YASKAWA

YASKAWA AC Drive CR700

For Cranes

Technical Manual

Type: CIPR-CR70Cxxxxxxxx
Models: 200 V Class, Three-Phase Input: 0.4 to 110 kW
400 V Class, Three-Phase Input: 0.4 to 315 kW

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Preface and General Precautions

This chapter gives information about important safety precautions for the use of this product. Failure to obey these precautions can cause serious injury or death, or damage to the product or related devices and systems. Yaskawa must not be held responsible for any injury or equipment damage as a result of the failure to observe these precautions and instructions.

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i.1 Receiving

These instructions contain the information necessary to use the product correctly. Read and understand the safety information and precautions before you start to use the product.

◆ Glossary

Terminology Used in this Document	Description
Drive	YASKAWA AC Drive CR700
V/f	V/f Control
CL-V/f	Closed Loop V/f Control
OLV	Open Loop Vector Control
CLV	Closed Loop Vector Control
AOLV	Advanced Open Loop Vector Control
MFDI	Multi-Function Digital Input
MFDO	Multi-Function Digital Output
MFAI	Multi-Function Analog Input
MFAO	Multi-Function Analog Output

◆ Registered Trademarks

- CANopen is a registered trademark of CAN in Automation (CIA).
- CC-Link is a registered trademark of CC-Link Partner Association.
- DeviceNet is a registered trademark of Open DeviceNet Vendor Association, Inc. (ODVA).
- EtherNet/IP is a registered trademark of Open DeviceNet Vendor Association, Inc. (ODVA).
- MECHATROLINK-I, MECHATROLINK-II, and MECHATROLINK-III are registered trademarks of MECHATROLINK Members Association (MMA).
- Modbus is a registered trademark of Schneider Electric SA.
- PROFIBUS-DP and PROFINET are registered trademarks of PROFIBUS International.
- Other company names and product names that appear in this document are trademarks or registered trademarks of the respective companies.

i.2 Using the Product Safely

◆ Explanation of Signal Words

⚠WARNING

Read and understand this manual before you install, operate, or do maintenance on the drive. Install the drive as specified by this manual and local codes.

The symbols in this section identify safety messages in this manual. If you do not obey these safety messages, the hazards can cause serious injury, death, or damage to the products and related equipment and systems.

These identifier words categorize and emphasize important safety precautions in these instructions.

⚠DANGER

This signal word identifies a hazard that will cause serious injury or death if you do not prevent it.

⚠WARNING

This signal word identifies a hazard that can cause death or serious injuries if you do not prevent it.

⚠CAUTION

This signal word identifies a hazardous situation, which, if not avoided, can cause minor or moderate injury.

NOTICE

This signal word identifies a property damage message that is not related to personal injury.

◆ Section Safety

General Precautions

- The diagrams in this manual may include options and drives without covers and safety shields to more clearly show what is inside the drive. Put back all covers and shields before operation. Use options and drives only as indicated in the instructions described in this manual
- The diagrams in this manual are provided as examples only. They may not pertain to all products covered by this manual.
- Yaskawa can change the products, specifications, and content of the instructions without notice to make the product and/or the instructions better.
- If you damage or lose these instructions, contact a Yaskawa representative or the nearest Yaskawa sales office on the rear cover of the manual, and tell them the document number on the front cover to order new copies.

⚠DANGER

Do not ignore the safety messages in this manual.

If you ignore the safety messages in this manual, it will cause serious injury or death. The manufacturer is not responsible for injuries or damage to equipment.

Electrical Shock Hazard

Do not examine, connect, or disconnect wiring on an energized drive. Before servicing, disconnect all power to the equipment and wait for the time specified on the warning label at a minimum. The internal capacitor stays charged after the drive is de-energized. The charge indicator LED extinguishes when the DC bus voltage decreases below 50 Vdc. When all indicators are OFF, remove the covers before measuring for dangerous voltages to make sure that the drive is safe.

If you do work on the drive when it is energized, it will cause serious injury or death from electrical shock.

⚠WARNING

Crush Hazard

Test the system to make sure that the drive operates safely after you wire the drive and set parameters.

If you do not test the system, it can cause damage to equipment or serious injury or death.

Sudden Movement Hazard

Before you do a test run, make sure that the setting values for virtual input and output function parameters are correct. Virtual input and output functions can have different default settings and operation than wired input and output functions.

Incorrect function settings can cause serious injury or death.

Remove all personnel and objects from the area around the drive, motor, and machine and attach covers, couplings, shaft keys, and machine loads before you energize the drive.

If personnel are too close or if there are missing parts, it can cause serious injury or death.

Electrical Shock Hazard

Do not modify the drive body or drive circuitry.

Modifications to drive body and circuitry can cause serious injury or death, will cause damage to the drive, and will void the warranty. Yaskawa is not responsible for modifications of the product made by the user.

Only let approved personnel install, wire, maintain, examine, replace parts, and repair the drive.

If personnel are not approved, it can cause serious injury or death.

Do not remove covers or touch circuit boards while the drive is energized.

If you touch the internal components of an energized drive, it can cause serious injury or death.

Damage to Equipment

Do not apply incorrect voltage to the main circuit of the drive. Operate the drive in the specified range of the input voltage on the drive nameplate.

Voltages that are higher than the permitted nameplate tolerance can cause damage to the drive.

Fire Hazard

Install sufficient branch circuit short circuit protection as specified by applicable codes and this manual. The drive is suitable for circuits that supply not more than 100,000 RMS symmetrical amperes, 240 Vac maximum (200 V Class), 480 Vac maximum (400 V Class).

Incorrect branch circuit short circuit protection can cause serious injury or death.

Electrical Shock Hazard

After the drive blows a fuse or trips an RCM/RCD, do not immediately energize the drive or operate peripheral devices. Wait for the time specified on the warning label at a minimum and make sure that all indicators are OFF. Then check the wiring and peripheral device ratings to find the cause of the problem. If you do not know the cause of the problem, contact Yaskawa before you energize the drive or peripheral devices.

If you do not fix the problem before you operate the drive or peripheral devices, it can cause serious injury or death.

⚠CAUTION

Crush Hazard

Tighten terminal cover screws and hold the case safely when you move the drive.

If the drive or covers fall, it can cause moderate injury.

NOTICE

Damage to Equipment

When you touch the drive and circuit boards, make sure that you observe correct electrostatic discharge (ESD) procedures.

If you do not follow procedures, it can cause ESD damage to the drive circuitry.

Do not do a withstand voltage test or use a megohmmeter or megger insulation tester on the drive.

These tests can cause damage to the drive.

Use an inverter-duty motor or vector-duty motor with reinforced insulation and windings applicable for use with an AC drive.

If the motor does not have the correct insulation, it can cause a short circuit or ground fault from insulation deterioration.

Do not operate a drive or connected equipment that has damaged or missing parts.

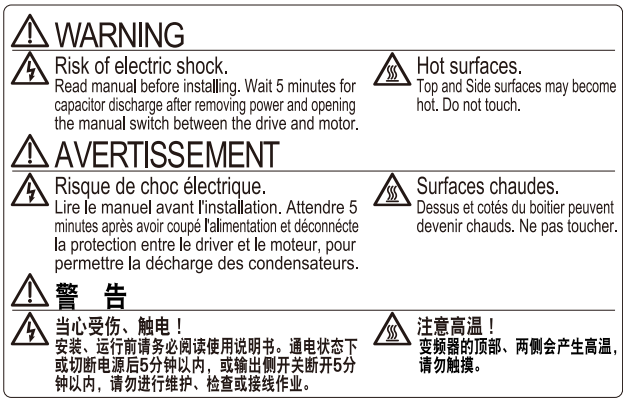
You can cause damage to the drive and connected equipment.

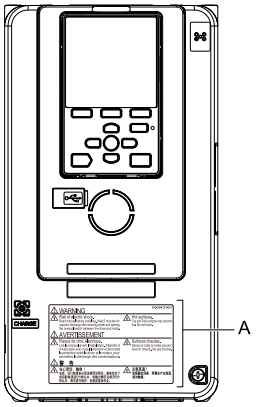
Do not use steam or other disinfectants to fumigate wood for packaging the drive. Use alternative methods, for example heat treatment, before you package the components.

Gas from wood packaging fumigated with halogen disinfectants, for example fluorine, chlorine, bromine, iodine or DOP gas (phthalic acid ester), can cause damage to the drive.

◆ Warning Label Content and Locations

Warning labels can be found at the following locations on the product. The product must be used in accordance with this information.





A - Warning label

Figure i.1 Warning Label Content and Locations

i.3 Warranty Information

◆ Exclusion of Liability

- This product is not designed and manufactured for use in life-support machines or systems.
- Contact a Yaskawa representative or your Yaskawa sales representative if you are considering the application of this product for special purposes, such as machines or systems used for passenger cars, medicine, airplanes and aerospace, nuclear power, electric power, or undersea relaying.

⚠WARNING

Injury to Personnel

When you use this product in applications where its failure could cause the loss of human life, a serious accident, or physical injury, you must install applicable safety devices.

If you do not correctly install safety devices, it can cause serious injury or death.

1

Receiving

This chapter gives information about the different drive models and features, and how to examine the drive when you receive it.

1.1 Section Safety 20
1.2 Crane Application Instructions 21
1.3 Model Number and Nameplate Check 22
1.4 Control Method Type and Corresponding Features 26

1.1 Section Safety

⚠DANGER

Do not ignore the safety messages in this manual.

If you ignore the safety messages in this manual, it will cause serious injury or death. The manufacturer is not responsible for injuries or damage to equipment.

1.2 Crane Application Instructions

For hoist applications, wire the drive so that the Forward Run command hoists the load, and the Reverse Run command lowers the load. If the machine does not move this way, crane software functions and performance will be reversed, making it impossible to take full advantage of the drive performance and capabilities.

If the direction of motor rotation is not consistent with machinery, do all these procedures to correct the direction of motor rotation.

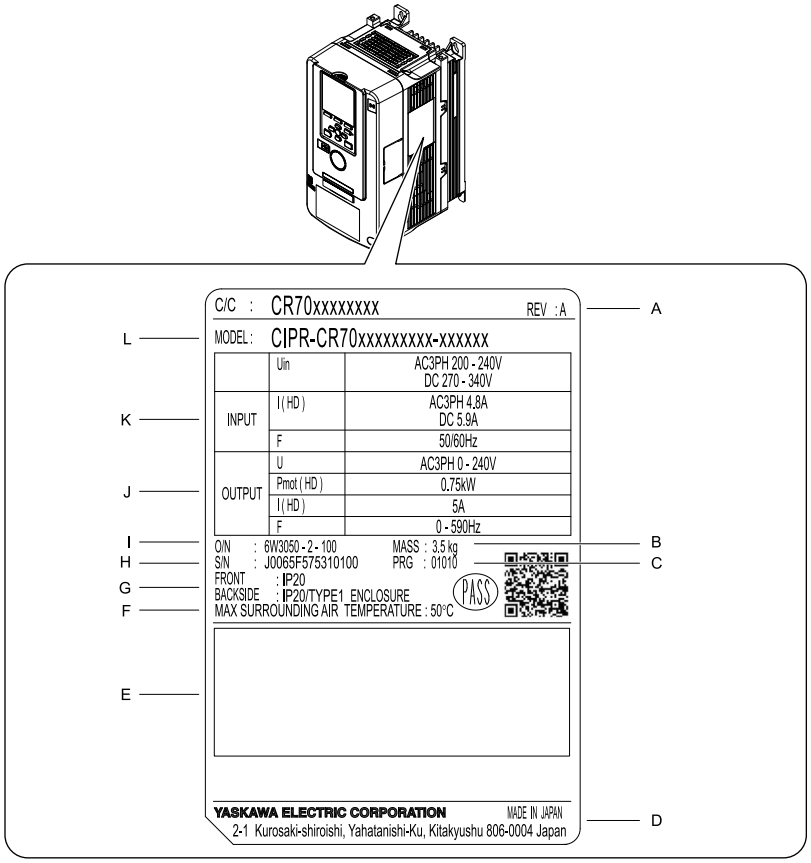
- Change two phases of the main circuit cables connecting the motor and drive.
- In Closed Loop Vector Control, change the setting of *F1-05 [Encoder 1 Rotation Selection]*.

1.3 Model Number and Nameplate Check

Please examine these items after you receive the drive:

- Examine the drive for damage. Immediately contact the shipping company if the drive is damaged. The Yaskawa warranty does not cover damage from shipping.
- Examine the drive model number to make sure that you received the correct model. Examine the model number in the “MODEL” section of the drive nameplate to make sure that you received the correct model.
- If you received the incorrect product or a product with a defect, contact Yaskawa or your nearest sales representative.

◆ Nameplate



A - Hardware revision
B - Weight
C - Drive software version
D - The address of the head office of Yaskawa Electric Corporation
E - Accreditation standards
F - Ambient temperature
G - Protection design
H - Serial number
I - Lot number
J - Output specifications
K - Input specifications
L - Drive Model

Figure 1.1 Nameplate Information Example

◆ How to Read the Model Number

Use the information in the figure and the table to understand the drive model number.

CIPR-	CR70	C	2	003	B	B	A	A	-	G	A	A	A	A	A
1	2	3	4	5	6	7	8	9		10	11	12	13	14	15

Figure 1.2 Drive Model

Table 1.1 Model Number Details

No.	Description
1	Drive
2	Product series
3	Region code • C: Europe • A: Japan • T: Asia (Singapore)
4	Input power supply voltage • 2: Three-Phase AC 200 V Class • 4: Three-Phase AC 400 V Class
5	The rated output current **Note:** Refer to the tables for the rated output current by model.
6	EMC noise filter • A: No internal EMC filter • B: Internal category C3 EMC filter
7	Protection design • B: IP20/UL Open Type
8	Environmental specification • A: Standard • K: Gas-resistant • M: Humidity-resistant and dust-resistant • N: Oil-resistant • P: Humidity-resistant, dust-resistant, and vibration-resistant • R: Gas-resistant and vibration-resistant • S: Vibration-resistant • T: Oil-resistant and vibration-resistant **Note:** Drives with these specifications do not guarantee complete protection for the environmental conditions shown.
9	Design revision order
10	Control circuit terminal board G: 10 digital input/screw clamp terminal board type
11	Option (connector CN5-A) • A: No option • D: AI-A3 (Analog Input) • E: DI-A3 (Digital Input) • F: SI-C3 (CC-Link) • G: SI-ET3 (MECHATROLINK-III) • H: SI-N3 (DeviceNet) • J: SI-P3 (PROFIBUS-DP) • K: SI-T3 (MECHATROLINK-II) • M: SI-S3 (CANopen) • S: SI-EP3 (PROFINET Communications) • P: SI-EM3 (ModbusTCP/IP) • R: SI-EN3 (EtherNet/IP)
12	Option (connector CN5-B) • A: No option • B: AO-A3 (Analog Monitor) • C: DO-A3 (Digital Output) • U: PG-B3 (Complementary Type PG) • V: PG-X3 (Motor PG Feedback Line Driver Interface)
13	Option (connector CN5-C) • A: No option • U: PG-B3 (Complementary Type PG) • V: PG-X3 (Motor PG Feedback Line Driver Interface) • Z: PG-RT3 (Motor Feedback Resolver TS2640N321E64 Interface)
14	Keypad • A: LCD keypad (standard) • B: LCD keypad (humidity-resistant and dust-resistant) • D: Bluetooth LCD keypad *1 • E: Bluetooth LCD keypad (humidity-resistant and dust-resistant) *1 • F: LED keypad • G: LED keypad (humidity-resistant and dust-resistant)
15	Special applications A: Standard

*1 This certification is not available in all regions where you will use the device. Contact Yaskawa or your nearest sales representative for more information.

■ Rated Output Current

These tables give the rated output current values.

Note:
- These output current values are applicable for drives that operate at the default settings.
- Derate the output current in applications that:
  – Increase the carrier frequency
  – Have high ambient temperature
  – Install drives side-by-side.

Table 1.2 Rated Output Current (Three-Phase AC 200 V)

Symbol	Maximum Applicable Motor Output kW	Rated Output Current A
003	0.55	3.2
005	0.75	5
008	1.5	8
011	2.2	11
014	3.0	14
018	4.0	17.5
025	5.5	25
033	7.5	33
047	11	47
060	15	60
075	18.5	75
088	22	88
115	30	115
145	37	145
180	45	180
215	55	215
283	75	283
346	90	346
415	110	415

Table 1.3 Rated Output Current (Three-Phase AC 400 V)

Symbol	Maximum Applicable Motor Output kW	Rated Output Current A
002	0.55	1.8
003	1.1	3.4
005	1.5	4.8
006	2.2	5.5
007	3.0	7.2
009	4.0	9.2
015	5.5	14.8
018	7.5	18
024	11	24
031	15	31
039	18.5	39
045	22	45
060	30	60
075	37	75

Symbol	Maximum Applicable Motor Output kW	Rated Output Current A
091	45	91
112	55	112
150	75	150
180	90	180
216	110	216
260	132	260
304	160	304
371	200	371
414	220	414
453	250	453
605	315	605

1.4 Control Method Type and Corresponding Features

This drive has 5 available control methods from which to select for different applications. The following table give information about the features of each control method.

Control Method	V/f Control (V/f)	Closed Loop V/f Control (CL-V/f)	Notes
Controlled Motor	**Induction Motor**		**-**
Parameter Settings	A1-02 = 0	A1-02 = 1	-
Basic Control	V/f	Closed loop V/f control with speed correction	-
Main Applications	General-purpose variable speed control for multiple motors in particular (applications connecting multiple motors to a single drive)	High-precision speed control with encoders on machines	-
Encoder Option Card	Not necessary	Necessary (PG-B3 or PG-X3)	-
Maximum Output Frequency	590 Hz	400 Hz	-
Speed Control Range	1:40	1:40	Represents the range of variable control. (Keep increases in motor temperature in mind when connecting and running motors in this manner.)
Starting Torque	150% / 3 Hz	150% / 3 Hz	This is the motor torque that can be generated at low speed during startup and the corresponding output frequency (rotation speed). Drive capacity must be considered if significant torque is required at low speed.
Auto-Tuning	Line-to-Line Resistance (usually, not necessary)	Line-to-Line Resistance (usually, not necessary)	Automatically tunes electrical motor parameters.
Torque Limits	No	No	Controls maximum motor torque to protect machines and loads.
Droop Control	No	No	Sets load torque slip for motors. Used to distribute motor loads.
Zero Servo Control	No	No	Locks servos without an external position controller to prevent movement caused by external force.
Feed Forward Control	No	No	Improves speed accuracy when the load changes by compensating effects of the system inertia.
Overexcitation Deceleration *1	Yes	Yes	Decreases the deceleration time by increasing motor loss by setting V/f higher than the setting value during deceleration.

*1 Motor loss increases during overexcitation braking and high-slip braking. Use a maximum braking frequency of 5% ED and a maximum braking time of 90 s. Use overexcitation braking to decelerate over a shorter time at a pre-determined speed.

Control Method	Open Loop Vector Control (OLV)	Closed Loop Vector Control (CLV)	Advanced Open Loop Vector Control (AOLV)	Notes
Controlled Motor	**Induction Motor**			**-**
Parameter Settings	A1-02 = 2 (Default)	A1-02 = 3	A1-02 = 4	-
Basic Control	Open Loop Current Vector Control	Closed Loop Current Vector Control	Open Loop Current Vector Control	-
Main Applications	• General-purpose variable speed control • Applications that require high-performance without machine encoders	Very high-performance control with motor encoders Example: High-precision speed control, torque limits	Sensorless vector control with speed control • General-purpose variable speed control • Applications that require high-performance without machine encoders	-
Encoder Option Card	Not necessary	Necessary (PG-B3 or PG-X3)	Not necessary	-
Maximum Output Frequency	590 Hz	400 Hz	120 Hz	-
Speed Control Range	1:200	1:1500	1:200	Represents the range of variable control. (Keep increases in motor temperature in mind when connecting and running motors in this manner.)
Starting Torque	200% / 0.3 Hz *1	200% / 0 min^{-1} *1	200% / 0.3 Hz *1	This is the motor torque that can be generated at low speed during startup and the corresponding output frequency (rotation speed). Drive capacity must be considered if significant torque is required at low speed.

Control Method	Open Loop Vector Control (OLV)	Closed Loop Vector Control (CLV)	Advanced Open Loop Vector Control (AOLV)	Notes
Controlled Motor	**Induction Motor**			**-**
Auto-Tuning *2	Rotational, Stationary, and Line-to-Line Resistance	Rotational, Stationary, and Line-to-Line Resistance	Rotational, Stationary, and Line-to-Line Resistance	Automatically tunes electrical motor parameters.
Torque Limits *2	Yes	Yes	Yes	Controls maximum motor torque to protect machines and loads.
Droop Control *2	No	Yes	Yes	Sets load torque slip for motors. Used to distribute motor loads.
Zero Servo Control *2	No	Yes	No	Locks servos without an external position controller to prevent movement caused by external force.
Feed Forward Control *2	No	Yes	Yes	Improves speed accuracy when the load changes by compensating effects of the system inertia.
Overexcitation Deceleration *2	Yes	Yes	Yes	Decreases the deceleration time by increasing motor loss by setting V/f higher than the setting value during deceleration.

*1 Select the drive capacity accordingly.
*2 Note these points when you use this function:

- When you can decouple the motor and machine for a test run, use Rotational Auto-Tuning. You must make adjustments to the control in the range where there is no vibration in the machine after Rotational Auto-Tuning.
- For vector control, use a 1:1 drive to motor ratio. You cannot use vector control when more than one motor is connected to one drive. Select a drive capacity so that the motor rated current is 50% to 100% of the drive rated current. If the carrier frequency is too high, the drive rated current is derated.
- Motor loss increases during overexcitation braking and high-slip braking. Use a maximum braking frequency of 5% ED and a maximum braking time of 90 s. Use overexcitation braking to decelerate over a shorter time at a pre-determined speed.
- Acceleration and deceleration have priority over torque limits in OLV control during acceleration and deceleration (soft start changes). The drive will not operate until the speed is at the minimum frequency or the reverse direction of motor rotation when the motor speed decreases because of torque limits during constant speed control. Set *L7-07 = 1 [Torque Limit during Accel/Decel = Proportional & Integral control]* to enable torque limits during acceleration/deceleration (for winding applications).

2

Mechanical & Electrical Installation

This chapter explains how to properly mount and install the drive, and to wire the control circuit terminals, motor, and power supply.

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2.3 Installation Orientation and Spacing 34
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2.1 Section Safety

⚠DANGER

Electrical Shock Hazard

Do not examine, connect, or disconnect wiring on an energized drive. Before servicing, disconnect all power to the equipment and wait for the time specified on the warning label at a minimum. The internal capacitor stays charged after the drive is de-energized. The charge indicator LED extinguishes when the DC bus voltage decreases below 50 Vdc. When all indicators are OFF, remove the covers before measuring for dangerous voltages to make sure that the drive is safe.

If you do work on the drive when it is energized, it will cause serious injury or death from electrical shock.

⚠WARNING

Electrical Shock Hazard

Do not operate the drive when covers are missing. Replace covers and shields before you operate the drive. Use the drive only as specified by the instructions.

Some figures in this section include drives without covers or safety shields to more clearly show the inside of the drive. If covers or safety shields are missing from the drive, it can cause serious injury or death.

Ground the neutral point on the power supply of drive models 2xxxB and 4xxxB to comply with the EMC Directive before you turn on the EMC filter.

If you turn ON the EMC filter, but you do not ground the neutral point, it can cause serious injury or death.

Make sure that the protective ground wire complies with technical standards and local safety regulations. The IEC/EN 61800-5-1:2007 standard specifies that you must wire the power supply to automatically de-energize when the protective ground wire disconnects. You can also connect a protective ground wire that has a minimum cross-sectional area of 10 mm² (copper wire) or 16 mm² (aluminum wire).

If you do not obey the standards and regulations, it can cause serious injury or death. The leakage current of the drive will be more than 3.5 mA in drive models 2xxxB, 4xxxB, and 4317A to 4605A.

When there is a DC component in the protective earthing conductor, the drive can cause a residual current. When a residual current operated protective or monitoring device prevents direct or indirect contact, always use a type B Residual Current Monitor/Residual Current Device (RCM/RCD) as specified by IEC/EN 60755.

If you do not use the correct RCM/RCD, it can cause serious injury or death.

Do not wear loose clothing or jewelry when you do work on the drive. Tighten loose clothing and remove all metal objects, for example watches or rings.

Loose clothing can catch on the drive and jewelry can conduct electricity and cause serious injury or death.

Do not remove covers or touch circuit boards while the drive is energized.

If you touch the internal components of an energized drive, it can cause serious injury or death.

Only let approved personnel install, wire, maintain, examine, replace parts, and repair the drive.

If personnel are not approved, it can cause serious injury or death.

Do not modify the drive body or drive circuitry.

Modifications to drive body and circuitry can cause serious injury or death, will cause damage to the drive, and will void the warranty. Yaskawa is not responsible for modifications of the product made by the user.

Fire Hazard

Tighten all terminal screws to the correct tightening torque.

Connections that are too loose or too tight can cause incorrect operation and damage to the drive. Incorrect connections can also cause death or serious injury from fire.

Tighten screws at an angle in the specified range shown in this manual.

If you tighten the screws at an angle not in the specified range, you can have loose connections that can cause damage to the terminal block or start a fire and cause serious injury or death.

⚠WARNING

Do not put flammable or combustible materials on top of the drive and do not install the drive near flammable or combustible materials. Attach the drive to metal or other noncombustible material.

Flammable and combustible materials can start a fire and cause serious injury or death.

Damage to Equipment

Do not apply incorrect voltage to the main circuit of the drive. Operate the drive in the specified range of the input voltage on the drive nameplate.

Voltages that are higher than the permitted nameplate tolerance can cause damage to the drive.

Fire Hazard

When you install a dynamic braking option, wire the components as specified by the wiring diagrams.

Incorrect wiring can cause damage to braking components or serious injury or death.

When you install the drive in an enclosure, use a cooling fan or cooler to decrease the temperature around the drive. Make sure that the intake air temperature to the drive is 50 °C (122 °F) or less for IP20/UL Open Type drives, and 40 °C (104 °F) or less for IP20/UL Type 1 drives.

If the air temperature is too hot, the drive can become too hot and cause a fire and serious injury or death.

Crush Hazard

Only approved personnel can operate a crane or hoist to move the drive.

If unapproved personnel operate a crane or hoist, it can cause serious injury or death from falling equipment.

Before you hang the drive vertically, use screws to correctly attach the drive front cover and other drive components.

If you do not secure the front cover, it can fall and cause minor injury.

When you use a crane or hoist to lift the drive during installation or removal, prevent more than 1.96 m/s² (0.2 G) vibration or impact.

Too much vibration or impact can cause serious injury or death from falling equipment.

When you lift the drive during installation or removal, do not try to turn the drive over and do not ignore the hanging drive.

If you move a hanging drive too much or if you ignore it, the drive can fall and cause serious injury or death.

Use a crane or hoist to move large drives when necessary.

If you try to move a large drive without a crane or hoist, it can cause serious injury or death.

⚠CAUTION

Crush Hazard

Tighten terminal cover screws and hold the case safely when you move the drive.

If the drive or covers fall, it can cause moderate injury.

NOTICE

Do not let unwanted objects, for example metal shavings or wire clippings, fall into the drive during drive installation. Put a temporary cover over the drive during installation. Remove the temporary cover before start-up.

Unwanted objects inside of the drive can cause damage to the drive.

Damage to Equipment

When you touch the drive and circuit boards, make sure that you observe correct electrostatic discharge (ESD) procedures.

If you do not follow procedures, it can cause ESD damage to the drive circuitry.

NOTICE

Select a motor that is compatible with the load torque and speed range. When 100% continuous torque is necessary at low speed, use an inverter-duty motor or vector-duty motor. When you use a standard fan-cooled motor, decrease the motor torque in the low-speed range.

If you operate a standard fan-cooled motor at low speed and high torque, it will decrease the cooling effects and can cause heat damage.

Obey the speed range specification of the motor as specified by the manufacturer. When you must operate the motor outside of its specifications, contact the motor manufacturer.

If you continuously operate oil-lubricated motors outside of the manufacturer specifications, it can cause damage to the motor bearings.

When the input voltage is 440 V or higher or the wiring distance is longer than 100 m (328 ft), make sure that the motor insulation voltage is sufficient or use an inverter-duty motor or vector-duty motor with reinforced insulation.

Motor winding and insulation failure can occur.

Install vibration-proof rubber on the base of the motor or use the frequency jump function in the drive to prevent specific frequencies that vibrate the motor.

Motor or system resonant vibration can occur in fixed speed machines that are converted to variable speed. Too much vibration can cause damage to equipment.

The motor may require more acceleration torque with drive operation than with a commercial power supply. Check the load torque characteristics of the machine to be used with the motor.

You can use the drive with an explosion-proof motor, but the drive is not explosion-proof. Install the drive only in the environment shown on the nameplate.

If you install the drive in a dangerous environment, it can cause damage to the drive.

Do not lift the drive with the covers removed.

If the drive does not have covers, you can easily cause damage to the internal parts of the drive.

Do not use unshielded wire for control wiring. Use shielded, twisted-pair wires and ground the shield to the ground terminal of the drive.

Unshielded wire can cause electrical interference and unsatisfactory system performance.

Before you connect a dynamic braking option to the drive, make sure that qualified personnel read and obey the Braking Unit and Braking Resistor Unit Installation Manual (TOBPC72060001).

If you do not read and obey the manual or if personnel are not qualified, it can cause damage to the drive and braking circuit.

Make sure that all connections are correct after you install the drive and connect peripheral devices.

Incorrect connections can cause damage to the drive.

2.2 Installation Environment

The installation environment is important for the lifespan of the product and to make sure that the drive performance is correct. Make sure that the installation environment agrees with these specifications.

Environment	Conditions
Area of Use	Indoors
Power Supply	Overvoltage Category III
Ambient Temperature Setting	Open chassis type (IP20): -10°C to +50 °C (14 °F to 122 °F) Enclosed wall-mounted type (UL Type 1): -10 °C to +40 °C (14 °F to 104 °F) • Drive reliability is better in environments where the temperature does not increase or decrease quickly. • When you install the drive in an enclosure, use a cooling fan or air conditioner to keep the internal air temperature in the permitted range. • Do not let the drive freeze. • To install the drive in areas with ambient temperatures ≤ 60 °C (140 °F), derate the output current and output voltage.
Humidity	95%RH or less Do not let condensation form on the drive.
Storage Temperature	-20 °C to +70 °C (-4 °F to +158 °F) (short-term temperature during transportation)
Surrounding Area	Pollution degree 2 or less Install the drive in an area without: • Oil mist, corrosive or flammable gas, or dust • Metal powder, oil, water, or other unwanted materials • Radioactive or flammable materials. • Harmful gas or fluids • Salt • Direct sunlight Keep wood and other flammable materials away from the drive.
Altitude	1000 m (3281 ft) maximum **Note:** Derate the output current by 1% for each 100 m (328 ft) to install the drive in altitudes between 1000 m to 4000 m (3281 ft to 13123 ft). It is not necessary to derate the rated voltage in these conditions: • Installing the drive at 2000 m (6562 ft) or lower • Installing the drive between 2000 m to 4000m (6562 ft to 13123 ft) and grounding the neutral point on the power supply. Contact Yaskawa or your nearest sales representative if you will not ground the neutral point.
Vibration	• 10 Hz to 20 Hz: 1 G (9.8 m/s^2, 32.15 ft/s^2) • 20 Hz to 55 Hz: 2003 to 2180, 4002 to 4150: 0.6 G (5.9 m/s^2, 19.36 ft/s^2) 2215 to 2415, 4180 to 4605: 0.2 G (2.0 m/s^2, 6.56 ft/s^2)
Installation Orientation	Install the drive vertically for sufficient airflow to cool the drive.

NOTICE: *Do not put drive peripheral devices, transformers, or other electronics near the drive. Shield the drive from electrical interference if components must be near the drive. Components near the drive can cause incorrect drive operation from electrical interference.*

NOTICE: *Do not let unwanted objects, for example metal shavings or wire clippings, fall into the drive during drive installation. Put a temporary cover over the drive during installation. Remove the temporary cover before start-up. Unwanted objects inside of the drive can cause damage to the drive.*

Note:

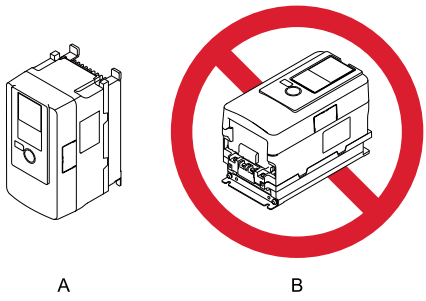
Do not put drive peripheral devices, transformers, or other electronics near the drive. Shield the drive from electrical interference if components must be near the drive. Components near the drive can cause incorrect drive operation from electrical interference.

2.3 Installation Orientation and Spacing

Install the drive vertically for sufficient cooling airflow.

Note:

Contact Yaskawa or your nearest sales representative for details about the drive models that can be installed on its side and their operating conditions.



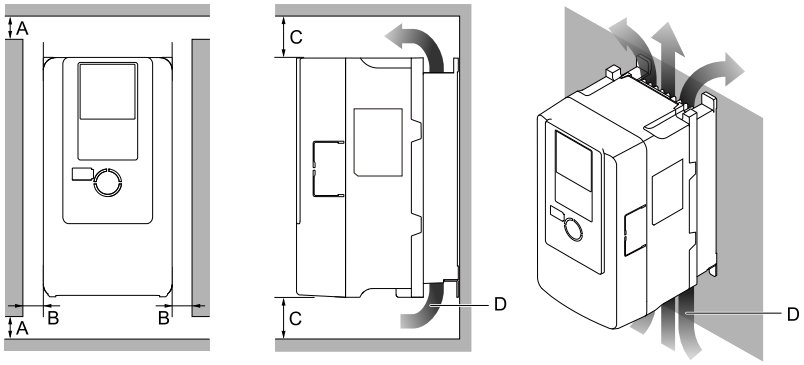
A - Upright installation

B - Horizontal installation

Figure 2.1 Installation Orientation

◆ Single Unit Installation

Install the drive with the clearances specified in Figure 2.2 to guarantee sufficient space for wiring and airflow.



A - At least 50 mm (2 in.)

B - At least 30 mm (1.2 in.) on both sides

C - At least 120 mm (4.7 in.) above and below

D - Airflow direction

Figure 2.2 Drive Installation Space (Single Unit)

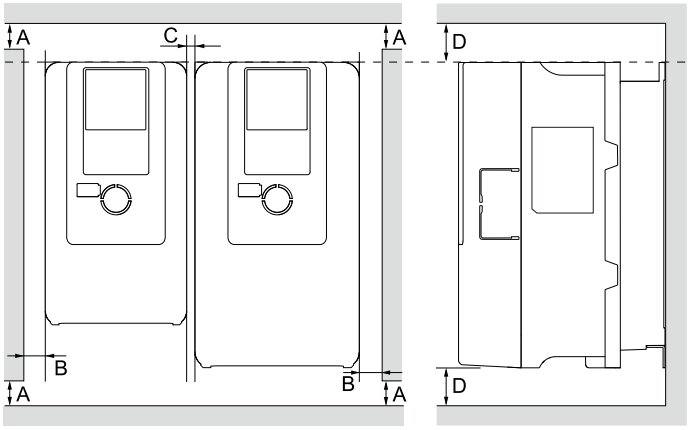
◆ Mounting Multiple Drives Side-by-Side

Drive models 2003xB to 2075xB and 4002xB to 4039xB can take advantage of side-by-side installation.

When installing other drive models, ensure that enough space for single unit installation is placed around each drive.

When performing side-by-side installation of drives, ensure that enough space is provided for the installation of the drives with the clearances specified in Figure 2.3. Set *L8-35 [Installation Method Selection]* to *1 [Side-by-Side Mounting]*.

Derate the output current to match the ambient temperature.



A - At least 50 mm (2 in.)
B - At least 30 mm (1.2 in.) on both sides
C - At least 2 mm (0.08 in.) between each drive
D - At least 120 mm (4.7 in.) above and below

Figure 2.3 Drive Installation Space (Side-by-Side Mounting)

Note:
- If the dimensions of the drives differ when using a side-by-side installation, then line up the tops of all the drives. This makes it easier to replace the cooling fan later.
- If mounting an enclosed wall-mounted type (UL Type 1) drive using a side-by-side installation, completely remove the top protective cover for the drive. Refer to "Attach the Top Protective Cover" to remove the top protective cover.

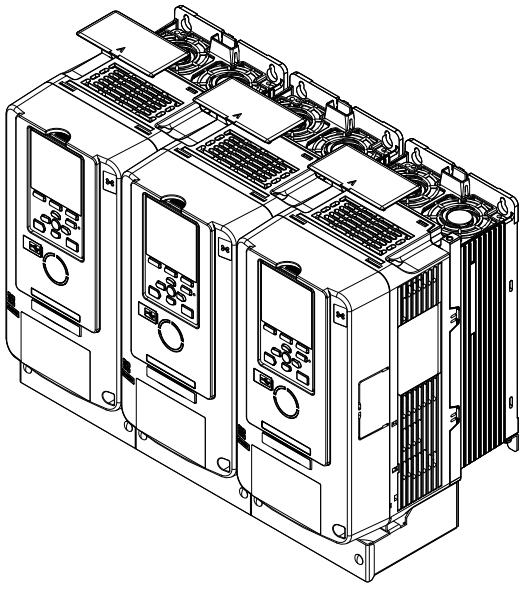


Figure 2.4 Enclosed Wall-Mounted Type (UL Type 1) Side-by-Side Mounting

2.4 Moving the Drive

Obey local laws and regulations when you move and install this product.

CAUTION! *Crush Hazard. Tighten terminal cover screws and hold the case safely when you move the drive. If the drive or covers fall, it can cause moderate injury.*

Drive Weight	Persons Necessary to Move the Drive
< 15 kg (33 lbs.)	1
≥ 15 kg (33 lbs.)	2 + using appropriate lifting equipment

Refer to *Using the Hanging Brackets to Move the Drive on page 36* for information about how to use suspension systems, wires, or hanging metal brackets to move the drive.

◆ Using the Hanging Brackets to Move the Drive

Use the hanging brackets attached to the drive to temporarily lift the drive when you install the drive to a control panel or wall or when you replace the drive. Do not let the drive stay vertically or horizontally suspended or move the drive over a long distance while it is suspended.

Before you install the drive, make sure that you read these precautions:

WARNING! *Crush Hazard. Before you hang the drive vertically, use screws to correctly attach the drive front cover and other drive components. If you do not secure the front cover, it can fall and cause minor injury.*

WARNING! *Crush Hazard. When you use a crane or hoist to lift the drive during installation or removal, prevent more than 1.96 m/s² (0.2 G) vibration or impact. Too much vibration or impact can cause serious injury or death from falling equipment.*

WARNING! *Crush Hazard. When you lift the drive during installation or removal, do not try to turn the drive over and do not ignore the hanging drive. If you move a hanging drive too much or if you ignore it, the drive can fall and cause serious injury or death.*

WARNING! *Crush Hazard. When you install the drive, do not hold the front cover. Install the drive with holding the heatsink. If you hold the front cover, the cover will come off and the drive will fall, then it can cause injury.*

◆ Instructions on Drive Suspension

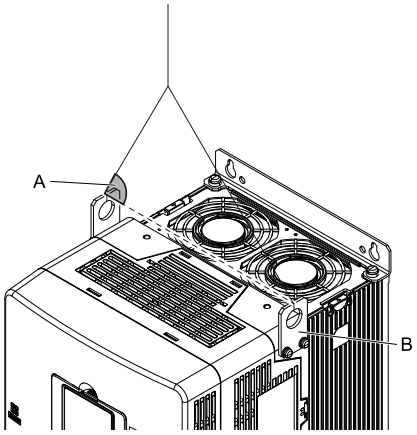
Use the procedures in this section to suspend the drive with wires.

Model	Suspension Method
2088 to 2180, 4060 to 4150	Vertically Suspending
2215 to 2415, 4180 to 4605	Horizontally Suspending

■ Vertical Suspension

To vertically suspend the drive with the hanging brackets, lift the drive with this procedure:

1. Put wire through the 2 holes in the hanging brackets.



A - Suspension angle of at least 50 degrees **B - Hanging bracket (2)**

Figure 2.5 Vertical Suspension

2. Use a crane to gradually wind up the wire. Visually make sure that there is sufficient tension in the wire, then lift the drive to its correct location. 3. Prepare the control panel for installation, then lower the drive.

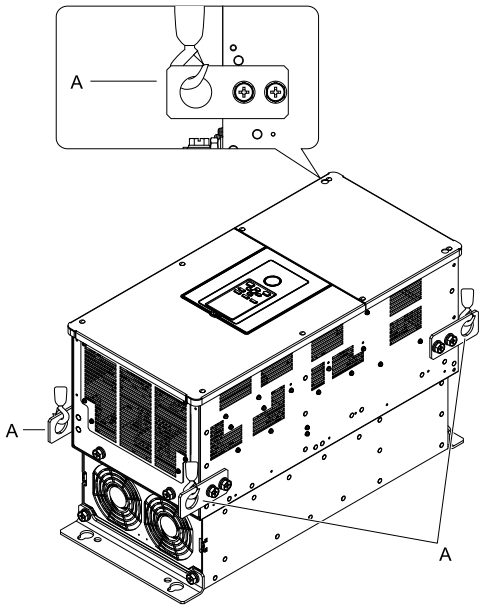
3. Prepare the control panel for installation, then lower the drive.

Note:
When lowering the drive, stop before the drive touches the floor, then slowly lower it the remaining distance.

■ Horizontal Suspension

If a horizontal suspension is required in the installation environment, hang the drive through the following steps. Put the drive on the ground horizontally. Connect wires to the 4 hanging brackets and use a crane to lift the drive.

NOTICE: *When you attach a horizontal lifting cable or chain to the drive, use a jig or pad between the wire and the drive. The wire can scratch the drive and cause damage to the drive.*



A - Hanging bracket (4)

Figure 2.6 Horizontal Suspension

2.5 Drive Watt Loss

Table 2.1 Drive Watt Loss (200 V Class)

Model	The rated output current A	Carrier Frequency kHz	Interior Unit Loss W	Cooling Fin Loss W	Total Loss W
2003	3.2	2	5	7	12
2005	5	2	9	13	22
2008	8	2	16	27	43
2011	11	2	21	42	63
2014	14	2	27	59	86
2018	17.5	2	32	74	106
2025	25	2	36	95	131
2033	33	2	53	126	179
2047	47	2	59	155	214
2060	60	2	110	299	409
2075	75	2	134	357	491
2088	88	2	147	467	614
2115	115	2	209	613	822
2145	145	2	265	748	1013
2180	180	2	297	935	1232
2215	215	2	362	1144	1506
2283	283	2	459	1508	1967
2346	346	2	520	1769	2289
2415	415	2	603	2216	2819

Table 2.2 Drive Watt Loss (400 V Class)

Model	The rated output current A	Carrier Frequency kHz	Interior Unit Loss W	Cooling Fin Loss W	Total Loss W
4002	1.8	2	13	14	27
4003	3.4	2	12	18	30
4005	4.8	2	21	32	53
4006	5.5	2	28	50	78
4007	7.2	2	35	70	105
4009	9.2	2	44	86	130
4015	14.8	2	55	116	171
4018	18	2	63	141	204
4024	24	2	93	206	299
4031	31	2	121	286	407
4039	39	2	132	331	463
4045	45	2	141	365	506
4060	60	2	188	497	685
4075	75	2	188	557	745
4091	91	2	225	658	883
4112	112	2	275	804	1079
4150	150	2	385	1012	1397
4180	180	2	397	1279	1676
4216	216	2	564	1484	2048
4260	260	2	573	1709	2282

Model	The rated output current A	Carrier Frequency kHz	Interior Unit Loss W	Cooling Fin Loss W	Total Loss W
4304	304	2	728	2075	2803
4371	371	2	976	2778	3754
4414	414	2	1118	3133	4251
4453	453	2	1272	3559	4831
4605	605	2	1495	4500	5995

2.6 Remove and Reattach the Keypad

NOTICE: *You must remove the keypad before you remove or reattach the front cover. Before you reattach the keypad, make sure that you attach the front cover into position. If you keep the keypad connected to the drive when you remove the front cover, it can cause an unsatisfactory connection and incorrect operation.*

◆ Remove the Keypad

1. Push down the tab on the top of the keypad, then pull the keypad forward and remove it from the drive.

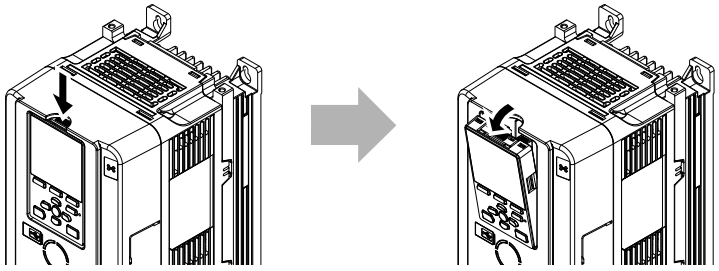
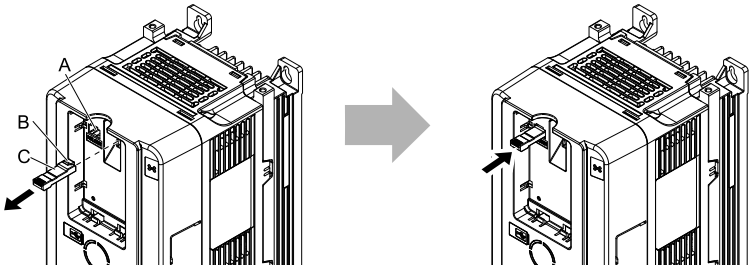


Figure 2.7 Remove the Keypad

2. Pull the keypad connector out from the drive horizontally, then put it in the holder.

Note:
Insert the end of the keypad connector that has the tab.



A - Holder
B - Hook
C - Keypad connector

Figure 2.8 Move the Keypad Connector to the Holder

◆ Reattach the Keypad

Insert the keypad connector to its initial position. Put the bottom of the keypad into position first, then carefully push on the top of the keypad until the hook clicks into place.

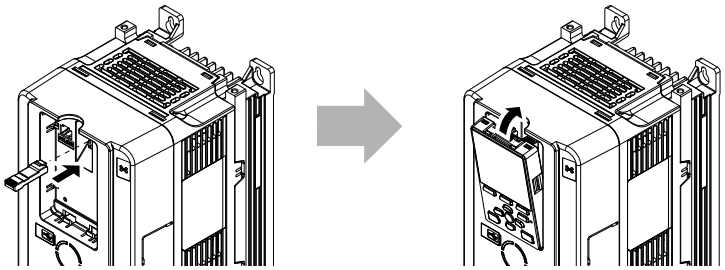


Figure 2.9 Reattach the Keypad

2.7 Install the Keypad in a Control Panel or Another Device

◆ Operate the Keypad from a Remote Location

You can remove the keypad from the drive and connect it to a remote control extension cable 3 m (9.8 ft) long to make operation easier when you cannot access the drive. It is not necessary to open or close the panel door to operate a drive that is in a control panel. To order optional accessories, contact Yaskawa or your nearest sales representative.

Name	Option Model	Intended Use
Keypad Remote Cable	WV001: 1 m (3.3 ft) WV003: 3 m (9.8 ft)	To connect the keypad and drive. This option is an RJ-45, 8-pin straight-through UTP CAT5e cable.
Installation Support Set A	900-192-933-001	To attach the keypad to the control panel. This option uses screws.
Installation Support Set B	900-192-933-002	To attach the keypad to the control panel. This option uses nut clamps. Use this option when weld studs are located in the control panel.

◆ Connect the Keypad from a Remote Location

Use the information in Table 2.3 to install the keypad in the best location for your application.

Table 2.3 Keypad Installation Method

Installation Method	Features	Necessary Tools and Installation Support Sets
Outside of the control panel	Simplified installation is possible. Separate installation support sets are not necessary.	Phillips screwdriver #2 (M3)
Inside of the control panel	Keypad does not extend farther than the front of the control panel.	• Phillips screwdriver #2 (M3, M4) • Installation support set A (for mounting with screws, model: 900-192-933-001)
		• Phillips screwdriver #2 (M3) • Wrench (M4) • Installation support set B (for mounting with nut clamp, model: 900-192-933-002)

Note:

Installation support sets are sold separately. If there are weld studs inside the control panel, use installation support set B. Contact Yaskawa or your nearest sales representative to make an order.

NOTICE: *Do not let unwanted objects, for example metal shavings or wire clippings, fall into the drive during drive installation. Put a temporary cover over the drive during installation. Remove the temporary cover before start-up. Unwanted objects inside of the drive can cause damage to the drive.*

■ External Dimensions of Keypad

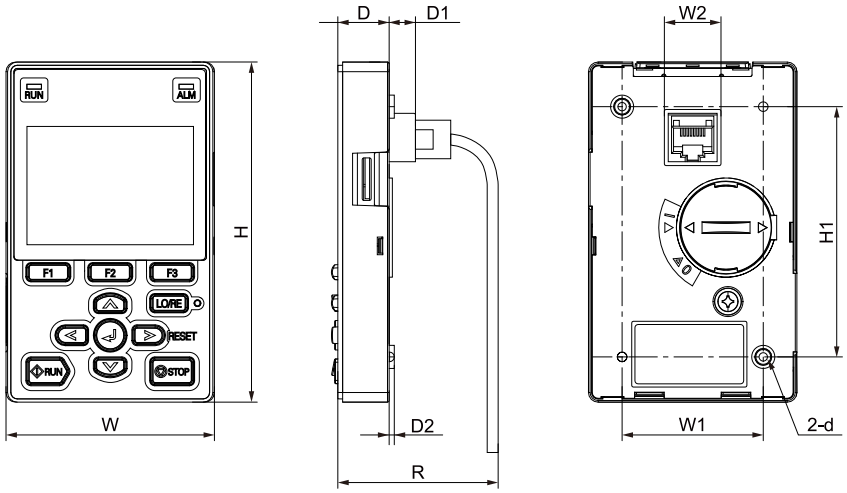


Figure 2.10 Exterior and Mounting Dimensions

Table 2.4 Exterior Dimensions (mm)

W	H	D	D1	D2	R *1	W1	W2	H1	d
65	106	16	8.2	1.6	53.8	44	15	78	M3

*1 Minimum bending radius

■ Mount to the Outside of Control Panel

1. Use the dimensions in Figure 2.11 and Table 2.5 to cut an opening in the control panel for the keypad.

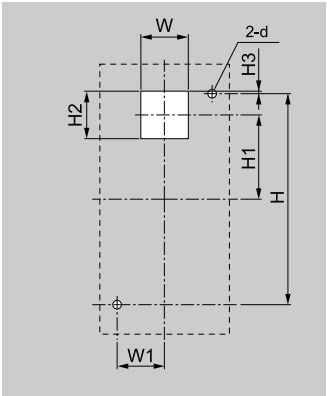


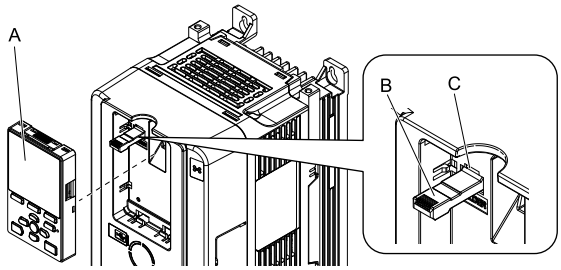
Figure 2.11 External/Face Mount Enclosure Panel Cut-Out Dimensions

Table 2.5 Panel Cut-Out Dimensions mm (in)

W	H	W1	H1	H2	H3	d
22 (0.89)	78 (3.07)	22 (0.89)	29 (1.14)	22 (0.89)	1 (0.04)	3.6 (0.14)

2. Remove the keypad and put the keypad connector in the holder on the front cover.

Note:
Insert the end of the keypad connector that has the tab.



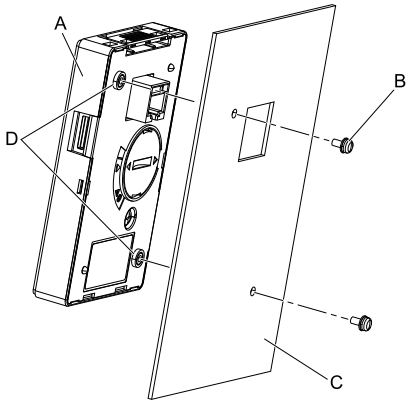
A - Keypad
B - Keypad connector
C - Holder

Figure 2.12 Remove the Keypad

3. Put the keypad on the outside of the control panel.

   Use M3 screws (6 mm (0.2 in) depth cross-recessed pan head screws) to attach the keypad from the inside. Tighten the screws to a correct tightening torque:

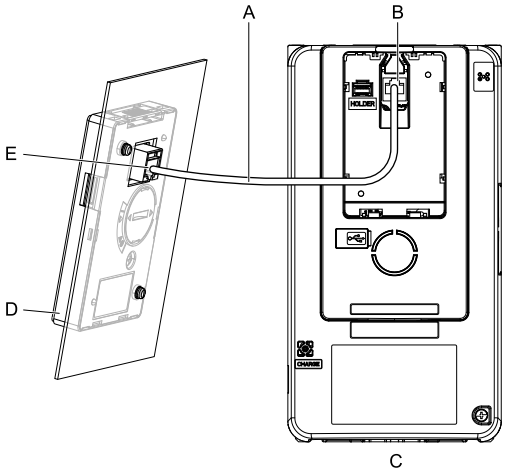
   • M3 screws: 0.49 N·m to 0.73 N·m (4.34 lbf·in to 6.46 lbf·in)



A - Keypad
B - M3 screws
C - Enclosure panel
D - Screw mounting holes

Figure 2.13 Mount to the Outside of Control Panel

4. Use the extension cable to connect the drive to the keypad.



A - Extension cable
B - Communications connector
C - Drive
D - Keypad
E - Cable connector

Figure 2.14 Connecting the Drive and Keypad with the Extension Cable

■ Mount to the Inside of Control Panel

Installation support sets A or B (sold separately) are necessary for Internal/Flush-Mount installation. To order optional accessories, contact Yaskawa or your nearest sales representative.

Note:
- The installation procedure and panel cut-out dimensions are the same for mounting brackets A and B.
- Use a gasket between the control panel and the keypad in environments with a large quantity of dust or other unwanted airborne material.

1. Use the dimensions in Figure 2.15 and Table 2.6 to cut an opening in the control panel for the keypad.

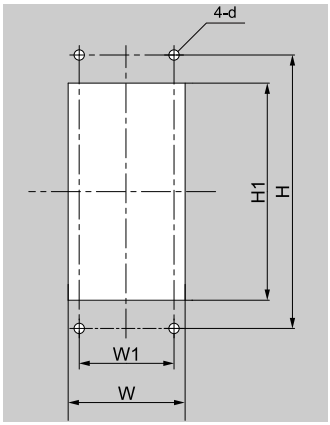


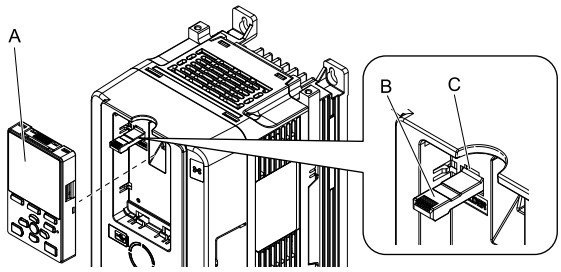
Figure 2.15 Panel Cut-Out Dimensions to Attach Inside Control Panel

Table 2.6 Panel Cut-Out Dimensions mm (in)

W	H	W1	H1	d
64 + 0.5 (2.52 + 0.02)	130 (5.12)	45 (1.77)	105 + 0.5 (4.13 + 0.02)	4.8 (0.12)

2. Remove the keypad and put the keypad connector in the holder on the front cover.

Note:
Insert the end of the keypad connector that has the tab.



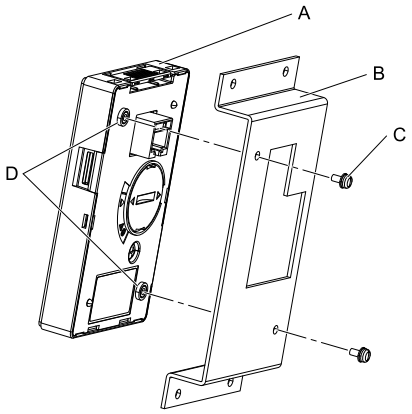
A - Keypad
B - Keypad connector
C - Holder

Figure 2.16 Remove the Keypad

3. Use the screws included with the mounting bracket, and attach the keypad to the mounting bracket.

   Use the screws included with the installation support set to attach it. Tighten the screws to a correct tightening torque:

   • M3 screws: 0.49 N·m to 0.73 N·m (4.34 lbf·in to 6.46 lbf·in)



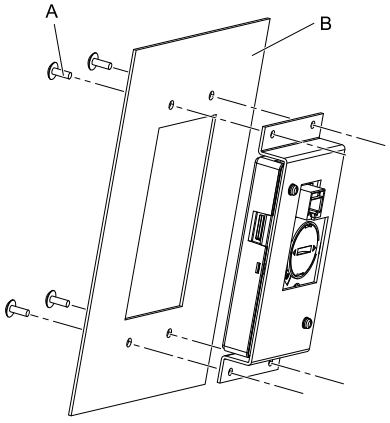
A - Keypad
B - Mounting bracket A
C - M3 screws
D - Screw mounting holes

Figure 2.17 Attach Keypad to Mounting Bracket

4. Put the mounting bracket that has the attached keypad in the control panel, and use the screws to attach it from the outside.

   Use the screws included with the installation support set to attach it. Tighten the screws to a correct tightening torque:

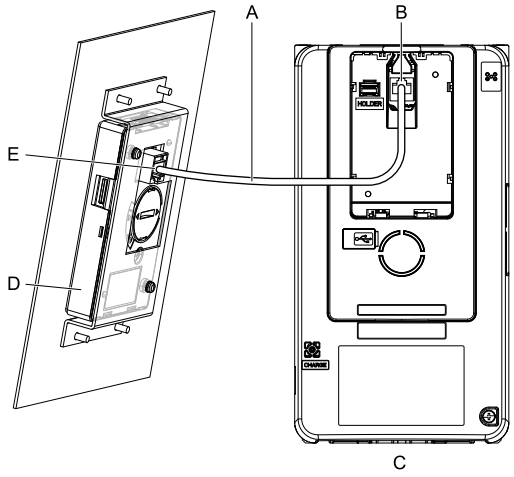
   • M4 screws: 0.98 N·m to 1.33 N·m (8.67 lbf·in to 11.77 lbf·in)



A - M4 screws
B - Enclosure panel

Figure 2.18 Mount Mounting Bracket to the Interior of the Control Panel

5. Use the extension cable to connect the drive to the keypad.



A - Extension cable
B - Communications connector
C - Drive
D - Keypad
E - Cable connector

Figure 2.19 Connecting the Drive and Keypad with the Extension Cable

2.8 Removing/Reattaching Covers

This section gives information about how to remove and reattach the front cover and terminal cover for wiring and inspection.

Different drive models have different procedures to remove and reattach the covers. Refer to Table 2.7 for details.

Table 2.7 Procedures to Remove Covers by Drive Model

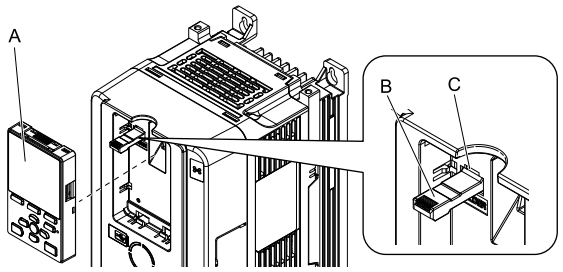
Model	Procedure
2003 - 2180 4002 - 4150	Procedure A
2215 - 2415 4180 - 4605	Procedure B

◆ Removing/Reattaching the Cover Using Procedure A

DANGER! *Electrical Shock Hazard. Do not examine, connect, or disconnect wiring on an energized drive. Before servicing, disconnect all power to the equipment and wait for the time specified on the warning label at a minimum. The internal capacitor stays charged after the drive is de-energized. The charge indicator LED extinguishes when the DC bus voltage decreases below 50 Vdc. When all indicators are OFF, remove the covers before measuring for dangerous voltages to make sure that the drive is safe. If you do work on the drive when it is energized, it will cause serious injury or death from electrical shock.*

■ Remove the Front Cover

1. Remove the keypad and the keypad connector, then insert the end of the keypad connector that has the tab into the keypad connector holder on the front cover.



A - Keypad
B - Keypad connector
C - Holder

Figure 2.20 Remove the Keypad and Keypad Connector

2. Loosen the front cover screws.

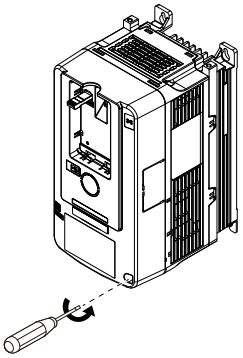


Figure 2.21 Loosen the Front Cover Screws

3. Push on the tab in the side of the front cover then pull the front cover forward to remove it from the drive.

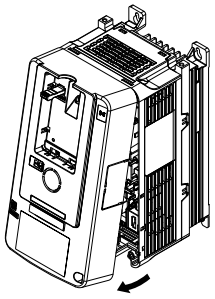


Figure 2.22 Remove the Front Cover

■ Install the Front Cover

1. Wire the drive and other peripheral devices.
2. Reverse the steps to reattach the cover.

Note:
- Wire the grounding terminals first, main circuit terminals next, and control circuit terminals last.
- Make sure that you do not pinch wires or signal lines between the front cover and the drive before you reattach the cover.
- Tighten the screws to a tightening torque of 0.98 N·m to 1.33 N·m (8.67 lbf·in to 11.77 lbf·in).

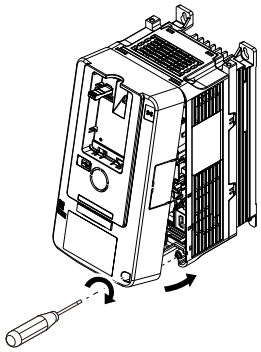


Figure 2.23 Install the Front Cover

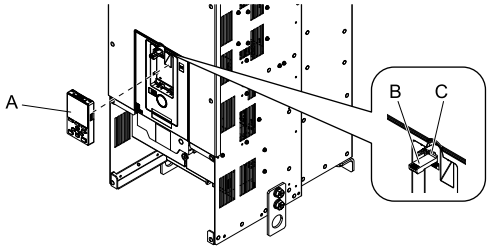
3. Reattach the keypad to the original position.

◆ Removing/Reattaching the Cover Using Procedure B

DANGER! *Electrical Shock Hazard. Do not examine, connect, or disconnect wiring on an energized drive. Before servicing, disconnect all power to the equipment and wait for the time specified on the warning label at a minimum. The internal capacitor stays charged after the drive is de-energized. The charge indicator LED extinguishes when the DC bus voltage decreases below 50 Vdc. When all indicators are OFF, remove the covers before measuring for dangerous voltages to make sure that the drive is safe. If you do work on the drive when it is energized, it will cause serious injury or death from electrical shock.*

■ Remove the Front Cover

1. Remove the terminal cover, keypad, and keypad connector, then insert the end of the keypad connector that has the tab into the keypad connector holder on the front cover.



A - Keypad
B - Keypad connector
C - Connector holder

Figure 2.24 Remove the Terminal Cover, Keypad, and Keypad Connector

2. Loosen the front cover screws.

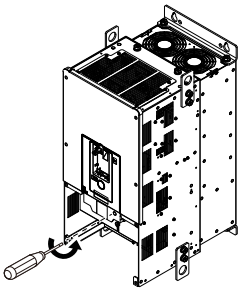
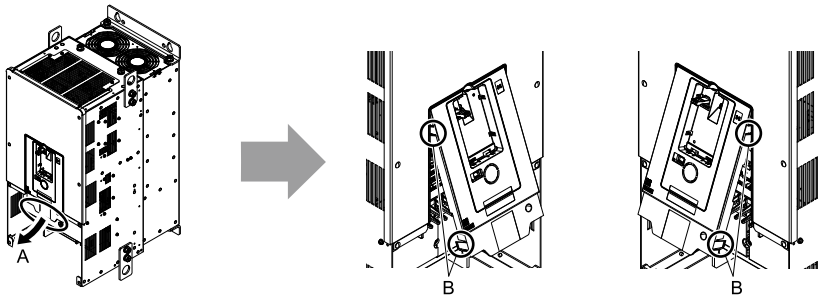


Figure 2.25 Loosen the Front Cover Screws

3. Push on the four tabs found on each side of the front cover, then pull the front cover forward to remove it from the drive.



A - Pull forward to remove the front cover.

B - Unhook the tabs found on the sides of the front cover.

Figure 2.26 Pull Forward to Remove the Front Cover

4. Remove the front cover from the drive.

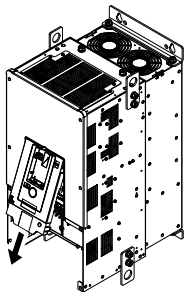


Figure 2.27 Remove the Front Cover

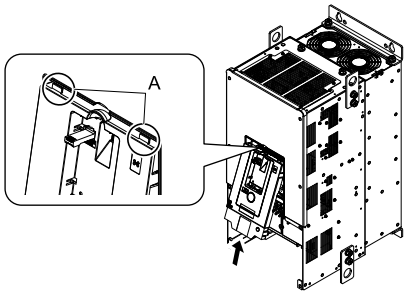
■ Reattach the Front Cover

Wire the drive and other peripheral devices then reattach the front cover.

Note:

Wire the grounding terminals first, main circuit terminals next, and control circuit terminals last.

1. Move the front cover to connect the hooks at the top of the front cover to the drive.



A - Hooks

Figure 2.28 Reattach the Front Cover

2. Move the front cover until it clicks into position while pushing on the hooks on the left and right sides of the front cover.

Note:
Make sure that you do not pinch wires or signal lines between the front cover and the drive before you reattach the cover.

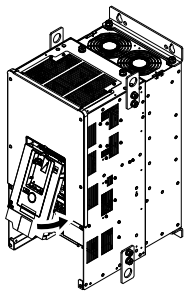


Figure 2.29 Reattach the Front Cover

3. Reattach the keypad to the original position.

■ Remove the Terminal Cover

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

   CAUTION! *Crush Hazard. Loosen the cover screws. Do not fully remove them. If you fully remove the cover screws, the terminal cover can fall and cause moderate injury.*

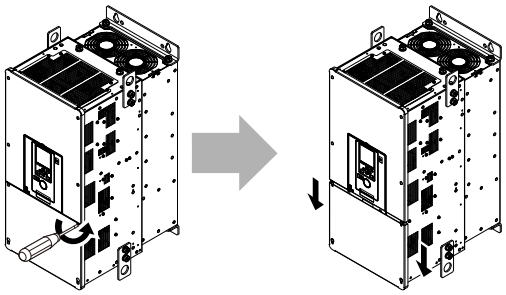


Figure 2.30 Loosen the Terminal Cover Mounting Screws

2. Pull the terminal cover away from the drive.

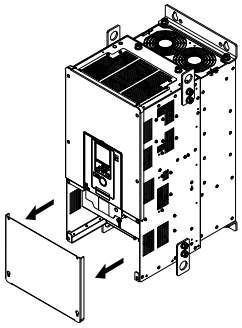


Figure 2.31 Remove the Terminal Cover

■ Reattach the Terminal Cover

Wire the drive and other peripheral devices then reattach the terminal cover.

Note:
- Wire the grounding terminals first, main circuit terminals next, and control circuit terminals last.
- Make sure that you do not pinch wires or signal lines between the wiring cover and the drive before you reattach the cover.
- Tighten the screws to a tightening torque of 0.98 N·m to 1.33 N·m (8.67 lbf·in to 11.77 lbf·in).

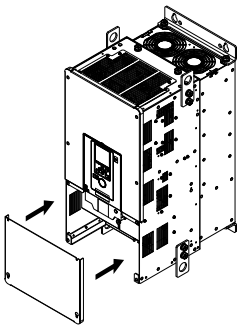


Figure 2.32 Reattach the Terminal Cover

2.9 Change the Drive Enclosure Type

The enclosure type of the drive is IP20/UL Open Type. This section gives information about how to install UL Type 1 protective covers to change the enclosure type to an enclosed wall-mounted type (UL Type 1).

Install the protective covers before you wire the drive.

Different drive models have different procedures to install the protective covers. Refer to Table 2.8 for more information.

Table 2.8 Procedures to Install UL Type 1 Covers by Drive Model

Drive Model	Procedure	Reference page
2003 - 2045 4002 - 4031	Procedure A	51
2060, 2075 4039, 4045	Procedure B	53
2088 4060	Procedure C	55
2115 4075, 4091	Procedure D	56
2145, 2180 4112, 4150	Procedure E	58
2215, 2283 4180, 4216, 4260	Procedure F	61
2346 4304	Procedure G	64

◆ Remove the Knock-Out Holes

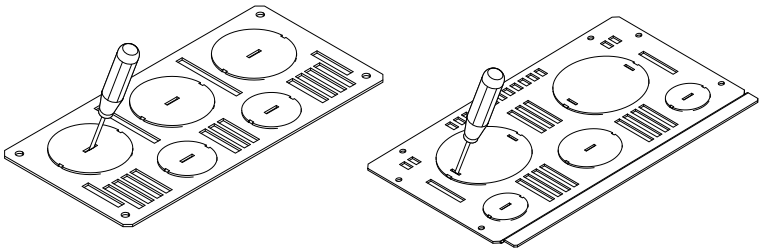
WARNING! *Injury to Personnel. Carefully move the screwdriver to remove the knock-out holes. If you use too much pressure on the circular metal plates, they can eject and cause injury.*

CAUTION! *Injury to Personnel. Use a file to remove sharp edges from the knock-out hole. If you touch the rough edges, it can cause injury.*

Note:

Remove the knock-out holes on the UL Type 1 base before you install the conduit bracket to the drive.

1. Put the end of the straight-edge screwdriver into the center hole and move it up and down to remove the plate.



2. Use a file to make the rough surface of the plate smooth.

Do the necessary procedures to prevent damage to the wiring, for example install a conduit.

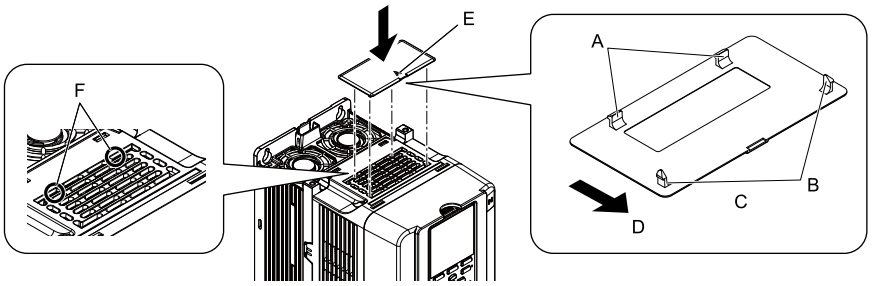
◆ Attach the Protective Cover (Procedure A)

■ Install the Top Protective Cover

Insert the back hooks on the back side of the top protective cover into the replacement holes on the rear side of the drive. Then put the front hooks into the replacement holes on the front side of the drive.

Note:

Install the top protective cover and make sure that the mark (△) on the upper surface of the top protective cover is on the front side of the drive.



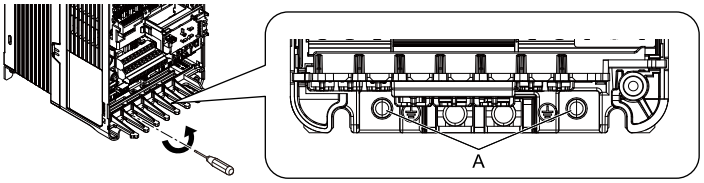
A - Back hooks
B - Front hooks
C - Back side of top protective cover
D - Drive front side
E - Mark
F - Temporary placement holes

Figure 2.33 Install the Top Protective Cover

■ Install the Conduit Bracket

Remove the keypad, connector, and front cover before you do these steps.

