base) D: 120 Hz (60 Hz base) E: 180 Hz (60 Hz base) F: Custom V/f. E1-04 through E1-13 settings define the V/f pattern.	0 to F	F	A	A	–	302	—
E1-04	Max Output 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: E1-04 ≥ E1-06> E1-07 ≥ E1-09	40.0 to 400.0 <21>	60 Hz <10>	S	S	S	303	84
E1-05 <24>	Max Output Voltage		0.0 to 255.0	230 V <10>	S	S	S	304	84
E1-06	Base Frequency		0.0 to E1-04	60 Hz <10>	S	S	S	305	84
E1-07	Mid Output Frequency		0.0 to E1-04	3.0 Hz <2>	A	A	A	306	—
E1-08 <24>	Mid Output Frequency Voltage		0.0 to 255.0	18.4 V <2> <12>	A	A	A	307	—
E1-09	Minimum Output Freq.		0.0 to E1-04	1.5 Hz <2> <10>	S	S	S	308	84
E1-10 <24>	Minimum Output Freq. Voltage		0.0 to 255.0	13.8 V <2> <12>	A	A	A	309	—
E1-11 <26>	Mid Output Frequency 2		0.0 to E1-04	0.0 Hz	A	A	A	30A	—
E1-12 <24> <26>	Mid Output Frequency Voltage 2		0.0 to 255.0	0.0 V	A	A	A	30B	—
E1-13 <24>	Base Voltage		0.0 to 255.0	0.0 V	A	S	S	30C	—



No.	Name	Description	Range	Def.	V/f	OLV	PM	Addr. Hex	Pg.
E2: Motor Parameters Use E2 parameters to set motor-related data.									
E2-01	Motor Rated Current	Sets the motor nameplate full load current in amperes (A). Automatically set during Auto-Tuning.	10 to 200% of drive rated current <27>	<57>	S	S	–	30E	87
E2-02	Motor Rated Slip	Sets the motor rated slip in Hertz (Hz). Automatically set during rotational Auto-Tuning.	0.00 to 20.00	<57>	A	A	–	30F	—
E2-03	Motor No-Load Current	Sets the magnetizing current of the motor as a percentage of the motor rated current (E2-01). Automatically set during rotational Auto-Tuning.	0 to less than E2-01	<57>	A	A	–	310	—
E2-04	Number of Motor Poles	Sets the number of motor poles. Automatically set during Auto-Tuning.	2 to 48	4 poles	A	A	–	311	—
E2-05	Motor Line-to-Line Resistance	Sets the phase-to-phase motor resistance in ohms. Automatically set during Auto-Tuning.	0.000 to 65.000 <37>	<57>	A	A	–	312	—
E2-06	Motor Leakage Inductance	Sets the voltage drop due to motor leakage inductance as a percentage of motor rated voltage. Automatically set during Auto-Tuning.	0.0 to 40.0	<57>	A	A	–	313	—
E2-07	Motor Iron-Core Saturation Coefficient 1	Sets the motor iron saturation coefficient at 75% of magnetic flux. Automatically set during Auto-Tuning.	E2-07 to 0.50	0.50	–	A	–	314	—
E2-08	Motor Iron-Core Saturation Coefficient 2	Sets the motor iron saturation coefficient at 75% of magnetic flux. Automatically set during Auto-Tuning.	[E2-07] to 0.75	0.75	–	A	–	315	—
E2-09	Motor Mechanical Loss	Sets the motor mechanical loss as a percentage of motor rated power (kW). Adjust in the following circumstances: • When there is a large amount of torque loss due to motor bearing friction. • When there is a large amount of torque loss.	0.0 to 10.0	0.0%	–	A	–	316	—
E2-10	Motor Iron Loss for Torque Compensation	Sets the motor iron loss in watts (W).	0 to 65535	<57>	A	–	–	317	—
E2-11	Motor Rated Output	Sets the motor rated power in kilowatts (kW). Automatically set during Auto-Tuning. (1HP = 0.746 kW).	0.00 to 650.00	0.40 kW <12>	S	S	–	318	85
E2-12	Motor Iron-Core Saturation Coefficient 3	Set to the motor iron saturation coefficient at 130% of magnetic flux. Automatically set during rotational Auto-Tuning.	1.30 to 5.00	1.30	–	A	–	328	—
E3: Motor 2 V/f Characteristics Use E3 parameters to set the V/f pattern for a second motor.									
E3-01	Motor 2 Control Method	0: V/f Control 2: Open Loop Vector (OLV)	0 or 2	0	A	A	–	319	—

No.	Name	Description	Range	Def.	Control Mode V/f	Control Mode OLV	Control Mode PM	Addr. Hex	Pg.
E3-04	Motor 2 Max Output Frequency	These parameters set the V/f pattern for motor 2. To set linear V/f characteristics, set the same values for E3-07 and E3-09. In this case, the setting for E3-08 will be disregarded. Ensure that the four frequencies are set according to these rules or OPE10 fault will occur: E3-04 ≥ E3-06 > E3-07 > E3-09 	40.0 to 400.0	60 Hz	A	A	–	31A	—
E3-05 <24>	Motor 2 Max Voltage		0.0 to 255.0	230 V	A	A	–	31B	—
E3-06	Motor 2 Base Frequency		0.0 to E3-04	60 Hz	A	A	–	31C	—
E3-07	Motor 2 Mid Output Freq.		0.0 to E3-04	3.0 Hz <53>	A	A	–	31D	—
E3-08 <24>	Motor 2 Mid Output Freq. Voltage		0.0 to 255.0	18.4 V <12> <53>	A	A	–	31E	—
E3-09	Motor 2 Min. Output Freq.		0.0 to E3-04	1.5 Hz <53>	A	A	–	31F	—
E3-10 <24>	Motor 2 Min. Output Freq. Voltage		0.0 to 255.0	13.8 V <12> <53>	A	A	–	320	—
E3-11 <26>	Motor 2 Mid Output Frequency 2		0.0 to E3-04	0.0 Hz	A	A	–	345	—
E3-12 <24> <52>	Motor 2 Mid Output Frequency Voltage 2		0.0 to 255.0 <24>	0.0 Vac	A	A	–	346	—
E3-13 <24>	Motor 2 Base Voltage		0.0 to 255.0 <24>	0.0 Vac	A	S	–	347	—
E4: Motor 2 Parameters Use E4 parameters to control a second motor operating on the same drive.									
E4-01	Motor 2 Rated Current	Sets the motor 2 name plate full load current in amperes (A). This value is automatically set during Auto-Tuning.	10 to 200% of drive rated current	<57>	A	A	–	321	—
E4-02	Motor 2 Rated Slip	Sets the motor 2 name plate full load current in amperes (A). Automatically set during Auto-Tuning.	0.00 to 20.00	<57>	A	A	–	322	—
E4-03	Motor 2 Rated No-Load Current	Sets the magnetizing current of motor 2 in percentage of full load current (E4-01). Automatically set during Rotational Auto-Tuning.	0 to less than [E4-01] <27>	<57>	A	A	–	323	—
E4-04	Motor 2 Motor Poles	Sets the number of poles of motor 2. This value is automatically set during Auto-Tuning.	2 to 48	4 poles	A	A	–	324	—
E4-05	Motor 2 Line-to-Line Resistance	Sets the phase-to-phase resistance of motor 2 in ohms. Automatically set during Auto-Tuning.	0.000 to 65.000 <37>	<57>	A	A	–	325	—
E4-06	Motor 2 Leakage Inductance	Sets the voltage drop due to motor leakage inductance as a percentage of rated voltage of motor 2. Automatically set during Auto-Tuning.	0.0 to 40.0	<57>	A	A	–	326	—
E4-07	Motor 2 Motor Iron-Core Saturation Coefficient 1	Set to the motor iron saturation coefficient at 50% of magnetic flux. Automatically set during Rotational Auto-Tuning.	0.00 to 0.50	0.50	–	A	–	343	—
E4-08	Motor 2 Motor Iron-Core Saturation Coefficient 2	Set to the motor iron saturation coefficient at 75% of magnetic flux. This value is automatically set during Rotational Auto-Tuning.	Setting for E4-07 to 0.75	0.75	–	A	–	344	—
E4-09	Motor 2 Mechanical Loss	Sets the motor mechanical loss as a percentage of motor rated power (kW) capacity. Adjust in the following circumstances: • When there is a large amount of torque loss due to motor bearing friction. • When there is a large amount of torque loss.	0.00 to 10.0	0.0	–	A	–	33F	—
E4-10	Motor 2 Iron Loss	Sets the motor iron loss in watts.	0 to 65535	<57>	–	A	–	340	—
E4-11	Motor 2 Rated Capacity	Sets the motor rated capacity in kW. Automatically set during Auto-Tuning.	0.00 to 650.00	<12>	A	A	–	327	—
E4-12	Motor 2 Iron-Core Saturation Coefficient 3	Set to the motor iron saturation coefficient at 130% of magnetic flux. Automatically set during Rotational Auto-Tuning.	1.30 to 5.00	1.30	–	A	–	342	—
E4-14 <22>	Motor 2 Slip Compensation Gain	Sets the slip compensation gain for motor 2. The function is the same as C3-01 for motor 1. Refer to the C3-01 description.	0.0 to 2.5	0.0 <53>	A	A	–	341	—
E4-15	Torque Compensation Gain - Motor 2	Sets the torque compensation gain for motor 2. The function is the same as C4-01 for motor 1. Refer to the C4-01 description.	1.00 to 2.50	1.00	A	A	–	341	—
E5: PM Motor Parameters									
E5-01 <25>	Motor Code Selection (for PM motor)	Enter the Yaskawa motor code for the PM motor being used. Various motor parameters are automatically set based on the value of this parameter. **Note:** Set to FFFF when using a specialized or custom motor. For all other motors:  All motor parameters are re-initialized to factory settings when this parameter is set.	0000 to FFFF	<12> <38>	–	–	S	329	321
E5-02 <25>	Motor Rated Capacity (for PM motor)	Sets the rated capacity of the motor.	0.10 to 18.5	<10>	–	–	S	32A	323
E5-03	Motor Rated Current	Sets the motor rated current in amps.	10 to 200% of drive rated current <27>	<4>	–	–	S	32B	323
E5-04 <25>	Motor Poles	Sets the number of motor poles.	2 to 48	<10>	–	–	S	32C	323
E5-05 <25>	Motor Resistance	Set the resistance for each motor phase in units of 0.001 Ω.	0.000 to 65.000	<10>	–	–	S	32D	323
E5-06 <25>	Motor d Axis Inductance	Sets the d axis inductance in units of 0.01 mH.	0.00 to 300.00	<10>	–	–	S	32E	323

Parameter List

B

No.	Name	Description	Range	Def.	Control Mode V/f	Control Mode OLV	Control Mode PM	Addr. Hex	Pg.
E5-07 <25>	Motor q Axis Inductance	Sets the q axis inductance in units of 0.01 mH.	0.00 to 600.00	<10>	–	–	S	32F	323
E5-09 <25>	Motor Induction Voltage Constant 1	Set the induced phase peak voltage in units of 0.1 mV (rad/min) [electrical angle]. Set this parameter when using a Yaskawa SSR1 series PM motor with derate torque, or a Yaskawa SST4 series motor with constant torque. When setting this parameter, E5-24 should be set to 0. An alarm will be triggered if both E5-09 and E5-24 are set to 0, or if neither parameter is set to 0.	0.0 to 2000.0	<10>	–	–	S	331	323
E5-24 <25>	Motor Induction Voltage Parameter 2	Set the induced phase-to-phase rms voltage in units of 0.1 mV/(r/min) [mechanical angle].Set this parameter when using a Yaskawa SMRA series pico motor. When setting this parameter, E5-09 should be set to 0. An alarm will be triggered if both E5-09 and E5-24 are set to 0, or if neither parameter is set to 0. If E5-03 (Motor Rated Current) is set to 0, however, then an alarm will not be triggered when both E5-09 and E5-24 are set to 0.	0.0 to 2000.0	0 <10>	–	–	S	353	323

Default setting value is dependent on parameter A1-02, Control Method Selection. The value shown is for A1-02 = 2-OLV control.
Default setting value is dependent on parameter A1-02, Control Method Selection. The value shown is for A1-02 = 0-V/f Control.
Default setting value is dependent on parameter A1-06. This setting value is 0 when A1-06 = 0, and 1 when A1-06 does not = 0.
Default setting value is dependent on parameter E5-01, Motor Code Selection.
Default setting value is dependent on parameter o2-04, Drive/kVA Selection.
Default setting value is dependent on parameter o2-04, Drive Capacity, when parameter H1-□□ = 16 Motor 2 is selected as a digital input. The value shown is when o2-04 = 98 (62H) 200V class 0.4 kW drive.
Range upper limit is dependent on parameters E5-01, Motor Code Selection, and A1-02, Control Method Selection. The value shown is for A1-02 = 5-PM OLV control.
Range upper limit is dependent on parameter E4-01 Motor 2 Rated Current.
Parameter can be changed during run.
Values shown here are for 200 V class drives. Double the value when using a 400 V class drive.
Parameter setting value is not reset to the default value during drive initialization, A1-03 = 1110, 2220, 3330.
Parameter ignored when E1-11, Motor 1 Mid Output Frequency 2, and E1-12, Motor 1 Mid Output Frequency Voltage 2, are set to 0.0.
Setting units for this parameter are determined by o2-04, Drive/kVA Selection. Less than 11 kW: 2 decimal points, 11 kW and above: 1 decimal point.
When parameter A1-02 = 5-PM OLV Control, E3-13 Motor 2 Base Voltage will be equal to T1-03, Motor Rated Voltage, after Auto-Tuning the drive
Default setting is determined by the V/f pattern selected to parameter E1-03.
Default setting changes when using OLV Control for PM motors.
Setting range becomes 0.00 to 130.00 for drives 0.2 kW and smaller.
If using a Yaskawa pico motor, the default setting is 1800 r/min.
Parameter ignored when E3-11, Motor 2 Mid Output Frequency 2, and E3-12, Motor 2 Mid Output Frequency Voltage 2, are set to 0.
Default setting depends on the control mode for motor 2 set in parameter E3-01. The given value is for V/f control.
Default setting value is dependent on parameter o2-04, Drive/kVA Selection and C6-01, Drive Duty Selection.

◆ F: Options

F parameters are used to program the drive for PG feedback and to function with option cards.

No.	Name	Description	Range	Def.	Control Mode V/f	Control Mode OLV	Control Mode PM	Addr. Hex	Pg.
F1: Simple PG V/f Parameters Use F1 parameters to set up the drive for Simple PG V/f control. These parameters are enabled only when H6-01 = 03.									
F1-02	Operation Selection at PG Open Circuit (PGO)	Sets stopping method when a PG open circuit fault (PGO) occurs. Refer to parameter F1-14. 0: Ramp to Stop - Decelerate to stop using the active deceleration time. 1: Coast to Stop 2: Fast-stop - Decelerate to stop using the deceleration time in C1-09. 3: Alarm only - Drive continues operation.	0 to 3	1	A	–	–	381	—
F1-03	Operation Selection at Overspeed (OS)	Sets the stopping method when an overspeed (OS) fault occurs. Refer to F1-08 and F1-09. 0: Ramp to stop - Decelerate to stop using the active deceleration time. 1: Coast to stop 2: Fast - Stop - Decelerate to stop using the deceleration time in C1-09. 3: Alarm Only - Drive continues operation.	0 to 3	1	A	–	–	382	—
F1-04	Operation Selection at Deviation	Sets the stopping method when a speed deviation (DEV) fault occurs. Refer to F1-10 and F1-11. 0: Ramp to stop - Decelerate to stop using the active deceleration time. 1: Coast to stop 2: Fast-stop - Decelerate to stop using the deceleration time in C1-09. 3: Alarm only - Drive continues operation.	0 to 3	3	A	–	–	383	—
F1-08	Overspeed Detection Level	Sets the speed feedback level which has to be exceeded for the time set in F1-09 before an OS fault will occur. Set as a percentage of the maximum output frequency (E1-04).	0 to 120	115%	A	–	–	387	—
F1-09	Overspeed Detection Delay Time	Sets the time in seconds for which the speed feedback has to exceed the overspeed detection level F1-08 before an OS fault will occur.	0.0 to 2.0	1.0	A	–	–	388	—
F1-10	Excessive Speed Deviation Detection Level	Sets the allowable deviation between motor speed and frequency reference before a speed deviation fault (DEV) is triggered. Set as a percentage of the maximum output frequency (E1-04).	0 to 50	10%	A	–	–	389	—
F1-11	Excessive Speed Deviation Detection Delay Time	Sets the time in seconds for which a deviation between motor speed and frequency reference has to exceed the speed deviation detection level F1-10 before a DEV fault will occur.	0.0 to 10.0	0.5 s	A	–	–	38A	—
F1-14	PG Open-Circuit Detection Time	Sets the time for which no PG pulses must be detected before a PG Open (PGO) fault is triggered.	0.0 to 10.0	2.0 s	A	–	–	38D	—

No.	Name	Description	Range	Def.	Control Mode V/f	Control Mode OLV	Control Mode PM	Addr. Hex	Pg.
F6 and F7: Serial Communications Option Card Settings Use F6 parameters to program the drive for serial communication.									
F6-01	Communications Error operation Selection	Selects the operation after a communications error occurred. 0: Ramp to stop using current accel/decel time 1: Coast to stop 2: Fast Stop using C1-09 3: Alarm only	0 to 3	1	A	A	A	3A2	
F6-02	External fault from comm. option selection	Sets when an external fault from a comm option is detected. 0: Always detected 1: Detection during Run only	0 or 1	0	A	A	A	3A3	
F6-03	External fault from comm. option operation selection	Selects the operation after an external fault set by a communications option (EF0). 0: Ramp to stop using current accel/decel time 1: Coast to stop 2: Fast Stop using C1-09 3: Alarm only	0 to 3	1	A	A	A	3A4	
F6-04	Trace Sampling Rate	-	0.0 to 5.0	2.0 s	A	A	A	3A5	
F6-10	CC-Link Node Address	Sets the node address if a CC-Link option card is installed	0 to 63	0	A	A	A	3E6	
F6-11	CC-Link communications speed	0: 156 Kbps 1: 625 Kbps 2: 2.5 Mbps 3: 5 Mbps 4: 10 Mbps	0 to 4	0	A	A	A	3E7	
F6-14	BUS Error auto reset	Selects if a BUS fault can be automatically reset.	0 or 1	0	A	A	A	3BB	
F6-20	DeviceNet MAC Address	Selects the drive’s MAC address for DeviceNet.	0 to 63	0	A	A	A	3C1	
F6-21	Device Net Communications Speed	0: 125 kbps 1: 250 kbps 2: 500 kbps 3: Detect automatically	0 to 3	3	A	A	A	3C2	
F6-22	Device Net PCA setting	I/O Polled Consuming Assembly Data Instance	0 to 255	0	A	A	A	3C3	
F6-23	Device Net PPA setting	I/O Polled Producing Assembly Data Instance	0 to 255	0	A	A	A	3C4	
F6-24	Device Net Idle mode fault detection	Selects if a fault s is detected during communication idle mode. 0: Disabled 1: Enabled	0 or 1	0	A	A	A	3C5	
F6-30	Profibus node address	Sets the node address for a Profibus option.	0 to 125	0	A	A	A	3CB	
F6-31	Profibus Clear mode selection	Selects the operation when a "Clear Mode" command is received. 0: Resets back to zero. 1: Maintains the previous value.	0 or 1	0	A	A	A	3CC	
F6-32	Profibus Map selections	0: PPO Type 1: Conventional	0 or 1	0	A	A	A	3CD	
F6-36	CANopen Node ID selection	Sets the Node ID for a CANopen option	0 to 127	99	A	A	A	3D0	
F6-37	CANopen Communications speed	0: Auto-adjust 1: 10 kbps 2: 20 kbps 3: 50 kbps 4: 125 kbps 5: 250 kbps 6: 500 kbps 7: 800 kbps 8: 1 Mbps	0 to 8	6	A	A	A	3D1	
F6-40	CompoNet Node ID	Sets the Node ID for a CompoNet option.	0 to 63	0	A	A	A	3D5	
F6-41	CompoNet Speed	0: 93.75kbit/s 1: Reserved 2: 1.5Mbit/s 3: 3Mbit/s 4: 4Mbit/s 5-255: Reserved	0 to 255	0	A	A	A	3D6	
F7-01	Ethernet IP Address 1	Combining these parameters like F7-01.F7-02.F7-03.F7-04 sets the Ethernet IP address. Example: (192.168.1.10)	0 to 255	0	A	A	A	3E5	
F7-02	Ethernet IP Address 1		0 to 255	0	A	A	A	3E6	
F7-03	Ethernet IP Address 1		0 to 255	0	A	A	A	3E7	
F7-04	Ethernet IP Address 1		0 to 255	0	A	A	A	3E8	
F7-05	Subnet Mask 1	Combining these parameters like F7-05.F7-06.F7-07.F7-08 sets the Ethernet Subnet Mask. Example: (255.255.255.0)	0 to 255	0	A	A	A	3E9	
F7-06	Subnet Mask 2		0 to 255	0	A	A	A	3EA	
F7-07	Subnet Mask 3		0 to 255	0	A	A	A	3EB	
F7-08	Subnet Mask 4		0 to 255	0	A	A	A	3EC	
F7-09	Gateway Address 1	Combining these parameters like F7-09.F7-10.F7-11.F7-12 sets the Ethernet Gateway Address. Example: (192.168.1.1)	0 to 255	0	A	A	A	3ED	
F7-10	Gateway Address 2		0 to 255	0	A	A	A	3EE	
F7-11	Gateway Address 3		0 to 255	0	A	A	A	3EF	
F7-12	Gateway Address 4		0 to 255	0	A	A	A	3F0	
F7-13	Dress Mode at Startup	Selects how the Ethernet IP address is set. 0: User defined 1: BOOTP 2: DHCP	0 to 2	0	A	A	A	3F1	
F7-14	Security password	Sets the password required for setup changes via the network. 0: No password required 1 - 9999: 4 digit password	0 to 9999	0	A	A	A	3F2	
F7-15	Duplex Mode Selection	0: Auto Negotiate 1: Half Duplex forced 2: Full Duplex forced	0 to 2	0	A	A	A	3F3	
F7-18	Communication Speed Selection	0: Auto Negotiate 10: 10 Mbps speed setting 100: 100Mbps Speed Setting	0, 10, 100	0	A	A	A	3F6	

No.	Name	Description	Range	Def.	Control Mode V/f	Control Mode OLV	Control Mode PM	Addr. Hex	Pg.
F7-19	Web Page Access	Selects the mode for modification on the Ethernet option board Web page settings. 0: All access 1: Only during stop 2: Never	0 to 2	0	A	A	A	3F7	
F7-20	Gateway selection	0: Gateway not used 1: Use Gateway	0 or 1	1	A	A	A	3F8	
F7-21	Communication loss time out	Multiplier for communication loss detection timeout value.	0 to 300	0	A	A	A	3F9	

◆ H Parameters: Multi-Function Terminals

H parameters assign functions to the multi-function input and output terminals.

No.	Name	Description	Range	Def.	Control Mode V/f	Control Mode OLV	Control Mode PM	Addr. Hex	Pg.
H1: Multi-Function Digital Input H1 parameters to assign functions to the multi-function digital input terminals. Unused terminals should be set to "F".									
H1-01	Multi-Function Digital Input Terminal S1 Function Selection	Selects the function of terminals S1 to S7 Refer to H1 Multi-Function Digital Input Selections on page 304 for a description of setting values.	1 to 9F <40>	40	A	A	A	438	—
H1-02	Multi-Function Digital Input Terminal S2 Function Selection			41	A	A	A	439	—
H1-03	Multi-Function Digital Input Terminal S3 Function Selection			24	A	A	A	400	—
H1-04	Multi-Function Digital Input Terminal S4 Function Selection			14	A	A	A	401	—
H1-05	Multi-Function Digital Input Terminal S5 Function Selection			3(0) <18>	A	A	A	402	—
H1-06	Multi-Function Digital Input Terminal S6 Function Selection			4(3) <18>	A	A	A	403	—
H1-07	Multi-Function Digital Input Terminal S7 Function Selection			6(4) <18>	A	A	A	404	—

<18> Parenthetical value is the default when parameter A1-03 = 3330 3-Wire Initialization.
<40> The availability of certain functions depends on the control method used.

H1 Multi-Function Digital Input Selections

H1-☐ Setting	Function	Description	Control Mode V/f	Control Mode OLV	Control Mode PM	Pg.
0	3-Wire Sequence	Closed: Reverse rotation (only if the drive is set up for 3-wire sequence)	O	O	O	—
1	Local/Remote Selection	Open: Remote, Reference 1 or 2 (b1-01/02 or b1-15/16) Closed: Local, LED operator is run and reference source	O	O	O	—
2	External Reference 1/2	Open: Run and frequency reference source 1 (b1-01/02) Closed: Run and frequency reference source 2 (b1-15/16)	O	O	O	—
3	Multi-Step Speed Reference 1	Used to select Multi-Step Speeds set in d1-01 to d1-16	O	O	O	—
4	Multi-Step Speed Reference 2		O	O	O	—
5	Multi-Step Speed Reference 3		O	O	O	—
6	Jog Reference Selection	Open: Selected speed reference Closed: Jog Frequency reference (d1-17). Jog has priority over all other reference sources.	O	O	O	—
7	Accel/Decel Time 1	Used to switch between Accel/Decel. Time 1/2	O	O	O	—
8	Baseblock Command (N.O.)	Open: Normal operation Closed: No drive output	O	O	O	—
9	Baseblock Command (N.C.)	Open: No drive output Closed: Normal operation	O	O	O	—
A	Accel/Decel Ramp Hold	Closed: The drive pauses during acceleration or deceleration and maintains the output frequency.	O	O	O	—
B	Drive Overheat Alarm (OH2)	Closed: Displays an OH2 alarm	O	O	O	—
C	Terminal A2 Enable	Open: Terminal A2 disabled Closed: Terminal A2 enabled	O	O	O	—
F	Not used	Select this setting when not using the terminal or when using the terminal in a pass-through mode.	O	O	O	—
10	Up Command	Open: Maintains the current frequency reference Closed: Increases or decreases the current frequency reference. Ensure that the increase and decrease commands are set in conjunction with one another. The frequency reference source must be set to operator (b1-01 = 0).	O	O	O	—
11	Down Command		O	O	O	—
12	Forward Jog	Closed: Runs forward at the Jog Frequency d1-17.	O	O	O	—
13	Reverse Jog	Closed: Runs reverse at the Jog Frequency d1-17.	O	O	O	—
14	Fault Reset	Closed: Resets faults if the cause is cleared and the Run command is removed.	O	O	O	—
15	Fast-Stop (N.O.)	Closed: Decelerates at the Fast-Stop time C1-09. To restart the Fast-Stop input must be released and Run must be cycled.	O	O	O	—
16	Motor 2 Selection	Open: Motor 1 (E1-☐☐, E2-☐☐) Closed: Motor 2 (E3-☐☐, E4-☐☐)	O	O	O	—
17	Fast-stop (N.C.)	Open: Decelerates according to C1-09 (Fast-stop Time)	O	O	O	—
18	Timer Input Function	Set the timer delay using parameters b4-01 and b4-02. Ensure this function is set in conjunction with the multi-function output timer (H2-☐☐= 12).	O	O	O	—
19	PID Disable	Closed: PID control disabled	O	O	O	—
1A	Accel/Decel Time Selection 2	Switches Accel/Decel times.	O	O	O	—
1B	Program Lockout	Open: Parameters can not be edited. (except U1-01 if reference source is set for operator) Closed: Parameters may be edited and saved.	O	O	O	—
1E	Reference Sample Hold	Closed: Samples the analog frequency reference and operates the drive at that speed.	O	O	O	—

H1 Multi-Function Digital Input Selections						
H1-□ Setting	Function	Description	Control Mode			Pg.
			V/f	OLV	PM	
20 to 2F	External Fault	20: N.O., Always Detected, Ramp To Stop 21: N.C., Always Detected, Ramp To Stop 22: N.O., During Run, Ramp To Stop 23: N.C., During Run, Ramp To Stop 24: N.O., Always Detected, Coast To Stop 25: N.C., Always Detected, Coast To Stop 26: N.O., During Run, Coast To Stop 27: N.C., During Run, Coast To Stop 28: N.O., Always Detected, Fast-stop 29: N.C., Always Detected, Fast-stop 2A: N.O., During Run, Fast-stop 2B: N.C., During Run, Fast-stop 2C: N.O., Always Detected, Alarm Only (continue running) 2D: N.C., Always Detected, Alarm Only (continue running) 2E: N.O., During Run, Alarm Only (continue running) 2F: N.C., During Run, Alarm Only (continue running)	O	O	O	—
30	PID Integral Reset	Closed: Resets the PID control integral value.	O	O	O	—
31	PID Integral Hold	Closed: Maintains the current PID control integral value.	O	O	O	—
32	Multi-Step Speed Reference 4	Used to select Multi-Step Speeds set in d1-01 to d1-16	O	O	O	—
34	PID Soft Starter	Closed: Disables the PID soft starter b5-17.	O	O	O	—
35	PID Input Switch	Closed: Inverses the PID input signal	O	O	O	—
40	Forward Run Command (2-wire sequence)	Open: Stop Closed: Forward run **Note:** Can not be set together with Settings 42 or 43.	O	O	O	—
41	Reverse Run Command (2-wire sequence)	Open: Stop Closed: Reverse run **Note:** Can not be set together with Settings 42 or 43.	O	O	O	—
42	Run Command (2-wire sequence 2)	Open: Stop Closed: Run **Note:** Can not be set together with Settings 40 or 41.	O	O	O	—
43	FWD/REV Command (2-wire sequence 2)	Open: Reverse Closed: Forward **Note:** Can not be set together with Settings 40 or 41.	O	O	O	—
44	Offset Frequency 1 Addition	Closed: Adds d7-01 to the frequency reference.	O	O	O	—
45	Offset Frequency 2 Addition	Closed: Adds d7-02 to the frequency reference.	O	O	O	—
46	Offset Frequency 3 Addition	Closed: Adds d7-03 to the frequency reference.	O	O	O	—
60	DC Injection Braking Command	Closed: Triggers DC Injection Braking (b2-02)	O	O	-	—
61	External Search Command 1	Closed: Activates Current Detection Speed Search from the max. output frequency (E1-04) if b3-01=0. Activates Speed Estimation Type Speed search if b3-01 =1.	O	O	O	—
62	External Search Command 2	Closed: Activates Current Detection Speed Search from the frequency reference b3-01=0. Activates Speed Estimation Type Speed search if b3-01 =1.	O	O	O	—
65	KEB Ride-Thru 1 (N.C.)	Open: KEB Ride-Thru 1 enabled Closed: Normal operation	O	O	O	—
66	KEB Ride-Thru 1 (N.O.)	Open: Normal operation Closed: KEB Ride-Thru 1 enabled	O	O	O	—
67	Communications Test Mode	Tests the MEMOBUS/Modbus RS-485/422 interface.	O	O	O	—
68	High-Slip Braking	Closed: High-Slip braking is executed. Drive stops.	O	-	-	—
6A	Drive Enable	Open: Drive disabled. If this input is opened during run, then the drive will stop as specified by parameter b1-03. Closed: Ready for operation.	O	O	O	—
75	Up 2 Command	Open: Maintains the current frequency reference Closed: Increases or decreases the frequency reference. UP 2 and Down 2 commands must be set in combination with each other. The frequency reference source must be assigned to the operator (b1-01 = “0”).	O	O	O	—
76	Down 2 Command		O	O	O	—
7A	KEB Ride-Thru 2 (N.C.)	Open: KEB Ride-Thru 2 enabled Closed: Normal operation	O	O	O	—
7B	KEB Ride-Thru 2 (N.O.)	Open: Normal operation Closed: KEB Ride-Thru 2 enabled	O	O	O	—
7C	Short-Circuit Braking (N.O.)	Open: Normal operation Closed: Short-Circuit Braking	-	-	O	—
7D	Short-Circuit Braking (N.C.)		-	-	O	—
7E	Forward/Reverse Detection	Direction of rotation detection (for Simple V/f w/PG)	O	-	-	—
9F	DriveWorksEZ enable	Open: DWEZ enabled Closed: DWEZ disabled	O	O	O	—

No.	Name	Description	Range	Def.	Control Mode			Addr. Hex	Pg.
					V/f	OLV	PM		
H2: Multi-Function Digital Outputs Use H2 parameters to assign functions to the multi-function digital outputs.									
H2-01	Terminal MA, MB and MC Function Selection (relay)	Refer to H2 Multi-Function Digital Output Settings on page 306 for a description of setting values.	0 to 192 <40>	E	A	A	A	40B	—
H2-02	Terminal P1 Function Selection (open-collector)			0	A	A	A	40C	—
H2-03	Terminal P2 Function Selection (open-collector)			2	A	A	A	40D	—

No.	Name	Description	Range	Def.	Control Mode			Addr. Hex	Pg.
					V/f	OLV	PM		
H2-06	Watt Hour Output Unit Selection	Sets the display units for one of the multi-function output terminals that is assigned to output the watt hours (H2-□□ = 39) is the value every 200 ms. An output pulse of 200 ms is provided for every kWh that occurs. Intended to drive a counter, meter or PLC for logging kWh. 0: 0.1 kWh units 1: 1 kWh units 2: 10 kWh units 3: 100 kWh units 4: 1000 kWh units	0 to 4	0	A	A	A	437	—

<40> The availability of certain functions depends on the control method used.

H2 Multi-Function Digital Output Settings						
H2-□□ Setting	Function	Description	Control Mode			Pg.
			V/f	OLV	PM	
0	During Run	Closed: A Run command is active or voltage is output.	O	O	O	—
1	Zero Speed	Closed: Output frequency is 0.	O	O	O	—
2	Fref/Fout Agree 1	Closed: Output frequency equals the speed reference (plus or minus the hysteresis set to L4-02).	O	O	O	—
3	Fref/Fset Agree 1	Closed: Output frequency and speed reference equal the value in L4-01 (plus or minus the hysteresis of L4-02).	O	O	O	—
4	Frequency (FOUT) Detection 1	Closed: Output frequency is less than or equal to the value in L4-01 with hysteresis determined by L4-02.	O	O	O	—
5	Frequency (FOUT) Detection 2	Closed: Output frequency is greater than or equal to the value in L4-01, with hysteresis determined by L4-02.	O	O	O	—
6	Drive Ready	Closed: Drive Ready. The drive is powered up, not in a fault state, and in the Drive mode.	O	O	O	—
7	DC Bus Undervoltage	Closed: DC bus voltage is below the UV trip level set in L2-05.	O	O	O	—
8	During Baseblock	Closed: This is no output voltage	O	O	O	—
9	Option Reference	Closed: Digital operator supplies the frequency reference.	O	O	O	—
A	Local/Remote	Open: Reference 1 or 2 are active Closed: Digital operator supplies the run command.	O	O	O	—
B	Torque Detection 1 (N.O.)	Closed: Output current/torque exceeds the torque value set in parameter L6-02 for longer than the time set in parameter L6-03.	O	O	O	—
C	Loss of Reference	Closed: Loss of the analog frequency reference detected. Enabled when L4-05 = 1.	O	O	O	—
D	Braking Resistor Fault	Closed: Braking resistor or transistor is overheated or faulted out. This selection requires that braking resistor protection parameter be set for ERF (L8-01 = “1”).	O	O	O	—
E	Fault	Closed: Fault occurred (other than CPF00 and CPF01).	O	O	O	—
F	Not used	Set this value when the terminal is not used, or when using the terminal in the pass-through mode.	O	O	O	—
10	Alarm	Closed: An alarm is triggered.	O	O	O	—
11	Reset Command Active	Closed: Reset command to the drive is active.	O	O	O	—
12	Timer Output	Timer output, controlled by b4-01 and b4-02. Used in conjunction with the digital input (H1-□□ = 18 “timer function”).	O	O	O	—
13	Fref/Fout Agree 2	Closed: When drive output frequency equals the frequency reference +/- L4-04.	O	O	O	—
14	Fref/Fset Agree 2	Closed: When the drive output frequency is equal to the value in L4-03 (plus or minus L4-04).	O	O	O	—
15	Frequency Detection 3	Closed: When the drive output frequency is less than or equal to the value in L4-03 with the hysteresis determined by L4-04.	O	O	O	—
16	Frequency Detection 4	Closed: When the output frequency is greater than or equal to the value in L4-03 with the hysteresis determined by L4-04.	O	O	O	—
17	Torque Detection 1 (N.C.)	Open: When the output current/torque exceeds the value set in parameter L6-02 for more time than is set in parameter L6-03.	O	O	O	—
18	Torque Detection 2 (N.O.)	Closed: When the output current/torque exceeds the value set in parameter L6-05 for more time than is set in parameter L6-06.	O	O	O	—
19	Torque Detection 2 (N.C.)	Open: Output current/torque exceeds the value set in parameter L6-05 for more time than is set in parameter L6-06.	O	O	O	—
1A	Reverse Direction	Closed: Drive is running in the reverse direction.	O	O	O	—
1B	Baseblock 2	Open: Drive is in base block condition. Output is disabled.	O	O	O	—
1C	Motor 2 Selection	Closed: Motor 2 is selected by a digital input (H1-□□ = 16)	O	O	−	—
1E	Restart Enabled	Closed: An automatic restart is performed	O	O	O	—
1F	Overload Alarm OL1	Closed: OL1 is at 90% of its trip point or greater.	O	O	O	—
20	OH Pre alarm	Closed: Heatsink temperature exceeds the parameter L8-02 value.	O	O	O	—
22	Mechanical Weakening (N.O.)	Closed: Mechanical Weakening detected.	O	O	O	—
30	During Torque Limit	Closed: When the torque limit has been reached.	−	O	−	—
37	During Frequency Output	Closed: Frequency is output Open: Operation stopped, Baseblock, DC Injection Braking, or Initial Excitation is being performed.	O	O	O	—
38	Drive Enable	Closed: Multi-function input closes (H1-□□ = 6A)	O	O	O	—
39	Watt Hour Pulse Output	Output units are determined by H2-06, outputs 200 ms pulse for each incremented kWh count.	O	O	O	—
3C	Drive Mode	Closed: Local Open: Remote (this signal combines setting values 9 and A)	O	O	O	—
3D	Speed Search	Closed: Speed search is being executed.	O	O	O	—
3E	PID Feedback Loss	Closed: PID Feedback Loss. PID feedback value is below the level set to b5-13 for longer than the time set in b5-14.	O	O	O	—
3F	PID Feedback Fault	Closed: PID Feedback Fault. PID feedback value exceeds the level set to b5-36 for longer than the time set to b5-37.	O	O	O	—
4A	KEB Operation	Closed: KEB is being performed.	O	O	O	—
4B	Short-Circuit Brake	Closed: Short-Circuit Braking is active.	−	−	O	—
4C	During Fast-stop	Closed: Fast-stop command is entered	O	O	O	—
4D	OH Pre-alarm Time Limit	Closed: OH Pre-alarm time limit is passed.	O	O	O	—

H2 Multi-Function Digital Output Settings						
H2-☐☐ Setting	Function	Description	Control Mode			Pg.
			V/f	OLV	PM	
100 to 14D	H2 Parameter Functions Reversed Output Switching of 0 to 92	Reverse 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. Examples: Setting "108" reverses the output of "During baseblock," which is setting value 08. Setting "14A" reverses the output of "During KEB operation", which is setting "4A".	O	O	O	—

No.	Name	Description	Range	Def.	Control Mode			Addr. Hex	Pg.
					V/f	OLV	PM		
H3: Analog Inputs Use H3 parameters to set the multi-function analog input terminals.									
H3-01	Terminal A1 Signal Level Selection	Sets the input level for terminal A1. 0: 0 to +10 V (lower limit) 1: 0 to +10 V (no lower limit)	0, 1	0	A	A	A	410	—
H3-02	Terminal A1 Function Selection	Sets the function of terminal A1. When terminal A1 is not used or is used as a through terminal, this parameter must be set to "F".	0 to 31 <40>	0	A	A	A	434	—
H3-03 <22>	Terminal A1 Gain Setting	Sets the level of the input value selected in H3-02 when 10V is input at terminal A1.	-999.9 to 999.9	100.0%	A	A	A	411	—
H3-04 <22>	Terminal A1 Bias Setting	Sets the level of the input value selected in H3-02 when 0V is input at terminal A1.	-999.9 to 999.9	0.0%	A	A	A	412	—
H3-09	Terminal A2 Signal Level Selection	Sets the input signal level for terminal A2. 0: 0 to +10 V (with lower limit) 1: 0 to +10 V (no lower limit) 2: 4 to 20 mA 3: 0 to 20 mA	0 to 3	2	A	A	A	417	—
			Switch between current or voltage inputs by using DIP switch S1-2 switch on the terminal board. *Refer to I/O Connections on page 48*.						
H3-10	Terminal A2 Function Selection	Sets the function of terminal A2. When terminal A2 is not used or is used as a through terminal, this parameter must be set to "F".	0 to 31 <40>	0	A	A	A	418	—
H3-11 <22>	Terminal A2 Gain Setting	Sets the level of the input value selected in H3-10 when 10 V (20 mA) is input at terminal A2.	-999.9 to 1000.0	100.0%	A	A	A	419	—
H3-12 <22>	Terminal A2 Input Bias	Sets the level of the input value selected in H3-10 when 0 V (0 or 4 mA) is input at terminal A2.	-999.9 to 999.-	0.0%	A	A	A	41A	—
H3-13	Analog Input Filter Time Constant	Sets the primary delay filter time constant for terminals A1 and A2. Used for noise filtering.	0.00 to 2.00	0.03 s	A	A	A	41B	—

<22> Parameter can be changed during run.
<40> The availability of certain parameters depends on the control method used.

H3 Multi-Function Analog Input Settings						
H3-☐☐ Setting	Function	Maximum Input Level Possible	Control Mode			Pg.
			V/f	OLV	PM	
0	Frequency Bias	Max output frequency (E1-04). Same value can be set using H3-02 and H3-10.	O	O	O	—
1	Frequency Gain	Frequency reference (voltage)	O	O	O	—
2	Auxiliary Frequency Reference (used as a multi step speed 2)	Max output frequency (E1-04)	O	O	O	—
4	Output Voltage Bias	Motor rated voltage (E1-05).	O	–	–	—
7	Overtorque/Undertorque Detection Level	Open Loop Vector: Motor rated torque V/f control: Drive rated current	O	O	O	—
B	PID Feedback	10V = 100%	O	O	O	—
C	PID Set Point	10V = 100%	O	O	O	—
E	Motor Temperature (PTC input)	10 V = 100.00% Determined by L1-03 and L1-04.	O	O	O	—
F	Not used / Pass-through mode	–	O	O	O	—
10	FWD Torque Limit	Motor rated torque	–	O	–	—
11	REV Torque Limit	Motor rated torque	–	O	–	—
12	Regenerative Torque Limit	Motor rated torque	–	O	–	—
15	FWD/REV Torque Limit	Motor rated torque	–	O	–	—
16	Differential PID Feedback	10 V = 100%	O	O	O	—

No.	Name	Description	Range	Def.	Control Mode			Addr. Hex	Pg.
					V/f	OLV	PM		
H4: Multi-Function Analog Outputs Use H4 parameters to configure the multi-function analog output terminals.									
H4-01	Multi-Function Analog Output Terminal AM)	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. When using this terminal in trough mode or when not using it at all, set "000" or "031".	000 to 999 <40>	102	A	A	A	41D	—
H4-02 <22>	Multi-Function Analog Output Terminal AM Gain	Sets terminal AM output level when selected monitor is at 100%. Maximum output voltage is 10 V.	-999.9 to 999.9	100.0%	S	S	S	41E	—
H4-03 <22>	Multi-Function Analog Output Terminal AM Gain	Sets terminal AM output level when selected monitor is at 0%.	-999.9 to 999.9	0.0%	A	A	A	41F	—

No.	Name	Description	Range	Def.	Control Mode V/f	Control Mode OLV	Control Mode PM	Addr. Hex	Pg.
H5: MEMOBUS/Modbus Communications Use H5 Parameters to connect the drive to a MEMOBUS/Modbus network.									
H5-01 <39>	Drive Node Address	Selects drive station node number (address) for MEMOBUS/Modbus terminals R+, R-, S+, S-. Cycle power for the setting to take effect.	0 to 20 H	1F	A	A	A	425	—
H5-02	Communication Speed Selection	Selects the baud rate for MEMOBUS/Modbus terminals R+, R-, S+ and S-. Cycle power for the setting to take effect. 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	0 to 8	3	A	A	A	426	—
H5-03	Communication Parity Selection	Selects the communication parity for MEMOBUS/Modbus terminals R+, R-, S + and S-. Cycle power for the setting to take effect. 0: No parity 1: Even parity 2: Odd parity	0 to 2	0	A	A	A	427	—
H5-04	Stopping Method After Communication Error	Selects the stopping method when a communication time-out fault (CE) is detected. 0: Ramp to stop 1: Coast to stop 2: Fast-stop 3: Alarm only	0 to 3	3	A	A	A	428	—
H5-05	Communication Fault Detection Selection	Enables or disables the communications time-out fault (CE) detection. 0: Disabled 1: Enabled - If communication is lost for more than two seconds, a CE fault will occur.	0, 1	1	A	A	A	429	—
H5-06	Drive Transmit Wait Time	Set the wait time between receiving and sending data.	5 to 65	5 ms	A	A	A	42A	—
H5-07	RTS Control Selection	Selects "request to send" (RTS) control: 0: Disabled - RTS is always on. 1: Enabled - RTS turns on only when sending.	0, 1	1	A	A	A	42B	—
H5-09	CE Detection Time	Sets the time required to detect a communications error. Adjustment may be need when networking several drives.	0.0 to 10.0 s	2.0 s	A	A	A	435	—
H5-10	Unit Selection for MEMOBUS/ Modbus Register 0025H	Selects the units used for MEMOBUS/Modbus register 0025H (Output Voltage Reference Monitor). 0: 0.1 V units 1: 1 V units	0, 1	0	A	A	A	436	—
H5-11	Communications ENTER Function Selection	Select the function for the enter command that saves parameter data to the drive. 0: Parameter changes are activated when ENTER command is entered. 1: Parameter changes are activated immediately without ENTER command (compatible with Varispeed VS606-V7).	0, 1	1	A	A	A	43C	—
H5-12	Run Command Method Selection	0: FWD/STOP, REV/STOP Method 1: RUN/STOP, FWD/REV Method	0, 1	0	A	A	A	43D	—
H6: Pulse Train Input/Output Use H6 parameters to configure Pulse Train I/O operation.									
H6-01	Pulse Train Input Terminal RP Function Selection	Selects pulse train input function. 0: Frequency reference 1: PID feedback value 2: PID setpoint value 3: Simple PG V/f control mode (can be set only when using motor 1 in the V/f control mode)	0 to 3	0	A	A	A	42C	—
H6-02 <22>	Pulse Train Input Scaling	Sets the number of pulses (Hz) that is equal to 100% of the value selected in H6-01.	1000 to 32000	1440 Hz	A	A	A	42D	—
H6-03 <22>	Pulse Train Input Gain	Sets the level of the value selected in H6-01 when a frequency with the value set in H6-02 is input.	0.0 to 1000.0	100.0%	A	A	A	42E	—
H6-04 <22>	Pulse Train Input Bias	Sets the level of the value selected in H6-01 when 0 Hz is input.	-100.0 to +100.0	0.0%	A	A	A	42F	—
H6-05 <22>	Pulse Train Input Filter Time	Sets the pulse train input filter time constant.	0.00 to 2.00	0.10 s	A	A	A	430	—
H6-06 <22>	Pulse Train Monitor Terminal MP Selection	Select the pulse train monitor output function (value of the □-□□ part of U□-□□). *Refer to U: Monitors on page 316* for the list of U monitors. Example: To select U5-01, set “501.” When not using this parameter or when using in the through mode, set “000.”	000, 031, 101, 102, 105, 116, 501, 502	102	A	A	A	431	—
H6-07 <22>	Pulse Train Monitor Scaling	Sets the pulse output frequency in Hz when the monitor value is 100%. Set H6-06 to “2” and H6-07 to “0”, to make the pulse train monitor output equal to the output frequency.	0 to 32000	1440 Hz	A	A	A	432	—

<22> Parameter can be changed during run.
<39> If this parameter is set to 0, the drive will be unable to respond to MEMOBUS/Modbus commands.
<40> The availability of certain functions depends on the control method used.

Note: Cycle power to the drive to enable MEMOBUS/Modbus settings.

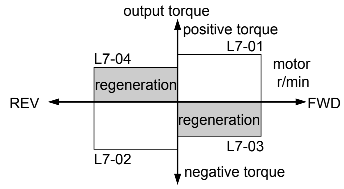
◆ L: Protection Function

L parameters provide protection to the drive and motor, such as: control during momentary power loss, stall prevention, frequency detection, fault restarts, overtorque detection, torque limits and other types of hardware protection.