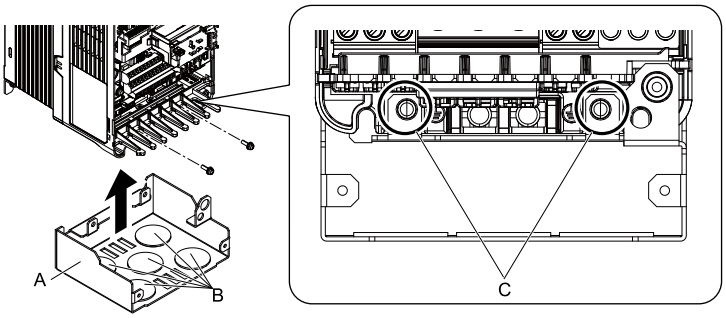
1. Remove the screws that install the protective covers to the drive.



A - Screws

Figure 2.34 Remove the Screws that Install the Protective Cover

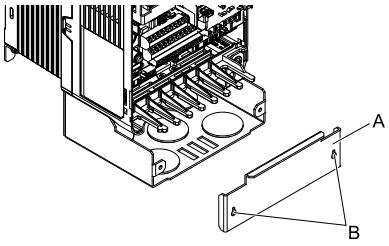
2. Remove the knock-out holes on the UL Type 1 base before you install the kit.
   Refer to *Remove the Knock-Out Holes on page 51* for more information.
3. Align the screw holes of the UL Type 1 base with the screw holes on the drive and safety the UL Type 1 base to the drive with the screws.
   Tighten the screws to a correct tightening torque:
   - 0.98 N·m to 1.33 N·m (8.67 lbf·in to 11.77 lbf·in)



A - UL Type 1 base
B - Knock-out holes
C - Screw holes

Figure 2.35 Install the UL Type 1 Base

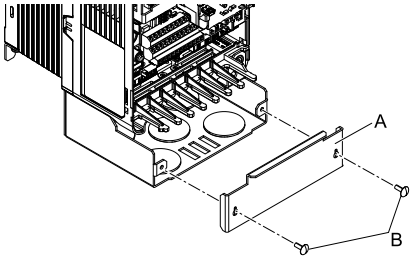
4. Remove the masking tape from the screw holes on the UL Type 1 front cover and apply an anti-corrosive or inductive grease.



A - Front cover **B - Masking tape**

Figure 2.36 Masking Tape Position

5. Use the included screws to install the front cover to the base.
   Tighten the screws to a correct tightening torque:
   - 0.98 N·m to 1.33 N·m (8.67 lbf·in to 11.77 lbf·in)



A - Front cover **B - M4 × 10 truss head screws**

Figure 2.37 Install the Front Cover

6. Install the drive front cover.

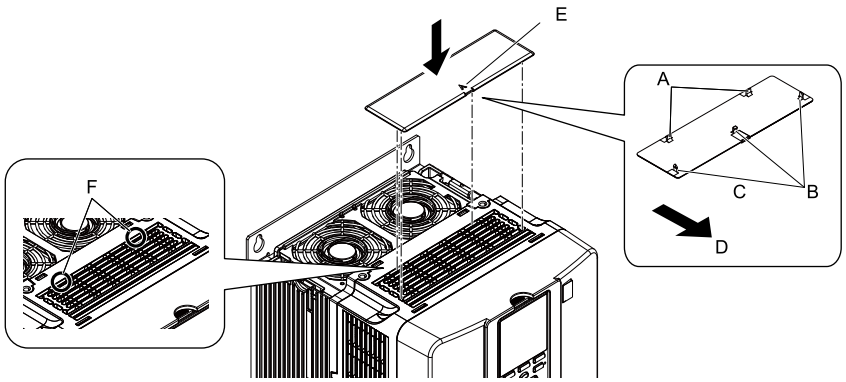
◆ Attach the Protective Cover (Procedure B)

■ Install the Top Protective Cover

Insert the back hooks on the back side of the top protective cover into the replacement holes on the rear side of the drive. Then put the front hooks into the replacement holes on the front side of the drive.

Note:

Install the top protective cover and make sure that the mark (△) on the upper surface of the top protective cover is on the front side of the drive.



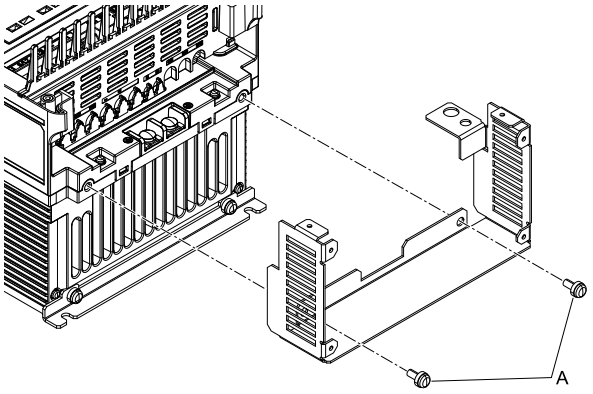
A - Back hooks **D - Drive front side**
B - Front hooks **E - Mark**
C - Back side of top protective cover **F - Temporary placement holes**

Figure 2.38 Install the Top Protective Cover

■ Install the Conduit Bracket

Remove the knock-out holes on the UL Type 1 base before you install it to the drive.
Refer to *Remove the Knock-Out Holes on page 51* for more information.

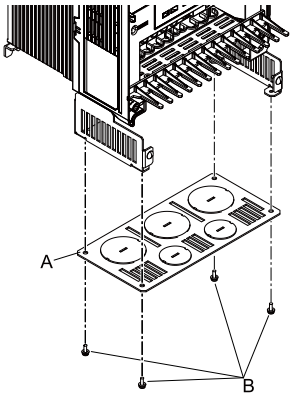
1. Use the included screws to install the UL Type 1 base to the drive.
   Tighten the screws to a correct tightening torque:
   • 3.92 N·m to 4.90 N·m (34.70 lbf·in to 43.37 lbf·in)



A - M6 × 14 pan head screws

Figure 2.39 Safety the Base

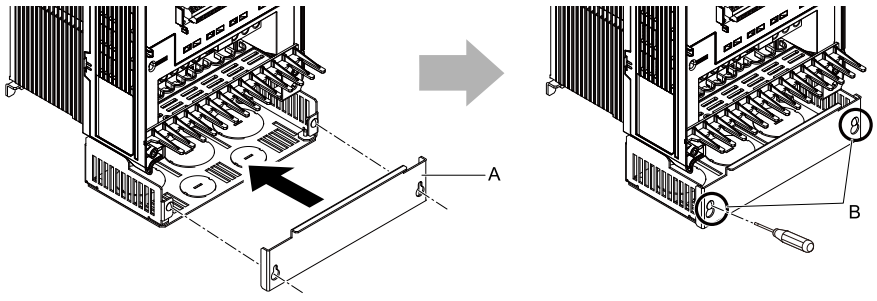
2. Use the included screws to install the UL Type 1 conduit bracket to the base.
   Tighten the screws to a correct tightening torque:
   • 0.98 N·m to 1.33 N·m (8.67 lbf·in to 11.77 lbf·in)



A - Conduit bracket **B - M4 × 10 pan head screws**

Figure 2.40 Install the Conduit Bracket

3. Use the included screws to install the front cover to the base.
   Tighten the screws to a correct tightening torque:
   • 0.98 N·m to 1.33 N·m (8.67 lbf·in to 11.77 lbf·in)



A - Front cover **B - M4 × 10 truss head screws**

Figure 2.41 Install the Front Cover

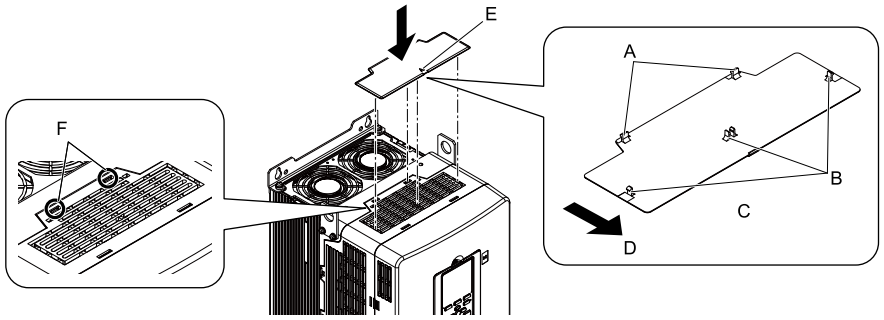
◆ Attach the Protective Cover (Procedure C)

■ Install the Top Protective Cover

Insert the back hooks on the back side of the top protective cover into the replacement holes on the rear side of the drive. Then put the front hooks into the replacement holes on the front side of the drive.

Note:

Install the top protective cover and make sure that the mark (△) on the upper surface of the top protective cover is on the front side of the drive.



A - Back hooks
B - Front hooks
C - Back side of top protective cover
D - Drive front side
E - Mark
F - Temporary placement holes

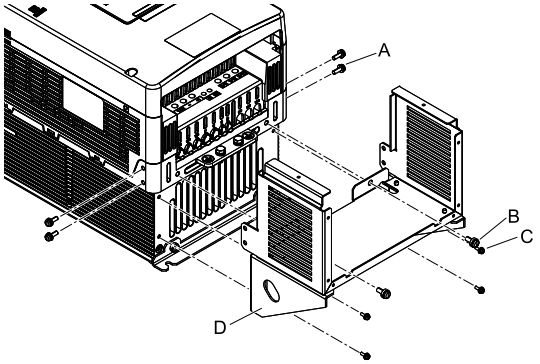
Figure 2.42 Install the Top Protective Cover

■ Install the Conduit Bracket

Remove the knock-out holes on the UL Type 1 base before you install it to the drive.

Refer to *Remove the Knock-Out Holes on page 51* for more information.

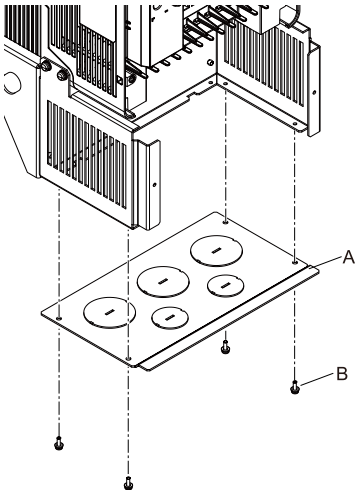
1. Use the included screws to install the UL Type 1 base on the drive.
   Tighten the screws to a correct tightening torque:
   - M5 × 14 pan head screws: 1.96 N·m to 2.53 N·m (17.35 lbf·in to 22.39 lbf·in)
   - M6 × 14 pan head screws: 3.92 N·m to 4.90 N·m (34.70 lbf·in to 43.37 lbf·in)
   - M4 × 10 pan head screws: 0.98 N·m to 1.33 N·m (8.67 lbf·in to 11.77 lbf·in)



A - M5 × 14 pan head screws
B - M6 × 14 pan head screws
C - M4 × 10 pan head screws
D - Base

Figure 2.43 Safety the Base

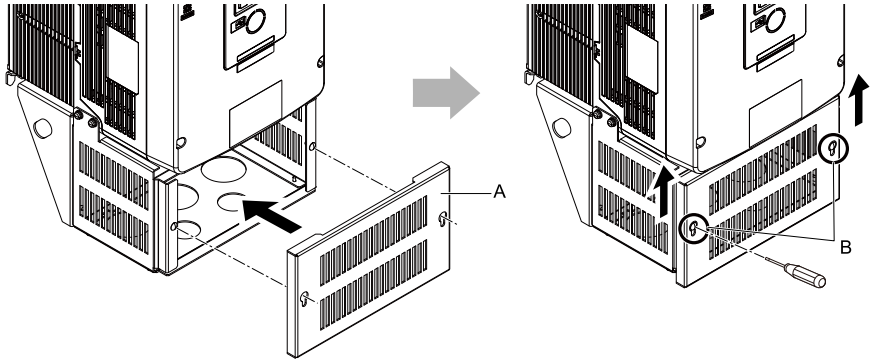
2. Use the included screws to install the UL Type 1 conduit bracket to the base.
   Tighten the screws to a correct tightening torque:
   - 0.98 N·m to 1.33 N·m (8.67 lbf·in to 11.77 lbf·in)



A - Conduit bracket **B - M4 × 10 pan head screws**

Figure 2.44 Install the Conduit Bracket

3. Use the included screws to install the front cover to the base.
   While slightly lifting the front cover, tighten the screws to a correct tightening torque:
   • 0.98 N·m to 1.33 N·m (8.67 lbf·in to 11.77 lbf·in)



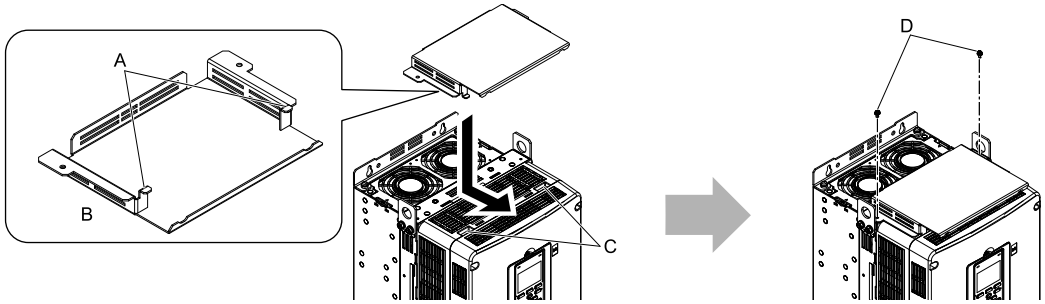
A - Front cover **B - M4 × 10 truss head screws**

Figure 2.45 Install the Front Cover

◆ Attach the Protective Cover (Procedure D)

■ Install the Top Protective Cover

Put the hooks on the back of the top protective cover into the hook holes on the top of the drive.
Move the top protective cover forward to align the screw holes.
Tighten the screws to a correct tightening torque:
• 0.98 N·m to 1.33 N·m (8.67 lbf·in to 11.77 lbf·in)



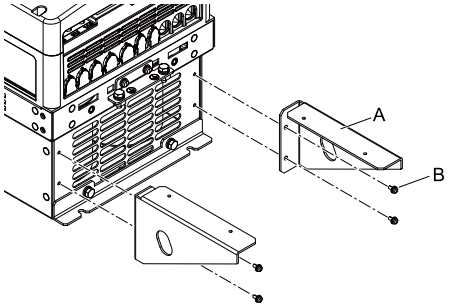
A - Hooks
B - Back side of top protective cover
C - Temporary placement holes
D - M4 × 8 pan head screws

Figure 2.46 Install the Top Protective Cover

■ Install the Conduit Bracket

- Remove the drive hanging brackets before you install the kit.
- Remove the knock-out holes on the UL Type 1 base before you install it to the drive. Refer to *Remove the Knock-Out Holes on page 51* for more information.

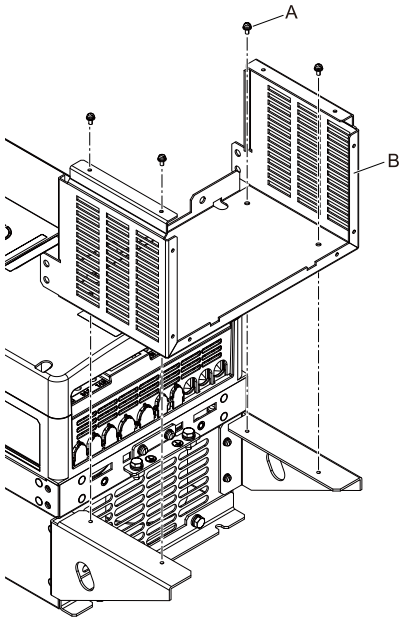
1. Use the included screws to install the stay bracket on the drive.
   Tighten the screws to a correct tightening torque:
   - 0.98 N·m to 1.33 N·m (8.67 lbf·in to 11.77 lbf·in)



A - Stay brackets **B - M4 × 8 pan head screws**

Figure 2.47 Install the Stay Brackets

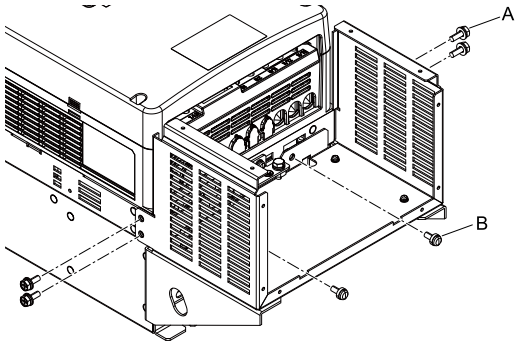
2. Use the included screws to install the UL Type 1 base on the stay brackets.
   Tighten the screws to a correct tightening torque:
   - 0.98 N·m to 1.33 N·m (8.67 lbf·in to 11.77 lbf·in)



A - M4 × 8 pan head screws **B - Base**

Figure 2.48 Install the Base on the Stay Brackets

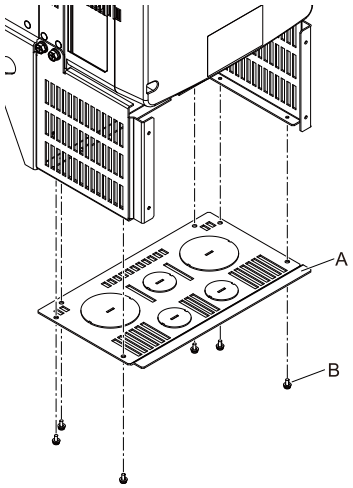
3. Use the included bolts and screws to install the UL Type 1 base to the drive.
   Tighten the bolts and screws to a correct tightening torque:
   - M6 × 16 upset bolts 3.92 N·m to 4.90 N·m (34.70 lbf·in to 43.37 lbf·in)
   - M6 × 14 pan head screws: 3.92 N·m to 4.90 N·m (34.70 lbf·in to 43.37 lbf·in)



A - M6 × 16 upset head bolts **B - M6 × 14 pan head screws**

Figure 2.49 Safety the Base

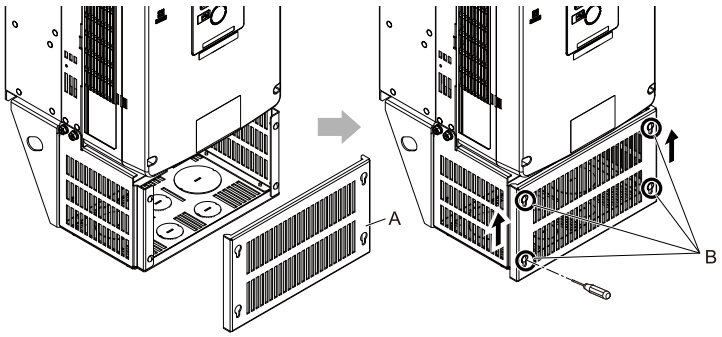
4. Use the included screws to install the UL Type 1 conduit bracket to the base.
   Tighten the screws to a correct tightening torque:
   • 0.98 N·m to 1.33 N·m (8.67 lbf·in to 11.77 lbf·in)



A - Conduit bracket **B - M4 × 8 pan head screws**

Figure 2.50 Install the Conduit Bracket

5. Use the included screws to install the front cover to the base.
   While slightly lifting the front cover, tighten the screws to a correct tightening torque:
   • 0.98 N·m to 1.33 N·m (8.67 lbf·in to 11.77 lbf·in)



A - Front cover **B - M4 × 10 truss head screws**

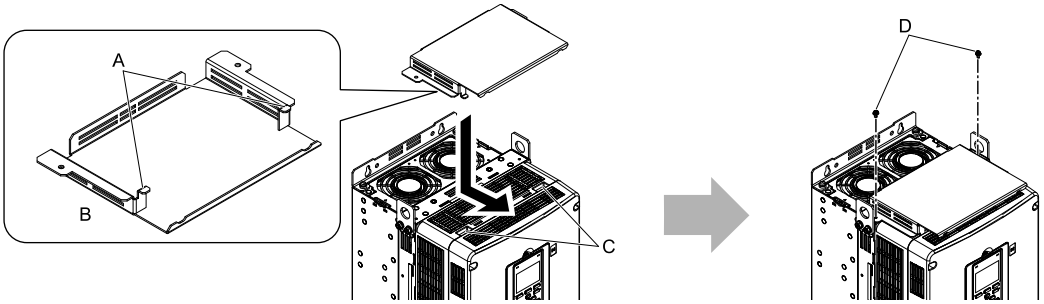
Figure 2.51 Install the Front Cover

◆ Attach the Protective Cover (Procedure E)

■ Install the Top Protective Cover

Put the hooks on the back of the top protective cover into the hook holes on the top of the drive.
Move the top protective cover forward to align the screw holes.
Tighten the screws to a correct tightening torque:

- 0.98 N·m to 1.33 N·m (8.67 lbf·in to 11.77 lbf·in)



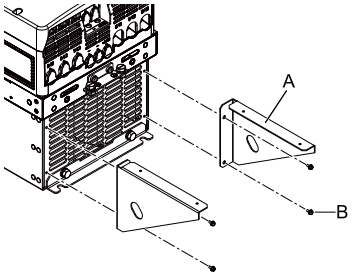
A - Hooks
B - Back side of top protective cover
C - Temporary placement holes
D - M4 × 8 pan head screws

Figure 2.52 Install the Top Protective Cover

■ Install the Conduit Bracket

- Remove the drive hanging brackets before you install the kit.
- Remove the knock-out holes on the UL Type 1 base before you install it to the drive. Refer to *Remove the Knock-Out Holes on page 51* for more information.

1. Use the included screws to assemble the stay brackets.
   Tighten the screws to a correct tightening torque:
   - 0.98 N·m to 1.33 N·m (8.67 lbf·in to 11.77 lbf·in)

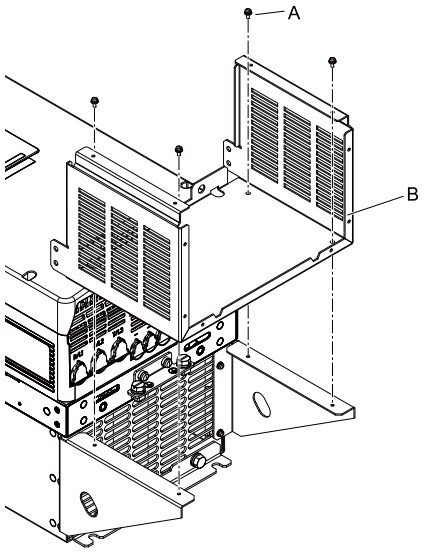


A - Stay brackets
B - M4 × 8 pan head screws

Figure 2.53 Install the Stay Brackets

2. Use the included screws to install the UL Type 1 base on the stay brackets.
   Tighten the screws to a correct tightening torque:
   - 0.98 N·m to 1.33 N·m (8.67 lbf·in to 11.77 lbf·in)

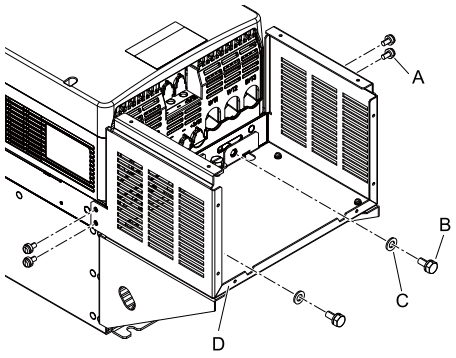
Note:
The number of screws are different for different models.
- 100-192-121-007: 4 screws
- 100-192-121-008: 6 screws



A - M4 × 8 pan head screws **B - Base**

Figure 2.54 Install the Base on the Stay Brackets

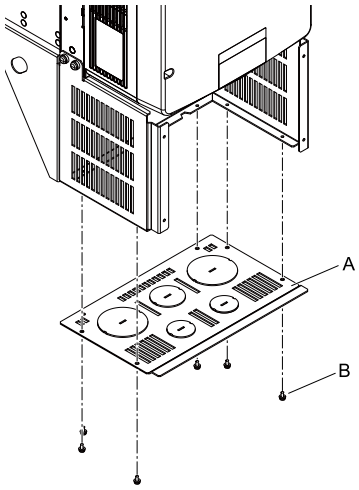
3. Use the included bolts to install the UL Type 1 base to the drive.
   Tighten the bolts to a correct tightening torque:
   - M6 × 16 upset bolts 3.92 N·m to 4.90 N·m (34.70 lbf·in to 43.37 lbf·in)
   - M8 × 16 hex bolts: 8.83 N·m to 10.79 N·m (78.15 lbf·in to 95.49 lbf·in)



A - M6 × 16 upset head bolts **C - M8 plain washers**
B - M8 × 16 hex bolts **D - Base**

Figure 2.55 Safety the Base

4. Use the included screws to install the UL Type 1 conduit bracket to the base.
   Tighten the screws to a correct tightening torque:
   - 0.98 N·m to 1.33 N·m (8.67 lbf·in to 11.77 lbf·in)

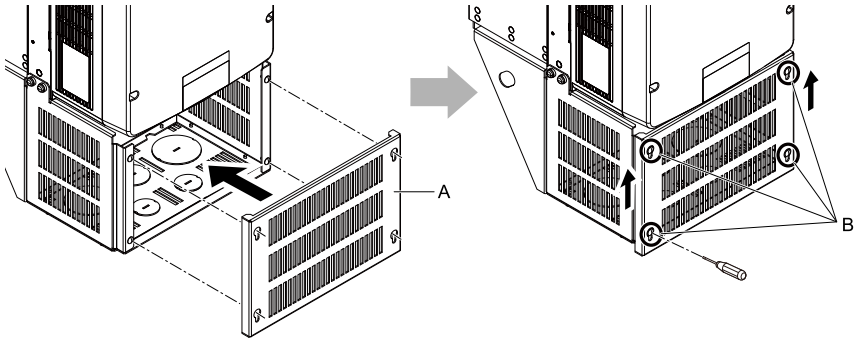


A - Conduit bracket **B - M4 × 8 pan head screws**

Figure 2.56 Install the Conduit Bracket

5. Use the included screws to install the front cover to the base.
   While slightly lifting the front cover, tighten the screws to a correct tightening torque:
   - 0.98 N·m to 1.33 N·m (8.67 lbf·in to 11.77 lbf·in)

Note:
The number of screws are different for different models.
- 100-192-121-007: 4 screws
- 100-192-121-008: 6 screws



A - Front cover **B - M4 × 10 truss head screws**

Figure 2.57 Install the Front Cover

◆ Attach the Protective Cover (Procedure F)

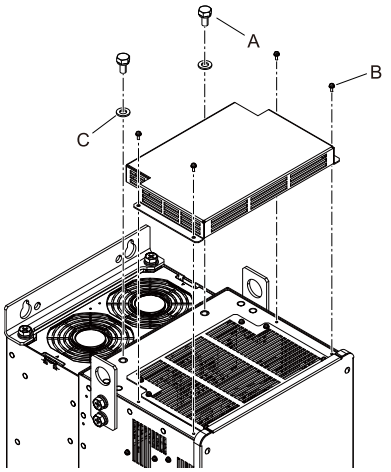
■ Install the Top Protective Cover

Note:
The appearance is different for different drives, but the installation procedures are the same.

Align the screw holes of the top protective cover with the screw holes on the drive and safety the top protective cover to the drive with the included screws.

Tighten the bolts and screws to a correct tightening torque:

- M10 × 20 hex bolts: 17.65 N·m to 22.56 N·m (156.22 lbf·in to 199.67 lbf·in)
- M4 × 10 pan head screws: 0.98 N·m to 1.33 N·m (8.67 lbf·in to 11.77 lbf·in)



A - M10 × 20 hex bolts *1
B - M4 × 10 pan head screws
C - M10 plain washers

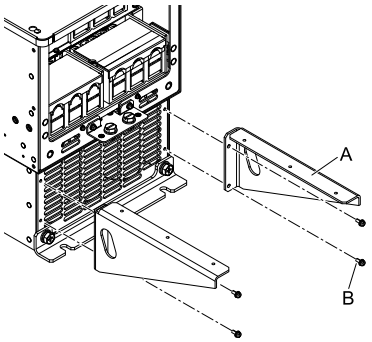
Figure 2.58 Install the Top Protective Cover

*1 Use the M10 x 20 hex bolts to fill the screw holes. Do not use them to attach the top protective cover.

■ Install the Conduit Bracket

- Remove the drive hanging brackets before you install the kit.
- Remove the knock-out holes on the UL Type 1 base before you install it to the drive. Refer to *Remove the Knock-Out Holes on page 51* for more information.

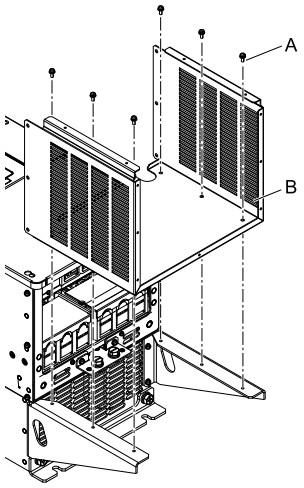
1. Use the included screws to assemble the stay brackets.
   Tighten the screws to a correct tightening torque:
   - 1.96 N·m to 2.53 N·m (17.35 lbf·in to 22.39 lbf·in)



A - Stay brackets
B - M5 × 12 pan head screws

Figure 2.59 Install the Stay Brackets

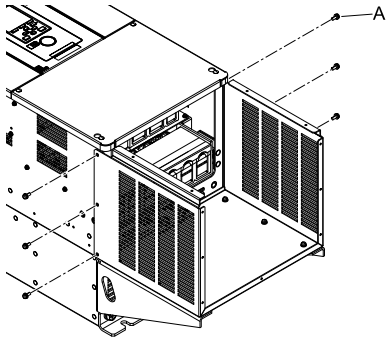
2. Use the included screws to install the UL Type 1 base on the stay brackets.
   Tighten the screws to a correct tightening torque:
   - 1.96 N·m to 2.53 N·m (17.35 lbf·in to 22.39 lbf·in)



A - M5 × 12 pan head screws **B - Base**

Figure 2.60 Install the Base on the Stay Brackets

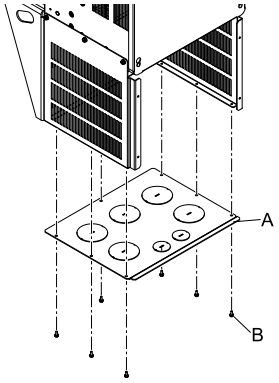
3. Use the included screws to install the UL Type 1 base to the drive.
   Tighten the screws to a correct tightening torque:
   • 1.96 N·m to 2.53 N·m (17.35 lbf·in to 22.39 lbf·in)



A - M5 × 12 pan head screws

Figure 2.61 Safety the Base

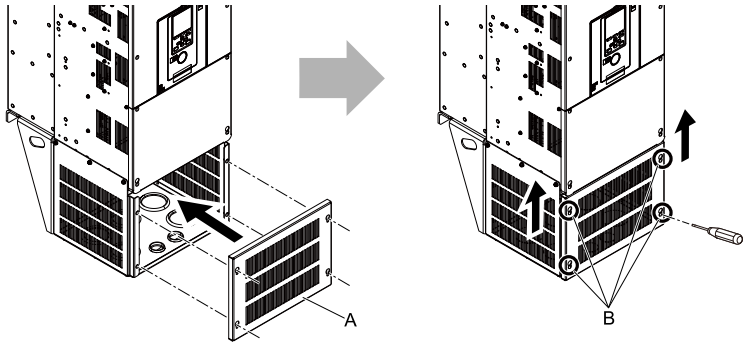
4. Use the included screws to install the UL Type 1 conduit bracket to the base.
   Tighten the screws to a correct tightening torque:
   • 0.98 N·m to 1.33 N·m (8.67 lbf·in to 11.77 lbf·in)



A - Conduit bracket **B - M4 × 10 pan head screws**

Figure 2.62 Install the Conduit Bracket

5. Use the included screws to install the front cover to the base.
   While slightly lifting the front cover, tighten the screws to a correct tightening torque:
   • 0.98 N·m to 1.33 N·m (8.67 lbf·in to 11.77 lbf·in)



A - Front cover **B - M4 × 10 truss head screws**

Figure 2.63 Install the Front Cover

◆ Attach the Protective Cover (Procedure G)

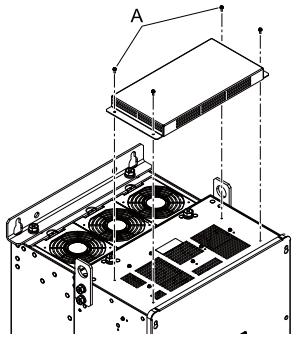
■ Install the Top Protective Cover

Note:
The appearance is different for different drives, but the installation procedures are the same.

Align the screw holes of the top protective cover with the screw holes on the drive and safety the top protective cover to the drive with the included screws.

Tighten the screws to a correct tightening torque:

- 0.98 N·m to 1.33 N·m (8.67 lbf·in to 11.77 lbf·in)



A - M4 × 10 pan head screws

Figure 2.64 Install the Top Protective Cover

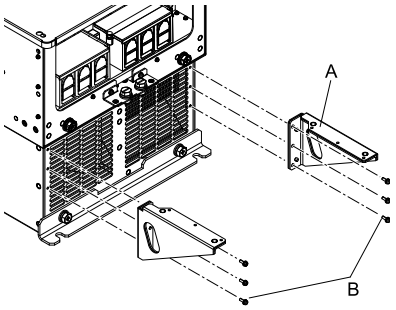
■ Install the Conduit Bracket

- Remove the drive hanging brackets before you install the kit.
- Remove the knock-out holes on the UL Type 1 base before you install it to the drive. Refer to *Remove the Knock-Out Holes on page 51* for more information.

1. Use the included screws to assemble the stay brackets.

   Tighten the screws to a correct tightening torque:

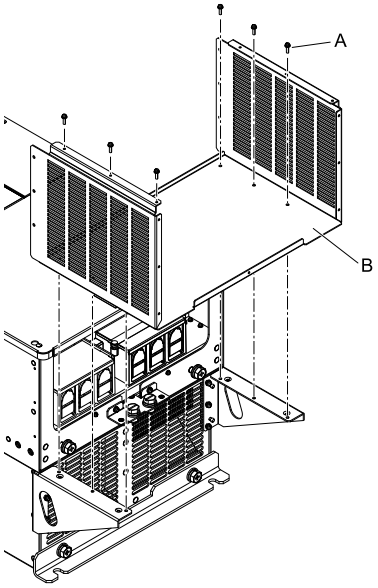
   - 1.96 N·m to 2.53 N·m (17.35 lbf·in to 22.39 lbf·in)



A - Stay brackets **B - M5 × 14 pan head screws**

Figure 2.65 Install the Stay Brackets

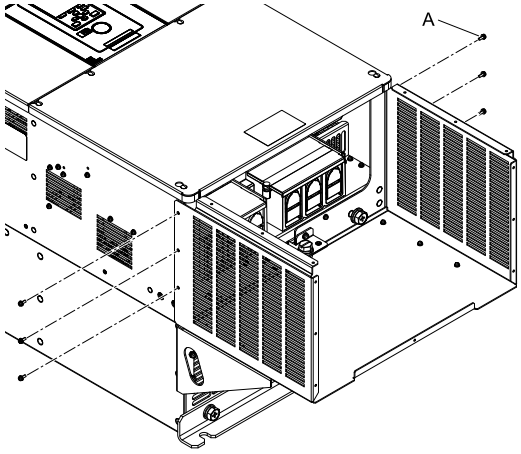
2. Use the included screws to install the UL Type 1 base on the stay brackets.
   Tighten the screws to a correct tightening torque:
   • 0.98 N·m to 1.33 N·m (8.67 lbf·in to 11.77 lbf·in)



A - M4 × 14 pan head screws **B - Base**

Figure 2.66 Install the Base on the Stay Brackets

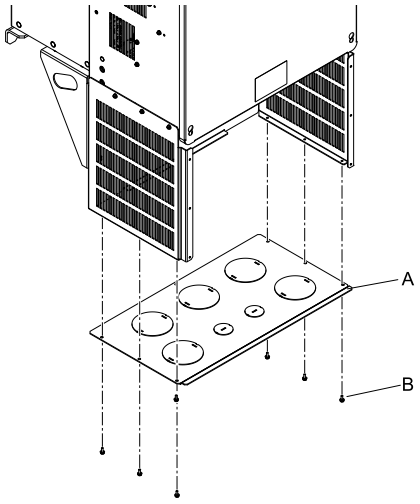
3. Use the included screws to install the UL Type 1 base to the drive.
   Tighten the screws to a correct tightening torque:
   • 0.98 N·m to 1.33 N·m (8.67 lbf·in to 11.77 lbf·in)



A - M4 × 10 pan head screws

Figure 2.67 Safety the Base

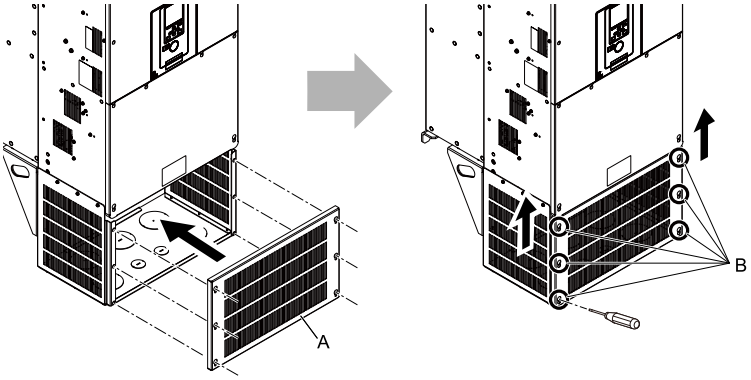
4. Use the included screws to install the UL Type 1 conduit bracket to the base.
   Tighten the screws to a correct tightening torque:
   • 0.98 N·m to 1.33 N·m (8.67 lbf·in to 11.77 lbf·in)



A - Conduit bracket **B - M4 × 10 pan head screws**

Figure 2.68 Install the Conduit Bracket

5. Use the included screws to install the front cover to the base.
   While slightly lifting the front cover, tighten the screws to a correct tightening torque:
   • 0.98 N·m to 1.33 N·m (8.67 lbf·in to 11.77 lbf·in)



A - Front cover **B - M4 × 10 truss head screws**

Figure 2.69 Install the Front Cover

2.10 Installation Methods

The drive installation methods include standard installation and external heatsink installation.

◆ Standard Installation

Refer to *Drive Exterior and Mounting Dimensions on page 439* for more information about external dimensions and installation methods.

◆ External Heatsink

Refer to Table 2.9 and Table 2.10 for the panel cut-out dimensions for external heatsink installations. Drive models smaller than 2075 and 4045 must use an attachment for panel-through mounting.

Note:
- The exterior mounting dimensions and installation dimensions for a standard installation are different than the dimensions for an external heatsink installation.
- The shaded parts of the panel cut-out dimensions are the gasket dimensions. Make sure that the gasket is not smaller than the specified dimension.

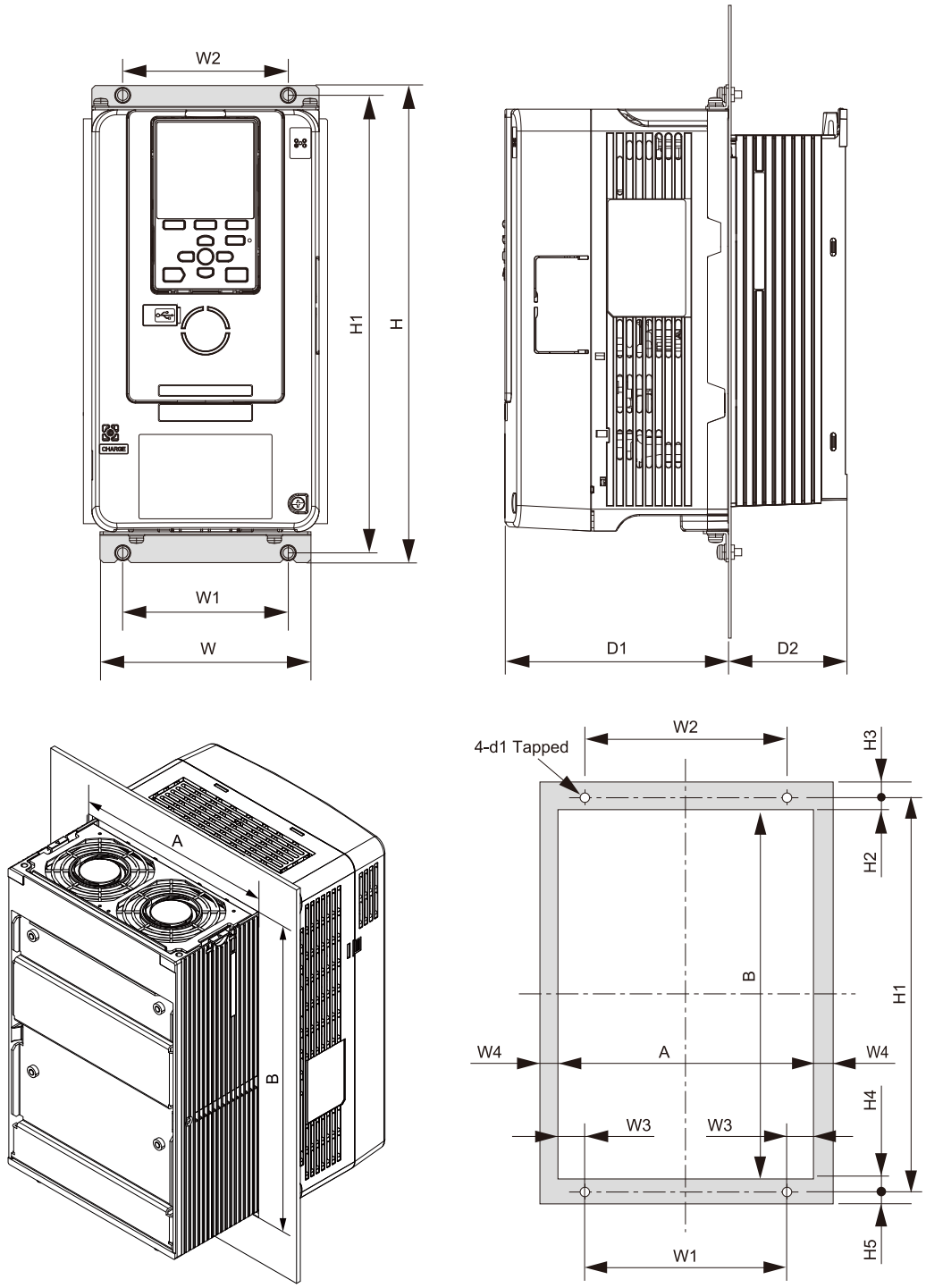


Figure 2.70 Panel Cut-Out Dimensions

Table 2.9 Panel Cut-Out Dimensions (200 V Class)

Model	Dimensions mm (in)															
	W	H	D1	D2	W1	W2	W3	W4	H1	H2	H3	H4	H5	A	B	d1
2003 *1	140 (5.51)	294 (11.57)	138 (5.43)	38 (1.50)	102 (4.02)	102 (4.02)	16 (0.630)	3 (0.118)	282 (11.10)	23 (0.906)	6 (0.236)	26 (1.02)	6 (0.236)	134 (5.28)	233 (9.17)	M5
2005 *1	140 (5.51)	294 (11.57)	138 (5.43)	38 (1.50)	102 (4.02)	102 (4.02)	16 (0.630)	3 (0.118)	282 (11.10)	23 (0.906)	6 (0.236)	26 (1.02)	6 (0.236)	134 (5.28)	233 (9.17)	M5
2008 *1	140 (5.51)	294 (11.57)	138 (5.43)	38 (1.50)	102 (4.02)	102 (4.02)	16 (0.630)	3 (0.118)	282 (11.10)	23 (0.906)	6 (0.236)	26 (1.02)	6 (0.236)	134 (5.28)	233 (9.17)	M5
2011 *1	140 (5.51)	294 (11.57)	138 (5.43)	38 (1.50)	102 (4.02)	102 (4.02)	16 (0.630)	3 (0.118)	282 (11.10)	23 (0.906)	6 (0.236)	26 (1.02)	6 (0.236)	134 (5.28)	233 (9.17)	M5
2014 *1	140 (5.51)	294 (11.57)	138 (5.43)	73 (2.87)	102 (4.02)	102 (4.02)	16 (0.630)	3 (0.118)	282 (11.10)	23 (0.906)	6 (0.236)	26 (1.02)	6 (0.236)	134 (5.28)	233 (9.17)	M5

Model	Dimensions mm (in)															
	W	H	D1	D2	W1	W2	W3	W4	H1	H2	H3	H4	H5	A	B	d1
2018 *1	140 (5.51)	294 (11.57)	138 (5.43)	73 (2.87)	102 (4.02)	102 (4.02)	16 (0.630)	3 (0.118)	282 (11.10)	23 (0.906)	6 (0.236)	26 (1.02)	6 (0.236)	134 (5.28)	233 (9.17)	M5
2025 *1	140 (5.51)	294 (11.57)	138 (5.43)	73 (2.87)	102 (4.02)	102 (4.02)	16 (0.630)	3 (0.118)	282 (11.10)	23 (0.906)	6 (0.236)	26 (1.02)	6 (0.236)	134 (5.28)	233 (9.17)	M5
2033 *1	140 (5.51)	294 (11.57)	138 (5.43)	73 (2.87)	102 (4.02)	102 (4.02)	16 (0.630)	3 (0.118)	282 (11.10)	23 (0.906)	6 (0.236)	26 (1.02)	6 (0.236)	134 (5.28)	233 (9.17)	M5
2047 *1	180 (7.09)	329 (12.95)	134 (5.28)	68 (2.68)	140 (5.51)	140 (5.51)	17 (0.669)	3 (0.118)	318 (12.52)	23.5 (0.925)	5 (0.197)	24.5 (0.965)	6 (0.236)	174 (6.85)	270 (10.63)	M5
2060 *1	220 (8.66)	384 (15.12)	140 (5.51)	87 (3.43)	192 (7.56)	192 (7.56)	11 (0.433)	3 (0.118)	371 (14.61)	27 (1.063)	7 (0.276)	25 (0.984)	6 (0.236)	214 (8.43)	319 (12.56)	M6
2075 *1	220 (8.66)	384 (15.12)	140 (5.51)	87 (3.43)	192 (7.56)	192 (7.56)	11 (0.433)	3 (0.118)	371 (14.61)	27 (1.063)	7 (0.276)	25 (0.984)	6 (0.236)	214 (8.43)	319 (12.56)	M6
2088	240 (9.45)	400 (15.75)	166 (6.54)	114 (4.49)	195 (7.68)	204 (8.03)	14.5 (0.571)	8 (0.315)	385 (15.16)	19.5 (0.768)	7.5 (0.295)	19.5 (0.768)	7.5 (0.295)	224 (8.82)	349 (13.62)	M6
2115	255 (10.04)	450 (17.72)	166 (6.54)	114 (4.49)	170 (6.69)	210 (8.27)	34.5 (1.36)	8 (0.315)	436 (17.17)	20 (0.787)	8 (0.315)	20 (0.787)	6 (0.236)	239 (9.41)	399 (15.59)	M6
2145	264 (10.39)	543 (21.38)	186 (7.32)	149 (5.87)	190 (7.48)	220 (8.66)	29 (1.14)	8 (0.315)	527 (20.75)	19.5 (0.768)	8.5 (0.335)	20.5 (0.807)	7.5 (0.295)	248 (9.76)	490 (19.17)	M8
2180	264 (10.39)	543 (21.38)	186 (7.32)	149 (5.87)	190 (7.48)	220 (8.66)	29 (1.14)	8 (0.315)	527 (20.75)	19.5 (0.768)	8.5 (0.335)	20.5 (0.807)	7.5 (0.295)	248 (9.76)	490 (19.17)	M8
2215	312 (12.28)	700 (27.56)	260 (10.24)	160 (6.30)	218 (8.58)	263 (10.35)	39 (1.54)	8 (0.315)	675 (26.56)	33 (1.299)	12 (0.472)	32 (1.26)	13 (0.512)	296 (11.65)	610 (24.02)	M10
2283	312 (12.28)	700 (27.56)	260 (10.24)	160 (6.30)	218 (8.58)	263 (10.35)	39 (1.54)	8 (0.315)	675 (26.56)	33 (1.299)	12 (0.472)	32 (1.26)	13 (0.512)	296 (11.65)	610 (24.02)	M10
2346	440 (17.32)	800 (31.50)	254 (10.00)	218 (8.58)	370 (14.57)	310 (12.20)	23 (0.91)	12 (0.472)	773 (30.43)	31.5 (1.240)	14 (0.551)	31.5 (1.24)	13 (0.512)	416 (16.38)	710 (27.95)	M12
2415	440 (17.32)	800 (31.50)	254 (10.00)	218 (8.58)	370 (14.57)	310 (12.20)	23 (0.91)	12 (0.472)	773 (30.43)	31.5 (1.240)	14 (0.551)	31.5 (1.24)	13 (0.512)	416 (16.38)	710 (27.95)	M12

*1 The attachment for external heatsink installation is necessary.

Table 2.10 Panel Cut-Out Dimensions (400 V Class)

Model	Dimensions mm (in)																	
	W	H	D1	D2	W1	W2	W3	W4	W5	W6	H1	H2	H3	H4	H5	A	B	d1
4002 *1	140 (5.51)	294 (11.57)	138 (5.43)	38 (1.50)	102 (4.02)	102 (4.02)	16 (0.630)	3 (0.118)	-	-	282 (11.10)	23 (0.906)	6 (0.236)	26 (1.02)	6 (0.236)	134 (5.28)	233 (9.17)	M5
4003 *1	140 (5.51)	294 (11.57)	138 (5.43)	38 (1.50)	102 (4.02)	102 (4.02)	16 (0.630)	3 (0.118)	-	-	282 (11.10)	23 (0.906)	6 (0.236)	26 (1.02)	6 (0.236)	134 (5.28)	233 (9.17)	M5
4005 *1	140 (5.51)	294 (11.57)	138 (5.43)	38 (1.50)	102 (4.02)	102 (4.02)	16 (0.630)	3 (0.118)	-	-	282 (11.10)	23 (0.906)	6 (0.236)	26 (1.02)	6 (0.236)	134 (5.28)	233 (9.17)	M5
4006 *1	140 (5.51)	294 (11.57)	138 (5.43)	73 (2.87)	102 (4.02)	102 (4.02)	16 (0.630)	3 (0.118)	-	-	282 (11.10)	23 (0.906)	6 (0.236)	26 (1.02)	6 (0.236)	134 (5.28)	233 (9.17)	M5
4007 *1	140 (5.51)	294 (11.57)	138 (5.43)	73 (2.87)	102 (4.02)	102 (4.02)	16 (0.630)	3 (0.118)	-	-	282 (11.10)	23 (0.906)	6 (0.236)	26 (1.02)	6 (0.236)	134 (5.28)	233 (9.17)	M5
4009 *1	140 (5.51)	294 (11.57)	138 (5.43)	73 (2.87)	102 (4.02)	102 (4.02)	16 (0.630)	3 (0.118)	-	-	282 (11.10)	23 (0.906)	6 (0.236)	26 (1.02)	6 (0.236)	134 (5.28)	233 (9.17)	M5
4015 *1	140 (5.51)	294 (11.57)	138 (5.43)	73 (2.87)	102 (4.02)	102 (4.02)	16 (0.630)	3 (0.118)	-	-	282 (11.10)	23 (0.906)	6 (0.236)	26 (1.02)	6 (0.236)	134 (5.28)	233 (9.17)	M5
4018 *1	140 (5.51)	294 (11.57)	138 (5.43)	73 (2.87)	102 (4.02)	102 (4.02)	16 (0.630)	3 (0.118)	-	-	282 (11.10)	23 (0.906)	6 (0.236)	26 (1.02)	6 (0.236)	134 (5.28)	233 (9.17)	M5
4024 *1	180 (7.09)	329 (12.95)	134 (5.28)	68 (2.68)	140 (5.51)	140 (5.51)	17 (0.669)	3 (0.118)	-	-	318 (12.52)	23.5 (0.925)	5 (0.197)	24.5 (0.965)	6 (0.236)	174 (6.85)	270 (10.63)	M5
4031 *1	180 (7.09)	329 (12.95)	134 (5.28)	68 (2.68)	140 (5.51)	140 (5.51)	17 (0.669)	3 (0.118)	-	-	318 (12.52)	23.5 (0.925)	5 (0.197)	24.5 (0.965)	6 (0.236)	174 (6.85)	270 (10.63)	M5
4039 *1	220 (8.66)	384 (15.12)	140 (5.51)	87 (3.43)	192 (7.56)	192 (7.56)	11 (0.433)	3 (0.118)	-	-	371 (14.61)	27 (1.063)	7 (0.276)	25 (0.984)	6 (0.236)	214 (8.43)	319 (12.56)	M6
4045 *1	220 (8.66)	384 (15.12)	140 (5.51)	106 (4.17)	192 (7.56)	192 (7.56)	11 (0.433)	3 (0.118)	-	-	371 (14.61)	27 (1.063)	7 (0.276)	25 (0.984)	6 (0.236)	214 (8.43)	319 (12.56)	M6

Model	Dimensions mm (in)																	
	W	H	D1	D2	W1	W2	W3	W4	W5	W6	H1	H2	H3	H4	H5	A	B	d1
4060	240 (9.45)	400 (15.75)	166 (6.54)	114 (4.49)	195 (7.68)	204 (8.03)	14.5 (0.571)	8 (0.315)	-	-	385 (15.16)	19.5 (0.768)	7.5 (0.295)	19.5 (0.768)	7.5 (0.295)	224 (8.82)	349 (13.62)	M6
4075	255 (10.04)	450 (17.72)	166 (6.54)	114 (4.49)	170 (6.69)	210 (8.27)	34.5 (1.36)	8 (0.315)	-	-	436 (17.17)	20 (0.787)	8 (0.315)	20 (0.787)	6 (0.236)	239 (9.41)	399 (15.59)	M6
4091	255 (10.04)	450 (17.72)	166 (6.54)	114 (4.49)	170 (6.69)	210 (8.27)	34.5 (1.36)	8 (0.315)	-	-	436 (17.17)	20 (0.787)	8 (0.315)	20 (0.787)	6 (0.236)	239 (9.41)	399 (15.59)	M6
4112	264 (10.39)	543 (21.38)	186 (7.32)	149 (5.87)	190 (7.48)	220 (8.66)	29 (1.14)	8 (0.315)	-	-	527 (20.75)	19.5 (0.768)	8.5 (0.335)	20.5 (0.807)	7.5 (0.295)	248 (9.76)	490 (19.17)	M8
4150	264 (10.39)	543 (21.38)	186 (7.32)	149 (5.87)	190 (7.48)	220 (8.66)	29 (1.14)	8 (0.315)	-	-	527 (20.75)	19.5 (0.768)	8.5 (0.335)	20.5 (0.807)	7.5 (0.295)	248 (9.76)	490 (19.17)	M8
4180	312 (12.28)	700 (27.56)	260 (10.24)	160 (6.30)	218 (8.58)	263 (10.35)	39 (1.54)	8 (0.315)	-	-	675 (26.56)	33 (1.299)	12 (0.472)	32 (1.26)	13 (0.512)	296 (11.65)	610 (24.02)	M10
4216	312 (12.28)	700 (27.56)	260 (10.24)	160 (6.30)	218 (8.58)	263 (10.35)	39 (1.54)	8 (0.315)	-	-	675 (26.56)	33 (1.299)	12 (0.472)	32 (1.26)	13 (0.512)	296 (11.65)	610 (24.02)	M10
4260	312 (12.28)	700 (27.56)	260 (10.24)	160 (6.30)	218 (8.58)	263 (10.35)	39 (1.54)	8 (0.315)	-	-	675 (26.56)	33 (1.299)	12 (0.472)	32 (1.26)	13 (0.512)	296 (11.65)	610 (24.02)	M10
4304	440 (17.32)	800 (31.50)	254 (10.00)	218 (8.58)	370 (14.57)	310 (12.20)	23 (0.91)	12 (0.472)	-	-	773 (30.43)	31.5 (1.240)	14 (0.551)	31.5 (1.24)	13 (0.512)	416 (16.38)	710 (27.95)	M12
4371	440 (17.32)	800 (31.50)	254 (10.00)	218 (8.58)	370 (14.57)	310 (12.20)	23 (0.91)	12 (0.472)	-	-	773 (30.43)	31.5 (1.240)	14 (0.551)	31.5 (1.24)	13 (0.512)	416 (16.38)	710 (27.95)	M12
4414	510 (20.08)	1136 (44.72)	260 (10.24)	220 (8.66)	450 (17.72)	404 (15.91)	18 (0.71)	12 (0.472)	179 (7.05)	225 (8.86)	1110 (43.70)	34 (1.339)	15 (0.591)	34 (1.34)	15 (0.591)	486 (19.13)	1042 (41.02)	M12
4453	510 (20.08)	1136 (44.72)	260 (10.24)	220 (8.66)	450 (17.72)	404 (15.91)	18 (0.71)	12 (0.472)	179 (7.05)	225 (8.86)	1110 (43.70)	34 (1.339)	15 (0.591)	34 (1.34)	15 (0.591)	486 (19.13)	1042 (41.02)	M12
4605	510 (20.08)	1136 (44.72)	260 (10.24)	220 (8.66)	450 (17.72)	404 (15.91)	18 (0.71)	12 (0.472)	179 (7.05)	225 (8.86)	1110 (43.70)	34 (1.339)	15 (0.591)	34 (1.34)	15 (0.591)	486 (19.13)	1042 (41.02)	M12

*1 The attachment for external heatsink installation is necessary.

2.11 Electrical Installation

DANGER! *Electrical Shock Hazard. Do not examine, connect, or disconnect wiring on an energized drive. Before servicing, disconnect all power to the equipment and wait for the time specified on the warning label at a minimum. The internal capacitor stays charged after the drive is de-energized. The charge indicator LED extinguishes when the DC bus voltage decreases below 50 Vdc. When all indicators are OFF, remove the covers before measuring for dangerous voltages to make sure that the drive is safe. If you do work on the drive when it is energized, it will cause serious injury or death from electrical shock.*

WARNING! *Electrical Shock Hazard. De-energize the drive and wait 5 minutes minimum until the Charge LED turns off. Remove the front cover and terminal cover to do work on wiring, circuit boards, and other parts. Use terminals for their correct function only. Incorrect wiring, incorrect ground connections, and incorrect repair of protective covers can cause death or serious injury.*

WARNING! *Electrical Shock Hazard. Correctly ground the drive before you turn on the EMC filter switch. If you touch electrical equipment that is not grounded, it can cause serious injury or death.*

WARNING! *Electrical Shock Hazard. Use the terminals for the drive only for their intended purpose. Refer to the technical manual for more information about the I/O terminals. Wiring and grounding incorrectly or modifying the cover may damage the equipment or cause injury.*

◆ Standard Connection Diagram

Wire the drive as specified by Figure 2.71.

WARNING! *Sudden Movement Hazard. Check the I/O signals and the external sequences for the drive before you set the Application Preset function. When you set the Application Preset function (A1-06 ≠ 0), it changes the I/O terminal functions for the drive and it can cause equipment to operate unusually. This can cause serious injury or death.*

WARNING! *Fire Hazard. Install sufficient branch circuit short circuit protection as specified by applicable codes and this manual. The drive is suitable for circuits that supply not more than 100,000 RMS symmetrical amperes, 240 Vac maximum (200 V Class), 480 Vac maximum (400 V Class). Incorrect branch circuit short circuit protection can cause serious injury or death.*

NOTICE: *When the input voltage is 440 V or higher or the wiring distance is longer than 100 m (328 ft), make sure that the motor insulation voltage is sufficient or use an inverter-duty motor or vector-duty motor with reinforced insulation. Motor winding and insulation failure can occur.*

Note:

Do not connect the AC control circuit ground to the drive enclosure. Incorrect ground wiring can cause the control circuit to operate incorrectly.

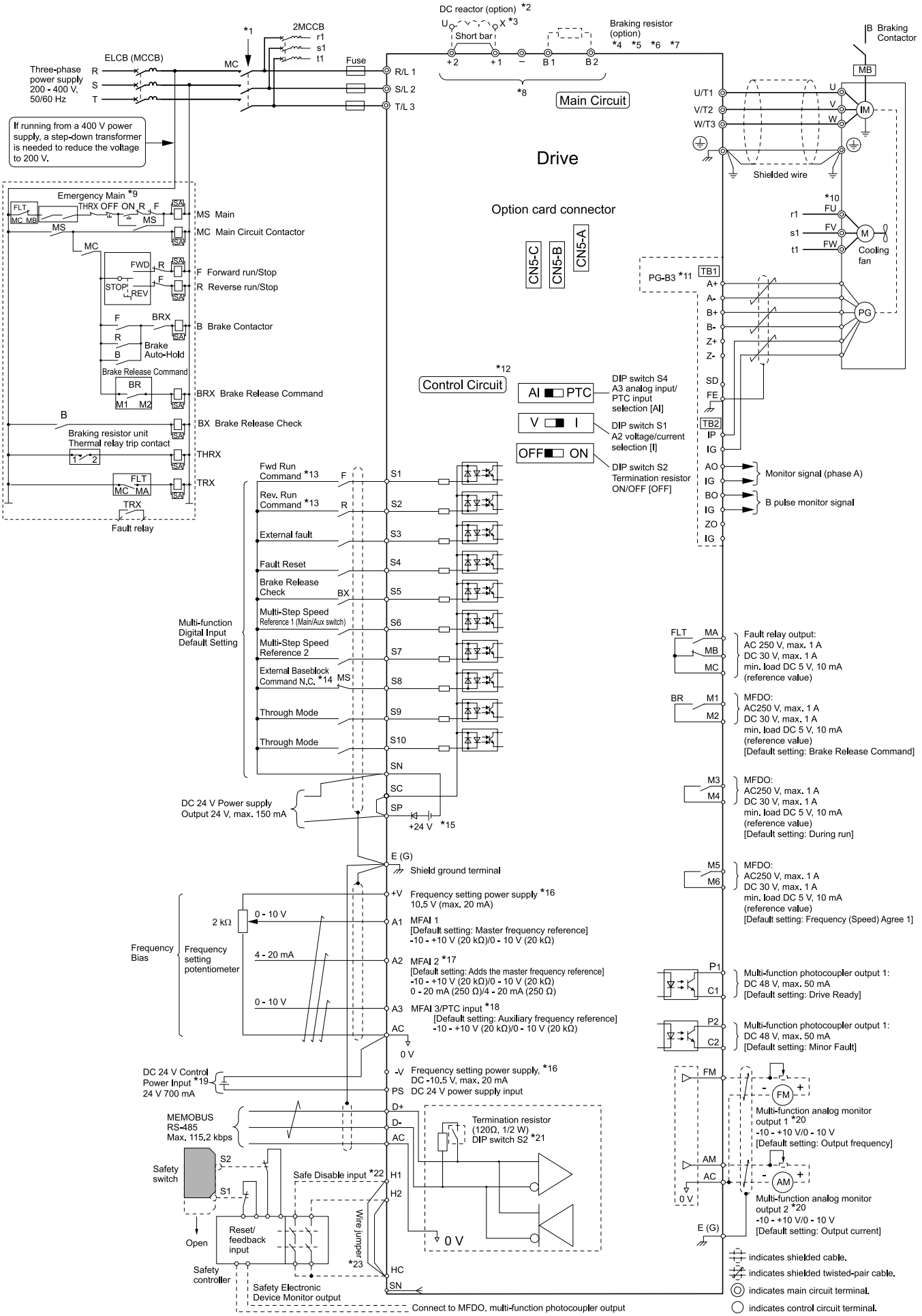


Figure 2.71 Standard Drive Connection Diagram

*1 Set the wiring sequence to de-energize the drive with the fault relay output.
*2 When you install a DC reactor, you must remove the jumper between terminals +1 and +2.
*3 Models 2088 to 2415 and 4045 to 4605 have a DC reactor.
*4 When you use a regenerative converter, regenerative unit, or braking unit, set *L8-55 = 0 [Internal DB TransistorProtection = Disable]*. the drive will detect *rF [Braking Resistor Fault]*.
*5 When you use a regenerative converter, regenerative unit, braking unit, braking resistor, or braking resistor unit, set *L3-04 = 0 [Stall Prevention during Decel = Disabled]*. If *L3-04 ≠ 0*, the drive could possibly not stop in the specified deceleration time.
*6 When you use an ERF-type braking resistor, set *L8-01 = 1 [3% ERF DB Resistor Protection = Enabled]* and set a wiring sequence to de-energize the drive with the fault relay output.
*7 When you connect a braking unit (CDBR series) or a braking resistor unit (LKEB series) to drive models 2088, 2115, and 4091, make sure that you use wires that are in the range of the applicable gauges for the drive. A junction terminal is necessary to connect wires that are less than the applicable gauge to the drive. Contact Yaskawa or your nearest sales representative for more information about selection and installation of the junction terminal.
*8 Connect peripheral options to terminals -, +1, +2, B1, and B2.

NOTICE: *When you use the drive with a non-grounding, high-resistance grounding, or asymmetric-grounding network, put the EMC Filter screw or screws in the OFF position to disable the built-in EMC filter. Failure to obey the instructions can damage the drive.*

*9 Set a wiring sequence to de-energize the drive with the fault relay output.
*10 Cooling fan wiring is not necessary for self-cooling motors.
*11 Encoder circuit wiring (wiring to PG-B3 option) is not necessary for applications that do not use motor speed feedback.
*12 Connect a 24 V power supply to terminals PS-AC to operate the control circuit while the main circuit power supply is OFF.
*13 Set up the wiring to rotate the motor forward (FWD) it hoists a load, and reverse (REV) when it lowers a load in all control methods.
*14 When the external baseblock command is ON, the drive releases the baseblock.
*15 To set the MFDI power supply (Sinking/Sourcing Mode or internal/external power supply), install or remove a jumper between terminals SC-SP or SC-SN depending on the application.

NOTICE: *Damage to Equipment. Do not close the circuit between terminals SP-SN. If you close the circuits between terminals SC-SP and terminals SC-SN at the same time, it will cause damage to the drive.*

- Sinking Mode, Internal power supply: Install the jumper to close the circuit between terminals SC-SP.
  Do not close the circuit between terminals SC-SN. If you connect the wires to the incorrect terminals, it will cause damage to the drive.
- Sourcing Mode, Internal power supply: Install the jumper to close the circuit between terminals SC-SN.
  Do not close the circuit between terminals SC-SP. If you connect the wires to the incorrect terminals, it will cause damage to the drive.
- External power supply: Remove the jumper from the MFDI terminals. It is not necessary to close the circuit between terminals SC-SP and terminals SC-SN.

*16 The maximum output current capacity for terminals **+** V and -V on the control circuit is 20 mA.

NOTICE: *Do not install a jumper between terminals +V, -V, and AC. A closed circuit between these terminals will cause damage to the drive.*

*17 DIP switch S1 sets terminal A2 for voltage or current input. The default setting for S1 is current input (“I” side).
*18 DIP switch S4 sets terminal A3 for analog or PTC input.
*19 Connect the positive lead from an external 24 Vdc power supply to terminal PS and the negative lead to terminal AC.

NOTICE: *Connect terminals PS and AC correctly for the 24 V power supply. If you connect the wires to the incorrect terminals, it will cause damage to the drive.*

*20 Use multi-function analog monitor outputs with analog frequency meters, ammeters, voltmeters, and wattmeters. Do not use monitor outputs with feedback-type signal devices.
*21 Set DIP switch S2 to the ON position to enable the termination resistor in the last drive when you use MEMOBUS/Modbus communications.
*22 To use the internal power supply with the Safe Disable input, use sourcing mode.
*23 Disconnect the wire jumpers between H1 and HC and H2 and HC to use the Safe Disable input.

2.12 Main Circuit Wiring

This section gives information about the functions, specifications, and procedures necessary to safely and correctly wire the main circuit in the drive.

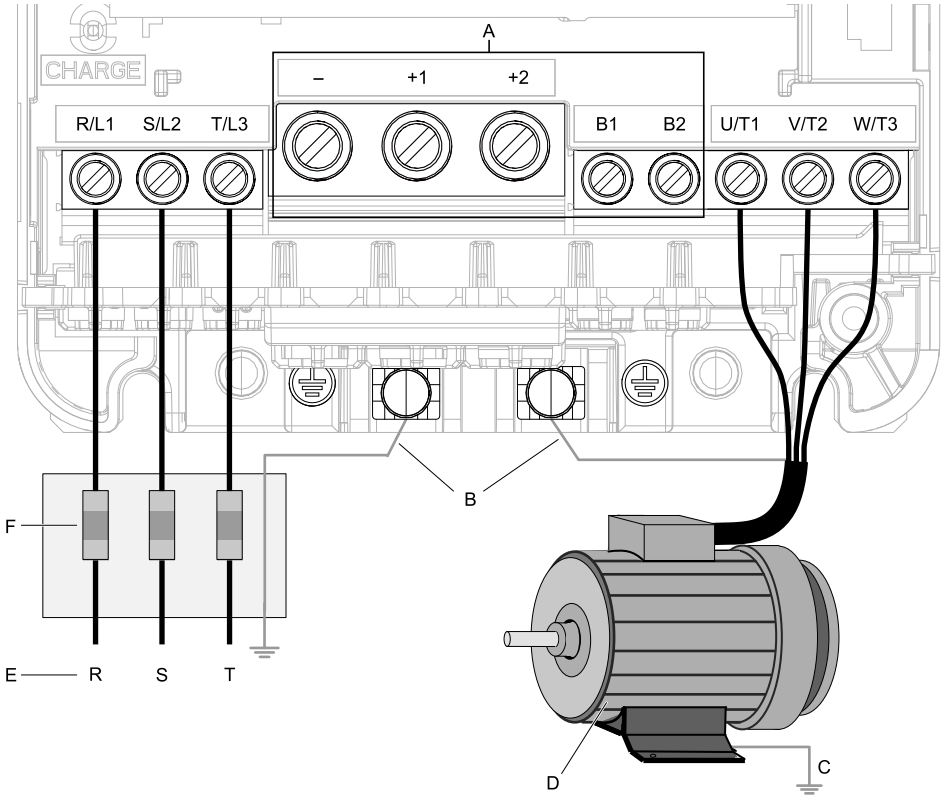
NOTICE: *Damage to Equipment. Do not energize and de-energize the drive more frequently than one time each 30 minutes. If you frequently energize and de-energize the drive, it can cause drive failure.*

Note:

Soldered wire connections can become loose over time and cause unsatisfactory drive performance.

◆ Motor and Main Circuit Connections

WARNING! *Electrical Shock Hazard. Do not connect terminals R/L1, S/L2, T/L3, U/T1, V/T2, W/T3, -, +1, +2, +3, B1, or B2 to the ground terminal. If you connect these terminals to earth ground, it can cause damage to the drive or serious injury or death.*



Note:

The location of terminals are different for different drive models.

A - DC bus terminal
B - Connect to the drive ground terminal.
C - Ground the motor case.
D - Three-Phase Motor
E - Use R, S, T for input power supply.
F - Input Protection (Fuses or Circuit Breakers)

Figure 2.72 Wiring the Main Circuit and Motor

◆ Configuration of Main Circuit Terminal Block

Refer to the following figure for the configuration of the main circuit terminal arrangement.