No.	Name	Description	Range	Def.	Control Mode V/f	Control Mode OLV	Control Mode PM	Addr. Hex	Pg.
L1: Motor Protection Functions Use L1 parameters to configure motor protective functions.									
L1-01	Motor Overload Protection Selection	Sets the motor thermal overload protection (OL1) based on the cooling capacity of the motor. 0: Disabled 1: Standard Fan Cooled (< 10:1 motor) 2: Standard Blower Cooled (≥ 10:1 motor) 3: Vector Motor (100:1 motor) 4: PM motor with variable torque **NOTICE:** The thermal protection is reset when the power is cycled. In applications where the power is frequently cycled, the drive may not be able to provide protection, even if this parameter is set to 1. Set to “0” and ensure each motor has a thermal relay installed.	0 to 4	1 <2>	S	S	S	480	87
L1-02	Motor Overload Protection Time	Sets the motor thermal overload protection (OL1) time. A larger L1-02 time will increase the time for an OL1 fault to occur. This parameter does not typically require adjustment. Should be set in accordance with the overload tolerance of the motor.	0.1 to 5.0	1.0 min	A	A	A	481	—
L1-03	Motor Overheat Alarm Operation Selection (PTC input)	Sets operation when the motor temperature analog input (H3-02/10 = E) exceeds the OH3 alarm level. 0: Ramp to Stop 1: Coast to Stop 2: Fast-stop using C1-09 3: Alarm Only (“oH3” will flash)	0 to 3	3	A	A	A	482	—
L1-04	Motor Overheat Fault Operation Selection (PTC input)	Sets stopping method when the motor temperature analog input (H3-02/10 = E) exceeds the OH4 fault level. 0: Ramp to Stop 1: Coast to Stop 2: Fast-stop	0 to 2	1	A	A	A	483	—
L1-05	Motor Temperature Input Filter Time (PTC input)	This parameter adjusts the filter on the motor temperature analog input (H3-02 or H3-10 = E). Increase to add stability, decrease to improve response.	0.00 to 10.00	0.20 s	A	A	A	484	—
L1-13	Continuous Electrothermal Operation Selection	Determines whether or not to hold the electrothermal value when the power supply is interrupted. 0: Disabled 1: Enabled	0 to 1	1	A	A	A	46D	—
L2: Momentary Power Loss Use L2 parameters to configure drive functions for momentary power loss conditions.									
L2-01	Momentary Power Loss Operation Selection	Enables and disables the momentary power loss function. 0: Disabled - Drive trips on (UV1) fault when power is lost. 1: Power Loss Ride-Thru Time - Drive will restart if power returns within the time set in L2-02. 2: CPU Power Active - Drive will restart if power returns as long as the CPU is working.	0 to 2 For a restart to occur, the run command must be maintained throughout the ride-thru period.	0	A	A	A	485	—
L2-02	Momentary Power Loss Ride-Thru Time	Sets the Power Loss Ride-Thru time. Only effective when L2-01 = 1.	0.0 to 25.5	<12>	A	A	A	486	—
L2-03	Momentary Power Loss Minimum Baseblock Time	Sets the minimum wait time for residual motor voltage decay before the drive output reenergizes after power loss ride-thru. If L2-03 is greater than L2-02, operation resumes after the time set in L2-03.	0.1 to 5.0	<57>	A	A	A	487	—
L2-04	Momentary Power Loss Voltage Recovery Ramp Time	Sets the time for the output voltage to return to the preset V/f pattern during speed search.	0.0 to 5.0	<12>	A	A	A	488	—
L2-05 <24>	Undervoltage Detection Level (UV)	Sets the DC Bus undervoltage trip level. If this is set lower than the default setting, additional AC input impedance or DC bus reactance may be necessary. Consult with the manufacturer before changing this parameter setting.This value is used for KEB activation if L2-01 > 0.	150 to 210	<9> <12>	A	A	A	489	—
L2-06	KEB Deceleration Time	Sets the time required to decelerate from the speed when KEB was activated to zero speed.	0.0 to 200.0	0.0 s	A	A	A	48A	—
L2-07	KEB Acceleration Time	Set the time to accelerate to the set speed after recovery from a momentary power loss. If set to 0.0, the active acceleration time is used.	0.0 to 25.5	0.0 s	A	A	A	48B	—
L2-08	KEB Start Output Frequency Reduction	Sets the percentage of output frequency reduction at the beginning of deceleration when a KEB command is input from multi-function input. Reduction = (slip frequency before KEB) x L2-08 x 2	0 to 300	100%	A	A	A	48C	—
L2-11 <24>	Desired DC Bus Voltage during KEB	Sets the desired value of the DC bus voltage during KEB.	150 to 400 V	E1-01 x 1.22	A	A	A	461	—
L3: Stall Prevention Function Use L3 parameters to configure the stall prevention function.									
L3-01	Stall Prevention Selection during Acceleration	Selects the stall prevention method used to prevent excessive current during acceleration. 0: Disabled - Motor accelerates at active acceleration rate. The motor may stall if load is too heavy or accel time is too short. 1: General Purpose - When output current exceeds L3-02 level, acceleration stops. Acceleration will continue when the output current level falls below the L3-02 level. 2: Intelligent - The active acceleration rate is ignored. Acceleration is completed in the shortest amount of time without exceeding the current value set in L3-02.	0 to 2 <29>	1	A	A	A	48F	—
L3-02	Stall Prevention Level during Acceleration	Used when L3-01 = 1 or 2. 100% is equal to the drive rated current. Decrease the set value if stalling or excessive current occurs with default setting.	0 to 150	<7>	A	A	A	490	—
L3-03	Stall Prevention Limit during Acceleration	Sets stall prevention lower limit during acceleration when operating in the constant power range. Set as a percentage of the drive's rated current.	0 to 100	50%	A	A	A	491	—

No.	Name	Description	Range	Def.	Control Mode			Addr. Hex	Pg.
					V/f	OLV	PM		
L3-04	Stall Prevention Selection during Deceleration	When using a braking resistor, use setting "0". Setting "3" is used in specific applications. 0: Disabled - The drive decelerates at the active deceleration rate. If the load is too large or the deceleration time is too short, an OV fault may occur. 1: General Purpose - The drive decelerates at the active deceleration rate, but if the main circuit DC bus voltage reaches the stall prevention level (380/760 VDC), deceleration will stop. Deceleration will continue once the DC bus level drops below the stall prevention level. 2: Intelligent - The active deceleration rate is ignored and the drive decelerates as fast as possible without hitting OV fault level. Range: C1-02 / 10. 3: Stall Prevention with Braking Resistor - Stall prevention during deceleration is enabled in coordination with dynamic braking. 4: Overexcitation Deceleration - Decelerates with the flux level determined by n3-13 (Overexcitation Gain).	0 to 4 <50>	1	S	S	S	492	—
L3-05	Stall Prevention Selection during Run	Selects the stall prevention method to use to prevent drive faults during run. 0: Disabled - Drive runs a set frequency. A heavy load may cause the drive to trip on an OC or OL fault. 1: Decel Time 1 - The drive will decelerate at Decel Time 1 (C1-02) if the output current exceeds the level set by L3-06. Once the current level drops below the L3-06 level, the drive will accelerate back to its frequency reference at the active acceleration rate. 2: Decel Time 2 - Same as setting 1 except the drive decelerates at Decel Time 2 (C1-04). When output frequency is 6 Hz or less, stall prevention during run is disabled regardless of the setting in L3-05.	0 to 2	1	A	–	A	493	—
L3-06	Stall Prevention Level during Run	Enabled when L3-05 is set to "1" or "2". 100% is equal to the drive rated current. Decrease the set value if stalling or excessive current occurs with the default settings.	30 to 200	<7>	A	–	A	494	—
L3-11	OV Suppression Function Selection	Enables or disables OV suppression function, which allows the drive to change the output frequency as the load changes, thus preventing an OV fault. 0: Disabled 1: Enabled **Note:** The frequency reference and motor speed diverge as the regenerative energy begins to flow back into the DC bus and triggers the OV suppression function. Disable this function when using a braking resistor.	0, 1	0	A	A	-	4C7	—
L3-17 <24>	Overvoltage Suppression and Stall Prevention Desired DC Bus Voltage	Sets the desired value for the DC bus voltage during overvoltage suppression and stall prevention during deceleration. Enabled only when L3-04 = 2.	150 to 400 V	370 V <9>	A	A	A	462	—
L3-20	Main Power Circuit Voltage Adjustment Gain	Sets the proportional gain used by KEB, Stall prevention and overvoltage suppression. If OV or UV1 occurs at the beginning of KEB deceleration, slowly increase this setting by 0.1.	0.00 to 5.00	1.00	A	A	A	465	—
L3-21	Accel/Decel Rate Calculation Gain	Sets the proportional gain used to calculate the deceleration rate during KEB, OV suppression function and stall prevention during deceleration (L3-04 = 2). This parameter does not typically require adjustment. Increase the value in steps of 1.0 if overcurrent and overvoltage occur.	0.00 to 200.00	1.00	A	A	A	466	—
L3-22	Deceleration Time at Stall Prevention during Acceleration	Sets the deceleration time used for stall prevention during acceleration in Open Loop Vector control for PM motors. When set to 0, the drive decelerates at the normal deceleration time.	0.0 to 6000.0	0.0 s	–	–	A	4F9	—
L3-23	Automatic Reduction Selection for Stall Prevention during Run	0: Sets the stall prevention level throughout the entire frequency range to the value in parameter L3-06. 1: Automatically lowers the stall prevention level in the constant output range. The lower limit value is 40% of L3-06.	0, 1	0	A	A	A	4FD	—
L3-24	Motor Acceleration Time for Inertia Calculations	Sets the time needed to accelerate the uncoupled motor at rated torque from stop to the maximum frequency. Setting the drive capacity to parameter o2-04 or changing E2-11 will automatically set this parameter for a 4-pole motor.	0.001 to 10.000	<57>	A	A	A	46E	—
L3-25	Load Inertia Ratio	Sets the ratio between the motor and machine inertia.	0.0 to 1000.0	1.0	A	A	A	46F	—
L4: Frequency Detection Use L4 parameters to configure frequency detection operation.									
L4-01	Speed Agreement Detection Level	These parameters configure the multi-function output (H2-□□ = 2, 3, 4, 5) settings "Fref/Fout Agree 1", "Fref/Set Agree 1", "Frequency Detection 1," and "Frequency detection 2". Parameter L4-01 sets the level while parameter L4-02 sets the hysteresis for the Speed Detection Output Function.	0.0 to 400.0	0.0 Hz	A	A	A	499	—
L4-02	Speed Agreement Detection Width		0.0 to 20.0	2.0 Hz	A	A	A	49A	—
L4-03	Speed Agreement Detection Level (+/-)	These parameters configure the Multi-Function Output (H2-□□ = 13, 14, 15, 16) settings "Fref/Fout Agree 2", "Fref/Set Agree 2", "Frequency Detection 3," or "Frequency Detection 4". Parameter L4-03 sets the level while parameter L4-04 sets the hysteresis for the Speed Detection Output Function.	-400.0 to +400.0	0.0 Hz	A	A	A	49B	—
L4-04	Speed Agreement Detection Width (+/-)		0.0 to 20.0	2.0 Hz	A	A	A	49C	—
L4-05	Frequency Reference Loss Detection Selection	Sets operation when the frequency reference is lost (reference drops 90% or more of within 400 ms). 0: Stop - Drive will stop. 1: Run at L4-06 PrevRef - Drive will run at the percentage set in L4-06 of the frequency reference before loss.	0, 1	0	A	A	A	49D	—
L4-06	Frequency Reference at Reference Loss	Sets the frequency reference when a reference loss was detected and L4-05 = 1. Reference will be: Fref = Fref at time of loss L4-06.	0.0 to 100.0	80.0%	A	A	A	4C2	—
L4-07	Frequency Detection Conditions	0: No detection during baseblock. 1: Detection always enabled.	0 to 1	0	A	A	A	470H	—
L5: Fault Reset Use L5 parameters to configure Automatic Restart after fault.									
L5-01	Number of Auto Restart Attempts	Sets the counter for the number of times the drive attempts to restart when the following faults occur: GF, LF, OC, OV, PF, PUF, RH, RR, OL1, OL2, OL3, OL4, UV1. If the drive faults after an auto restart attempt, the counter is incremented. When the drive operates without fault for 10 minutes, the counter will be reset.	0 to 10	0	A	A	A	49E	—
L5-02	Auto Restart Operation Selection	Sets fault contact activation during automatic restart attempts. 0: Fault output (H2-□□ = E) not active. 1: Fault output (H2-□□ = E) active during restart attempt.	0, 1	0	A	A	A	49F	—

No.	Name	Description	Range	Def.	Control Mode V/f	Control Mode OLV	Control Mode PM	Addr. Hex	Pg.
L5-04	Fault Reset Interval Time	Sets the amount of time to wait between performing fault restarts. Enabled when L5-05 is set to 1.	0.5 to 600.0 s	10.0 s	A	A	A	46C	—
L5-05	Fault Reset Operation Selection	Selects the method of incrementing the restart counter. 0: Continuously attempt to restart and increment counter after successful restart (like Varispeed VS616-F7/G7) 1: Attempt to restart with the interval time set in L5-04. Every trial increments the counter. (like Varispeed VS606-V7)	0 to 1	0	A	A	A	467	—
L6: Overtorque Detection Use L6 parameters to configure overtorque detection.									
L6-01	Torque Detection Selection 1	Selects the overtorque/undertorque operation. overtorque and undertorque are determined by the settings in parameters L6-02 and L6-03. The multi-function output settings (H2-□□ = B and 17) are also active if programmed. 0: Disabled 1: OL3 at Speed Agree - Alarm (overtorque detection only active during Speed Agree and operation continues after detection). 2: OL3 at RUN - Alarm (overtorque detection is always active and operation continues after detection). 3: OL3 at Speed Agree - Fault (overtorque detection only active during Speed Agree and drive output will shut down on an OL3 fault). 4: OL3 at RUN - Fault (overtorque detection is always active and drive output will shut down on an OL3 fault). 5: UL3 at Speed Agree - Alarm (undertorque detection is only active during Speed Agree and operation continues after detection). 6: UL3 at RUN - Alarm (undertorque detection is always active and operation continues after detection). 7: UL3 at Speed Agree - Fault (undertorque detection only active during Speed Agree and drive output will shut down on an OL3 fault). 8: UL3 at RUN - Fault (undertorque detection is always active and drive output will shut down on an OL3 fault).	0 to 8	0	A	A	A	4A1	—
L6-02	Torque Detection Level 1	Sets the overtorque/undertorque detection level. 100% is equal to the motor rated current in V/f control and the motor rated torque in Open Loop Vector control.	0 to 300	150%	A	A	A	4A2	—
L6-03	Torque Detection Time 1	Sets the length of time an overtorque/undertorque condition must exist before Torque Detection 1 is triggered.	0.0 to 10.0	0.1 s	A	A	A	4A3	—
L6-04	Torque Detection Selection 2	Sets the response to an overtorque/undertorque condition. overtorque and undertorque are determined by the settings in parameters L6-05 and L6-06. The multi-function output settings (H2-□□ = 18 and 19). 0: Disabled 1: OL4 at Speed Agree - Alarm (overtorque Detection only active during Speed Agree and Operation continues after detection). 2: OL4 at RUN - Alarm (overtorque Detection is always active and operation continues after detection). 3: OL4 at Speed Agree - Fault (overtorque Detection only active during Speed Agree and drive output will shut down on an OL4 fault). 4: OL4 at RUN - Fault (overtorque Detection is always active and drive output will shut down on an OL4 fault). 5: UL4 at Speed Agree - Alarm (undertorque Detection is only active during Speed Agree and operation continues after detection). 6: UL4 at RUN - Alarm (undertorque Detection is always active and operation continues after detection). 7: UL4 at Speed Agree - Fault (undertorque Detection only active during Speed Agree and drive output will shut down on an OL4 fault). 8: UL4 at RUN - Fault (undertorque Detection is always active and drive output will shut down on an OL4 fault).	0 to 8	0	A	A	A	4A4	—
L6-05	Torque Detection Level 2	Sets the overtorque/undertorque detection level. 100% is equal to the motor rated current in V/f control and the motor rated torque in Open Loop Vector control.	0 to 300	150%	A	A	A	4A5	—
L6-06	Torque Detection Time 2	Sets the length of time an overtorque/undertorque condition must exist before torque detection 2 is recognized by the drive.	0.0 to 10.0	0.1 s	A	A	A	4A6	—
L6-08	Mechanical Weakening (OL5) Detection Operation	This function can detect an over/undertorque in a certain speed range as a result of machine fatigue. It is triggered by a certain operation time and uses the OL1 detection settings (L6-01 to L6-03) 0: Mechanical Weakening Detection disabled. 1: Continue running if the speed (signed) is greater than L6-09 (alarm only). 2: Continue running if the speed (not signed) is greater than L6-09 (alarm only). 3: Interrupt drive output when the motor speed (signed) is greater than L6-09 (protection operation). 4: Interrupt drive output when the motor speed (not signed) is greater than L6-09 (protection operation). 5: Continue running if the speed (signed) is less than L6-09 (alarm only). 6: Continue running if the speed (not signed) is less than L6-09 (alarm only). 7: Interrupt drive output when the motor speed (signed) is less than L6-09 (protection operation). 8: Interrupt drive output when the motor speed (not signed) is less than L6-09 (protection operation).	0 to 8	0	A	A	A	468	—
L6-09	Mechanical Weakening Detection Speed Level	• Sets the speed that triggers mechanical weakening detection. • When L6-08 is set for an unsigned value, the absolute value is used even if the setting is negative.	-110.0 to +110.0%	110%	A	A	A	469	—
L6-10	Mechanical Weakening Detection Time	Sets the time a mechanical weakening has to be detected before an Alarm/Fault is triggered.	0.0 to 10.0 s	0.1 s	A	A	A	46A	—
L6-11	Mechanical Weakening Detection Start Time	Sets the operation time (U1-04) that has to be passed before Mechanical weakening detection is active.	0 to 65535	0	A	A	A	46B	—

No.	Name	Description	Range	Def.	Control Mode V/f	Control Mode OLV	Control Mode PM	Addr. Hex	Pg.
		L7: Torque Limit Use L7 parameters to configure the torque limit function.							
L7-01	Forward Torque Limit	Sets the torque limit value as a percentage of the motor rated torque. Four individual quadrants can be set.	0 to 300	200%	–	A	–	4A7	—
L7-02	Reverse Torque Limit		0 to 300	200%	–	A	–	4A8	—
L7-03	Forward Regenerative Torque Limit		0 to 300	200%	–	A	–	4A9	—
L7-04	Reverse Regenerative Torque Limit		0 to 300	200%	–	A	–	4AA	—
L7-06	Torque Limit Integral Time Constant	Sets the integral time constant for the torque limit.	5 to 10000	200 ms	–	A	–	4AC	—
L7-07	Torque Limit Control Method Selection during Accel/Decel	Selects the method of torque limit control during accel/decel. 0: Proportional Control (change to integral controls at fixed speeds). Use this setting when acceleration to the desired speed has priority over torque limitation. 1: Integral Control. Use this setting if the torque limitation has priority. When torque limit is applied to the motor, accel/decel time may increase and motor speed may not meet the speed reference.	0, 1	0	–	A	–	4C9	—
		L8: Hardware Protection Use L8 parameters to configure hardware protection functions.							
L8-01	Internal Dynamic Braking Resistor Protection Selection (ERF type)	Selects the Braking resistor when using a 3% duty cycle heatsink mounted Yaskawa braking resistor. This parameter does not enable or disable the braking transistor of the drive. 0: Resistor overheat protection disabled 1: Resistor overheat protection enabled	0, 1	0	A	A	A	4AD	—
L8-02	Overheat Alarm Level	When the heatsink temperature exceeds the value set in this parameter, an Overheat Alarm (OH) will occur.	50 to 130	<12>	A	A	A	4AE	—
L8-03	Overheat Pre-Alarm Operation Selection	Sets the drive operation when an overheat alarm OH is detected. 0: Ramp to Stop using the active decel time. 1: Coast to Stop. 2: Fast-stop using the time set in C1-09. 3: Alarm Only. Drive continues running, but displays an alarm. 4: Reduced Speed Operation. Drive continues to run with reduced frequency reference as specified in L8-19. Settings 0 through 2 trigger a fault relay if the heatsink becomes too hot.	0 to 4	3	A	A	A	4AF	—
L8-05	Input Phase Loss Protection Selection	Selects the detection of input current phase loss, power supply voltage imbalance, or main circuit electrolytic capacitor deterioration. 0: Disabled 1: Enabled	0, 1	1 <56>	A	A	A	4B1	—
L8-07	Output Phase Loss Protection	Selects the output phase loss detection. 0: Disabled 1: Enabled (triggered by a single phase loss). 2: Enabled (triggered when two phases are lost). Output phase loss is detected when operating with less than 5% of the drive rated current. Detection can mistakenly occur if the motor is too small relative to the drive capacity rating (this parameter should be disabled in such cases).	0 to 2	0	A	A	A	4B3	—
L8-09	Output Ground Fault Detection Selection	Selects the output ground fault detection. 0: Disabled 1: Enabled	0, 1	<12>	A	A	A	4B5	—
L8-10	Heatsink Cooling Fan Operation Selection	Controls the heatsink cooling fan operation. 0: Fan On-Run Mode - Fan will operate only when the drive is running and for L8-11 seconds after stop. 1: Fan always on - Cooling fan operates whenever the drive is powered up.	0, 1	0	A	A	A	4B6	—
L8-11	Heatsink Cooling Fan Operation Delay Time	This parameter sets the delay time for the cooling fan to shut off after the run command is removed when L8-10 = 0.	0 to 300	60 s	A	A	A	4B7	—
L8-12	Ambient Temperature Setting	Used to input the ambient temperature. This value adjusts the drives OL2 detection level.	-10 to 50	40 °C	A	A	A	4B8	—
L8-15	OL2 Characteristics Selection at Low Speeds	Sets the OL2 characteristics at output frequencies below 6 Hz. 0: No OL2 level reduction below 6Hz. 1: OL2 level is reduced linearly below 6 Hz. It is halved at 0 Hz.	0, 1	1	A	A	A	4BB	—
L8-18	Soft CLA Selection	Selects the software current limit function. Typically no adjustment is required. 0: Disabled 1: Enabled	0, 1	1	A	A	–	4BE	—
L8-19	Frequency Reduction Rate during OH Pre-Alarm	Specifies the frequency reference reduction gain at overheat prealarm when L8-03 = 4.	0.1 to 1.0	0.8	A	A	A	4BF	—
L8-29	Current Unbalance Detection (LF2)	Selects the detection of unbalanced output currents caused by faulty devices in the output circuit. 0: Disabled 1: Enabled	0 to 1	1	–	–	A	4DF	—
L8-35	Installation Method	Selects the installation type: 0: Standard installation of Open Chassis drive 1: Side-by-Side installation with top cover removed 2: Standard Installation of NEMA Type 1 drive 3: Finless / Fin outside installation	0 to 2	<12> <25>	A	A	A	4ECH	—
L8-38	Carrier Frequency Reduction	Provides protection to the IGBTs by reducing the carrier frequency at low speeds. 0: Disabled 1: Enabled below 6 Hz 2: Enabled for the whole speed range	0 to 2	0	A	A	A	4EF	—
L8-40	Carrier Frequency Reduction Time	Sets the time for that the drive continues running with reduced carrier frequency after the carrier reduction condition has gone (see also L8-38). A setting of 0.00 s disables the carrier frequency reduction time.	0.00 to 2.00	0.50	A	A	A	4F1	

No.	Name	Description	Range	Def.	Control Mode V/f	Control Mode OLV	Control Mode PM	Addr. Hex	Pg.
L8-41	Current Alarm Selection	Configures an alarm when the output current exceeds 150% of the drive rated current. 0: Alarm disabled. 1: Alarm enabled (alarm is output).	0, 1	0	A	A	A	4F2	—

<1> Default setting value is dependent on parameter A1-02, Control Method Selection. The value shown is for A1-02 = 2-OLV control.
<2> Default setting value is dependent on parameter A1-02, Control Method Selection. The value shown is for A1-02 = 0-V/f Control.
<7> Default setting value is 120% when C6-01 is set to 1 (ND) and 150% when C6-01 is set to 0 (HD).
<9> Default setting value is dependent on parameter E1-01, Input Voltage Setting.
<12> Default setting value is dependent on parameter o2-04, Drive/kVA Selection.
<14> Default setting value is dependent on parameter o2-09, Initialization Spec. Selection.
<15> Default setting value is dependent on parameter A1-02, Control Method Selection. The value shown is for A1-02 = 5-PM OLV Control.
<24> Values shown here are for 200 V class drives. Double the value when using a 400 V class drive.
<25> Parameter setting value is not reset to the default value during drive initialization, A1-03 = 1110, 2220, 3330.
<29> Setting value 2 is not available A1-02 = 5-PM OLV Control. When enabled, the drive stops accelerating when it exceeds the value of L3-02, Stall Prevention Level. The drive decelerates after 100 ms and begins accelerating again after restoring the current level.
<31> Use caution when working with regenerative loads as motor speed can exceed the frequency reference during overvoltage suppression function operation. Set to "Disable" when motor speed needs to accurately match the frequency reference, and also when using a braking resistor. An OV fault may still occur even when this function is enabled if there is a sudden increase in the regenerative load.
<50> The setting range depends on the control mode set in A1-02. For PM OLV Control the setting range is 0 to 2.
<51> Parameter value is changed if E2-11 is manually changed or changed by Auto-Tuning.
<56> The default value is 0 for all 200 V Single-Phase drives.
<57> Default setting value is dependent on parameter o2-04, Drive/kVA Selection and C6-01, Drive Duty Selection.