Model	Diagram
2003 to 2033, 4002 to 4018	Figure 2.73
2047, 4024, 4031	Figure 2.74
2060, 2075	Figure 2.75
4039	Figure 2.76
4045	Figure 2.77
2088	Figure 2.78
4060	Figure 2.79

Model	Diagram
4075	Figure 2.80
2115, 4091	Figure 2.81
2145, 2180, 4112, 4150	Figure 2.82
2215, 2283, and 4180 to 4260	Figure 2.83
2346, 2415, 4304, 4371	Figure 2.84
4414 to 4605	Figure 2.85

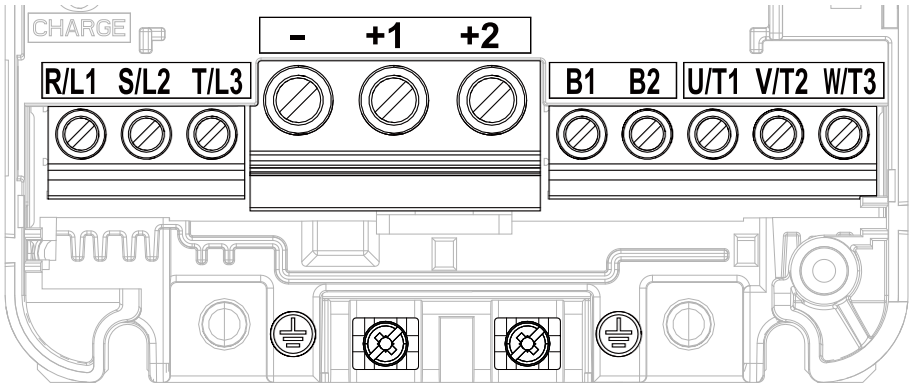


Figure 2.73 Configuration of Main Circuit Terminal Block

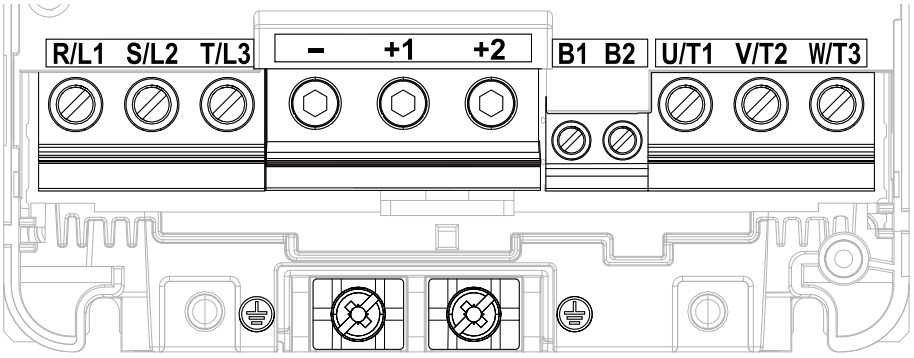


Figure 2.74 Configuration of Main Circuit Terminal Block

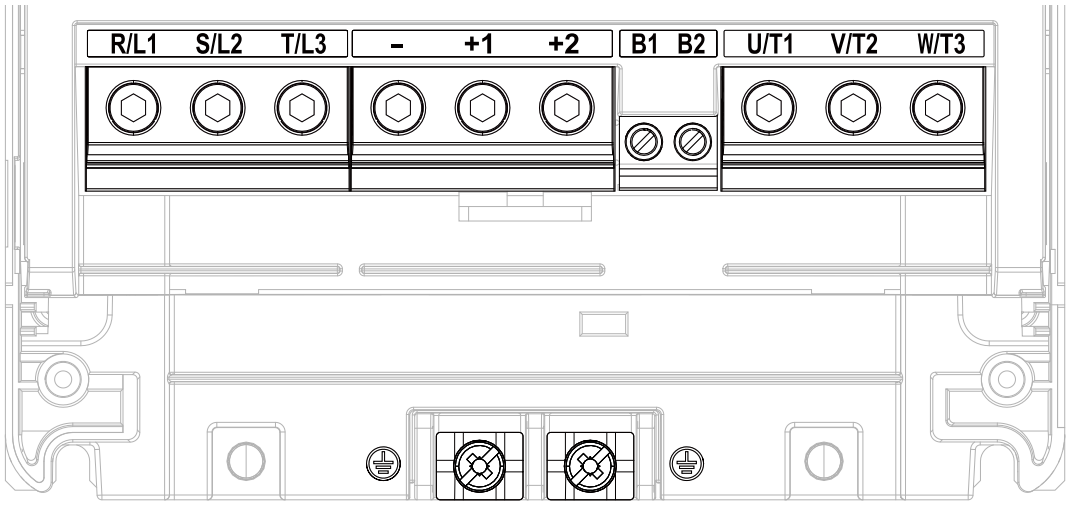


Figure 2.75 Configuration of Main Circuit Terminal Block

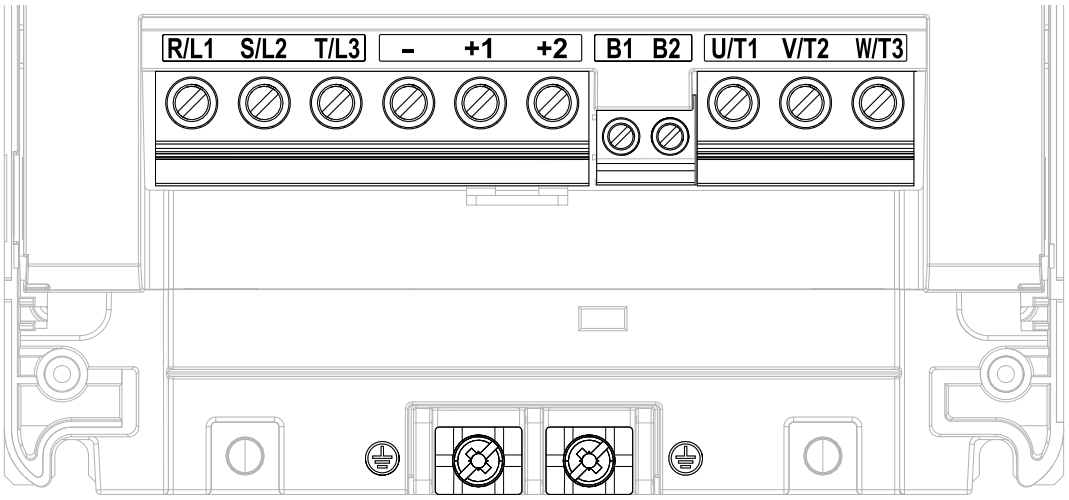


Figure 2.76 Configuration of Main Circuit Terminal Block

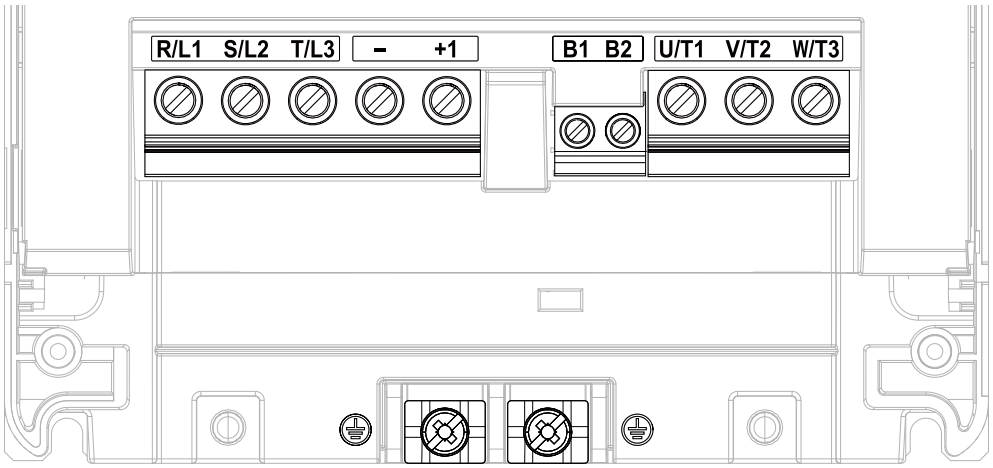


Figure 2.77 Configuration of Main Circuit Terminal Block

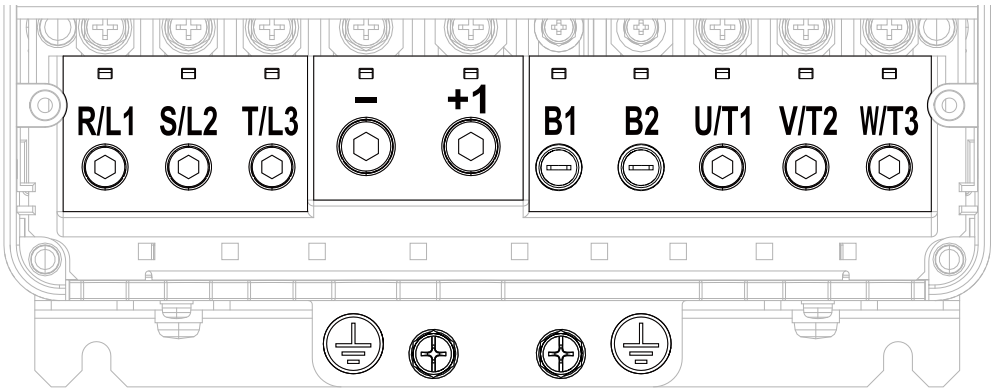


Figure 2.78 Configuration of Main Circuit Terminal Block

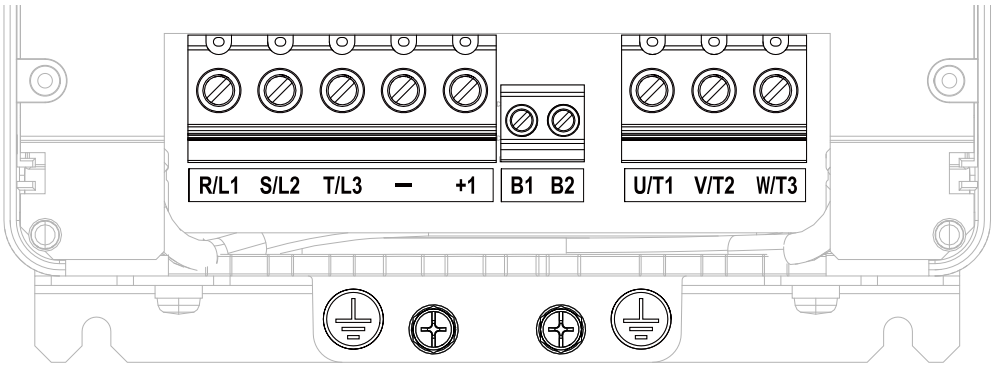


Figure 2.79 Configuration of Main Circuit Terminal Block

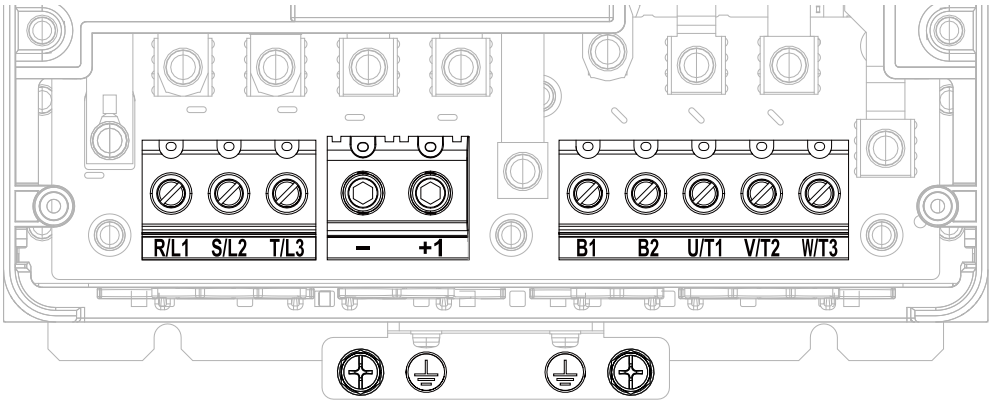


Figure 2.80 Configuration of Main Circuit Terminal Block

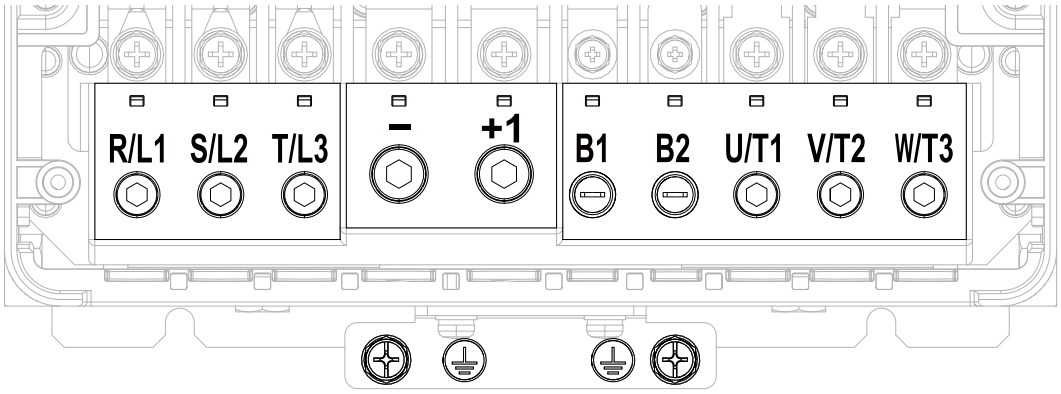


Figure 2.81 Configuration of Main Circuit Terminal Block

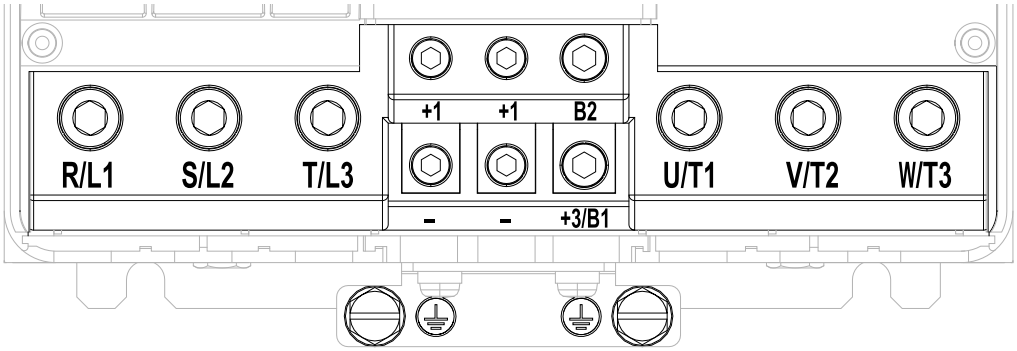


Figure 2.82 Configuration of Main Circuit Terminal Block

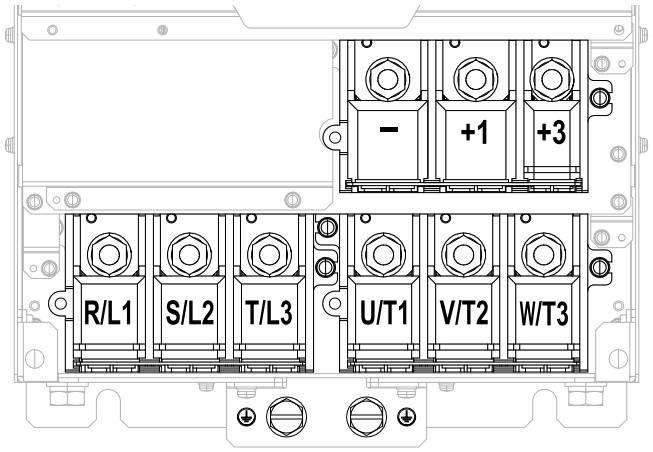


Figure 2.83 Configuration of Main Circuit Terminal Block

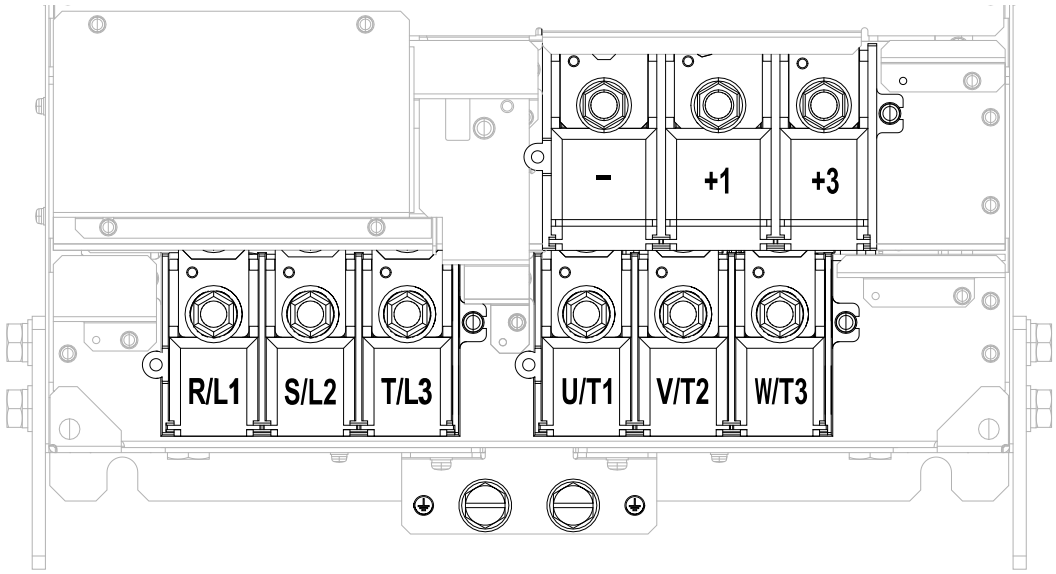


Figure 2.84 Configuration of Main Circuit Terminal Block

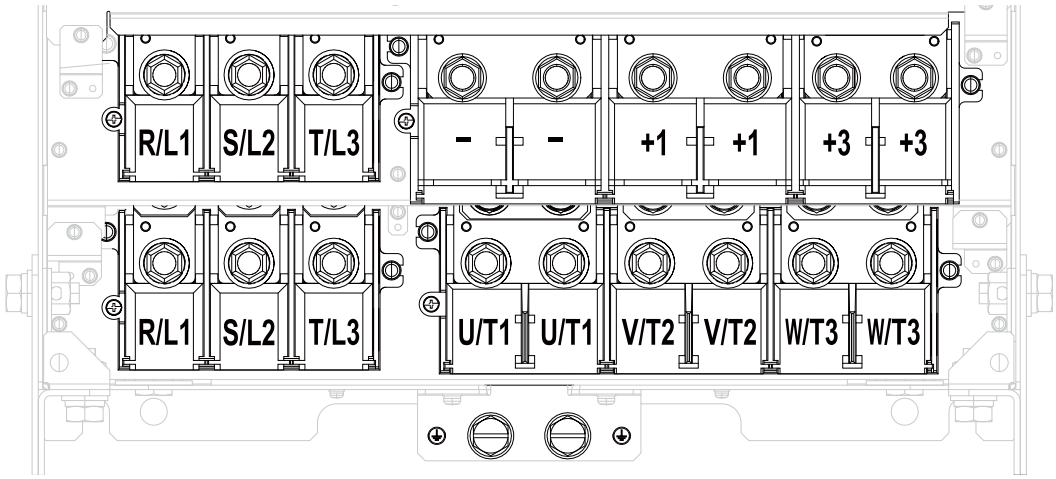


Figure 2.85 Configuration of Main Circuit Terminal Block

◆ Main Circuit Terminal Functions

Refer to the following table for drive main circuit terminals and functions.

Table 2.11 Main Circuit Terminal Functions

<table>
<tr><th rowspan="3">Terminals</th><th colspan="3">Name</th><th rowspan="3">Function</th></tr>
<tr><th rowspan="2">Model</th><th>2003 - 2075</th><th>2088 - 2115</th><th>2145 - 2415</th></tr>
<tr><th>4002 - 4039</th><th>4045 - 4150</th><th>4180 - 4605</th></tr>
<tr><td>R/L1</td><td colspan="3" rowspan="3">Main circuit power supply input</td><td rowspan="3">Connecting a commercial power supply.</td></tr>
<tr><td>S/L2</td></tr>
<tr><td>T/L3</td></tr>
<tr><td>U/T1</td><td colspan="3" rowspan="3">Drive output</td><td rowspan="3">Connecting a motor.</td></tr>
<tr><td>V/T2</td></tr>
<tr><td>W/T3</td></tr>
<tr><td>B1</td><td colspan="2" rowspan="2">Braking resistor connection</td><td rowspan="2">-</td><td rowspan="2">Connecting a braking resistor or braking resistor unit.</td></tr>
<tr><td>B2</td></tr>
<tr><td>+2</td><td rowspan="3">• DC power supply input (+1 and -)
• DC reactor connection (+1 and +2)</td><td colspan="2">-</td><td rowspan="4">Connecting peripheral devices such as:
• DC power input
• Braking unit
• DC Reactor
Note:
Remove the jumper between the terminals +1 and +2 when connecting a DC reactor.</td></tr>
<tr><td>+1</td><td rowspan="2">DC power supply input (+1 and -)</td><td rowspan="3">• DC power supply input (+1 and -)
• Braking unit connection (+3 and -)</td></tr>
<tr><td>-</td></tr>
<tr><td>+3</td><td colspan="2">-</td></tr>
<tr><td>⏚</td><td colspan="3">• 200 V: D class grounding (ground to 100 Ω or less)
• 400 V: C class grounding (ground to 10 Ω or less)</td><td>Grounding.</td></tr>
</table>

Note:

Use terminals B1 and - to connect a control unit (CDBR-type) to drive models 2003 to 2115 and 4002 to 4150 with built-in braking transistors.

◆ Main Circuit Wire Gauges and Tightening Torques

Select the correct wires for main circuit wiring.

Refer to *Wire Gauges and Tightening Torques on page 250* for wire gauges and tightening torques as specified by European standards.

Refer to *Wire Gauges and Tightening Torques on page 275* for wire gauges and tightening torques as specified by UL standards.

■ Wire Selection Precautions

WARNING! *Electrical Shock Hazard. Make sure that the protective ground wire complies with technical standards and local safety regulations. The IEC/EN 61800-5-1:2007 standard specifies that you must wire the power supply to automatically de-energize when the protective ground wire disconnects. You can also connect a protective ground wire that has a minimum cross-sectional area of 10 mm² (copper wire) or 16 mm² (aluminum wire). If you do not obey the standards and regulations, it can cause serious injury or death. The leakage current of the drive will be more than 3.5 mA in drive models 2xxxB, 4xxxB, and 4317A to 4605A.*

Think about line voltage drop before selecting wire gauges. Select wire gauges that drop the voltage by 2% or less of the rated voltage. Increase the wire gauge and the cable length when the risk of voltage drops increases. Calculate line voltage drop with this formula:

Line voltage drop (V) = $\sqrt{3}$ × wire resistance (Ω/km) × wiring distance (m) × motor rated current (A) × 10^{-3}.

■ Precautions during Wiring

- Use terminals B1 and - to connect braking units to drives that have built-in braking transistors (models 2003 to 2115 and 4002 to 4150). Use terminals +3 and - to connect braking units to drives that do not have built-in braking transistors.
- Refer to “Yaskawa AC Drive Option Braking Unit, Braking Resistor Unit Instruction Manual (TOBPC72060001)” for information about wire gauges and tightening torques to connect braking resistor units or braking units.
- Use terminals +1 and - to connect a regenerative converter or regenerative unit.

WARNING! *Fire Hazard. Do not connect a braking resistor to terminals +1 or -. Use terminals B1 and B2 for the braking resistor connections. If you connect a braking resistor to the incorrect terminals, it can cause damage to the drive and braking circuit and serious injury or death.*

■ Main Circuit Wire Gauges and Tightening Torques

WARNING! *Electrical Shock Hazard. Make sure that the protective ground wire complies with technical standards and local safety regulations. The IEC/EN 61800-5-1:2007 standard specifies that you must wire the power supply to automatically de-energize when the protective ground wire disconnects. You can also connect a protective ground wire that has a minimum cross-sectional area of 10 mm² (copper wire) or 16 mm² (aluminum wire). If you do not obey the standards and regulations, it can cause serious injury or death. The leakage current of the drive will be more than 3.5 mA in drive models 2xxxB, 4xxxB, and 4317A to 4605A.*

Note:

- The recommended wire gauges are based on drive continuous current ratings with 75 °C (167 °F) 600 V class 2 heat-resistant indoor PVC wire. Assume these conditions:
  - –Ambient temperature: 40 °C (104 °F) maximum
  - –Wiring distance: 100 m (3281 ft) maximum
  - –Rated current value
- Use terminals +1, +2, +3, -, B1, and B2 to connect a peripheral option such as a DC reactor or a braking resistor. Do not connect other items to these terminals.
- Refer to the instruction manual for each device for recommended wire gauges to connect peripheral devices or options to terminals +1, +2, +3, -, B1, and B2. Contact Yaskawa or your nearest sales representative if the recommended wire gauges for the peripheral devices or options are out of the range of the applicable gauges for the drive.

Three-Phase 200 V Class

Model	Terminal	Recomm. Gauge mm²	Applicable Gauge (IP20 Applicable Gauge *1) mm²	Wire Stripping Length *2 mm	Terminal Screw		Tightening Torque N·m (lbf·in)
					Size	Shape	
2003	R/L1, S/L2, T/L3	2	2 - 14 (2 - 14)	10	M4	Slotted (-)	1.5 - 1.7 (13.5 - 15)
	U/T1, V/T2, W/T3	2	2 - 14 (2 - 14)	10	M4	Slotted (-)	1.5 - 1.7 (13.5 - 15)
	-, +1, +2	2	2 - 22 (2 - 22)	18	M5	Slotted (-)	2.3 - 2.5 (19.8 - 22) *3
	B1, B2	2	2 - 5.5 (2 - 5.5)	10	M4	Slotted (-)	1.5 - 1.7 (13.5 - 15)
	⏚	2	2 - 8 (-)	-	M4	Phillips/slotted combo	1.2 - 1.5 (10.6 - 13.3)
2005	R/L1, S/L2, T/L3	2	2 - 14 (2 - 14)	10	M4	Slotted (-)	1.5 - 1.7 (13.5 - 15)
	U/T1, V/T2, W/T3	2	2 - 14 (2 - 14)	10	M4	Slotted (-)	1.5 - 1.7 (13.5 - 15)
	-, +1, +2	2	2 - 22 (2 - 22)	18	M5	Slotted (-)	2.3 - 2.5 (19.8 - 22) *3
	B1, B2	2	2 - 5.5 (2 - 5.5)	10	M4	Slotted (-)	1.5 - 1.7 (13.5 - 15)
	⏚	2	2 - 8 (-)	-	M4	Phillips/slotted combo	1.2 - 1.5 (10.6 - 13.3)
2008	R/L1, S/L2, T/L3	2	2 - 14 (2 - 14)	10	M4	Slotted (-)	1.5 - 1.7 (13.5 - 15)
	U/T1, V/T2, W/T3	2	2 - 14 (2 - 14)	10	M4	Slotted (-)	1.5 - 1.7 (13.5 - 15)
	-, +1, +2	2	2 - 22 (2 - 22)	18	M5	Slotted (-)	2.3 - 2.5 (19.8 - 22) *3
	B1, B2	2	2 - 5.5 (2 - 5.5)	10	M4	Slotted (-)	1.5 - 1.7 (13.5 - 15)
	⏚	2	2 - 8 (-)	-	M4	Phillips/slotted combo	1.2 - 1.5 (10.6 - 13.3)

Model	Terminal	Recomm. Gauge mm²	Applicable Gauge (IP20 Applicable Gauge *1) mm²	Wire Stripping Length *2 mm	Terminal Screw		Tightening Torque N·m (lbf·in)
					Size	Shape	
2011	R/L1, S/L2, T/L3	3.5	2 - 14 (2 - 14)	10	M4	Slotted (-)	1.5 - 1.7 (13.5 - 15)
	U/T1, V/T2, W/T3	2	2 - 14 (2 - 14)	10	M4	Slotted (-)	1.5 - 1.7 (13.5 - 15)
	-, +1, +2	3.5	2 - 22 (2 - 22)	18	M5	Slotted (-)	2.3 - 2.5 (19.8 - 22) *3
	B1, B2	2	2 - 5.5 (2 - 5.5)	10	M4	Slotted (-)	1.5 - 1.7 (13.5 - 15)
	⏚	3.5	2 - 8 (-)	-	M4	Phillips/slotted combo	1.2 - 1.5 (10.6 - 13.3)
2014	R/L1, S/L2, T/L3	3.5	2 - 14 (2 - 14)	10	M4	Slotted (-)	1.5 - 1.7 (13.5 - 15)
	U/T1, V/T2, W/T3	3.5	2 - 14 (2 - 14)	10	M4	Slotted (-)	1.5 - 1.7 (13.5 - 15)
	-, +1, +2	5.5	2 - 22 (2 - 22)	18	M5	Slotted (-)	2.3 - 2.5 (19.8 - 22) *3
	B1, B2	2	2 - 5.5 (2 - 5.5)	10	M4	Slotted (-)	1.5 - 1.7 (13.5 - 15)
	⏚	3.5	2 - 8 (-)	-	M4	Phillips/slotted combo	1.2 - 1.5 (10.6 - 13.3)
2018	R/L1, S/L2, T/L3	8	2 - 14 (2 - 14)	10	M4	Slotted (-)	1.5 - 1.7 (13.5 - 15)
	U/T1, V/T2, W/T3	3.5	2 - 14 (2 - 14)	10	M4	Slotted (-)	1.5 - 1.7 (13.5 - 15)
	-, +1, +2	8	2 - 22 (2 - 22)	18	M5	Slotted (-)	2.3 - 2.5 (19.8 - 22) *3
	B1, B2	2	2 - 5.5 (2 - 5.5)	10	M4	Slotted (-)	1.5 - 1.7 (13.5 - 15)
	⏚	3.5	3.5 - 8 (-)	-	M4	Phillips/slotted combo	1.2 - 1.5 (10.6 - 13.3)
2025	R/L1, S/L2, T/L3	14	2 - 14 (2 - 14)	10	M4	Slotted (-)	1.5 - 1.7 (13.5 - 15)
	U/T1, V/T2, W/T3	8	2 - 14 (2 - 14)	10	M4	Slotted (-)	1.5 - 1.7 (13.5 - 15)
	-, +1, +2	14	2 - 22 (2 - 22)	18	M5	Slotted (-)	2.3 - 2.5 (19.8 - 22) *3
	B1, B2	3.5	2 - 5.5 (2 - 5.5)	10	M4	Slotted (-)	1.5 - 1.7 (13.5 - 15)
	⏚	5.5	5.5 - 8 (-)	-	M5	Phillips/slotted combo	2.0 - 2.5 (17.7 - 22.1)
2033	R/L1, S/L2, T/L3	14	2 - 14 (2 - 14)	10	M4	Slotted (-)	1.5 - 1.7 (13.5 - 15)
	U/T1, V/T2, W/T3	14	2 - 14 (2 - 14)	10	M4	Slotted (-)	1.5 - 1.7 (13.5 - 15)
	-, +1, +2	22	2 - 22 (2 - 22)	18	M5	Slotted (-)	2.3 - 2.5 (19.8 - 22) *3
	B1, B2	5.5	2 - 5.5 (2 - 5.5)	10	M4	Slotted (-)	1.5 - 1.7 (13.5 - 15)
	⏚	5.5	5.5 - 8 (-)	-	M5	Phillips/slotted combo	2.0 - 2.5 (17.7 - 22.1)

Model	Terminal	Recomm. Gauge mm²	Applicable Gauge (IP20 Applicable Gauge *1) mm²	Wire Stripping Length *2 mm	Terminal Screw		Tightening Torque N·m (lbf·in)
					Size	Shape	
2047	R/L1, S/L2, T/L3	22	2 - 22 (8 - 22)	18	M5	Slotted (-)	2.3 - 2.5 (19.8 - 22) *3
	U/T1, V/T2, W/T3	14	2 - 14 (5.5 - 14)	18	M5	Slotted (-)	2.3 - 2.5 (19.8 - 22) *3
	-, +1, +2	38	2 - 38 (8 - 38)	20	M6	Hex socket cap (WAF: 5 mm)	5 - 5.5 (45 - 49)
	B1, B2	14	2 - 14 (2 - 14)	10	M4	Slotted (-)	1.5 - 1.7 (13.5 - 15)
	⏚	8	8 - 14 (-)	-	M6	Phillips/slotted combo	5.4 - 6.0 (47.8 - 53.1)
2060	R/L1, S/L2, T/L3	38	2 - 38 (22 - 38)	20	M6	Hex socket cap (WAF: 5 mm)	5 - 5.5 (45 - 49)
	U/T1, V/T2, W/T3	22	2 - 22 (14 - 22)	20	M6	Hex socket cap (WAF: 5 mm)	5 - 5.5 (45 - 49)
	-, +1, +2	50	2 - 50 (22 - 50)	20	M6	Hex socket cap (WAF: 5 mm)	5 - 5.5 (45 - 49)
	B1, B2	14	2 - 14 (2 - 14)	10	M4	Slotted (-)	1.5 - 1.7 (13.5 - 15)
	⏚	8	8 - 22 (-)	-	M6	Phillips/slotted combo	5.4 - 6.0 (47.8 - 53.1)
2075	R/L1, S/L2, T/L3	50	2 - 50 (22 - 50)	20	M6	Hex socket cap (WAF: 5 mm)	5 - 5.5 (45 - 49)
	U/T1, V/T2, W/T3	30	2 - 30 (14 - 30)	20	M6	Hex socket cap (WAF: 5 mm)	5 - 5.5 (45 - 49)
	-, +1, +2	60	2 - 60 (22 - 60)	20	M6	Hex socket cap (WAF: 5 mm)	5 - 5.5 (45 - 49)
	B1, B2	14	2 - 14 (2 - 14)	10	M4	Slotted (-)	1.5 - 1.7 (13.5 - 15)
	⏚	14	14 - 22 (-)	-	M6	Phillips/slotted combo	5.4 - 6.0 (47.8 - 53.1)
2088	R/L1, S/L2, T/L3	38	22 - 38 (22 - 38)	27	M6	Hex socket cap (WAF: 5 mm)	8 - 9 (71 - 80)
	U/T1, V/T2, W/T3	38	22 - 38 (22 - 38)	27	M6	Hex socket cap (WAF: 5 mm)	8 - 9 (71 - 80)
	-, +1	60	30 - 60 (30 - 60)	27	M8	Hex socket cap (WAF: 6 mm)	10 - 12 (89 - 107)
	B1, B2	22	8 - 22 (8 - 22)	21	M6	Slotted (-)	3 - 3.5 (27 - 31)
	⏚	14	14 - 38 (-)	-	M6	Hex bolt (+)	5.4 - 6.0 (47.8 - 53.1)
2115	R/L1, S/L2, T/L3	60	22 - 60 (38 - 60)	27	M6	Hex socket cap (WAF: 5 mm)	8 - 9 (71 - 80)
	U/T1, V/T2, W/T3	60	22 - 60 (38 - 60)	27	M6	Hex socket cap (WAF: 5 mm)	8 - 9 (71 - 80)
	-, +1	80	30 - 80 (50 - 80)	27	M8	Hex socket cap (WAF: 6 mm)	10 - 12 (89 - 107)
	B1, B2	30	8 - 30 (8 - 30)	21	M6	Slotted (-)	3 - 3.5 (27 - 31)
	⏚	22	22 - 38 (-)	-	M6	Hex bolt (+)	5.4 - 6.0 (47.8 - 53.1)

Model	Terminal	Recomm. Gauge mm²	Applicable Gauge (IP20 Applicable Gauge *1) mm²	Wire Stripping Length *2 mm	Terminal Screw		Tightening Torque N·m (lbf·in)
					Size	Shape	
2145	R/L1, S/L2, T/L3	80	50 - 100 (80 - 100)	37	M10	Hex socket cap (WAF: 8 mm)	12 - 14 (107 - 124)
	U/T1, V/T2, W/T3	80	50 - 125 (80 - 125)	37	M10	Hex socket cap (WAF: 8 mm)	12 - 14 (107 - 124)
	-, -, +1, +1 *4 *5	38	22 - 50 (50)	28	M6	Hex socket cap (WAF: 5 mm)	8 - 9 (71 - 80)
	+3 *5	60	30 - 80 (50 - 80)	28	M8	Hex socket cap (WAF: 6 mm)	8 - 9 (71 - 80)
	⏚	22	22 - 60 (-)	-	M8	Hex bolt (slotted)	9.0 - 11 (79.7 - 97.4)
2180	R/L1, S/L2, T/L3	100	50 - 100 (80 - 100)	37	M10	Hex socket cap (WAF: 8 mm)	12 - 14 (107 - 124)
	U/T1, V/T2, W/T3	125	50 - 125 (80 - 125)	37	M10	Hex socket cap (WAF: 8 mm)	12 - 14 (107 - 124)
	-, -, +1, +1 *4 *5	50	22 - 50 (50)	28	M6	Hex socket cap (WAF: 5 mm)	8 - 9 (71 - 80)
	+3 *5	80	30 - 80 (50 - 80)	28	M8	Hex socket cap (WAF: 6 mm)	8 - 9 (71 - 80)
	⏚	22	22 - 60 (-)	-	M8	Hex bolt (slotted)	9.0 - 11 (79.7 - 97.4)
2215	R/L1, S/L2, T/L3	60 × 2P	22 - 100 × 2P (80 - 100 × 2P)	-	M10	Hex self-locking nut	20 (177)
	U/T1, V/T2, W/T3	50 × 2P	22 - 100 × 2P (80 - 100 × 2P)	-	M10	Hex self-locking nut	20 (177)
	-, +1	80 × 2P	30 - 125 × 2P (100 - 125 × 2P)	-	M10	Hex self-locking nut	20 (177)
	+3	50 × 2P	22 - 60 × 2P (50 - 60 × 2P)	-	M10	Hex self-locking nut	20 (177)
	⏚	22	22 - 200 (-)	-	M10	Hex bolt (slotted)	18 - 23 (159 - 204)
2283	R/L1, S/L2, T/L3	80 × 2P	22 - 100 × 2P (80 - 100 × 2P)	-	M10	Hex self-locking nut	20 (177)
	U/T1, V/T2, W/T3	80 × 2P	22 - 100 × 2P (80 - 100 × 2P)	-	M10	Hex self-locking nut	20 (177)
	-, +1	100 × 2P	30 - 125 × 2P (100 - 125 × 2P)	-	M10	Hex self-locking nut	20 (177)
	+3	60 × 2P	22 - 60 × 2P (50 - 60 × 2P)	-	M10	Hex self-locking nut	20 (177)
	⏚	38	38 - 200 (-)	-	M10	Hex bolt (slotted)	18 - 23 (159 - 204)
2346	R/L1, S/L2, T/L3	125 × 2P	60 - 125 × 2P (125 × 2P)	-	M12	Hex self-locking nut	35 (310)
	U/T1, V/T2, W/T3	125 × 2P	60 - 125 × 2P (125 × 2P)	-	M12	Hex self-locking nut	35 (310)
	-, +1	150 × 2P	100 - 150 × 2P (150 × 2P)	-	M12	Hex self-locking nut	35 (310)
	+3	80 × 2P	38 - 150 × 2P (150 × 2P)	-	M12	Hex self-locking nut	35 (310)
	⏚	38	38 - 200 (-)	-	M12	Hex bolt (slotted)	32 - 40 (283 - 354)

Model	Terminal	Recomm. Gauge mm²	Applicable Gauge (IP20 Applicable Gauge *1) mm²	Wire Stripping Length *2 mm	Terminal Screw		Tightening Torque N·m (lbf·in)
					Size	Shape	
2415	R/L1, S/L2, T/L3	125 × 2P	60 - 125 × 2P (125 × 2P)	-	M12	Hex self-locking nut	35 (310)
	U/T1, V/T2, W/T3	125 × 2P	60 - 125 × 2P (125 × 2P)	-	M12	Hex self-locking nut	35 (310)
	-, +1	150 × 2P	100 - 150 × 2P (150 × 2P)	-	M12	Hex self-locking nut	35 (310)
	+3	80 × 2P	38 - 150 × 2P (150 × 2P)	-	M12	Hex self-locking nut	35 (310)
	⏚	60	60 - 200 (-)	-	M12	Hex bolt (slotted)	32 - 40 (283 - 354)

*1 For IP20 protection, use wires that are in the range of applicable gauges.
*2 Remove insulation from the ends of wires to expose the length of wire shown.
*3 For wire gauges more than 30 mm², tighten to a tightening torque of 4.1 N·m to 4.5 N·m (36 lbf·in to 40 lbf·in).
*4 Terminals - and +1 have two screws. The Recommended Gauge is the wire gauge for one terminal.
*5 A junction terminal is necessary to connect a braking unit (CDBR-series) to terminals - and +3.

Three-Phase 400 V Class

Model	Terminal	Recomm. Gauge mm²	Applicable Gauge (IP20 Applicable Gauge *1) mm²	Wire Stripping Length *2 mm	Terminal Screw		Tightening Torque N·m (lbf·in)
					Size	Shape	
4002	R/L1, S/L2, T/L3	2	2 - 14 (2 - 14)	10	M4	Slotted (-)	1.5 - 1.7 (13.5 - 15)
	U/T1, V/T2, W/T3	2	2 - 14 (2 - 14)	10	M4	Slotted (-)	1.5 - 1.7 (13.5 - 15)
	-, +1, +2	2	2 - 22 (2 - 22)	18	M5	Slotted (-)	2.3 - 2.5 (19.8 - 22) *3
	B1, B2	2	2 - 5.5 (2 - 5.5)	10	M4	Slotted (-)	1.5 - 1.7 (13.5 - 15)
	⏚	2	2 - 8 (-)	-	M4	Phillips/slotted combo	1.2 - 1.5 (10.6 - 13.3)
4003	R/L1, S/L2, T/L3	2	2 - 14 (2 - 14)	10	M4	Slotted (-)	1.5 - 1.7 (13.5 - 15)
	U/T1, V/T2, W/T3	2	2 - 14 (2 - 14)	10	M4	Slotted (-)	1.5 - 1.7 (13.5 - 15)
	-, +1, +2	2	2 - 22 (2 - 22)	18	M5	Slotted (-)	2.3 - 2.5 (19.8 - 22) *3
	B1, B2	2	2 - 5.5 (2 - 5.5)	10	M4	Slotted (-)	1.5 - 1.7 (13.5 - 15)
	⏚	2	2 - 8 (-)	-	M4	Phillips/slotted combo	1.2 - 1.5 (10.6 - 13.3)
4005	R/L1, S/L2, T/L3	2	2 - 14 (2 - 14)	10	M4	Slotted (-)	1.5 - 1.7 (13.5 - 15)
	U/T1, V/T2, W/T3	2	2 - 14 (2 - 14)	10	M4	Slotted (-)	1.5 - 1.7 (13.5 - 15)
	-, +1, +2	2	2 - 22 (2 - 22)	18	M5	Slotted (-)	2.3 - 2.5 (19.8 - 22) *3
	B1, B2	2	2 - 5.5 (2 - 5.5)	10	M4	Slotted (-)	1.5 - 1.7 (13.5 - 15)
	⏚	3.5	2 - 8 (-)	-	M4	Phillips/slotted combo	1.2 - 1.5 (10.6 - 13.3)

Model	Terminal	Recomm. Gauge mm²	Applicable Gauge (IP20 Applicable Gauge *1) mm²	Wire Stripping Length *2 mm	Terminal Screw		Tightening Torque N·m (lbf·in)
					Size	Shape	
4006	R/L1, S/L2, T/L3	2	2 - 14 (2 - 14)	10	M4	Slotted (-)	1.5 - 1.7 (13.5 - 15)
	U/T1, V/T2, W/T3	2	2 - 14 (2 - 14)	10	M4	Slotted (-)	1.5 - 1.7 (13.5 - 15)
	-, +1, +2	2	2 - 22 (2 - 22)	18	M5	Slotted (-)	2.3 - 2.5 (19.8 - 22) *3
	B1, B2	2	2 - 5.5 (2 - 5.5)	10	M4	Slotted (-)	1.5 - 1.7 (13.5 - 15)
	⏚	3.5	2 - 8 (-)	-	M4	Phillips/slotted combo	1.2 - 1.5 (10.6 - 13.3)
4007	R/L1, S/L2, T/L3	2	2 - 14 (2 - 14)	10	M4	Slotted (-)	1.5 - 1.7 (13.5 - 15)
	U/T1, V/T2, W/T3	2	2 - 14 (2 - 14)	10	M4	Slotted (-)	1.5 - 1.7 (13.5 - 15)
	-, +1, +2	2	2 - 22 (2 - 22)	18	M5	Slotted (-)	2.3 - 2.5 (19.8 - 22) *3
	B1, B2	2	2 - 5.5 (2 - 5.5)	10	M4	Slotted (-)	1.5 - 1.7 (13.5 - 15)
	⏚	3.5	2 - 8 (-)	-	M4	Phillips/slotted combo	1.2 - 1.5 (10.6 - 13.3)
4009	R/L1, S/L2, T/L3	2	2 - 14 (2 - 14)	10	M4	Slotted (-)	1.5 - 1.7 (13.5 - 15)
	U/T1, V/T2, W/T3	2	2 - 14 (2 - 14)	10	M4	Slotted (-)	1.5 - 1.7 (13.5 - 15)
	-, +1, +2	3.5	2 - 22 (2 - 22)	18	M5	Slotted (-)	2.3 - 2.5 (19.8 - 22) *3
	B1, B2	2	2 - 5.5 (2 - 5.5)	10	M4	Slotted (-)	1.5 - 1.7 (13.5 - 15)
	⏚	3.5	2 - 8 (-)	-	M4	Phillips/slotted combo	1.2 - 1.5 (10.6 - 13.3)
4015	R/L1, S/L2, T/L3	3.5	2 - 14 (2 - 14)	10	M4	Slotted (-)	1.5 - 1.7 (13.5 - 15)
	U/T1, V/T2, W/T3	3.5	2 - 14 (2 - 14)	10	M4	Slotted (-)	1.5 - 1.7 (13.5 - 15)
	-, +1, +2	5.5	2 - 22 (2 - 22)	18	M5	Slotted (-)	2.3 - 2.5 (19.8 - 22) *3
	B1, B2	2	2 - 5.5 (2 - 5.5)	10	M4	Slotted (-)	1.5 - 1.7 (13.5 - 15)
	⏚	3.5	2 - 8 (-)	-	M5	Phillips/slotted combo	2.0 - 2.5 (17.7 - 22.1)
4018	R/L1, S/L2, T/L3	8	2 - 14 (2 - 14)	10	M4	Slotted (-)	1.5 - 1.7 (13.5 - 15)
	U/T1, V/T2, W/T3	5.5	2 - 14 (2 - 14)	10	M4	Slotted (-)	1.5 - 1.7 (13.5 - 15)
	-, +1, +2	14	2 - 22 (2 - 22)	18	M5	Slotted (-)	2.3 - 2.5 (19.8 - 22) *3
	B1, B2	2	2 - 5.5 (2 - 5.5)	10	M4	Slotted (-)	1.5 - 1.7 (13.5 - 15)
	⏚	3.5	3.5 - 8 (-)	-	M5	Phillips/slotted combo	2.0 - 2.5 (17.7 - 22.1)

Model	Terminal	Recomm. Gauge mm²	Applicable Gauge (IP20 Applicable Gauge *1) mm²	Wire Stripping Length *2 mm	Terminal Screw		Tightening Torque N·m (lbf·in)
					Size	Shape	
4024	R/L1, S/L2, T/L3	14	2 - 22 (8 - 22)	18	M5	Slotted (-)	2.3 - 2.5 (19.8 - 22) *3
	U/T1, V/T2, W/T3	8	2 - 14 (5.5 - 14)	18	M5	Slotted (-)	2.3 - 2.5 (19.8 - 22) *3
	-, +1, +2	14	2 - 38 (8 - 38)	20	M6	Hex socket cap (WAF: 5 mm)	5 - 5.5 (45 - 49)
	B1, B2	3.5	2 - 14 (2 - 14)	10	M4	Slotted (-)	1.5 - 1.7 (13.5 - 15)
	⏚	5.5	5.5 - 14 (-)	-	M6	Phillips/slotted combo	5.4 - 6.0 (47.8 - 53.1)
4031	R/L1, S/L2, T/L3	14	2 - 22 (8 - 22)	18	M5	Slotted (-)	2.3 - 2.5 (19.8 - 22) *3
	U/T1, V/T2, W/T3	14	2 - 14 (5.5 - 14)	18	M5	Slotted (-)	2.3 - 2.5 (19.8 - 22) *3
	-, +1, +2	22	2 - 38 (8 - 38)	20	M6	Hex socket cap (WAF: 5 mm)	5 - 5.5 (45 - 49)
	B1, B2	5.5	2 - 14 (2 - 14)	10	M4	Slotted (-)	1.5 - 1.7 (13.5 - 15)
	⏚	8	5.5 - 14 (-)	-	M6	Phillips/slotted combo	5.4 - 6.0 (47.8 - 53.1)
4039	R/L1, S/L2, T/L3	14	2 - 14 (3.5 - 14)	18	M5	Slotted (-)	2.3 - 2.5 (19.8 - 22) *3
	U/T1, V/T2, W/T3	14	2 - 14 (5.5 - 14)	18	M5	Slotted (-)	2.3 - 2.5 (19.8 - 22) *3
	-, +1, +2	22	2 - 22 (3.5 - 22)	18	M5	Slotted (-)	2.3 - 2.5 (19.8 - 22) *3
	B1, B2	8	2 - 8 (2 - 8)	10	M4	Slotted (-)	1.5 - 1.7 (13.5 - 15)
	⏚	8	8 - 22 (-)	-	M6	Phillips/slotted combo	5.4 - 6.0 (47.8 - 53.1)
4045	R/L1, S/L2, T/L3	14	2 - 14 (3.5 - 14)	18	M5	Slotted (-)	2.3 - 2.5 (19.8 - 22) *3
	U/T1, V/T2, W/T3	14	2 - 14 (5.5 - 14)	18	M5	Slotted (-)	2.3 - 2.5 (19.8 - 22) *3
	-, +1	22	2 - 22 (3.5 - 22)	18	M5	Slotted (-)	2.3 - 2.5 (19.8 - 22) *3
	B1, B2	14	2 - 14 (2 - 14)	10	M4	Slotted (-)	1.5 - 1.7 (13.5 - 15)
	⏚	8	8 - 22 (-)	-	M6	Phillips/slotted combo	5.4 - 6.0 (47.8 - 53.1)
4060	R/L1, S/L2, T/L3	22	2 - 22 (3.5 - 22)	18	M5	Slotted (-)	2.3 - 2.5 (19.8 - 22) *3
	U/T1, V/T2, W/T3	22	2 - 22 (3.5 - 22)	18	M5	Slotted (-)	2.3 - 2.5 (19.8 - 22) *3
	-, +1	30	2 - 30 (3.5 - 30)	18	M5	Slotted (-)	2.3 - 2.5 (19.8 - 22) *3
	B1, B2	14	2 - 14 (2 - 14)	10	M4	Slotted (-)	1.5 - 1.7 (13.5 - 15)
	⏚	14	14 - 38 (-)	-	M6	Hex bolt (+)	5.4 - 6.0 (47.8 - 53.1)

Model	Terminal	Recomm. Gauge mm²	Applicable Gauge (IP20 Applicable Gauge *1) mm²	Wire Stripping Length *2 mm	Terminal Screw		Tightening Torque N·m (lbf·in)
					Size	Shape	
4075	R/L1, S/L2, T/L3	30	2 - 30 (5.5 - 30)	18	M5	Slotted (-)	2.3 - 2.5 (19.8 - 22) *3
	U/T1, V/T2, W/T3	30	2 - 30 (5.5 - 30)	18	M5	Slotted (-)	2.3 - 2.5 (19.8 - 22) *3
	-, +1	38	2 - 38 (22 - 38)	20	M6	Hex socket cap (WAF: 5 mm)	5 - 5.5 (45 - 49)
	B1, B2	22	2 - 22 (3.5 - 22)	18	M5	Slotted (-)	2.3 - 2.5 (19.8 - 22) *3
	⏚	22	14 - 38 (-)	-	M6	Hex bolt (+)	5.4 - 6.0 (47.8 - 53.1)
4091	R/L1, S/L2, T/L3	38	22 - 60 (38 - 60)	27	M6	Hex socket cap (WAF: 5 mm)	8 - 9 (71 - 80)
	U/T1, V/T2, W/T3	38	22 - 60 (38 - 60)	27	M6	Hex socket cap (WAF: 5 mm)	8 - 9 (71 - 80)
	-, +1	50	30 - 80 (50 - 80)	27	M8	Hex socket cap (WAF: 6 mm)	10 - 12 (89 - 107)
	B1, B2	30	8 - 30 (8 - 30)	21	M6	Slotted (-)	3 - 3.5 (27 - 31)
	⏚	22	14 - 38 (-)	-	M6	Hex bolt (+)	5.4 - 6.0 (47.8 - 53.1)
4112	R/L1, S/L2, T/L3	60	50 - 100 (80 - 100)	37	M10	Hex socket cap (WAF: 8 mm)	12 - 14 (107 - 124)
	U/T1, V/T2, W/T3	60	50 - 125 (80 - 125)	37	M10	Hex socket cap (WAF: 8 mm)	12 - 14 (107 - 124)
	-, -, +1, +1 *4	30	22 - 50 (50)	28	M6	Hex socket cap (WAF: 5 mm)	8 - 9 (71 - 80)
	B1, B2 *5	50	30 - 80 (50 - 80)	28	M8	Hex socket cap (WAF: 6 mm)	8 - 9 (71 - 80)
	⏚	22	22 - 60 (-)	-	M8	Hex bolt (slotted)	9.0 - 11 (79.7 - 97.4)
4150	R/L1, S/L2, T/L3	80	50 - 100 (80 - 100)	37	M10	Hex socket cap (WAF: 8 mm)	12 - 14 (107 - 124)
	U/T1, V/T2, W/T3	80	50 - 125 (80 - 125)	37	M10	Hex socket cap (WAF: 8 mm)	12 - 14 (107 - 124)
	-, -, +1, +1 *4	38	22 - 50 (50)	28	M6	Hex socket cap (WAF: 5 mm)	8 - 9 (71 - 80)
	B1, B2 *5	60	30 - 80 (50 - 80)	28	M8	Hex socket cap (WAF: 6 mm)	8 - 9 (71 - 80)
	⏚	22	22 - 60 (-)	-	M8	Hex bolt (slotted)	9.0 - 11 (79.7 - 97.4)
4180	R/L1, S/L2, T/L3	50 × 2P	22 - 100 × 2P (80 - 100 × 2P)	-	M10	Hex self-locking nut	20 (177)
	U/T1, V/T2, W/T3	50 × 2P	22 - 100 × 2P (80 - 100 × 2P)	-	M10	Hex self-locking nut	20 (177)
	-, +1	80 × 2P	30 - 125 × 2P (100 - 125 × 2P)	-	M10	Hex self-locking nut	20 (177)
	+3	38 × 2P	22 - 60 × 2P (50 - 60 × 2P)	-	M10	Hex self-locking nut	20 (177)
	⏚	22	22 - 200 (-)	-	M10	Hex bolt (slotted)	18 - 23 (159 - 204)

Model	Terminal	Recomm. Gauge mm²	Applicable Gauge (IP20 Applicable Gauge *1) mm²	Wire Stripping Length *2 mm	Terminal Screw		Tightening Torque N·m (lbf·in)
					Size	Shape	
4216	R/L1, S/L2, T/L3	50 × 2P	22 - 100 × 2P (80 - 100 × 2P)	-	M10	Hex self-locking nut	20 (177)
	U/T1, V/T2, W/T3	50 × 2P	22 - 100 × 2P (80 - 100 × 2P)	-	M10	Hex self-locking nut	20 (177)
	-, +1	80 × 2P	30 - 125 × 2P (100 - 125 × 2P)	-	M10	Hex self-locking nut	20 (177)
	+3	50 × 2P	22 - 60 × 2P (50 - 60 × 2P)	-	M10	Hex self-locking nut	20 (177)
	⏚	30	22 - 200 (-)	-	M10	Hex bolt (slotted)	18 - 23 (159 - 204)
4260	R/L1, S/L2, T/L3	80 × 2P	22 - 100 × 2P (80 - 100 × 2P)	-	M10	Hex self-locking nut	20 (177)
	U/T1, V/T2, W/T3	80 × 2P	22 - 100 × 2P (80 - 100 × 2P)	-	M10	Hex self-locking nut	20 (177)
	-, +1	100 × 2P	30 - 125 × 2P (100 - 125 × 2P)	-	M10	Hex self-locking nut	20 (177)
	+3	60 × 2P	22 - 60 × 2P (50 - 60 × 2P)	-	M10	Hex self-locking nut	20 (177)
	⏚	30	30 - 200 (-)	-	M10	Hex bolt (slotted)	18 - 23 (159 - 204)
4304	R/L1, S/L2, T/L3	125 × 2P	60 - 125 × 2P (125 × 2P)	-	M12	Hex self-locking nut	35 (310)
	U/T1, V/T2, W/T3	125 × 2P	60 - 125 × 2P (125 × 2P)	-	M12	Hex self-locking nut	35 (310)
	-, +1	125 × 2P	100 - 150 × 2P (150 × 2P)	-	M12	Hex self-locking nut	35 (310)
	+3	100 × 2P	38 - 150 × 2P (150 × 2P)	-	M12	Hex self-locking nut	35 (310)
	⏚	38	30 - 200 (-)	-	M12	Hex bolt (slotted)	32 - 40 (283 - 354)
4371	R/L1, S/L2, T/L3	125 × 2P	60 - 125 × 2P (125 × 2P)	-	M12	Hex self-locking nut	35 (310)
	U/T1, V/T2, W/T3	125 × 2P	60 - 125 × 2P (125 × 2P)	-	M12	Hex self-locking nut	35 (310)
	-, +1	150 × 2P	100 - 150 × 2P (150 × 2P)	-	M12	Hex self-locking nut	35 (310)
	+3	125 × 2P	38 - 150 × 2P (150 × 2P)	-	M12	Hex self-locking nut	35 (310)
	⏚	60	38 - 200 (-)	-	M12	Hex bolt (slotted)	32 - 40 (283 - 354)
4414	R/L1, S/L2, T/L3 R1/L11, S1/L21, T1/L31	125 × 4P	60 - 125 × 4P (125 × 4P)	-	M12	Hex self-locking nut	35 (310)
	U/T1, V/T2, W/T3	100 × 4P	60 - 150 × 4P (125 - 150 × 4P)	-	M12	Hex self-locking nut	35 (310)
	-, +1	100 × 4P	80 - 150 × 4P (150 × 4P)	-	M12	Hex self-locking nut	35 (310)
	+3	80 × 4P	30 - 125 × 4P (100 - 125 × 4P)	-	M12	Hex self-locking nut	35 (310)
	⏚	60	50 - 150 (-)	-	M12	Hex bolt (slotted)	32 - 40 (283 - 354)

Model	Terminal	Recomm. Gauge mm²	Applicable Gauge (IP20 Applicable Gauge *1) mm²	Wire Stripping Length *2 mm	Terminal Screw		Tightening Torque N·m (lbf·in)
					Size	Shape	
4453	R/L1, S/L2, T/L3 R1/L11, S1/L21, T1/L31	125 × 4P	60 - 125 × 4P (125 × 4P)	-	M12	Hex self-locking nut	35 (310)
	U/T1, V/T2, W/T3	100 × 4P	60 - 150 × 4P (125 - 150 × 4P)	-	M12	Hex self-locking nut	35 (310)
	-, +1	100 × 4P	80 - 150 × 4P (150 × 4P)	-	M12	Hex self-locking nut	35 (310)
	+3	80 × 4P	30 - 125 × 4P (100 - 125 × 4P)	-	M12	Hex self-locking nut	35 (310)
	⏚	60	60 - 150 (-)	-	M12	Hex bolt (slotted)	32 - 40 (283 - 354)
4605	R/L1, S/L2, T/L3 R1/L11, S1/L21, T1/L31	125 × 4P	60 - 125 × 4P (125 × 4P)	-	M12	Hex self-locking nut	35 (310)
	U/T1, V/T2, W/T3	100 × 4P	60 - 150 × 4P (125 - 150 × 4P)	-	M12	Hex self-locking nut	35 (310)
	-, +1	125 × 4P	80 - 150 × 4P (150 × 4P)	-	M12	Hex self-locking nut	35 (310)
	+3	100 × 4P	30 - 125 × 4P (100 - 125 × 4P)	-	M12	Hex self-locking nut	35 (310)
	⏚	60	60 - 150 (-)	-	M12	Hex bolt (slotted)	32 - 40 (283 - 354)

*1 For IP20 protection, use wires that are in the range of applicable gauges.
*2 Remove insulation from the ends of wires to expose the length of wire shown.
*3 For wire gauges more than 30 mm², tighten to a tightening torque of 4.1 N·m to 4.5 N·m (36 lbf·in to 40 lbf·in).
*4 Terminals - and +1 have two screws. The Recommended Gauge is the wire gauge for one terminal.
*5 A junction terminal is necessary to connect a braking resistor unit (LKEB-series) to terminals B1 and B2.

◆ Main Circuit Terminal and Motor Wiring

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

NOTICE: *Make sure that you align the phase order for the drive and motor when you connect the motor to drive output terminals U/T1, V/T2, and W/T3. If the phase order is incorrect, it can cause the motor to run in reverse. If the motor accidentally runs in reverse, it can cause serious injury or death.*

NOTICE: *Use the drive ground wire to ground the drive only. Do not try to use the drive ground wire for other devices, for example welding machines or large-current electrical equipment.*

WARNING! *Electrical Shock Hazard. Do not connect main power supply wiring to drive motor terminals U/T1, V/T2, and W/T3. Connect main power supply wiring to main circuit input terminals R/L1, S/L2, and T/L3. Incorrect wiring can cause serious injury or death from fire.*

■ Cable Length Between Drive and Motor

When the wiring between the drive and the motor is too long, voltage drop along the motor cable can decrease motor torque, usually at low frequency output. If you connect motors in parallel with long motor cable, this is also a problem. Drive output current increases when the leakage current from the cable increases. An increase in leakage current can cause overcurrent and decrease the precision of the current detection.

Use the values in Table 2.12 to adjust the drive carrier frequency. For systems that have 100 m or longer motor wiring, if you use metal conduits or isolated cables for each phase, it will increase stray capacitance.

Table 2.12 Carrier Frequency against Cable Length Between Drive and Motor

Wiring Distance Between the Drive and Motor	50 m Maximum	100 m Maximum	More than 100 m
Carrier Frequency	15 kHz or less	5 kHz or less	2 kHz or less

Note:

To set the carrier frequency in a drive that is operating more than one motor, calculate the cable length as the total distance of wiring to all connected motors.

■ Ground Wiring

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

WARNING! *Electrical Shock Hazard. Make sure that the protective ground wire complies with technical standards and local safety regulations. The IEC/EN 61800-5-1:2007 standard specifies that you must wire the power supply to automatically de-energize when the protective ground wire disconnects. You can also connect a protective ground wire that has a minimum cross-sectional area of 10 mm² (copper wire) or 16 mm² (aluminum wire). If you do not obey the standards and regulations, it can cause serious injury or death. The leakage current of the drive will be more than 3.5 mA in drive models 2xxxB, 4xxxB, and 4317A to 4605A.*

WARNING! *Electrical Shock Hazard. Ground the neutral point on the power supply of drive models 2xxxB and 4xxxB to comply with the EMC Directive before you turn on the EMC filter. If you turn ON the EMC filter, but you do not ground the neutral point, it can cause serious injury or death.*

WARNING! *Electrical Shock Hazard. Use a ground wire that complies with technical standards on electrical equipment and use the minimum length of ground wire. Incorrect equipment grounding can cause serious injury or death from dangerous electrical potentials on the equipment chassis.*

WARNING! *Electrical Shock Hazard.*
Correctly ground the ground terminals. Obey federal and local electrical wiring codes for correct grounding methods. The maximum grounding resistance is
- *200 V class: ground to 100 Ω or less*
- *400 V class: ground to 10 Ω or less*

If you touch electrical equipment that is not grounded, it can cause serious injury or death.

NOTICE: *When you install more than one drive connected to the same ground circuit, obey the grounding instructions. Incorrect equipment grounding can cause drive or equipment malfunction from electrical interference.*

NOTICE: *Use conduit or metal cable tray dividers to isolate motor wires U/T1, V/T2, and W/T3 from all other wires to decrease the risk of problems from electrical interference. If motor wires are adjacent to other wires, it can cause incorrect operation of the drive and equipment.*

When you connect more than one drive, refer toFigure 2.86. Do not loop the grounding wire.

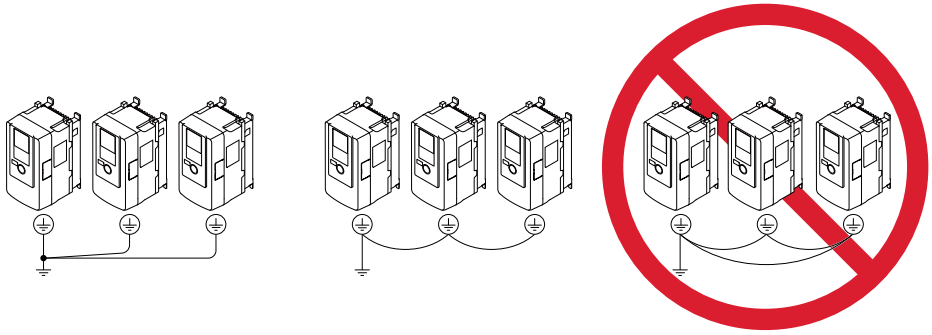


Figure 2.86 Wiring More than One Drive

■ Wiring the Main Circuit Terminal Block

WARNING! *Electrical Shock Hazard. Before you wire the main circuit terminals, make sure that MCCB and MC are OFF. If you touch electrical equipment when MCCB and MC are ON, it can cause serious injury or death.*

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

■ Main Circuit Configuration

The figures in this section show the different schematics of the drive main circuit. The connections change when the drive capacity changes. The DC power supply for the main circuit also supplies power to the control circuit.

Note:

Drive models 2003A to 2415A and 4002A to 4605A do not have a built-in EMC filter circuit.

WARNING! *Fire Hazard. Do not connect a braking resistor to terminals +1 or -. Use terminals B1 and B2 for the braking resistor connections. If you connect a braking resistor to the incorrect terminals, it can cause damage to the drive and braking circuit and serious injury or death.*

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

Model	Figure
2003 - 2075, 4002 - 4039	Figure 2.87
2088 - 2115, 4045 - 4150	Figure 2.88
2145 - 2283, 4180 - 4216	Figure 2.89
2346 - 2415, 4260 - 4605	Figure 2.90

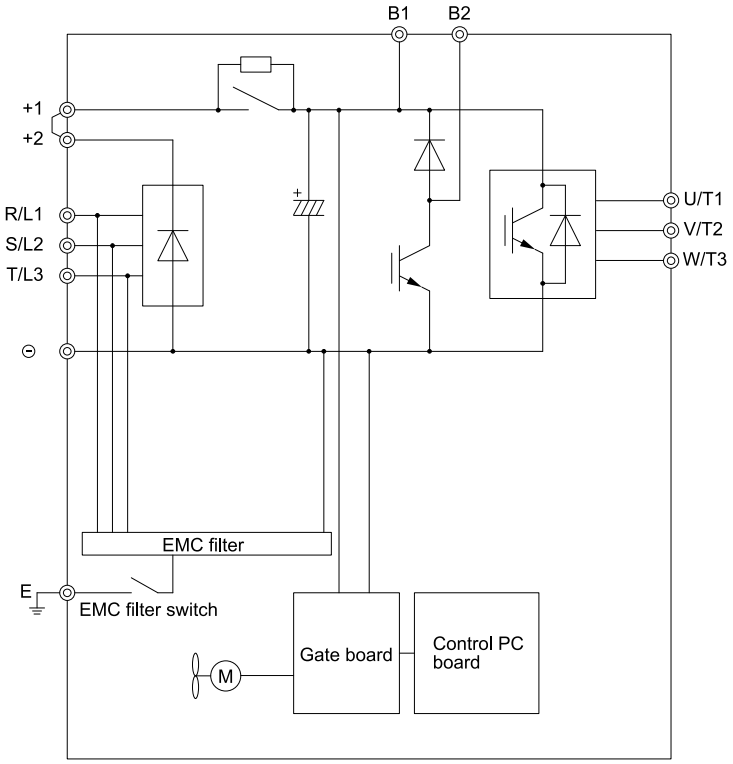


Figure 2.87 Drive Main Circuit Configuration

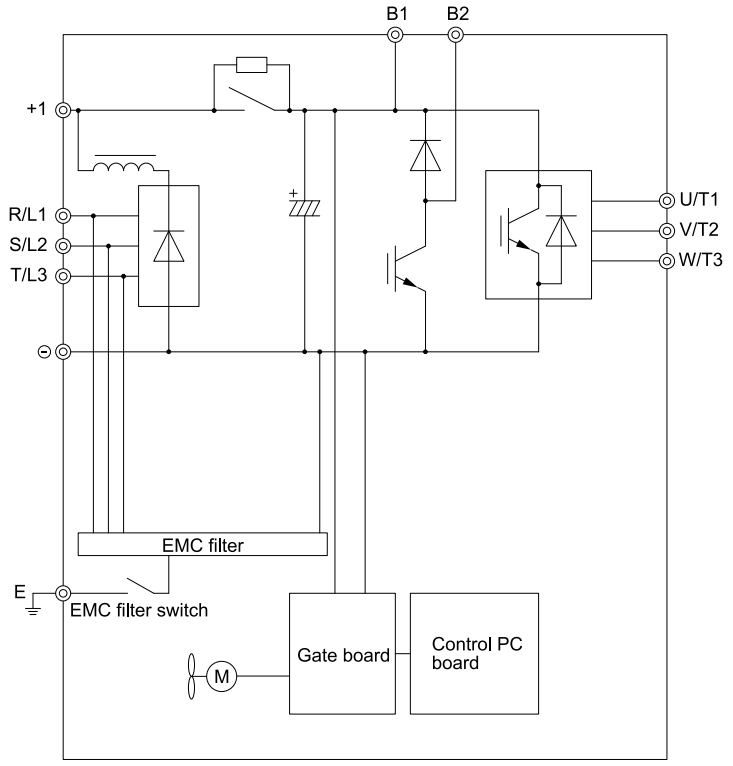


Figure 2.88 Drive Main Circuit Configuration

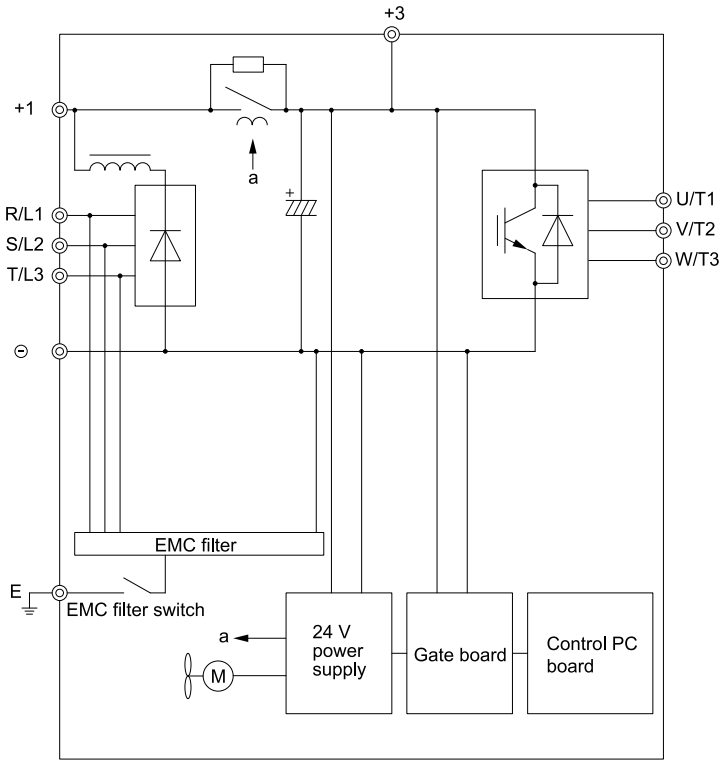


Figure 2.89 Drive Main Circuit Configuration

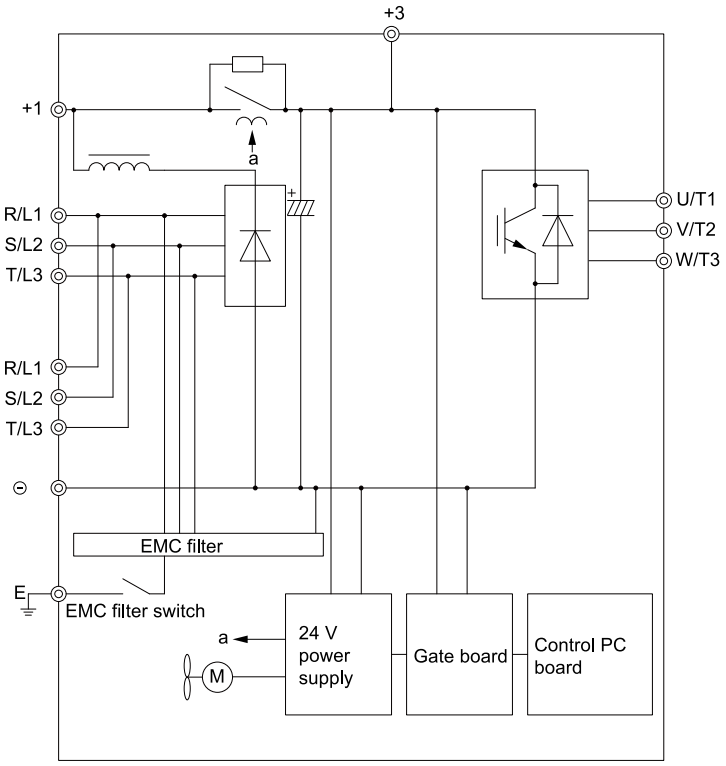


Figure 2.90 Drive Main Circuit Configuration

◆ Protection of Main Circuit Terminals

When you wire the main circuit terminals, do not let cable ends go near terminals or the drive. If you use crimped terminals, make sure that you also use insulation caps.