◆ n: Advanced Performance Set-Up

The n parameters are used to adjust more advanced performance characteristics such as hunting prevention, speed feedback detection, high-slip braking and R1 tuning.

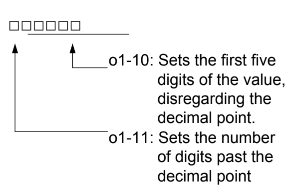
No.	Name	Description	Range	Def.	Control Mode V/f	Control Mode OLV	Control Mode PM	Addr. Hex	Pg.
n1: Hunting Prevention Use n1 parameters to configure hunting prevention operation.									
n1-01	Hunting Prevention Selection	If the motor vibrates while lightly loaded, Hunting Prevention may reduce the vibration. 0: Disabled 1: Enabled When quick response is needed disable Hunting Prevention.	0, 1	1	A	–	–	580	—
n1-02	Hunting Prevention Gain Setting	Sets the gain for the Hunting Prevention Function. 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.	0.00 to 2.50	1.00	A	–	–	581	—
n1-03	Hunting Prevention Time Constant	Sets the time constant used for hunting prevention.	0 to 500	<12>	A	–	–	582	—
n1-05	Hunting Prevention Gain while in Reverse	Sets the gain used for Hunting Prevention. When set to 0, the gain n1-02 is used for operation in reverse direction.	0.00 to 2.50	0.00	A	–	–	530	—
n2: Speed Feedback Detection Control Function Use n2 parameters to configure the Speed Feedback Detection Control function operation.									
n2-01	Speed Feedback Detection Control (AFR) Gain	Sets the internal speed feedback detection control gain in the automatic frequency regulator (AFR). This parameter does not typically require adjustment. Adjust this parameter as follows: If hunting occurs, increase the set value. If response is low, decrease the set value.	0.00 to 10.00	1.00	–	A	–	584	—
			Adjust the setting by 0.05 units at a time, while checking the response.						
n2-02	Speed Feedback Detection Control (AFR) Time Constant	Sets the AFR time constant 1.	0 to 2000	50 ms	–	A	–	585	—
n2-03	Speed Feedback Detection Control (AFR) Time Constant 2	Sets the AFR time constant 2. Increase the setting if overvoltage occurs during sudden load changes or the speed overshoots during fast acceleration.	0 to 2000	750 ms	–	A	–	586	—
n3: High-Slip Braking Use n3 parameters to configure the high-slip braking function.									
n3-01	High-Slip Braking Deceleration Frequency Width	Sets the output frequency reduction step width when the drive stops the motor using high-slip braking (HSB). If Overvoltage (OV) faults occur during HSB, this parameter may need to be increased.	1 to 20	5%	A	–	–	588	—
n3-02	High-Slip Braking Current Limit	Sets the current limit during HSB. Higher n3-02 settings will shorten motor stopping times but increase the motor current, and therefore motor heating.	100 to 200	150%	A	–	–	589	—
n3-03	High-Slip Braking Dwell Time at Stop	Sets the time the drive will run with minimum frequency (E1-09) at the end of deceleration. If this time is set too low, the machine inertia can cause the motor to rotate slightly after HSB completion.	0.0 to 10.0	1.0 s	A	–	–	58A	—
n3-04	High-Slip Braking Overload Time	Sets the time required for an HSB overload fault (OL7) to occur when the drive output frequency does not change during an HSB stop. This parameter does not typically require adjustment.	30 to 1200	40 s	A	–	–	58B	—
n3-13	Overexcitation Deceleration Gain	Applies a gain to the V/f pattern during deceleration (L3-04=4). Returns to normal values after ramp to stop or at re-acceleration. To improve the braking power of overexcitation, increase the gain by 1.25 to 1.30.	1.00 to 1.40	1.10	A	A	–	531	—
n3-21	High-Slip Suppression Current Level	If overcurrent or overload occur during high-slip deceleration, reduce the high-slip suppression current level. Set as a percentage of the drive rated current.	0 to 150	100%	A	A	–	579	—

No.	Name	Description	Range	Def.	Control Mode V/f	Control Mode OLV	Control Mode PM	Addr. Hex	Pg.
n3-23	Overexcitation Operation Selection	0: Disabled 1: Enabled only when rotating forward 2: Enabled only when in reverse	0 to 2	0	A	A	–		—
n6: Tuning of Resistance between Motor Lines Use n6 parameters to adjust the motor line-to-line resistance.									
n6-01	Line-to-Line Motor Resistance Online Tuning	Tunes the line-to-line motor resistance continuously during operation. 0: Disabled 1: Enabled	0, 1	1	–	A	–	570	—
n8: Permanent Magnet (PM) Motor Control Use n8 parameters to control the PM motor control.									
n8-45	Speed Feedback Detection Control Gain	Sets the gain for internal speed feedback detection control. This parameter does not typically require adjustment. Increase this setting if hunting occurs. Decrease to lower the response.	0.0 to 10.0	0.8	–	–	A	538	—
n8-47	Pull-In Current Compensation Time Constant	Sets the time constant to make the pull-in current and actual current value agree. Decrease the value if the motor begins to oscillate. Increase the value if it takes too long for the current reference to equal the output current.	0.0 to 100.0 s	5.0 s	–	–	A	53A	—
n8-48	Pull-In Current	Defines the amount of current provided to the motor during no load operation at a constant speed. Set as a percentage of the motor rated current. Increase this setting when hunting occurs while running at a constant speed.	20 to 200%	30%	–	–	A	53B	—
n8-49	Load Current	Sets the amount of d-axis current when using Energy Saving control.	-200.0 to 0.0%	0%	–	–	A	53C	—
n8-51	Acceleration Pull-In Current	Sets the pull-in current during acceleration as a percentage of the motor rated current (E5-03). Set to a high value when more starting torque is needed.	0 to 200%	50%	–	–	A	53E	—
n8-54	Voltage Error compensation time constant	Sets the time constant for voltage error compensation. Adjust the value when • hunting occurs at low speed. • hunting occurs with sudden load changes. Increase in steps of 0.1 or disable the compensation by setting n8-45 to 0. • oscillations occur ar start. Increase the value in steps of 0.1.	0.00 to 10.00 s	1.00s	–	–	A	56D	—
n8-55	Load Inertia	Sets the ratio between motor and machine inertia. 0: less than 1:10. 1: between 1:10 to 1:30. 2: between 1:30 to 1:50. 3: higher than 1:50.	0 to 3	0	–	–	A	56E	—
n8-62 <24>	Output voltage limit	Sets the limit for the output voltage. Adjustment is normally needed only if the input voltage is below the n8-62 set value. In this case set n8-62 to the input voltage.	0.0 to 230.0	200 Vac	-	-	A	57D	—

<12> Default setting value is dependent on parameter o2-04, Drive/kVA Selection.
<24> Values shown here are for 200 V class drives. Double the value when using a 400 V class drive.

◆ o: Operator Related Parameters

o parameters are used to set up the LED digital operator displays.

No.	Name	Description	Range	Def.	Control Mode V/f	Control Mode OLV	Control Mode PM	Addr. Hex	Pg.
o1: Display Settings Use o1 parameters to configure the digital operator display.									
o1-01 <22>	Drive Mode Unit Monitor Selection	Selects which monitor will be displayed in the operation menu upon power-up when o1-02 = 5. The monitor parameter number is entered into the spaces provided: U□-□□. For example, set “403” to display monitor parameter U4-03.	104 to 621	106	A	A	A	500	—
			Set to U1-06 as a default (Output Voltage Reference).						—
o1-02 <22>	User Monitor Selection After Power Up	Selects the monitor to display upon power-up. 1: Frequency Reference (U1-01) 2: Forward/Reverse 3: Output Frequency (U1-02) 4: Output Current (U1-03) 5: User Monitor (set by o1-01)	1 to 5	1	A	A	A	501	—
o1-03	Digital Operator Display Selection	Sets the units to display the frequency reference and output frequency. 0: Hz 1:% (100% = E1-04) 2: r/min (enter the number of motor poles into E2-04/E4-04/E5-04) 3: User defined by parameters o1-10 and o1-11	0 to 3	0	A	A	A	502	—
o1-10	Frequency Reference Setting and User-Set Display	These settings define the display values when o1-03 is set to 3. o1-10 sets display values when operating at the maximum output frequency. o1-11 sets the position of the decimal positions.	1 to 60000	<11>	A	A	A	520	—
o1-11	Frequency Reference Setting / Decimal Display		0 to 3	<11>	A	A	A	521	—

No.	Name	Description	Range	Def.	Control Mode V/f	Control Mode OLV	Control Mode PM	Addr. Hex	Pg.
o2: Operator Keypad Functions Use o2 parameters to configure LED digital operator key functions.									
o2-01	LOCAL/REMOTE Key Function Selection	Enables/Disables the digital operator LOCAL/REMOTE key. 0: Disabled 1: Enabled	0, 1	1	A	A	A	505	—
o2-02	STOP Key Function Selection	Enables/Disables the operator panel STOP key when the drive is operated form external sources (not operator). 0: Disabled 1: Enabled	0, 1	1	A	A	A	506	—
o2-03	User Parameter Default Value	Allows storing of parameter settings as a User Initialization Selection (value 1110 for A1-03). The value returns to 0 after entering 1 or 2. 0: No Change 1: Set Defaults - Saves current parameter settings as user initialization. 2: Clear All - Clears the currently saved user initialization.	0 to 2	0	A	A	A	507	—
o2-04	Drive/kVA Selection	Sets the kVA of the drive. This parameter only needs to be set when installing a new control board. Do not change for other reason.	0 to FF	<12>	A	A	A	508	—
o2-05	Frequency Reference Setting Method Selection	Selects if the ENTER key must be pressed when inputting the frequency reference by the operator keypad. 0: Data/Enter key must be pressed to enter a frequency reference. 1: Data/Enter key is not required. The frequency reference is adjusted by the “up” and “down” arrow keys.	0, 1	0	A	A	A	509	—
o2-06	Operation Selection when Digital Operator is Disconnected	Sets drive action when the digital operator is removed in Local mode or with b1-02 = 0. 0: The drive will continue operation 1: The drive will trigger a fault (OPR) and the motor will coast to stop	0, 1	0	A	A	A	50A	—
o2-07	Motor Direction at Power Up when Using Operator	0: Forward 1: Reverse This parameter requires that drive operation be assigned to the digital operator.	0 to 1	0	A	A	A	527	—
o4: Maintenance Period Use o4 parameters to perform maintenance.									
o4-01	Accumulated Operation Time Setting	Sets the starting value for the cumulative operation time of the drive in units of 10h.	0 to 9999	0	A	A	A	50B	—
o4-02	Accumulated Operation Time Selection	Sets this parameter to log the cumulative operation time (U4-01). 0: Logs power-on time 1: Logs operation time when the drive output is active (output operation time).	0 to 1	0	A	A	A	50C	—
o4-03	Cooling Fan Operation Time Setting	Used to resets the Cooling Fan operation time counter U1-04.	0 to 9999	0	A	A	A	50E	—
o4-05	Capacitor Maintenance Setting	Resets the capacitor maintenance time monitor U4-05.	0 to 150	0%	A	A	A	51D	—
o4-07	Inrush Prevention Relay Maintenance Setting	Resets the Inrush Prevention Relay Maintenance monitor U4-06.	0 to 150	0%	A	A	A	523	—
o4-09	IGBT Maintenance Setting	Resets the counter that logs the IGBTs usage time. Refer to U4-07 (IGBT Maintenance).	0 to 150	0%	A	A	A	525	—
o4-11	U2, U3 Initialize Selection	Selects if U2-oo (Fault Trace), U3-oo (Fault History) monitors are reset at drive initialization. 0: Saves the fault monitor data 1: Resets the fault monitor data	0 to 1	0	A	A	A	510	—
o4-12	kWh Monitor Initialize Selection	Selects if U4-10 and U4-11 (kWh monitor) are reset at drive initialization. 0: Saves the U4-10 and U4-11 monitor data. 1: Resets the U4-10 and U4-11 monitor data.	0 to 1	0	A	A	A	512	—
o4-13	Number of Run Commands Initialize Selection	Selects if the Run command counter (U4-02) is reset at drive initialization. 0: Saves the number of Run commands 1: Resets the number of Run commands	0 to 1	0	A	A	A	528	—

<9> Default setting value is dependent on parameter E1-01, Input Voltage Setting.
<11> Default setting value is dependent on parameter o1-03, Digital Operator Display Selection.
<12> Default setting value is dependent on parameter o2-04, Drive/kVA Selection.
<22> Parameter can be changed during run.

◆ r: DWEZ Parameters

No.	Name	Description	Range	Def.	Control Mode V/f	Control Mode OLV	Control Mode PM	Addr. Hex	Pg.
r1-01	DWEZ Connection Parameter 1 (upper)	Parameter 1 for connecting DWEZ (upper).	0000 to FFFF(H)	0	A	A	A	1840	—
r1-02	DWEZ Connection Parameter 1 (lower)	Parameter 1 for connecting DWEZ (lower).	0000 to FFFF(H)	0	A	A	A	1841	—
r1-03	DWEZ Connection Parameter 2 (upper)	Parameter 2 for connecting DWEZ (upper).	0000 to FFFF(H)	0	A	A	A	1842	—
r1-04	DWEZ Connection Parameter 2 (lower)	Parameter 2 for connecting DWEZ (lower).	0000 to FFFF(H)	0	A	A	A	1843	—
r1-05	DWEZ Connection Parameter 3 (upper)	Parameter 3 for connecting DWEZ (upper).	0000 to FFFF(H)	0	A	A	A	1844	—
r1-06	DWEZ Connection Parameter 3 (lower)	Parameter 3 for connecting DWEZ (lower).	0000 to FFFF(H)	0	A	A	A	1845	—
r1-07	DWEZ Connection Parameter 4 (upper)	Parameter 4 for connecting DWEZ (upper).	0000 to FFFF(H)	0	A	A	A	1846	—
r1-08	DWEZ Connection Parameter 4 (lower)	Parameter 4 for connecting DWEZ (lower).	0000 to FFFF(H)	0	A	A	A	1847	—
r1-09	DWEZ Connection Parameter 5 (upper)	Parameter 5 for connecting DWEZ (upper).	0000 to FFFF(H)	0	A	A	A	1848	—
r1-10	DWEZ Connection Parameter 5 (lower)	Parameter 5 for connecting DWEZ (lower).	0000 to FFFF(H)	0	A	A	A	1849	—
r1-11	DWEZ Connection Parameter 6 (upper)	Parameter 6 for connecting DWEZ (upper).	0000 to FFFF(H)	0	A	A	A	184A	—
r1-12	DWEZ Connection Parameter 6 (lower)	Parameter 6 for connecting DWEZ (lower).	0000 to FFFF(H)	0	A	A	A	184BH	—
r1-13	DWEZ Connection Parameter 7 (upper)	Parameter 7 for connecting DWEZ (upper).	0000 to FFFF(H)	0	A	A	A	184C	—
r1-14	DWEZ Connection Parameter 7 (lower)	Parameter 7 for connecting DWEZ (lower).	0000 to FFFF(H)	0	A	A	A	184D	—
r1-15	DWEZ Connection Parameter 8 (upper)	Parameter 8 for connecting DWEZ (upper).	0000 to FFFF(H)	0	A	A	A	184E	—
r1-16	DWEZ Connection Parameter 8 (lower)	Parameter 8 for connecting DWEZ (lower).	0000 to FFFF(H)	0	A	A	A	184F	—

No.	Name	Description	Range	Def.	Control Mode			Addr. Hex	Pg.
					V/f	OLV	PM		
r1-17	DWEZ Connection Parameter 9 (upper)	Parameter 9 for connecting DWEZ (upper).	0000 to FFFF(H)	0	A	A	A	1850	—
r1-18	DWEZ Connection Parameter 9 (lower)	Parameter 9 for connecting DWEZ (lower).	0000 to FFFF(H)	0	A	A	A	1851	—
r1-19	DWEZ Connection Parameter 10 (upper)	Parameter 10 for connecting DWEZ (upper).	0000 to FFFF(H)	0	A	A	A	1852	—
r1-20	DWEZ Connection Parameter 10 (lower)	Parameter 10 for connecting DWEZ (lower).	0000 to FFFF(H)	0	A	A	A	1853	—
r1-21	DWEZ Connection Parameter 11 (upper)	Parameter 11 for connecting DWEZ (upper).	0000 to FFFF(H)	0	A	A	A	1854	—
r1-22	DWEZ Connection Parameter 11 (lower)	Parameter 11 for connecting DWEZ (lower).	0000 to FFFF(H)	0	A	A	A	1855	—
r1-23	DWEZ Connection Parameter 12 (upper)	Parameter 12 for connecting DWEZ (upper).	0000 to FFFF(H)	0	A	A	A	1856	—
r1-24	DWEZ Connection Parameter 12 (lower)	Parameter 12 for connecting DWEZ (lower).	0000 to FFFF(H)	0	A	A	A	1857	—
r1-25	DWEZ Connection Parameter 13 (upper)	Parameter 13 for connecting DWEZ (upper).	0000 to FFFF(H)	0	A	A	A	1858	—
r1-26	DWEZ Connection Parameter 13 (lower)	Parameter 13 for connecting DWEZ (lower).	0000 to FFFF(H)	0	A	A	A	1859	—
r1-27	DWEZ Connection Parameter 14 (upper)	Parameter 14 for connecting DWEZ (upper).	0000 to FFFF(H)	0	A	A	A	185A	—
r1-28	DWEZ Connection Parameter 14 (lower)	Parameter 14 for connecting DWEZ (lower).	0000 to FFFF(H)	0	A	A	A	185B	—
r1-29	DWEZ Connection Parameter 15 (upper)	Parameter 15 for connecting DWEZ (upper).	0000 to FFFF(H)	0	A	A	A	185C	—
r1-30	DWEZ Connection Parameter 15 (lower)	Parameter 15 for connecting DWEZ (lower).	0000 to FFFF(H)	0	A	A	A	185D	—
r1-31	DWEZ Connection Parameter 16 (upper)	Parameter 16 for connecting DWEZ (upper).	0000 to FFFF(H)	0	A	A	A	185E	—
r1-32	DWEZ Connection Parameter 16 (lower)	Parameter 16 for connecting DWEZ (lower).	0000 to FFFF(H)	0	A	A	A	185F	—
r1-33	DWEZ Connection Parameter 17 (upper)	Parameter 17 for connecting DWEZ (upper).	0000 to FFFF(H)	0	A	A	A	1860	—
r1-34	DWEZ Connection Parameter 17 (lower)	Parameter 17 for connecting DWEZ (lower).	0000 to FFFF(H)	0	A	A	A	1861	—
r1-35	DWEZ Connection Parameter 18 (upper)	Parameter 18 for connecting DWEZ (upper).	0000 to FFFF(H)	0	A	A	A	1862	—
r1-36	DWEZ Connection Parameter 18 (lower)	Parameter 18 for connecting DWEZ (lower).	0000 to FFFF(H)	0	A	A	A	1863	—
r1-37	DWEZ Connection Parameter 19 (upper)	Parameter 19 for connecting DWEZ (upper).	0000 to FFFF(H)	0	A	A	A	1864	—
r1-38	DWEZ Connection Parameter 19 (lower)	Parameter 19 for connecting DWEZ (lower).	0000 to FFFF(H)	0	A	A	A	1865	—
r1-39	DWEZ Connection Parameter 20 (upper)	Parameter 20 for connecting DWEZ (upper).	0000 to FFFF(H)	0	A	A	A	1866	—
r1-40	DWEZ Connection Parameter 20 (lower)	Parameter 20 for connecting DWEZ (lower).	0000 to FFFF(H)	0	A	A	A	1867	—

◆ T: Motor Tuning

Enter data into the following parameters to tune the motor and drive for optimal performance

No.	Name	Description	Range	Def.	Control Mode			Addr. Hex	Pg.
					V/f	OLV	PM		
T1-00	Motor Selection 1/2	Selects which set of motor parameters are used and set during Auto-Tuning. If Motor 2 selection (H1-☐☐ = 16) is not selected, this parameter will not be displayed. 1: 1st Motor - E1 to E2 2: 2nd Motor - E3 to E4 (this selection is not displayed if motor 2 has not been selected)	1, 2	1	A	A	–	700	—
T1-01	Auto-Tuning Mode Selection	Selects the Auto-Tuning mode. 0: Rotational Auto-Tuning 2: Stationary Auto-Tuning, Terminal resistance only, 3: Rotational Auto-Tuning for V/f control (necessary for Energy Savings and Speed Estimation type speed search)	0, 2, 3 <54>	2 or 3 in V/f 0 or 2 in OLV2 for Motor 2	A	A	–	701	—
T1-02	Motor Rated Power	Sets the motor rated power in kilowatts (kW). **Note:** If motor power is given in horsepower, power in kW can be calculated using the following formula: kW = HP x 0.746.	0.00 to 650.00	0.40 kW	A	A	–	702	—
T1-03 <24>	Motor Rated Voltage	Sets the motor rated voltage in volts (V).	0.0 to 255.5	200.0 V	A	A	–	703	—
T1-04	Motor Rated Current	Sets the motor rated current in amperes (A).	10 to 200% of drive rated current	<12>	A	A	–	704	—
T1-05	Motor Base Frequency	Sets the base frequency of the motor in Hertz (Hz).	0.0 to 400.0	60.0 Hz	A	A	–	705	—
T1-06	Number of Motor Poles	Sets the number of motor poles.	2 to 48	4	A	A	–	706	—
T1-07	Motor Base Speed	Sets the base speed of the motor in revolutions per minute r/min (RPM).	0 to 24000	1750 r/min	A	A	–	707	—
T1-11	Motor Iron Loss	Provides the iron loss for determining the Energy Saving coefficient. The value set to E2-10 (motor iron loss) when the power is cycled. If T1-02 is changed, an initial value valid for the selected capacity will be shown.	0 to 65535	14W These values differ depending on the motor code value and motor parameter settings.	A	–	–	70B	—

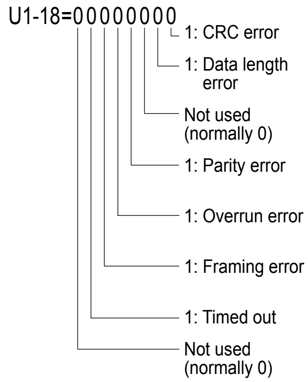
<12> Default setting value is dependent on parameter o2-04, Drive/kVA Selection.
<24> Values shown here are for 200 V class drives. Double the value when using a 400 V class drive.
<54> The available tuning methods depend on control mode. Select values 2 or 3 in V/f control, 0 or 2 in OLV control, and 2 for Motor 2 control.

◆ U: Monitors

Monitor parameters allow the user to view drive status, fault information, and other information about drive operation.