2.13 Main Circuit Terminal Block Wiring Procedure

DANGER! *Electrical Shock Hazard. Do not examine, connect, or disconnect wiring on an energized drive. Before servicing, disconnect all power to the equipment and wait for the time specified on the warning label at a minimum. The internal capacitor stays charged after the drive is de-energized. The charge indicator LED extinguishes when the DC bus voltage decreases below 50 Vdc. When all indicators are OFF, remove the covers before measuring for dangerous voltages to make sure that the drive is safe. If you do work on the drive when it is energized, it will cause serious injury or death from electrical shock.*

The procedures to wire the main circuit terminal block are different for different drive models. Refer to Table 2.13 for more information.

Table 2.13 Types of Wiring Procedure for the Main Circuit Terminal Block

Model	Procedure
2003 - 2180 4002 - 4150	Procedure A
2215 - 2415 4180 - 4605	Procedure B

◆ Wire the Main Circuit Terminal Block with Procedure A

■ Notes on Wiring the Main Circuit Terminal Block

- Use copper wire. Do not use alumnium or other non-copper wire.
- Remove all unwanted objects that are near the terminal block connections.
- Remove the insulation from the connection wires to the wire stripping lengths shown in the manual.
- Do not use bent or crushed wires. Remove the damaged end of the wire before you use it.
- Do not solder stranded wire.
- If you use stranded wire, make sure that all of the wire strands are in the connection. Also, do not twist the stranded wire too much.
- Put the wire all the way into the terminal block. Remove the insulation from the wire to the recommended wire stripping length to fit the wire with insulation in the plastic housing.
- The tightening torque is different for different terminals. Tighten the screws to the specified tightening torque.
- Use a torque driver, torque ratchet, or torque wrench for the screws. A slotted driver or a hex tool will be necessary to wire the screw clamp terminal. Use applicable tools as specified by the recommended conditions in the product manual.
- If you use power tools to tighten the terminal screws, use a low speed setting (300 to 400 r/min).
- Users can purchase wiring tools from Yaskawa. Contact Yaskawa or your nearest sales representative for more information.
- Wire gauges on existing drive models to be replaced may not match wire gauge ranges on new drives. Contact Yaskawa or your nearest sales representative for wire gauges that you can and cannot use.
- Do not tighten the terminal screws at an angle of 5 degrees or more.

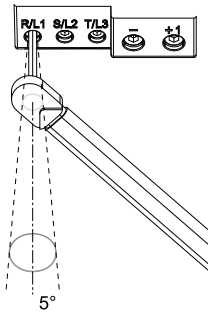


Figure 2.91 Permitted Angle

- Put the bit all the way into the hex socket to tighten the hex socket cap screw.
- When tightening straight-edge screws, hold the tip of the screwdriver in the center of the screw head. Do not let the tip of the screwdriver slip out from the groove of the screw.

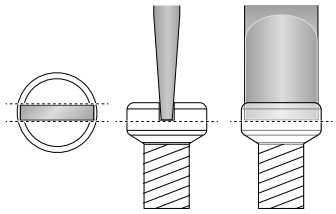
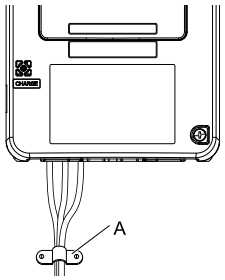


Figure 2.92 Tightening Slotted Screws

- After you connect the wires to the terminal block, lightly pull on the wires to make sure that they do not come out of the terminals.
- Remove the correct section of the wiring cover to make wiring easier.
- Regularly tighten loose terminal block screws to their specified tightening torques.
- Do not let strain on the wiring cause damage. Use a strain relief near the wiring to release the tension. Refer to Figure 2.93 for an example.



A - Strain relief

Figure 2.93 Strain Relief Example

Table 2.14 Recommended Wiring Tools

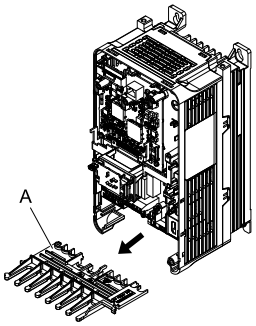
Screw Size	Screw Shape	Adapter	Bit		Torque Driver Model (Tightening Torque)	Torque Wrench
			Model	Manufacturer		
M4	Slotted (-)	Bit	SF-BIT-SL 1,0X4,0-70	PHOENIX CONTACT	TSD-M 3NM (1.2 - 3 N·m (10.6 - 26.6 lbf·in))	-
M5 *1	Slotted (-)	Bit	SF-BIT-SL 1,2X6,5-70	PHOENIX CONTACT	Wire Gauge ≤ 25 mm² (AWG 10): TSD-M 3NM (1.2 - 3 N·m (10.6 - 26.6 lbf·in))	Wire Gauge ≤ 25 mm² (AWG 10): -
					Wire Gauge ≥ 30 mm² (AWG 8): -	Wire Gauge ≥ 30 mm² (AWG 8): 4.1 - 4.5 N·m (36.3 - 39.8 lbf·in) *2 *3
M6	Hex socket cap (WAF: 5 mm)	Bit	SF-BIT-HEX 5-50	PHOENIX CONTACT	-	5 - 9 N·m (44.3 - 79.9 lbf·in) *2 *3
	Minus (-)	Bit	SF-BIT-SL 1,2X6,5-70	PHOENIX CONTACT	-	3 - 3.5 N·m (26.6 - 31.0 lbf·in) *2 *3
M8	Hex socket cap (WAF: 6 mm)	Bit	SF-BIT-HEX 6-50	PHOENIX CONTACT	-	8 - 12 N·m (70.8 - 106.2 lbf·in) *2 *3
M10	Hex socket cap (WAF: 8 mm)	Bit	SF-BIT-HEX 8-50	PHOENIX CONTACT	-	12 - 14 N·m (106.2 - 123.9 lbf·in) *2 *3

*1 When wiring drive models 2047, 4075, and smaller, select the correct tools for the wire gauge.
*2 Use 6.35 mm (0.25 in) bit socket holder.
*3 Use a torque wrench that can apply this torque measurement range.

■ Main Circuit Terminal Block Wiring Procedure

Remove the keypad and front cover before wiring the main circuit terminal block.

1. Pull the wiring cover away from the drive to remove it.



A - Wiring cover

Figure 2.94 Remove the Wiring Cover

2. Put the end of a prepared wire into the terminal block.

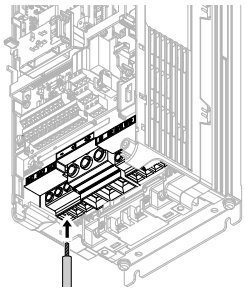


Figure 2.95 Install the Electrical Wire

Note:
If there is a jumper between terminals +1 and +2, loosen the terminal block screws and remove the jumper before wiring the terminals.

3. Tighten the screws to the specified torque.

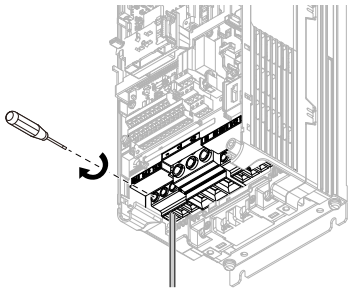
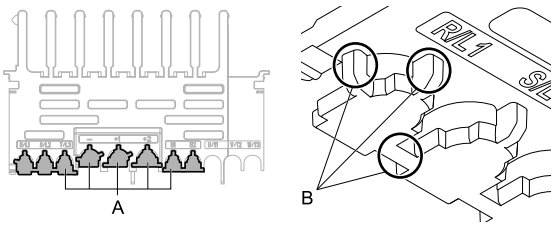


Figure 2.96 Tighten Terminal Block Screws

4. Examine the signal from the wired terminal and use a diagonal-cutting pliers to remove areas of the wiring cover cutaway section.
   To remove the wiring cover, cut off the portion shown in Figure 2.97.



A - Cutaway sections

B - Cut this portion with a diagonal-cutting pliers

Figure 2.97 Clip the Cutaway Section of the Wiring Cover

Note:
- Different drive models have different wiring cover shapes.
- Only clip the section of the wiring cover that applies to the wired terminal. If you clip areas that do not apply to wired terminals, the protective enclosure will not keep its IP20 protective level.
- Tightly hold the cutaway section when removing pieces of the cutaway section. Pieces of the cutaway section can fly out and cause injury.
- Make sure that the clipped section does not cause damage to the wires.
- If you use wires that are not specified by Yaskawa, the protective enclosure could lose its IP20 protective level, although the wiring cover is correct. Contact Yaskawa or your nearest sales representative for more information.

5. Put the wiring cover in its initial position. Put the cables through the holes cut from the wiring cover.

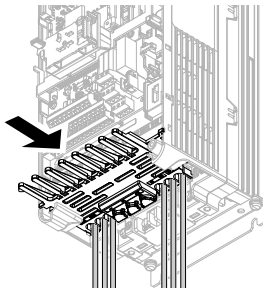


Figure 2.98 Reattach the Wiring Cover

6. Install the front cover and the keypad to their initial positions.

◆ Wire the Main Circuit Terminal Block with Procedure B

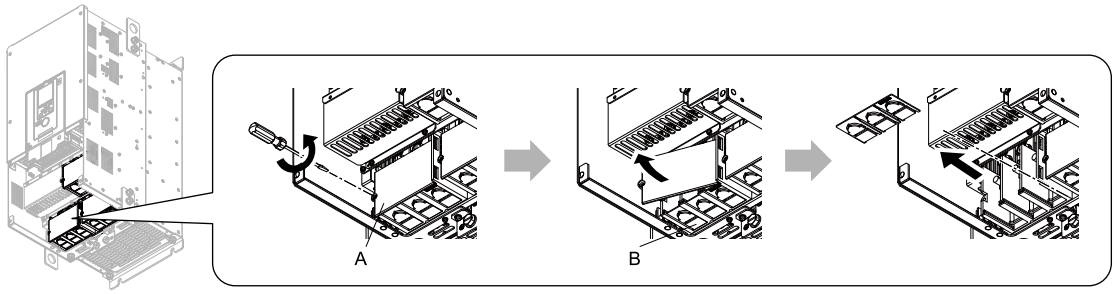
■ Notes on Wiring the Main Circuit Terminal Block

Note:
- After the wiring, do not twist or shake the electrical wires too much.
- Be sure to use only wires with the correct size, stripped wire length, and tightening torque as specified by Yaskawa.
- Use tools that fit the shape of the screw head to tighten and loosen the terminal block screws.
- Make sure that there are no loose stranded wires or frayed wires after wiring is complete.

■ Main Circuit Terminal Block Wiring Procedure

Remove the terminal cover before wiring the main circuit terminal block.

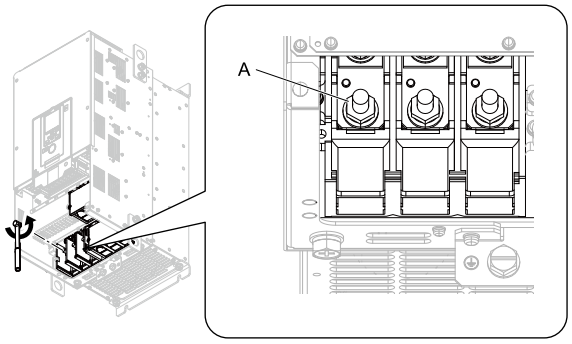
1. Remove the screws on the terminal block cover and pull the terminal block cover away from the drive. Pull the wiring cover away from the drive to remove the wiring cover after removing the terminal block cover.



A - Terminal block cover **B - Wiring cover**

Figure 2.99 Remove the Wiring Cover

2. Remove the terminal block nut.



A - Nut

Figure 2.100 Remove the Terminal Block Nut

3. Wire the closed-loop crimp terminal to the main circuit terminal block.

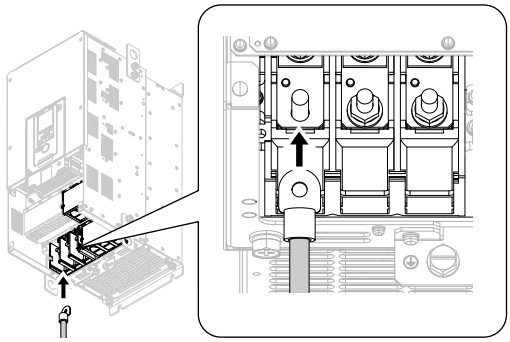


Figure 2.101 Install the Electrical Wire

4. Tighten the nut to the specified torque.

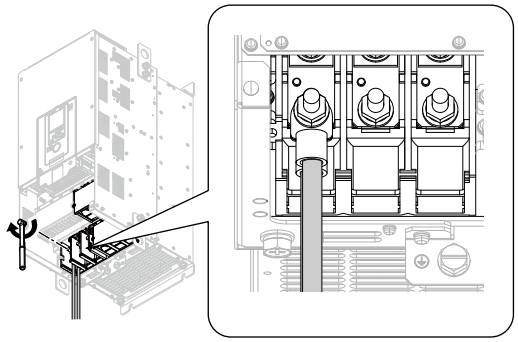
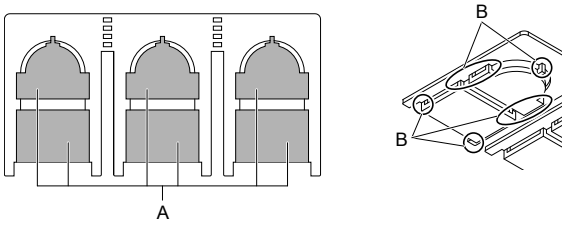


Figure 2.102 Tighten the Terminal Block Nut

5. Examine the signal from the wired terminal and use a diagonal-cutting pliers to remove areas of the wiring cover cutaway section.
   Cut the areas shown in Figure 2.103.



A - Cutaway sections **B - Use a diagonal-cutting pliers to clip this area.**

Figure 2.103 Clip the Cutaway Section of the Wiring Cover

Note:
- Different drive models have different wiring cover shapes.
- Clip only the areas from the wiring cover that apply to the wired terminal. If you clip areas that do not apply to wired terminals, the drive will not keep its IP20 protective level.
- When you clip pieces of the cutaway section, tightly hold the cutaway section. Pieces of the cutaway section can fly out and cause injury.
- Make sure that the clipped section does not cause damage to the wires.
- Although the wiring cover is correct, if you use wires that are not specified by Yaskawa, the drive will not keep its IP20 protective level.
- When you use the recommended gauge for the electrical wires, it is not necessary to attach the wiring cover of the main circuit power input terminal and the drive output terminal. When you use the applicable gauge for the electrical wires, attach the wiring cover.

6. Attach the wiring cover and terminal block cover to their initial positions and tighten the screws on the terminal block cover.

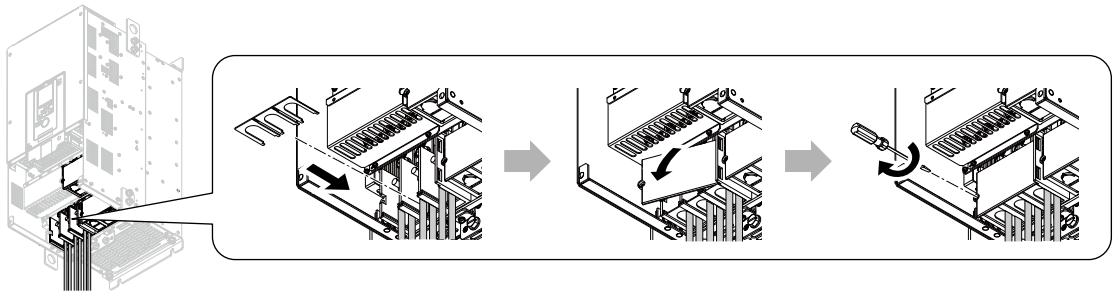


Figure 2.104 Reattach the Wiring Cover

7. Put the terminal cover back in its initial position.

2.14 Control Circuit Wiring

This section gives information about how to correctly wire the control circuit.

◆ Control Circuit Connection Diagram

Wire the drive control circuit as shown in Figure 2.105.

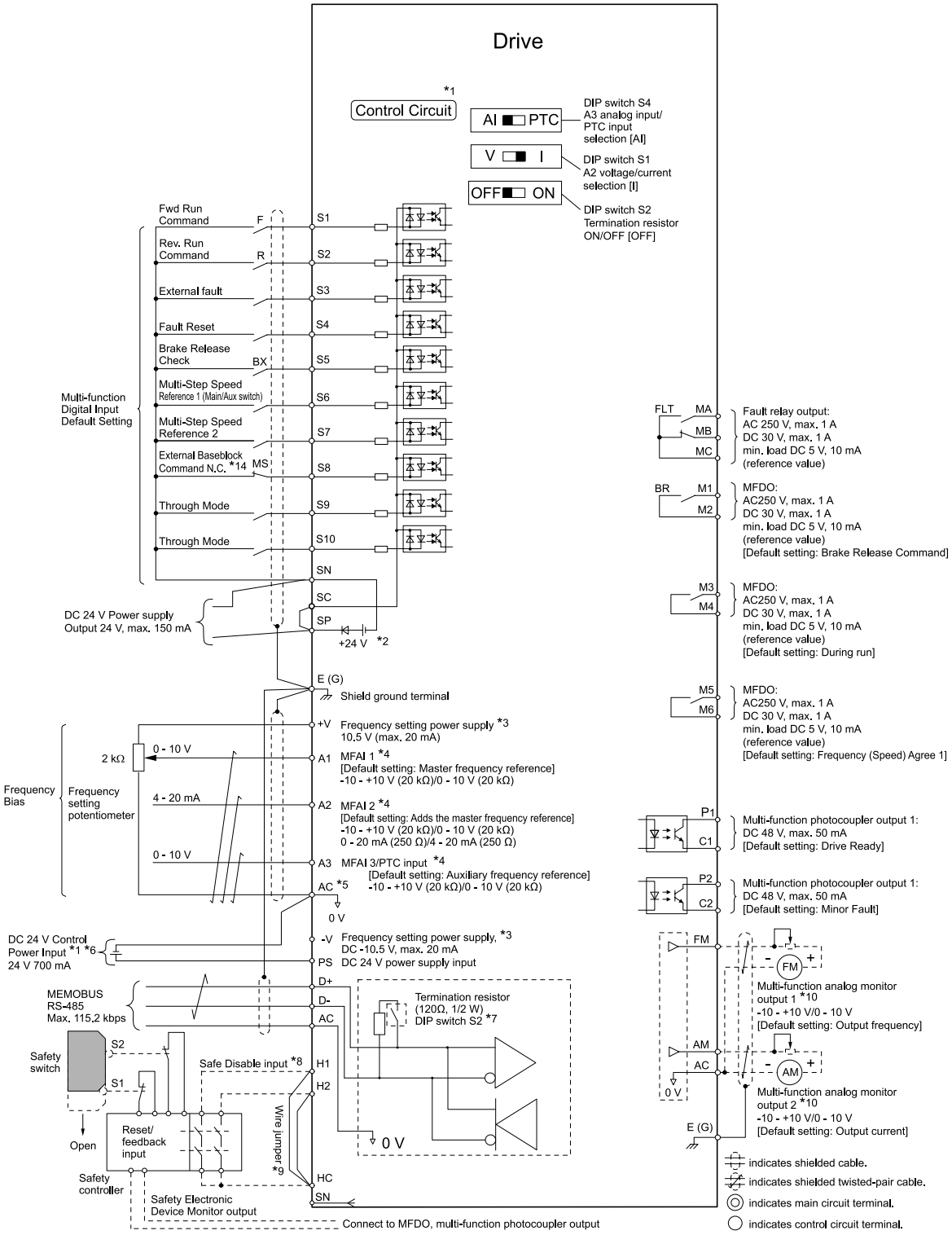


Figure 2.105 Control Circuit Connection Diagram

*1 Connect a 24 V power supply to terminals PS-AC to operate the control circuit while the main circuit power supply is OFF.

*2 To set the MFDI power supply (Sinking/Sourcing Mode or internal/external power supply), install or remove a jumper between terminals SC-SP or SC-SN depending on the application.

NOTICE: *Damage to Equipment. Do not close the circuit between terminals SP-SN. If you close the circuits between terminals SC-SP and terminals SC-SN at the same time, it will cause damage to the drive.*

- Sinking Mode, Internal power supply: Install the jumper to close the circuit between terminals SC-SP. Do not close the circuit between terminals SC-SN. If you connect the wires to the incorrect terminals, it will cause damage to the drive.
- Sourcing Mode, Internal power supply: Install the jumper to close the circuit between terminals SC-SN. Do not close the circuit between terminals SC-SP. If you connect the wires to the incorrect terminals, it will cause damage to the drive.
- External power supply: Remove the jumper from the MFDI terminals. It is not necessary to close the circuit between terminals SC-SP and terminals SC-SN.

*3 The output current capacity of the +V and -V terminals on the control circuit is 20 mA.

NOTICE: *Do not install a jumper between terminals +V, -V, and AC. A closed circuit between these terminals will cause damage to the drive.*

*4 DIP switch S1 sets terminal A2 for voltage or current input. The default setting for S1 is current input (“I” side).
*5 Do not ground the control circuit terminals AC or connect them to the drive chassis. Failure to comply may cause malfunction or failure
*6 Do not connect terminals PS and AC inversely. If you connect the wires to the incorrect terminals, it will cause damage to the drive.
*7 Set DIP switch S2 to the ON position to enable the termination resistor in the last drive in a MEMOBUS/Modbus communications.
*8 To use the internal power supply with the Safe Disable input, use sourcing mode.
*9 Disconnect the wire jumpers between H1 and HC and H2 and HC to use the Safe Disable input.
*10 Use multi-function analog monitor outputs with analog frequency meters, ammeters, voltmeters, and wattmeters. Do not use monitor outputs with feedback-type signal devices.

◆ Control Circuit Terminal Block Functions

Hx-xx parameters set functions for the multi-function input and output terminals.

WARNING! *Sudden Movement Hazard. Correctly wire and test all control circuits to make sure that the control circuits operate correctly. If you use a drive that has incorrect control circuit wiring or operation, it can cause death or serious injury.*

WARNING! *Sudden Movement Hazard. Check the I/O signals and the external sequences for the drive before you set the Application Preset function. When you set the Application Preset function (A1-06 ≠ 0), it changes the I/O terminal functions for the drive and it can cause equipment to operate unusually. This can cause serious injury or death.*

NOTICE: *Damage to Equipment. Do not energize and de-energize the drive more frequently than one time each 30 minutes. If you frequently energize and de-energize the drive, it can cause drive failure.*

■ Input Terminals

Refer to Table 2.15 for a list of input terminals and functions.

Text in parenthesis indicates the default setting for each multi-function output.

Table 2.15 Multi-function Digital Input Terminals

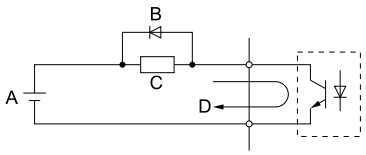
Mode	Terminals	Name (Default)	Function (Signal Level)
Digital Inputs	S1	Multi-function input selection 1 (ON: Forward run OFF: Stop)	• Photocoupler • 24 V, 6 mA **Note:** Install the wire jumpers between terminals SC-SP and SC-SN to set the MFDI power supply. • SINK Mode: Install a jumper between terminals SC and SP. Do not short circuit terminals SC and SN. Failure to obey will cause damage to the drive. • SOURCE Mode: Install a jumper between terminals SC and SN. Do not short circuit terminals SC and SP. Failure to obey will cause damage to the drive. • External power supply: No jumper necessary between terminals SC-SN and terminals SC-SP.
	S2	Multi-function input selection 2 (ON: Reverse run OFF: Stop)	
	S3	Multi-function input selection 3 (External fault (N.O.))	
	S4	Multi-function input selection 4 (Fault reset)	
	S5	Multi-function input selection 5 Brake Release Check	
	S6	Multi-function input selection 6 (Multi-step speed reference 1)	
	S7	Multi-function input selection 7 (Multi-step speed reference 2)	
	S8	Multi-function input selection 8 Baseblock Command (N.C.)	
	S9	Multi-function input selection 9 (Through Mode)	
	S10	Multi-function input selection 10 (Through Mode)	
	SN	Multi-function input power supply 0 V	MFDI power supply and sensor power supply, 24 Vdc (max. 150 mA) **Note:** Do not short circuit terminals SP and SN. Failure to obey will cause damage to the drive.
	SC	Multi-function input selection common	
	SP	Multi-function input power supply +24 Vdc	
Safe Disable Input	H1	Safe Disable input 1	Remove the jumper between terminals H1-HC and H2-HC when using the Safe Disable input. • 24 V, 6 mA • ON: Normal operation • OFF: Coasting motor • Internal impedance 4.7 kΩ • OFF time of at least 2 ms
	H2	Safe Disable input 2	
	HC	Safe Disable function common	
Master Frequency Reference	+V	Power supply for frequency setting	10.5 Vdc (allowable current 20 mA max.)
	-V	Power supply for frequency setting	-10.5 Vdc (allowable current 20 mA max.)
	A1	Multi-function analog input 1 (Master frequency reference)	Voltage input Select the signal level with *H3-01 [Terminal A1 Signal Level Select]*. • -10 V to +10 V/-100% to +100% (input impedance: 20 kΩ) • 0 V to 10 V/100% (input impedance: 20 kΩ)
	A2	Multi-function analog input 2 (Combined to terminal A1)	Voltage input or current input Select the signal level with DIP switch S1 and *H3-09 [Terminal A2 Signal Level Select]*. • -10 V to +10 V/-100% to +100% (input impedance: 20 kΩ) • 0 V to 10 V/100% (input impedance: 20 kΩ) • 4 mA to 20 mA/100%, 0 mA to 20 mA/100% (input impedance: 250 Ω)
	A3	Multi-function analog input 3/PTC input (Auxiliary frequency reference)	Voltage input Select the signal level with *H3-05 [Terminal A3 Signal Level Select]*. • -10 V to +10 V/-100% to +100% (input impedance: 20 kΩ) • 0 V to 10 V/100% (input impedance: 20 kΩ) PTC input (Motor Overheat Protection) Set DIP switch S4 to "PTC" to set terminal A3 for PTC input.
	AC	Frequency reference common	0 V
	E (G)	Shielded cable	-

■ Output Terminals

Refer to Table 2.16 and Table 2.17 for a list of output terminals and functions.
Text in parenthesis indicates the default setting for each multi-function output.

Table 2.16 Control Circuit Output Terminals

Mode	Terminals	Name (Default)	Function (Signal Level)
Fault relay output	MA	N.O. output (Fault)	• Relay output • DC30 V, 10 mA to 1 A • AC250 V, 10 mA to 1 A • Minimum load: 5 V, 10 mA (Reference value)
	MB	N.C. output (Fault)	
	MC	Digital output common	
Digital Outputs	M1	Digital Outputs (Brake Release Command)	• Relay output • DC30 V, 10 mA to 1 A • AC250 V, 10 mA to 1 A • Minimum load: 5 V, 10 mA (Reference value) **Note:** Switching life is estimated at 8,000,000 times (assumes 30 mA, inductive load) or 200,000 times (assumes 1 A, resistive load). When switching inductive load such as relay coils, connect surge absorbing element in parallel against the load for effective protection of relay contact.
	M2		
	M3	Digital Outputs (During run)	
	M4		
	M5	Digital Outputs (Speed agree 1)	
	M6		
Multi-function photocoupler output	P1	Multi-function photocoupler output (Drive operation ready (READY))	• Photocoupler output • 48 V, 2 mA to 50 mA **Note:** Connect a flywheel diode as shown in Figure 2.106 when driving a reactive load such as a relay coil. Ensure the diode rating is greater than the circuit voltage.
	C1		
	P2	Multi-function photocoupler output (Minor Fault)	
	C2		



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

Figure 2.106 Connecting a Flywheel Diode

Table 2.17 Control Circuit Monitor Output Terminals

Mode	Terminals	Name (Default)	Function (Signal Level)
Monitor output	FM	Analog monitor output 1 (Output frequency)	Voltage output • 0 V to +10 V/0% to 100% • -10 V to +10 V/-100% to +100% **Note:** Select with *H4-07 [MFAO Term FM Signal Level Select]* or *H4-08 [MFAO Term AM Signal Level Select]*.
	AM	Analog monitor output 2 (Output current)	
	AC	Monitor common	0 V

■ External Power Supply Input Terminals

Refer to Table 2.18 for a list of the functions of the external power supply input terminals.

Table 2.18 External Power Supply Input Terminals

Type	Terminal	Name (Default)	Function
External Power Supply Input Terminals	PS	External 24 V power supply input	Supplies backup power to the drive control circuit, keypad, and option board. 21.6 VDC to 26.4 VDC, 700 mA
	AC	External 24 V power supply ground	0 V

Alarm Display When You Use External 24 V Power Supply

When you use an external 24 V power supply, the drive detects an alarm as shown in Table 2.19 if you set *o2-23 [External 24V Powerloss Detection]* and *o2-26 [Alarm Display at Ext. 24V Power]* for the main circuit power supply. Set the alarm display as necessary.

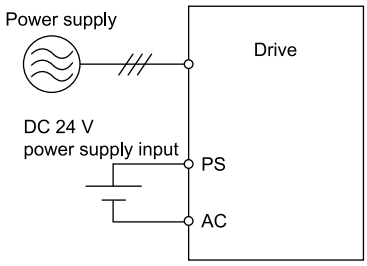


Table 2.19 Power Supply and Alarm Display

Main Circuit Power Supply	External 24 V Power Supply	o2-23 [External 24V Powerloss Detection]	o2-26 [Alarm Display at Ext. 24V Power]	Alarm Display
ON	ON	-	-	-
ON	OFF	0 [Disabled]	-	-
		1 [Enabled]	-	*L24v [Loss of External Power 24 Supply]*
OFF	ON	-	0 [Disabled]	"Ready" LED light flashes quickly
		-	1 [Enabled]	*EP24v [External Power 24V Supply]*

Operation When Using External 24 V Power Supply

To operate the drive, de-energize the main circuit power supply and connect an external 24 V power supply to terminals PS-AC.

Function	Operation	Solution
Keypad	The keypad operates the same as when the main circuit power supply is ON. The drive will not detect *oPr [Keypad Connection Fault]*.	-
Data Log	The data log function operates the same as when the main circuit power supply is ON. The operation is different for different drive software versions. *1	-
Communications by Communication Option or MEMOBUS/Modbus Communication Terminals	Communication operates the same as when the main circuit power supply is ON.	-
MFAI	MFAI operates the same as when the main circuit power supply is ON.	-
MFAO	MFAO operates the same as when the main circuit power supply is ON.	-
MFDI	MFDI does not operate when the main circuit power supply of the drive is OFF.	Connect the external 24 V power supply to the MFDI selection common terminal (SC). *2
MFDO Multi-Function Photocoupler Output Fault Relay Output Terminal	MFDO operates the same as when the main circuit power supply is ON. The operations of MFDO terminals and fault relay output terminals set for *H2-xx = E, 10E [Fault]* are different for different drive software versions. *3	-
Encoder Option Speed Detection (PG-B3, PG-X3, PG-RT3)	Encoder options do not operate when the main circuit power supply of the drive is OFF. The operation to detect encoder option-related faults is different for different software versions. *4	When you use an encoder, make sure that the drive main circuit power supply is ON. *5
Analog Input Option (AI-A3)	Analog input options operate the same as when the main circuit power supply is ON.	-
Analog Output Option (AO-A3)	Analog output options operate the same as when the main circuit power supply is ON. The operation is different for different drive software versions. *6	-
Digital Input Option (DI-A3)	Digital input options do not operate when the main circuit power supply of the drive is OFF.	Connect the external 24 V power supply to the Input signal common terminal (SC). *2
Digital Output Option (DO-A3)	Digital output options operate the same as when the main circuit power supply is ON.	-

*1 When you use an external 24 V power supply, the operation of the data log function is different for different drive software versions. On drives with software versions PRG: 01021 and later, you can continue the data log function.

Note:

The "PRG" column on the nameplate on the right side of the drive identifies the software version. You can also use *U1-25 [SoftwareNumber FLASH]* to identify the software version.

*2 When you use MFDI and a Digital Input option (DI-A3), wire the terminals as shown in *Wiring MFDI Terminals on page 105* or *Wiring Digital Input Option (DI-A3) on page 105*.

*3 When you use an external 24 V power supply, the operation of the MFDO terminals are different for different drive software versions.

Note:

The "PRG" column on the nameplate on the right side of the drive identifies the software version. You can also use *U1-25 [SoftwareNumber FLASH]* to identify the software version.

- Drive software versions PRG: 01020 and later
  When the main circuit power supply of the drive turns off, and you remove the cause of a fault and do a fault reset from the keypad, the fault relay output terminals and the MFDO terminals set for *H2-xx = E, 10E [Fault]* will change status.
- Drive software versions PRG: 01019 and earlier
  When the main circuit power supply of the drive turns off, remove the cause of a fault and do a fault reset from the keypad. The fault relay output terminals and the MFDO terminals set for *H2-xx = E, 10E [Fault]* will keep the same status as before the main circuit power supply of the drive turned off. The fault code shown on the keypad will disappear.

*4 If you connect a drive with software version PRG: 01019 or earlier to an encoder option, the drive detects a fault. Drives with software versions PRG: 01020 and later do not detect a fault.

- If you connect external 24 V power to terminal PS-AC while the main circuit power supply of the drive is OFF, the drive detects *oPE06 [Control Method Selection Error]*.
- If you de-energize the drive main circuit power supply and re-energize it under these conditions, the drive detects *oPE06 [Control Method Selection Error]*.
  – The drive main circuit power supply is energized
  – There is an external 24 V power supply connected to terminals PS-AC.

*5 If the motor shaft can rotate while the 24 V control power supply is energized and the main circuit power supply is de-energized, re-energize the 24 V control power supply and energize the main circuit power supply.

*6 When you use an external 24 V power supply, the operation of the Analog Output option is different for different drive software versions. On drives with software versions PRG:01021 and later, the Analog Output option (AO-A3) can output the analog signals.

Note:

The "PRG" column on the nameplate on the right side of the drive identifies the software version. You can also use *U1-25 [SoftwareNumber FLASH]* to identify the software version.

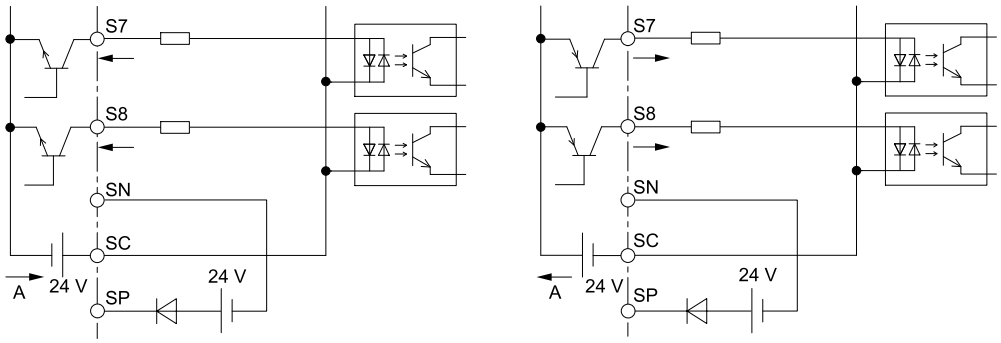
When you use an external 24 V power supply, if you de-energize the main circuit power supply, the encoder option will not operate, even when you connect the external 24 V power supply to terminals PS-AC. When you use an encoder option, energize the drive main circuit power supply.

Note:

Yaskawa recommends that you use different external power supplies for the external power supply input terminals (PS-AC) and MFDI selection common terminal (SC) / Input signal common terminal (SC).

Wiring MFDI Terminals

If you de-energize the main circuit power supply, the MFDI terminals will not operate, even when you connect the external 24 V power supply to terminals PS-AC. When you set N.O. functions to *H1-xx [MFDI Function Select]*, MFDI terminals always deactivate. When you set N.C. functions, MFDI terminals always activate. Connect the external 24 V power supply to the MFDI selection common terminal (SC).

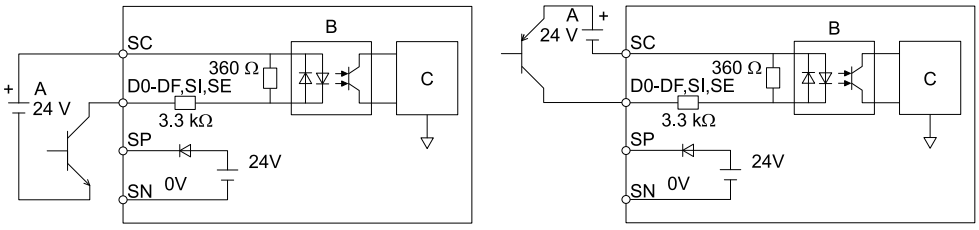


A - External power supply

Figure 2.107 Wiring MFDI Terminals

Wiring Digital Input Option (DI-A3)

If you de-energize the main circuit power supply, the Digital Input Option terminals will not operate, even when you connect the external 24 V power supply to terminals PS-AC. When you set N.O. functions to *F3-xx [Terminal Dx Function Selection]*, the input terminals on the digital input option always deactivate. When you set N.C. functions, the input terminals on the digital input option always activate. Connect the external 24 V power supply to the Input signal common terminal (SC).



A - External power supply
B - Photocoupler
C - Signal processor

Figure 2.108 Wiring Digital Input Option (DI-A3)

■ Serial Communication Terminals

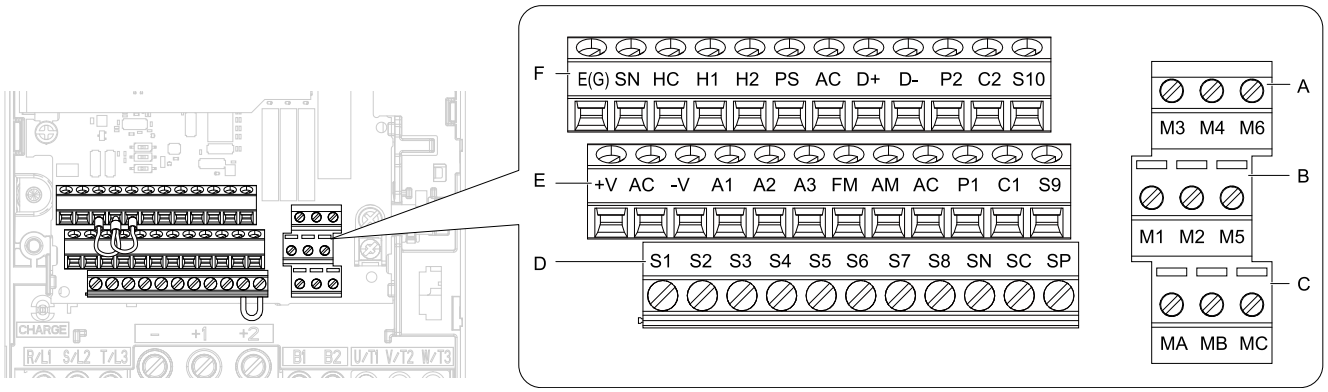
Refer to Table 2.20 for a list of serial communication terminals and functions.

Table 2.20 Serial Communication Terminals

Type	Terminal	Terminal Name	Function (Signal Level)	
Modbus Communication	D+	Communication input/output (+)	MEMOBUS/Modbus communications Use an RS-485 cable to connect the drive. **Note:** Set DIP switch S2 to ON to enable the termination resistor in the last drive in a MEMOBUS/Modbus network.	• RS-485 • MEMOBUS/Modbus communication protocol • Maximum 115.2 kbps
	D-	Communication output (-)		
	AC	Shield ground	0 V	

◆ Terminal Configuration

Control circuit terminals should are arranged as shown in the following figure.



A - Terminal block (TB2-3)
B - Terminal block (TB2-2)
C - Terminal block (TB2-1)
D - Terminal block (TB1)
E - Terminal block (TB3)
F - Terminal block (TB4)

Figure 2.109 Control Circuit Terminal Arrangement

The tightening torque for terminals is displayed on the reverse side of the front cover.

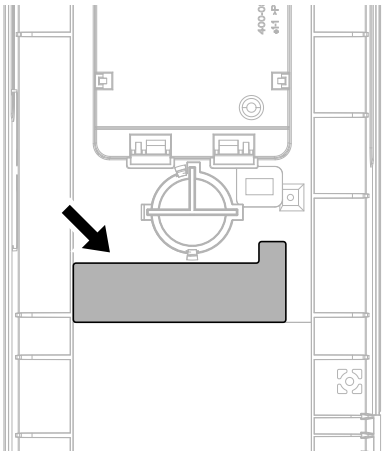


Figure 2.110 Tightening Torque Display (the Reverse Side of the Front Cover)

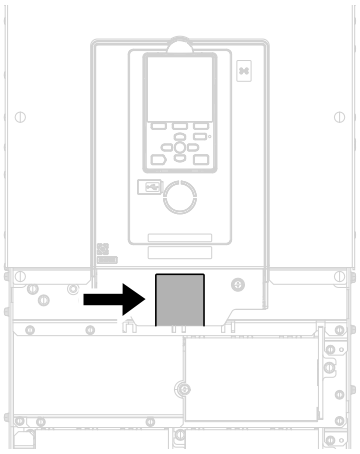


Figure 2.111 Tightening Torque Display (the below side of the front cover)

■ Control Circuit Wire Gauges and Tightening Torques

Use the tables in this section to select the correct wires. Use shielded wire to wire the control circuit terminal block. Use crimp ferrules on the wire ends to make the wiring procedure easier and more reliable.

The tightening torque for the terminal screws is shown on the reverse side or the lower front side of the drive front cover.

Table 2.21 Main Circuit Wire Gauges and Tightening Torques

Terminal	Screw Size	Tightening Torque N·m (lbf·in)	Bare Wire		Crimp Ferrule	
			Recomm. Gauge mm² (AWG)	Applicable Gauge mm² (AWG)	Recomm. Gauge mm² (AWG)	Applicable Gauge mm² (AWG)
S1-S10, SC, SN, SP H1, H2, HC, SN +V, -V, A1, A2, A3, AC MA, MB, MC, M1 - M6 P1, C1, P2, C2 FM, AM, AC D+, D-, AC PS, E (G)	M3	0.5 - 0.6 (4.4 - 5.3)	0.75 (18)	• Stranded wire 0.2 - 1.0 (24 - 18) • Solid wire 0.2 - 1.5 (24 - 16)	0.5 (20)	0.25 - 0.5 (24 - 20)

Crimp Ferrules

Attach an insulated sleeve when you use crimp ferrules. Refer to the table for the recommended external dimensions and model numbers of the crimp ferrules.

Use the CRIMPFOX 6, a crimping tool made by PHOENIX CONTACT.

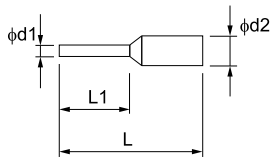


Figure 2.112 External Dimensions of Crimp Ferrules

Table 2.22 Crimp Ferrule Models and Sizes

Wire Gauge mm² (AWG)	Model	L (mm)	L1 (mm)	d1 (mm)	d2 (mm)
0.25 (24)	AI 0.25-8YE	12.5	8	0.8	2.0
0.34 (22)	AI 0.34-8TQ	12.5	8	0.8	2.0
0.5 (20)	AI 0.5-8WH, AI 0.5-8OG	14	8	1.1	2.5

◆ Wiring the Control Circuit Terminal

WARNING! *Electrical Shock Hazard. Do not remove covers or touch circuit boards while the drive is energized. If you touch the internal components of an energized drive, it can cause serious injury or death.*

NOTICE: *Do not let wire shields touch other signal lines or equipment. Insulate the wire shields with electrical tape or shrink tubing. If you do not insulate the wire shields, it can cause a short circuit and damage the drive.*

Note:
- Isolate 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 wiring. If control circuit wiring is adjacent to main circuit wiring, it can cause incorrect operation of the drive and equipment from electrical interference.
- Isolate wiring for contact output terminals MA, MB, MC and M1-M6 from other control circuit wiring. If contact output terminal wiring is adjacent to other control circuit wiring, it can cause incorrect operation of the drive and equipment from electrical interference.
- Use a Class 2 power supply to connect external power to the control terminals. If the power supply for peripheral devices is incorrect, it can cause a decrease in drive performance.
- Connect the shield of shielded cable to the applicable ground terminal. Incorrect equipment grounding can cause drive or equipment malfunction from electrical interference.

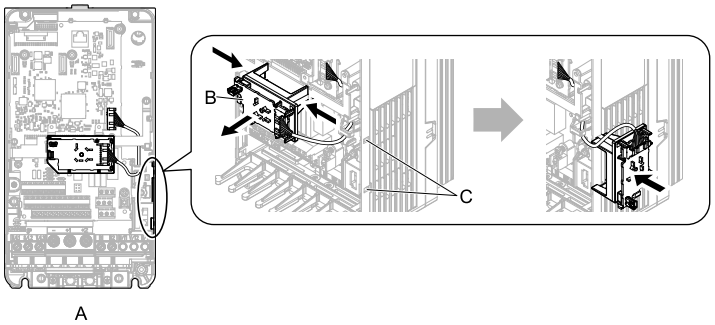
Correctly ground the drive terminals and complete main circuit wiring before you wire the control circuit. Remove the keypad and front cover.

1. Push in on the tabs on the both sides of the LED status ring board to release the board from the bracket. Pull the board forward to remove it.

   NOTICE: *When you remove the LED Status Board from the drive bracket, make sure that you temporarily install it in the holding position provided on the drive. If you cause damage to the LED status ring board, the LEDs will not function correctly.*

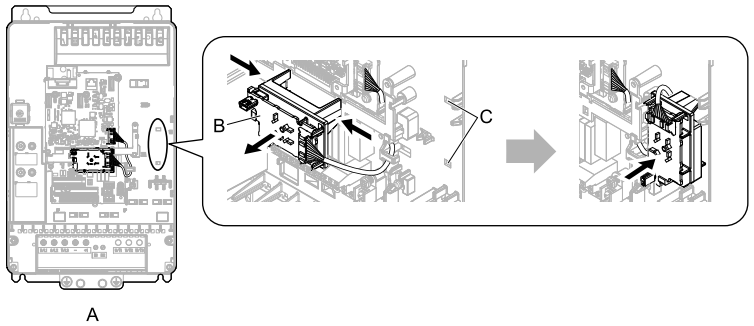
Note:

You can temporarily store the LED status ring board with the temporary placement holes on the drive. The location of the temporary placement holes is different on different drive models.



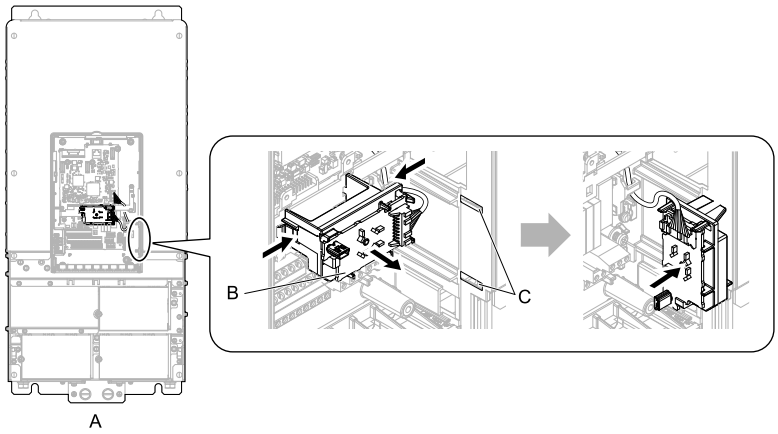
A - Drive front
B - LED status ring board
C - Temporary placement holes

Figure 2.113 Remove the LED Status Ring Board



A - Drive front
B - LED status ring board
C - Temporary placement holes

Figure 2.114 Remove the LED Status Ring Board



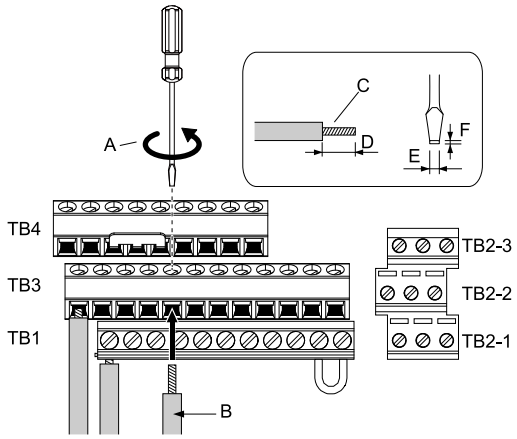
A - Drive front
B - LED status ring board
C - Temporary placement holes

Figure 2.115 Remove the LED Status Ring Board

2. Refer to the figure and wire the control circuit.

   WARNING! *Fire Hazard. Tighten all terminal screws to the correct tightening torque. Connections that are too loose or too tight can cause incorrect operation and damage to the drive. Incorrect connections can also cause death or serious injury from fire.*

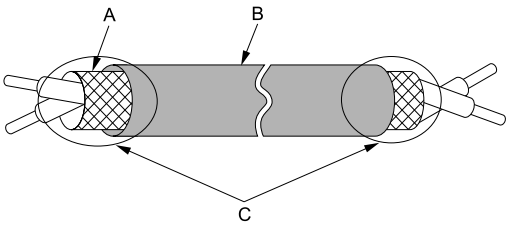
Note:
- Use shielded, twisted-pair wires and ground the shield to the ground terminal of the drive. Incorrect equipment grounding can cause drive or equipment malfunction from electrical interference.
- Do not use control circuit wiring that is longer than 50 m (164 ft) to supply the analog frequency reference from a remote source. If the control circuit wiring is too long, it can cause unsatisfactory system performance.



A - Loosen the screws and put the wire into the opening on the terminal block.
B - Wire with a crimp ferrule attached, or unsoldered wire with the core wires lightly twisted
C - Pull back the shielding and lightly twist the end with your fingers to keep the ends from fraying.
D - When you do not use crimp ferrules, remove approximately 5.5 mm (0.21 in) of the covering at the end of the wire.
E - Blade width of 2.5 mm (0.1 in) or less
F - Blade thickness of 0.4 mm (0.01 in) or less

Figure 2.116 Wiring Procedure for the Control Circuit

Note:
- Do not solder the core wire. Soldered wiring connections can become loose and cause the drive to malfunction.
- Tighten all terminal screws to the correct tightening torque. Connections that are too loose or too tight can cause incorrect operation and damage to the drive. Incorrect connections can also cause death or serious injury from fire.
- Refer to Figure 2.117 for information to prepare terminal ends of the shielded wire.
- Prepare the wire ends of shielded twisted-pair wires as shown in Figure 2.117 to use an analog reference from an external frequency setting potentiometer to set the frequency. Connect the shield to terminal E (G) of the drive.



A - Connect the shield to terminal E (G) of the drive.
B - Sheath
C - Insulate with electrical tape or shrink tubing.

Figure 2.117 Prepare the Ends of Shielded Wire

3. Put the cable through the clearance in the wiring cover.

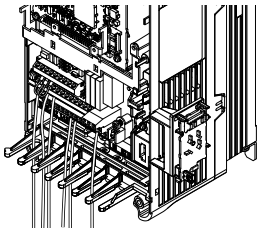


Figure 2.118 Control Circuit Wiring

4. Install the LED status ring board, front cover, and the keypad to their initial positions.

◆ Switches and Jumpers on the Terminal Board

The terminal board is equipped with several switches used to adapt the drive I/Os to the external control signals as shown in the Figure 2.119.

Set the switches to select the functions for the respective terminals.

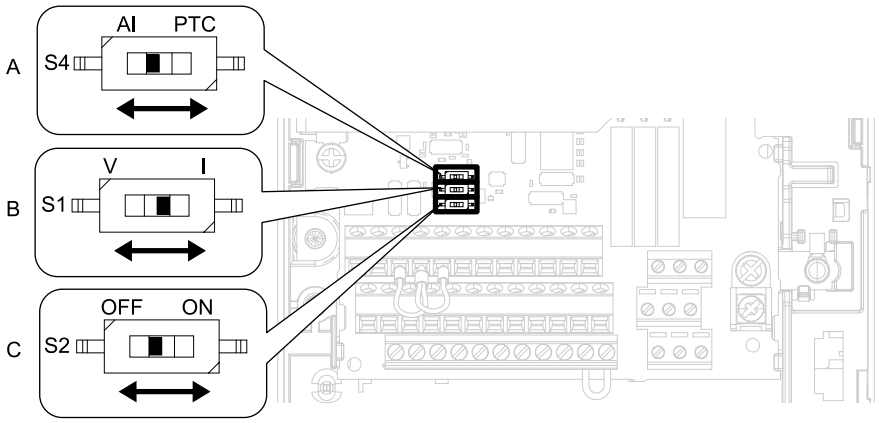


Figure 2.119 Locations of Switches

Table 2.23 I/O Terminals and Switches Functions

Position	Switch	Terminal	Function	Default
A	Dip switch S4	A3	Selects MFAI or PTC input.	AI (analog input)
B	DIP switch S1	A2	Selects the input signal type (voltage/current).	I (current input)
C	DIP switch S2	-	Enables or disables the MEMOBUS/Modbus communications termination resistor.	OFF

2.15 Control I/O Connections

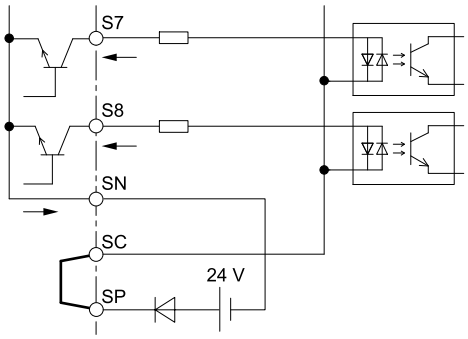
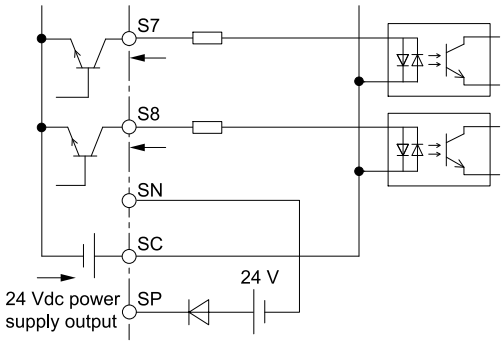
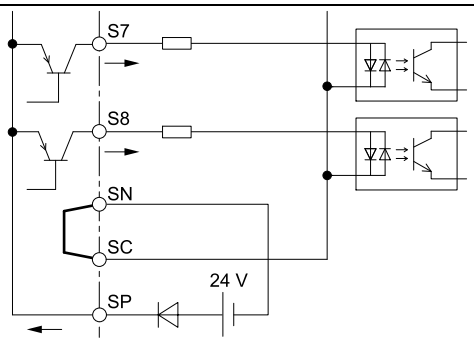
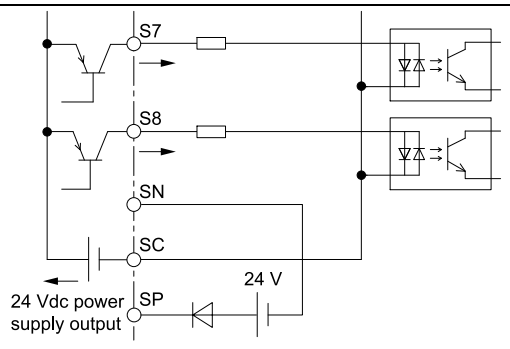
This section explains the settings for the listed I/O signals for the control circuit.

- Multi-function digital input (terminals S1 to S10)
- Multi-function digital output (terminals M1 to M6)
- Multi-function photocoupler output (terminals P1, C1, P2, C2)
- Multi-function analog input (terminals A1 to A3)
- PTC input (terminal A3)
- Multi-function analog monitor output (terminals FM, AM)
- MEMOBUS/Modbus communications (terminal D+, D-, AC)

◆ Set Sinking Mode/Sourcing Mode

Close the circuit between terminals SC-SP and SC-SN to set the sinking mode/sourcing mode and the internal/external power supply for the MFDI terminals. The default setting for the drive is internal power supply sinking mode.

NOTICE: *Damage to Equipment. Do not close the circuit between terminals SP-SN. If you close the circuits between terminals SC-SP and terminals SC-SN at the same time, it will cause damage to the drive.*

Mode	Internal Power Supply (Terminal SN-SP)	External 24 V power supply
Sinking Mode (NPN)		
Sourcing Mode (PNP)		

◆ Select Input Signals for Multi-Function Analog Input Terminals A1 to A3

Terminal A1 and A3 are set to voltage input. Terminal A2 can be used to input either a voltage or a current signal. Set the signal type as shown in the following table.

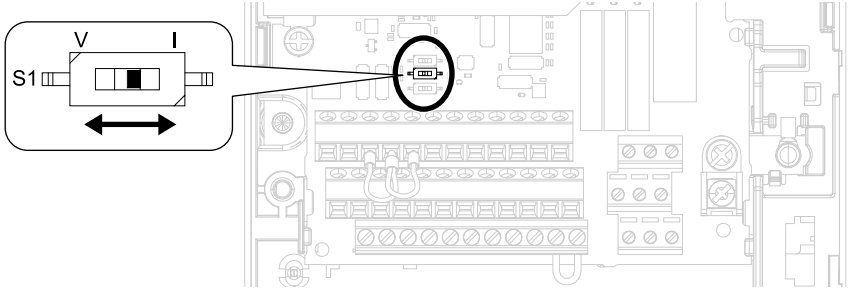


Figure 2.120 Location of DIP Switch S1

Terminal	Input Signal	DIP Switch Settings		Parameters	
		Switch	Setting	No.	Signal Level
A1	Voltage input	-	-	H3-01	0: 0 V to 10 V/100% (input impedance: 20 kΩ) 1: -10 V to +10 V/-100% to +100% (input impedance: 20 kΩ)
A2	Voltage input	S1	V	H3-09	0: 0 V to 10 V/100% (input impedance: 20 kΩ) 1: -10 V to +10 V/-100% to +100% (input impedance: 20 kΩ)
	Current input		I (Default)		2: 4 mA to 20 mA/100% (input impedance: 250 Ω) 3: 0 mA to 20 mA/100% (input impedance: 250 Ω)
A3	Voltage input	S4	AI (Default)	H3-05	0: 0 V to 10 V/100% (input impedance: 20 kΩ) 1: -10 V to +10 V/-100% to +100% (input impedance: 20 kΩ)

Note:
- To set both A1 and A2 to frequency reference, set *H3-02, H3-10 = 0 [Terminal A1 Function Selection, Terminal A2 Function Selection = Frequency Bias]*. Both analog input values will be combined to create the frequency reference.
- To set DIP switches, use tweezers or a jig that has a tip of approximately 0.8 mm.
- To use terminal A3 as a voltage input terminal, set DIP switch S4 to "AI". The default setting of DIP switch S4 is "AI".

◆ Set Multi-Function Analog Input Terminal A3 to PTC Input

Terminal A3 can be configured either as multi-function analog input, or as PTC input for motor overload protection.

Use DIP switch S4 to select the input function.

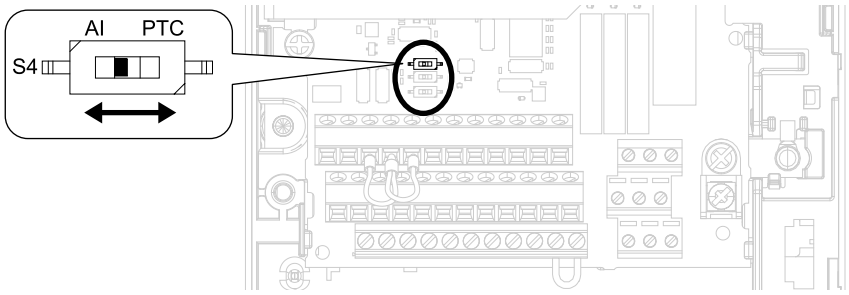


Figure 2.121 Location of DIP Switch S4

Terminal	Settings for DIP Switches	Description
A3	AI (Default)	Functions as multi-function analog input terminal. Select the function with *H3-06 [Terminal A3 Function Selection]*. Select the signal level with *H3-05 [Terminal A3 Signal Level Select]*. • 0: 0 V to 10 V/100% (input impedance: 20 kΩ) • 1: -10 V to +10 V/-100% to +100% (input impedance: 20 kΩ)
	PTC	Functions as PTC input terminal. Set *H3-06 = E [Motor Temperature (PTC input)]*. Set *H3-05 = 0 [0 to 10 V]*.

◆ Select Output Signals for Multi-Function Analog Output Terminals FM, AM

The signal level for the voltage output of terminals AM and FM can be set. Set using *H4-07 and H4-08*.

Terminal	Types of Output Signals	Parameters	
		No.	Signal Level
FM	Voltage output	*H4-07 [Terminal FM Signal Level Select]*	0: 0 to 10 Vdc (default) 1: -10 to +10 Vdc
AM	Voltage output	*H4-08 [Terminal AM Signal Level Select]*	0: 0 to 10 Vdc (default) 1: -10 to +10 Vdc

◆ Switch ON Termination Resistor for MEMOBUS/Modbus Communications

Set DIP switch S2 to the ON position when the drive is the last slave in a MEMOBUS/Modbus communications. This drive is equipped with a built-in termination resistor for the RS-485 interface.

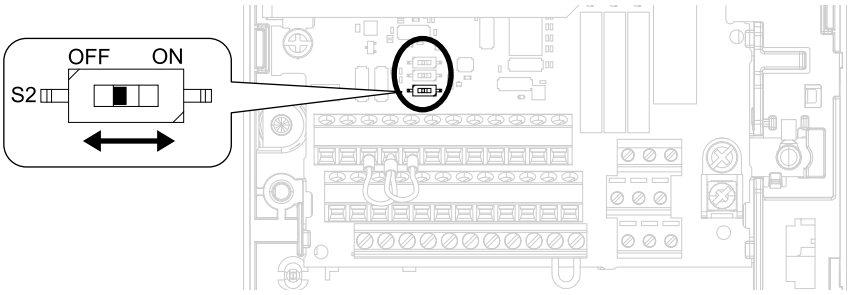


Figure 2.122 Location of DIP Switch S2

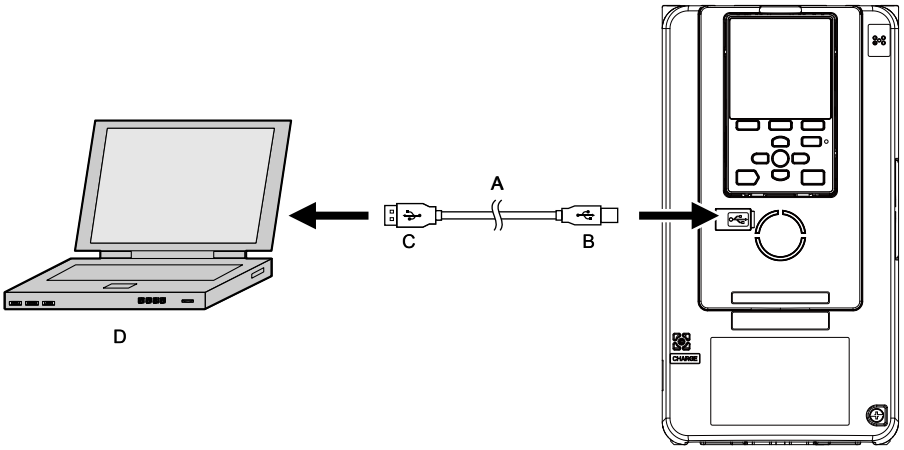
Table 2.24 MEMOBUS/Modbus Communications Termination Resistor Setting

DIP Switch S2	Description
ON	The built-in termination resistor is switched ON.
OFF (default)	The built-in termination resistor is switched OFF.

2.16 Connect the Drive to a PC

The drive has a mini-B type USB port.

You can use a USB cable (USB 2.0, type: A - mini-B) to connect the drive to a type-A USB port on a PC. After you connect the drive to the PC, you can use Yaskawa DriveWizard Industrial software to monitor drive performance and manage parameter settings.



A - USB 2.0, type A - mini-B cable
B - Mini-B type connector
C - Type-A connector
D - PC

Figure 2.123 Connect to a PC (USB)

Yaskawa recommends that you use a USB cable with connectors connected with shielded wires.

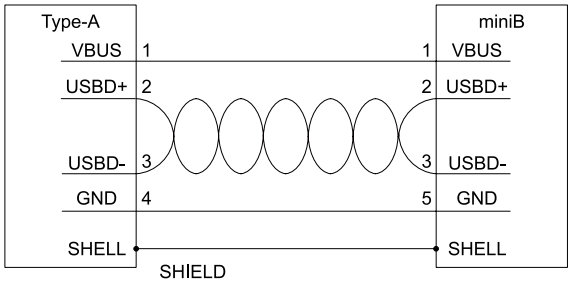


Figure 2.124 Recommended USB Cable

2.17 Braking Resistor Installation

A braking resistor or braking resistor unit (dynamic braking option) helps stop the motor quickly and smoothly when there is high load inertia. If you try to decelerate a motor in less time than usual for a coast to stop, the motor will rotate faster than the synchronous speed that aligns with the set frequency. This will cause the motor to become an induction generator. The inertia energy of the motor and regenerate to the drive and charge the drive DC bus capacitor and increase the voltage. If the voltage is more than the overvoltage level, an *ov [Overvoltage]* will occur. To prevent these overvoltage faults, a dynamic braking option is necessary.

WARNING!
Set L3-04 = 0 [Stall Prevention during Decel = Disabled] when you operate the drive with:
- *a regenerative converter*
- *regenerative unit*
- *braking unit*
- *braking resistor*
- *braking resistor unit.*

If you set the parameter incorrectly, the drive can decelerate for too long and cause serious injury or death.

NOTICE: *Damage to Equipment. Before you connect a dynamic braking option to the drive, make sure that qualified personnel read and obey the Braking Unit and Braking Resistor Unit Installation Manual (TOBPC72060001). If you do not read and obey the manual or if personnel are not qualified, it can cause damage to the drive and braking circuit.*

Note:
- Select the correct braking circuit size to dissipate the power that is necessary to decelerate the load in the correct time. Before you run the drive, make sure that the braking circuit can dissipate the energy for the set deceleration time.
- To install a dynamic braking option, set *L8-01 = 0 [3% ERF DB Resistor Protection = Disabled]*.

WARNING! *Fire Hazard. Do not connect a braking resistor to terminals +1 or -. Use terminals B1 and B2 for the braking resistor connections. If you connect a braking resistor to the incorrect terminals, it can cause damage to the drive and braking circuit and serious injury or death.*

NOTICE: *Connect braking resistors to the drive as shown in the connection diagram examples. If you wire the braking circuits incorrectly, it can cause damage to the drive or equipment.*

To connect a Yaskawa ERF series braking resistor to the drive, set *L8-01 = 1 [Enabled]*.

To use a non-ERF type braking resistor, connect a thermal overload relay between the drive and the braking resistor, and set a circuit to de-energize the drive at the trip contacts of the thermal overload relay.

◆ Installing a Braking Resistor: ERF Type

Connect the braking resistor as shown in the following figure for drive models 2003 to 2018 and 4002 to 4009.

Set *L8-01 = 1 [3% ERF DB Resistor Protection = Enabled]* and set any parameter from *H2-01 to H2-05 [MFDO Function Selection]* to *D [Braking Resistor Fault]*. Use a sequence that shuts the power OFF by using MFDO.

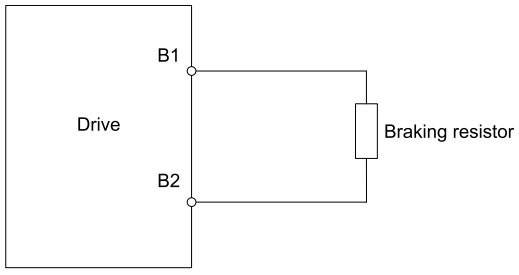


Figure 2.125 Installing a Braking Resistor: ERF Type

◆ Installing a Braking Resistor Unit : LKEB Type

Connect the braking resistor unit as shown in the following figure. To install a braking resistor unit, set *L8-01 = 0 [3% ERF DB Resistor Protection = Disabled]*.

Models 2003 to 2115 and 4002 to 4150 have a built-in braking transistor.

To protect the braking resistor unit from overheating, set up a sequence that shuts off the supply of power at the trip contacts of the thermal overload relay.

Note:

A junction terminal is required when connecting a braking resistor unit (LKEB type) to 2145, 2180, 4112, and 4150.

Install and wire a junction terminal that can be connected to power lines that allow for connection with the drive peripheral device and options according to specifications.

The following table lists recommended junction terminals. Contact Yaskawa or your nearest sales representative for details on selection and installation of the junction terminal.

Drive Model	Junction Terminal Model Manufacturer: MIBU DENKI INDUSTRIAL CO., LTD.
2145, 4112, 4150	DTK-200N × 2P *1*
2180	DTK-300N × 2P *1*

*1 A junction terminal with 2 poles or more is necessary.

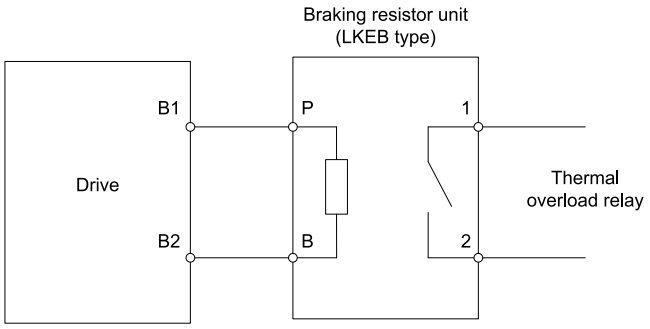


Figure 2.126 Installing a Braking Resistor Unit: LKEB type (Example: 2003 to 2115, 4002 to 4150)

◆ Installing a Braking Unit Connection: CDBR Type

To install a CDBR type braking unit, connect the terminal +3 of the drive to the terminal + on the braking unit. Next, wire together the terminal - on the drive and braking unit. The terminal +2 is not used.

Set *L8-55 = 0 [Internal DB TransistorProtection = Disable]*.

Note:

- To install a CDBR type braking unit to the drive with a built-in braking transistor (models 2003 to 2115, 4002 to 4150), connect the drive terminal B1 to the terminal + on the braking unit. Next, wire the terminal - on the drive and braking unit together. Terminal B2 is not used.
- A junction terminal is required when connecting a braking unit (CDBR series) to the drive models 2145, 2180, 4112, and 4150.
  Install and wire a junction terminal that can be connected to power lines that allow for connection with the drive peripheral device and options according to specifications.
  The following table lists recommended junction terminals. Contact Yaskawa or your nearest sales representative for details on selection and installation of the junction terminal.

Drive Model	Junction Terminal Model Manufacturer: MIBU DENKI INDUSTRIAL CO., LTD.
2145, 4112, 4150	DTK-200N × 2P *1*
2180	DTK-300N × 2P *1*

*1 A junction terminal with 2 poles or more is necessary.

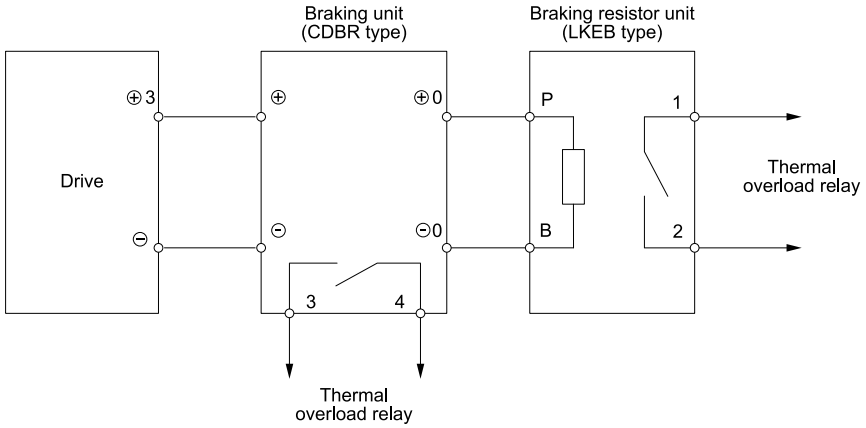


Figure 2.127 Installing a Braking Unit: CDBR Type/Braking Resistor Unit: LKEB Type (Example: 2145 to 2415, 4180 to 4605)

■ Braking Unit Connection Wire Gauge (CDBR-Type)

When you connect a braking unit (CDBR-type) to drive models 2215 to 2415 or 4108 to 4605, refer to Table 2.25 and Table 2.26 to select the wires.