No.	Name	Description	Analog Output Level	Unit	Control Mode			Addr. Hex
					V/f	OLV	PM	
U1: Operation Status Monitors Use U1 monitors to display the operation status of the drive.								
U1-01	Frequency Reference	Monitors the frequency	10 V: Max frequency	0.01Hz	A	A	A	40
U1-02	Output Frequency	Displays the output voltage. Display units are determined by o1-03.	10 V: Max frequency	0.01Hz <27>	A	A	A	41
U1-03	Output Current	Displays the output current.	10 V: Drive rated current	0.01A	A	A	A	42

No.	Name	Description	Analog Output Level	Unit	Control Mode V/f	Control Mode OLV	Control Mode PM	Addr. Hex
U1-04	Control Mode	Control method set in A1-02. 0: V/f without PG 2: Open Loop Vector (OLV) 5: PM Open Loop Vector (PM)	No output signal available	–	A	A	A	43
U1-05	Motor Speed	Displays the motor speed feedback. Display units are determined by o1-03.	10 V: Maximum speed	0.01Hz	–	A	A	44
U1-06	Output Voltage Reference	Displays the output voltage.	10 V: 200 Vrms (400 Vrms)	0.1 V	A	A	A	45
U1-07	DC Bus Voltage	Displays the DC bus voltage.	10 V: 400 V (800 V)	1 V	A	A	A	46
U1-08	Output Power	Displays the output voltage (this value is determined internally).	10 V: Drive capacity (kW) (max. motor capacity allowed)	<27>	A	A	A	47
U1-09	Torque Reference	Monitor of internal torque reference value for Open Loop Vector (OLV) control	10 V: Motor rated torque	–	–	A	–	
U1-10	Input Terminal Status	Displays the input terminal status. U1-09=0000000 1: FWD run command (terminal S1 enabled) 1: REV run command (terminal S2 enabled) 1: Multi-Function Digital Input 1 (terminal S3 enabled) 1: Multi-Function Digital Input 2 (terminal S4 enabled) 1: Multi-Function Digital Input 3 (terminal S5 enabled) 1: Multi-Function Digital Input 4 (terminal S6 enabled) 1: Multi-Function Digital Input 5 (terminal S7 enabled)	No output signal available	–	A	A	A	49
U1-11	Output Terminal Status	Displays the output terminal status. U1-11=000 1: Multi-Function Digital Output (fault) (terminal MA/MB-MC) 1: Multi-Function Digital Output 1 (terminal P1) enabled 1: Multi-Function Digital Output 2 (terminal P2) enabled	No output signal available	–	A	A	A	4A
U1-12	Drive Status	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 output signal available	–	A	A	A	4B
U1-13	Terminal A1 Input Voltage	Displays the analog input A1 input level. 100% when the input is 10 V	10 V: 100%	0.1%	A	A	A	4E
U1-14	Terminal A2 Input Voltage	Displays the analog input A2 input level. 100% when the input is 10 V / 20 mA	10 V: 100%	0.1%	A	A	A	4F
U1-16	Output Frequency after Soft Start	Displays the output frequency including ramp times, S-curves. Units are determined by o1-03.	10 V: Max frequency	0.01Hz	A	A	A	53
U1-18	OPE Fault Parameter	Displays the parameter number for oPE☐☐ or Err (operator error) where the error occurred.	No output signal available	–	A	A	A	61

No.	Name	Description	Analog Output Level	Unit	Control Mode			Addr. Hex
					V/f	OLV	PM	
U1-19	MEMOBUS/Modbus Error Code	Displays the contents of a MEMOBUS/Modbus error. 	No output signal available	–	A	A	A	66
U1-24	Input Pulse Monitor	Displays the Pulse Train input RP frequency.	32000					7D
U1-25	Software No. (Flash)	Yaskawa Flash ID	No signal output available					4D
U1-26	Software No. (ROM)	Yaskawa ROM ID	No signal output available					5B
U2: Fault Trace Use U2 monitor parameters to view fault trace data.								
U2-01	Current Fault	Display of the current fault.	No signal output avail.	–	A	A	A	80
U2-02	Previous Fault	Display of the previous fault.	No signal output avail.	–	A	A	A	81
U2-03	Frequency Reference at Previous Fault	Displays the frequency reference at the previous fault.	No signal output avail.	0.01Hz	A	A	A	82
U2-04	Output Frequency at Previous Fault	Displays the output frequency at the previous fault.	No signal output avail.	0.01Hz	A	A	A	83
U2-05	Output Current at Previous Fault	Displays the output current at the previous fault.	No signal output avail.		A	A	A	84
U2-06	Motor Speed at Previous Fault	Displays the motor speed at the previous fault.	No signal output avail.	0.01 Hz	–	A	–	85
U2-07	Output Voltage at Previous Fault	Displays the output voltage at the previous fault.	No signal output avail.	0.1 V	A	A	A	86
U2-08	DC Bus Voltage at Previous Fault	Displays the DC bus voltage at the previous fault.	No signal output avail.	1 V	A	A	A	87
U2-09	Output Power at Previous Fault	Displays the output power at the previous fault.	No signal output avail.	0.1 kW	A	A	A	88
U2-10	Torque Reference at Previous Fault	Displays the torque reference at the previous fault.	No signal output avail.	0.1%	–	A	–	89
U2-11	Input Terminal Status at Previous Fault	Displays the input terminal status at the previous fault. Displayed as in U1-10.	No signal output avail.	–	A	A	A	8A
U2-12	Output Terminal Status at Previous Fault	Displays the output status at the previous fault. Displays the same status displayed in U1-11.	No signal output available	–	A	A	A	8B
U2-13	Drive Operation Status at Previous Fault	Displays the operation status of the drive at the previous fault. Displays the same status displayed in U1-12.	No signal output available	–	A	A	A	8C
U2-14	Cumulative Operation Time at Previous Fault	Displays the cumulative operation time at the previous fault.	No signal output available	1 H	A	A	A	8D
U2-15	Soft Starter Speed Reference at Previous Fault	Displays the speed reference for the soft starter at the previous fault.	No signal output available	0.01%	A	A	A	7E0
U2-16	Motor q-Axis Current at Previous Fault	Displays the q-axis current for the motor at the previous fault.	No signal output avail.	0.10%	–	A	A	7E1
U2-17	Motor d-Axis Current at Previous Fault	Displays the d-axis current for the motor at the previous fault.	No signal output avail.	0.10%	–	A	A	7E2
U3: Fault History Use U3 parameters to display fault data.								
U3-01	Most Recent Fault	Displays the most recent fault.	No signal output avail.	–	A	A	A	90(800)
U3-02	2nd Most Recent Fault	Displays the second most recent fault.	No signal output avail.	–	A	A	A	91(801)
U3-03	3rd Most Recent Fault	Displays the third most recent fault.	No signal output avail.	–	A	A	A	92(802)
U3-04	4th Most Recent Fault	Displays the fourth most recent fault.	No signal output available	–	A	A	A	93(803)
U3-05	5th Most Recent Fault	Displays the fifth most recent fault.	No signal output available	–	A	A	A	804
U3-06	6th Most Recent Fault	Displays the sixth most recent fault.	No signal output available	–	A	A	A	805
U3-07	7th Most Recent Fault	Displays the seventh most recent fault.	No signal output available	–	A	A	A	806
U3-08	8th Most Recent Fault	Displays the eighth most recent fault.	No signal output available	–	A	A	A	807
U3-09	9th Most Recent Fault	Displays the ninth most recent fault.	No signal output available	–	A	A	A	808
U3-10	10th Most Recent Fault	Displays the tenth most recent fault.	No signal output available	–	A	A	A	809
U3-11	Cumulative Operation Time at Most Recent Fault	Displays the cumulative operation time at the most recent fault.	No signal output available	1 h	A	A	A	94(80A)
U3-12	Cumulative Operation Time at 2nd Most Recent Fault	Displays the cumulative operation time at the second most recent fault.	No signal output available	1 h	A	A	A	95(80B)
U3-13	Cumulative Operation Time at 3rd Most Recent Fault	Displays the cumulative operation time at the third most recent fault.	No signal output available	1 h	A	A	A	96(80C)
U3-14	Cumulative Operation Time at 4th Most Recent Fault	Displays the cumulative operation time at the fourth most recent fault.	No signal output available	1 h	A	A	A	97(80D)
U3-15	Cumulative Operation Time at 5th Most Recent Fault	Displays the cumulative operation time at the fifth most recent fault.	No signal output available	1 h	A	A	A	80E
U3-16	Cumulative Operation Time at 6th Most Recent Fault	Displays the cumulative operation time at the sixth most recent fault.	No signal output available	1 h	A	A	A	80F
U3-17	Cumulative Operation Time at 7th Most Recent Fault	Displays the cumulative operation time at the seventh most recent fault.	No signal output available	1 h	A	A	A	810E

No.	Name	Description	Analog Output Level	Unit	Control Mode			Addr. Hex
					V/f	OLV	PM	
U3-18	Cumulative Operation Time at 8th Most Recent Fault	Displays the cumulative operation time at the eighth most recent fault.	No signal output available	1 h	A	A	A	811E
U3-19	Cumulative Operation Time at 9th Most Recent Fault	Displays the cumulative operation time at the ninth most recent fault.	No signal output available	1 h	A	A	A	812
U3-20	Cumulative Operation Time at 10th Most Recent Fault	Displays the cumulative operation time at the tenth most recent fault.	No signal output available	1 h	A	A	A	813
U4: Maintenance Monitors Use U4 parameters to display drive maintenance information.								
U4-01	Accumulated Operation Time	Displays the cumulative operation time of the drive. The value for the cumulative operation time counter can be set 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 avail.	1 h	A	A	A	4C
U4-02	Number of Run Commands	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 avail.		A	A	A	76
U4-03	Cooling Fan Operation Time	Displays the cumulative operation time of the cooling fan. The default value for the fan operation time is set to parameter o4-03. This value will reset to 0 and start counting again after reaching 65535.	No signal output avail.	1H	A	A	A	67
U4-05	Capacitor Maintenance	Displays main circuit capacitor usage time in in percent of their expected performance life. Parameter o4-06 resets this monitor.	No signal output avail.	1%	A	A	A	7C
U4-07	IGBT Maintenance	Displays IGBT usage time as a percent of expected performance life. One of the multi-function contact outputs can be set to close when the value reaches 50% (H2-□□ = 2F), triggering an alarm. One of the multi-function contact outputs can be set to close when the value reaches 90% (H2-□□ = 10), triggering an alarm. Parameter o4-09 resets this monitor.	No signal output avail.	1%	A	A	A	7D7
U4–08 <60>	Heatsink Temperature	Monitors the heatsink for the drive.	No signal output avail.	1°C	A	A	A	68
U4-09	LED Check	Lights all segments of the LED to verify that the display is working properly.	No signal output avail.	–	A	A	A	3C
U4-10	kWH, Lower 4 Digits	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 Analog monitor: No output signal available.	No signal output avail.	kWh	A	A	A	5C
U4-11	kWH, Upper 5 Digits			MWh	A	A	A	5D
U4-13	Peak Hold Current	Displays the peak hold current during run.	10 V: Motor rated current	0.01A	A	A	A	7CF
U4-14	Peak Hold Output Frequency	Displays the output frequency when operating at the peak hold current.	10 V: Max frequency	0.01Hz	A	A	A	7D0
U4-16	Motor Overload Estimate (OL1)	100% = OL1 detection level	100% = OL1 detection level	0.1%	A	A	A	7D8
U4-18	Frequency Reference Source Selection	Displays the source for the frequency reference as XY-nn. X: indicates which reference is used: 1 = Reference 1 (b1-01) 2 = Reference 2 (b1-15) Y-nn: indicates the reference source 0-01 = Operator (d1-01) 1-01 = Analog (terminal A1) 1-02 = Analog (terminal A2) 2-02 to 17 = Multi-step speed (d1-02 to 17) 3-01 = MEMOBUS/Modbus comm. 4-01 = Option 5-01 = Pulse Input 6-01 = CASE 7-01 = DWEZ			A	A	A	7DA
U4-19	Frequency Reference from MEMOBUS/Modbus Comm.	Displays the frequency reference provided by MEMOBUS/Modbus (decimal)			A	A	A	7DB
U4-20	Option Frequency Reference	Displays the frequency reference input by an option card (decimal).			A	A	A	7DD
U4-21	Run Command Source Selection	Displays the source for the Run command as XY-nn. X: Indicates which Run source is used: 1 = Reference 1 (b1-02) 2 = Reference 2 (b1-16) Y: Input power supply data 0 = Operator 1 = External terminals 2 = Not used 3 = MEMOBUS/Modbus communications 4 = Option 5 = Not used 6 = CASE 7 = DWEZ 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 the soft charge bypass contactor after the power is switched on (UV or UV1 flashes after 10 seconds). 04: Waiting for “Run Command Prohibited” time period to end. 05: Fast-stop (digital input (H1-□□ = 15), operator) 06: b1-17 (run command given at power-up). 07: During Baseblock while coast to stop with timer 08: Frequency reference is below minimal reference during base block 09: Waiting for Enter command			A	A	A	7DD
U4-22	MEMOBUS/Modbus Communications Reference	Displays the drive control data set by MEMOBUS/Modbus communications register No. 0001H as a 4 digit hexadecimal number.			A	A	A	7DE
U4-23	Option Card Reference	Displays drive control data set by an option card as a 4 digit hexadecimal number.			A	A	A	7DF

Parameter List

B

No.	Name	Description	Analog Output Level	Unit	Control Mode			Addr. Hex
					V/f	OLV	PM	
U5: Application Monitor Use U5 parameters to view application-specific settings.								
U5-01	PID Feedback	Displays the PID feedback value in.	10V: 100% (max. freq.)	0.01%	A	A	A	57
U5-02	PID Input	Displays the amount of PID input (deviation between PID target and feedback).		0.01%	A	A	A	63
U5-03	PID Output	Displays PID control output.		0.01%	A	A	A	64
U5-04	PID Setpoint	Displays the PID setpoint.		0.01%	A	A	A	65
U5-05	PID differential feedback	Displays the 2nd PID feedback value if differential feedback is used.		0.01%	A	A	A	
U5-06	PID Adjusted Feedback	Displays the subtraction value of both feedback values if differential feedback is used.		0.01%	A	A	A	
U6: Application Monitor Use U6 parameters to display drive control information.								
U6-01	Motor Secondary Current (Iq)	Displays the value of the motor secondary current (Iq).	10 V: Motor rated secondary current	0.1%	A	A	A	51
U6-02	Motor Excitation Current (ld)	Displays the value calculated for the motor excitation current (Id) as a percentage of the motor rated secondary current (Iq).	10 V: Motor rated secondary current	0.1%	–	A	A	52
U6-03	ASR Input	Displays the ASR input value if Simple PG is used in V/f control.	10V: 100% (max. freq.)	0.1%	A	–	–	
U6-04	ASR Output	Displays the ASR output value if Simple PG is used in V/f control.	10V: 100% (max. freq.)	0.1%	A	–	–	55
U6-05	Output voltage reference (Vq)	Output voltage reference (Vq). (q-axis)	10 V: 200 V (400 V)	0.1 Vac	–	A	A	59
U6-06	Output Voltage Reference (Vd)	Output voltage reference (Vd). (d-axis)	10 V: 200 V (400 V)	0.1 Vac	–	A	A	5A
U6-07	q-axis ACR Output	Displays the current control (ACR) output of for the motor secondary current (Iq).	10 V: 100%	0.1%	–	A	–	5F
U6-08	d-Axis ACR Output	Displays the current control (ACR) output of for the motor excitation current (Id).	10 V: 100%	0.1%	–	A	–	60
U6-20	Frequency Reference Bias (Up/ Down 2)	Displays the bias value used to adjust the frequency reference.	10 V: max. frequency	0.1%	A	A	A	7D4
U6-21	Offset Frequency	Displays the frequency added to the main frequency reference.	10 V: max. frequency	0.1%	A	A	A	7D5
U8: Custom Monitors for DriveWorksEZ U8 parameters are reserved for DriveWorksEZ								
U8-01	–	Reserved for DriveWorksEZ, Monitor 1.	–	0.01%	A	A	A	1950
U8-02	–	Reserved for DriveWorksEZ, Monitor 2.	–	0.01%	A	A	A	1951
U8-03	–	Reserved for DriveWorksEZ, Monitor 3.	–	0.01%	A	A	A	1952
U8-04	–	Reserved for DriveWorksEZ, Monitor 4.	–	0.01%	A	A	A	1953
U8-05	–	Reserved for DriveWorksEZ, Monitor 5.	–	0.01%	A	A	A	1954
U8-06	–	Reserved for DriveWorksEZ, Monitor 6.	–	0.01%	A	A	A	1955
U8-07	–	Reserved for DriveWorksEZ, Monitor 7.	–	0.01%	A	A	A	1956
U8-08	–	Reserved for DriveWorksEZ, Monitor 8.	–	0.01%	A	A	A	1957
U8-09	–	Reserved for DriveWorksEZ, Monitor 9.	–	0.01%	A	A	A	1958
U8-10	–	Reserved for DriveWorksEZ, Monitor 10.	–	0.01%	A	A	A	1959

<27> Setting units for this parameter are determined by o2-04, Drive/kVA Selection. Less than 11 kW: 2 decimal points, 11 kW and above: 1 decimal point.
<60> Available for the drive software version 1011 or later.

◆ Control Mode Dependent Parameter Default Values

The tables below list parameters that depend on the control mode selection (A1-02 for motor 1, E3-01 for motor 2). These parameters are initialized to the shown values if the control mode is changed.

Table B.1 A1-02 (Motor 1 Control Mode) Dependent Parameters and Default Values

No.	Description	Setting Range	Resolution	Control Modes (A1-02)		
				V/f (0)	OLV (2)	PM (5)
b3-02	Speed Search deactivation current	0 to 200	1%	120	100	–
b8-02	Energy Saving gain	0.0 to 10.0	0.1	–	0.7	–
C2-01	S-curve time at acceleration start	0.00 to 10.00	0.01 s	0.20	0.20	1.00
C3-01	Slip compensation gain	0.0 to 2.5	0.1	0.0	1.0	–
C3-02	Slip compensation time constant	0 to 10000	1 msec	2000	200	–
C4-01	Torque comp. gain	0.00 to 2.50	0.01	1.00	1.00	0.00
C4-02	Torque comp. primary delay time	0 to 10000	1 msec	200	20	100
C6-02	Carrier frequency	1 to F	1	7 <12>	7 <12>	2
E1-04	Maximum output frequency	40.0 to 400.0	0.1 Hz	60.0	60.0	<10>
E1-05	Maximum output voltage <24>	0.0 to 255.0	0.1 V	230.0	230.0	<10>
E1-06	Base Frequency	0.0 to 400.0	0.1 Hz	60.0	60.0	<10>
E1-07	Middle output frequency	0.0 to 400.0	0.1 Hz	3.0	3.0	–
E1-08	Middle output freq. voltage <24>	0.0 to 255.0	0.1 V	18.4	13.8	–
E1-09	Minimum output frequency	0.0 to 400.0	0.1 Hz	1.5	0.5	<10>
E1-10	Minimum output voltage <24>	0.0 to 255.0	0.1 V	13.8	2.9	–
E1-11	Middle output frequency 2	0.0 to 400.0	0.1 Hz	0.0	0.0	–
E1-12	Middle output freq. voltage 2 <24>	0.0 to 255.0	0.1 V	0.0	0.0	–
E1-13	Base voltage <24>	0.0 to 255.0	0.1 V	0.0	0.0	–
L1-01	Motor protection selection	0 to 4	-	1	1	4
L3-20	Accel/Decel rate calculation rate	0.00 to 5.00	0.01	1.00	0.30	0.65

No.	Description	Setting Range	Resolution	Control Modes (A1-02)		
				V/f (0)	OLV (2)	PM (5)
L3-21	Decel time at stall prevention during acceleration	0.00 to 200.00	0.01	1.00	1.00	2.50

<10> Default setting value is dependent on parameter E5-01, Motor Code Selection.
<12> Default setting value is dependent on parameter o2-04, Drive/kVA Selection.
<24> Values shown here are for 200 V class drives. Double the value when using a 400 V class drive.

Table B.2 E3-01 (Motor 2 Control Mode) Dependent Parameters and Default Values

No.	Description	Setting Range	Resolution	Control Modes (E3-01)	
				V/f (0)	OLV (2)
E3-04	Maximum output frequency	40.0 to 400.0	0.1 Hz	60.0	60.0
E3-05	Maximum output voltage <24>	0.0 to 255.0	0.1 V	230.0	230.0
E3-06	Base Frequency	0.0 to 400.0	0.1Hz	60.0	60.0
E3-07	Middle output frequency	0.0 to 400.0	0.1Hz	3.0	3.0
E3-08	Middle output freq. voltage <24>	0.0 to 255.0	0.1 V	18.4	13.8
E3-09	Minimum output frequency	0.0 to 400.0	0.1 Hz	1.5	0.5
E3-10	Minimum output voltage <24>	0.0 to 255.0	0.1 V	13.8	2.9
E3-11	Middle output frequency 2	0.0 to 400.0	0.1 Hz	0.0	0.0
E3-12	Middle output freq. voltage 2 <24>	0.0 to 255.0	0.1 V	0.0	0.0
E3-13	Base voltage <24>	0.0 to 255.0	0.1 V	0.0	0.0
E3-14	Motor 2 Slip compensation gain	0.0 to 2.5	0.1	0.0	1.0

<24> Values shown here are for 200 V class drives. Double the value when using a 400 V class drive.

◆ V/f Pattern Default Values

The tables below show the V/f pattern settings default values depending on the control mode (A1-02) and the V/f pattern selection (E1-03 in V/f control).

Table B.3 E1-03 V/f Pattern Settings for Drive Capacity: CIMR-VABA0001 to CIMR-VABA0010; CIMR-VA2A0001 to CIMR-VA2A0010; CIMR-VA4A0001 to CIMR-VA4A0005

No.	U	V/f Control																OLV
E1-03	–	0	1 <55>	2	3	4	5	6	7	8	9	A	B	C	D	E	F	
E1-04	Hz	50.0	60.0	60.0	72.0	50.0	50.0	60.0	60.0	50.0	50.0	60.0	60.0	90.0	120	180	60.0	60.0
E1-05 <24>	V	200	200	200	200	200	200	200	200	200	200	200	200	200	200	200	200	200
E1-06	Hz	50.0	60.0	50.0	60.0	50.0	50.0	60.0	60.0	50.0	50.0	60.0	60.0	60.0	60.0	60.0	60.0	60.0
E1-07	Hz	2.5	3.0	3.0	3.0	25.0	25.0	30.0	30.0	2.5	2.5	3.0	3.0	3.0	3.0	3.0	3.0	3.0
E1-08 <24>	V	16.0	16.0	16.0	16.0	35.0	50.0	35.0	50.0	19.0	24.0	19.0	24.0	16.0	16.0	16.0	16.0	12.0
E1-09	Hz	1.3	1.5	1.5	1.5	1.3	1.3	1.5	1.5	1.3	1.3	1.5	1.5	1.5	1.5	1.5	1.5	0.5
E1-10 <24>	V	12.0	12.0	12.0	12.0	8.0	9.0	8.0	9.0	12.0	13.0	12.0	15.0	12.0	12.0	12.0	12.0	2.5

<24> Values shown here are for 200 V class drives. Double the value when using a 400 V class drive.
<55> Used as default settings for E1-04 to E1-10 and E2-04 to E2-10

Table B.4 E1-03 V/f Pattern Settings for Drive Capacity: CIMR-VABA0012 to CIMR-VABA0020; CIMR-VA2A0012 to CIMR-VA2A0069; CIMR-VA4A0007 to CIMR-VA4A0038

No.	U	V/f Control																OLV
E1-03	–	0	1 <55>	2	3	4	5	6	7	8	9	A	B	C	D	E	F	
E1-04	Hz	50.0	60.0	60.0	72.0	50.0	50.0	60.0	60.0	50.0	50.0	60.0	60.0	90.0	120	180	60.0	60.0
E1-05 <24>	V	200	200	200	200	200	200	200	200	200	200	200	200	200	200	200	200	200
E1-06	Hz	50.0	60.0	50.0	60.0	50.0	50.0	60.0	60.0	50.0	50.0	60.0	60.0	60.0	60.0	60.0	60.0	60.0
E1-07	Hz	2.5	3.0	3.0	3.0	25.0	25.0	30.0	30.0	2.5	2.5	3.0	3.0	3.0	3.0	3.0	3.0	3.0
E1-08 <24>	V	14.0	14.0	14.0	14.0	35.0	50.0	35.0	50.0	18.0	23.0	18.0	23.0	14.0	14.0	14.0	14.0	11.0
E1-09	Hz	1.3	1.5	1.5	1.5	1.3	1.3	1.5	1.5	1.3	1.3	1.5	1.5	1.5	1.5	1.5	1.5	0.5
E1-10 <24>	V	7.0	7.0	7.0	7.0	6.0	7.0	6.0	7.0	9.0	11.0	9.0	13.0	7.0	7.0	7.0	7.0	2.0

<24> Values shown here are for 200 V class drives. Double the value when using a 400 V class drive.
<55> Used as default settings for E1-04 to E1-10 and E2-04 to E2-10

◆ Default Settings Determined by Drive Capacity (o2-04) and Normal / Heavy Duty Selection (C6-01)

Table B.5 Single-Phase, 200 V Class Drives
Default Settings by Drive Capacity and Normal/Heavy Duty Selection

No.	Description	Unit	Default Settings					
–	Model CIMR-Vo	–	BA0001		BA0002		BA0003	
C6-01	Normal/Heavy Duty Sel.	Hex.	HD	ND	HD	ND	HD	ND
o2-04	kVA Selection	–	30		31		32	
E2-11 (E4-11, T1-02)	Motor rated power	kW	0.1	0.2	0.2	0.4	0.4	0.75
b3-06	Speed Search current 1	–	1	1	1	1	1	1
b8-04	Energy saving coefficient	–	481.7	356.9	356.9	288.2	288.2	223.7
C6-02	Carrier frequency	–	4	7	4	7	4	7
E2-01 (E4-01, T1-04)	Motor rated current	A	0.6	1.1	1.1	1.9	1.9	3.3