Table 2.25 200 V Class

Model	Wiring Conditions (Number of Connections)	Terminal	Recomm. Gauge (mm²)	Applicable Gauge (mm²)	Cutaway section	Ref.
2215	2022D (× 2) Specified Wire Gauge	+3	6 × 2P *1	6 - 10 × 2P *1	A	Figure 2.128
		-	6 × 2P *1	6 - 10 × 2P *1	A	Figure 2.128
	Applicable Gauge	+3	35 × 2P	25 - 70 × 2P	B	Figure 2.129
		-	35 × 2P *2	25 - 70 × 2P *2	B	Figure 2.129
2283	2110D (× 1) Specified Wire Gauge	+3	35 *1	35 *1	A	Figure 2.128
		-	35 *1	35 *1	A	Figure 2.128
	Applicable Gauge	+3	50 × 2P	25 - 70 × 2P	B	Figure 2.129
		-	50 × 2P *2	25 - 70 × 2P *2	B	Figure 2.129
2346	2110D (× 1) Specified Wire Gauge	+3	35 *1	35 *1	C	Figure 2.130
		-	35 *1	35 *1	C	Figure 2.130
2415	2110D (× 1) Specified Wire Gauge	+3	35 *1	35 *1	C	Figure 2.130
		-	35 *1	35 *1	C	Figure 2.130

*1 When connecting the specified wire for a braking unit (CDBR Type).
*2 This is the applicable wire gauge when you use the same wires for terminal - and terminal +3.

Table 2.26 400 V Class

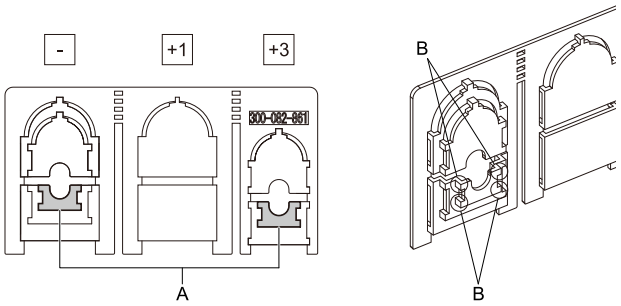
Model	Wiring Conditions	Terminal	Recomm. Gauge (mm²)	Applicable Gauge (mm²)	Cutaway section	Ref.
4180	4045D (× 2) Specified Wire Gauge	+3	5.5 × 2P *1	5.5 - 8.0 × 2P *1	A	Figure 2.128
		-	5.5 × 2P *1	5.5 - 8.0 × 2P *1	A	Figure 2.128
	Applicable Gauge	+3	38 × 2P	50 - 60 × 2P	B	Figure 2.129
		-	38 × 2P *2	50 - 60 × 2P *2	B	Figure 2.129
4216	4220D (× 1) Specified Wire Gauge	+3	30 *1	30 - 38 *1	A	Figure 2.128
		-	30 *1	30 - 38 *1	A	Figure 2.128
	Applicable Gauge	+3	50 × 2P	50 - 60 × 2P	B	Figure 2.129
		-	50 × 2P *2	50 - 60 × 2P *2	B	Figure 2.129

Model	Wiring Conditions	Terminal	Recomm. Gauge (mm²)	Applicable Gauge (mm²)	Cutaway section	Ref.
4260	4220D (× 1) Specified Wire Gauge	+3	30 *1	30 - 38 *1	A	Figure 2.128
		-	30 *1	30 - 38 *1	A	Figure 2.128
	Applicable Gauge	+3	60 × 2P	50 - 60 × 2P	B	Figure 2.129
		-	60 × 2P *2	50 - 60 × 2P *2	B	Figure 2.129
4304	4220D (× 1) Specified Wire Gauge	+3	30 *1	30 - 38 *1	C	Figure 2.130
		-	30 *1	30 - 38 *1	C	Figure 2.130
4371	4220D (× 1) Specified Wire Gauge	+3	30 *1	30 - 38 *1	C	Figure 2.130
		-	30 *1	30 - 38 *1	C	Figure 2.130
4414	4220D (× 1) Specified Wire Gauge	+3	30 *1	30 - 38 *1	D	Figure 2.131
		-	30 *1	30 - 38 *1	D	Figure 2.131
	Applicable Gauge	+3	80 × 4P	100 - 125 × 4P	F	Figure 2.133
		-	80 × 4P *2	100 - 125 × 4P *2	F	Figure 2.133
4453	4220D (× 1) Specified Wire Gauge	+3	30 *1	30 - 38 *1	D	Figure 2.131
		-	30 *1	30 - 38 *1	D	Figure 2.131
	Applicable Gauge	+3	80 × 4P	100 - 125 × 4P	F	Figure 2.133
		-	80 × 4P *2	100 - 125 × 4P *2	F	Figure 2.133
4605	4220D (× 2) Specified Wire Gauge	+3	30 × 2P *1	30 - 38 × 2P *1	E	Figure 2.132
		-	30 × 2P *1	30 - 38 × 2P *1	E	Figure 2.132
	Applicable Gauge	+3	100 × 4P	100 - 125 × 4P	F	Figure 2.133
		-	100 × 4P *2	100 - 125 × 4P *2	F	Figure 2.133

*1 When connecting the specified wire for a braking unit (CDBR Type).
*2 This is the applicable wire gauge when you use the same wires for terminal - and terminal +3.

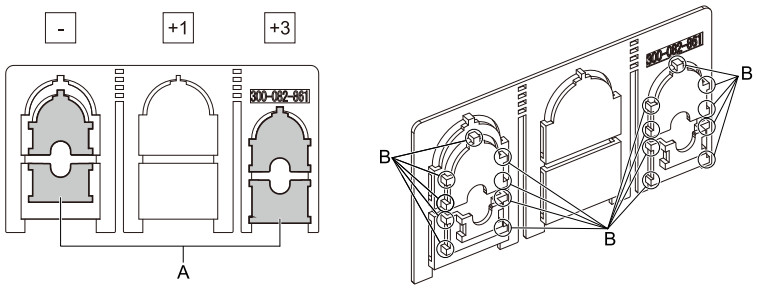
■ Cutaway Section of the Wiring Cover

Examine the terminal symbols on the braking unit and use a nipper to clip the cutaway section of the corresponding wiring cover.



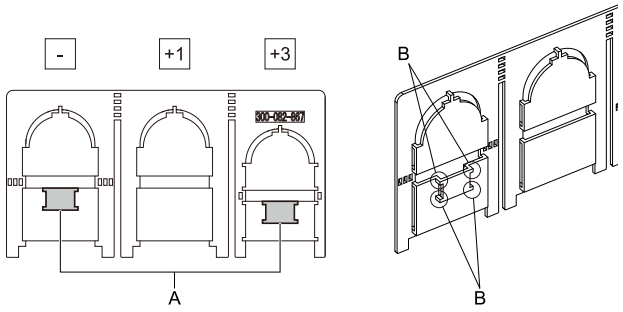
A - Cutaway sections **B - Use a diagonal-cutting pliers to clip this area.**

Figure 2.128 Cutaway Sections



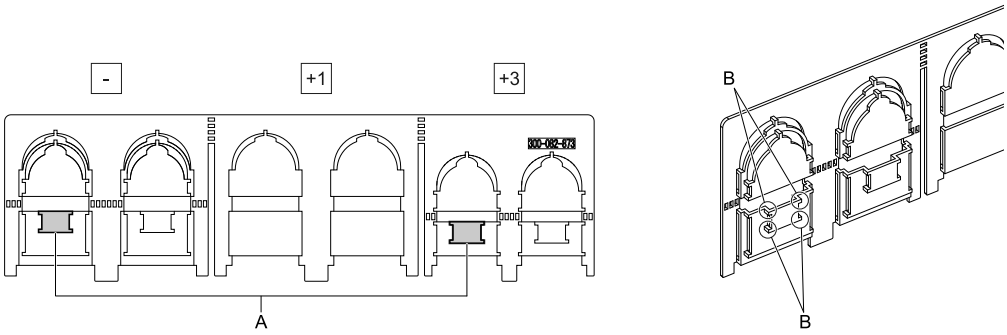
A - Cutaway sections **B - Use a diagonal-cutting pliers to clip this area.**

Figure 2.129 Cutaway Sections



A - Cutaway sections **B - Use a diagonal-cutting pliers to clip this area.**

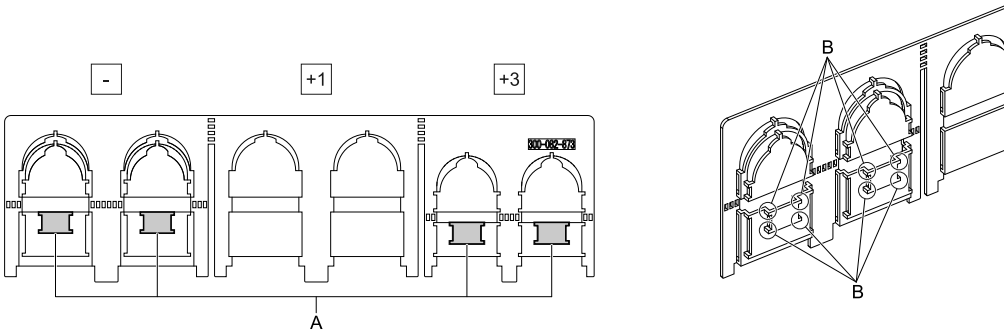
Figure 2.130 Cutaway Sections



A - Cutaway section *1 **B - Use a diagonal-cutting pliers to clip this area.**

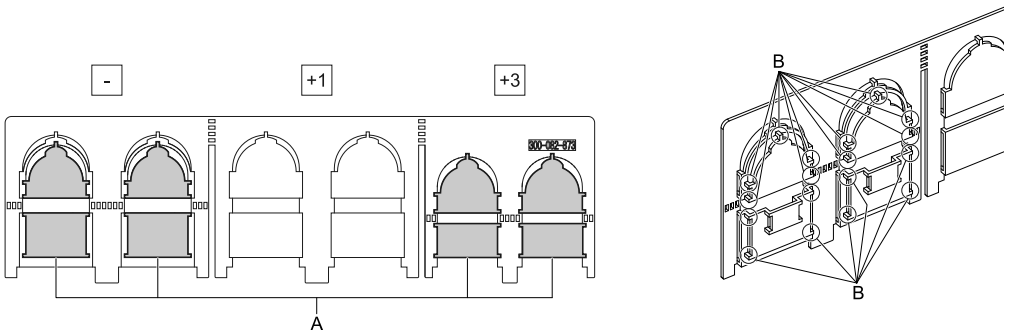
Figure 2.131 Cutaway Sections

*1 Cut away either of the two portions: terminal - or terminal +3. You may cut away either portion.



A - Cutaway sections **B - Use a diagonal-cutting pliers to clip this area.**

Figure 2.132 Cutaway Sections



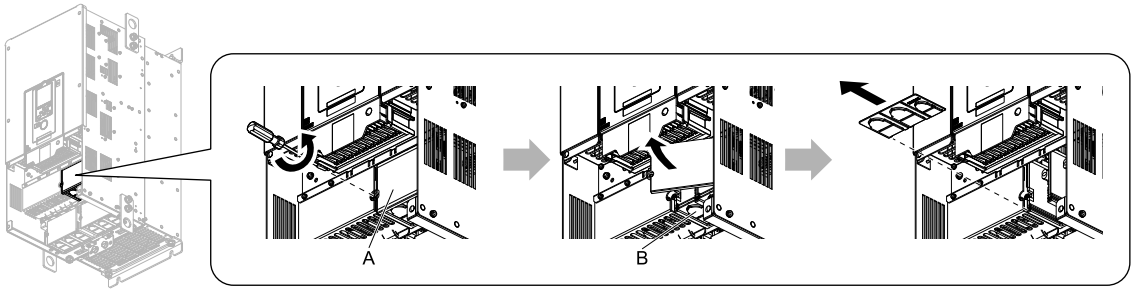
A - Cutaway sections **B - Use a diagonal-cutting pliers to clip this area.**

Figure 2.133 Cutaway Sections

■ Installing a Braking Unit Connection (CDBR-Type)

Remove the terminal cover before you connect the braking unit (CDBR-type) to the drive.

1. Remove the screws on the terminal block cover and pull the terminal block cover away from the terminal block. Pull the wiring cover away from the drive to remove the wiring cover after removing the terminal block cover.



A - Terminal block cover **B - Wiring cover**

Figure 2.134 Remove the Wiring Cover

2. Examine the signal from the wired terminal and use a diagonal-cutting pliers to remove areas of the wiring cover cutaway section.
   Refer to *Cutaway Section of the Wiring Cover on page 119* for more information.

Note:
- Different drive models have different wiring covers.
- Only clip the section of the wiring cover that applies to the wired terminal. If you clip areas that do not apply to wired terminals, the protective enclosure will not keep its IP20 protective level.
- Make sure that you hold the cutaway section tightly when you remove pieces of the cutaway section. Pieces of the cutaway section can fly out and cause injury.
- Make sure that the clipped section does not cause damage to the wires.
- If you use wires that are not specified by Yaskawa, the protective enclosure could lose its IP20 protective level, although the wiring cover is correct. Contact Yaskawa or your nearest sales representative for more information.
- When you use the recommended gauge for the electrical wires, it is not necessary to attach the wiring cover of the main circuit power input terminal and the drive output terminal. If you use the applicable gauge for the electrical wires, you must attach the wiring cover.

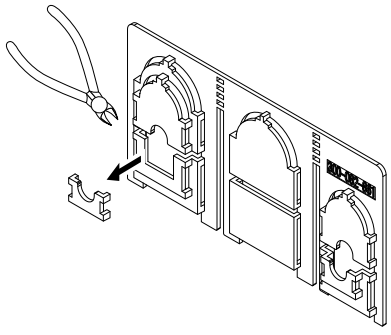
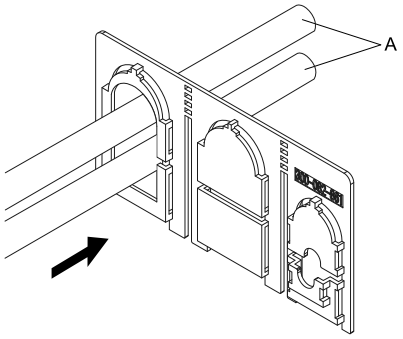


Figure 2.135 Clip the Cutaway Section of the Wiring Cover

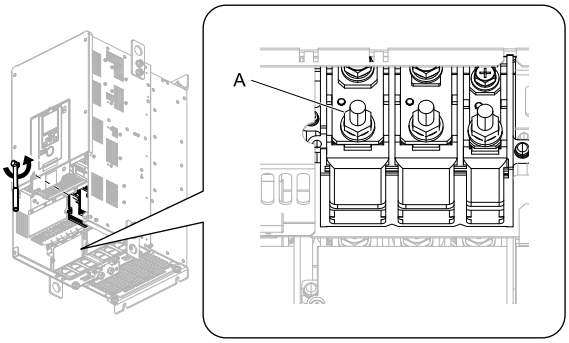
3. Put the wires through the holes that you cut out of the wiring cover.



A - Wire

Figure 2.136 Lead the Wire through the Wiring Cover

4. Crimp the closed-loop crimp terminal to the wire.
5. Remove the main circuit terminal block nut.



A - Nut

Figure 2.137 Remove the Terminal Block Nut

6. Wire the closed-loop crimp terminal to the main circuit terminal block.

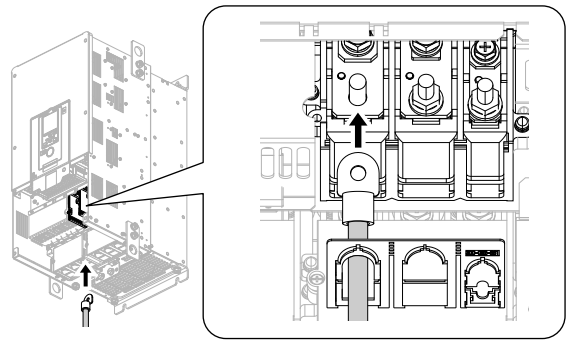


Figure 2.138 Connect the Wire

7. Tighten the nut to the specified torque.

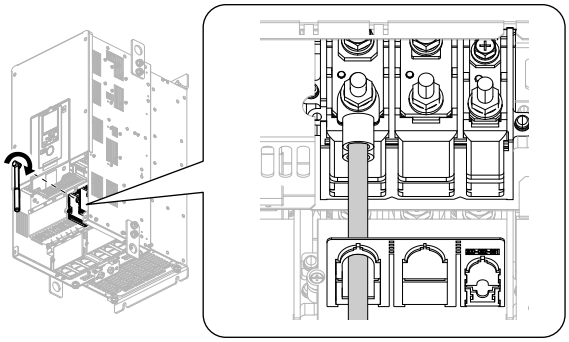


Figure 2.139 Tighten the Terminal Block Nut

8. Attach the wiring cover and terminal block cover to their initial positions and tighten the screws on the terminal block cover.

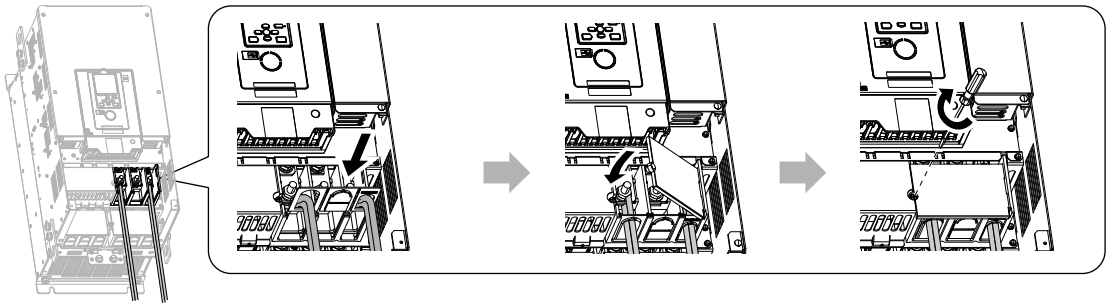


Figure 2.140 Reattach the Wiring Cover

9. Put the terminal cover back in its initial position.

◆ Connect Braking Units in Parallel

When connecting two or more braking units in parallel, refer to the following figure to determine the wiring and connector selections.

On braking units, there are connectors for selecting master or slave. Select the master side for only the first braking unit. For the second unit on, select the slave side.

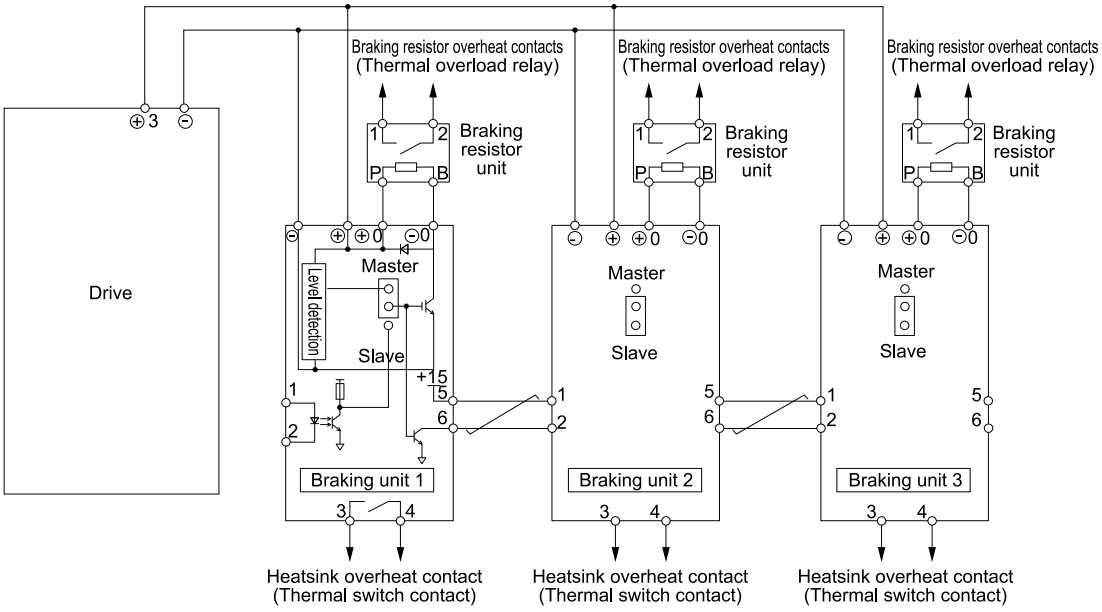


Figure 2.141 Connect Braking Units in Parallel

◆ Dynamic Braking Option Overload Protection

To prevent overheating the dynamic braking option, set a sequence to de-energize the drive at the trip contacts of the thermal overload relay.

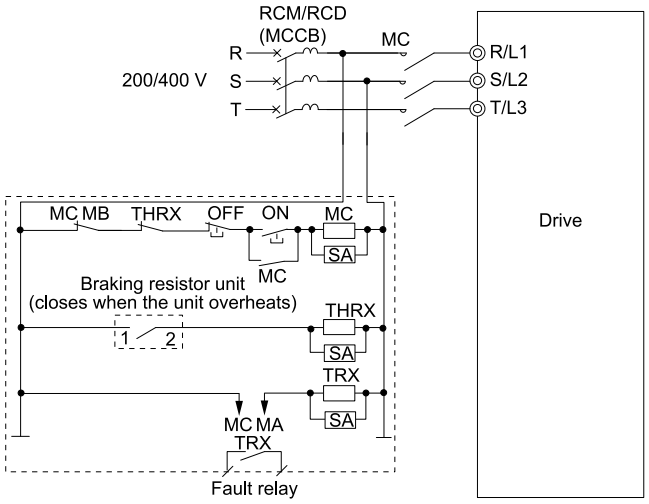


Figure 2.142 Power Supply Interrupt for Overheat Protection Example

WARNING! *Fire Hazard. When you use a braking unit, use a thermal relay on the braking resistors and set a fault contact output for the braking resistor unit to disconnect drive main power through an input contactor. Incorrect braking circuit protection can cause the resistors to become too hot and cause serious injury or death.*

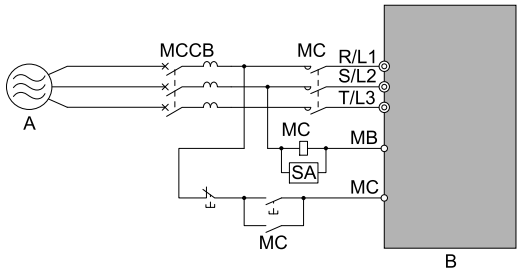
2.18 Drive Wiring Protection

◆ Installing a Molded-Case Circuit Breaker (MCCB) or Residual Current Monitor/ Device (RCM/RCD)

Install a molded-case circuit breaker (MCCB) or a residual current monitor/device (RCM/RCD) for line protection between the power supply and main circuit power supply input terminals R/L1, S/L2, and T/L3. The MCCB or RCM/RCD gives overload protection and also prevent damage to the main circuit and the devices that are wired to the main circuit.

Use the information in this section to select the correct MCCB or RCM/RCD and to safely connect the device.

- The capacity of the MCCB or RCM/RCD must be 1.5 to 2 times the rated output current of the drive. Use an MCCB or RCM/RCD as an alternative to overheat protection (150% for one minute at the rated output current) to prevent drive faults.
- When you connect more than one drive or the drive and other device to an MCCB or RCM/RCD, refer to Figure 2.143, use a magnetic contactor (MC), and set a sequence that de-energizes the drive when it outputs errors.



A - Power supply **B - Drive**

Figure 2.143 Connect an MCCB

WARNING! *Electrical Shock Hazard. Use an MCCB, RCM/RCD, or Magnetic Contactor (MC) to de-energize the drive before you wire the main circuit terminal. If the main circuit terminal is energized during wiring, it will cause serious injury or death.*

◆ Installing a Residual Current Monitoring/Detection (RCM/RCD)

When the drive output switches at high speeds, it causes high frequency leakage current. To prevent electrical shock and fires caused by ground fault protection that is not sufficient, install an RCM/RCD.

Use a high frequency RCM/RCD at the power input side of the drive and make sure that each drive has a minimum cumulative sensitivity amperage of 30 mA. The specialized breaker detects only the leakage current from frequency bands that are dangerous to humans.

If a device does not have protection against high frequencies, high frequency leakage currents can cause the device to malfunction. If you have a malfunction on a device that is not protected, decrease the carrier frequency of the drive, switch to a better breaker, or use an RCM/RCD with a minimum cumulative sensitivity amperage of 200 mA for each drive.

These conditions can have an effect on leakage current:

- Drive capacity
- Carrier frequency
- Wiring distance and types of motor cables
- EMI/RFI filter

To prevent damage and injury to personnel and drives, use a high-frequency RCM/RCD that is rated for AC and DC power supplies.

Note:

Yaskawa recommends these RCMs/RCDs, which are designed to operate with high frequencies:
- Mitsubishi Electric Corporation, NV series
- Schneider Electric, NS series

You can use a molded-case circuit breaker (MCCB) as a replacement for an RCM/RCD that is upstream in the power supply system.

2.19 Dynamic Braking Option, Motor Protection

◆ Install an Electromagnetic Contactor (MC) at the Input Side of the Drive

If something triggers the protective functions of the drive or emergency stop occurs, and the sequence is set to shut off the main circuit power supply, you can use an MC instead of a moldedcase circuit breaker (MCCB). If you use an MC on the input side (primary side) of the drive to stop the drive, regenerative braking will not operate and the drive will coast to stop.

NOTICE: *When you connect electromagnetic switches or magnetic contactors to the output motor circuits, make sure that you sequence them correctly. If the output motor circuit sequence is incorrect, it can cause damage to the drive.*

NOTICE: *Damage to Equipment. Do not energize and de-energize the drive more frequently than one time each 30 minutes. If you frequently energize and de-energize the drive, it can cause drive failure.*

Note:
- Wire the magnetic contactor to open when a fault output terminal is triggered. Use a magnetic contactor to make sure that you can fully remove power to the drive when necessary.
- When machinery must not restart after recovery from a momentary power loss that occurred during run, install an MC at the input side of the drive and set a sequence that does not automatically set the Run command to ON after recovery of power.

■ Protect the Braking Resistor/Braking Resistor Unit

Use an MC on the input side (primary side) to prevent damage to the braking resistor/braking resistor unit.

WARNING! *Fire Hazard. When you use a braking unit, use a thermal relay on the braking resistors and set a fault contact output for the braking resistor unit to disconnect drive main power through an input contactor. Incorrect braking circuit protection can cause the resistors to become too hot and cause serious injury or death.*

◆ Installing a Thermal Overload Relay on the Drive Output

A thermal overload relay disconnects the power line to the motor during a motor overload condition to prevent damage to the motor.

Install a thermal overload relay between the drive and motor in these conditions:

- When you operate more than one motor with one drive
- When you operate the motor directly from the power line with a power line bypass

When you operate one motor with one drive, it is not necessary to install a thermal overload relay. The drive has electronic motor overload protection in the drive software.

Note:
- When you install a thermal overload relay, set parameter *L1-01 = 0 [Motor Overload (oL1) Protection = Disabled]*.
- Set up a sequence that will trip an external fault (coast to stop) for the contacts of the thermal overload relay.

■ General Precautions When Using Thermal Overload Relays

When you use a motor thermal overload relay on the drive output to prevent nuisance trips and overheating of the motor at low speeds, be sure to think about these application precautions:

- Operation of a low speed motor
- When you operate more than one motor with one drive
- Length of the motor cables
- Nuisance tripping because of high drive carrier frequency

Operation of a Low Speed Motor

Usually, you use thermal overload relays on general-purpose motors (standard motors). When a drive drives a general-purpose motor, the motor current is approximately 5% to 10% more than with a commercial power supply. When a motor with a shaft-driven fan operates at low speeds, the cooling capacity decreases. This can cause the motor to overheat when the load current is in the motor rated value. Enable the electronic thermal protection in the drive when possible to prevent this problem.

The electronic thermal overload function uses the relation between the speed and heat characteristics in the variable speed control range to simulate the cooling ability of general-purpose motors and forced-vented motors to prevent damage to the motor.

When You Operate More than One Motor with One Drive

To disable the overload protection function of the electronic thermal protector of the drive, set *L1-01 = 0 [Motor Overload (oL1) Protection = Disabled]*.

Note:

If you operate more than one motor from one drive, you cannot use the electronic thermal protection of the drive.

Length of the Motor Cables

If you use long motor cables with a high carrier frequency, the increased leakage current can cause nuisance tripping of the thermal relay. To prevent this, decrease the carrier frequency or increase the tripping level of the thermal overload relay.

Nuisance Tripping Because of High Drive Carrier Frequency

High carrier frequency PWM drives make current waveforms that can increase the temperature in overload relays. It may be necessary to increase the trip level setting when encountering nuisance triggering of the relay.

WARNING! *Fire Hazard. Before you increase the detection level of the thermal relay, make sure that a secondary problem is not the cause of the overload. Make sure that you know the local codes for electrical wiring, then adjust the electrothermal settings. Incorrect thermal relay adjustment and incorrect wiring can cause serious injury or death.*

2.20 Improve the Power Factor

◆ Connect an AC Reactor or a DC Reactor

AC reactors and DC reactors decrease surges in current and improve the power factor on the input side of the drive.

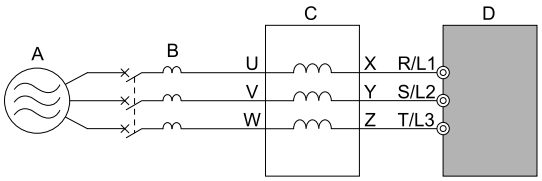
Connect an AC reactor or a DC reactor to the input side (primary side) in the these conditions:

- To decrease harmonic current or improve the power factor of the power supply
- When there is switching of phase advancing capacitor
- With a large capacity power supply transformer (600 kVA or more).

Note:

- You can use an AC reactor and DC reactor together.
- When you connect a thyristor converter (for example, a DC drive) to the same power supply system, use an AC reactor.
- The main circuit terminal block for the drive and the terminal blocks for the AC and DC reactors come in different shapes. Correctly prepare the ends of the wiring.
- Ground the AC and DC reactors (option) on the back of the mounting base. Remove all paint from the mounting surface of the control panel.

■ Connect an AC Reactor

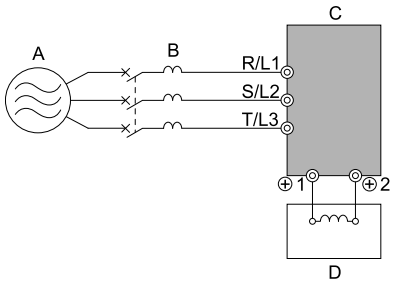


A - Power Supply
B - MCCB
C - AC reactor
D - Drive

Figure 2.144 AC Reactor Connection Example

■ Connect a DC Reactor

When you install a DC link choke, remove the jumper between terminals +1 and +2. If you will not use a DC link choke, do not remove the jumper. Refer to Figure 2.145 for an example of how to wire the DC reactor.



A - Power supply
B - MCCB
C - Drive
D - DC reactor

Figure 2.145 DC Reactor Connection Example

2.21 Prevent Switching Surge

◆ Connect a Surge Protective Device

A surge protective device decreases the surge voltage generated when you switch an inductive load near the drive. Inductive loads include:

- Magnetic contactors
- Electromagnetic relays
- Magnetic valves
- Solenoids
- Magnetic brakes.

Always use a surge protective device or diode with inductive loads.

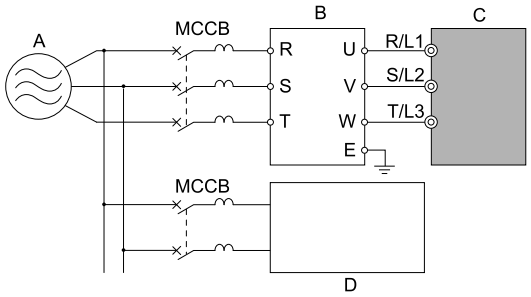
Note:
Do not connect a surge protective device to the drive output side.

2.22 Decrease Noise

◆ Connect a Noise Filter to the Input Side (Primary Side)

High-speed switching makes noise in the drive output. This noise flows from the drive to the power supply, and can possibly have an effect on other equipment. Install a noise filter to the input side of the drive to decrease the quantity of noise that flows to the power supply. A noise filter also prevents noise from entering the drive from the power supply.

- Use a noise filter specially designed for drives.
- Install the noise filter as close as possible to the drive.



A - Power Supply
B - Input side (primary side) noise filter
C - Drive
D - Other controller

Note:
The input side (primary side) noise filter model is LNFD-xx.

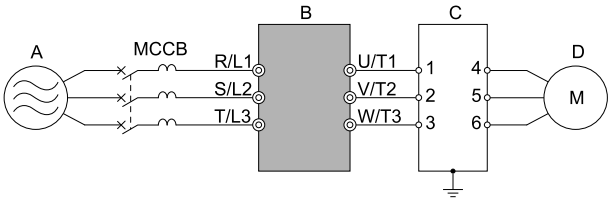
Figure 2.146 Example of Connecting the Noise Filter on the Input Side (Primary Side)

◆ Connect a Noise Filter to the Output Side (Secondary Side)

A noise filter on the output side of the drive decreases inductive noise and radio frequency interference.

Figure 2.147 shows an example of noise filter wiring.

NOTICE: *Do not connect phase-advancing capacitors, LC/RC noise filters, or leakage breakers (RCM/RCD) to the motor circuit. If you connect these devices to the output circuits, it can cause damage to the drive and connected equipment.*



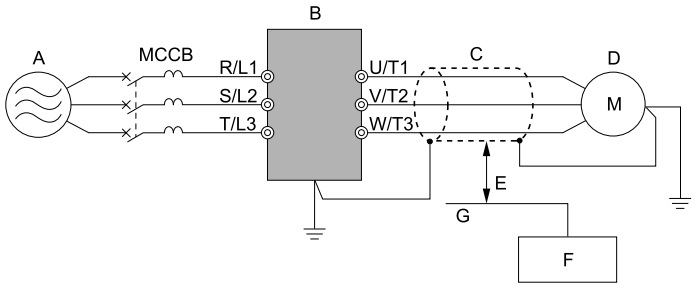
A - Power supply
B - Drive
C - Noise filter on output side (secondary side)
D - Motor

Figure 2.147 Example of Connecting the Noise Filter on the Output Side (Secondary Side)

Note:
Glossary
- Radio frequency interference:
  Electromagnetic waves radiated from the drive and cables make noise through the full radio bandwidth that can have an effect on nearby devices.
- Inductive noise:
  The noise from electromagnetic induction can have an effect on the signal line and can cause the controller to malfunction.

■ Prevent Inductive Noise

In addition to installing a noise filter, you can also run all wiring through a grounded metal conduit to decrease inductive noise occurring at the output side. Put the cables a minimum of 30 cm (11.8 in) away from the signal line to prevent induced noise. Ground the cables to metal conduits.



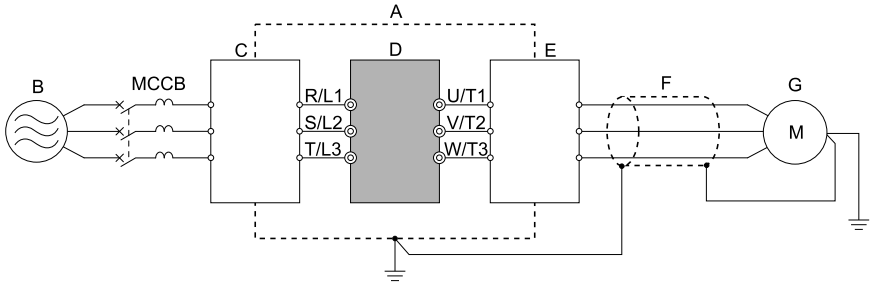
A - Power supply
B - Drive
C - Shielded motor cable
D - Motor
E - Minimum of 30 cm (11.8 in) apart
F - Controller
G - Signal line

Figure 2.148 Prevent Inductive Noise

■ Decrease Radio Frequency Interference

The drive, input lines, and output lines generate radio frequency interference. Use noise filters on input and output sides and install the drive in a steel box to decrease radio frequency interference.

Note:
Keep the cable between the drive and motor as short as possible.



A - Steel box
B - Power supply
C - Noise filter
D - Drive
E - Noise filter
F - Shielded motor cable
G - Motor

Figure 2.149 Decrease Radio Frequency Interference

2.23 Protect the Drive during Failures

◆ Factory-Recommended Branch Circuit Protection

Use branch circuit protection to protect against short circuits and to maintain compliance with UL61800-5-1. Yaskawa recommends connecting semiconductor protection fuses on the input side for branch circuit protection. Refer to Table 2.27 to Table 2.28for the recommended fuses.

- 200 V Class
  This product complies with UL under the conditions for use on a circuit capable of delivering not more than 100,000 RMS symmetrical Amperes and 240 Vac maximum during a short circuit of the power supply, when protected by fuses as specified in this document.
- 400 V Class
  This product complies with UL under the conditions for use on a circuit capable of delivering not more than 100,000 RMS symmetrical Amperes and 480 Vac maximum during a short circuit of the power supply, when protected by fuses as specified in this document.

The built-in short circuit protection of the drive does not provide branch circuit protection. The user must provide branch circuit protection as specified by the National Electric (NEC), the Canadian Electric Code, Part I (CEC), and local codes.

Table 2.27 Factory-Recommended Branch Circuit Protection: 200 V Class

Drive Model	The maximum applicable motor output kW (HP)	Input Current Rating A	Semiconductor Protection Fuse Rated Current Manufacturer: EATON/Bussmann
2003	0.55 (0.5)	3.6	FWH-45B
2005	0.75 (1)	4.8	FWH-45B
2008	1.5 (2)	8.9	FWH-45B
2011	2.2 (3)	12.7	FWH-100B
2014	3 (4)	17	FWH-100B
2018	3.7 (5)	20.7	FWH-100B
2025	5.5 (7.5)	30	FWH-125B
2033	7.5 (10)	40.3	FWH-150B
2047	11 (15)	58.2	FWH-200B
2060	15 (20)	78.4	FWH-225A
2075	18.5 (25)	96	FWH-225A FWH-250A *1
2088	22 (30)	82	FWH-225A FWH-250A *1
2115	30 (40)	111	FWH-275A FWH-300A *1
2145	37 (50)	136	FWH-275A FWH-350A *1
2180	45 (60)	164	FWH-325A FWH-450A *1
2215	55 (75)	200	FWH-600A
2283	75 (100)	271	FWH-800A
2346 *2	90 (125)	324	FWH-1000A
2415 *2	110 (150)	394	FWH-1000A

*1 Yaskawa recommends a fuse with a large rated current for applications with repeated loads.
*2 Approval pending. Contact Yaskawa or your nearest sales representative.

Table 2.28 Factory-Recommended Branch Circuit Protection: 400 V Class

Drive Model	The maximum applicable motor output kW (HP)	Input Current Rating A	Semiconductor Protection Fuse Rated Current Manufacturer: EATON/Bussmann
4002	0.55 (0.75)	1.9	FWH-50B
4003	1.1 (1.5)	3.5	FWH-50B

Drive Model	The maximum applicable motor output kW (HP)	Input Current Rating A	Semiconductor Protection Fuse Rated Current Manufacturer: EATON/Bussmann
4005	1.5 (2)	4.7	FWH-50B
4006	2.2 (3)	6.7	FWH-60B
4007	3 (4)	8.9	FWH-60B
4009	4.0 (5.3)	11.7	FWH-60B
4015	5.5 (7.5)	15.8	FWH-80B
4018	7.5 (10)	21.2	FWH-90B
4024	11 (15)	30.6	FWH-150B
4031	15 (20)	41.3	FWH-200B
4039	18.5 (25)	50.5	FWH-200B
4045	22 (30)	43.1	FWH-225A
4060	30 (40)	58.3	FWH-250A
4075	37 (50)	71.5	FWH-275A
4091	45 (60)	86.5	FWH-275A
4112	55 (75)	105	FWH-300A
4150	75 (100)	142	FWH-325A FWH-400A *1
4180	90 (125)	170	FWH-500A
4216	110 (150)	207	FWH-600A
4260	132 (175)	248	FWH-700A
4304 *2	160 (200)	300	FWH-800A
4371 *2	200 (250)	373	FWH-1000B
4414 *2	220 (300)	410	FWH-1200B
4453 *2	250 (335)	465	FWH-1200B
4605 *2	315 (400)	584	FWH-1400A FWH-1600A *1

*1 Yaskawa recommends a fuse with a large rated current for applications with repeated loads.
*2 Approval pending. Contact Yaskawa or your nearest sales representative.

2.24 Wiring Checklist

After wiring of the drive is complete, go through the following checklist before test run.

Table 2.29 Power Supply Voltage

Check	No.	Item to Check
	1	The power supply voltage should be within the input voltage specification range of the drive.

Table 2.30 Main Circuit Wiring

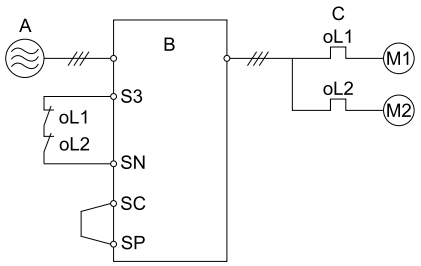
Check	No.	Item to Check
	1	The power supply should be passed through a molded-case circuit breaker (MCCB) before being input. An appropriate molded-case circuit breaker (MCCB) should be connected.
	2	Properly wire the power supply to drive terminals R/L1, S/L2, and T/L3.
	3	Properly wire the drive and motor together. The motor lines and drive output terminals U/T1, V/T2, and W/T3 should match to produce the desired phase order. If the phase order is incorrect, the drive will rotate in the opposite direction.
	4	Use 600 V heat resistant indoor PVC wire for the power supply and motor lines. **Note:** Wire gauge recommendations assume use of 600 V class 2 heat resistant indoor PVC wire.
	5	Use the correct wire gauges for the main circuit. **Note:** • When the wiring distance between the drive and the motor is long, confirm that the voltage drop in the wire meets the value calculated as follows: Motor rated voltage (V) × 0.02 ≥ √3 × wire resistance (Ω/km) × wiring distance (m) × motor rated current (A) × 10^{-3} • If the cable between the drive and motor exceeds 50 m, lower the carrier frequency using *C6-02 [Carrier Frequency Selection]*.
	6	Properly ground the drive.
	7	Tighten main circuit and grounding terminal screws of the drive to their specified torques.
	8	Set up overload protection circuits when running multiple motors from a single drive.  **A - Power Supply** **B - Drive Series** **C - oL1 - oLn: thermal overload relay** **Note:** Set *H1-03 = 25 [Terminal S3 Function Selection = External Fault (NC-Always-Coast)]*.
	9	Install an electromagnetic contactor (MC) when using a braking resistor or a braking resistor unit. Properly install the resistor and ensure that overload protection shuts off the power supply using the electromagnetic contactor.
	10	Verify phase advancing capacitors, input noise filters, or earth leakage circuit breakers are NOT installed on the output side of the drive.

Table 2.31 Control Circuit Wiring

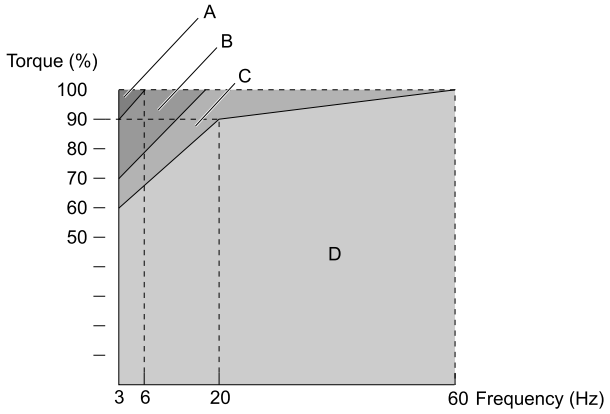
Check	No.	Item to Check
	1	Use twisted-pair cable for all drive control circuit wiring.
	2	Ground the shields of shielded wiring to the terminal E (G).
	3	Properly wire any option cards.
	4	Check for any other wiring mistakes. **Note:** Only use a multimeter to check wiring.
	5	Tighten the control circuit terminal screws of the drive to their specified torques.
	6	Pick up all wire clippings.
	7	Ensure that no frayed wires on the terminal block are touching other terminals or connections.
	8	Properly separate control circuit wiring and main circuit wiring.
	9	Control circuit wiring should not exceed 50 m.
	10	Safe Disable input wiring should not exceed 30 m.

2.25 Motor Application Precautions

◆ Precautions for Existing Standard Motors

■ Low-Speed Range

When a drive operates a standard motor, it will lose more power compared to operating the motor with a commercial power supply. In the low speed range, the temperature of the motor increases quickly because the motor cannot decrease its temperature when the speed decreases. In these conditions, decrease the load torque of the motor in the low-speed range. Figure 2.150 shows the permitted load characteristics for a Yaskawa standard motor. When 100% continuous torque is necessary at low speeds, use a motor designed to operate with a drive.



A - 25% ED (or 15 min)
B - 40% ED (or 20 min)
C - 60% ED (or 40 min)
D - Continuous operation

Figure 2.150 Permitted Load Characteristics for a Yaskawa Standard Motors

■ Insulation Withstand Voltage

Consider motor voltage tolerance levels and motor insulation in applications with an input voltage of over 440 V or particularly long wiring distances. Use an insulated drive motor.

NOTICE: *Use an inverter-duty motor or vector-duty motor with reinforced insulation and windings applicable for use with an AC drive. If the motor does not have the correct insulation, it can cause a short circuit or ground fault from insulation deterioration.*

■ High-Speed Operation

If you operate a motor more than its rated speed, you can have problems with the motor bearing durability and dynamic balance of the machine. Contact the motor or machine manufacturer.

■ Torque Characteristics

When you operate a motor with a drive, the torque characteristics are different than when you operate the motor directly from line power. Make sure that you know about the load torque characteristics for your application.

■ Vibration

Vibrations could occur in the these conditions:

- Resonance with the natural frequency of machinery
  Use caution if you add a variable-speed drive to applications that operate the motor from line power at a constant speed. If resonance occurs, install shock-absorbing rubber around the base of the motor and enable the Jump frequency control.
- The motor is not balanced
  Use caution if the motor speed is more than the rated motor speed.
- Subsynchronous resonance
  Subsynchronous resonance can occur with long motor shafts and in applications such as turbines, blowers, and fans with high inertia loads.
  Use Closed Loop Vector Control when these applications have subsynchronous resonance problems.

■ Audible Noise

The audible noise of the motor changes when the carrier frequency setting changes. When you use a high carrier frequency, audible noise from the motor is equivalent to the motor noise generated when you operate from line power. If you operate at speeds that are more than the rated rotation speed, the unwanted motor noise increases.

◆ Precautions Concerning Use of Specialized Motors

■ Pole Change Motor

The rated current of pole change motors differs from that of standard motors. Check the maximum current of the motor before selecting a drive. Always stop the motor before switching between the number of motor poles. If the number of poles is changed while the motor is turning, the motor will coast to stop due to overvoltage from regeneration or the overcurrent protection circuitry.

■ Explosion-Proof Motors

To use an explosion-proof motor, you must do an explosion-proof test with the drive. The same is true even for existing installations of explosion-proof motors. The drive is not designed for explosion-proof areas. Ensure that the drive is installed in a safe location.

The encoder used with pressure-resistant explosion-proof motors is intrinsically safe. When wiring between the drive and encoder, always connect through a specialized pulse coupler.

■ Geared Motors

The continuous speed range differs depending on the lubricating method and the manufacturer. In particular, in the case of oil lubrication, continuous operation in the low speed range may cause burnout. Consult with the manufacturer for the applications that require frequencies in excess of the rated frequency.

■ Single-Phase Motors

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

■ Motor with Brake

When using a drive to operate a motor with brake, and the brake is connected to the output side of the drive, it may not release at start due to low voltage levels. Use a motor with brake that has an independent source of power for the brake. Connect the brake power supply to the power supply side of the drive. Note that motors with built-in brakes tend to generate a fair amount of noise when running at low speeds.

◆ Notes on the Power Transmission Mechanism

For power transmission machinery that uses oil to lubricate gearboxes, transmissions, or reduction gears, make sure that you use precaution if you operate the machinery continuously at low speed. Oil does not lubricate the system as well at low speeds. If you operate at frequencies higher than the rated frequency, it can cause problems with the power transmission mechanism. These problems include audible noise, decreased service life, and decreased durability.

3

Startup Procedure and Test Run

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3.1 Section Safety

⚠DANGER

Electrical Shock Hazard

Do not examine, connect, or disconnect wiring on an energized drive. Before servicing, disconnect all power to the equipment and wait for the time specified on the warning label at a minimum. The internal capacitor stays charged after the drive is de-energized. The charge indicator LED extinguishes when the DC bus voltage decreases below 50 Vdc. When all indicators are OFF, remove the covers before measuring for dangerous voltages to make sure that the drive is safe.

If you do work on the drive when it is energized, it will cause serious injury or death from electrical shock.

⚠WARNING

Electrical Shock Hazard

Do not operate the drive when covers are missing. Replace covers and shields before you operate the drive. Use the drive only as specified by the instructions.

Some figures in this section include drives without covers or safety shields to more clearly show the inside of the drive. If covers or safety shields are missing from the drive, it can cause serious injury or death.

Do not remove covers or touch circuit boards while the drive is energized.

If you touch the internal components of an energized drive, it can cause serious injury or death.

Sudden Movement Hazard

When you use a mechanical holding brake with the drive in a lifting application, you must close the brake if an input terminal triggers the Baseblock command to stop drive output.

If you enter the baseblock command, the motor will suddenly coast and the load will slip, which can cause serious injury or death.

Crush Hazard

Install a fall detector or overspeed detector to the external controller.

If you do not install these components, it can cause damage to the drive or serious injury or death.

3.2 Component Names and Functions

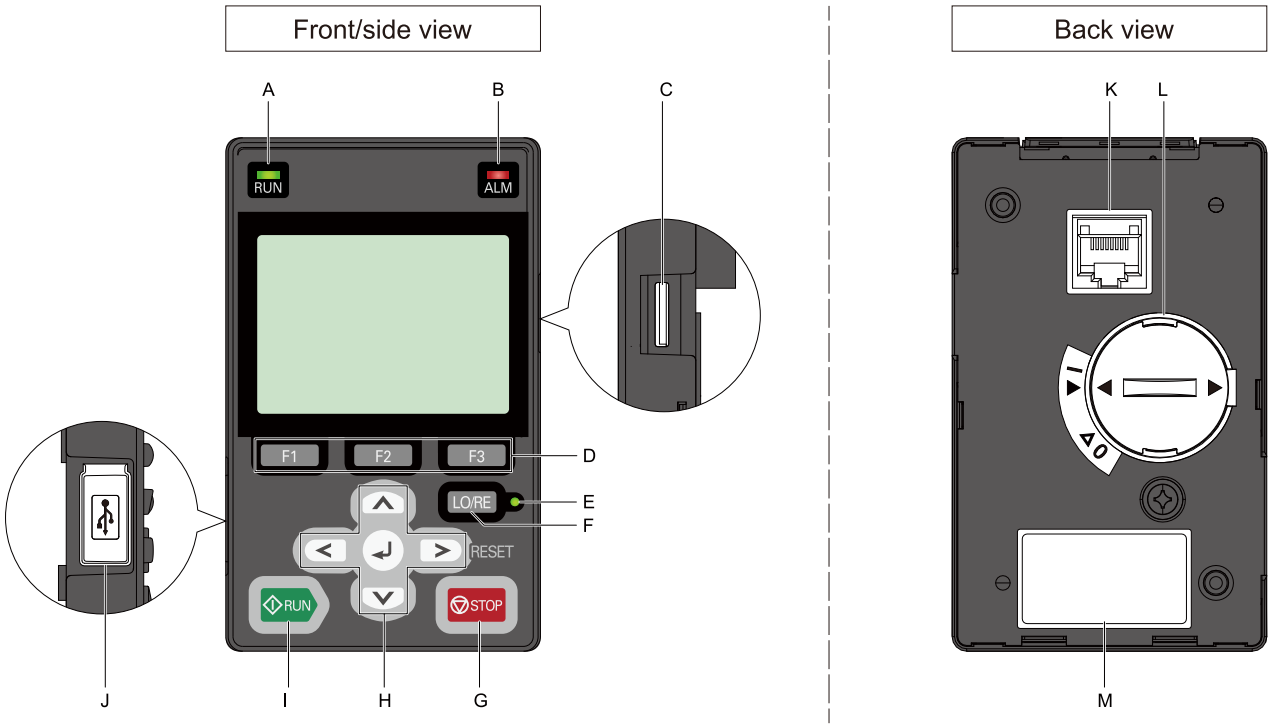


Figure 3.1 Keypad

Table 3.1 Component Names and Functions

No.	Name	Function
A	RUN LED	Illuminates to show that the drive is operating the motor. The LED turns OFF when the drive stops. Flashes to show that: • The drive is decelerating to stop. • The drive received a Run command but the frequency reference is 0 Hz. Flashes quickly to show that: • The drive received a Run command from the MFDI terminals when the drive is not in Drive Mode. • The drive received a Fast Stop command. • The safety function shuts off the drive output. • The user pushed on the keypad while the drive is operating in REMOTE Mode. • The drive is energized with an active Run command and *b1-17 = 0 [Run Command at Power Up = Disregard Existing RUN Command]*.
B	ALM LED	Illuminates when the drive detects a fault. Flashes when the drive detects: • Alarm • An oPE parameter setting error • A fault or alarm during Auto-Tuning The light switches off when the drive is in normal operation. There is no fault or alarm.
C	microSD Card Insertion Slot	The insertion point for a microSD card.
D	Function Keys (F1, F2, F3)	The menu shown on the keypad sets the functions for function keys. The name of each function is in the lower half of the display window.
E	LO/RE LED	Illuminated: The keypad controls the Run command (LOCAL Mode). OFF: The control circuit terminal or serial transmission device controls the Run command (REMOTE Mode). **Note:** • LOCAL: Operated using the keypad. Use the keypad to enter Run/Stop commands and the frequency reference command. • REMOTE: Operated from the control circuit terminal or serial transmission. Use the frequency reference source entered in *b1-01* and the Run command source selected in *b1-02*.
F	LO/RE Selection Key	This key is not used. **Note:** Cannot switch from Local Mode to Remote Mode.

No.	Name	Function
G	STOP Key	Stops drive operation. **Note:** The STOP key has highest priority Push STOP to stop the motor even when a Run command (REMOTE Mode) is active at MFDI terminals. Set *o2-02 = 0 [STOP Key Function Selection = Disabled]* to disable the priority in STOP.
H	Left Arrow Key	Moves the cursor to the left.
	Up Arrow Key/Down Arrow Key	• Scrolls up or down to display the next item or the previous item. • Selects parameter numbers, and increments or decrements setting values.
	Right Arrow Key (RESET)	• Moves the cursor to the right. • Continues to the next screen. • Clears drive faults.
	ENTER Key	• Enters parameter values and settings. • Selects menu items to move the user between keypad displays. • Selects each mode, parameter, and set value.
I	RUN Key	Starts the drive in LOCAL mode. Starts the motor tuning procedure in Auto-Tuning Mode.
J	USB Terminal	Uses a USB cable (USB standard 2.0, type A - mini-B) to connect the keypad to a PC.
K	RJ-45 Connector	Connects to the drive using an RJ-45 8-pin straight through UTP CAT5e extension cable or keypad connector.
L	Clock Battery Cover	Remove it when installing/replacing the clock battery. **Note:** • Refer to "Replace the Keypad's Battery" for details on the type of battery required and the installation procedure. • The clock battery is not supplied as accessories.
M	Nameplate	Displays keypad model, lot number, and FLASH number. **Note:** Keypads with FLASH number of 1002 or later can be used. Keypads with FLASH number of 1001 or earlier may not display messages properly.

◆ LCD Display

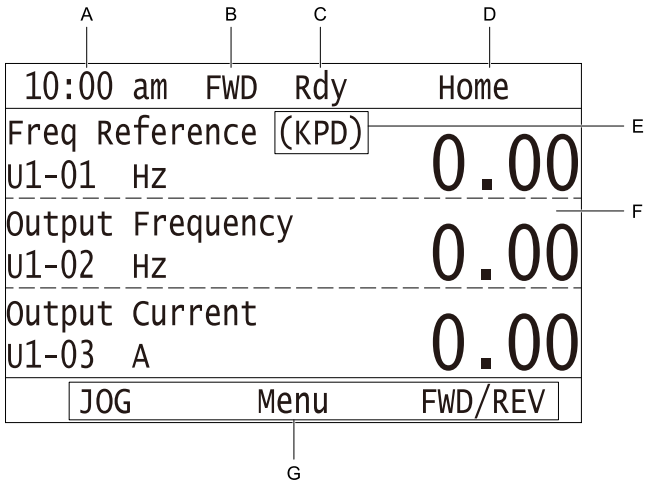


Figure 3.2 LCD Display Indications

Table 3.2 LCD Display Indications and Meaning

No.	Name	Description
A	Time display area	Current time is displayed. Time is set in the default settings screen.
B	Forward run/Reverse indication	Shows direction of motor rotation. • FWD: Displayed when set to Forward run. • REV: Displayed when set to Reverse.
C	Ready	Rdy is displayed when the drive is ready for operation or is currently running.
D	Mode display area	The name of the currently displayed mode or screen is shown here.

No.	Name	Description
E	Frequency reference source indication	The current frequency reference source is shown here. • KPD: keypad • AI: analog input terminal (terminals A1 to A3) • COM: MEMOBUS/Modbus communications • OPT: option card
F	Data display area	Values set for parameters, current values of monitors, and details of operational results are shown here.
G	Function keys 1 to 3 (F1 to F3)	The function names shown here change depending on the screen that is selected. Execute a function by pressing one of the function keys F1 to F3 on the keypad.

◆ Indicator LEDs and Drive Status

LED	Display	Drive Status
RUN LED	Illuminated	The drive is operating the motor.
	Flashing	• The drive is decelerating to stop. • The drive received a Run command with a frequency reference of 0 Hz, but the drive is not set for zero speed control. • The drive received a DC Injection Braking command.
	Flashing Quickly	• The drive received a Run command from the MFDI terminals and is switching to REMOTE Mode while the drive is in LOCAL Mode. • The drive received a Run command from an external source and the drive is not in Drive Ready (READY) condition. • The drive received a Fast Stop command. • The safety function shut off the drive output. • You pushed STOP on the keypad while the drive is operating in REMOTE Mode. • The drive is energized with an active Run command and *b1-17 = 0 [Run Command at Power Up = Disregard Existing RUN Command]*. • When *b1-03 = 3 [Stopping Method Selection = Coast to Stop with Timer]*, the Run command is disabled then enabled during the Run wait time. • The drive received a DC Injection Braking command. • The voltage of the main circuit power supply decreased, and the 24 V power supply is supplying power only the the drive.
	OFF	The motor is stopped.
ALM LED	Illuminated	The drive detects a fault.
	Flashing	The drive detected one of the following: • An alarm • An oPE parameter setting error • A fault or error during Auto-Tuning **Note:** The digital characters displayed on the keypad will also flash.
	OFF	There are no drive faults or alarms.
LO/RE LED	Illuminated	The keypad controls the Run command (LOCAL Mode).
	OFF	The control circuit terminal or serial transmission device controls the Run command (REMOTE Mode).

■ LED Flashing Statuses

Refer to Figure 3.3 for information about the differences between flashing and “flashing quickly”.

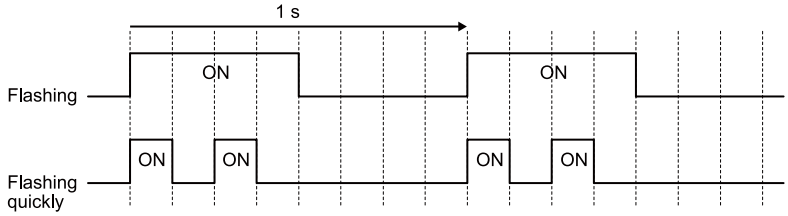


Figure 3.3 LED Flashing Statuses

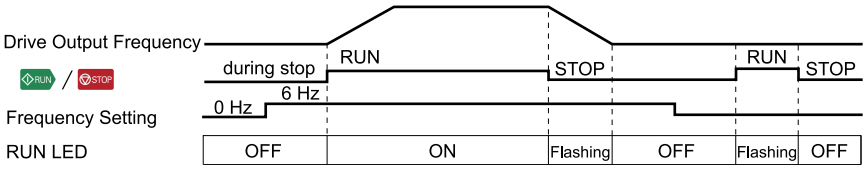


Figure 3.4 Relation between RUN indicator and Drive Operation

◆ Keypad Mode and Menu Displays

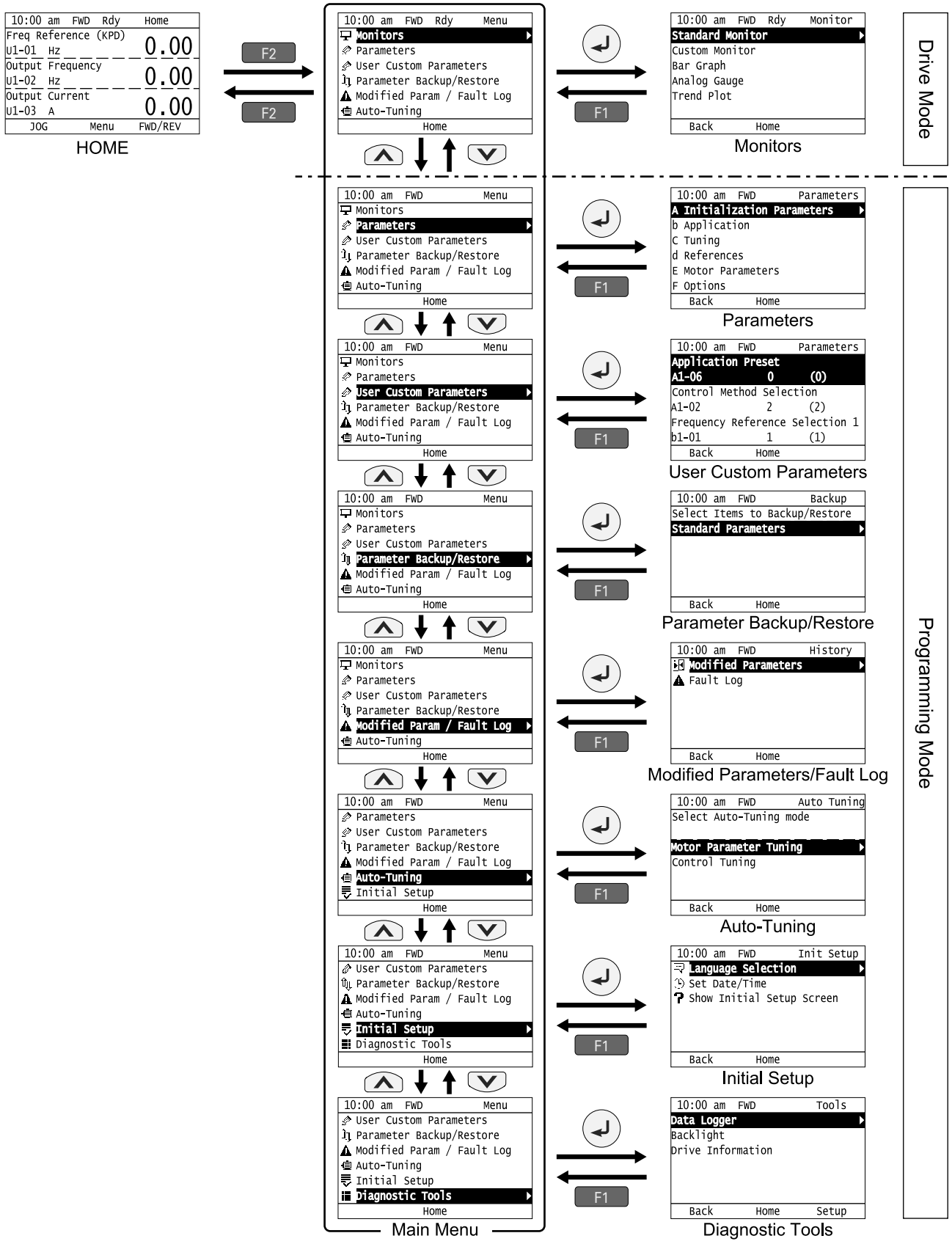


Figure 3.5 Keypad Functions and Display Levels

Note:

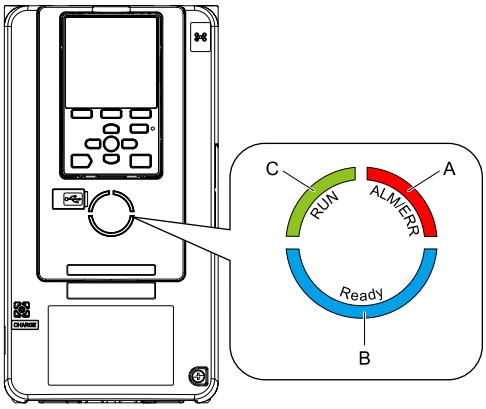
- Energize the drive with factory defaults to show the Initial Setup screen. Push F2 (Home) to show the HOME screen.
  – Select [No] from the [Show Initial Setup Screen] setting to not display the Initial Setup screen.
- Push < from the Home screen to show drive monitors.
- Push ↵ to set *d1-01 [Reference 1]* when the Home screen shows *U1-01 [Frequency Reference]* in LOCAL Mode.
- The keypad will show [Rdy] when the drive is in Drive Mode. The drive is prepared to accept a Run command.

Table 3.3 Drive Mode Screens and Functions

Mode	Keypad Screen	Function
Drive Mode	Monitors	Sets monitor items to display.
Programming Mode	Parameters	Changes parameter settings.
	User Custom Parameters	Shows the User Parameters.
	Parameter Backup/Restore	Saves parameters to the keypad as backup.
	Modified Parameters/Fault Log	Shows modified parameters and fault history.
	Auto-Tuning	Auto-Tunes the drive.
	Initial Setup Screen	Changes initial settings.
	Diagnostic Tools	Sets data logs and backlight.

3.3 LED Status Ring

The LED Status Ring on the drive cover shows the drive operating status.



A - ALM/ERR **C - RUN**
B - Ready

LED		Status	Description
A	ALM/ERR	Illuminated	The drive detects a fault.
		Flashing *1	The drive detects: • Alarm • An oPE parameter setting error • A fault or error during Auto-Tuning. **Note:** The LED will illuminate to identify a fault if the drive detects a fault and an alarm at the same time.
		OFF	No fault or alarm occurs on the drive.
B	Ready	Illuminated	The drive is operating or is prepared for operation.
		Flashing *1	The drive is in *STo [Safe Torque OFF]* Mode.
		Flashing Quickly *1	The voltage of the main circuit power supply dropped, and only the external 24 V power supply provides the power to the drive.
		OFF	• The drive detects a fault. • There is no fault and the drive received a Run command, but the drive cannot operate (such as when in Programming Mode, or when RUN is flashing).
C	RUN	Illuminated	The drive is in regular operation.
		Flashing *1	• The drive is decelerating to stop. • The drive received a Run command but the frequency reference is 0 Hz. • The drive received a DC Injection Braking command.
		Flashing Quickly *1	• The drive received a Run command from the MFDI terminals and is switching to REMOTE Mode while the drive is in LOCAL Mode. • The drive received a Run command from the MFDI terminals when the drive is not in Drive Mode. • The drive received a Fast Stop command. • The safety function shuts off the drive output. • The user pushed STOP on the keypad while the drive is operating in REMOTE Mode. • The drive is energized with an active Run command and *b1-17 = 0 [Run Command at Power Up = Disregard Existing RUN Command]*. • The drive is set to coast-to-stop with timer (*b1-03 = 3 [Stopping Method Selection = Coast to Stop with Timer]*), and the Run command is disabled then enabled during the Run wait time.
		OFF	The motor is stopped.

*1 Refer to Figure 3.6 for the difference between flashing and flashing quickly.

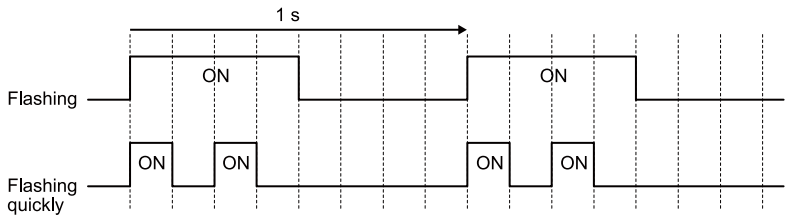


Figure 3.6 LED Flashing Statuses

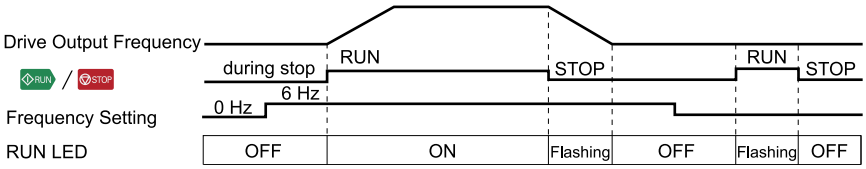
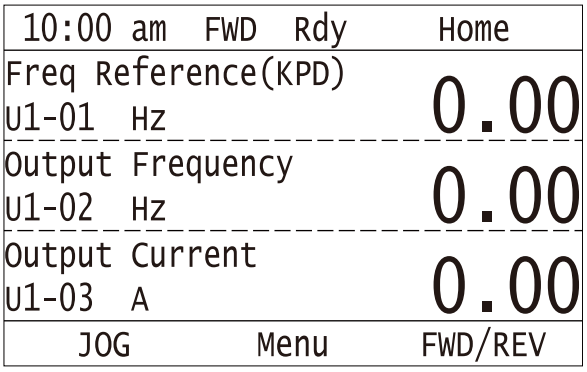


Figure 3.7 Relation between RUN LED and Drive Operation

3.4 Keypad Operation

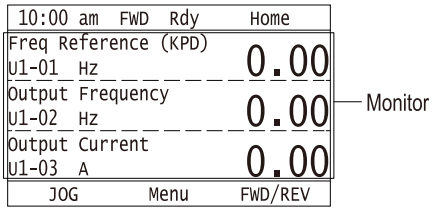
◆ Use the HOME Screen

The functions that can be controlled from the HOME screen and the content that is displayed are explained in the following.



■ View Monitors Shown in Home Screen

This figure shows monitor data in the data display area of the HOME screen.



- The monitor that is shown can be changed by changing the setting for *o1-40 [Home Screen Display Selection]*.
- When "Custom Monitor" is set for *o1-40 [Home Screen Display Selection]*, and there are a multiple number of screens, use ^ or v to switch among screens.

■ JOG Operation

You can use the JOG operation by setting *b1-02 = 0 [Run Command Selection 1 = Keypad]*, thus making the keypad the Run command source.

The motor will rotate while F1 (JOG) is pushed. Cease from pushing the key, and the motor stops.

■ Change Motor between Forward/Reverse Run

You can use the keypad to switch the direction of motor rotation between forward and reverse by setting *b1-02 = 0 [Run Command Selection 1 = Keypad]*.

Push F3 (FWD/REV) to toggle the direction of motor rotation between forward and reverse.

■ Show the Standard Monitor

Push < to show the standard monitor (*Ux-xx*). Push F2 (HOME) to return to the HOME screen.

Note:

When a fault, minor fault, or an error occurs, push < to show the content of the fault. If you push < again, the standard monitor (*Ux-xx*) is shown.

■ Change the Frequency Reference Value

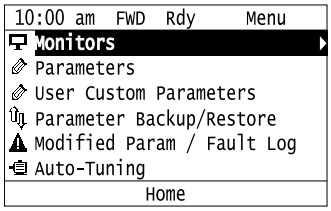
You can set the source of the frequency reference to the keypad from the Home screen by setting *b1-01 = 0 [Frequency Reference Selection 1 = Keypad]* and following the procedure below.

1. Push ↵ to access the screen for changing the frequency.
2. Push < or > to select the digit, then push ^ or v to change the value.
3. Push ↵ to confirm the changes in the value.

Note:
You cannot use this function when the keypad is not set to be the Run command source (REMOTE), or when *U1-01 [Frequency Reference]* is not shown in the HOME screen.

■ Show the Main Menu

Push F2 to show the main menu. Push F2 (HOME) to return to the HOME screen.



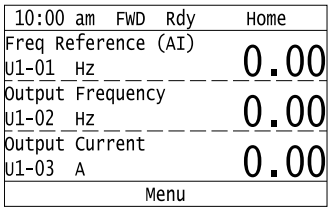
◆ Show the Monitor

This section shows how to show the standard monitors (*Ux-xx*).

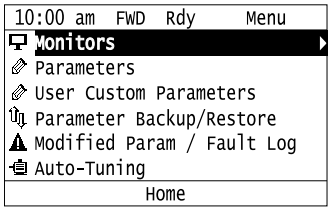
1. Push F2 [Home] to show the HOME screen.

Note:
- When the drive is in HOME Mode, the screen shows [Home] in the upper right-hand corner of the screen.
- If [Home] is not shown on F2, push F1 (Back) to show [Home] on F2.

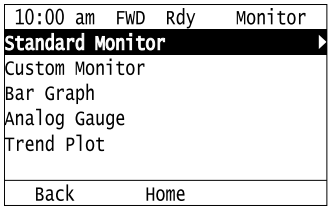
2. Push F2 (Menu).



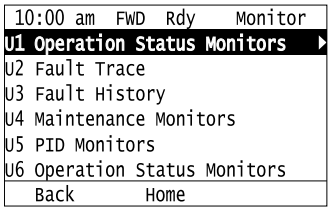
3. Push ▲ or ▼ to select [Monitors], then push ↵.



4. Push ▲ or ▼ to select [Standard Monitor], then push ↵.

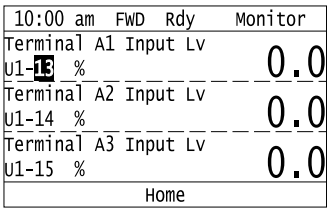


5. Push ▲ or ▼ to select monitor group, then push ↵.



6. Push ▲ or ▼ to change the monitor number to show the monitor item.

Note:
Push ← to go back to the previous page.



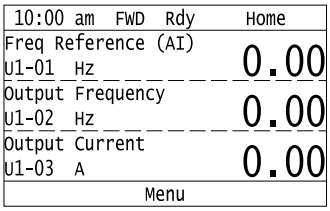
◆ Set Custom Monitors

You can select and register a maximum of 12 monitoring items to regularly show on the keypad.
This procedure shows how to set the motor speed to [Custom Monitor 1].

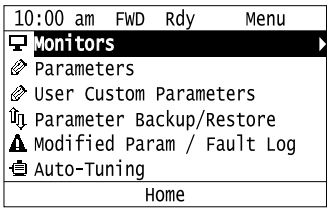
1. Push F2 (Home) to show the HOME screen.

Note:
- The keypad will show [Home] in the top right corner when the HOME screen is active.
- If the keypad does not show [Home] on F2, push F1 (Back) to show [Home] on F2.

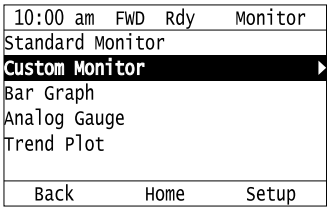
2. Push F2 (Menu).



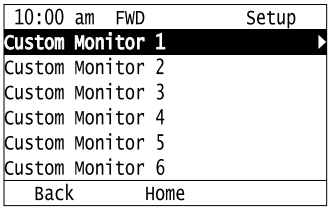
3. Push ▲ or ▼ to select [Monitors], then push ↵.



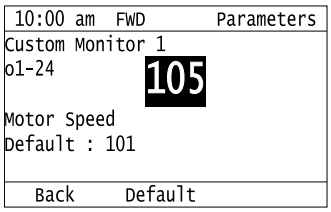
4. Push ▲ or ▼ to select [Custom Monitor], then push F3 (Setup).



5. Push ▲ or ▼ to select [Custom Monitor 1], then push ↵.



6. Push ▲ or ▼ to select the monitor number to register, then push ↵.
   Set the x-xx part of monitor *Ux-xx*. For example, to show monitor *U1-05*, set it to “105” as shown in this figure.



The configuration procedure is complete.

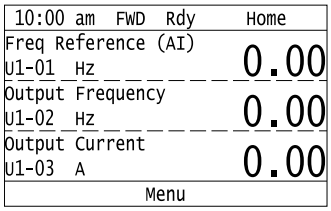
◆ Show Custom Monitors

The procedure in this section shows how to show the registered custom monitors.

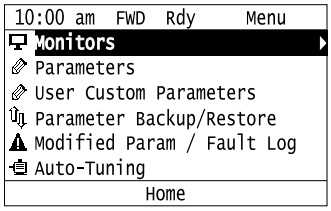
1. Push F2 [Home] to show the HOME screen.

Note:
- The keypad will [Home] in the top right corner when the HOME screen is active.
- If [Home] is not shown on F2, push F1 [Back] to show [Home] on F2.

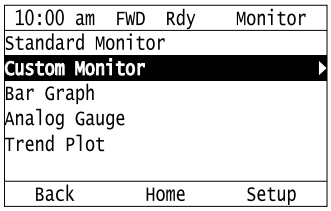
2. Push F2 [Menu].



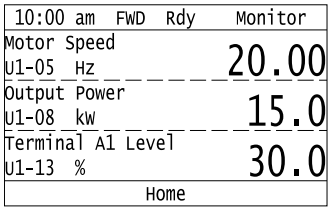
3. Push ▲ or ▼ to select [Monitors], then push ↵.



4. Push ▲ or ▼ to select [Custom Monitor], then push ↵.



The keypad shows the selected monitor as shown in this figure.



- When there are a minimum of two screens, push ▲ or ▼ to switch between screens.
- If you registered only one custom monitor to [Custom Monitor 1], the screen will show only one monitor. If you registered custom monitors only to [Custom Monitor 1] and [Custom Monitor 2], the screen will show only two monitors.

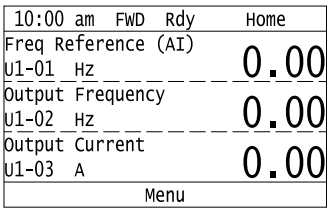
◆ Set the Monitors to Show as a Bar Graph

The procedure in this section shows how to show the frequency reference monitor as a bar graph.

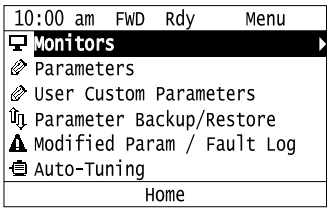
1. Push F2 [Home] to show the HOME screen.

Note:
• The keypad will [Home] in the top right corner when the HOME screen is active.
• If [Home] is not shown on F2, push F1 [Back] to show [Home] on F2.

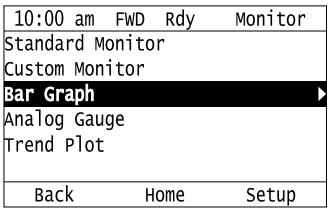
2. Push F2 [Menu].



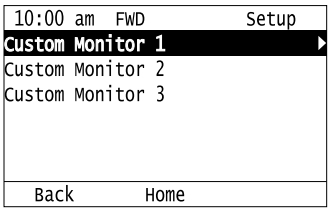
3. Push ▲ or ▼ to select [Monitors], then push ↵.



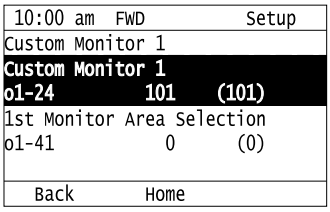
4. Push ▲ or ▼ to select [Bar Graph], then push F3 [Setup].



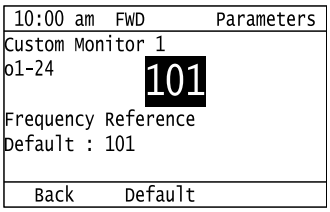
5. Push ▲ or ▼ to select the location to store the monitor, then push ↵.



6. Push ↵.



7. Push ▲ or ▼ to select the monitor number to register, then push ↵.
Monitor Set the x-xx part of the *Ux-xx*. For example, to show monitor *U1-01 [Frequency Reference]*, set it to "101" as shown in this figure.



The configuration procedure is complete.

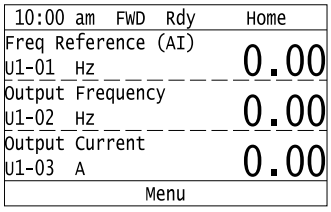
◆ Show Monitors as Bar Graphs

The procedure in this section shows how to show a specific monitor as a bar graph. You can show a maximum of three.

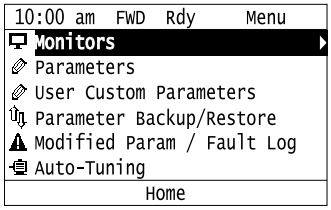
1. Push F2 (Home) to show the HOME screen.

Note:
• The keypad will show [Home] in the top right corner when the HOME screen is active.
• If [Home] is not shown on F2, push F1 (Back) to show [Home] on F2.

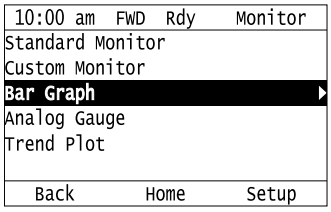
2. Push F2 (Menu).



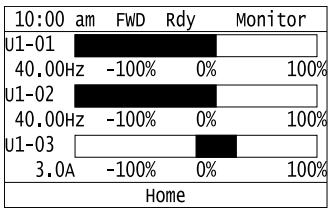
3. Push ▲ or ▼ to select [Monitors], then push ↵.



4. Push ▲ or ▼ to select [Display Bar Graph], then push ↵.



The screen will show the monitors as shown in this figure.



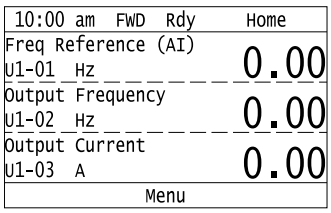
◆ Set the Monitors to Show as Analog Gauges

The procedure in this section shows how to show the frequency reference monitor as an analog gauge.

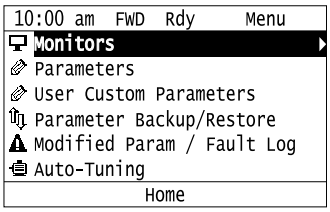
1. Push F2 [Home] to show the HOME screen.

Note:
• The keypad will [Home] in the top right corner when the HOME screen is active.
• If [Home] is not shown on F2, push F1 [Back] to show [Home] on F2.

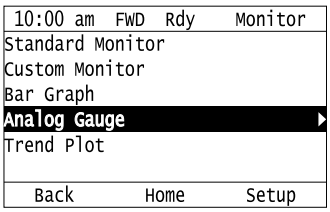
2. Push F2 [Menu].



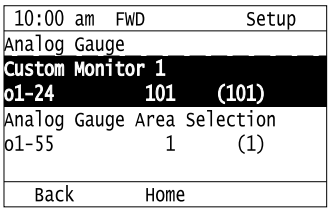
3. Push ▲ or ▼ to select [Monitors], then push ↵.



4. Push ▲ or ▼ to select [Analog Gauge], then push F3 [Setup].

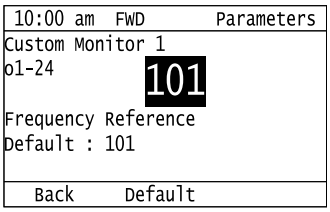


5. Push ↵.



6. Push ▲ or ▼ to select the monitor number to register, then push ↵.

   Monitor Set the x-xx part of the *Ux-xx*. For example, to show monitor *U1-01 [Frequency Reference]*, set it to "101" as shown in this figure.



The configuration procedure is complete.

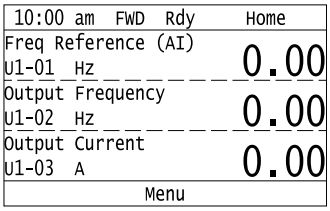
◆ Display Monitors as an Analog Gauge

The following explains how to display the contents selected for a monitor as an analog gauge.

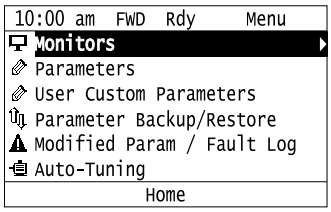
1. Push F2 [Home] to show the HOME screen.

Note:
- The keypad will [Home] in the top right corner when the HOME screen is active.
- If [Home] is not shown on F2, push F1 [Back] to show [Home] on F2.

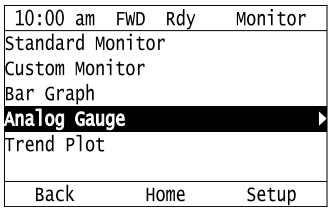
2. Push F2 [Menu].



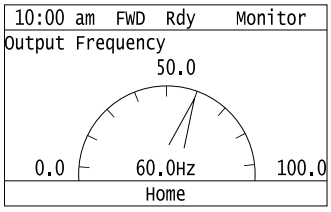
3. Push ▲ or ▼ to select [Monitors], then push ↵.



4. Push ▲ or ▼ to select [Analog Gauge], then push ↵.

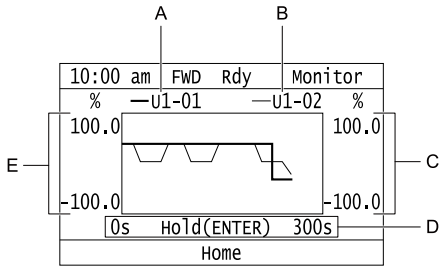


It will be displayed as follows.



◆ Set Monitoring Items to be Shown as a Trend Plot

You must set the items in this figure to display as a trend plot.



A - Monitor Parameter 1 (set with [Custom Monitor 1])
B - Monitor Parameter 2 (set with [Custom Monitor 2])
C - Trend Plot 2 Scale Maximum/Minimum Value
D - Trend Plot Time Scale
E - Trend Plot 1 Scale Maximum/Minimum Value

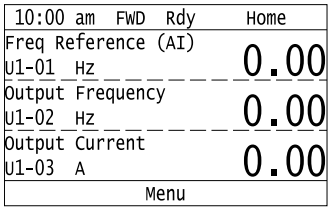
■ Select Monitor Items to Show as a Trend Plot

The procedure in this section shows how to show the frequency reference monitor as a trend plot.

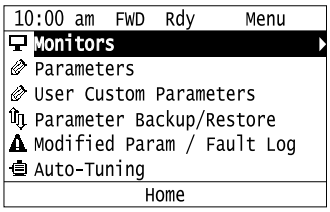
1. Push F2 [Home] to show the HOME screen.

Note:
• The keypad will [Home] in the top right corner when the HOME screen is active.
• If [Home] is not shown on F2, push F1 [Back] to show [Home] on F2.

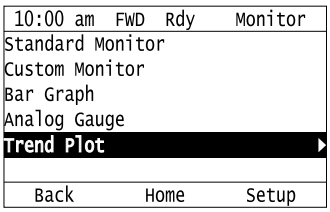
2. Push F2 [Menu].



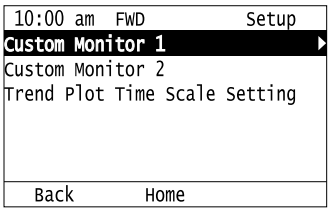
3. Push ▲ or ▼ to select [Monitors], then push ↵.



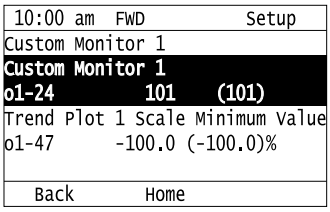
4. Push ▲ or ▼ to select [Trend Plot], then push F3 [Setup].



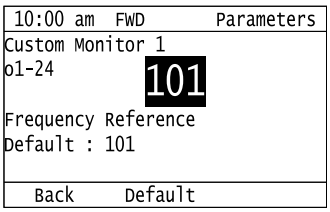
5. Push ▲ or ▼ to select [Custom Monitor 1], then push ↵.



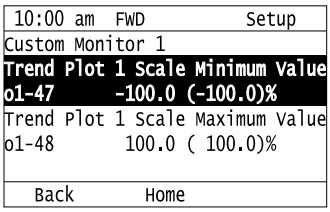
6. Push ↵.



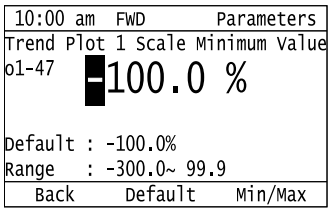
7. Push ▲ or ▼ to select the monitor number to register, then push ↵.
When the *U parameters* are on the display as "*Ux-xx*", the three digits in "x-xx" identify which monitor to output. For example, to show monitor *U1-01 [Frequency Reference]*, set it to "101" as shown in this figure.



8. Push ▲ or ▼ to select [Trend Plot 1 Scale Minimum Value], then push ↵.

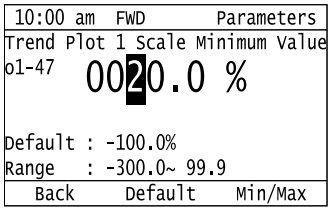


9. Push < or > to select the specified digit, then push ^ or v to select the correct number.

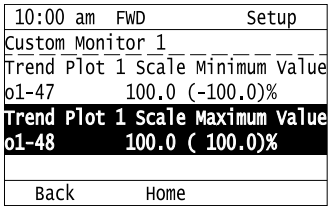


- Push F2 [Default] to set the parameters to factory defaults.
- Push F3 [Min/Max] to move between the minimum value and maximum value.

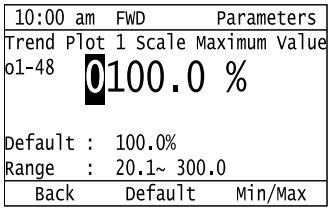
10. Push ↵ to keep the changes.



11. Push ^ or v to select [Trend Plot 1 Scale Maximum Value], then push ↵.

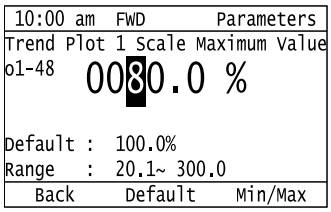


12. Push < or > to select the specified digit, then push ^ or v to select the correct number.



- Push F2 [Default] to set the parameters to factory defaults.
- Push F3 [Min/Max] to move between the minimum value and maximum value.

13. Push ↵ to keep the changes.



14. Push F1 [Back].
    If necessary, use the same procedure to set [Custom Monitor 2].

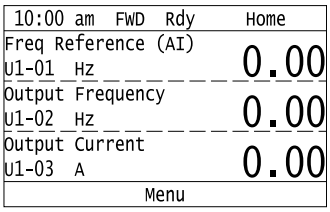
■ Set the Time Scale for the Trend Plot Monitor

The procedure in this section shows how to set the time scale for the trend plot monitor.

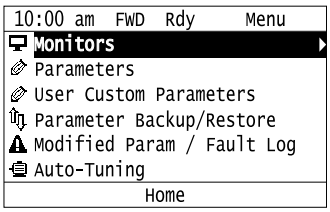
1. Push F2 (Home) to show the HOME screen.

Note:
- The keypad will show [Home] in the top right corner when the HOME screen is active.
- If [Home] is not shown on F2, push F1 (Back) to show [Home] on F2.

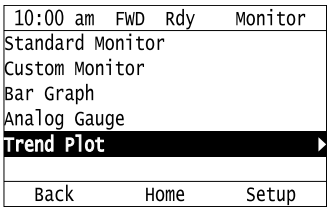
2. Push F2 (Menu).



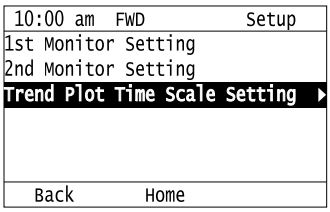
3. Push ▲ or ▼ to select [Monitors], then push ↵.



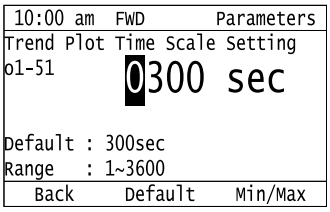
4. Push ▲ or ▼ to select [Trend Plot], then push F3 (Setup).



5. Push ▲ or ▼ to select [Trend Plot Time Scale Setting], then push ↵.

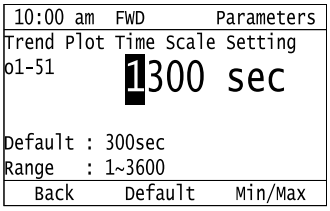


6. Push ◀ or ▶ to select the specified digit, then push ▲ or ▼ to select the correct number.



- Push F2 (Default) to set the parameters to the factory default.
- Push F3 (Min/Max) to move between the minimum value and maximum value.

7. Push ↵ to keep the changes.



The configuration procedure is complete.

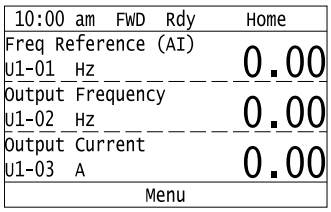
◆ Show Monitor Items as a Trend Plot

The procedure in this section shows how to show the selected monitor data as a trend plot.

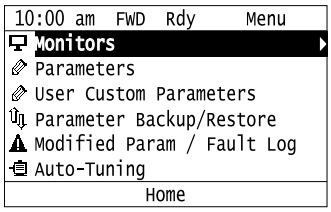
1. Push F2 [Home] to show the HOME screen.

Note:
• The keypad will [Home] in the top right corner when the HOME screen is active.
• If [Home] is not shown on F2, push F1 [Back] to show [Home] on F2.

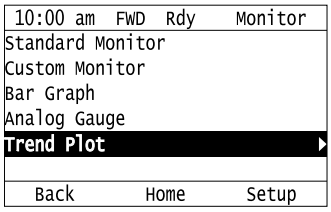
2. Push F2 [Menu].



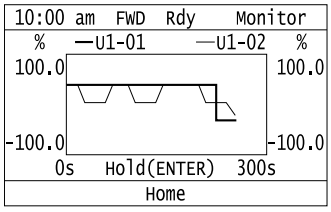
3. Push ^ or v to select [Monitors], then push ↵.



4. Push ^ or v to select [Trend Plot], then push ↵.



The screen will show the monitors as shown in this figure.



Note:

Push ↵ [Hold] to switch between Pause and Restart for the monitor display. The "Hold (ENTER)" message flashes while you pause monitoring.

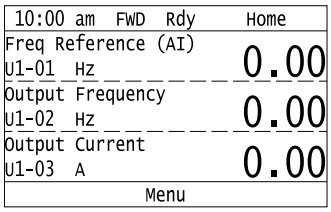
◆ Change Parameter Setting Values

This example shows how to change the setting value for *C1-01 [Acceleration Time 1]*. Do the steps in this procedure to set parameters for the application.

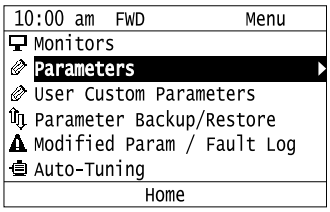
1. Push F2 (Home) to show the HOME screen.

Note:
• When the drive is in HOME Mode, the screen shows [Home] in the upper right-hand corner of the screen.
• If [Home] is not shown above the F2, push F1 (Back).

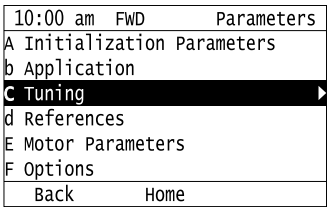
2. Push F2 (Menu).



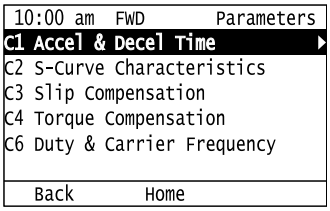
3. Push ▲ or ▼ to select [Parameters], then push ↵.



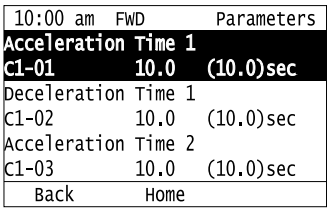
4. Push ▲ or ▲ to select [C Tuning], then push ↵.



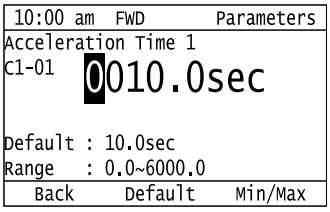
5. Push ▲ or ▼ to select [C1 Accel & Decel Time], then push ↵.



6. Push ▲ or ▼ to select *C1-01*, then push ↵.

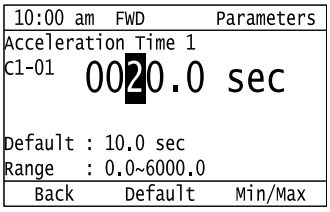


7. Push ◀ or ▶ to select the specified digit, then push ▲ or ▼ to select the correct number.



- Push F2 [Default] to set the parameter to factory default.
- Push F3 [Min/Max] to show the minimum value or the maximum value on the display.

8. Push ↵ to keep the changes.



9. Continue to change parameters, then push F1 [Back], F2 [Home] to go back to the home screen after you change all the applicable parameters.

◆ Examine User Custom Parameters

The User Custom Parameters show the parameters set in *A2-01 to A2-32 [User Parameter 1 to User Parameter 32]*. This lets users to quickly access and change settings to these parameters.

Note:

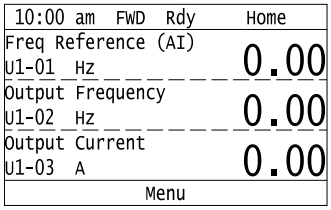
The User Custom Parameters always show *A1-06 [Application Selection]* at the top of the list. The *A2-01 to A2-32* settings change when the *A1-06* setting changes, which makes it easier to set and reference the necessary parameter settings.

1. Push F2 (Home) to show the HOME screen.

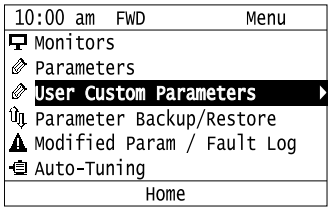
Note:

- When the drive is in HOME Mode, the screen shows [Home] in the upper right-hand corner of the screen.
- If [Home] is not shown on F2, push F1 (Back) to show [Home] on F2.

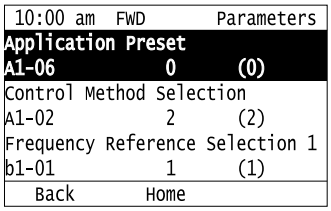
2. Push F2 (Menu).



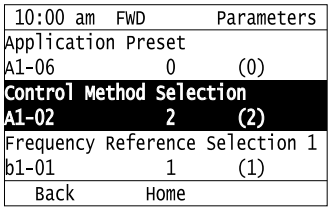
3. Push ▲ or ▼ to select [User Custom Parameters], then push ↵.



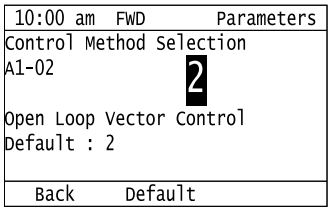
4. Push ▲ or ▼ to show the parameter to examine.



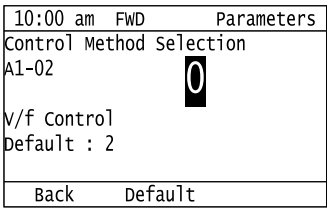
5. To re-edit a parameter, push ▲ or ▼, select the parameter to edit, then push ↵.



6. Push ◀ or ▶ to select the digit, then push ▲ or ▼ to change the value.



7. When you are done changing the value, push ↵.



The parameter setting procedure is complete.

◆ Save the Backup of Parameters

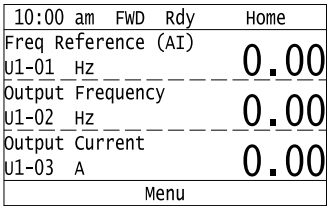
You can save a backup of the drive parameters to the keypad. The keypad can store parameter setting values for a maximum of four drives in different storage areas. Making backups of the parameter settings can save time when setting parameters after replacing a drive. If you set up more than one drive, you can copy the parameter settings from a drive that completed a test run to the other drives.

Note:
- Always stop the motor before making a backup of the parameters.
- While making a backup, the drive will not accept Run commands.

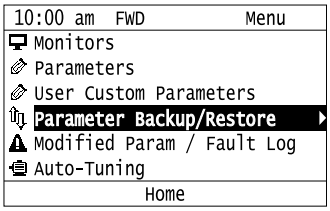
1. Push F2 (Home) to show the HOME screen.

Note:
- The keypad will show [Home] in the top right corner when the HOME screen is active.
- If [Home] is not on F2, push F1 (Back) to show [Home] on F2.

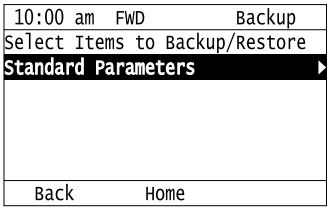
2. Push F2 (Menu).



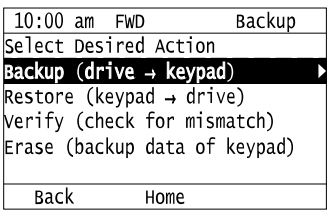
3. Push ∧ or ∨ to select [Parameter Backup/Restore], then push ↵.



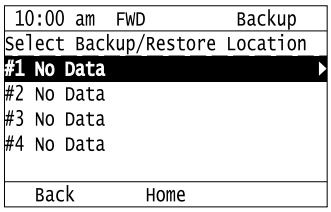
4. Push ∧ or ∨ to select the items to back up, then push ↵.



5. Push ∧ or ∨ to select [Backup (drive → keypad)], then push ↵.



6. Push ▲ or ▼ to select a memory location, then push ↵.



The keypad shows “End” when the backup procedure completes successfully.

◆ Write Backed-up Parameters to the Drive

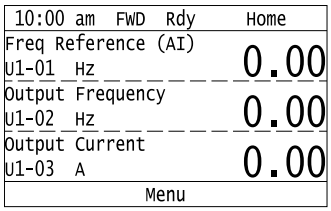
Users can write the parameters backed up on the keypad to another drive.

Note:
- Always stop the drive before starting the restoration procedure for parameter backups.
- The drive rejects a Run command while restoring parameters.

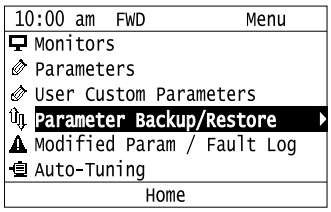
1. Push F2 (Home) to show the HOME screen.

Note:
- The keypad will show [Home] in the top right corner when the HOME screen is active.
- If [Home] is not on F2, push F1 (Back) to show [Home] on F2.

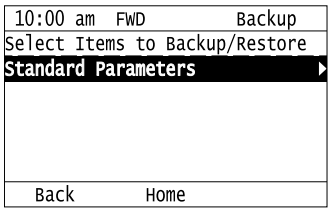
2. Push F2 (Menu).



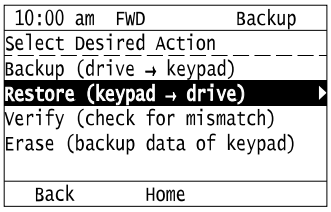
3. Push ▲ or ▼ to select [Parameter Backup/Restore], then push ↵.



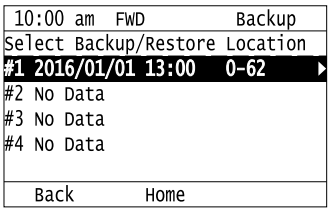
4. Push ▲ or ▼ to select the item to restore, then push ↵.



5. Push ▲ or ▼ to select [Restore (keypad → drive)], then push ↵.

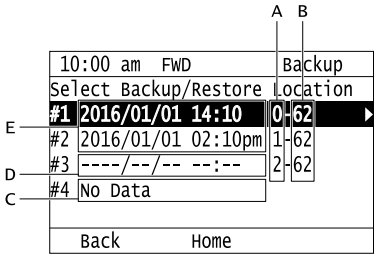


6. Push ▲ or ▼ to select the backed-up parameter data, then push ↵.



The keypad will show the "End" message when the write process is complete.

Note:
The keypad display differs depending on settings and conditions.



A - *A1-02 [Control Method Selection]* settings
B - *o2-04 [Drive Model (KVA) Selection]* settings (2 or 3 digits)
C - Parameter backup data is not registered
D - Backup data does not contain the date Information
E - Backup date

◆ Verify Keypad Parameters and Drive Parameters

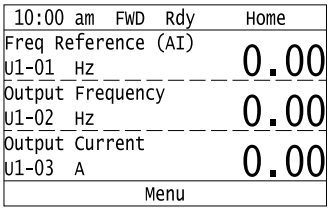
This procedure verifies that the parameter setting values that were backed up in the keypad agree with the parameter setting values in the drive.

Note:
- Always stop the drive before you start to verify the parameters.
- The drive does not accept Run commands while verifying parameters.

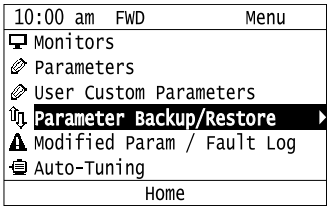
1. Push F2 (Home) to show the HOME screen.

Note:
- The keypad will show [Home] in the top right corner when the HOME screen is active.
- If [Home] is not on F2, push F1 (Back) to show [Home] on F2.

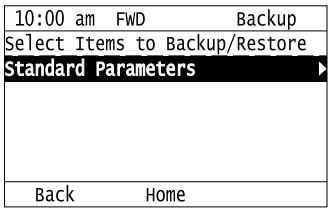
2. Push F2 (Menu).



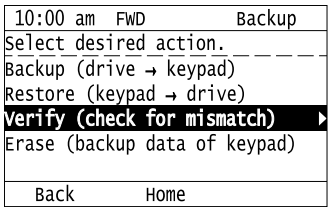
3. Push ▲ or ▼ to select [Parameter Backup/Restore], then push ↵.



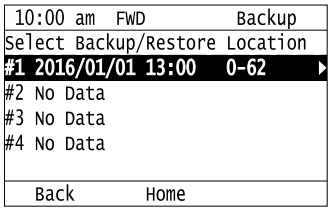
4. Push ▲ or ▼ to select the item to verify, then push ↵.



5. Push ▲ or ▼ to select [Verify (check for mismatch)], then push ↵.



6. Push ▲ or ▼ to select the data to verify, then push ↵.



The keypad shows “End” when the parameter settings backed up in the keypad agree with the parameter settings copied to the drive.

Note:

The keypad shows *vFyE [Parameters do not Match]* when the parameter settings backed up in the keypad do not agree with the parameter settings copied to the drive. Push one of the keys to return to the screen in Step 6.

◆ Erase Parameters Backed Up to the Keypad

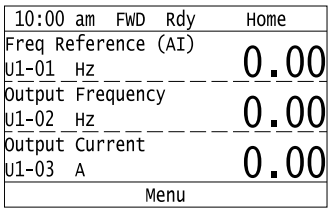
This procedure deletes parameters that were backed up to the keypad.

1. Push F2 (Home) to show the HOME screen.

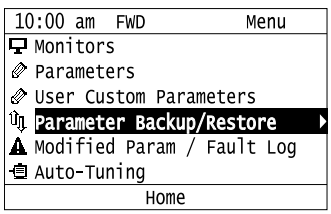
Note:

- The keypad will show [Home] in the top right corner when the HOME screen is active.
- If [Home] is not on F2, push F1 (Back) to show [Home] on F2.

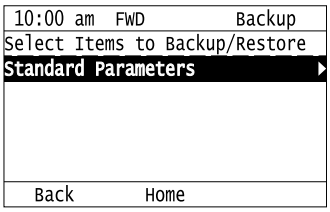
2. Push F2 (Menu).



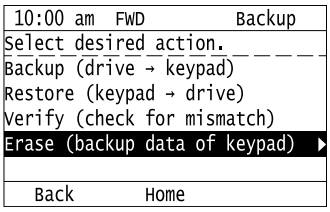
3. Push ▲ or ▼ to select [Parameter Backup/Restore], then push ↵.



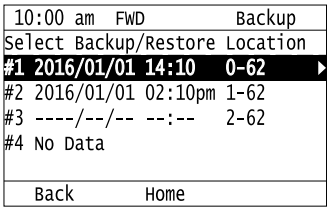
4. Push ▲ or ▼ to select the item to delete, then push ↵.



5. Push ▲ or ▼ to select [Erase (backup data of keypad)], then push ↵.



6. Push ▲ or ▼ to select the data to delete, then push ↵.



The keypad will show the "End" message when the write process is complete.

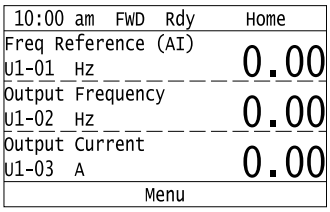
◆ Check Modified Parameters

This procedure will show all parameters that are not at their default values. This is very useful when you replace a drive. This lets you quickly access and re-edit changed parameters. When all parameters are at their default values, the keypad will show "0 Parameters".

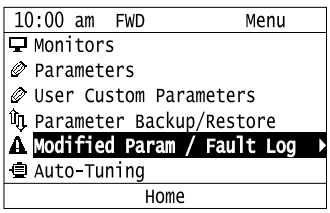
1. Push F2 (Home) to show the HOME screen.

Note:
- When the drive is in HOME Mode, the screen shows [Home] in the upper right-hand corner of the screen.
- If [Home] is not shown on F2, push F1 (Back) to show [Home] on F2.

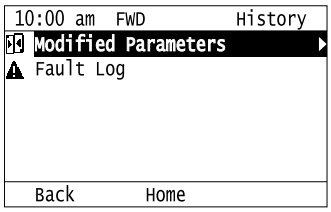
2. Push F2 (Menu).



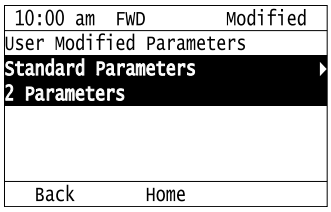
3. Push ▲ or ▼ to select [Modified Param / Fault Log], then push ↵.



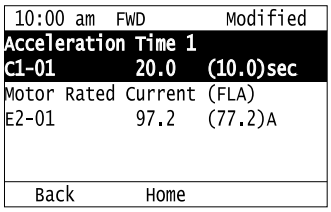
4. Push ▲ or ▼ to select [Modified Parameters], then push ↵.



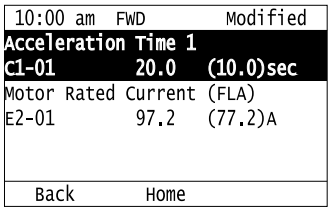
5. Push ↵.



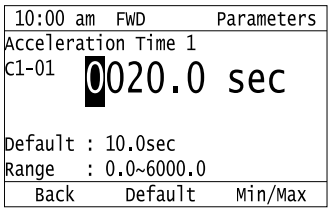
6. Push ▲ or ▼ to show the parameter to examine.



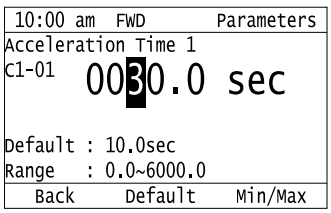
7. To re-edit a parameter, push ▲ or ▼, select the parameter to edit, then push ↵.



8. Push ◀ or ▶ to select the digit, then push ▲ or ▼ to change the value.



9. When you are done changing the value, push ↵.



The parameter revision procedure is complete.

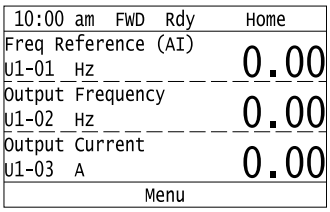
◆ Restore Modified Parameters to Defaults

This procedure will set all parameters with changed values to their default settings.

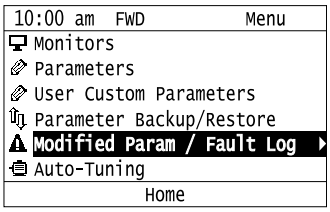
1. Push F2 (Home) to show the HOME screen.

Note:
- The keypad will show [Home] in the top right corner when the HOME screen is active.
- If [Home] is not shown on F2, push F1 (Back) to show [Home] on F2.

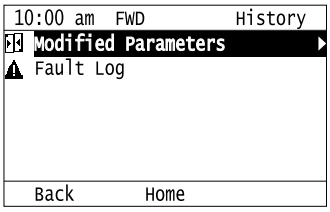
2. Push F2 (Menu).



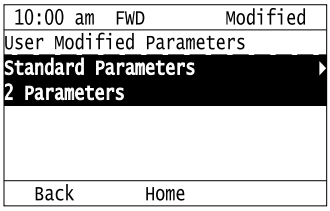
3. Push ^ or v to select [Modified Param / Fault Log], then push ↵.



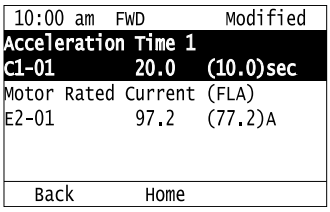
4. Push ^ or v to select [Modified Parameters], then push ↵.



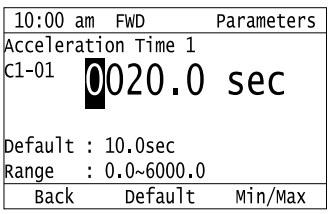
5. Push ↵.



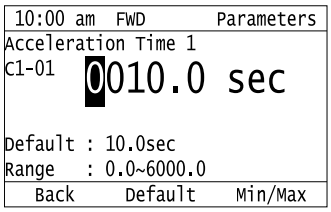
6. Push ^ or v to select the parameters to return to their default settings, then push ↵.



7. Push F2 (Default).



8. Push ↵.



The modified parameters are now set to default values.

◆ Show Fault History

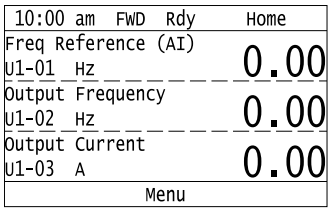
You can examine a maximum of 10 fault codes and dates and times that the faults occurred.

Note:
- To monitor the date and time of faults, you must first set the date and time on the keypad.
- If the keypad does not have a clock battery, you must set the date and time each time you energize the drive.

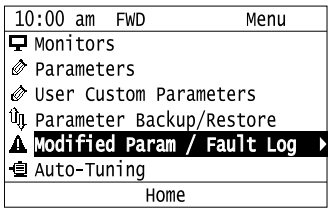
1. Push F2 (Home) to show the HOME screen.

Note:
- The keypad will show [Home] in the top right corner when the HOME screen is active.
- If [Home] is not shown on F2, push F1 (Back) to show [Home] on F2.

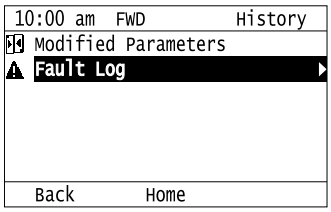
2. Push F2 (Menu).



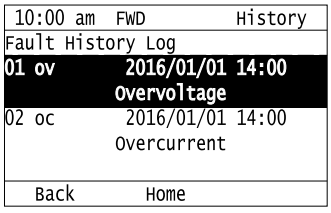
3. Push ∧ or ∨ to select [Modified Param / Fault Log], then push ↵.



4. Push ∧ or ∨ to select [Fault Log], then push ↵.

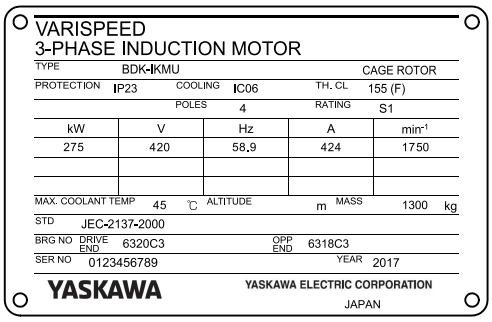


5. Push ∧ or ∨ to show the fault history you will examine.



◆ Auto-Tuning the Drive

Auto-Tuning uses motor characteristics to automatically set drive parameters.
Refer to the motor nameplate or the motor test report for the necessary information for Auto-Tuning.


VARISPEED
3-PHASE INDUCTION MOTOR

TYPE	BDK-IKMU			CAGE ROTOR
PROTECTION	IP23	COOLING	IC06	TH. CL 155 (F)
		POLES	4	RATING S1

kW	V	Hz	A	min-1
275	420	58,9	424	1750

MAX. COOLANT TEMP 45 ℃ ALTITUDE m MASS 1300 kg
STD JEC-2137-2000
BRG NO DRIVE END 6320C3 OPP END 6318C3
SER NO 0123456789 YEAR 2017
YASKAWA
YASKAWA ELECTRIC CORPORATION
JAPAN

Figure 3.8 Motor Nameplate (Example)

WARNING! *Sudden Movement Hazard. Before you do Auto-Tuning, remove all personnel and objects from the area around the drive, motor, and load. The drive and motor can start suddenly during Auto-Tuning and cause serious injury or death.*

WARNING! *Electrical Shock Hazard. During Auto-Tuning, the motor will receive high voltage when the motor is stopped. Do not touch the motor until Auto-Tuning is complete. If you touch a motor that is energized, it can cause serious injury or death.*

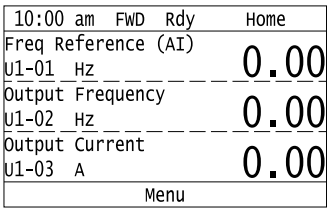
WARNING! *Sudden Movement Hazard. Before you do Rotational Auto-Tuning, disconnect the load from the motor. The load can move suddenly and cause serious injury or death.*

This procedure shows how to do Rotational Auto-Tuning.

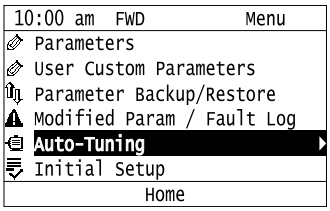
1. Push F2 (Home) to show the HOME screen.

Note:
- The keypad will show [Home] in the top right corner when the HOME screen is active.
- If [Home] is not shown on F2, push F1 (Back) to show [Home] on F2.

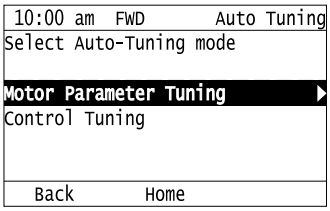
2. Push F2 (Menu).



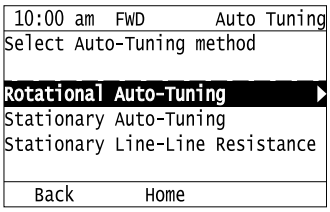
3. Push ▲ or ▼ to select [Auto-Tuning], then push ↵.



4. Push ▲ or ▼ to select [Motor Parameter Tuning], then push ↵.

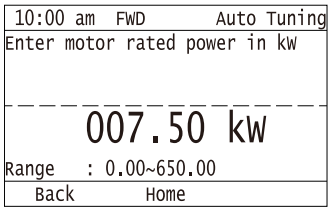


5. Push ▲ or ▼ to select [Rotational Auto-Tuning], then push ↵.

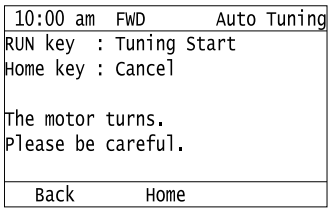


6. Follow the messages shown on the keypad to input the necessary Auto-Tuning data.

Example: Push < or > to select the specified digit, then push ^ or v to change the number. Push ↵ to save the change and move to the next entry field

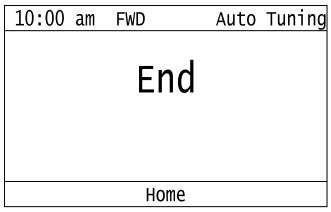


7. Follow the messages shown on the keypad to do the next steps.
8. When the keypad shows the Auto-Tuning start screen, push RUN.



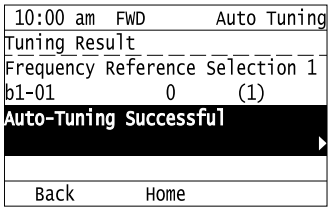
Auto-Tuning starts.
When you do Rotational Auto-Tuning, the motor will stay stopped for approximately one minute with power energized and then the motor will start to rotate.

9. When the keypad shows this screen after Auto-Tuning is complete for 1 or 2 minutes, push ↵ or >



The keypad will show a list of the changed parameters as the result of Auto-Tuning.

10. Push ^ or v in the parameter change confirmation screen to check the changed parameters, then select [Auto-Tuning Successful] at the bottom of the screen and push ↵.

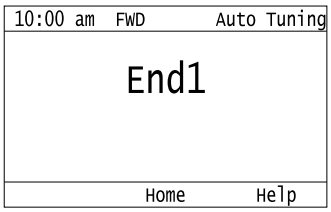


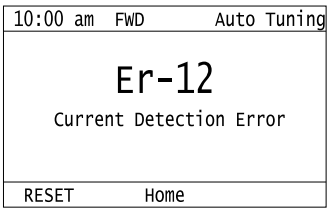
To change a parameter again, push ^ or v to select the parameter to change, then push ↵ to show the parameter setting screen.

Auto-Tuning is complete.

Note:

If the drive detects an error or you push STOP before Auto-Tuning is complete, Auto-Tuning will stop and the keypad will show an error code. *Endx* identifies that Auto-Tuning was successful with calculation errors. Find and repair the cause of the error and do Auto-Tuning again, or set the motor parameters manually. You can use the drive in the application if you cannot find the cause of the *Endx* error. *Er-xx* identifies that Auto-Tuning was not successful. Find and repair the cause of the error and do Auto-Tuning again.





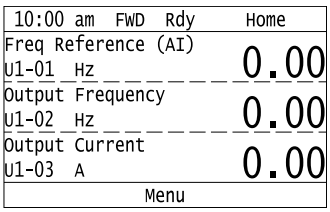
◆ Set the Keypad Language Display

The procedure in this section shows how to set the language shown on the keypad.

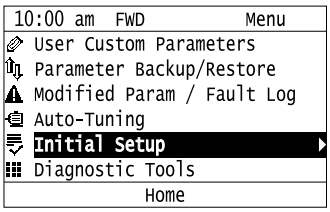
1. Push F2 (Home) to show the HOME screen.

Note:
- The keypad will show [Home] in the top right corner when the HOME screen is active.
- If [Home] is not shown on F2, push F1 (Back), to show [Home] on F2.

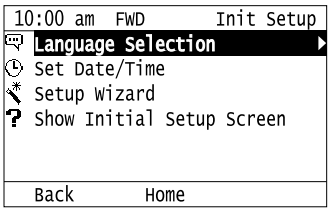
2. Push F2 (Menu).



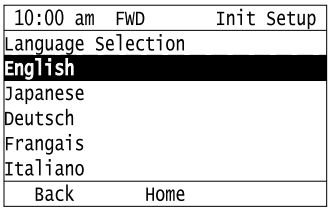
3. Push ▲ or ▼ to select [Initial Settings], then push ↵.



4. Push ▲ or ▼ to select [Language Selection], then push ↵.



5. Push ▲ or ▼ to select the language, then push ↵.



The procedure to set the keypad language is complete.

◆ Set the Date and Time

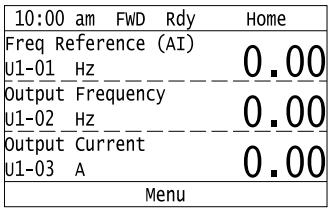
The procedure in this section shows how to set the date and time.

Note:
- Refer to *Replace the Keypad Battery on page 419* for information about the battery installation procedure.
  To set the drive to detect an alarm when the battery is dead or when the clock is not set, install the battery then set *o4-24 = 1 [bAT Detection selection = Enable (Alarm Detected)]*.
- If the keypad does not have a clock battery, you must set the date and time each time you energize the drive.

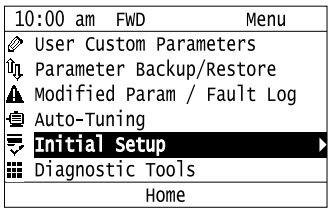
1. Push F2 (Home) to show the HOME screen.

Note:
- When the drive is in HOME Mode, the screen shows [Home] in the upper right-hand corner of the screen.
- If [Home] is not shown on F2, push F1 (Back) to show [Home] on F2.

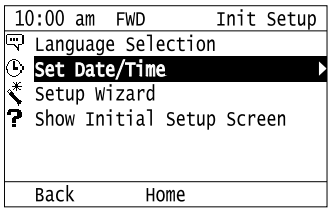
2. Push F2 (Menu).



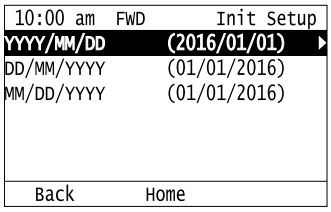
3. Push ▲ or ▼ to select [Initial Setup], then push ↵.



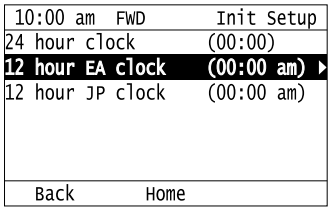
4. Push ▲ or ▼ to select [Set Date/Time], and push ↵.



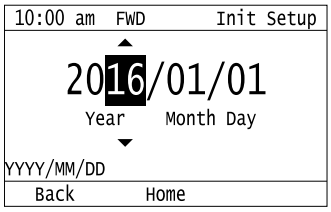
5. Push ▲ or ▼ to select the format of date display, then push ↵.



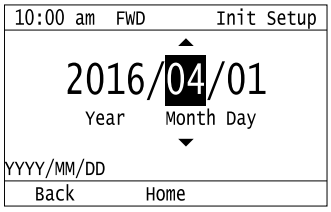
6. Push ▲ or ▼ to select the format of time display, then push ↵.



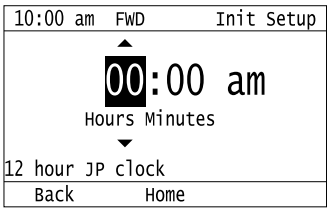
7. Push ◀ or ▶ to select the Year/Month/Day, then push ▲ or ▼ to change the value.



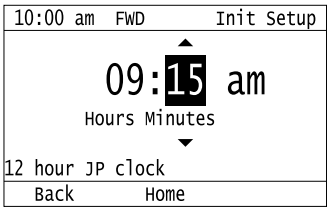
8. When you are done changing the value, push ↵.



9. Push < or > to select the hour or minute, then push ^ or v to change the value.



10. When you are done setting the time, push Enter.



The procedure for setting the date and time is complete.

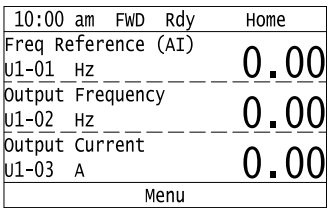
◆ Disable the Initial Setup Screen

Do the steps in this procedure to not show the initial start-up screen when the drive is energized.

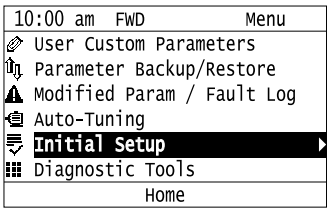
1. Push F2 (Home) to show the HOME screen.

Note:
- When the drive is in HOME Mode, the screen shows [Home] in the upper right-hand corner of the screen.
- If the screen does not show [Home] for F2, push F1 (Back), and then push F2 to show [Home].

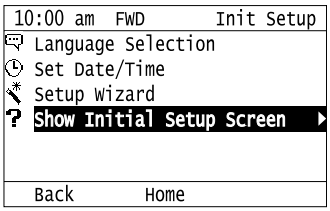
2. Push F2 (Menu).



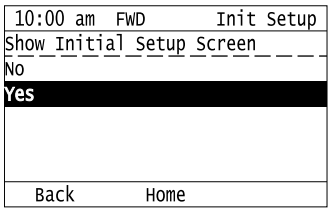
3. Push ^ / v to select [Initial Setup], then push Enter.



4. Push ^ / v to select [Show Initial Setup Screen], then push Enter.



5. Push ▲ / ▼ to select [No], then push ↵.



- [No]: The keypad will not show the Initial Setup Screen when the drive is energized.
- [Yes]: The keypad will show the Initial Setup Screen when the drive is energized.

◆ Start Data Logging

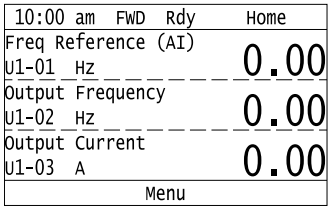
The data log function saves drive status information. Monitors *Ux-xx* are the source of log information. The procedure in this section shows how to start logging data.

You can record a maximum of 10 monitors.

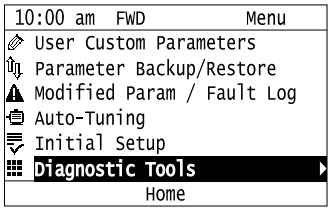
1. Make sure that a microSD card is inserted in the keypad.
2. Push F2 (Home) to show the HOME screen.

Note:
- When the drive is in HOME Mode, the screen shows [Home] in the upper right-hand corner of the screen.
- If [Home] is not shown on F2, push F1 (Back) to show [Home] on F2.

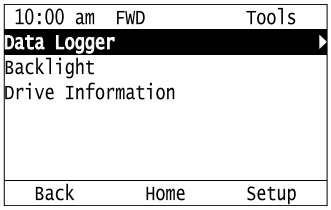
3. Push F2 (Menu).



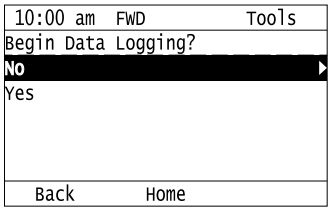
4. Push ▲ or ▼ to select [Diagnostic Tools], then push ↵.



5. Push ▲ or ▼ to select [Data Logger], then push ↵.

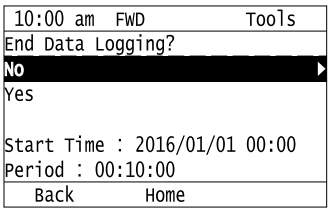


6. Push ▲ or ▼ to select [Yes] or [No], then push ↵.



- [Yes]: Data logging starts.
- [No]: Data logging will not start.

If the drive was logging data when you entered the command, the keypad look like this:



◆ Configuring the Data Log Content

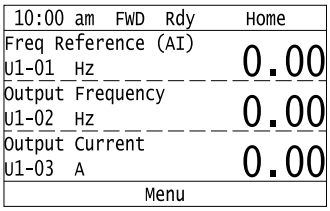
■ Set Monitor to Log

The procedure in this section shows how to set the monitor for which to log data.

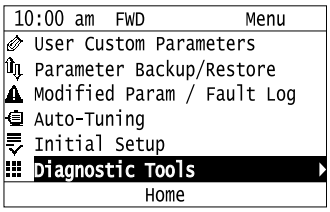
1. Push F2 (Home) to show the HOME screen.

Note:
- When the drive is in HOME Mode, the screen shows [Home] in the upper right-hand corner of the screen.
- If the screen does not show [Home] for F2, push F1 (Back), and then push F2 to show [Home].

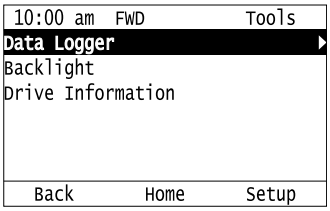
2. Push F2 (Menu).



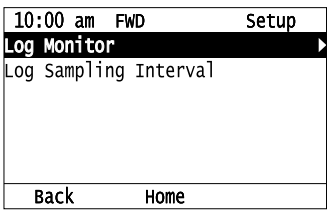
3. Push ▲ or ▼ to select [Diagnostic Tools], then push ↵.



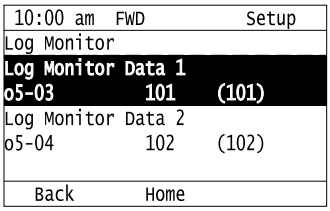
4. Push ▲ or ▼ to select [Data Logger], then push F3 (Setup).



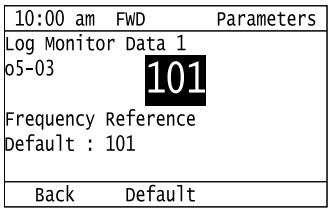
5. Push ▲ or ▼ to select [Log Monitor], then push ↵.



6. Push ▲ or ▼ to select the save-destination monitor parameter, then push ↵.



7. Push ▲ or ▼ to select the monitor number to be logged, then push ↵.



The configuration procedure is complete.

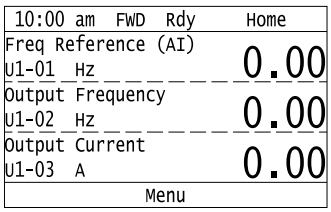
■ Set the Sampling Time

The procedure in this section shows how to set the sampling time for data logging.

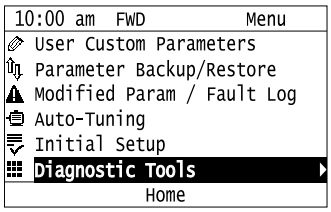
1. Push F2 (Home) to show the HOME screen.

Note:
- When the drive is in HOME Mode, the screen shows [Home] in the upper right-hand corner of the screen.
- If the screen does not show [Home] for F2, push F1 (Back), and then push F2 to show [Home].

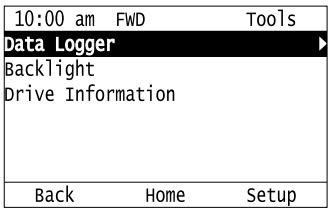
2. Push F2 (Menu).



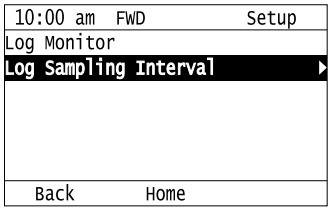
3. Push ▲ or ▼ to select [Diagnostic Tools], then push ↵.



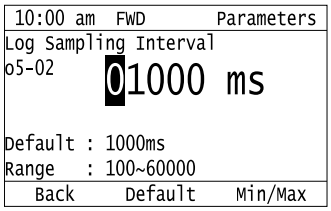
4. Push ▲ or ▼ to select [Data Logger], then push F3 (Setup).



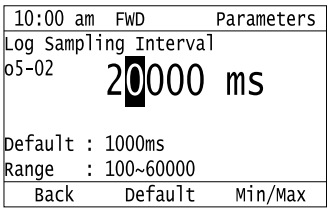
5. Push ▲ or ▼ to select [Log Sampling Interval], then push ↵.



6. Push ◀ or ▶ to select the digit, then push ▲ or ▼ to change the value.



7. When you complete changing the value, push ↵.



The procedure to set the sampling time is complete.

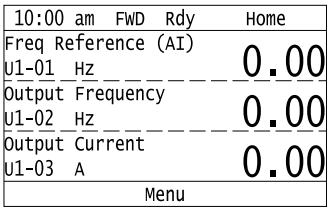
◆ Set Backlight to Automatically Turn OFF

You can set the backlight of the keypad screen to automatically turn OFF after a set length of time since the last key operation on the keypad. The procedure in this section shows how to turn ON and turn OFF the backlight.

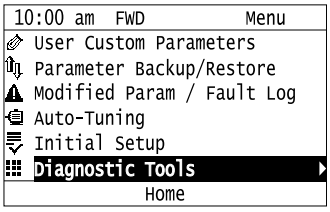
1. Push F2 (Home) to show the HOME screen.

Note:
• The keypad will show [Home] in the top right corner when the HOME screen is active.
• If [Home] is not shown on F2, push F1 (Back) to show [Home] on F2.

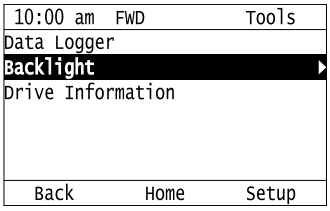
2. Push F2 (Menu).



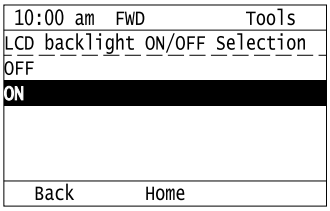
3. Push ∧ or ∨ to select [Diagnostic Tools], then push ↵.



4. Push ∧ or ∨ to select [Backlight], then push ↵.

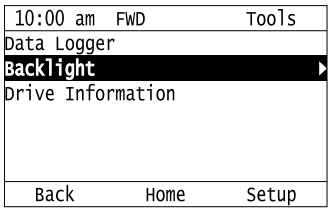


5. Push ∧ or ∨ to select [ON] or [OFF], then push ↵.

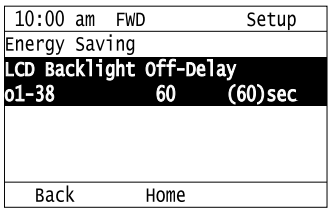


- [ON]: Backlight is always ON
- [OFF]: Backlight turns OFF after set length of time.

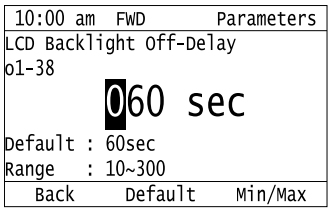
6. Push F3 (Setup).



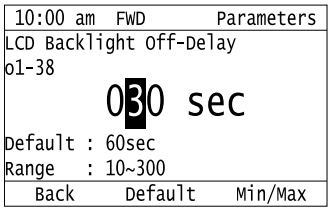
7. Push ↵.



8. Push < or > to select the digit, then push ∧ or ∨ to change the value.



9. When you are done changing the value, push ↵.



The procedure to set the backlight to turn OFF automatically is complete.

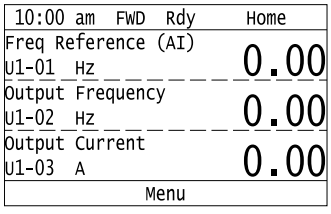
◆ Show Information about the Drive

The procedure in this section shows how to show the drive model, maximum applicable motor output, rated output current, software version, and serial number on the keypad.

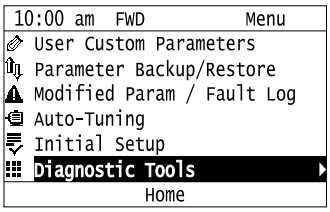
1. Push F2 (Home) to show the HOME screen.

Note:
- The keypad will show [Home] in the top right corner when the HOME screen is active.
- If [Home] is not shown on F2, push F1 (Back) to show [Home] on F2.

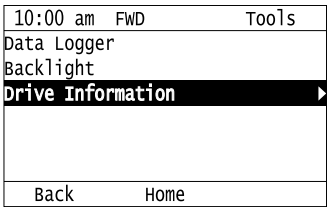
2. Push F2 (Menu).



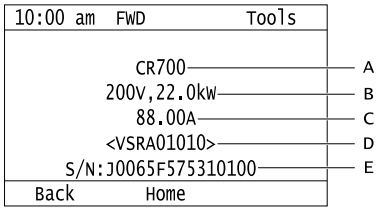
3. Push ▲ or ▼ to select [Diagnostic Tools], then push ↵.



4. Push ▲ or ▼ to select [Drive Information], then push ↵.



The keypad will show the drive information.



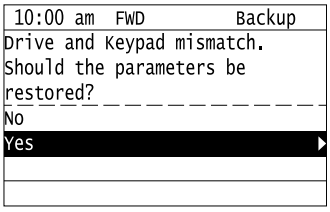
A - Drive Series
B - Maximum Applicable Motor Output
C - The rated output current
D - Drive software version
E - Serial number

◆ Write Automatically Backed-up Parameters to the Drive

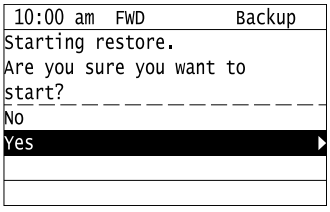
You can automatically back up parameters to the keypad connected to the drive and write those parameters to a drive from the same drive series as specified by the settings of *o3-06 [Auto Parameter Backup Selection]* and *o3-07 [Auto Parameter Backup Interval]*.

Note:
- Set *o3-06 = 1 [Auto Parameter Backup Selection = Enabled]* in each drive to which you will write the parameters.
- This operation is not available when the parameters in the keypad and the parameters on the other drives are set to the same values.

1. Connect the keypad to the drive.
2. Push ▲ or ▼ to select [Yes], then push ↵.



3. Push ▲ or ▼ to select [Yes], then push ↵.



The keypad will show the “End” message when the write process is complete.

3.5 Items to Check before Starting Up the Drive

◆ Check before Energizing the Drive

Examine the items in Table 3.4 before you energize the drive.

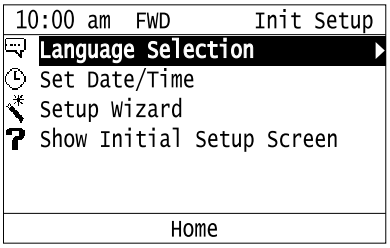
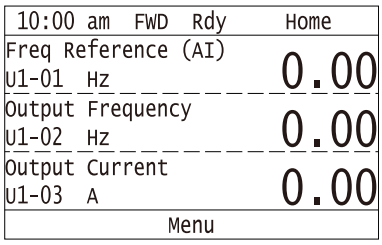
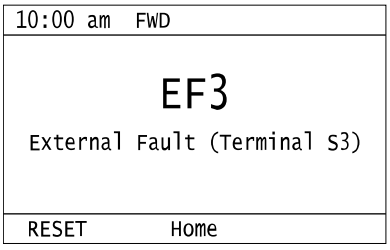
Table 3.4 Items to Check before Energizing the Drive

Items to Check	Description
Input Power Supply Voltage	The voltage of the input power supply must be: 200 V class: three-phase 200 Vac to 240 Vac 50/60 Hz, 270 Vdc to 340 Vdc 400 V class: three-phase 380 Vac to 480 Vac 50/60 Hz, 510 Vdc to 680 Vdc
	Correctly and safely wire power supply input terminals R/L1, S/L2, T/L3.
	Correctly ground the drive and motor.
Connection between Drive Output Terminals and Motor Terminals	Make sure that you connected drive output terminals U/T1, V/T2, and W/T3 in the correct sequence to agree with motor terminals U, V, and W without loosened screws.
Control Circuit Terminal Wiring	Make sure that you connected the drive control circuit terminals in the correct sequence to agree with devices and switches without loosened screws.
Control Circuit Terminal Status	Turn OFF the inputs from all devices and switches connected to the drive control circuit terminals.
Connection between Machinery and Motor	Disengage all couplings and belts that connect the motor and machinery.

◆ Check after You Energize the Drive

Check the items in Table 3.5 after you energize the drive. The keypad display is different depending on drive status.

Table 3.5 Display Status after You Energize the Drive

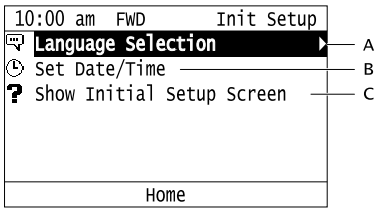
Status	Display	Description
During Usual Operation	 Initial Setup Screen or  HOME Screen	• The data display area will show the Initial Setup screen or the HOME screen • Energize the drive with factory defaults to show the Initial Setup screen. Select [No] from the [Show Initial Setup Screen] settings to show the HOME screen without showing the Initial Setup screen.
When the Drive Detects a Fault		The display is different for different faults. Refer to “Troubleshooting” to remove the cause of the fault. ALM will illuminate. **Note:** If the screen shows a different screen, do these steps to show the fault content again: 1. Push < from the HOME screen. 2. Push F2 [Home] from a different screen than the HOME screen.

◆ Perform the Initial Settings

The initial startup screen appears on the keypad when the drive is energized for the first time after purchase. Users can set the date and time or the language to show on the keypad.

Note:
If the keypad does not show the Initial Setup screen, or shows a different screen, select [Initial Setup] from the Main Menu to show the Initial Setup screen.

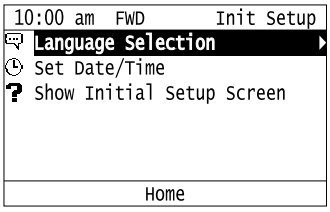
1. Make the initial settings for each item.



A - Language Selection
B - Set Date/Time
C - Show Initial Setup Screen

Note:
If you select [Yes] from the [Show Initial Setup Screen] setting, the keypad will show the Initial Setup screen each time the drive is energized. If you select [NO], the keypad will not show the Initial Setup each time the drive is energized, starting with the next time.

2. Push F2 (Home).



The display shows the HOME screen.

◆ Control Method Selection

After energizing the drive, select the control method most appropriate for the application first. Encoder options are necessary for CL-V/f control and CLV control.

Table 3.6 Control Method Selection

Control Method	A1-02 Setting	Encoder Option
V/f Control	0	Not required
Closed Loop V/f control	1	PG-B3 or PG-X3
Open Loop Vector control	2	Not required
Closed Loop Vector control	3	PG-B3 or PG-X3
Advanced Open Loop Vector control	4	Not required

Refer to *Control Method Type and Corresponding Features on page 26* for more information about the features of each control method.