No.	Description	Unit	Default Settings					
–	**Model CIMR-Vo**	**–**	**BA0001**		**BA0002**		**BA0003**	
C6-01	**Normal/Heavy Duty Sel.**	**Hex.**	**HD**	**ND**	**HD**	**ND**	**HD**	**ND**
o2-04	**kVA Selection**	**–**	**30**		**31**		**32**	
E2-11 (E4-11, T1-02)	**Motor rated power**	**kW**	**0.1**	**0.2**	**0.2**	**0.4**	**0.4**	**0.75**
E2-02 (E4-02)	Motor rated slip	Hz	2.5	2.6	2.6	2.9	2.9	2.5
E2-03 (E4-03, T1-09)	Motor no load current	A	0.4	0.8	0.8	1.2	1.2	1.8
E2-05 (E4-05)	Motor line-to-line resistance	Ω	35.98	20.56	20.56	9.842	9.842	5.156
E2-06 (E4-06)	Motor leakage inductance	%	21.6	20.1	20.1	18.2	18.2	13.8
E2-10 (E4-10)	Motor Iron Loss	W	6	11	11	14	14	26
E5-01	Motor code	hex	FFFF	FFFF	FFFF	FFFF	0002	0002
L2-02	Momentary power loss ride-through time	s	0.1	0.1	0.1	0.1	0.1	0.1
L2-03	Momentary power loss base block time	s	0.2	0.2	0.2	0.2	0.2	0.3
L2-04	Momentary power loss voltage recovery time	s	0.3	0.3	0.3	0.3	0.3	0.3
L2-05	UV detection voltage	V dc	160	160	160	160	160	160
L3-24	Motor acceleration time	s	0.178	0.178	0.178	0.178	0.178	0.142
L8-02	Overheat alarm level	°C	115	115	115	115	110	110
L8-09	Ground fault selection	–	0	0	0	0	0	0
L8-38	Carrier freq. reduction sel.	–	1	1	1	1	1	1
n1-03	Hunting Prev. Time Const.	ms	10	10	10	10	10	10

No.	Description	Unit	Default Settings						
–	**Model CIMR-Vo**	**–**	**BA0006**		**BA0010**		**BA0012**		**BA0018**
C6-01	**Normal/Heavy Duty**	**–**	**HD**		**HD**	**ND**	**HD**	**ND**	**HD**
o2-04	**kVA Selection**	**Hex.**	**33**		**34**		**35**		**37**
E2-11 (E4-11, T1-02)	**Motor rated power**	**kW**	**0.75**	**1.1**	**1.5**	**2.2**	**2.2**	**3.0**	**3.7**
b3-06	Speed Search current 1	–	0.5	0.5	0.5	0.5	0.5	0.5	0.5
b8-04	Energy saving coefficient	–	223.7	169.4	169.4	156.8	156.8	136.4	122.9
C6-02	Carrier frequency	–	4	7	3	7	3	7	3
E2-01 (E4-01, T1-04)	Motor rated current	A	3.3	6.2	6.2	8.5	8.5	11.4	14.0
E2-02 (E4-02)	Motor rated slip	Hz	2.5	2.6	2.6	2.9	2.9	2.7	2.73
E2-03 (E4-03)	Motor no load current	A	1.8	2.8	2.8	3	3	3.7	4.5
E2-05 (E4-05)	Motor line-to-line resistance	Ω	5.156	1.997	1.997	1.601	1.601	1.034	0.771
E2-06 (E4-06)	Motor leakage inductance	%	13.8	18.5	18.5	18.4	18.4	19	19.6
E2-10 (E4-10)	Motor Iron Loss	W	26	53	53	77	77	91	112
E5-01	Motor Code	hex	0003	0003	0005	0005	0006	0006	0008
L2-02	Momentary power loss ride-through time	s	0.2	0.2	0.3	0.3	0.5	0.5	1.0
L2-03	Momentary power loss base block time	s	0.3	0.4	0.4	0.5	0.5	0.5	0.6
L2-04	Momentary power loss voltage recovery time	s	0.3	0.3	0.3	0.3	0.3	0.3	0.3
L2-05	UV detection voltage	V dc	160	160	160	160	160	160	160
L3-24	Motor acceleration time	s	0.142	0.142	0.166	0.145	0.145	0.145	0.154
L8-02	Overheat alarm level	°C	105	105	100	100	95	95	100
L8-09	Ground fault selection	–	0	0	0	0	0	0	0
L8-38	Carrier frequency reduction selection	–	1	1	1	1	1	1	1
n1-03	Hunting Prevention Time Constant	ms	10	10	10	10	10	10	10

Table B.6 Three-Phase, 200 V Class Drives
Default Settings by Drive Capacity and Normal/Heavy Duty Selection

No.	Description	Unit	Default Settings									
–	**Model CIMR-V□**	**–**	**2A0001**		**2A0002**		**2A0004**		**2A0006**		**2A0010**	
C6-01	**Normal/Heavy Duty Sel.**	**–**	**HD**	**ND**	**HD**	**ND**	**HD**	**ND**	**HD**	**ND**	**HD**	**ND**
o2-04	**kVA Selection**	**Hex.**	**60**		**61**		**62**		**63**		**65**	
E2-11 (E4-11, T1-02)	**Motor rated power**	**kW**	**0.1**	**0.2**	**0.2**	**0.4**	**0.4**	**0.75**	**0.75**	**1.1**	**1.5**	**2.2**
b3-06	Speed Search current 1	–	1.0	1.0	1.0	1.0	1.0	1.0	0.5	0.5	0.5	0.5
b8-04	Energy saving coefficient	–	481.7	356.9	356.9	288.2	288.2	223.7	223.7	196.6	169.4	156.8
C6-02	Carrier frequency	–	4	7	4	7	4	7	4	7	3	7
E2-01 (E4-01, T1-04)	Motor rated current	A	0.6	1.1	1.1	1.9	1.9	3.3	3.3	4.9	6.2	8.5
E2-02 (E4-02)	Motor rated slip	Hz	2.5	2.6	2.6	2.9	2.9	2.5	2.5	2.6	2.6	2.9
E2-03 (E4-03)	Motor no load current	A	0.4	0.8	0.8	1.2	1.2	1.8	1.8	2.3	2.8	3.0
E2-05 (E4-05)	Motor line-to-line resistance	Ω	35.98	20.56	20.56	9.842	9.842	5.156	5.156	3.577	1.997	1.601
E2-06 (E4-06)	Motor leakage inductance	%	21.6	20.1	20.1	18.2	18.2	13.8	13.8	18.5	18.5	18.4
E2-10 (E4-10)	Motor Iron Loss	W	6	11	11	14	14	26	26	38	53	77
E5-01	Motor Code	hex	FFFF	FFFF	FFFF	FFFF	0002	0002	0003	0003	0005	0005
L2-02	Momentary power loss ride-through time	s	0.1	0.1	0.1	0.1	0.1	0.1	0.2	0.2	0.3	0.3
L2-03	Momentary power loss base block time	s	0.2	0.2	0.2	0.2	0.2	0.3	0.3	0.4	0.4	0.5
L2-04	Momentary power loss voltage recovery time	s	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3
L2-05	UV detection voltage	V dc	190	190	190	190	190	190	190	190	190	190

No.	Description	Unit	Default Settings									
–	Model CIMR-V□	–	2A0001		2A0002		2A0004		2A0006		2A0010	
C6-01	Normal/Heavy Duty Sel.	–	HD	ND	HD	ND	HD	ND	HD	ND	HD	ND
o2-04	kVA Selection	Hex.	60		61		62		63		65	
E2-11 (E4-11, T1-02)	Motor rated power	kW	0.1	0.2	0.2	0.4	0.4	0.75	0.75	1.1	1.5	2.2
L3-24	Motor acceleration time	s	0.178	0.178	0.178	0.178	0.178	0.142	0.142	0.142	0.166	0.145
L8-02	Overheat alarm level	°C	110	110	110	110	115	115	100	100	100	100
L8-09	Ground fault selection	–	0	0	0	0	0	0	0	0	0	0
L8-38	Carrier frequency reduction selection	–	1	1	1	1	1	1	1	1	1	1
n1-03	Hunting Prevention Time Constant	ms	10	10	10	10	10	10	10	10	10	10

Table B.7 Three-Phase 400V Class Drives - Default Settings by Drive Capacity and Normal/Heavy Duty Selection

No.	Description	Unit	Default Settings							
–	Model CIMR-V□	–	4A0001		4A0002		4A0004		4A0005	
C6-01	Normal/Heavy Duty	–	HD	ND	HD	ND	HD	ND	HD	ND
o2-04	kVA Selection	Hex.	91		92		93		94	
E2-11 (E4-11, T1-02)	Motor rated power	kW	0.2	0.4	0.4	0.75	0.75	1.5	1.5	2.2
b3-06	Speed Search current 1	–	1.0	1.0	0.5	0.5	0.5	0.5	0.5	0.5
b8-04	Energy saving coefficient	–	713.8	576.4	576.4	447.4	447.4	338.8	338.8	313.6
C6-02	Carrier frequency	–	3	7	3	7	3	7	3	7
E2-01 (E4-01, T1-04)	Motor rated current	A	0.6	1	1	1.6	1.6	3.1	3.1	4.2
E2-02 (E4-02)	Motor rated slip	Hz	2.5	2.9	2.9	2.6	2.6	2.5	2.5	3
E2-03 (E4-03)	Motor no load current	A	0.4	0.6	0.6	0.8	0.8	1.4	1.4	1.5
E2-05 (E4-05)	Motor line-to-line resistance	Ω	83.94	38.198	38.198	22.459	22.459	10.1	10.1	6.495
E2-06 (E4-06)	Motor leakage inductance	%	21.9	18.2	18.2	14.3	14.3	18.3	18.3	18.7
E2-10 (E4-10)	Motor Iron Loss	W	12	14	14	26	26	53	53	77
E5-01	Motor Code	hex	FFFF	FFFF	FFFF	FFFF	FFFF	FFFF	FFFF	FFFF
L2-02	Momentary power loss ride-through time	s	0.1	0.1	0.1	0.1	0.2	0.2	0.3	0.3
L2-03	Momentary power loss base block time	s	0.2	0.2	0.2	0.3	0.3	0.4	0.4	0.5
L2-04	Momentary power loss voltage recovery time	s	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3
L2-05	UV detection voltage	V dc	380	380	380	380	380	380	380	380
L3-24	Motor acceleration time	s	0.178	0.178	0.178	0.142	0.142	0.166	0.166	0.145
L8-02	Overheat alarm level	°C	110	110	110	110	110	110	90	90
L8-09	Ground fault selection	–	0	0	0	0	0	0	0	0
L8-35	Enclosure/Mounting selection	–	0	0	0	0	0	0	0	0
L8-38	Carrier frequency reduction selection	–	1	1	1	1	1	1	1	1
n1-03	Hunting Prevention Time Constant	ms	10	10	10	10	10	10	10	10

◆ Parameters that Change with the Motor Code Selection

The following tables show parameters and default settings that change with the motor code selection E5-01 when Open Loop Vector for PM motors is used.

■ Yaskawa Pico Motor (SPM motor)

Table B.8 1800 rpm Yaskawa Pico Motor Settings

Par.	Description	Unit	Default Settings				
E5-01	Motor Code	–	0002	0003	0005	0006	0008
	Voltage class Rated power	–	200 Vac 0.4 kW	200 Vac 0.75 kW	200 Vac 1.5 kW	200 Vac 2.2 kW	200 Vac 3.7 kW
	Rated speed	min-1	1800	1800	1800	1800	1800
E5-02	Motor rated power	kW	0.4	0.75	1.5	2.2	3.7
E5-03	Motor rated current	A	2.1	4.0	6.9	10.8	17.4
E5-04	Motor pole number	–	8	8	8	8	8
E5-05	Motor winding resistance	Ω	2.47	1.02	0.679	0.291	0.169
E5-06	d-axis inductance	mH	12.7	4.8	3.9	3.6	2.5
E5-07	q-axis inductance	mH	12.7	4.8	3.9	3.6	2.5
E5-09	Induction voltage constant 1	mVsec/rad	0	0	0	0	0
E5-24	Induction voltage constant 2	mV/min-1	62.0	64.1	73.4	69.6	72.2
E1-04	Maximum output frequency	Hz	120	120	120	120	120
E1-05	Maximum output voltage	V	200.0	200.0	200.0	200.0	200.0
E1-06	Base voltage	Hz	120	120	120	120	120
E1-09	Minimum output voltage	Hz	6	6	6	6	6
L3-24	Motor acceleration time	s	0.064	0.066	0.049	0.051	0.044
n8-49	Pull-in current	%	0	0	0	0	0

Table B.9 3600 rpm Yaskawa Pico Motor Settings

Par.	Description	Unit	Default Settings			
E5-01	Motor Code	–	0103	0105	0106	0108
	Voltage class Rated power	–	200 Vac 0.75 kW	200 Vac 1.5 kW	200 Vac 2.2 kW	200 Vac 3.7 kW
	Rated speed	min-1	3600	3600	3600	3600
E5-02	Motor rated power	kW	0.75	1.5	2.2	3.7
E5-03	Motor rated current	A	4.1	8.0	10.5	16.5
E5-04	Motor pole number	–	8	8	8	8
E5-05	Motor winding resistance	Ω	0.538	0.20	0.15	0.097
E5-06	d-axis inductance	mH	3.2	1.3	1.1	1.1
E5-07	q-axis inductance	mH	3.2	1.3	1.1	1.1
E5-09	Induction voltage constant 1	mVsec/rad	0	0	0	0
E5-24	Induction voltage constant 2	mV/min-1	32.4	32.7	36.7	39.7
E1-04	Maximum output frequency	Hz	240	240	240	240
E1-05	Maximum output voltage	V	200.0	200.0	200.0	200.0
E1-06	Base voltage	Hz	240	240	240	240
E1-09	Minimum output voltage	Hz	12	12	12	12
L3-24	Motor acceleration time	s	0.064	0.066	0.049	0.051
n8-49	Pull-in current	%	0	0	0	0

■ SS5 Motor: Yaskawa SSR1 Series IPM Motor

Table B.10 200 V, 1750 rpm Yaskawa SSR1 Series Motor

Par.	Description	Unit	Default Settings				
E5-01	Motor Code	–	1202	1203	1205	1206	1208
	Voltage class Rated power	–	200 Vac 0.4 kW	200 Vac 0.75 kW	200 Vac 1.5 kW	200 Vac 2.2 kW	200 Vac 3.7 kW
	Rated speed	min-1	1750	1750	1750	1750	1750
E5-02	Motor rated power	kW	0.4	0.75	1.5	2.2	3.7
E5-03	Motor rated current	A	1.65	2.97	5.50	8.10	13.40
E5-04	Motor pole number	–	6	6	6	6	6
E5-05	Motor winding resistance	Ω	8.233	2.284	1.501	0.827	0.455
E5-06	d-axis inductance	mH	54.84	23.02	17.08	8.61	7.20
E5-07	q-axis inductance	mH	64.10	29.89	21.39	13.50	10.02
E5-09	Induction voltage constant 1	mVsec/rad	233.0	229.5	250.9	247.9	248.6
E5-24	Induction voltage constant 2	mV/min-1	0.0	0.0	0.0	0.0	0.0
E1-04	Maximum output frequency	Hz	87.5	87.5	87.5	87.5	87.5
E1-05	Maximum output voltage	V	190.0	190.0	190.0	190.0	190.0
E1-06	Base voltage	Hz	87.5	87.5	87.5	87.5	87.5
E1-09	Minimum output voltage	Hz	4.4	4.4	4.4	4.4	4.4
L3-24	Motor acceleration time	s	0.092	0.076	0.051	0.066	0.075
n8-49	Pull-in current	%	–7.2	–10.8	–11.1	–17.8	–17.5

Par.	Description	Unit	Default Settings			
E5-01	Motor Code	–	120A	120B	120D	120E
	Voltage class Rated power	–	200 Vac 5.5 kW	200 Vac 7.5 kW	200 Vac 11 kW	200 Vac 15 kW
	Rated speed	min-1	1750	1750	1750	1750
E5-02	Motor rated power	kW	5.5	7.5	11.0	15
E5-03	Motor rated current	A	19.80	27.00	39.7	53.2
E5-04	Motor pole number	–	6	6	6	6
E5-05	Motor winding resistance	Ω	0.246	0.198	0.094	0.066
E5-06	d-axis inductance	mH	4.86	4.15	3.40	2.65
E5-07	q-axis inductance	mH	7.43	5.91	3.91	3.11
E5-09	Induction voltage constant 1	mVsec/rad	249.6	269.0	249.3	266.6
E5-24	Induction voltage constant 2	mV/min-1	0.0	0.0	0.0	0.0
E1-04	Maximum output frequency	Hz	87.5	87.5	87.5	87.5
E1-05	Maximum output voltage	V	190.0	190.0	190.0	190.0
E1-06	Base voltage	Hz	87.5	87.5	87.5	87.5
E1-09	Minimum output voltage	Hz	4.4	4.4	4.4	4.4
L3-24	Motor acceleration time	s	0.083	0.077	0.084	0.102
n8-49	Pull-in current	%	–22.0	–17.3	–10.1	–10.3

Table B.11 400 V, 1750 rpm Yaskawa SSR1 Series Motor

Par.	Description	Unit	Default Settings				
E5-01	Motor Code	–	1232	1233	1235	1236	1238
	Voltage class Rated power	–	400 Vac 0.4 kW	400 Vac 0.75 kW	400 Vac 1.5 kW	400 Vac 2.2 kW	400 Vac 3.7 kW
	Rated speed	min-1	1750	1750	1750	1750	1750
E5-02	Motor rated power	kW	0.4	0.75	1.5	2.2	3.7
E5-03	Motor rated current	A	0.83	1.49	2.75	4.05	6.80
E5-04	Motor pole number	–	6	6	6	6	6
E5-05	Motor winding resistance	Ω	32.932	9.136	6.004	3.297	1.798
E5-06	d-axis inductance	mH	219.36	92.08	68.32	40.39	32.93
E5-07	q-axis inductance	mH	256.40	119.56	85.56	48.82	37.70
E5-09	Induction voltage constant 1	mVsec/rad	466.0	459.0	501.8	485.7	498.7
E5-24	Induction voltage constant 2	mV/min-1	0.0	0.0	0.0	0.0	0.0

Par.	Description	Unit	Default Settings				
E1-04	Maximum output frequency	Hz	87.5	87.5	87.5	87.5	87.5
E1-05	Maximum output voltage	V	380.0	380.0	380.0	380.0	380.0
E1-06	Base voltage	Hz	87.5	87.5	87.5	87.5	87.5
E1-09	Minimum output voltage	Hz	4.4	4.4	4.4	4.4	4.4
L3-24	Motor acceleration time	s	0.092	0.076	0.051	0.066	0.075
n8-49	Pull-in current	%	–7.2	–10.7	–11.1	–8.9	–7.9

Par.	Description	Unit	Default Settings			
E5-01	Motor Code	−	123A	123B	123D	123E
	Voltage class Rated power	−	400 Vac 5.5 kW	400 Vac 7.5 kW	400 Vac 11 kW	400 Vac 15 kW
	Rated speed	min-1	1750	1750	1750	1750
E5-02	Motor rated power	kW	5.5	7.5	11.0	15
E5-03	Motor rated current	A	9.90	13.10	19.9	26.4
E5-04	Motor pole number	–	6	6	6	6
E5-05	Motor winding resistance	Ω	0.982	0.786	0.368	0.263
E5-06	d-axis inductance	mH	22.7	16.49	13.38	10.51
E5-07	q-axis inductance	mH	26.80	23.46	16.99	12.77
E5-09	Induction voltage constant 1	mVsec/rad	498.0	541.7	508.7	531.9
E5-24	Induction voltage constant 2	mV/min-1	0.0	0.0	0.0	0.0
E1-04	Maximum output frequency	Hz	87.5	87.5	87.5	87.5
E1-05	Maximum output voltage	V	380.0	380.0	380.0	380.0
E1-06	Base voltage	Hz	87.5	87.5	87.5	87.5
E1-09	Minimum output voltage	Hz	4.4	4.4	4.4	4.4
L3-24	Motor acceleration time	s	0.083	0.077	0.084	0.102
n8-49	Pull-in current	%	–10.2	–17.4	–15.8	–12.6

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Appendix: C

MEMOBUS/Modbus Communications

C.1 MEMOBUS/Modbus Hardware

Yaskawa drives can be controlled with a PLC using the MEMOBUS/Modbus protocol to conduct serial communications.

MEMOBUS/Modbus communication can be configured using one master (PLC) and a maximum of 31 slaves. Serial communication between master and slave are normally started by the master and the slaves respond.

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 perform serial communications using that address. A slave that receives a command from the master performs the specified function and sends a response back to the master.

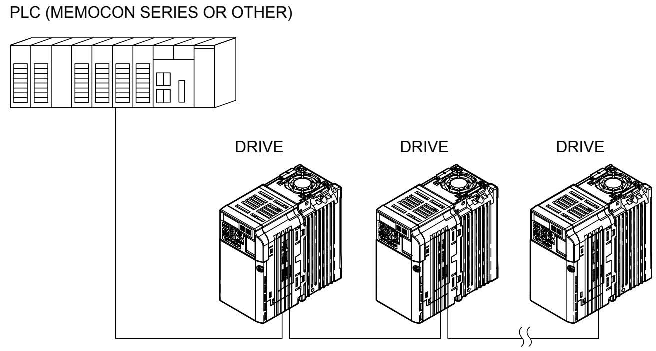


Figure C.1 Connecting Multiple Drives to a PLC

◆ Communication Specifications

MEMOBUS/Modbus specifications appear in the following table:

Item	Specifications	
Interface	RS-422, RS-485	
Communications Cycle	Asynchronous (Start-stop synchronization)	
Communication Parameters	Communication Speeds Available	12, 24, 48, 96, 192, 384, 576, 768, 1152 kbps
	Data length	8 bits (fixed)
	Parity	Select even, odd, or none.
	Stop bit	1 bit (fixed)
Protocol	MEMOBUS/Modbus (using RTU mode only)	
Max Number of Connections	31 drives (using RS-485)	

◆ Communication Terminal Resistance

The MEMOBUS communication uses the following terminals: S+, S-, R+, and R-. Enable the terminating resistance by setting pin 1 of DIP switch S2 to the ON position.

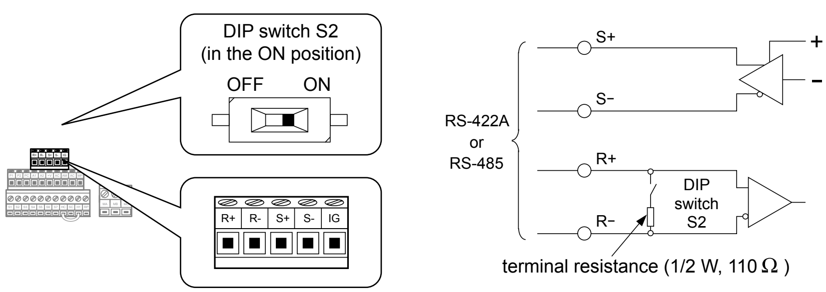


Figure C.2 Serial Communications Terminal and DIP Switch S2

Note: Separate the communications cables from the main circuit cables and other wiring and power cables. Use shielded cables for the communications cables, and properly shielded clamps to prevent problems with noise. When using RS-485 communications, connect S+ to R+, and S- to R- as shown in the diagram below.

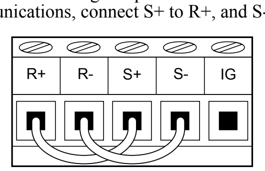


Figure C.3 RS-485 Terminal Wiring

◆ Connecting a PLC

Follow the instructions below to connect the drive to a PLC.

1. With the power shut off, connect the communications cable to the drive and PLC.
2. Switch the power on.
3. Set the parameters need for serial communications (H5-01 through H5-12) using the LED operator.
4. Shut the power off, waiting until the display on the LED operator goes out completely.
5. Turn the power back on.
6. The drive is now ready to begin communicating with the PLC.

Note: A timer should be set to watch how long it takes for the slave drive(s) to respond to the master. If no response is received with in a certain amount of time, the master should try resending the message.

C.2 MEMOBUS/Modbus Parameters

◆ MEMOBUS/Modbus Parameters

■ H5-01: Drive Node Address

This parameter tells the PLC what the node address is for the individual drive.

No.	Name	Description	Setting Range	Default	MEMOBUS Address
H5-01	Drive Node Address	Selects drive station node number (address) for MEMOBUS/Modbus terminals R+, R-, S+, S-. Cycle power for the setting to take effect.	0 to 20 H*	1F	425H

*If the address is set to 0, no response will be provided during communications.

For serial communciations to work, each individual slave drive must be assigned a unique node address. Setting H5-01 to any value besides 0 assigns the drive its address in the network. Slave address don't need to be assigned in sequential order, but each address needs to be unique so that no two drives have the same address. The power to the drive needs to be cycled after setting the address for the node address to take affect.

■ H5-02: Communication Speed Selection

■ H5-03: Communication Parity Selection

These parameters set the communication speed and the parity.

No.	Name	Description	Setting Range	Default	MEMOBUS Address
H5-02	Communication Speed Selection	Selects the baud rate for MEMOBUS/Modbus terminals R+, R-, S+ and S-. Cycle power for the setting to take effect. 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	0 to 8	3	426H
H5-03	Communication Parity Selection	Selects the communication parity for MEMOBUS/Modbus terminals R+, R-, S+ and S-. Cycle power for the setting to take effect. 0: No parity 1: Even parity 2: Odd parity	0 to 2	0	427H

Detailed Description

Parameters H5-02 and H5-03 should be set according to the network specifications run by the master controller. Because the power to the drive needs to be cycled in order for these parameter settings to take affect, the application will have to be stopped to change these settings.