◆ Parameter Settings for Operation Without the Brake Sequence

If you operate the drive without the brake sequence, set *S1-54 = 0 [Brake Sequence Selection = Disabled]*.

◆ Setting the Direction of Motor Rotation

For hoist applications, wire the drive so that the Forward Run command hoists the load, and the Reverse Run command lowers the load. If the machine does not move this way, crane software functions and performance will be reversed, making it impossible to take full advantage of the drive performance and capabilities.

Follow the procedure below to confirm the direction of motor rotation.

- Check the order of the U, V, and W phase output from the drive by checking the voltage (looking at the motor from the load side, most motors will rotate clockwise as the forward direction).
  Check the direction of motor rotation as it corresponds to the U, V, and W phase order.
- Check if *b1-14 = 0 [Phase Order Selection = Standard]* when operating the motor to hoist the load with the phase order U, V, and W.

- If the phase order is U, V, and W when operating the motor to lower the load, then check if *b1-14 = 1 [Switch Phase Order]*.

Note:

First set the direction of motor rotation before setting the direction of rotation for the encoder.

◆ Setting the Encoder (Pulse Generator)

■ Setting the Number of Pulses

Set the number of pulses for the encoder (pulse generator) in *F1-01 [Encoder 1 Pulse Count (PPR)]*.

■ Setting the Direction of Motor Rotation

Use the drive to confirm that the rotation direction of the PG or encoder is correctly set by the following steps.

When Encoder Signal is Available

1. Check if the output signal from the PG and encoder leads with the A phase or the B phase when the Forward run command is input.
2. If the output signal leads with the A phase (the A pulse leads at 90° from the B phase when the motor rotates forward), then set *F1-05 = 0 [Encoder 1 Rotation Selection = Pulse A leads in FWD Direction]*.
3. If the output signal leads with the B phase (the B pulse leads at 90° from the A phase when the motor rotates forward), then set *F1-05 = 1 [Pulse B leads in FWD Direction]*.

When Encoder Signal is Not Available

1. Manually rotate the motor in the forward direction for the crane (hoisting) and verify the changes in *U1-05 [Motor Speed]*.
2. If the value display in *U1-05* is positive, then the PG and encoder are rotating in the correct direction.
3. If the value display in *U1-05* is negative, change the setting to *F1-05 = 1* if it is set to 0, and change the setting to *F1-05 = 0* if it is set to 1.

Note:

First set the direction of motor rotation before setting the direction of rotation for the encoder.

3.6 Application Preset

WARNING! *Sudden Movement Hazard. Check the I/O signals and the external sequences for the drive before you set the Application Preset function. When you set the Application Preset function (A1-06 ≠ 0), it changes the I/O terminal functions for the drive and it can cause equipment to operate unusually. This can cause serious injury or death.*

The drive software contains the application presets shown below. Set *A1-06 [Application Selection]* to align with the application to let the drive automatically set the best parameter settings for the selected application.

Set application preset as necessary. The device changes the related parameters based on *A1-06* as shown in Table 3.7.

Application	A1-06	Description
Crane (Hoist)	1	The drive automatically sets the parameters for a hoist application. **Note:** Make sure that you do Auto-Tuning after you set *A1-06* for a hoist application.
Crane (Traveling)	2	The drive automatically sets the parameters for a traveling application.
Closed Loop Crane (Hoist)	3	The drive automatically sets the parameters for a closed loop crane (hoist) application. **Note:** After you set *A1-06* for a closed loop crane (hoist) application, make sure that you do Auto-Tuning.

Note:

- Before you set *A1-06*, make sure that you set *A1-03 = 2220 [Initialize Parameters = 2-Wire Initialization]* to initialize parameters.
- It is not possible to change the *A1-06* value. To set an application preset, set *A1-03 = 2220* to initialize parameters, then set this parameter. If initializing all parameters will cause a problem, do not change the settings.

Table 3.7 A1-06 Setting Values and Best Parameter Settings

No.	Name	Application Preset (A1-06 Setting)		
		Crane (Hoist) (1)	Crane (Traveling) (2)	Closed Loop Crane (Hoist) (3)
A1-02	Control Method Selection	2: Open Loop Vector	0: V/f Control	3: Closed Loop Vector Control
b1-01	Frequency Reference Selection 1	0: Keypad	0: Keypad	0: Keypad
C1-01	Acceleration Time 1	3.0 s	3.0 s	3.0 s
C1-02	Deceleration Time 1	3.0 s	3.0 s	3.0 s
C1-09	Fast Stop Time	2.0 s	2.0 s	2.0 s
d1-01	Reference 1	5.00 Hz	5.00 Hz	5.00 Hz
d1-02	Reference 2	25.00 Hz	25.00 Hz	25.00 Hz
d1-03	Reference 3	50.00 Hz	50.00 Hz	50.00 Hz
E1-03	V/f Pattern Selection	F: Custom	-	F: Custom
F1-05	Encoder 1 Rotation Selection	-	-	1: Pulse B leads in FWD Direction
H1-05	Terminal S5 Function Selection	-	3: Multi-Step Speed Reference 1	-
H1-06	Terminal S6 Function Selection	-	4: Multi-Step Speed Reference 2	-
H1-07	Terminal S7 Function Selection	-	6: Jog Reference Selection	-
H2-01	Term M1-M2 Function Selection	21: Brake Release Command	0: During Run	21: Brake Release Command
H2-02	Term M3-M4 Function Selection	1: Zero Speed	37: During Frequency Output	1: Zero Speed
H3-06	Terminal A3 Function Selection	F: Not Used	F: Not Used	F: Not Used
L2-03	Minimum Baseblock Time	0.1 s	-	0.1 s
L3-04	Stall Prevention during Decel	0: Disabled	0: Disabled	0: Disabled
L4-01	Speed Agree Detection Level	0.0 Hz	-	-
L4-02	Speed Agree Detection Width	0.0 Hz	-	-
L8-05	Input Phase Loss Protection Sel	1: Enabled	1: Enabled	1: Enabled
L8-07	Output Phase Loss Protection Sel	1: Enabled	1: Enabled	1: Enabled
L8-38	Carrier Frequency Reduction	1: Enabled below 6 Hz	1: Enabled below 6 Hz	1: Enabled below 6 Hz
L8-41	High Current Alarm Selection	1: Enabled	1: Enabled	1: Enabled
S1-01	Brake Release Frequency (FWD)	2.0 Hz	0.0 Hz	0.0 Hz
S1-02	Brake Release Frequency (REV)	2.0 Hz	0.0 Hz	0.0 Hz

No.	Name	Application Preset (A1-06 Setting)		
		Crane (Hoist) (1)	Crane (Traveling) (2)	Closed Loop Crane (Hoist) (3)
S1-03	Brake Delay Frequency	3.0 Hz	0.0 Hz	0.0 Hz
S1-04	Brake Delay Time	0.30 s	0.00 s	0.00 s
S1-09	Torque Compensation (FWD)	50%	-	0%
S1-12	Brake Hold Frequency (FWD)	3.0 Hz	0.0 Hz	3.0 Hz
S1-13	Brake Hold Frequency (REV)	3.0 Hz	0.0 Hz	3.0 Hz
S1-14	Slip Prevention Frequency	3.0 Hz	0.0 Hz	0.0 Hz
S1-15	Slip Prevention Time	0.30 s	0.00 s	0.00 s
S1-16	Sequence Fault SE1 Detect Time	0.30 s	0.00 s	0.30 s
S1-17	Sequence Fault SE2 Detect Time	1.00 s	0.00 s	1.00 s
S1-18	Sequence Fault SE3 Detect Time	0.50 s	0.00 s	0.50 s
S1-19	Sequence Fault SE4 Detect Time	0.50 s	0.00 s	0.50 s
S1-54	Brake Sequence Selection	1: Enabled	0: Disabled	1: Enabled

Note:

When *A1-06 [Application Preset] ≠ 0*, the drive shows different parameters on the keypad for different application presets. Set *A1-13 [All Function Parameter Display] = 0* to show all available parameters.

3.7 Test Run Procedure

This section describes the procedure for performing a test run. Note that only the most basic settings are introduced here.

1. Make sure the following information is in hand before attempting to perform a test run.
   - Motor test report
   - Data that makes it possible to check the control method and how the overall operation is working (sequence diagrams, etc.)
2. Check to make sure that the output current does not exceed 150% of the drive rated current at start, as well as when closing and releasing the brake at stop. Yaskawa recommends the following to keep the motor current within 150% of the drive rated current when running a crane application.
   Drive rated current × Coefficient (0.6 - 0.9) > Motor rated current

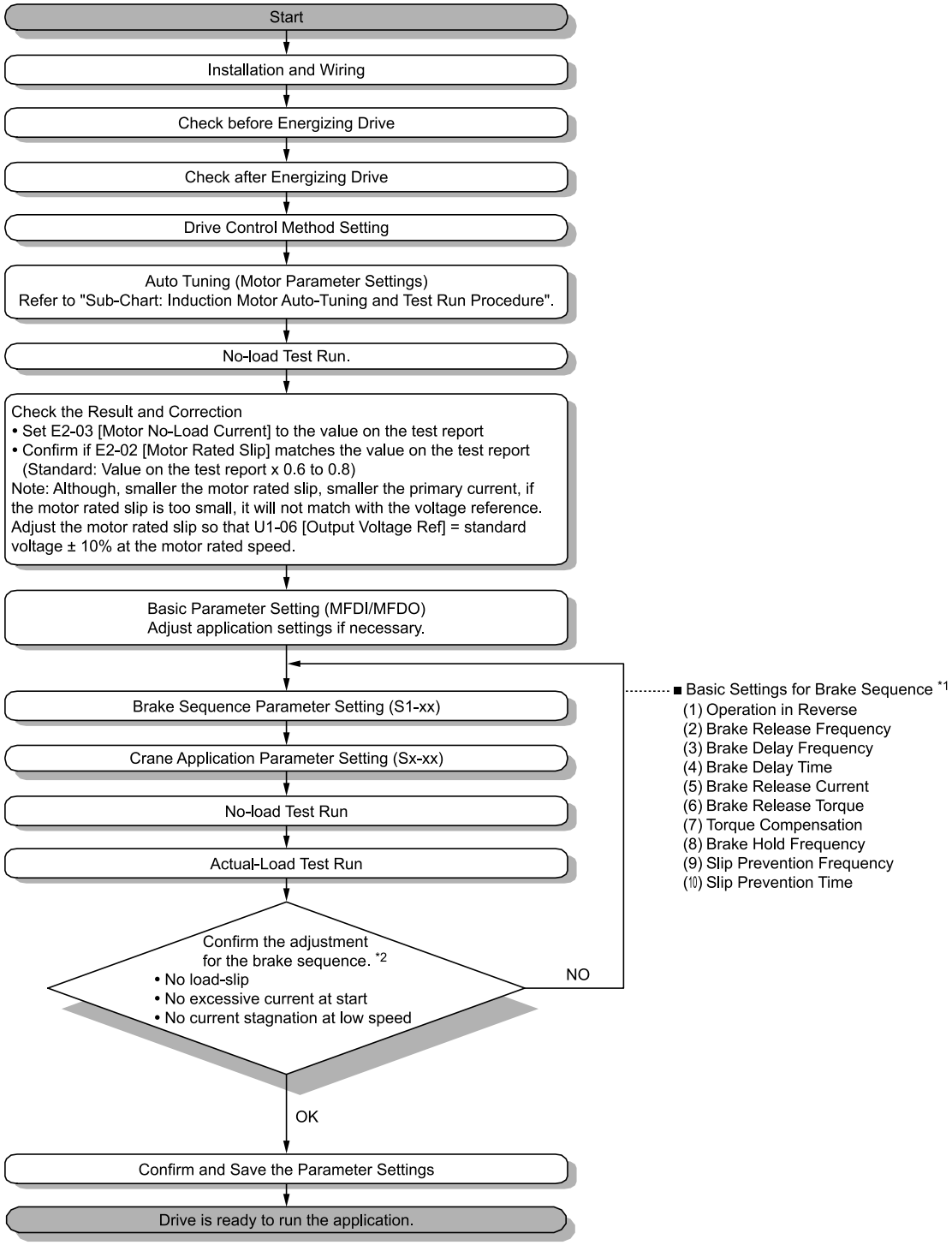
Control Method	Target Value for the Coefficient
CLV Control	0.9
OLV Control	0.8
V/f Control	0.7
Using V/f Control with Multiple Motors	0.6

3. Make sure that the output current does not exceed the motor rated current while operating at constant speed. Take the following corrective action if the output current exceeds the motor rated current.
   - Decouple the motor and machinery and perform Auto-Tuning with just the motor connected.

   Note:
   If Auto-Tuning has already been performed, then it does not need to be done again.
   - Make sure that the holding brake is released before performing Rotational Auto-Tuning. Rotational Auto-Tuning can not be performed correctly if the brake is not released. Failure to comply can result in erroneous operation of the drive, which may lead to injury.
   - Adjust drive parameters.
   - Change the value set in *S2-03 [Run Cmd Delay Timer (REV/FWD)]* if there is too much current when starting to hoist the load after it is lowered while operating in V/f Control or OLV control.

   Note:
   Refer to *Run Command Delay Timer (REV/FWD) on page 205* for more information about the setting a delay for the Run command.
4. To use the application selection function, refer to the section where *A1-06* is explained.
5. Refer to *Problems that Can Frequently Occur during Setup and Possible Solutions on page 226* if other problems arise during the test run, and take the recommended corrective action.
6. Do not use *L3-xx [Stall Prevention]* with crane and hoist applications, because this Stall Prevention can lead to accidents in such applications.

◆ Test Run Flowchart



*1 Refer to *Brake Sequence on page 195* for details. If you readjust the drive in crane adjustment checks, refer to *Controllability Problems and Possible Solutions on page 238* for more information.

*2 Refer to *Brake Sequence Checks on page 186* for details. If the adjustment result has a problem, readjust *S1-xx [Brake Sequence]*.

Figure 3.9 Test Run Procedure

■ Brake Sequence Checks

Perform the following checks when adjusting brake sequences.

- No slipping during startup or stops
- No excessive startup current during startup or stops
  Use the following method to quickly determine if there is excessive startup current. Records should usually be made in charts when performing this check.

– The *HCA [High Current Alarm]* appears during drive startup

Note:
Current alarm appears when current is over 150%.

– Current is at least 125% when the frequency reference is 6 Hz or less

Note:
Monitor with *U4-13 [Peak Hold Current]* and *U4-14 [PeakHold Output Freq]*.

- Low-speed startup is not negatively affected by a output frequency hanging

■ Sub-Chart (Induction Motor Auto-Tuning and Test Run Procedure)

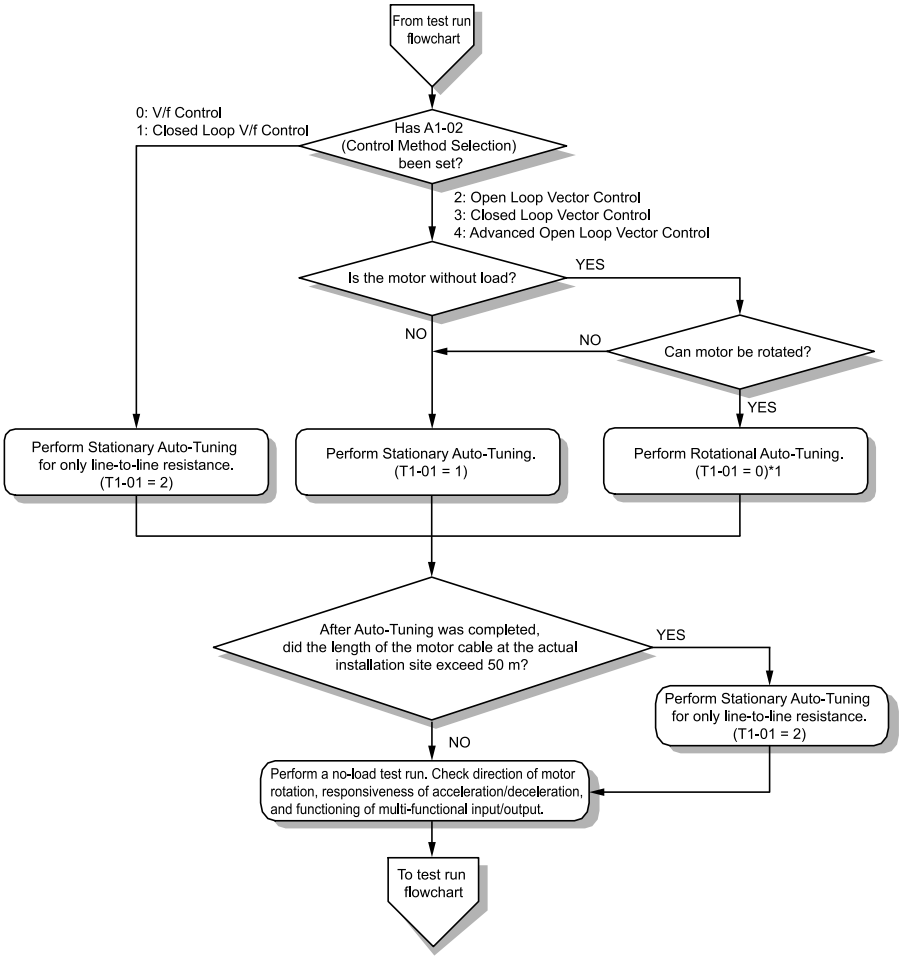


Figure 3.10 Induction Motor Auto-Tuning and Test Run Procedure

*1 Before performing Rotational Auto-Tuning, check that the holding brake is released.
*2 Before performing Inertia Tuning, check to make sure that the holding brake is released.
*3 Before performing ASR Tuning, check that the holding brake is released. Parameters related to Feed Forward control are automatically tuned when ASR Tuning is selected.

3.8 Auto-Tuning

Auto-Tuning uses motor characteristics to automatically set drive parameters for vector control. Think about the type of motor, drive control method, and the motor installation environment and select the best Auto-Tuning method.

The keypad will show the messages with prompts to input the necessary parameter information. These prompts are specified by the selected Auto-Tuning method and the control method setting in *A1-02*.

◆ Auto-Tuning for Induction Motors

The following explains the method of Auto-Tuning for induction motors. Set the following parameters for Auto-Tuning.

- Motor parameters *E1-xx and E2-xx* (*E3-xx and E4-xx* for motor 2, *E7-xx* for motor 3)
- Speed feedback detection-use *F1-xx* (only with Closed Loop Vector Control)

Note:

Stationary Auto-Tuning is used as a replacement measure when Rotational Auto-Tuning cannot be carried out. Consequently, a large discrepancy between the measured results and the motor characteristics could be observed when the Auto-Tuning is complete. After performing Stationary Auto-Tuning, check the parameters for the measured motor characteristics.

Table 3.8 Types of Auto-Tuning for Induction Motors

Mode	Parameter Settings	Application Conditions and Benefits	Applicable Control Methods (A1-02 Value)				
			V/f (0)	CL-V/f (1)	OLV (2)	CLV (3)	AOLV (4)
Rotational Auto-Tuning	T1-01 = 0	• When motor can be decoupled from machinery and rotate freely while Auto-Tuning is performed • When running motors having fixed output characteristics • When using motors requiring high-precision control Rotational Auto-Tuning gives the most accurate results, and is recommended if possible. • When motor and load cannot be decoupled but the motor load is below 30%	-	-	x	x	x
Stationary Auto-Tuning	T1-01 = 1	• When motor and load cannot be decoupled and the motor load is greater than 30% • When information from the motor test report or nameplate is not available With Stationary Auto-Tuning, the drive remains stopped while it is energized for about 1 minute. During this time the necessary motor parameters are automatically measured. • When operating the motor with a light load after Auto-Tuning It is possible to have the drive automatically calculate the motor parameter settings needed for vector control. Set *T1-12 = 1 [Test Mode Selection = Yes]* to perform the test run after Auto-Tuning.	-	-	x	x	x
Stationary Auto-Tuning for Line-to-Line Resistance	T1-01 = 2	• After Auto-Tuning was carried out, the wiring distance between the drive and motor changed by 50 m or more. • When the wiring distance is 50 m or more in the V/f Control mode. • When the motor output and drive capacity are different.	x	x	x	x	x

■ Input Data for Induction Motor Auto-Tuning

To perform Auto-Tuning, input data for the items marked with “x” in the following chart. Before starting Auto-Tuning, prepare the motor test report or nameplate to check.

Table 3.9 Input Data for Induction Motor Auto-Tuning

Input Data	Parameters	Unit	Auto-Tuning Mode (T1-01 Value)		
			Rotational Auto-Tuning (0)	Stationary Auto-Tuning (1)	Stationary Auto-Tuning for Line-to-Line Resistance (2)
Motor Rated Power	T1-02	kW	x	x	x
Motor Rated Voltage	T1-03	V	x	x	-
Motor Rated Current (FLA)	T1-04	A	x	x	x
Motor Base Frequency	T1-05	Hz	x	x	-
Number of Motor Poles	T1-06	-	x	x	-
Motor Base Speed	T1-07	min^{-1}	x	x	-

Input Data	Parameters	Unit	Auto-Tuning Mode (T1-01 Value)		
			Rotational Auto-Tuning (0)	Stationary Auto-Tuning (1)	Stationary Auto-Tuning for Line-to-Line Resistance (2)
Encoder Pulse Count (PPR)	T1-08	-	x *1	x *1	-
Motor No-Load Current	T1-09	A	-	x	-
Motor Rated Slip Frequency	T1-10	Hz	-	x *2	-
Test Mode Selection *3	T1-12	-	-	x *4	-
No-load voltage	T1-13	V	x *5	x *5	-

*1 Input this value when *A1-02 = 3 [Control Method Selection = Closed Loop Vector]*.
*2 0 Hz is displayed as the initial value. Leave the setting at 0 Hz if the Motor Rated Slip Frequency is not known.
*3 If *T1-12 = 1 [Test Mode Selection = Yes]*, the drive will automatically set *E2-02 [Motor Rated Slip]* and *E2-03 [Motor No-Load Current]* when first running the motor in the Drive Mode after the Auto-Tuning.
*4 Select this when *T1-10 [Motor Rated Slip Frequency]* = 0 Hz.
*5 Set the same value to No-Load Voltage as *T1-03 [Motor Rated Voltage]* to get the same characteristics using Yaskawa 1000-Series drives or earlier models.

◆ ASR and Inertia Tuning

To enhance the drive responsiveness and prevent hunting, use Auto-Tuning, which automatically adjusts the control-related parameters.

The following types of Auto-Tuning are available for the control system:

- Inertia Tuning
- ASR Tuning
- Deceleration Rate Tuning

Note:

When performing ASR and Inertia Tuning for the control system, *H1-xx = 16 [Motor 2 Selection]* cannot be used. Do not perform ASR and Inertia Tuning for applications that switch between motor 1 and motor 3.

Table 3.10 ASR and Inertia Tuning Selection

Mode	T3-00	Application Conditions and Benefits	Applicable Control Method (A1-02 Setting)				
			V/f (0)	CL-V/f (1)	OLV (2)	CLV (3)	AOLV (4)
Inertia Tuning	0	To perform Feed Forward control	-	-	-	x	-
ASR (Speed Regulator)	1	To automatically adjust the ASR gain based on the set response frequency (including Inertia Tuning)	-	-	-	x	-
Deceleration Rate Tuning	2	To automatically adjust the deceleration rate to prevent an *ov [Overvoltage]*	x	x	x	x	x

Table 3.11 Input Data for Control Tuning

Input Data	Parameters	Unit	Auto-Tuning Mode (T3-00 Value)		
			Inertia Tuning (0)	ASR (Speed Regulator) (1)	Deceleration Rate Tuning (2)
Test Signal Frequency	T3-01	Hz	x	x	-
Test Signal Amplitude	T3-02	Rad	x	x	-
Motor Inertia	T3-03	Kg·m²	x	x	-
System Response Frequency	T3-04	Hz	-	x	-

■ Inertia Tuning

Inertia Tuning estimates the system inertia based on the motor speed and torque reference and automatically sets the drive parameters related to the inertia ratio of the machinery and motor. Use Inertia Tuning when using Feed Forward Control.

Through identification of load inertia and optimization of speed loop gain and feed-forward gain, even higher level control capabilities can be achieved. Moreover, speed response can be set without regard to the load, so accuracy when synchronizing multiple drives is enhanced. Motors can continue to run during a power failure.

■ ASR Tuning

ASR Tuning estimates the motor load inertia and automatically sets the parameters as well as Inertia Tuning. Additionally, an automatic adjustment is carried out after calculating the proportional gain of speed control (ASR), based on the measured load inertia value.

■ Deceleration Rate Tuning

Deceleration Rate Tuning automatically sets the deceleration rate so that an *ov [Overvoltage]* fault does not occur during motor deceleration. Set *C1-11 [Accel/Decel Time Switchover Freq]* first to automatically set parameters *C1-02 [Deceleration Time 1]* (high speed range) and *C1-08 [Deceleration Time 4]* (low speed range).

ASR and Inertia Tuning automatically sets the following parameters to the optimal values.

Parameters Automatically Set	Inertia Tuning	ASR Tuning	Deceleration Rate Tuning
C1-02 [Deceleration Time 1]	-	-	x
C1-08 [Deceleration Time 4]	-	-	x *1
C1-09 [Fast Stop Time]	-	-	-
C5-01 [ASR Proportional Gain 1]	-	x	-
C5-17 [Motor Inertia]	x	x	-
C5-37 [Motor 2 Inertia]	x	x	-
C5-18 [Load Inertia Ratio]	x	x	-
C5-38 [Motor 2 Load Inertia Ratio]	x	x	-
L3-24 [Motor Accel Time @ Rated Torque]	x	x	-
L3-25 [Load Inertia Ratio]	x	x	-
n5-02 [Motor Inertia Acceleration Time]	x	x	-
n5-03 [Feed Forward Control Gain]	x	x	-

*1 The drive automatically sets *C1-08 [Deceleration Time 4]* only when *C1-11 [Accel/Decel Time Switchover Freq] ≠ 0*.

◆ Precautions before Auto-Tuning

Examine the topics in this section before you start Auto-Tuning.

■ Prepare for Basic Auto-Tuning

- You must input data from the motor nameplate or motor test report to do Auto-Tuning. Make sure that this data is available before you do Auto-Tuning.
- For best performance, make sure that the drive input supply voltage is equal to or more than the motor rated voltage.

  Note:

  Better performance is possible when you use a motor with a base voltage that is less than the input supply voltage (20 V for 200 V class models and 40 V for 400 V class models). If the input power supply is equal to the motor rated voltage, the drive output voltage will not be sufficient and performance will decrease.

- Push STOP on the keypad to cancel Auto-Tuning.
- If a Safe Disable input signal is input to the drive during Auto-Tuning, Auto-Tuning measurements will not complete successfully. If this occurs, cancel Auto-Tuning, then do it again.
- Table 3.12 shows the status of multi-function input/output terminals during Auto-Tuning.

Table 3.12 Status of Input/Output Terminals during Auto-Tuning

Auto-Tuning Type	Mode		Multi-Function Input	Digital Output *1
Induction Motor Auto-Tuning	Rotational	Rotational Auto-Tuning	Disabled	Functions the same as during usual operation.
	Stationary	Stationary Auto-Tuning 1	Disabled	Keeps the status at the start of Auto-Tuning.
		Line-to-Line Resistance	Disabled	Keeps the status at the start of Auto-Tuning.
ASR and Inertia Tuning	Rotational	Inertia Tuning	Disabled	Functions the same as during usual operation.
		ASR (Speed Regulator)	Disabled	Functions the same as during usual operation.
		Deceleration Rate Tuning	Disabled	Functions the same as during usual operation.

*1 A terminal to which *H2-xx = E [MFDO Function Select = Fault]* is assigned functions the same as during usual operation.

WARNING! *Crush Hazard. Wire a sequence that will not let a multi-function output terminal open the holding brake during Stationary Auto-Tuning. If the holding brake is open during Stationary Auto-Tuning, it can cause serious injury or death.*

WARNING! *Sudden Movement Hazard. Before you do Rotational Auto-Tuning, disconnect the load from the motor. The load can move suddenly and cause serious injury or death.*

WARNING! *Injury to Personnel. Rotational Auto-Tuning rotates the motor at 50% or more of the motor rated frequency. Make sure that there are no issues related to safety in the area around the drive and motor. Increased motor frequency can cause serious injury or death.*

■ Precautions before Rotational Auto-Tuning

WARNING! *Electrical Shock Hazard. During Auto-Tuning, the motor will receive high voltage when the motor is stopped. Do not touch the motor until Auto-Tuning is complete. If you touch a motor that is energized, it can cause serious injury or death.*

- To do Rotational Auto-Tuning, uncouple the drive from the motor. If the drive and motor stay connected, the drive can malfunction. The drive cannot accurately calculate motor parameters if the load is connected to the motor while doing Rotational Auto-Tuning, and the drive will not operate the motor correctly.
- When the load is 30% or less of the motor duty rating, you can do Auto-Tuning with the motor connected to a load. If you do Rotational Auto-Tuning while connected to a load that is more than 30%, the drive will not correctly calculate the motor parameters, and it can be dangerous because the motor can operate incorrectly.
- Make sure that the motor magnetic brake is released.
- Make sure that external force from the machine will not cause the motor to rotate.

■ Precautions before Stationary Auto-Tuning

- Make sure that the motor magnetic brake is not open.
- Make sure that external force from the machine will not cause the motor to rotate.

WARNING! *Electrical Shock Hazard. During Auto-Tuning, the motor will receive high voltage when the motor is stopped. Do not touch the motor until Auto-Tuning is complete. If you touch a motor that is energized, it can cause serious injury or death.*

Automatically Setting E2-02 [Motor Rated Slip] and E2-03 [Motor No-Load Current]

If *T1-12 = 1 [Test Mode Selection = Yes]* is set when selecting the Stationary Auto-Tuning, motor parameters *E2-02 [Motor Rated Slip]* and *E2-03 [Motor No-Load Current]* are set automatically when using the motor for the first time in Drive Mode after Auto-Tuning has been performed.

After performing Stationary Auto-Tuning, use the following procedure to run the test operation.

1. Check the *E2-02* and *E2-03* values on the “Modified Parameters/Fault Log” screen or the “Parameters” screen.
2. Operate the motor in Drive Mode with the following conditions.
   - Do not disconnect the wiring between the motor and drive.
   - Do not lock the motor shaft with a mechanical brake or other device.
   - The maximum motor load should be 30% of the rated load.
   - Maintain a constant speed of 30% of *E1-06 [Base Frequency]* (default value = maximum frequency) or higher for 1 s or longer.
3. After the motor is stopped, recheck the *E2-02* and *E2-03* values on the “Modified Parameters/Fault Log” screen or the “Parameters” screen.
4. Make sure that the input data is correct.
   If the settings in *E2-02* and *E2-03* are different from the measurement taken in step 1, then the values were set automatically by the drive.

Note:
- When the conditions in step 2 cannot be met for the first test run, then the following problems may occur if the values set in *E2-02* and *E2-03* are significantly different from data in the official test report for the motor and the data listed in *Parameters Changed by o2-04 [Drive Model (KVA) Selection] on page 557*.
  –Motor vibrations, hunting
  –Insufficient torque
  –Overcurrent
  Particularly when used in an elevator, there is the risk of the cage dropping and personal injury. Take one of the following measures to decrease risk.
  –After performing Stationary Auto-Tuning, operate the drive in accordance with the previously described conditions and procedure.
  –Set *T1-12 = 0 [Test Mode Selection = No]*.
  –Perform Rotational Auto-Tuning.
- If the drive is initialized after completing step 1, then go back and repeat Stationary Auto-Tuning.
- When using a general-purpose motor, the target value for *E2-02* should be 1 Hz to 3 Hz, and the target rated current for *E2-03* should be 30% to 65%. Generally, larger capacity motor have a lower rated slip, and a smaller ratio for the no-load current rated current. Refer to *Parameters Changed by o2-04 [Drive Model (KVA) Selection] on page 557* for details.

■ Precautions before Stationary Auto-Tuning for Line-to-Line Resistance and Stator Resistance Auto-Tuning

In V/f control, when the motor cable is 50 meters (164 feet) or longer, do Stationary Auto-Tuning for Line-to-Line Resistance.

WARNING! *Electrical Shock Hazard. During Auto-Tuning, the motor will receive high voltage when the motor is stopped. Do not touch the motor until Auto-Tuning is complete. If you touch a motor that is energized, it can cause serious injury or death.*

■ Precautions before Inertia Tuning and ASR Tuning

Before Inertia Tuning or ASR Tuning, check these items:

WARNING! *Electrical Shock Hazard. During Auto-Tuning, the motor will receive high voltage when the motor is stopped. Do not touch the motor until Auto-Tuning is complete. If you touch a motor that is energized, it can cause serious injury or death.*

- Do rotational motor parameter tuning or look at the motor test report or nameplate to enter the values manually.
- Make sure that the motor magnetic brake is released.
- Connect the motor and load.
- Make sure that external force from the machine will not cause the motor to rotate.
- Make sure that the machine does not prevent reverse rotation. You cannot do Inertia Tuning or ASR Tuning with machines that prevent reverse rotation.
- When the motor can rotate during Auto-Tuning, check for safety issues near the drive, motor, and machine.

Note:
If there are gears between the machine and motor shaft, Inertia Tuning or ASR Tuning are possibly not applicable.

■ Deceleration Rate Tuning Precautions

Check the following before performing Deceleration Rate Tuning.

Note:
- Do not use Deceleration Rate Tuning if also using a braking resistor unit or a regenerative converter.
- Perform Deceleration Rate Tuning with the load attached to the motor.
- Do not use the Deceleration Rate Tuning with the following applications. When performing Deceleration Rate Tuning, the drive will automatically rotate the motor forward and repeatedly accelerate and decelerate the motor.
  –Applications that cannot handle sudden acceleration and sudden deceleration
- Do not perform Deceleration Rate Tuning if the drive is set to *H1-xx = 16 [MFDI Function Selection = Motor 2 Selection]*. Failure to obey can cause an *ov [Overvoltage]* fault.

3.9 No-load Test Runs

After you set the basic parameters and do Auto-Tuning, do a test run.

WARNING! *Crush Hazard. Test the system to make sure that the drive operates safely after you wire the drive and set parameters. If you do not test the system, it can cause damage to equipment or serious injury or death.*

◆ No-load Test Runs

Before connecting the motor with machinery, run a no-load test to confirm operational status.

■ Precautions before Operation

Before rotating the motor, check the following items.

- Make sure there are no issues related to safety around the motor and machinery.
- Ensure that all emergency stop circuits and machine safety mechanisms are functioning correctly.

■ Checklist before Operation

Before operation check the following items:

- Is the motor rotating in the forward direction?
- Is the motor rotating smoothly (no abnormal sounds or abnormal vibrations)?
- Is the motor accelerating and decelerating smoothly?

◆ Perform a No-Load Test Run

This section explains how to perform a no-load test run.

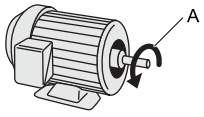
1. Set *b1-01 = 0 [Frequency Reference Selection 1 = Keypad]* or *b1-02 = 0 [Run Command Selection 1 = Keypad].*

   LO/RE will illuminate when the keypad is the Run command source.
2. Push F2 (Home) to show the HOME screen.

   If [Home] is not on F2, push F1 (Back) to show (Home) on F2.
3. Push ↵ to show *d1-01 [Reference 1]*, and set it to *6.00 Hz*.
4. Push RUN.

   RUN LED illuminates, and the motor runs at 6.00 Hz in the forward direction.
5. Make sure that the motor is rotating in the correct direction and that the drive does not show a fault.

   If the drive detects a fault, remove the cause.



A - Forward Rotation of Motor (Counter Clockwise Direction as Seen from Load Shaft)

6. Push ∧ to increase the frequency reference.

   Change the setting value in increments of 10 Hz if necessary and examine the response.
7. Each time you increase the setting value, use *U1-03 [Output Current]* to check the drive output current.

   When the output current of the drive is not more than the motor rated current, the status is correct.

   Example: 6 Hz -> 20 Hz -> 30 Hz -> 40 Hz -> 50 Hz -> 60 Hz
8. Make sure that the motor rotates correctly, then push STOP.

   RUN will flash. When the motor stops, the LED will go out.

Change settings as needed according to how *b1-01* and *b1-02* have assigned the Run command source and frequency reference.

3.10 Crane Application Setup Procedure

◆ External Interlock

In applications where the system will be negatively impacted if the drive goes down, always create an interlock between fault relay output and the Ready signal of a multi-function digital output.

■ Drive Ready

MFDO: The Drive Ready (READY) signal turns on when the drive is ready and running. The READY signal will be switched OFF in the following situations if the drive cannot be operated, even when no fault signal is detected or output, and even when the Run command is entered.

- The drive is de-energized
- During a fault
- There is problem with the control power supply
- There is a parameter setting error that will not let the drive run, although a Run command is entered
- There is an overvoltage or undervoltage fault during stop, and the drive detects faults and stops when the Run command is entered
- When the drive is in the Programming mode and will not accept a Run command even when entered

◆ Run Command

■ Run

Before operating the crane, make sure that the Forward Run command rotates the motor to raise the load, and that the Reverse Run command rotates the motor to lower the load. These conditions must be met to start hoisting or lowering:

- A speed reference signal set with MFDI is input.
- The Safe Disable signal is input from an external source to terminal H1-HC and H2-HC (this is separate from a baseblock situation).
- The Software baseblock command signal is not input from any of the MFDI terminals (this is separate from a baseblock situation).
- The conditions must be met to output a Brake release command.
  - Output frequency after a soft start ≥ Brake release frequency
  - Output current > Brake release current
  - Torque reference ≥ Brake release torque (OLV control only)
- When *H1-xx = 0 [Brake Release Check]*, the magnetic contactor closes.

■ Stop

When the Run command (Forward or Reverse) is cleared, the crane will stop operation.

■ Run Command Method Selection

You can select how to enter the Run command (FWD/REV) to the drive with *b1-02 [Run Command Selection 1]*.

b1-02 Setting	Name	Description
0	Keypad	Use the keypad to enter the Forward Run/Reverse Run command. Use this operation only in a test run.
1	Digital Input	Use the control circuit terminals S1 and S2 to enter the Forward Run/Reverse Run command. Usually, use this setting.
2	MEMOBUS/Modbus Communications	Use MEMOBUS/Modbus communications to enter the Forward Run/Reverse Run command.
3	Option PCB	Use an input option card to enter the Forward Run/Reverse Run command.

◆ Operation When the External Baseblock Command is Input and Cleared

To prevent load slipping when clearing the Baseblock command, the drive does not have a Speed Search function.

■ Operation When the External Baseblock Command is Input

- The drive executes baseblock (drive output stop) for at least 0.1 s.
  When using the brake sequence, the Brake release command is switches OFF.
- Set SFS Output Frequency to 0.

■ Operation When the External Baseblock Command is Cleared

- Acceleration always starts from the zero speed when the Run command is input.
- The baseblock state is maintained when the Run command is not input.

◆ Speed Reference

■ Speed Reference Method Selection

You can select how to enter the speed reference to the drive with *b1-01 [Frequency Reference Selection 1]*.

b1-01 Setting	Name	Description
0	Keypad	Use the keypad to enter the speed reference.
1	Analog Input	Use the MFAI terminals A1, A2, and A3 to enter the speed reference.
2	MEMOBUS/Modbus Communications	Use MEMOBUS/Modbus communications to enter the speed reference.
3	Option PCB	Use an input option card to enter the speed reference.

■ Input Signal Setup

Multi-Funciton Digital Inputs (Terminals S1 to S10)

Use the *H1 Parameters* to set functions to the MFDI terminals (S1 to S10). For more information about MFDI functions, refer to *H1-xx: MFDI Setting Values on page 500*.

Multi-Function Digital Outputs

Use the *H2 Parameters* to set functions to the MFDO terminals (M1-M6, MA, MB, MC, P1-C1, P2-C2). Refer to *H2-xx: MFDO Setting Values on page 505* for more information about MFDO functions.

Multi-Function Analog Inputs

Use the *H3 Parameters* to set functions to the MFAI terminals (A1, A2, A3). Refer to *H3-xx: Multi-Function Analog Input Terminal Settings on page 510* for more information about MFAI functions.

Multi-Function Analog Outputs

Use the *H4 Parameters* to set functions to the MFAO terminals (FM, AM). When you enter the “x-xx” part of the monitor *Ux-xx*, you can set the MFAO functions. Refer to *U: Monitors on page 539* for more information about the monitors.

◆ Brake Sequence

To ensure the appropriate amount of torque for the load at start and stop when opening and closing the brake, the Brake release command is output based on the drive internal frequency reference, the motor current, and the torque reference.

■ Related Parameters

Table 3.13 Parameters for the Brake Sequence

No.	Name	Adjustment Method
S1-01	Brake Release Frequency(FWD)	Set a value that is lower than *S1-03*, but higher than *b2-01 [DC Injection/Zero SpeedThreshold]* and *E1-09 [Minimum Output Frequency]*. • Closed Loop Vector Control Usually, used at 0 Hz. If slipping occurs when starting to hoist the load in a crane that does not use a counterweight, then set a high value in *S1-09*. • Open Loop Vector Control Method Set a value that is 1.0 to 1.5 times the motor rated slip. • V/f Control Mode Because it is difficult to ensure enough torque in V/f Control, set a value that is 1.5 to 2.0 times the motor rated slip.
S1-02	Brake Release Frequency(REV)	
S1-03	Brake Delay Frequency	Set a value that is equal to *S1-01* and *S1-02*, or a value that is higher than *S1-01* and *S1-02*. • Closed Loop Vector Control Usually, used at 0 Hz. However, if the 1-notch reference is 1 Hz or less, then *SE2 [Brake Sequence Fault 2 (SE2)]* may occur due to the lack of current flowing through the motor at start. In such cases, decrease the setting as low as 0.5 Hz. • OLV Control, V/f Control Set with the target value as the motor rated slip plus 1 Hz. **Note:** If the setting value is too high, shock will likely occur during startup. If the setting value is too low, then *SE2 [Brake Sequence Fault 2 (SE2)]* may occur due to the lack of current flowing through the motor at start.
S1-04	Brake Delay Time	Sets a delay time from when the Brake release command is issued until the brake is actually released.
S1-05	Brake Release Current (FWD)	• CLV Control, OLV Control Set *E2-03 [Motor No-Load Current]* × 100 / *E2-01 [Motor Rated Current]*. • V/f Control Mode For hoisting, set *S1-05 = 100%, S1-06 = 50%*. For traveling, set 50%. **Note:** • If the load differs when operating forwards and in reverse, then change the setting appropriately to match the load. • If the setting value is too low for hoisting the load, then load slips will likely occur at start. • If the setting value is too high, then *SE2 [Brake Sequence Fault 2 (SE2)]* may occur, and the brake may slip just before it is released.
S1-06	Brake Release Current (REV)	
S1-07 *1	Brake Release Torque (FWD)	For hoisting, set *S1-07 = 100%*, *S1-08 = 0%*. For traveling, set 50%. (If the load differs when operating forwards and in reverse, then change the setting appropriately to match the load.) **Note:** • If there is fair amount of lurching out, set 70 - 80% for hoisting the load. • If the setting value is too low, then load slips will likely occur at start. • If the setting value is too high, then *SE2 [Brake Sequence Fault 2 (SE2)]* may occur, and the brake may slip just before it is released.
S1-08	Brake Release Torque (REV)	
S1-09 *2	Torque Compensation (FWD)	• Closed Loop Vector Control Usually, set to *S1-09 = 0*, *S1-10 = 0*. Refer to the descriptions for *S1-01* and *S1-02*. If the drive is too slow in outputting the Brake release command or slipping occurs at start, then set a high value. • Open Loop Vector Control Method Here, the drive does not use torque compensation, but instead uses torque forcing. If the drive is too slow in outputting the Brake release command, then set a high value. Lower this setting if machine shock occurs at start. If the load slips when starting to hoist it, then set *S1-09* to a high value. However, be sure to also set *L7-01 [Forward Torque Limit]* to the upper limit.
S1-10 *2	Torque Compensation (REV)	
S1-11 *2	Torque Compensation Delay Time	Usually, set to 50 ms. Sets the time for torque compensation to build up until the brake is actually released.
S1-12	Brake Hold Frequency (FWD)	Usually, set to the value of *S1-14* + 3 to 4 Hz. For a higher degree of precision, set this parameter using the following formula. *S1-12* and *S1-13* = (Delay time until the brake is actually released) × (Maximum output frequency / Deceleration time)
S1-13	Brake Hold Frequency (REV)	
S1-14	Slip Prevention Frequency	Usually, set to the same value as *S1-03*.
S1-15	Slip Prevention Time	Sets a delay time until the brake is actually closed after the Brake close command is ON.
S1-16	Sequence Fault SE1 Detect Time	-
S1-17	Sequence Fault SE2 Detect Time	-
S1-18	Sequence Fault SE3 Detect Time	-
S1-19	Sequence Fault SE4 Detect Time	-
S1-20 *3	Operation in Reverse	If oscillation occurs when lowering in a hoist/lowering crane without a counterweight, set *S1-20 = 1*. **Note:** If used with the motor alone (without the load attached), then shock will occur. There should be problem if set so that *S1-20 = 0*.
S1-22	DB Phase Fix	-
S1-54	Brake Sequence Selection	Enables and disables the brake sequence. 0: Disabled 1: Enabled

No.	Name	Adjustment Method
b2-01	DC Injection/Zero SpeedThreshold	-
b2-04	DC Inject Braking Time at Stop	-
E1-09	Minimum Output Frequency	-

*1 This parameter is enabled when *A1-02 = 2, 3, or 4 [Control Method Selection = Open Loop Vector, Closed Loop Vector, Advanced Open Loop Vector]*.

*2 The names of parameters *S1-09* to *S1-11* change according to the control method that is selected.

Example

- When *A1-02 = 2*, the name of *S1-09* is *[Torque Forcing (FWD)]*.
- When *A1-02 = 3*, the name of *S1-09* is *[Torque Compensation (FWD)]*.

*3 Enabled when *A1-02 = 2 [Control Method Selection = Open Loop Vector]*.

■ Multi-Funciton Digital Input

H1-xx Setting Value	Name	Description
0	Brake Release Check	When terminal is ON, it functions as the brake release check.

■ Multi-Function Digital Output

H2-xx Setting Value	Name	Description
21	Brake Release Command	When terminal is ON, it functions as the brake release command.

■ Description of Operation

The following time chart shows the terminal functions when *b1-01 = 1 [Frequency Reference Selection 1 = Analog Input]*, *b1-02 = 1 [Run Command Selection 1 = Digital Input]*.

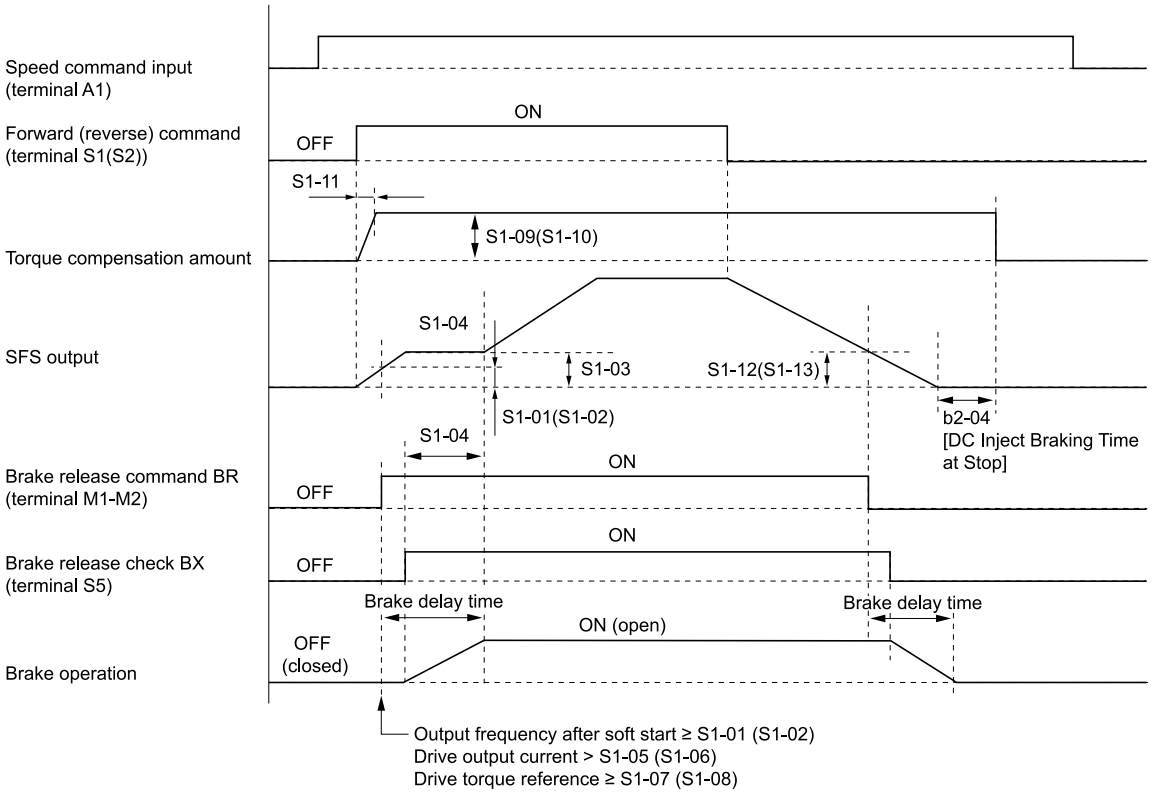
- Terminals S1, S2 (Forward run command, Reverse run command)
  Terminals receive the Forward run command and Reverse run command. The signal combinations work as shown below.
  However, the following operations may be restricted based on the Run command tuning function. Refer to *Adjusting the Run Command on page 204* for details.

Forward Run Command	Reverse Run Command	Operation	Ref.
OFF	OFF	Ramps to stop according to the stop sequence.	200
ON	OFF	The motor rotates in the forward direction.	-
OFF	ON	The motor rotates in the reverse direction.	-
ON	ON	The keypad shows *SE1 [Brake Sequence Fault 1 (SE1)]*, and the motor will coast to stop. The Brake release command is switched OFF as soon as the fault occurs, and the brake closes. **Note:** When *S1-16 [Sequence Fault SE1 Detect Time] = 0.00*, then the keypad shows *EF [FWD/REV Run Command Input Error]*, and the motor will ramp to stop. A fault signal is not output at this time.	-

Note:

- Note the following when the Run command source is set to the keypad.
  - When *b1-02 = 0 [Run Command Selection 1 = Keypad]*, the brake sequence set with *S1-xx parameters* will not function.
  - Make sure that the Run command is not issued from the keypad when connecting the brake signal to the drive. If the Run command is issued from the keypad, then the brake may slip or drive overload may result because the brake will not be released.
  - If Auto-Tuning is executed after the Brake release command signal is connected to the drive, then the drive will show *Er-09 [Acceleration Error]* or *Er-11 [Motor Speed Error]*, and abandon the Auto-Tuning procedure.
- Make sure to include an external sequence for the drive in order to release the brake after the Brake release command is switched ON, and also to close the brake after the Brake release command is switched OFF. Refer to the standard connection diagram in *Electrical Installation on page 71* for information about the connection of the control circuit I/O terminals.

■ Closed Loop Vector Control



S1-01 - Brake Release Frequency(FWD)

S1-02 - Brake Release Frequency(REV)

S1-03 - Brake Delay Frequency

S1-04 - Brake Delay Time

S1-05 - Brake Release Current (FWD)

S1-06 - Brake Release Current (REV)

S1-07 - Brake Release Torque (FWD)

S1-08 - Brake Release Torque (REV)

S1-09 - Torque Compensation (FWD)

S1-10 - Torque Compensation (REV)

S1-11 - Torque Compensation Delay Time

S1-12 - Brake Hold Frequency (FWD)

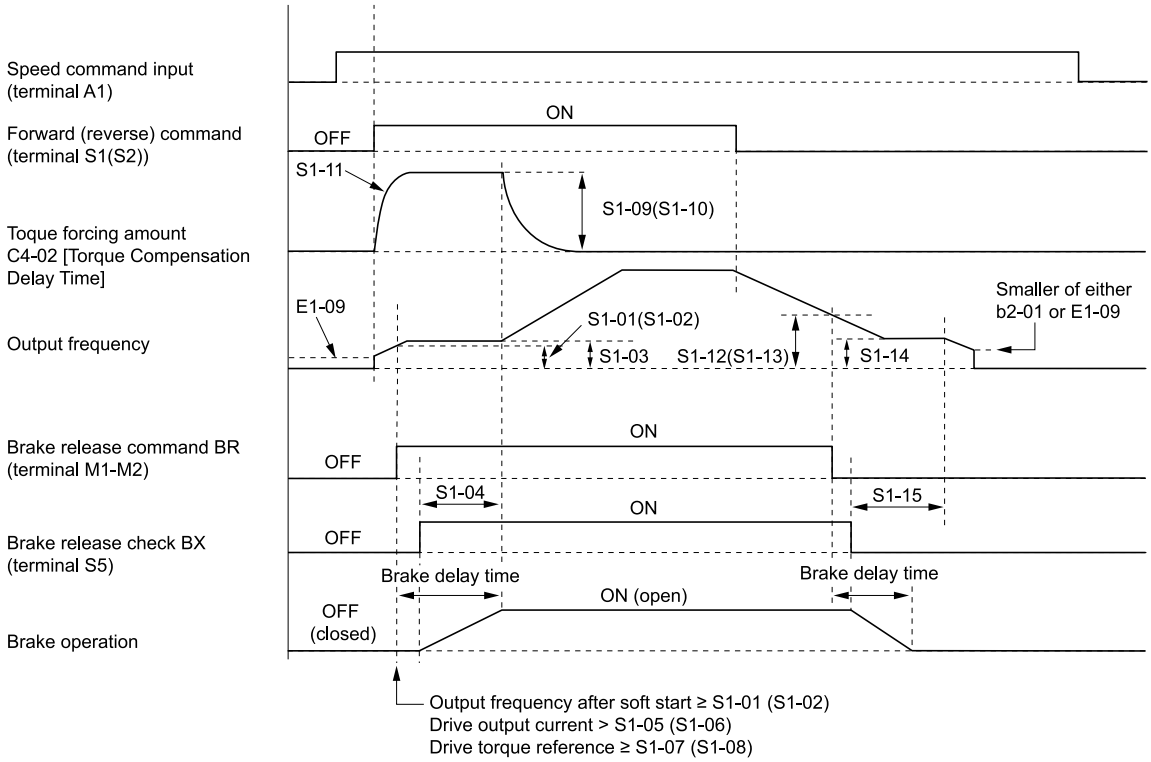
S1-13 - Brake Hold Frequency (REV)

b2-04 - DC Inject Braking Time at Stop

Note:

- Note the following precautions regarding parameter setting.
  - –Set *S1-15 = 0 [Slip Prevention Time = 0 s]*.
  - –Set *b2-04 = Brake Operation Delay Time* as the stop timer.
  - –The default setting of *S1-03* and *S1-04* is 0 for Closed Loop Vector Control.
- Note the following precautions regarding the use of torque compensation.
  - –Torque compensation is used to perform the following operations with hoisting cranes that lack counterweights. Set *S1-01* and *S1-02* to 0 to use torque compensation.
    - –Release brakes when the output frequency is low (shockless operation).
    - –Release brakes as quickly as possible (shorten operation cycles).
  - –Reception of torque compensation analog input signals from terminal A3 can be enabled using either of the following methods.
    - –Set the amount of torque compensation with *S1-09* and *S1-10*.
    - –Set *H3-06 = 14 [Terminal A3 Function Selection = Torque Compensation]*.
  - –The actual amount of torque compensation is determined at the time of Forward run command and Reverse run command input.
  - –S1-11 is used to set the time taken for torque compensation to reach from 0% to 100% . Torque compensation reaches 100% in half the amount of time set to *S1-11* when *S1-09* or *S1-10 is set to 50%.*

■ Open Loop Vector Control Method



S1-01 - Brake Release Frequency(FWD)

S1-02 - Brake Release Frequency(REV)

S1-03 - Brake Delay Frequency

S1-04 - Brake Delay Time

S1-05 - Brake Release Current (FWD)

S1-06 - Brake Release Current (REV)

S1-07 - Brake Release Torque (FWD)

S1-08 - Brake Release Torque (REV)

S1-09 - Torque Compensation (FWD)

S1-10 - Torque Compensation (REV)

S1-11 - Torque Compensation Delay Time

S1-12 - Brake Hold Frequency (FWD)

S1-13 - Brake Hold Frequency (REV)

S1-14 - Slip Prevention Frequency

S1-15 - Slip Prevention Time

b2-01 - DC Injection/Zero SpeedThreshold

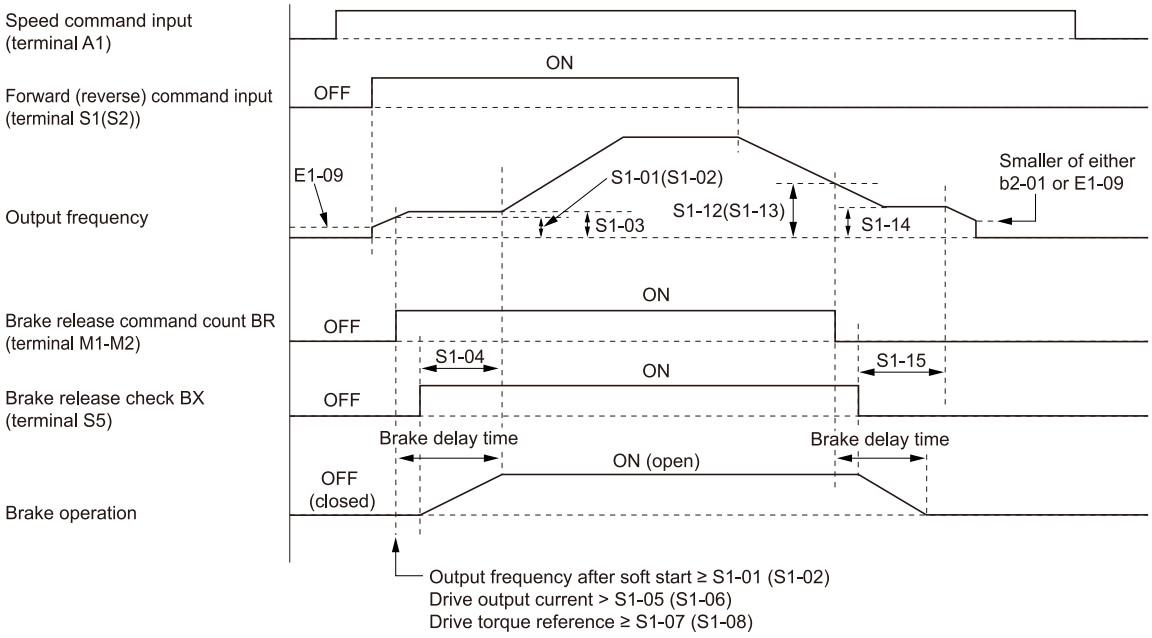
E1-09 - Minimum Output Frequency

Note:

Note the following precautions regarding the use of torque forcing.

- Torque forcing is used to perform the following operations. The operation is selected with *S1-09*.
  - –Compensate for slipping that occurs with heavy loads.
  - –Release brakes as quickly as possible (shorten operation cycles).
- When *S1-04 = 0*, torque forcing per *S1-09* or *S1-10* is active until the output frequency reaches the setting value of either *S1-01* or *S1-02*.

■ V/f Control Mode



S1-01 - Brake Release Frequency(FWD)

S1-02 - Brake Release Frequency(REV)

S1-03 - Brake Delay Frequency

S1-04 - Brake Delay Time

S1-05 - Brake Release Current (FWD)

S1-06 - Brake Release Current (REV)

S1-07 - Brake Release Torque (FWD)

S1-08 - Brake Release Torque (REV)

S1-12 - Brake Hold Frequency (FWD)

S1-13 - Brake Hold Frequency (REV)

S1-14 - Slip Prevention Frequency

S1-15 - Slip Prevention Time

b2-01 - DC Injection/Zero SpeedThreshold

E1-09 - Minimum Output Frequency

■ Sequence at Startup

To prevent the load from suspension drops at startup, the brake is released only after checking that enough torque is generated to hold the load in place.

Description of Operation

1. Once the Run command is input (either the Forward run command or the Reverse run command is switched ON), the drive will accelerate the motor up to *S1-03 [Brake Delay Frequency]*, with the brake still clamped shut. At this time, the amount of torque compensation (or the amount of torque forcing) is input that corresponds to the setting value.

   Note:
   In Open Loop Vector, the drive uses torque forcing instead of torque compensation.

2. After verifying that all of the following conditions have been satisfied, the drive switches ON the Brake Release command (BR). Once the Brake Release command is ON, the Brake Release Check (BX) switches ON through an external sequence.
   - Output frequency after a soft start ≥ *S1-01, S1-02 [Brake Release Frequency]*
   - Drive output current > *S1-05, S1-06 [Brake Release Current]*
   - In Vector control, the drive torque reference ≥ *S1-07, S1-08 [Brake Release Torque]*

   Note:
   The brake release frequency, brake release current, brake release torque, and the brake close frequency all need to be set separately for forward and reverse operation.

3. After accelerating up to *S1-03 [Brake Delay Frequency]*, the drive will operate at that frequency for the time set in *S1-04 [Brake Delay Time]*. Once the time in *S1-04* passes, the drive accelerates up to the frequency set to terminal A1. When *S1-04 = 0*, the drive will not stop acceleration at the value set in *S1-03*.

■ Stop Sequence

To prevent the load from slipping when the motor is stopped, enough torque needs to be generated to hold the load in place until the brake is fully closed.

Note:
- Under the following conditions, if the output frequency after Soft Start is less than or equal to the brake close frequency, then the drive will switch OFF the brake release command.
  – Both the Forward run command and the Reverse run command are OFF
  – The drive is switching between forward and reverse rotation
- Without a Stop command being entered (either the Forward run command or the Reverse run command is still ON), once the frequency reference fall below the brake release frequency or the brake hold frequency, then the drive will operate at the whichever speed reference is greater.

Description of Operation

1. Once the Stop command is input (meaning that the Forward run command or the Reverse run command is switched OFF), the drive will follow *b1-03 [Stopping Method Selection]* and decelerate to *S1-14 [Slip Prevention Frequency]* according to the deceleration time set to the drive.

   Note:
   The drive will decelerate to Zero Speed when *S1-15 = 0 [Slip Prevention Time = 0.00 s]*.
2. When the output frequency after Soft Start is *S1-12 [Brake Hold Frequency (FWD)]* or *S1-13 [Brake Hold Frequency (REV)]*, the Brake Release Command (BR) shuts OFF, and the Brake Release Check (BX) also shuts OFF due to the external sequence.
3. The drive operates at the frequency set in *S1-14 [Slip Prevention Frequency]* for the time set in *S1-15*, and then ramps to stop.

   Note:
   In the Closed Loop Vector mode, the drive performs Speed Control as it operates at Zero Speed for the stop time set in *b2-04 [DC Inject Braking Time at Stop]*.

■ Switching between Forward and Reverse Rotation

V/f Control, OLV Control

It is not possible to perform continuous operation while switching from forward to reverse or from reverse to forward without closing the brake. If a Run command is entered that is in the opposite direction that the motor is currently rotating in, then once the stop sequence has been carried out and the brake has fully closed, the drive will carry out the start sequence and operate in the opposite direction.

Note:
Refer to *Stop Sequence on page 200* for more information about the stop sequence. Refer to *Sequence at Startup on page 200* for more information about the start sequence.

Closed Loop Vector Control

The drive continues operation while switching from forward to reverse or from reverse to forward without closing the brake. There are case in which the brake closes. Refer to *Run Command Minimum On Time Function on page 204* for details. When switching between forward and reverse, the brake will close when frequency reference falls below *S1-01 [Brake Release Frequency (FWD)]*, *S1-02 [Brake Release Frequency (REV)]*.

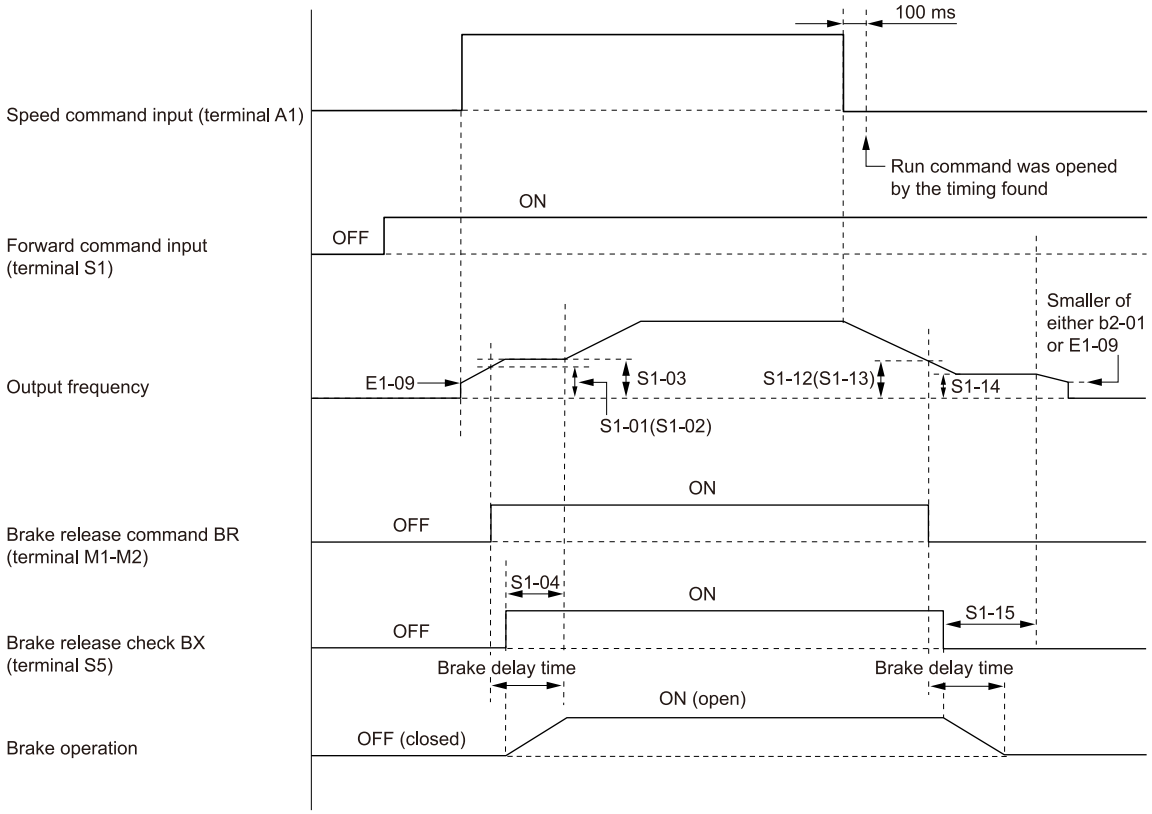
■ Brake Open/Close Operation by Speed Reference Input from Terminal A1

By setting *H3-01 = 1 [-10 to +10V (Bipolar Reference)]*, it is possible to open and close the brake using a speed reference input from terminal A1. The following is a time chart and description of the operation to open and close the brake.

Note:
- When *H3-01 = 0 [Terminal A1 Signal Level Select = 0 to 10V (Lower Limit at 0)]*, you cannot open and close the brake using a speed reference input from terminal A1. With the exception of what is explained in this section, the braking sequences discussed in this manual presume that the drive has been set so that *H3-01 = 0*.
- When *H3-01 = 1 [Terminal A1 Signal Level Select = -10 to +10V (Bipolar Reference)]*, the drive will recognize a Stop command that is entered and execute the sequence to stop the motor, provided that the following 2 conditions are met.
  – Frequency reference ≤ *b2-01 [DC Injection/Zero SpeedThreshold]*
  – Frequency reference < *E1-09 [Minimum Output Frequency]* for more than 100 ms

  In this situation, the drive will interrupt output and execute baseblock if a frequency reference is entered that is less than *E1-09*, regardless of the setting in *b1-05 [Operation Below Minimum Freq]*.

When Momentary Changes Occur in the Speed Reference Input



S1-01 - Brake Release Frequency(FWD)

S1-02 - Brake Release Frequency(REV)

S1-03 - Brake Delay Frequency

S1-04 - Brake Delay Time

S1-12 - Brake Hold Frequency (FWD)

S1-13 - Brake Hold Frequency (REV)

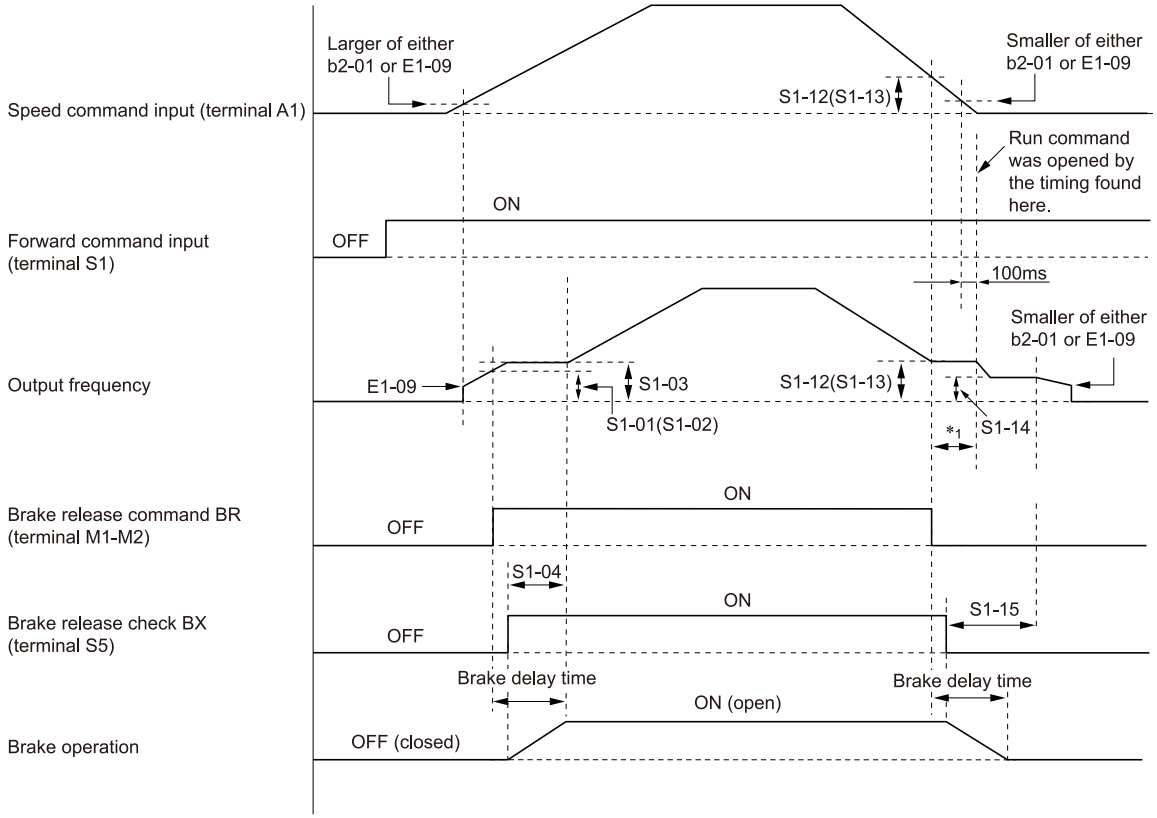
S1-14 - Slip Prevention Frequency

S1-15 - Slip Prevention Time

b2-01 - DC Injection/Zero SpeedThreshold

E1-09 - Minimum Output Frequency

When Slight Changes Occur in the Speed Reference Input



S1-01 - Brake Release Frequency(FWD)

S1-02 - Brake Release Frequency(REV)

S1-03 - Brake Delay Frequency

S1-04 - Brake Delay Time

S1-12 - Brake Hold Frequency (FWD)

S1-13 - Brake Hold Frequency (REV)

S1-14 - Slip Prevention Frequency

S1-15 - Slip Prevention Time

b2-01 - DC Injection/Zero SpeedThreshold

E1-09 - Minimum Output Frequency

*1 Until the Run command is shut OFF, the drive will continue operation using the speed reference from *S1-01 [Brake Release Frequency(FWD)]* and *S1-02 [Brake Release Frequency(REV)]*, or *S1-12 [Brake Hold Frequency (FWD)]* and *S1-13 [Brake Hold Frequency (REV)]* whichever value is larger.