■ H5-04: Stopping Method After Communication Error

Tells the drive how it should stop the motor when a communication error occurs.

No.	Name	Description	Setting Range	Default	MEMOBUS Address
H5-04	Stopping Method After Communication Error	0: Ramp to stop (decelerates according to C1-02) 1: Coast to stop2: Fast-Stop3: Alarm only	0 to 3	3	428H

■ H5-05: Communication Fault Detection Selection

Enables or disables the communications time-out fault (CE).

No.	Name	Description	Setting Range	Default	MEMOBUS Address
H5-05	Communication Fault Detection Selection	0: Disabled - A communication loss will not cause a communication fault. 1: Enabled - If communication is lost for more than two seconds, a CE fault will occur.	0, 1	1	429H

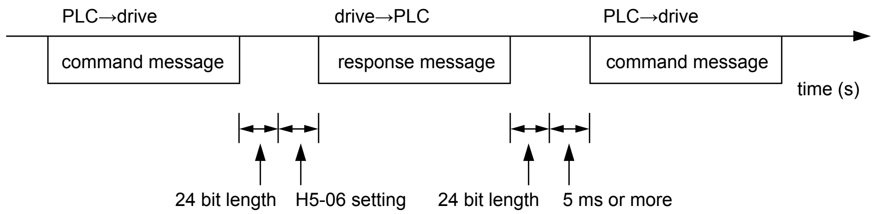
If H5-05 is set to 1, a fault will occur if the master controller does not receive a response from the drive after two seconds. The power to the drive needs to be cycled for the setting in H5-05 to take affect.

■ H5-06: Drive Transmit Wait Time

Sets how long the drive should wait to send a response after it receives data.

No.	Name	Description	Setting Range	Default	MEMOBUS Address
H5-06	Drive Transmit Wait Time	Set the delay time from when the drive receives data to when the drive sends data.	5 to 65	5 ms	42AH

Drive power needs to be cycled for the setting in H5-06 to take effect.



■ H5-07: RTS Control Selection

Enables ore disables RTS (“request-to-send”).

No.	Name	Description	Setting Range	Default	MEMOBUS Address
H5-07	RTS Control Selection	0: Disabled - RTS is always on. 1: Enabled - RTS turns on only when sending.	0, 1	1	42BH

Disable when using RS-485, and enable this setting when using RS-422. Power to the drive needs to be cycled for any setting changes to take affect.

■ H5-09: CE Detection Time

Sets the time required to detect a communications error. Adjustment may be need when networking several drives.

No.	Name	Description	Setting Range	Default	MEMOBUS Address
H5-09	CE Detection Time	Sets the time required to detect a communications error. Adjustment may be need when networking several drives.	0.0 to 10.0 s	2.0 s	435H

■ H5-10: Unit Selection for MEMOBUS/Modbus Register 0025H

Selects the units used for MEMOBUS/Modbus registry 0025H (Output Voltage Reference Monitor).

No.	Name	Description	Setting Range	Default	MEMOBUS Address
H5-10	Unit Selection for MEMOBUS/Modbus Register 0025H	0: 0.1 V units 1: 1 V units	0, 1	0	436H

■ H5-11: Communications ENTER Function Selection

Select the function for the enter command that saves parameter data to the drive.

No.	Name	Description	Setting Range	Default	MEMOBUS Address
H5-11	Communications ENTER Function Selection	0: Save parameter data that was edited to the drive when the enter command is given. 1: Parameter data that has been edited is saved when the enter command is given (compatible with the V7).	0, 1	1	43CH

■ H5-12: Run Command Method Selection

Determines how the Run command works when given via serial communications.

No.	Name	Description	Setting Range	Default	MEMOBUS Address
H5-12	Run Command Method Selection	0: FWD/STOP, REV/STOP Method 1: RUN/STOP, FWD/REV Method	0, 1	0	43DH

C.3 Related Parameters

The user can perform the following actions with MEMOBUS/Modbus communications regardless of how b1-01, b1-02, b1-15, and b1-16 are set.

- Observe drive operation from a PLC
- Reference and set parameters
- Reset faults
- Multi-function input commands

When commands are issued from the PLC to the multi-function input terminals S1 through S7, they become OR commands.

No.	Name	Description	Setting Range	Default	MEMOBUS Address	Page
b1-01	Frequency Reference Selection 1	Selects the frequency reference input source. 0: Operator 1: Terminals - Analog input terminal A1 (or terminal A2 based on parameter H3-09) 2: Serial Com 3: Option PCB4: Pulse Input (Terminal RP)	0 to 4	1	180H	–
b1-02	Run Command Selection 1	Selects the run command input source. 0: Operator - RUN and STOP keys on the operator. 1: Terminals - Contact closure on terminals S1 or S2 2: Serial Com 3: Option PCB.	0 to 3	1	181H	–
b1-15	Frequency Reference Selection 2	Selects the frequency reference input source. 0: Operator - Digital preset speed U1-01 or d1-01 to d1-17 1: Terminals - Analog input terminal A1 (or terminal A2 based on parameter H3-09) 2: Serial Com 3: Option PCB4: Pulse Input (Terminal RP)	0 to 4	0	1C4H	–
b1-16	Run Command Selection 2	Selects the run command input source. 0: Operator - RUN and STOP keys on the operator 1: Terminals - Contact closure on terminals S1 or S2 2: Serial Com 3: Option PCB	0 to 3	0	1C5H	–

C.4 Message Format

In MEMOBUS 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

Some space is required between messages as shown below:

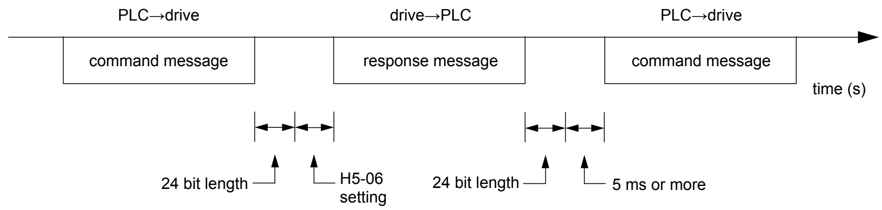


Figure C.4 Space Between Messages

◆ Slave Address

Set the drive address between 0 and 20 in hexadecimal. If set to 0, commands from the master will be received by all slaves (the drive does not provide a response when a command has been broadcast to all slave devices).

◆ Function Code

The three types of function codes are shown in the table below.

Function Code (Hexadecimal)	Function Name	Command Message		Response Message	
		Minimum (bytes)	Maximum (bytes)	Minimum (bytes)	Maximum (bytes)
03H	Read memory contents	8	8	7	37
08H	Loopback test	8	8	8	8
10H	Write to multiple memory registers	11	41	8	8

◆ Data

Configure consecutive data by combining the memory register address (test code for a loopback address) and the data the register contains. The data length changes depending on the command details.

◆ Error Check

Errors during communication are detected using CRC-16 (cyclic redundancy check, checksum method). Calculations are performed in the following order:

1. Although the general default setting for CRC-16 calculations is 0, the default for the MEMOBUS/Modbus protocol should be set to -1 (i.e., all 16 bits equal 1).
2. Calculate CRC-16 with MSB for the final data as LSB, and the LSB for the slave address as MSB.
3. Be sure to also calculate CRC-16 relative to the response messages, and refer to that CRC-16 value in the response message.

C.5 Command/Response Message Format

Below are some examples of command and response messages.

◆ Reading Drive Memory Register Contents

The contents of the memory register are separated into higher 8 bits and lower 8 bits. A maximum of 16 drive memory 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
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			

◆ Loop Back Test

The loopback test returns command messages directly as response messages without changing the contents to check the communications between the master and slave. User-defined test code and data values can be set.

The following table shows a message example when performing a loop back test with the slave 1 drive.

Command Message			Response Message (normal)			Response Message (fault)		
Slave Address		01H	Slave Address		01H	Slave Address		01H
Function Code		08H	Function Code		08H	Function Code		89H
Test Code	Upper	00H	Test Code	Upper	00H	Error Code		01H
	Lower	00H		Lower	00H	CRC-16	Upper	86H
Data	Upper	A5H	Data	Upper	A5H		Lower	50H
	Lower	37H		Lower	37H			
CRC-16	Upper	DAH	CRC-16	Upper	DAH			
	Lower	8DH		Lower	8DH			

◆ Writing to Multiple Registers

The writing of drive memory registers works similar to the reading process, i.e., the address of the first register that is to be written and the quantity of to be written registers must be set in the command message. The data to be written must be consecutive, starting from the specified address in the command message. The data order must be higher 8 bits, then lower 8 bits. The data must be in memory register address order.

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.

Command Message			Response Message (normal)			Response Message (fault)		
Slave Address		01H	Slave Address		01H	Slave Address		01H
Function Code		10H	Function Code		10H	Function Code		90H
Starting No.	Upper	00H	Starting No.	Upper	00H	Error Code		02H
	Lower	01H		Lower	01H	CRC-16	Upper	CDH
Quantity	Upper	00H	Quantity	Upper	00H		Lower	C1H
	Lower	02H		Lower	02H			
Data Quantity		04H	CRC-16	Upper	10H			
Starting Data	Upper	00H		Lower	08H			
	Lower	01H						
Next Data	Upper	02H						
	Lower	58H						
CRC-16	Upper	63H						
	Lower	39H						

Note: For the number of data value in the command message, take double the number of the data value.

C.6 MEMOBUS/Modbus Data Table

Table below lists all MEMOBUS/Modbus data. There are three types of data: command data, monitor data, and broadcast data.

◆ Command Data

It is possible to both read and write command data.

Note: Bits that are not used should be written as 0. Refrain from writing to reserved registers.

Register No.	Contents	
0000H	Reserved	
0001H	Operation Signals	
	bit 0	H5-12 = 0: Forward Run Command (0 = Stop, 1 = Run) H5-12 = 1: Run Command (0 = Stop, 1 = Forward Run)
	bit 1	H5-12 = 0: Reverse Run Command (0 = Stop, 1 = Run) H5-12 = 1: Forward/Reverse (0 = Stop, 1 = Reverse Run)
	bit 2	External Fault (EF0)
	bit 3	Fault Reset
	bit 4	Multi-Function Input Command 1 ComRef when set for Forward/Stop Note: If H1-01 = 40, then bit 4 becomes ComRef.
	bit 5	Multi-Function Input Command 2 ComCtrl when set for Reverse/Stop Note: If H1-02 = 42, then bit 5 becomes ComCtrl.
	bit 6	Multi-Function Input 3
	bit 7	Multi-Function Input 4
	bit 8	Multi-Function Input 5
	bit 9	Multi-Function Input 6
	bit A	Multi-Function Input 7
	bit B to bit F	Reserved
0002H	Frequency Reference	Varies by the setting units set to o1-03.
0003H	V/f Gain	
0004H-0005H	Reserved	
0006H	PID Target (0.01% signed)	
0007H	Analog Output 1 setting (10 V / 4000 H)	
0008H	Analog Output 2 setting (10 V / 4000 H)	
0009H	Settings for Multi-Function Digital Outputs	
	bit 0	Contact Output (terminal MA/MB-MC)
	bit 1	Photocoupler Output 1 (terminal P1-PC)
	bit 2	Photocoupler Output 2 (terminal P2-PC)
	bit 3 to bit 5	Reserved
	bit 6	Fault Contact Output Enabled (1 = enabled by bit 7)
	bit 7	Fault contact (terminal MA/MB-MC)
	bit 8 to bit F	Reserved
000AH	PO Output	1/1 Hz Setting Range: 0 to 32000
000BH-000EH	Reserved	
000FH	Control Selection Setting	
	bit 0	Reserved
	bit 1	PID Target Input
	bit 2 to bit B	Reserved
	bit C	Broadcast Data Terminal S5 Input
	bit D	Broadcast Data Terminal S6 Input
	bit E	Broadcast Data Terminal S7 Input
	bit F	Reserved

◆ Monitor Data

Monitor data is read only.

Register No.	Contents	
0020H	Drive Status	
	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 (terminal MA/MB-MC)
	bit 6	Multi-Function Photocoupler Output 1 (terminal P1 - PC)
	bit 7	Multi-Function Photocoupler Output 2 (terminal P2 - PC)
	bit 8 to bit D	Reserved
	bit E	ComRef status
	bit F	ComCtrl status

Register No.	Contents	
0021H	Fault Contents 1	
	bit 0	oC, GF: Overcurrent or Ground Fault
	bit 1	oV: DC Bus Overvoltage
	bit 2	oL2: Drive Overload
	bit 3	oH1, oH2: Overheat Fault
	bit 4	rH, rr: Braking Resistor Fault
	bit 5	Reserved
	bit 6	FbL, FbH: PID Feedback Fault
	bit 7	EF0 to 7: External Fault
	bit 8	CPF□□: Hardware Fault (includes OFx)
	bit 9	oL1, oL3, oL4, UL3, UL4: Motor Overload/Overtorque 1 or 2, Undertorque 1 or 2
	bit A	PGo, oS, dEv: PG Disconnect, Overspeed, Speed Deviation
	bit B	Uv1: DC Bus Undervoltage
	bit C	Uv1, Uv2, Uv3: DC Bus Undervoltage, Control Power Supply Fault, Inrush Prevention Circuit Fault
	bit D	PF, LF: Input/Output Phase Loss
	bit E	CE, bUS: Communication Loss
	bit F	oPr: Operator Disconnected
0022H	Data Link Status	
	bit 0	Writing Data
	bit 1	Reserved
	bit 2	Reserved
	bit 3	Upper/Lower Limit Error
	bit 4	Data Integrity Error
	bit 5	Writing to EEPROM
	bit 6 to bit F	Reserved
0023H	Frequency Reference (U1-01)	
0024H	Output Frequency (U1-02)	
0025H	Output Voltage Reference (U1-06), units: 1/0.1 V Note: Switch between setting units using parameter H5-10.	
0026H	Output Current (U1-03), units: 10/1 A	
0027H	Output Power (U1-08)	
0028H	Torque Reference (U1-09)	
0029H	Fault Contents 2	
	bit 0	SC: Load Short Circuit
	bit 1	GF: Ground Fault
	bit 2	PF: DC Bus Voltage Fault
	bit 3	LF: Output Phase Loss
	bit 4	rH: Braking Resistor Overheat
	bit 5 to bit F	Reserved
002AH	Alarm Contents1	
	bit 0 to bit 1	Reserved
	bit 2	EF: Simultaneous Forward and Reverse Run Commands
	bit 3	bb: Drive Baseblock
	bit 4	oL3: Overtorque 1
	bit 5	oH: Heatsink Overheat
	bit 6	oV: DC Bus Overvoltage
	bit 7	Uv: DC Bus Undervoltage
	bit 8	Reserved
	bit 9	CE: Communications Error
	bit A	bUS: Option Error
	bit B	UL3: Undertorque 1
	bit C	oH2: Drive Overheat Prealarm
	bit D	FbL, FbH: PID Feeback Alarm
	bit E	Reserved
	bit F	CALL: Waiting for Communications
002BH	Input Terminal Status (U1-10)	
	bit 0	Terminal S1 Closed
	bit 1	Terminal S2 Closed
	bit 2	Terminal S3 Closed
	bit 3	Terminal S4 Closed
	bit 4	Terminal S5 Closed
	bit 5	Terminal S6 Closed
	bit 6	Terminal S7 Closed
	bit 7 to bit F	Reserved

Register No.	Contents	
002CH	Drive Status 2	
	bit 0	During Run
	bit 1	Zero Speed
	bit 2	Speed Agree
	bit 3	User Speed Agree
	bit 4	Frequency Detection 1
	bit 5	Frequency Detection 2
	bit 6	Drive Ready
	bit 7	During Undervoltage
	bit 8	During Baseblock
	bit 9	Frequency Reference from Operator Keypad
	bit A	Run Command from Operator Keypad
	bit B	Over/Undertorque 1, 2
	bit C	Frequency Reference Loss
	bit D	During Fault Restart
	bit E	Fault
	bit F	Communication Timeout
002DH	Output Terminal Status (U1-11)	
	bit 0	Multi-Function Contact Output (terminal MA/MB-MC)
	bit 1	Multi-Function Photocoupler Output 1 (terminal P1 - PC)
	bit 2	Multi-Function Photocoupler Output 2 (terminal P2 - PC)
	bit 3 - 6	Reserved
	bit 7	Fault Contact (terminal MA/MB-MC)
	bit 8 to bit F	Reserved
002EH	Reserved	
002FH	Frequency Reference Bias (UP2, DOWN2) 1000/100%	
0030H	Reserved	
0031H	DC Bus Voltage (U1-07)	
0032H	Torque Monitor (units: 1/1%)	
0033H	Reserved	
0034H	Product Code 1 [ASCII] V O	
0035H	Product Code 2 [ASCII] A O	
0036H	Reserved	
0037H	Reserved	
0038H	PID Feedback (100% / max. output frequency; 1/0.1% resolution; not signed)	
0039H	PID Input (100% / max. output frequency; 1/0.1% resolution; signed)	
003AH	PID Output (100% / max. output frequency; 1/0.1% resolution; signed)	
003B to 003CH	Reserved	
003DH	Communications Error Contents*	
	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	Revolutions per Minute
003FH	Output Frequency	0.01% Units

*The contents of a communication error are saved until fault is reset.

◆ Broadcast Messages

Data can be written from the controller 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 (set by H1-01)
	bit 5	Fault Reset (set by H1-02)
	bit 6 to bit B	Reserved
	bit C	Multi-Function Contact Input S5
	bit D	Multi-Function Contact Input S6
	bit E	Multi-Function Contact Input S7
	bit F	Reserved
0002H	Frequency Reference	30000/100%

Note: See the following page for information on Enter Command Data (0900H, 0910H).

C.7 Enter Command

When writing parameters to the drive from the PLC using MEMOBUS/Modbus communication, the parameters are temporarily stored in the parameter data area of the drive. To enable these parameters in the parameter data area, the Enter command must be used.

There are two types of Enter commands: Enter commands that enable parameter data in RAM only (changes are lost when the drive is shut off), and Enter commands that write data into the EEPROM (non-volatile memory) of the drive and enable the data in RAM at the same time.

The following table shows the Enter command data. The Enter command is enabled by writing 0 to register number 0900H or 0910H.

Register No.	Description
0900H	Saves parameter data to EEPROM
0910H	Updates parameter data to RAM without saving to EEPROM

Note: Because the EEPROM can be written to a maximum of 100,000 times, refrain from writing to the EEPROM too often. The ENTER command registers are write-only. Consequently, if these registers are read, then the register address will be invalid (Error code: 02H). An ENTER command is not required if reference or broadcast data are sent to the drive.

◆ ENTER Command Settings when Upgrading the Drive

To transfer parameter settings from an earlier Yaskawa model drive to V1000, parameter H5-11 needs to be set in accordance with how the Enter command functions in the older drive.

If upgrading from a G7 or F7 series drive to V1000, set parameter H5-11 to 0.

If upgrading from a V7 series drive to V1000, set parameter H5-11 to 1.

No.	Name	Description	Setting	Default	Control Mode			Addr. Hex
					VF	OLV	PM	
H5-11	Communications ENTER Function Selection	Select the function for the enter command that saves parameter data to the drive.0: Save parameter data that was edited to the drive when the enter command is given.1: Parameter data that has been edited is saved when the enter command is given (compatible with the V7).	0.1	1	A	A	A	43CH

Note: Option cards are designed for a specific model, and are not compatible between drives.

■ H5-11 and the Enter Command

H5-11 Settings	H5-11 = 0	H5-11 = 1
Drive being replaced	G7, F7	V7
How parameter settings are enabled	When the ENTER key is pressed	As soon as the value is changed
Upper/Lower limit check	Determined by related parameters	Single upper/lower limit
Default value of related parameters	Not affected	Determines the default values of related parameters
Error when setting multiple parameters	Data is accepted even if one setting is invalid	Error occurs if one setting is invalid
Operation when saving several parameter settings at once	Allows all valid settings to be saved	No data is written if a single piece of data is invalid

C.8 Error Codes

A list of MEMOBUS/Modbus errors appears below.

When an error occurs, remove whatever it was that 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
	None of the register numbers exist. Attempted to send a broadcast message that did not start with 0001H or 0002H.
03H	Bit Count Error
	Read data or write data is greater than 16 bits.
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
	Attempted to write while the drive was operating to a parameter that cannot be written to during run. During an EEPROM data error (CPF06), the PLC attempted to write to a parameter other than A1-00 to -05, E1-03, or o2-04. Attempted to write to read-only data.
23H	DC Bus Undervoltage Write Error
	Attempted to write from the PLC during an undervoltage fault (Uv1). Attempted to execute and Enter command from the PLC during Uv1.
24H	Write Error During Parameter Process
	PLC attempted writing to the drive while the drive was processing parameter data.

C.9 Slave Not Responding

In the following situations the slave drive will ignore the command message sent from the master, and not send a response message:

- When a communications error (overrun, framing, parity or CRC-16) is detected in the command message.
- When the slave address in the command message and the slave address in the drive do not match (remember to set the slave address for the drive using H5-01).
- When the gap between two blocks (8 bit) of a message exceeds 24 bits.
- When the command message data length is invalid.

Note: If the slave address specified in the command message is 00H, all slaves execute the write function, but do not return response messages to the master.

◆ Application Notes

Set the time that the master device should wait for the slave to respond after a command message has been sent. If a response is not received within the specified time, the message can be sent again.

C.10 Self-Diagnostics

The drive has a built-in self-diagnosing function of the serial communication interface circuits. To perform the self-diagnosis function use the following procedure.

1. Turn on the power to the drive.

2. Set terminal S7 for the communications test mode (H1-07 = 67).

3. Turn off the power to the drive.

4. With the power off, wire the drive as shown in the illustration below.

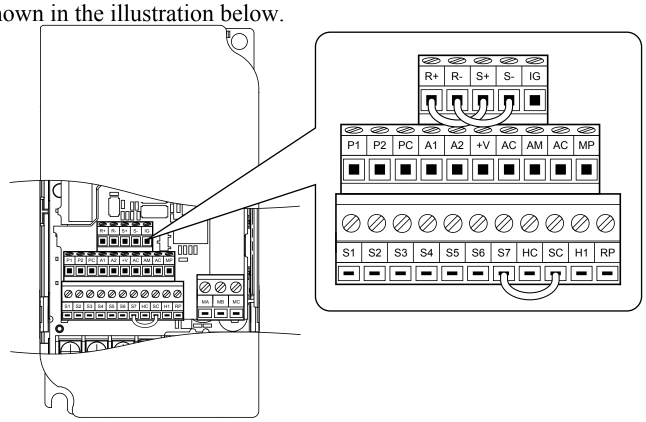


Figure C.5 Terminal Connections for Communication Self-Diagnostics

5. The last slave in the series should have DIP switch 2 placed to the ON position in order to enable terminal resistance.

6. Turn the power to the drive back on. The DIP switch setting takes affect after the drive is turned on again.

During normal operation, the drive will display PASS. This indicates that the communications test mode is operating normally. When a fault occurs, the drive will display CE on the keypad screen. Once the output contact closes, the “Drive Ready” signal will open.

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Appendix: D

Standards Compliance

This chapter explains the guidelines and criteria for maintaining CE and UL standards.

D.1 Section Safety

DANGER

Electrical Shock Hazard

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

Failure to comply will result in death or serious injury.

WARNING

Electrical Shock Hazard

Do not operate equipment with covers removed.

Failure to comply could result in death or serious injury.

The diagrams in this section may 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. The charge indicator LED will extinguish when the DC bus voltage is below 50 Vdc. To prevent electric shock, wait at least five minutes after all indicators are off and measure the DC bus voltage level to confirm safe level.

WARNING

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 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 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.
Carefully review instruction manual TOBPC72060000 when connecting a braking option 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 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.

D.2 European Standards

Figure D.1 CE Mark

The CE mark indicates compliance with European safety and environmental regulations and is required for engaging in business and commerce in Europe.

European standards include the Machinery Directive for machine manufacturers, the Low Voltage Directive for electronics manufacturers and the EMC guidelines for controlling noise.

This drive displays the CE mark based on the EMC guidelines and the Low Voltage Directive.

- **EMC Guidelines:** Devices used in combination with this drive must also be CE certified and display the CE mark. When using drives displaying the CE mark in combination with other devices, it is ultimately the responsibility of the user to ensure compliance with CE standards. After setting up the device, verify that conditions meet European standards.
- **Low Voltage Directive:** 73/23/EEC, 93/68/EEC

◆ CE Low Voltage Directive Compliance

This drive has been tested according to European standard EN50178, and it fully complies with the Low Voltage Directive.

To comply with the Low Voltage Directive, be sure to meet the following conditions when combining this drive with other devices:

■ Area of Use

Do not use drives in areas with pollution higher than severity 2 and overvoltage category 3 in accordance with IEC664.

■ Installing Fuses on the Input Side

Install recommended UL-approved fuses at the main power input of the drive. Select fuses according to ***Table D.1*** .

Table D.1 Recommended Input Fuse Selection

Drive Model CIMR-V☐	Time Delay/ Class RK5 Fuses 600 Vac, 200 kAIR	Fuse Ampere Rating	Non-Time Delay/ Class T Fuses 600 Vac, 200 kAIR
200 V Class Single-Phase Drives			
BA0001	TRS5R	5	Contact Yaskawa
BA0002	TRS10R	10	
BA0003	TRS20R	20	
BA0006	TRS35R	35	
BA0010	TRS50R	50	
BA0012	TRS60R	60	
BA0018	Contact Yaskawa		
200 V Class Three-Phase Drives			
2A0001	TRS5R	5	Contact Yaskawa
2A0002	TRS5R	5	
2A0004	TRS10R	10	
2A0006	TRS15R	15	
2A0010	TRS25R	25	
2A0012	TRS35R	35	
2A0020	TRS60R	60	
2A0030	Not Available	70	A6T70
2A0040		100	A6T100
2A0056		150	A6T150
2A0069		200	A6T200
400 V Class Three-Phase Drives			
4A0001	TRS2.5R	2.5	Contact Yaskawa
4A0002	TRS5R	5	
4A0004	TRS10R	10	
4A0005	TRS20R	20	
4A0007	TRS20R	20	
4A0009	TRS20R	20	
4A0011	TRS30R	30	
4A0018	Not Available	50	A6T50
4A0023		60	A6T60
4A0031		70	A6T70
4A0038		80	A6T80

■ Guarding Against Harmful Materials

When installing IP20/Open-Chassis drives, use an enclosure that prevents foreign material from entering the drive from above or below.

■ Grounding

The drive is designed to be used in T-N (grounded neutral point) networks. If installing the drive in other types of grounded systems, contact your dealer or Yaskawa for instructions.

◆ EMC Guidelines Compliance

This drive is tested according to European standards EN61800-3 and it complies with the EMC guidelines.

■ EMC Filter Installation

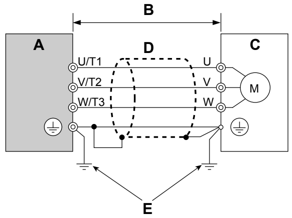
The following conditions must be met to ensure continued compliance with guidelines.

- **EMC Filter Selection**: Refer to Yaskawa catalog for EMC filter selection.
- **EMC Filter Installation**: Refer to option manual for option installation instructions.

Installation Method

Verify the following installation conditions to ensure that other devices and machinery used in combination with this drive also comply with EMC guidelines.

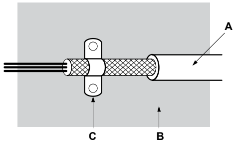
1. Install an EMC noise filter to the input side specified by Yaskawa for compliance with European standards.
2. Place the drive and EMC noise filter in the same enclosure.
3. Use braided shield cable for the drive and motor wiring or run the wiring through a metal conduit.
4. Keep wiring as short as possible. Ground the shield on both the drive side and the motor side.



A – Drive
B – 20 m max cable length between drive and motor
C – Motor
D – Metal conduit
E – Ground wire should be as short as possible.

Figure D.2 Installation Method

5. Ground the largest possible surface area of the shield to the metal conduit when using braided shield cable. Yaskawa recommends using a cable clamp.



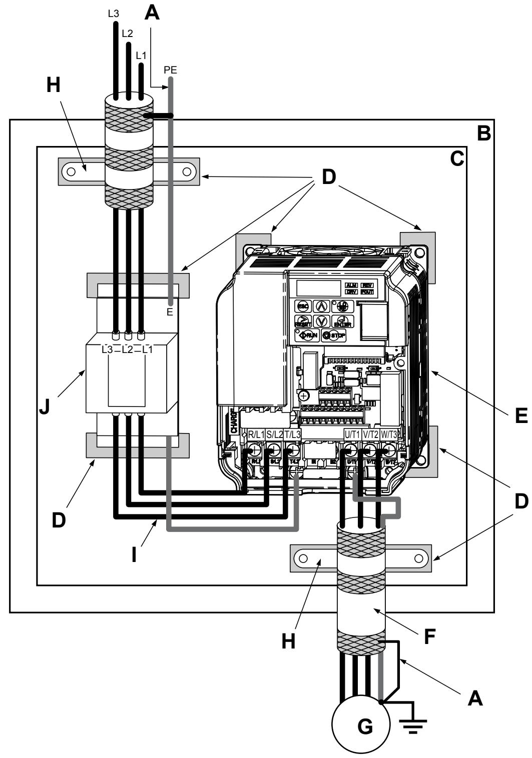
A – Braided shield cable
B – Metal panel
C – Cable clamp (conductive)

Figure D.3 Ground Area

Standards Compliance

D

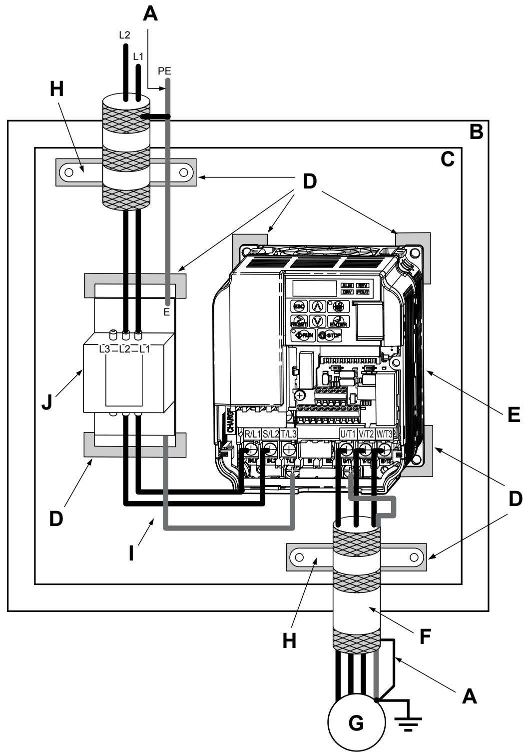
Three-Phase 200 V / 400 V Class



A – Ground the cable shield
B – Enclosure panel
C – Metal plate
D – Grounding surface (remove any paint or sealant)
E – Drive
F – Motor cable (braided shield cable, max. 20 m)
G – Motor
H – Cable clamp
I – Max. distance between drive and noise filter
J – EMC noise filter

Figure D.4 EMC Filter and Drive Installation for CE Compliance (Three-Phase 200 V / 400 V Class)

Single-Phase 200 V Class



A – Ground the cable shield
B – Enclosure panel
C – Metal plate
D – Grounding surface (remove any paint or sealant)
E – Drive
F – Motor cable (braided shield cable, max. 20 m)
G – Motor
H – Cable clamp
I – Max. distance between drive and noise filter
J – EMC noise filter

Figure D.5 EMC Filter and Drive Installation for CE Compliance (Single-Phase 200 V Class)

■ EMC Filters

The drive should be installed with the EMC filters listed below in order to comply with the EN 61800-3, category C1 requirements.

Table D.2 EN 61800-3 Category C1 Filters

Drive CIMR-V☐	Filter Data (Manufacturer: Schaffner)						
	Type	Rated Current [A]	Weight [kg]	Dimensions [W x L x H] (mm)	Y x X	Drive Mounting Screw A	Filter Mounting Screw
200 V Single-Phase Units							
BA0001	FS 5855-10/07	10	0.4	71 x 169 x 45	51 x 156	M4	M5
BA0002	FS 5855-10/07	10	0.4	71 x 169 x 45	51 x 156	M4	M5
BA0003	FS 5855-10/07	10	0.4	71 x 169 x 45	51 x 156	M4	M5
BA0006	FS 5855-20/07	20	0.7	111 x 169 x 50	91 x 156	M4	M5
BA0010	FS 5855-20/07	20	0.7	111 x 169 x 50	120 x 161	M4	M5
BA0012	FS 5855-30/07	30	1.0	144 x 174 x 50	120 x 161	M4	M5
BA0018	Contact Yaskawa						
200 V Three-Phase Units							
2A0001	FS 5856-10-07	10	0.7	82 x 194 x 50	62 x 181	M4	M5
2A0002	FS 5856-10-07	10	0.7	82 x 194 x 50	62 x 181	M4	M5
2A0004	FS 5856-10-07	10	0.7	82 x 194 x 50	62 x 181	M4	M5
2A0006	FS 5856-10-07	10	0.7	82 x 194 x 50	62 x 181	M4	M5
2A0010	FS 5856-20-07	20	0.8	111 x 169 x 50	91 x 156	M4	M5
2A0012	FS 5856-20-07	20	0.8	111 x 169 x 50	91 x 156	M4	M5
2A0020	FS 5856-30-07	30	0.9	144 x 174 x 50	120 x 161	M4	M5
2A0030	FS 5973-35-07	35	1.4	141 x 330 x 46	115 x 313	M4	M5
2A0040	FS 5973-60-07	60	3.0	206 x 355 x 60	175 x 336	M5	M6
2A0056	FS 5973-100-07	60	3.0	206 x 355 x 60	175 x 336	M5	M6
2A0069	FS 5973-100-07	100	4.9	236 x 408 x 80	205 x 390	M8	M8
200 V Three-Phase Units							
4A0001	FS 5857-5/07	5	0.5	111 x 169 x 45	91 x 156	M4	M5
4A0002	FS 5857-5/07	5	0.5	111 x 169 x 45	91 x 156	M4	M5
4A0004	FS 5857-10/07	10	0.75	111 x 169 x 45	91 x 156	M4	M5
4A0005	FS 5857-10/07	10	0.75	111 x 169 x 45	91 x 156	M4	M5
4A0007	FS 5857-10/07	10	0.75	111 x 169 x 45	91 x 156	M4	M5
4A0009	FS 5857-20/07	20	1.0	144 x 174 x 50	120 x 161	M4	M5

Drive CIMR-V☐	Filter Data (Manufacturer: Schaffner)						
	Type	Rated Current [A]	Weight [kg]	Dimensions [W x L x H] (mm)	Y x X	Drive Mounting Screw A	Filter Mounting Screw
4A0011	FS 5857-20/07	20	1.0	144 x 174 x 50	120 x 161	M4	M5
4A0018	FS 5972-35-07	35	2.1	206 x 355 x 50	175 x 335	M4	M5
4A0023	FS 5972-35-07	35	2.1	206 x 355 x 50	175 x 335	M4	M5
4A0031	FS 5972-60-07	60	4.0	236 x 408 x 65	390 x 205	M4	M5
4A0038	FS 5972-60-07	60	4.0	236 x 408 x 65	390 x 205	M6	M6

Note: Noise filters for models CIMR-V☐2A0030 through 0069 are in compliance with IEC61800–3, Category 2. All other models comply with Category 1.

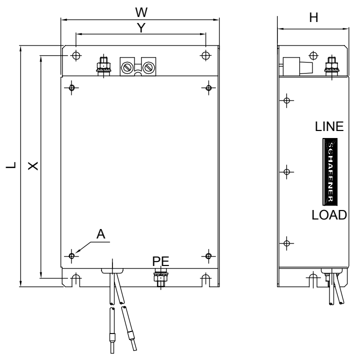


Figure D.6 EMC Filter Dimensions

■ DC Reactors

Table D.3 DC Reactors for Harmonics Reduction

Inverter Type CIMR-V☐	DC Reactor	
	Model	Rating
200V Three Phase Units		
2A0004	UZDA-B	5.4 A 8 mH
2A0006		
400 V Three Phase Units		
4A0002	UZDA-B	3.2 A 28 mH
4A0004		

Note: Contact Yaskawa for information about DC reactors for other models.

D.3 UL Standards

The UL/cUL mark applies to products in the United States and Canada 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 D.7 UL/cUL Mark

◆ UL Standards Compliance

This drive is tested in accordance with UL standard UL508C and complies with UL requirements. The following conditions 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 severity 2 (UL standard).

■ Main Circuit Terminal Wiring

Yaskawa recommends using UL-listed copper wires (rated at 75°C) and closed-loop connectors or CSA-certified ring connectors sized for the selected wire gauge to maintain proper clearances when wiring the drive. Use the correct crimp tool to install connectors per manufacturer recommendation. ***Table D.4*** lists a suitable closed-loop connector manufactured by JST Corporation.

Table D.4 Closed-Loop Crimp Terminal Size (JIS C 2805) (same for 200 V and 400 V)

Wire Gauge mm^2 (AWG)	Terminal Screws	Crimp Terminal Model Numbers	Tightening Torque N m (lb to in.)
0.75 (18)	M3.5	R1.25-3.5	0.8 to 1.0 (7.1 to 8.9)
	M4	R1.25-4	1.2 to 1.5 (10.6 to 13.3)
1.25 (16)	M3.5	R1.25-3.5	0.8 to 1.0 (7.1 to 8.9)
	M4	R1.25-4	1.2 to 1.5 (10.6 to 13.3)
2 (14)	M3.5	R2-3.5	0.8 to 1.0 (7.1 to 8.9)
	M4	R2-4	1.2 to 1.5 (10.6 to 13.3)
	M5	R2-5	2.0 to 2.5 (17.7 to 22.1)
	M6	R2-6	4.0 to 5.0 (35.4 to 44.3)
3.5/5.5 (12/10)	M4	R5.5-4	1.2 to 1.5 (10.6 to 13.3)
	M5	R5.5-5	2.0 to 2.5 (17.7 to 22.1)
	M6	R5.5-6	4.0 to 5.0 (35.4 to 44.3)
	M8	R5.5-8	9.0 to 11.0 (79.7 to 97.4)
8 (8)	M4	R8-4	1.2 to 1.5 (10.6 to 13.3)
	M5	R8-5	2.0 to 2.5 (17.7 to 22.1)
	M6	R8-6	4.0 to 5.0 (35.4 to 44.3)
	M8	R8-8	9.0 to 11.0 (79.7 to 97.4)
14 (6)	M4	R8-4	1.2 to 1.5 (10.6 to 13.3)
	M5	R14-5	2.0 to 2.5 (17.7 to 22.1)
	M6	R14-6	4.0 to 5.0 (35.4 to 44.3)
	M8	R14-8	9.0 to 11.0 (79.7 to 97.4)
22 (4)	M6	R22-6	4.0 to 5.0 (35.4 to 44.3)
	M8	R22-8	9.0 to 11.0 (79.7 to 97.4)
30/38 (3/2)	M8	R38-8	9.0 to 11.0 (79.7 to 97.4)

Note: Use the specified crimp terminals (Model 14-NK4) when using CIMR-V□2A0030, V□2A0040, V□4A0023 with 14 mm^2 (6 AWG).

Note: Use crimp insulated terminals or insulated shrink tubing for wiring connections. Wires should have a continuous maximum allowable temperature of 75°C 600 Vac UL-approved vinyl-sheathed insulation.

Table D.5 Recommended Input Fuse Selection

Drive Model CIMR-V□	Time Delay/ Class RK5 Fuses 600 Vac, 200 kAIR	Fuse Ampere Rating
200 V Class Single-Phase Drives		
BA0001	TRS5R	5
BA0002	TRS10R	10
BA0003	TRS20R	20
BA0006	TRS35R	35
BA0010	TRS50R	50
BA0012	TRS60R	60
BA0018	Contact Yaskawa	
200 V Class Three-Phase Drives		
2A0001	TRS5R	5
2A0002	TRS5R	5
2A0004	TRS10R	10

Drive Model CIMR-V□	Time Delay/ Class RK5 Fuses 600 Vac, 200 kAIR	Fuse Ampere Rating
2A0006	TRS15R	15
2A0010	TRS25R	25
2A0012	TRS35R	35
2A0020	TRS60R	60
2A0030	Contact Yaskawa	70
2A0040		100
2A0056		150
2A0069		200
400 V Class Three-Phase Drives		
4A0001	TRS2.5R	2.5
4A0002	TRS5R	5
4A0004	TRS10R	10
4A0005	TRS20R	20
4A0007	TRS20R	20
4A0009	TRS20R	20
4A0011	TRS30R	30
4A0018	Contact Yaskawa	50
4A0023		60
4A0031		70
4A0038		80

■ Low Voltage Wiring for Control Circuit Terminals

Wire low voltage wires with NEC Class 1 circuit conductors. Refer to national state or local codes for wiring. Use a class 2 (UL regulations) power supply for the control circuit terminal.

Table D.6 Control Circuit Terminal Power Supply

Input / Output	Terminal Signal	Power Supply Specifications
Digital outputs	P1*, P2*, PC*, MA, MB, MC, MP	*Requires class 2 power supply.
Digital inputs	S1, S2, S3, S4, S5, S6, S7, SC, H1, HC	Use the internal power supply of the drive. Use class 2 for external power supply.
Main frequency reference (multi-function analog inputs)	RP, +V, A1, A2, AC	Use the internal power supply of the drive. Use class 2 for external power supply.

■ Drive Short-Circuit Rating

This drive has undergone the UL short-circuit test, which certifies that during a short circuit in the power supply the current flow will not rise above 30,000 amps maximum at 240 V for 200 V class drives and 480 V for 400 V class drives.

- The MCCB and breaker protection and fuse ratings shall be equal to or greater than the short-circuit tolerance of the power supply being used.
- Suitable for use on a circuit capable of delivering not more than 30,000 RMS symmetrical amperes for 240 V in 200 V class drives (up to 480 V for 400 V class drives) motor overload protection.

◆ Drive Motor Overload Protection

Set parameter E2-01 (motor rated current) to the appropriate value to enable motor overload protection. The internal motor overload protection is UL listed and in accordance with the NEC and CEC.

■ E2-01 Motor Rated Current

Setting Range: Model Dependent

Factory Default: Model Dependent

Parameter E2-01 (motor rated current) protects the motor if parameter L1-01 is not set to 0 (default is 1, standard induction motor protection enabled).

If Auto-Tuning has been performed successfully, the motor data that was entered in T1-04 is automatically written into parameter E2-01. If Auto-Tuning has not been performed, manually enter the correct motor rated current in parameter E2-01.

■ L1-01 Motor Overload Protection Selection

The drive has an electronic overload protection function (OL1) based on time, output current and output frequency, which protects the motor from overheating. The electronic thermal overload function is UL-recognized, so it does not require an external thermal overload relay for single motor operation.

This parameter selects the motor overload curve used according to the type of motor applied.

Table D.7 Overload Protection Settings

Setting	Description
0	Disabled
1	Std Fan Cooled (< 10:1 motor) (factory default)
2	Standard Blower Cooled (10:1 motor)
3	Vector Motor (1000:1 motor)
4	PM motor

Disable the electronic overload protection (L1-01 = 0: Disabled) and wire each motor with its own motor thermal overload when connecting the drive to more than one motor for simultaneous operation.

Enable the motor overload protection (L1-01 = “1”, “2”, or “3”) when connecting the drive to a single motor unless there is another means of preventing motor thermal overload. The electronic thermal overload function causes an OL1 fault, which shuts off the output of the drive and prevents additional overheating of the motor. The motor temperature is continually calculated as long as the drive is powered up.

Setting L1-01 = 1 selects a motor with limited cooling capability below rated (base) speed when running at 100% load. The OL1 function derates the motor when it is running below base speed.

Setting L1-01 = 2 selects a motor capable of cooling itself over a 10:1 speed range when running at 100% load. The OL1 function derates the motor when it is running at 1/10 or less of its rated speed.

Setting L1-01 = 3 selects a motor capable of cooling itself at any speed — including zero speed — when running at 100% load. The OL1 function does not derate the motor at any speed.

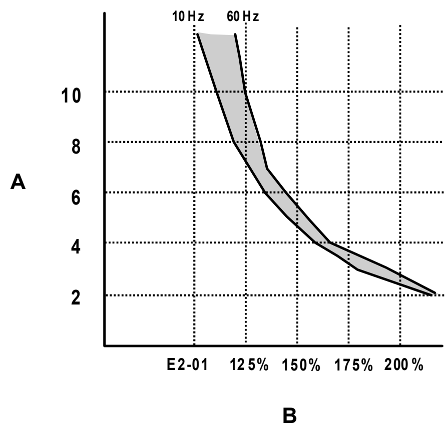
Setting L1-01 = 4 selects protection for a PM motor.

■ L1-02 Motor Overload Protection Time

Setting Range: 0.1 to 20.0 Minutes

Factory Default: 8.0 Minutes

The L1-02 parameter sets the allowed operation time before the OL1 fault occurs when the drive is running at 60 Hz and 133% of the full load amp rating (E2-01) of the motor. Adjusting the value of L1-02 can shift the set of OL1 curves up the Y-axis of the diagram below but will not change the shape of the curves.



A – Time (minutes)

B – Output Current (Percent of motor FLA)

Figure D.8 Motor Overload Protection Time

D.4 Safe Disable Input Precautions

◆ Safe Disable Function Description

The Safe Disable function can be utilized to perform a safe stop following the EN60204-1, stop category 0 (Uncontrolled stop by power removal). It is designed to meet the requirements of the EN954-1, Safety Category 3 and EN61508, SIL2.

Removing the voltage from the terminal H1 activates the disables the drive output, i.e. the power supply to the motor is cut by stopping the switching of the output transistors in a safe way and "Hbb" is shown in the display. Safe Disable is applicable for induction and permanent magnet motors.

◆ Installation

- If the Safe Disable function is utilized, the wire link between the terminals HC and H1, which is preinstalled at the shipment, has to be removed entirely.
- Connect the drive to an EN954-1, Safety Category 3 interrupting device so that in case of a safe stop request the connection between the terminals HC and H1 is opened.
- Wiring for the safety input should be kept under 30 meters.

Note: Drive output is interrupted in less than 1 ms after the safety input is activated.

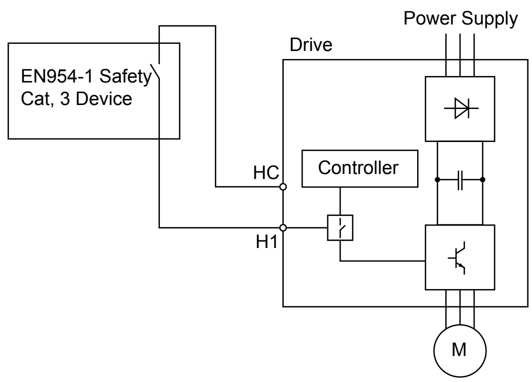


Figure D.9 Safe Disable Wiring Example

Note:
1. To assure that the Safe Disable function appropriately fulfills the safety requirements of the application, a throughout risk assessment for the whole safety system has to be carried out.
2. The drive must be installed in a cabinet with a protection degree of at least IP54 in order to maintain EN954-1, safety category 3 compliance.
3. If the safety device and the drive are installed in separate cabinets, the Safe Disable wires must be installed in a short circuit proof way.
4. The Safe Disable function does not cut the power supply to the drive and does not provide electrical isolation. Before any installation or maintenance work is done, the drives power supply must be switched off.
5. When PM motors are used, the following must be considered:
   Even if the HWBB function is active, although unlikely a failure in two of the drives power devices can occur which means that current flows through the motor winding. In an induction motor no torque can be produced by that. However, if this happens and a PM motor is connected a torque is produced causing an alignment of the rotor magnets. The rotor may turn up to 180 degrees electrically. It must be ensured, that this possible failure mode is not safety critical for the application.
6. The time from opening the Safe Disable input until the drive output is switched off is less than 1 ms.

D.5 User Setting Table

No.	Name	User Setting
A1-01	Access Level Selection	
A1-02	Control Method Selection	
A1-03	Initialize Parameters	
A1-04	Password 1	
A1-05	Password 2	
A1-06	Application Preset	
A1-07	DriveWorksEZ Function Selection	
A2-02 to A2-32	User Parameters, 2 to 32	
A2-33	User Parameter Automatic Selection	
b1-01	Frequency Reference Selection 1	
b1-02	Run Command Selection 1	
b1-03	Stopping Method Selection	
b1-04	Reverse Operation Selection	
b1-07	Local/Remote Run Selection	
b1-08	Run Command Selection while in Programming Mode	
b1-14	Phase Order Selection	
b1-15	Frequency Reference 2	
b1-16	Run Command Source 2	
b1-17	Run Command at Power Up	
b2-01	DC Injection Braking Start Frequency	
b2-02	DC Injection Braking Current	
b2-03	DC Injection Braking Time/DC Excitation Time at Start	
b2-04	DC Injection Braking Time at Stop	
b2-08	Magnetic Flux Compensation Capacity	
b2-12	Short Circuit Brake Time at Start	
b2-13	Short Circuit Brake Time at Stop	
b2-15	DC Injection Braking Current 2	
b3-01	Speed Search Selection	
b3-02	Speed Search Deactivation Current	
b3-03	Speed Search Deceleration Time	
b3-05	Speed Search Delay Time	
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YASKAWA AC Drive – V1000

Compact Vector Control Drive

Technical Manual (Preliminary)

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