Note:
- When the speed reference input from terminal A1 is negative, the drive will operate in reverse.
- If the speed reference input from terminal A1 is lower than *b2-01 [DC Injection/Zero SpeedThreshold]* and *E1-09 [Minimum Output Frequency]* for more than 100 ms, then the drive will determine that the Run command has been switched OFF.

Description of Operation

1. With terminal S1 switched ON, if a signal is input to terminal A1 with a level (absolute value) greater than *b2-01* and *E1-09*, then the drive will determine that a Run command has been entered, and begin the sequence to start the motor. A positive value from terminal A1 will be used as a Forward run command, and a negative value will be used as a Reverse run command. Refer to *Sequence at Startup on page 200* for more information about the start sequence.

   Note:
   Be sure that terminal S2 always remains OFF. The motor rotates in reverse when terminal S2turns ON.

2. If a signal is input to terminal A1 with a level (absolute value) lower than *b2-01* and *E1-09* for more than 100 ms, then the drive will determine that a Stop command has been entered, and begin the sequence to stop the motor. Refer to *Stop Sequence on page 200* for more information about the stop sequence.

Note:

If the speed reference entered from terminal A1 slowly changes, then the following operation will be executed after the Brake release command is switched OFF.

- For forward run, the drive operate at the speed reference from *S1-01 [Brake Release Frequency(FWD)]* and *S1-12 [Brake Hold Frequency (FWD)]*, whichever is larger, until the Run command is switched OFF.
- For reverse run, the drive operate at the speed reference from *S1-02 [Brake Release Frequency(REV)]* and *S1-13 [Brake Hold Frequency (REV)]*, whichever is larger, until the Run command is switched OFF.
- Even after the brake is engaged, because the drive will continue to run the motor until the Run command is switched OFF, makes sure that the speed reference input from terminal A1 drops to 0 within 100 ms before the output frequency reaches *S1-12*, *S1-13*. Failing to make this setting can cause the brake to slip.

■ Sequence Fault Monitoring Function

If a brake sequence error is detected, then the drive will switch OFF the brake release command, perform baseblock, and trigger a fault relay output. Refer to the parameters used to set up the detection time, and to the chapter on Troubleshooting for details.

Table 3.14 Sequence Fault Table

Code	Name	Cause	Solution	Parameters for Detection Time
SE1	Brake Sequence Fault 1 (SE1)	A forward and a reverse command were input simultaneously.	Examine the forward and reverse command sequence circuit.	S1-16
SE2	Brake Sequence Fault 2 (SE2)	The motor is not connected and the current does not flow. The break release command (BR) does not turn ON.	Examine the motor circuit.	S1-17
		The brake release current and torque setting value is too high.	Decrease the parameter setting values appropriately for the load.	
		Brake grinding occurs and it does not reach the brake release torque.	Examine the brake torque.	
SE3	Brake Sequence Fault 3 (SE3)	Sequence Error of the Brake Circuit.	Examine the sequence circuit of brake release check signal (BX).	S1-18
		The response (scan) of the Sequence circuit is slow.		
		Loose connection or disconnection of the relay, electromagnetic contactor and brake.	Examine the relay, electromagnetic contactor and brake.	
SE4	Brake Sequence Fault 4 (SE4)	The break release check (BX) turns ON when the break release command (BR) is OFF.	Examine the sequence circuit of brake release check signal (BX).	S1-19
		Loose connection or disconnection of the relay, electromagnetic contactor and brake.	Examine the relays, electromagnetic contactor, and brake, as well as the wiring.	

Note:

The following settings will keep the drive from detecting a sequence error. The function for detecting sequence errors should usually be enabled to ensure that the brake operates properly.

- If none of the MFDIs are set to the Brake release check signal, then the drive will detect an *SE3* or *SE4* error.
- No sequence error detection will occur if the detection times in parameters *S1-16* to *S1-19* are set to 0.00.

◆ Adjusting the Run Command

■ Run Command Minimum On Time Function

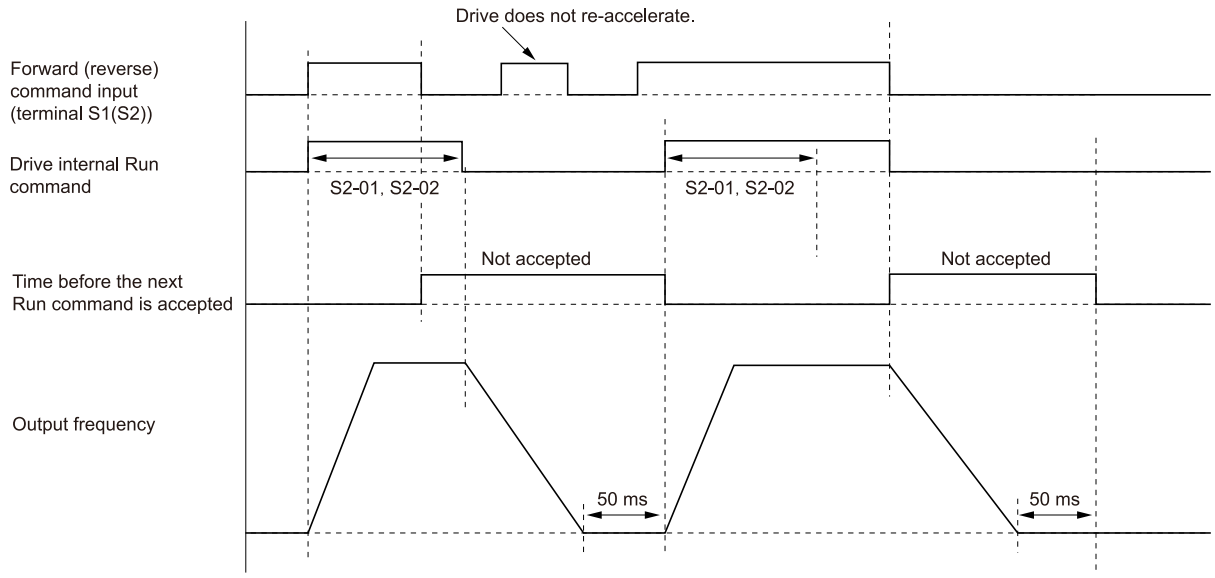
If the input time for the Run command is shorter than the settings in *S2-01 [Run Cmd Minimum On Time (FWD)]*, *S2-02 [Run Cmd Minimum On Time (REV)]*, then the drive will hold the Run command only for the time set in *S2-01* and *S2-02*.

Related Parameters

No.	Name	Adjustment Method
S2-01	Run Cmd Minimum On Time (FWD)	Increase this value if the drive control and brake operation do not operate as expected during extremely quick inching operation and the load slips.
S2-02	Run Cmd Minimum On Time (REV)	Increase the value if movement is unstable during extremely quick inching operation.

Description of Operation

The following is a description of the operation performed when $S2\text{-}01 \neq 0$, $S2\text{-}02 \neq 0$.



S2-01 - Run Cmd Minimum On Time (FWD)

S2-02 - Run Cmd Minimum On Time (REV)

- Entering the Run command when stopped
  If the input time for the Run command is shorter than the settings in *S2-01* or *S2-02*, then the drive will hold the Run command only for the time set in *S2-01* or *S2-02*.
  If the input time for the Run command is longer than the settings in *S2-01* or *S2-02*, then the drive will maintain the Run command internally only for as long as the Run command is input.
  This is the same for all of the drive control methods.
- Run command Entered during Rump to Stop
  The drive will carry out the following operation if a Run command is entered in the same direction as the output frequency. This is the same for all of the drive control methods.

Conditions for Run Command	S2-01 = 0, S2-02 = 0		S2-01 ≠ 0, S2-02 ≠ 0	
	Output Frequency > fα	Output Frequency ≤ fα	Output Frequency > fα	Output Frequency ≤ fα
Drive operation	Starts accelerating again.	Closes the brake, and briefly stops. (Stops for at least 50 ms)		

The drive will operate the following if a Run command is entered in the direction opposite to the output frequency.

Conditions for Run Command	Control Method	S2-01 = 0, S2-02 = 0		S2-01 ≠ 0, S2-02 ≠ 0	
		Output Frequency > fα *1	Output Frequency ≤ fα *1	Output Frequency > fα *1	Output Frequency ≤ fα *1
Drive operation	Closed Loop Vector Control	Switches between Forward/ Reverse run without engaging the brake. *2	Closes the brake, and briefly stops. (Stops for at least 50 ms)		
	Other than CLV control	Closes the brake, and briefly stops. (Stops for at least 50 ms)			

*1 For fα, the drive displays whichever value is larger, *S1-01 [Brake Release Frequency(FWD)]* and *S1-02 [Brake Release Frequency(REV)]*, or *S1-12 [Brake Hold Frequency (FWD)]* and *S1-13 [Brake Hold Frequency (REV)]*.

*2 The drive will switch between FWD/REV without engaging the brake if a Run command is entered in the opposite direction while decelerating with the output frequency > fα.

■ Run Command Delay Timer (REV/FWD)

If hoisting the load immediately after lowering it in Open Loop Vector or in V/f Control, then this can cause an excess amount of current to flow when starting to hoist the load. In such cases, having a small delay before entering the Run command to hoist makes it possible to lower the peak output current of the drive.

Related Parameters

No.	Name	Adjustment Method
S2-03 *1	Run Cmd Delay Timer (REV/FWD)	Usually, set *S2-03 = 0.0 s*.

*1 This parameter is enabled when *A1-02 = 0, 1, or 2 [Control Method Selection = V/f Control, V/f Control with Encoder, or Open Loop Vector]*.

By using *S2-03 [Run Cmd Delay Timer (REV/FWD)]*, it is possible to delay the hoisting operation immediately after lowering a load. If the Forward run command is switched OFF → ON → OFF while the timer is operating, the Forward run command will not be accepted during that time.

If the time to enter the Run command in order to hoist the load after lowering is shorter than the time set in *S2-03*, then there will be a delay before beginning the hoist operation. The following calculation is made and set in *S2-03* as the target value.

$$\frac{\sqrt{(\text{E2-01})^2 - (\text{E2-03})^2}}{2\pi \times \text{E2-02} \times \text{E2-03}} \times 1.5 \text{ s}$$

Note:
If the current level is not too high even if hoisting the load immediately after lowering it, then this setting is not necessary.

◆ Impact Stop Function

For applications such as transport conveyor lines, entering a Stop command while a terminal set to *H1-xx = 35 [MFDI Function Selection = Impact Stop Enable]* is ON will stop operation when the torque reference or output current is above the base value, and if the drive detects that the transport cart has bumped into something. This allows for simple positioning (Impact Stop).

This function is enabled only when *b1-03 = 0 [Stopping Method Selection = Ramp to Stop]*.

Note:
If the load is such that the wheels continue to spin when the transport cart bumps into something, then the Impact Stop function should not be used. Even when the transport cart bumps into something, the motor output axle does not lock up, so because the torque reference or the output current does not rise, Impact Stop is not activated.

■ Related Parameters

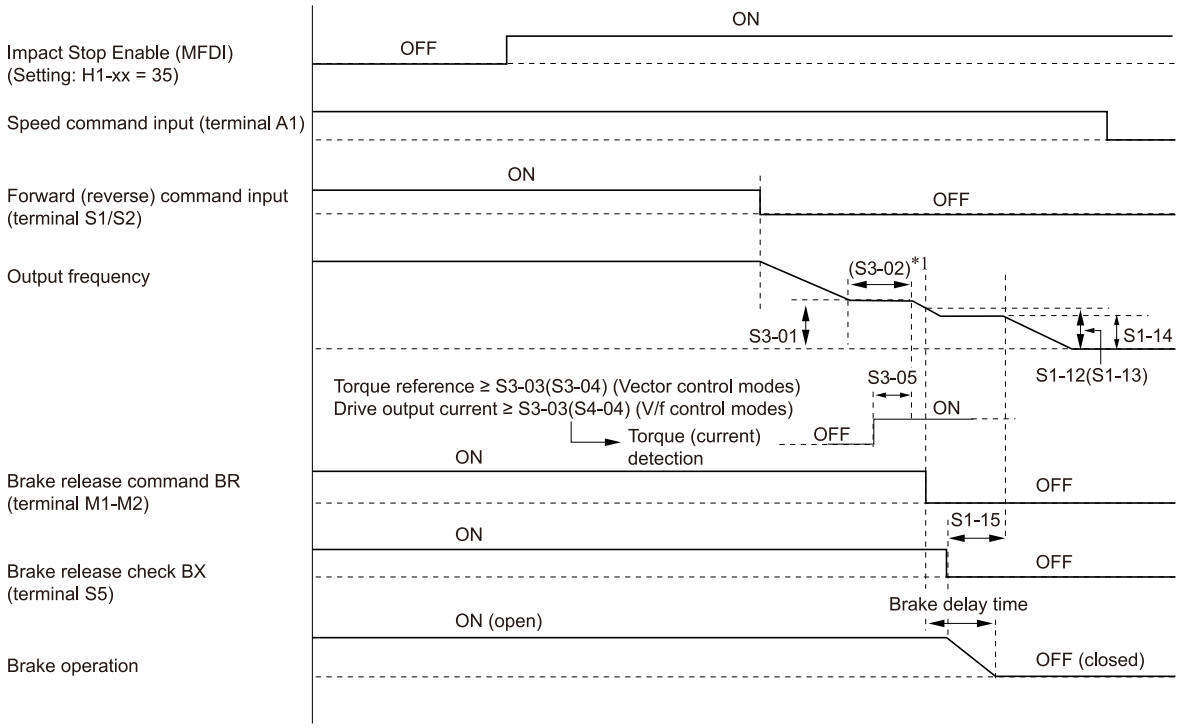
Table 3.15 Parameters for Impact Stop

No.	Name	Description
S3-01	Impact Stop Creep Frequency	Set this value higher than *S1-14 [Slip Prevention Frequency]*.
S3-02	Impact Stop Creep Time	Usually set to 10 s. If the drive detects that the torque reference or output current is above the base value even though the Stop command has been entered, then consider how to protect the load, and change the setting accordingly because the motor will still continue to rotate for the time set in S3-02 and at the speed set in S3-01.
S3-03	Impact Stop Detect Torque (FWD)	Set a value to this parameter that is higher than the amount of current while running at the speed set in *S3-01*. This value is set as a percentage of the motor rated current (usually set to 100%). • If *S3-03/S3-04* are set too low, then the motor may stop before the transport cart actually hits anything. • If *S3-03/S3-04* are set too high, then the motor will continue to rotate at the speed set in *S3-01* for the time set in *S3-02*.
S3-04	Impact Stop Detect Torque (REV)	
S3-05	Impact Stop Detection Time	Usually set between 0.2 s and 0.3 s. If *S3-05* is set too low, then the motor may stop before the transport cart actually hits anything.

■ Multi-Funciton Digital Input

H1-xx Setting Value	Name	Description
35	Impact Stop Command	The Impact Stop command is activated when the terminal switches ON.

■ Description of Operation



S3-01 - Impact Stop Creep Frequency

S3-02 - Impact Stop Creep Time

S3-03 - Impact Stop Detect Torque (FWD)

S3-04 - Impact Stop Detect Torque (REV)

S3-05 - Impact Stop Detection Time

S1-12 - Brake Hold Frequency (FWD)

S1-13 - Brake Hold Frequency (REV)

S1-14 - Slip Prevention Frequency

S1-15 - Slip Prevention Time

*1 In the situations listed below, the output frequency is the value set in *S3-01*, and the run time is the value set in *S3-02*.

- When the drive torque reference is less than *S3-03* or *S3-04* (in OLV control)
- When the drive torque reference is less than *S3-03* or *S3-04* (in V/f control)

1. If the Impact Stop Enable command (*H1-xx = 35*) is switched ON and the output frequency is greater than or equal to *S3-01*, then once the Stop command is entered (meaning that the Forward run command or Reverse run command is switched OFF), then the drive will decelerate to the value set in *S3-01*.
2. The motor will decelerate if the torque reference (the output frequency in V/f Control) is lower than or equal to the value set in *S3-03* (or the value set in *S3-04* if operating in reverse) for the time set in *S3-05* or longer while operating at the speed set in *S3-01*. Consequently, once the output frequency reference reaches the value set in *S1-01 [Brake Release Frequency(FWD)]* (in reverse, *S1-02 [Brake Release Frequency(REV)]*), then the terminal set to *H2-xx = 21 [Brake Release Command]* will shut OFF from an external circuit. Once the Brake release command (BR) turns OFF, then the terminal set to *H1-xx = 0 [Brake Release Check]* turns OFF from an external circuit.
3. If both of the above 2 conditions are not met and the time set in *S3-02* passes, then the Brake Release Command (BR) will switch OFF. Once the Brake Release Command (BR) turns OFF, then the terminal set to the Brake Release Check (BX) will turns OFF using an external sequence.
4. If the Impact Stop Enable command is switched OFF during Impact Stop operation, then the drive will interrupt the Impact Stop function, and switch OFF the Brake Release Command (BR). Once the Brake Release Command (BR) turns OFF, then the terminal set to the Brake Release Check (BX) will turns OFF using an external sequence.

◆ Light-load Acceleration 1 Function

This function monitors how high the drive torque reference and output current get. If the drive detects that the load is light, then it will increase the frequency reference. This shortens the operation time.

This function allows the drive to accelerate up to the frequency reference given when the drive detects that it is working with a light load. Even with a light load, the drive will not accelerate above the frequency reference input to the drive.

Set *H1-xx = 30 [MFDI Function Selection = Light-load Accel 1 Enabled]* to program a digital input to enable/disable Light-load Acceleration 1. Set *S4-01 = 1 [Light-load Accel Ctrl Selection = Light-load Accel Ctrl 1 enabled]* to have Light-load Acceleration 1 enabled all the time.

Note:
- The distance required for the crane to stop when the Run command is switched OFF is determined by the speed of the crane. Higher speeds have longer stopping distances. Switch OFF the Run command with an sufficient distance when in high speed operation.
- The output current may increase after Light-load Acceleration is executed.

■ Related Parameters

Table 3.16 Light-load Acceleration 1 Function Parameters

No.	Name	Adjustment Method
S4-01	Light-load Accel Ctrl Selection	-
S4-02	Light-load 1 Max. Freq(FWD)	Set the output frequency after Light-load Acceleration, and within the motor and crane specifications. If *S4-02* or *S4-03* is more than *E1-04 [Maximum Output Frequency]*, set the output frequency after increasing the speed up to *E1-04*. **Note:** If *E1-04* is changed, the drive will automatically change the acceleration/deceleration rate accordingly.
S4-03	Light-load 1 Max. Freq(REV)	
S4-04	Light-load 1 Detect Torque (FWD)	Usually, set *S4-04 = 50%* and *S4-05 = 50%*. The setting is determined by the motor specifications.
S4-05	Light-load 1 Detect Torque (REV)	
S4-06	Light-load 1 Detect Frequency	Usually, set *S4-06 = E1-06 [Base Frequency]*.
S4-07	Light-load 1 Detect Time	Usually, set *S4-07 = 1 s*. • If setting is too short, then the drive may not be able to accurately detect the load, and this can cause the crane to oscillate. • If setting is too long, the effectiveness of shortening the operation time will decrease.
S4-19 *1	Light-load 1 Torque Bias (FWD)	Sets the mechanical loss of the crane.
S4-20 *1	Light-load 1 Torque Bias (REV)	

*1 This parameter is enabled when *A1-02 = 2, 4 [Control Method Selection = Open Loop Vector, Advanced Open Loop Vector]*.

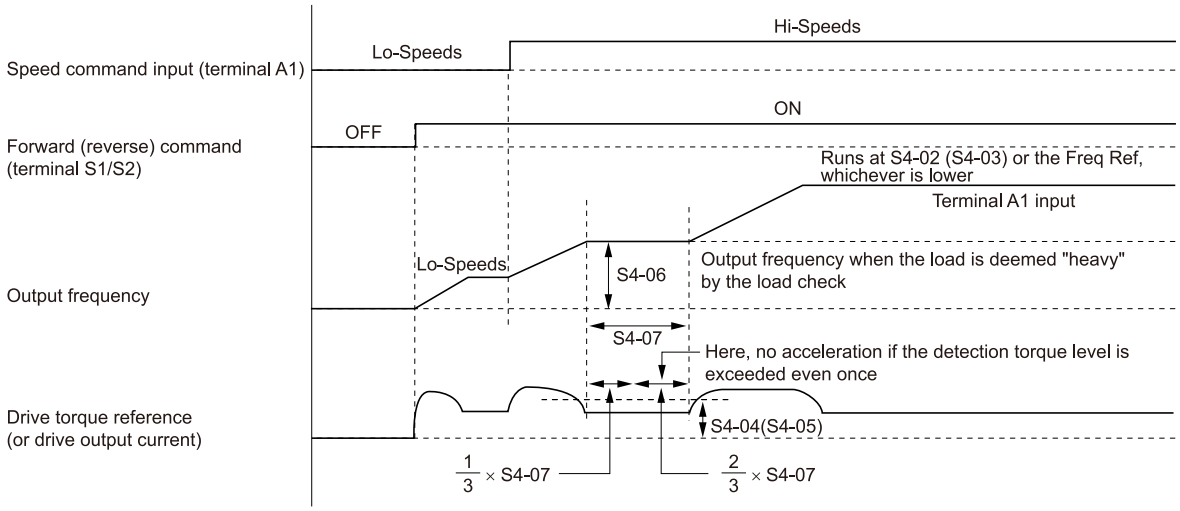
■ Multi-Funciton Digital Input

Table 3.17 Requirement for Enabling Light-load Acceleration

H1-xx Setting Value	Name	Description
30	Light-load Accel 1 Enabled	ON: Enabled OFF: Disabled

MFDI Function Settings			S4-01 Setting	Light-load Accel 1 Enable/Disable
H1-xx = 30	Digital Inputs	OFF	Unrelated to settings	The output frequency will not exceed *S4-06*.
		ON		Light-load Acceleration 1 is enabled.
H1-xx ≠ 30			1: Light-load Accel Ctrl 1 enabled	Light-load Acceleration 1 is enabled.
			2: Light-load Accel Ctrl 2 enabled	Light-load Acceleration 2 is enabled.
			0: Light-load Accel Ctrl disabled	Light-load Acceleration 1 and 2 are disabled. Uses the frequency reference to run the motor.

■ Description of Operation



S4-02 - Light-load 1 Max. Freq(FWD)

S4-03 - Light-load 1 Max. Freq(REV)

S4-04 *1 - Light-load 1 Detect Torque (FWD)

S4-05 *1 - Light-load 1 Detect Torque (REV)

S4-06 - Light-load 1 Detect Frequency

S4-07 - Light-load 1 Detect Time

*1 Sets the motor rating as the base value.

1. When Light-load Acceleration 1 is enabled, if a frequency reference is entered that is higher than *S4-06*, then the drive will accelerate up to the frequency set in *S4-06*. The drive will check the load (by comparing the drive torque reference with *S4-04/S4-05*) after 1/3 of the time set in *S4-07* passes.
2. If the drive torque reference (or output current when using V/f Control) continues to be less than *S4-04/S4-05* for 2/3 of the time set in *S4-07*, then it will re-accelerate the motor (Light-load Acceleration) and operate at either the frequency reference or *S4-02/S4-03*, whichever is lower.
3. If the drive torque reference (or output current when using V/f Control) is great than *S4-04/S4-05*, then it will operate at the frequency reference set in *S4-06*. Afterwards, the drive will not re-accelerate (Light-load Acceleration), no matter how low the torque reference is.

Light-load Acceleration is reset under the following conditions. After resetting Light-load Acceleration, the drive will not accelerate until performing the load check described above.

- When the Run command is switched OFF
- When the frequency reference ≤ *S4-06*
- When a fault occurs
- When the reverse Run command is entered
- When the External baseblock command is entered

■ Adjusting Light-load Acceleration 1 Torque Bias

When lowering the load (reverse), the drive may not perform Light-load Acceleration even if the load is lighter than the detection torque set in *S4-05* because of the mechanical loss applied to the crane. In such cases, adjust *S4-20 [Light-load 1 Torque Bias (REV)]* while referring to the following table.

When hoisting the load (forward), it is possible to skip adjustment of *S4-19 [Light-load 1 Torque Bias (FWD)]* by adding the degree of mechanical loss to the detection torque set in *S4-04*.

The drive may not perform Light-load Acceleration with the same load because the torque reference value for the drive will change because of the effect of changes in motor temperature. Set parameters considering a 5% to 7% margin.

Note:

S4-19/S4-20 are enabled when *A1-02 = 2, 4 [Control Method Selection = Open Loop Vector, Advanced Open Loop Vector]*.

No.	Adjustment Method
S4-19	1. When there is no load, the drive will operate in the forward direction using the frequency reference set in *S4-06* along with the monitor *U1-09 [Torque Reference]*. 2. Set the reverse value of *U1-09* in *S4-19*. 3. Adjust *S4-04* while monitoring *U4-15 [Torque Ref@UL1]*.
S4-20	1. When there is no load, the drive will operate in the reverse direction using the frequency reference set in *S4-06* along with the monitor *U1-09 [Torque Reference]*. 2. Set the reverse value of *U1-09* in *S4-20*. 3. Adjust *S4-05* while monitoring *U4-15 [Torque Ref@UL1]*.

Note:

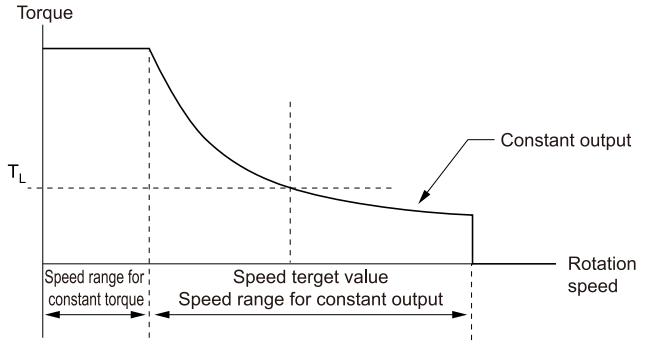
1. Set the parameters to satisfy the following conditions.
   - *S4-06 ≤ S4-02*
   - *S4-03 ≤ E1-04 [Maximum Output Frequency]*
     For motor 2, *S4-03 ≤ E3-04 [Motor 2 Maximum Output Frequency]*
2. If *S4-02/S4-03 < S4-06*, the motor will decelerate once Light-load Acceleration 1 is triggered.
3. After Light-load Acceleration, the drive will operate at the frequency reference or the value set in *S4-02/S4-03*, whichever is smaller.

◆ Light-load Acceleration 2 Function

Light-load Acceleration 2 has the drive automatically determine if it should accelerate up to the frequency reference input to the drive.

If the motor acceleration time is too short and if there is not enough headroom in the motor rated output for what is needed to accelerate within the designated acceleration time, then the drive will automatically extend the acceleration time or simply stop accelerating. This allows for efficient operation while also protecting the load (mainly the braking mechanism).

When enabling Light-load Acceleration 2, enter the target frequency reference (the desired acceleration speed).



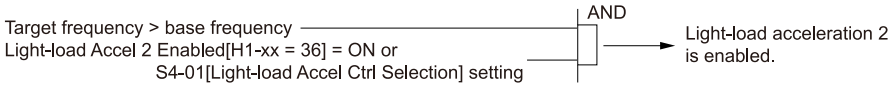
Determine the speed according to following criteria to optimize control.

Output power = Power required for acceleration + Load power

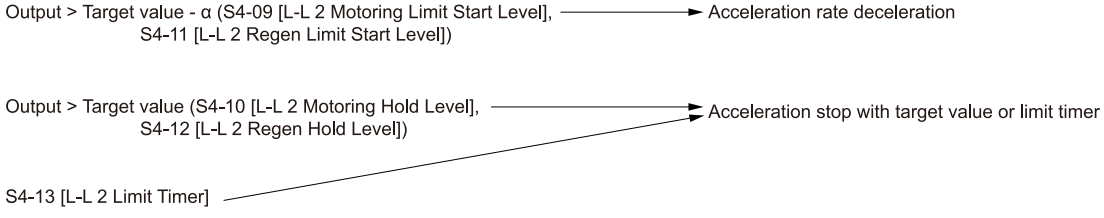
Note:

- By calculating the output power according to the formula above, the drive will extend the acceleration time so that it remains within the drive rated output range, thus operating with minimal impact on the drive acceleration ability.
- Determines the output frequency while monitoring motor output.

- Operation Conditions



- Target Motor Speed Calculation



■ Related Parameters

Table 3.18 Light-load Acceleration 2 Function Parameters

No.	Name	Adjustment Method
E1-20	UL Motor1 Sel	-
S4-01	Light-load Accel Ctrl Selection	Light-load Acceleration 2 function is enabled when *S4-01 = 2 [Light-load Accel Ctrl 2 enabled]*. **Note:** If *S4-01 ≠ 2*, then Light-load Acceleration 2 function can also be enabled by switching ON a terminal set to *H1-xx = 36 [MFDI Function Selection = Light-load Accel 2 Enabled]*.
S4-08	Light-load 2 Activation Freq	Usually, set the 80% to 100% value of *S4-08 = E1-06 [Base Frequency]*.
S4-09	L-L 2 Motoring Limit Start Level	For the gentle acceleration start, the drive will automatically adjust the acceleration time according to the load and the designated acceleration time, within the high speed range for operating a motoring load (the rated output range). Set the start level for Light-load Acceleration 2 as the motor rated output is 100%. Usually, set to a value lower than *S4-10*. The recommended value is 50% to 80%.
S4-10	L-L 2 Motoring Hold Level	Adjust when the motor rated power is not suppressed within the high speed range for operating a motoring load (the rated output range), even while making the acceleration time smoother. Set the level to stop acceleration (hold acceleration) as the motor rated output is 100%. The recommended value is 50% to 120%. • If the setting value is too low, the motor will not accelerate even when the load is light. • If the value is too high, then motor may stall along with load slipping and falling because the drive attempt to operate at high speed when the load is heavy.
S4-11	L-L 2 Regen Limit Start Level	For the gentle acceleration, the drive will automatically adjust the acceleration time according to the load and the designated acceleration time, within the high speed range for operating a regenerative load (the rated output range). Set the start level for Light-load Acceleration 2 as the motor rated output is 100%. Usually, set to a value lower than*S4-12*. The recommended value is 0% to 50%. **Note:** The motor-load rate during regenerative acceleration is a low value, only a fraction of the power required for acceleration, and the opposite of a motoring load. • Motor-load rate during motoring acceleration = Load motoring + Power needed to accelerate the load • Motor-load rate during regenerative acceleration = (Load motoring) × (-1) + Power needed to accelerate the load Slowly adjust the acceleration time within the high speed range (the rated output range) with *S4-17* to ensure the load detection in regeneration operation. Also set *S4-11 = 0% to 50%*.
S4-12	L-L 2 Regen Hold Level	Sets the level at which the drive stops accelerating (to hold acceleration) as a percentage of the motor rated output for when the motor output power is not kept within the high speed range (the rated output range) while working with a regenerative load. (Usually, set between 50% and 120%) • If the setting value is too low, the motor will not accelerate even when the load is light. • If the value is too high, then motor may stall along with load slipping and falling because the drive attempt to operate at high speed when the load is heavy.
S4-13	L-L 2 Limit Timer	Prevents the motor from re-accelerating when there is a momentary light-load situation, or when hanging load arrives on the ground in a crane application. The drive stops acceleration after the time set passes if the extended acceleration time or the acceleration hold time in the high-speed range continues for the time set in *S4-13* or longer. Usually, set between 50% and 100% of the acceleration time in the high-speed range.
S4-14	L-L 2 Fault Operation Selection	-
S4-15	L-L 2 Fault Detection Level	Sets the detection level to trigger protection operation when the motor output power is not suppressed even if the drive automatically adjusts the acceleration time to make it smoother or even stopping acceleration. Set the level at which a fault is detected during Light-load Acceleration 2 as the motor rated current is 100% to *S4-15*. The recommended value is 100% to 150%. Usually, set *S4-16* between 0.1 s and 1.0 s.
S4-16	L-L 2 Fault Detection Time	
S4-17	L-L 2 Accel Time Gain	Adjusts the acceleration time beyond the range set in *S4-08* to detect load power with greater precision, and decrease the effect of the power required for acceleration. The actual acceleration time is as follows. *C1-01, C1-03, C1-05, C1-07 [Acceleration Times] × S4-17* Usually, set *S4-17 = 1.5 to 3.0*. **Note:** If *S4-17 = 1.0*, the acceleration time will be exactly what is set in *C1-01, C1-03, C1-05, and C1-07*.
S4-18	L-L 2 Select during Regeneration	Disables *S4-18* when there is not enough load power for detection during regeneration due to the effect of the power needed for acceleration. Even when Light-load Acceleration 2 is enabled, if *S4-18* is disabled, then the frequency will not increase above the value set for Light-load Acceleration 2 in *S4-08* during regeneration. **Note:** Make sure that proper safety measures are in place on the machine side to detect if the load falls when using Light-load Acceleration 1 or Light-load Acceleration 2.
S4-21	L-L 2 Deceleration Width for oL6	-
S4-22	L-L 2 Freq Upper Limit Select	-
S4-23	Hold Clear FREQ	-
S4-24	Auto Spe Ctrl Sel @UL	-

Note:

Consider the target frequency reference as the maximum output frequency. The limit start level and the hold level are calculated differently when motoring and during regeneration.

$$\text{When motoring} = \frac{W(\text{ton}) \cdot V(\text{m/min})}{6.12 \cdot \eta}$$

$$\times \eta^2$$

$$\text{When regenerating} = \frac{W(\text{ton}) \cdot V(\text{m/min}) \cdot \eta}{6.12}$$

- Set the value of *S4-10* × η^2 *(0.9² = 0.81)* to S4-12 as a target value. If there is no problem with the default setting of 100%, then there is no need to change *S4-12*, because it will not get any higher than the target frequency.
- Separate calculations are used when motoring and during regeneration. As a result, the speed is not the same when hoisting the load and when lowering it.

■ Multi-Funciton Digital Input

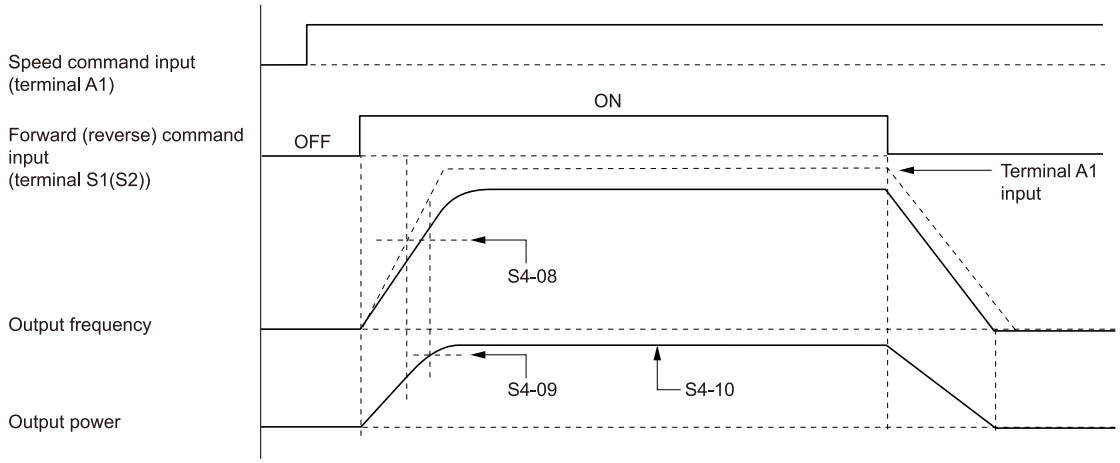
H1-xx Setting	Name	Description
36	Light-load Accel 2 Enabled	ON: Enabled OFF: Disabled

Table 3.19 Requirement for Enabling Light-load Acceleration

MFDI Function Settings			S4-01 Setting	Light-load Accel 2 Enable/Disable
H1-xx = 36	Digital Inputs	OFF	Unrelated to settings	The output frequency will not exceed *S4-08*.
		ON		Light-load Acceleration 2 is enabled.
H1-xx ≠ 36			1: Light-load Accel Ctrl 1 enabled	Light-load Acceleration 1 is enabled.
			2: Light-load Accel Ctrl 2 enabled	Light-load Acceleration 2 is enabled.
			0: Light-load Accel Ctrl disabled	Light-load Acceleration 1 and 2 are disabled. Uses the frequency reference to run the motor.

■ Description of Operation

The following is an example of drive operation while motoring.



S4-08 - Light-load 2 Activation Freq

S4-09 - L-L 2 Motoring Limit Start Level

S4-10 - L-L 2 Motoring Hold Level

Note:

The dotted line indicates where the drive output still has headroom. Speed loss (stalling) will actually occur if the drive has insufficient power.

Type	Operation
Motoring	If Light-load Acceleration 2 is enabled, when the frequency reference exceeds *S4-08*, the acceleration times = *S4-17 × C1-01, C1-03, C1-05, C1-07 [Acceleration Times]*, and the drive will monitor output power.
	If the output power ≥ *S4-09* then the drive will make acceleration even more gradual, and start the counter for the limit timer set in *S4-13*.
	The drive will stop accelerating the motor if any of the following conditions arise, regardless of how much it has smoothed out acceleration already. • Output power reached the level set in *S4-10*. • The counter for Light-load Acceleration 2 reaches the value set for the limit timer in *S4-13*. If the counter reaches the value set for the limit timer in *S4-13* and acceleration is stopped, then the drive will not accelerate again until after the motor has stopped.
Regenerative operation	If Light-load Acceleration 2 is enabled, then once the frequency reference exceeds *S4-08*, the acceleration times = *S4-17 × C1-01, C1-03, C1-05, C1-07*, and the drive will monitor output power.
	If the output power ≥ *S4-11* then the drive will make acceleration even more gradual, and start the counter for the limit timer set in *S4-13*.
	The drive will stop accelerating the motor if any of the following conditions arise, regardless of how much it has smoothed out acceleration already. • Output power reached the level set in *S4-12*. • The counter for Light-load Acceleration 2 reaches the value set for the limit timer in *S4-13*. If the counter reaches the value set for the limit timer in *S4-13* and acceleration is stopped, then the drive will not accelerate again until after the motor has stopped.

Note:
- The counter for the limit timer will be cleared once the output power falls below *S4-09*.
- Set *S4-18 = 1 [L-L 2 Select during Regeneration = Enabled]* to enable operation during regeneration.
- The following fault detection will occur if the output frequency > *S4-08*. The drive detects *oL6 [Light-load Accel 2 Fault (oL6)]* if the output power is equal to or greater than the fault level set in *S4-15* for the time set in *S4-16* or longer. After the fault detection, the drive follows the protective operation set in *S4-14*.

S4-14 Setting	Operation after Detection	Mode
0	Ramp to stop	Fault (triggers a fault relay output) *1
1	Coast to stop	
2	Emergency stop	
3	Acceleration prohibited	Minor fault *2
4	Frequency deceleration Decreases the output frequency only by the frequency set in *S4-21*. This operation will repeat at the interval set by *S4-16* for as long as the output power ≥ *S4-15*.	-

*1 The keypad will display *oL6* until the fault is reset.
*2 The keypad will flash *oL6* until the Run command is switched OFF, and the motor stops. The keypad will continue to flash *oL6* even if you perform a fault reset.

◆ Overload Detection

This function limits drive operation depending on how high the drive torque reference or the output current is in order to ensure safety. If the drive detects an overload situation, then it displays *oL5 [Overload Detection (oL5)]* on the keypad. You can set 2 levels for overload detection, and 2 types of action to take after detecting overtorque.

Note:
1. The overload detection function is enabled only when the brake is released.
2. The overload detection function is disabled when the Run command source is set to the keypad.

■ Related Parameters

Table 3.20 Overload Detection Parameters

No.	Name	Description
S5-01	OverL Detect Operation Select 1	Enables overload detection, and sets the conditions for detection as well as the operation to perform after an overload situation is detected.
S5-04	OverL Detect Operation Select 2	
S5-02	OverL Detect Operation Select 1	Sets the level to trigger an overload. • V/f Control Mode Sets the amount of current to detect overload as the motor rated current is 100%. • OLV Control Sets the amount of torque to detect overload as the motor rated torque is 100%.
S5-05	Overload Detection Torque 2	
S5-03	Overload Detection Time 1	If the motor current and motor torque exceed the value set in *S5-02* for longer than the time set in this parameter, then an overload will be detected.
S5-06	Overload Detection Time 2	If the motor current and motor torque exceed the value set in *S5-05* for longer than the time set in this parameter, then an overload will be detected.

■ S5-01/S5-04 Settings

Setting Value	Detection		Conditions		Type	Operation after Detection	Drive Recovery
	Enabled	Disabled	During Run	During Speed Agreement			
0	-	x	-	-	-	-	-
1	x	-	-	x	Alarm	Acceleration prohibited	When the Run command is OFF and the motor has stopped, the drive will return to the state before the fault was triggered. *1
2	x	-	x	-			
3	x	-	-	x		Ramps to stop according to *C1-09 [Fast Stop Time]*	When the Run command is OFF and the motor has stopped, the drive will return to the state before the fault was triggered. *1
4	x	-	x	-			
5	x	-	-	x	Fault (Triggers a fault relay output)	Coast to Stop	Push on the keypad or turn ON the terminal set for "Fault Reset" to reset the fault.
6	x	-	x	-			

*1 Pushing on the keypad will not reset an alarm.

■ Multi-Function Digital Output

The following table shows the ON/OFF conditions of the MFDO terminals.

H2-xx Setting Value	Name	Description
22	Overload Detection (N.O.)	If the drive detects overload based on the conditions set for Overload Detection 1 or 2, then this digital output will switch ON. The digital output will switch OFF when *oL5* is cleared from the keypad display.
23	Weight Det N.C.	If the drive detects overload based on the conditions set for Overload Detection 1 or 2, then this digital output will switch OFF. The digital output will switch ON when *oL5* is cleared from the keypad display.

◆ Overtorque Detection

This function limits drive operation depending on how high the drive torque reference or the output current is in order to provide mechanical protection to the crane. If the drive detects an overtorque situation, then it displays *oL3 [Overtorque Detection 1]* or *oL4 [Overtorque Detection 2]* on the keypad. You can set 2 levels for overtorque detection, and 2 types of action to take after detecting overtorque.

Note:

The overtorque detection function is disabled when the Run command source is set to the keypad.

■ Related Parameters

Table 3.21 Overtorque Detection Parameters

No.	Name	Description	Error Code
S6-01	OverT Detect Operation Select 1	Enables overtorque detection, and sets the conditions for detection as well as the operation to perform after an overtorque is detected.	oL3
S6-04	OverT Detect Operation Select 2		oL4
S6-02	Overtorque Detection Level 1	Sets the level to trigger an overtorque.	-
S6-05	Overtorque Detection Level 2	• V/f Control Mode Sets the amount of torque that triggers overtorque detection as the motor rated current is 100%. • OLV Control Sets the amount of torque that triggers overtorque detection as the motor rated torque is 100%.	-
S6-03	Overtorque Detection Time 1	If the motor current and motor torque exceed the value set in *S6-02* for longer than the time set in this parameter, then Overtorque 1 will be detected.	oL3
S6-06	Overtorque Detection Time 2	If the motor current and motor torque exceed the value set in *S6-05* for longer than the time set in this parameter, then Overtorque 2 will be detected.	oL4
S6-09	Torque Detection Filter Time	Sets the time constant for a primary filter to the torque reference or to the output current used to detect overtorque.	-

■ S6-01 and S6-04 Settings

Setting Value	Detection		Conditions		Type	Operation after Detection	Drive Recovery
	Enabled	Disabled	During Run	During speed agreement			
0	-	x	-	-	-	-	-
1	x	-	-	x	Alarm	Alarm Only	When the Run command is OFF and the motor has stopped, the drive will return to the state before the fault was triggered. *1
2	x	-	x	-			
3	x	-	-	x	Fault (Triggers a fault relay output)	Coast to Stop	Push [>] on the keypad or turn ON the terminal set for "Fault Reset" to reset the fault.
4	x	-	x	-			
5	x	-	-	x	Alarm	Alarm Only	When the Run command is OFF and the motor has stopped, the drive will return to the state before the fault was triggered. *1
6	x	-	x	-			

*1 Pushing [>] on the keypad will not reset an alarm.

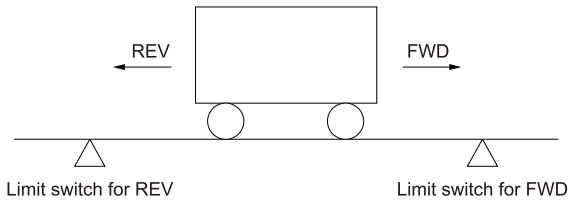
■ Multi-Function Digital Output

The following table shows the ON/OFF conditions of the MFDO terminals.

H2-xx Setting Value	Name	Description
0B	Torque Detection 1 (N.O.)	If the drive detects overtorque based on the conditions set for Overtorque Detection 1, then this digital output will switch ON. The digital output will switch OFF when *oL3* is cleared from the keypad display.
17	Torque Detection 1 (N.C.)	If the drive detects overtorque based on the conditions set for Overtorque Detection 1, then this digital output will switch OFF. The digital output will switch ON when *oL3* is cleared from the keypad display.
18	Torque Detection 2 (N.O.)	If the drive detects overtorque based on the conditions set for Overtorque Detection 2, then this digital output will switch ON. The digital output will switch OFF when *oL4* is cleared from the keypad display.
19	Torque Detection 2 (N.C.)	If the drive detects overtorque based on the conditions set for Overtorque Detection 2, then this digital output will switch OFF. The digital output will switch ON when *oL4* is cleared from the keypad display.

◆ Travel Limit Function

The Travel Limit function is a limit switch used to prevent over-travel by the transport cart and over-hoist in a hoist application. You can set the MFDI terminals for FWD/REV and N.O./N.C. switching.



Note:
If the Run command on the forward side is disabled, then by triggering an input terminal set for the Travel Limit, the drive will show *FWdL [Fwd Limit (FWdL)]* on the keypad. If the Run command on the reverse side is disabled, the drive will show *rEvL [Rev Limit (rEvL)]* on the keypad.

■ Multi-Funciton Digital Input

The following table shows the MFDI terminal operation after Travel Limit Detection.

H1-xx Setting Value	Name	Operation after Detection
31	Forward Travel Limit (N.O.)	Once the terminal switches ON during forward run, the drive switches OFF the Brake release command (close the brake), the motor coasts to stop, and the output frequency drops to 0. While the terminal is ON, only a Reverse run command is accepted. Once the terminal switches OFF, both the Forward run command and the Reverse run command are accepted. Operation does not change even if the terminal switches ON during reverse run.
32	Forward Travel Limit (N.C.)	Once the terminal switches OFF during forward run, the drive switches OFF the Brake release command (close the brake), the motor coasts to stop, and the output frequency drops to 0. While the terminal is OFF, only a Reverse run command is accepted. Once the terminal switches ON, both the Forward run command and the Reverse run command are accepted. Operation does not change even if the terminal switches ON during reverse run.
33	Reverse Travel Limit (N.O.)	Once the terminal switches ON during reverse run, the drive switches OFF the Brake release command (close the brake), the motor coasts to stop, and the output frequency drops to 0. While the terminal is ON, only a Forward run command is accepted. Once the terminal switches OFF, both the Forward run command and the Reverse run command are accepted. Operation does not change even if the terminal switches ON during forward run.
34	Reverse Travel Limit (N.C.)	Once the terminal switches OFF during reverse run, the drive switches OFF the Brake release command (close the brake), the motor coasts to stop, and the output frequency drops to 0. While the terminal is OFF, only a Forward run command is accepted. Once the terminal switches ON, both the Forward run command and the Reverse run command are accepted. Operation does not change even if the terminal switched ON during forward run.

◆ Motor Switch Function

The drive operates by switching between 3 motors using an external input. Motor 1 and motor 2 can be used for hoisting, raising, lowering, and traverse applications. Motor 3 can be used for traveling and slewing applications. The drive saves the control methods, V/f patterns, and motor parameters for each of the 3 motors, and optimizes control for each of those motors.

Note:

Some of the following functions restriction apply when switching drive operation between motors.

- There is wait time when switching between motors. The Run command must be entered after the wait time has passed. The wait time for switchover is 500 ms when switching between motor 1 and motor 2 if those motors use encoders. The wait time is 200 ms if using a control method that does not require a PG encoder.

Motor	Control Method	Application	Brake Sequence
Motor 1	All	Hoisting, traversing, traveling, slewing	x
Motor 2	Other than AOLV Control	Hoisting, traversing, traveling, slewing	x
Motor 3	V/f	Traveling, slewing	Setting possible only with brake release/close control

■ Description of Operation

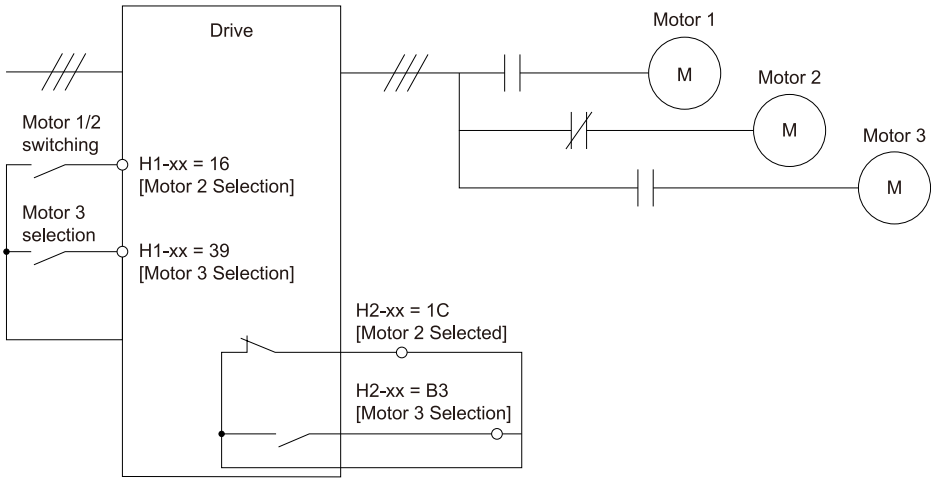
Switch between motors with an ON/OFF combination of terminals set to *H1-xx = 16 [Motor 2 Selection]* and *H1-xx = 39 [Motor 3 Selection]*.

Switch between motors with an ON/OFF combination of terminals set to *H1-xx = 16 [Motor 2 Selection]* and *H1-xx = 39 [Motor 3 Selection]*.

H1-xx = 16 [Motor 2 Selection] *1	H1-xx = 39 [Motor 3 Selection]	Selected Motors	Parameters for Control Method Setting
OFF	OFF	Motor 1	Select with *A1-02*. *2
	ON	Motor 3	N/A *3
ON	OFF	Motor 2	Select with *E3-01*. *2
	ON	Motor 3	N/A *3

*1 If *H1-xx = 39* is set while *H1-xx = 16* is not set, *oPE03 [Multi-Function Input Setting Err]* is detected.
*2 The motor switch function is disabled when *A1-02 = 4 [Control Method Selection = Advanced Open Loop Vector]*.
*3 You cannot set the control method for motor 3. Motor 3 is enabled only when operating the drive with V/f Control.

You cannot switch between motors 1, 2, and 3 during run. The drive detects *rUn [Motor Switch during Run]* when attempting to switch the motors during run.



When switching between motors, the parameters used by the drive are switched to the parameters for motor 2 and motor 3.

Table 3.22 Switch Parameters for Switching Between Motors

Item	Parameter Name	Motor Switch Command		
		Motor 1	Motor 2	Motor 3
Motor Selection	Motor Selection	T1-00	T1-00	T1-00
Control Method	Control Method Selection	A1-02	E3-01	V/f control only
Accel & Decel Time	Acceleration Time 1	C1-01	C1-05	C1-22
	Deceleration Time 1	C1-02	C1-06	C1-23
	Acceleration Time 2	C1-03	C1-07	C1-24
	Deceleration Time 2	C1-04	C1-08	C1-25
Slip Compensation	Slip Compensation Gain	C3-01	C3-21	Default setting for V/f Control
	Slip Compensation Delay Time	C3-02	C3-22	Default setting for V/f Control
	Slip Compensation Limit	C3-03	C3-23	Default setting for V/f Control
	Slip Compensation at Regen	C3-04	C3-24	Default setting for V/f Control
Torque Compensation	Torque Compensation Gain	C4-01	C4-07	Default setting for V/f Control
	Torque Compensation Delay Time	C4-02	C4-08	Default setting for V/f Control
	Torque Comp Delay Time Select	C4-13	C4-14	Default setting for V/f Control
	Torque Comp Delay Time Select	C4-15	C4-08	Default setting for V/f Control
	Torque Comp Delay Time Select	C4-16	C4-14	Default setting for V/f Control
ASR	ASR Proportional Gain 1	C5-01	C5-21	-
	ASR Integral Time 1	C5-02	C5-22	-
	ASR Proportional Gain 2	C5-03	C5-23	-
	ASR Integral Time 2	C5-04	C5-24	-
	ASR Limit	C5-05	C5-25	-
	ASR Delay Time	C5-06	C5-26	-
	ASR Gain Switchover Frequency	C5-07	C5-27	-
	ASR Integral Limit	C5-08	C5-28	-
	Integral Operation @ Accel/Decel	C5-12	C5-32	-
	Motor Inertia	C5-17	C5-37	-
	Load Inertia Ratio	C5-18	C5-38	-

Item	Parameter Name	Motor Switch Command		
		Motor 1	Motor 2	Motor 3
V/f Pattern	Maximum Output Frequency	E1-04	E3-04	E7-04
	Maximum Output Voltage	E1-05	E3-05	E7-05
	Base Frequency	E1-06	E3-06	E7-06
	Mid Point A Frequency	E1-07	E3-07	E7-07
	Mid Point A Voltage	E1-08	E3-08	E7-08
	Minimum Output Frequency	E1-09	E3-09	E7-09
	Minimum Output Voltage	E1-10	E3-10	E7-10
	Mid Point B Frequency	E1-11	E3-11	E7-11
	Mid Point B Voltage	E1-12	E3-12	E7-12
	Base Voltage	E1-13	E3-13	E7-13
	Middle Out Freq Volt Select	E1-14	E3-14	E7-08
	Minimum Out Freq Volt Select	E1-15	E3-15	E7-10
	Middle Out Freq Volt Select	E1-16	E3-08	E7-08
	Minimum Out Freq Volt Select	E1-17	E3-10	E7-10
	Middle Out Freq Volt Select	E1-18	E3-14	E7-08
	Minimum Out Freq Volt Select	E1-19	E3-15	E7-10
Motor Parameters	Motor Rated Current (FLA)	E2-01	E4-01	E7-21
	Motor Rated Slip	E2-02	E4-02	Default setting for V/f Control
	Motor No-Load Current	E2-03	E4-03	Default setting for V/f Control
	Motor Pole Count	E2-04	E4-04	E7-24
	Motor Line-to-Line Resistance	E2-05	E4-05	E7-25
	Motor Leakage Inductance	E2-06	E4-06	Default setting for V/f Control
	Motor Saturation Coefficient 1	E2-07	E4-07	-
	Motor Saturation Coefficient 2	E2-08	E4-08	-
	Motor Mechanical Loss	E2-09	E4-09	-
	Motor Iron Loss	E2-10	E4-10	Default setting for V/f Control
	Motor Rated Power (kW)	E2-11	E4-11	E7-31
Encoder Pulse Count (PPR)	Encoder Pulse Count (PPR)	F1-01	F1-31	-
	Encoder Rotation Selection	F1-05	F1-32	-
	Encoder Gear Teeth 1	F1-12	F1-33	-
	Encoder Gear Teeth 2	F1-13	F1-34	-
	Encoder Pulse Monitor Scaling	F1-06	F1-35	-
	Encoder PCB Disconnect Detect	F1-20	F1-36	-
	Encoder Signal Selection	F1-21	F1-37	-
Motor Protection	oL1 Current Level	L1-08	L1-09	-

Item	Parameter Name	Motor Switch Command		
		Motor 1	Motor 2	Motor 3
Brake Sequence	Brake Sequence Selection *1	S1-54	S1-55	S1-56
	Brake Release Frequency(FWD)	S1-01	S1-23	S1-52
	Brake Release Frequency(REV)	S1-02	S1-24	S1-52
	Brake Delay Frequency	S1-03	S1-25	-
	Brake Delay Time	S1-04	S1-26	0.00 s
	Brake Release Current (FWD)	S1-05	S1-27	0%
	Brake Release Current (REV)	S1-06	S1-28	0%
	Brake Release Torque (FWD)	S1-07	S1-29	-
	Brake Release Torque (REV)	S1-08	S1-30	-
	Torque Compensation (FWD)	S1-09	S1-31	-
	Torque Compensation (REV)	S1-10	S1-32	-
	Torque Compensation Delay Time	S1-11	S1-33	-
	Brake Hold Frequency (FWD)	S1-12	S1-34	S1-53
	Brake Hold Frequency (REV)	S1-13	S1-35	S1-53
	Slip Prevention Frequency	S1-14	S1-36	-
	Slip Prevention Time	S1-15	S1-37	0.00 s
	Sequence Fault SE1 Detect Time	S1-16	S1-38	0.00 s
	Sequence Fault SE2 Detect Time	S1-17	S1-39	0.00 s
	Sequence Fault SE3 Detect Time	S1-18	S1-40	0.00 s
	Sequence Fault SE4 Detect Time	S1-19	S1-41	0.00 s
	Operation in Reverse	S1-20	S1-42	-

*1 Set *S1-54 to S1-56 = 0 [Disabled]* when you do not use the brake sequence.

Note:

- When the 3 motors are used, a protective function set in *L1-01 [Motor Overload (oL1) Protection]* is applied to motor 1 and motor 2 only. For motor 3, set up a thermal overload relay between the drive and motor 3, so that the sequence trips an external fault (coast to stop).
- You cannot switch between V/f patterns during run for motor 3. Even when *b1-23 = 1 [Selection REV Parameters = Enabled]*, the drive will not switch between motors even when the counterweight signal is input.
- If the frequency reference exceeds the maximum output frequency, then it will still be limited by the maximum output frequency set to each motor. For example, if you set *E1-04 = 60 Hz*, *E3-04 = 50 Hz*, *d1-04 [Reference 4] = 60 Hz*, and *d1-04* as the part of multi-step speed reference, then the frequency reference for motor 1 will be 60 Hz, and 50 Hz for motor 2.
- Refer to the following for the default settings change as the control method.
  –
  –

Table 3.23 Multi-Funciton Digital Input

H1-xx Setting Value	Name	Description
16	Motor 2 Selection	Switches between motors 1 and 2. ON: Selects motor 2 OFF: Selects motor 1
39	Motor 3 Selection	Switches to motor 3. It is necessary to set *H1-xx = 16* when setting *H1-xx = 39*. If *H1-xx = 39* is set while *H1-xx = 16* is not set, *oPE03 [Multi-Function Input Setting Err]* is detected. ON: Selects motor 3 OFF: Clears the selection of motor 3

Note:

When *H1-xx = 16 and/or 39*, the drive does not detect *oPE08 [Parameter Selection Error]* concerning contradictory settings in the MFDIs, MFDOs, analog inputs, and monitor outputs. The drive recognizes terminals that have not been set to a function as "Not Used".

Table 3.24 Multi-Function Digital Output

H2-xx Setting Value	Name	Description
1C	Motor 2 Selected	The terminal turns on when motor 2 is selected. ON: Motor 2 is selected OFF: Motor 1 is selected
B3	Motor 3 Selection	The terminal turns on when motor 3 is selected. ON: Motor 3 is selected OFF: Clears the selection of motor 3

■ Related Monitors

No.	Bit
MEMOBUS/Modbus Communications Registers 004B(Hex.) bit A	1: Motor 2 Selection
MEMOBUS/Modbus Communications Registers 004B (Hex.) bit C	1: Motor 3 Selection

◆ Parameter Switching Function for Reverse Operation

This function allows the application to switch between the torque compensation delay time, the mid point a voltage, and the minimum output voltage. The conditions for switching are based on the input terminal status and the direction of the Run command (forward or reverse), along with the parameter setting combinations.

Set the following parameters when using this function.

- Set *b1-23 = 1 [Selection REV Parameters = Enabled]*.
- Set *H1-xx = 38[MFDI Function Selection = Counterweight Selection]*.

Note:

The switching function is disabled during run.

■ Related Parameters

Table 3.25 Related Parameters

No.	Name
b1-23	Selection REV Parameters
C4-02	Torque Compensation Delay Time
C4-08	M2 Torque Comp Delay Time
C4-13	Torque Comp Delay Time Select 1
C4-14	M2 Torque Comp Delay Time Sel 1
C4-15	Torque Comp Delay Time Select 2
C4-16	Torque Comp Delay Time Select 3
E1-08	Mid Point A Voltage
E1-10	Minimum Output Voltage
E1-14	Middle Out Freq Volt Select 1

No.	Name
E1-15	Minimum Out Freq Volt Select 1
E1-16	Middle Out Freq Volt Select 2
E1-17	Minimum Out Freq Volt Select 2
E1-18	Middle Out Freq Volt Select 3
E1-19	Minimum Out Freq Volt Select 3
E3-08	Motor 2 Mid Point A Voltage
E3-10	Motor 2 Minimum Output Voltage
E3-14	M2 Middle Out Freq Volt Select
E3-15	M2 Minimum Out Freq Volt Select

The table below shows the combinations for the switching function.

Motor Selection	Digital Input Terminals H1-xx = 38 [Counterweight Selection] *1	b1-23	Run Command	Torque Compensation Time Constant	Mid Point A Voltage	Minimum Output Frequency Voltage
Motor 1	OFF	0	RUN Forward	C4-02	E1-08	E1-10
			RUN Reverse			
		1	RUN Forward	C4-02	E1-08	E1-10
			RUN Reverse	C4-13	E1-14	E1-15
	ON	0	RUN Forward	C4-15	E1-16	E1-17
			RUN Reverse			
		1	RUN Forward	C4-15	E1-16	E1-17
			RUN Reverse	C4-16	E1-18	E1-19
Motor 2	OFF	0	RUN Forward	C4-08	E3-08	E3-10
			RUN Reverse			
		1	RUN Forward	C4-08	E3-08	E3-10
			RUN Reverse	C4-14	E3-14	E3-15
	ON	0	RUN Forward	C4-08	E3-08	E3-10
			RUN Reverse			
		1	RUN Forward	C4-08	E3-08	E3-10
			RUN Reverse	C4-14	E3-14	E3-15

*1 If the terminal is not set with *H1-xx = 38*, then it is the same as turning the operation OFF.

◆ Crane Maintenance Monitor

This function counts the number of Run commands or brake release commands and outputs an alarm once the count number reaches the count set with the related parameter.

This function provides a guide on when to perform brake maintenance such as system inspections and parts replacement.

■ Description of Operation

This function counts the number of Run commands or brake release commands. Select the count type with *S2-08 [Number of Driving count selec]*. The count type selected with *S2-08* is applicable to all three motors (motor 1, motor 2, and motor 3).

Note:

If a particular motor does not have a brake sequence enabled, the Run command will be counted even when *S2-08 = 1 [Brake Release Command count]*.

Applicable motor	Motor 1	Motor 2	Motor 3
Count type	Select the command to be counted with *S2-08*. 0: Run Command count 1: Brake Release Command count		
Cumulative Startup Count Value Monitor *1	• U4-54 [Num of Driv 1 (High)] • U4-53 [Num of Driv 1 (Low)]	• U4-56 [Num of Driv 2 (High)] • U4-55 [Num of Driv 2 (Low)]	• U4-58 [Num of Driv 3 (High)] • U4-57 [Num of Driv 3 (Low)]
Alarm Output Operation Setting *2 *3	The operation selected with *S2-12 [MentenanceTimer Output Selection]* applies to all motors. 0: Disable 1: Alarm 2: Fault		
Alarm Output Detection Level Setting	S2-13 [Motor1 Number of Driving Limit]	S2-14 [Motor2 Number of Driving Limit]	S2-15 [Motor3 Number of Driving Limit]
Fault/Minor Fault Code *2 *3	CnT1 [Number of Driving Over]	CnT2 [Number of Driving Over]	CnT3 [Number of Driving Over]
Number of Starts Alarm Output	When the startup count exceeds the detection level, the output terminal selected with *H2-xx = 52 [Warning Signal]* turns on.		
Startup Count Reset Setting *4	S2-09 [Motor1 Number of Driving start]	S2-10 [Motor2 Number of Driving start]	S2-11 [Motor3 Number of Driving start]

*1 The maximum count value is 10,000,000. This function stops counting startups when the maximum value is reached.
*2 The following operations are selected with *S2-12 [MentenanceTimer Output Selection]*.

- Enable and disable alarm output
- Continue or stop drive operation when an alarm is triggered

*3 Detection as a fault or minor fault is only applicable to the motor selected by the motor switch function. A fault or minor fault is output when conditions are satisfied for the selected motor.
*4 When replacing a drive, set *S2-09 to S2-11* with the startup count information in the old drive.

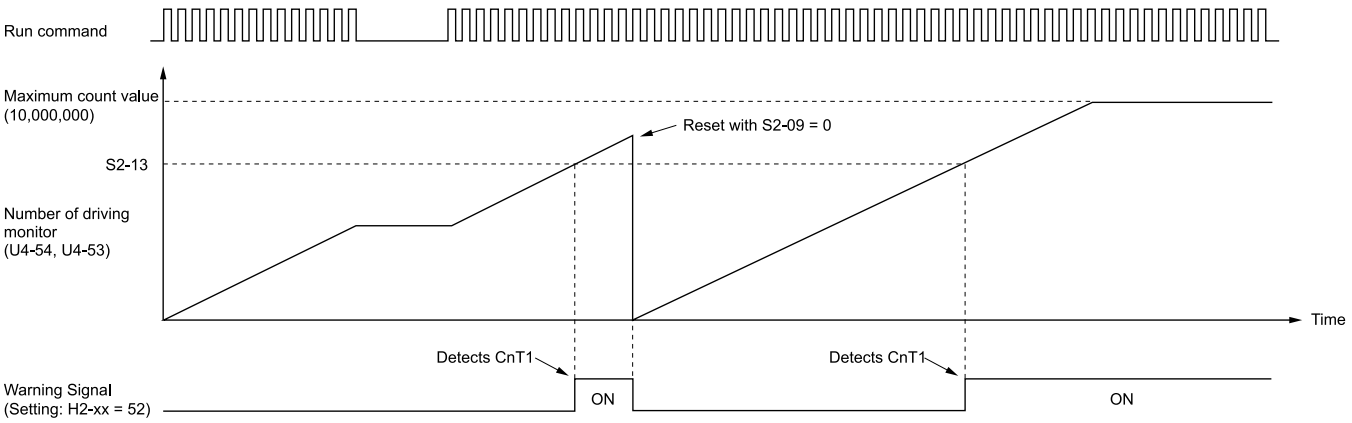


Figure 3.11 Example Maintenance Monitor Operation (Run Command count: S2-08 = 0)

S2-09 - Motor1 Number of Driving start
S2-13 - Motor1 Number of Driving Limit
U4-54 - Num of Driv 1 (High)
U4-53 - Num of Driv 1 (Low)

■ Related Parameters

Table 3.26 Maintenance Monitor Parameters

No.	Name	Adjustment Method
S2-08	Number of Driving count selec	Sets the type of startup count for motors 1 to 3. 0: Run Command count 1: Brake Release Command count
S2-09 *1 *2	Motor1 Number of Driving start	Sets the motor 1 startup count in increments of 10,000 repetitions. Starts counting from the set value value.
S2-10 *1 *2	Motor2 Number of Driving start	Sets the motor 2 startup count in increments of 10,000 repetitions. Starts counting from the set value value.
S2-11 *1 *2	Motor3 Number of Driving start	Sets the motor 3 startup count in increments of 10,000 repetitions. Starts counting from the set value value.
S2-12	MentenanceTimer Output Selection	Sets the method of alarm output. 0: Disable 1: Alarm 2: Fault
S2-13 *3	Motor1 Number of Driving Limit	Sets the startup count 1 fault/minor fault output level in increments of 10,000 repetitions. *CnT1* is detected when *S2-13 = U4-54*.
S2-14 *3	Motor2 Number of Driving Limit	Sets the startup count 2 fault/minor fault output level in increments of 10,000 repetitions. *CnT2* is detected when *S2-14 = U4-56*.
S2-15 *3	Motor3 Number of Driving Limit	Sets the startup count 3 fault/minor fault output level in increments of 10,000 repetitions. *CnT3* is detected when *S2-15 = U4-58*.

*1 These parameters are not initialized by *A1-03 [Initialize Parameters]*.
*2 The setting value of these parameters changes in accordance with the applicable monitor. For example, when the Run command count reaches 10,000 after *S2-09 is set to 1*, the value of *U4-54* changes from 1 to 2. *S2-09 also changes to 2* at this same timing.
*3 When, S2-13 through S2-15 = 0, the startup count warning output setting is disabled.

■ Digital Outputs

H2-xx Setting	Name	Description
52	Warning Signal	The terminal turns on when the number of starts reaches the detection level.

■ Related Monitors

No.	Name	Bit
U4-53	Num of Driv 1 (Low)	Displays the lower 4 digits of the cumulative motor 1 startup count. **Note:** The drive run count appears as an 8-digit number. *U4-54* displays the upper 4 digits, and *U4-53* displays the lower 4 digits. The maximum count value is 10,000,000. The counter stops once the maximum value is reached. The count value can be changed with *S2-09*.
U4-54	Num of Driv 1 (High)	Displays the upper 4 digits of the cumulative motor 1 startup count. **Note:** The drive run count appears as an 8-digit number. *U4-54* displays the upper 4 digits, and *U4-53* displays the lower 4 digits. The maximum count value is 10,000,000. The counter stops once the maximum value is reached. The count value can be changed with *S2-09*.
U4-55	Num of Driv 2 (Low)	Displays the lower 4 digits of the cumulative motor 2 startup count. **Note:** The drive run count appears as an 8-digit number. *U4-56* displays the upper 4 digits, and *U4-55* displays the lower 4 digits. The maximum count value is 10,000,000. The counter stops once the maximum value is reached. The count value can be changed with *S2-10*.
U4-56	Num of Driv 2 (High)	Displays the upper 4 digits of the cumulative motor 2 startup count. **Note:** The drive run count appears as an 8-digit number. *U4-56* displays the upper 4 digits, and *U4-55* displays the lower 4 digits. The maximum count value is 10,000,000. The counter stops once the maximum value is reached. The count value can be changed with *S2-10*.
U4-57	Num of Driv 3 (Low)	Displays the lower 4 digits of the cumulative motor 3 startup count. **Note:** The drive run count appears as an 8-digit number. *U4-58* displays the upper 4 digits, and *U4-57* displays the lower 4 digits. The maximum count value is 10,000,000. The counter stops once the maximum value is reached. The count value can be changed with *S2-11*.
U4-58	Num of Driv 3 (High)	Displays the upper 4 digits of the cumulative motor 3 startup count. **Note:** The drive run count appears as an 8-digit number. *U4-58* displays the upper 4 digits, and *U4-57* displays the lower 4 digits. The maximum count value is 10,000,000. The counter stops once the maximum value is reached. The count value can be changed with *S2-11*.

◆ Frequency Reduction Gain

This function switches to low-speed operation when the crane load is near the target position.

The frequency is adjusted by multiplying the gain against the smallest frequency reference from among *d1-01 [Reference 1] through d1-17 [Jog Reference]* as selected by the multi-step speed reference. When the external input terminal to which frequency reduction gain is assigned turns on, the gain set to *S2-16* or *S2-17* is applied to the normal frequency reference followed by a corresponding switch to low-speed operation.

Note:

This function is disabled when the frequency reference is held through the use of *H1-xx = A [Accel/Decel Ramp Hold]* or *H1-xx = 10 or 11 [Up/Down Command]*.

■ Related Parameters

No.	Name	Description	Default (Range)
S2-16	Micro Speed Gain1	Sets the gain used to decrease the frequency reference. This parameter is enabled when the terminal set to *H1-xx = 3A [MFDI Function Select = Micro Speed Gain1]* turns on.	1.00 (0.00 - 1.00)
S2-17	Micro Speed Gain2	Sets the gain used to decrease the frequency reference. This parameter is enabled when the terminal set to *H1-xx = 3B [MFDI Function Select = Micro Speed Gain2]* turns on.	1.00 (0.00 - 1.00)

Note:

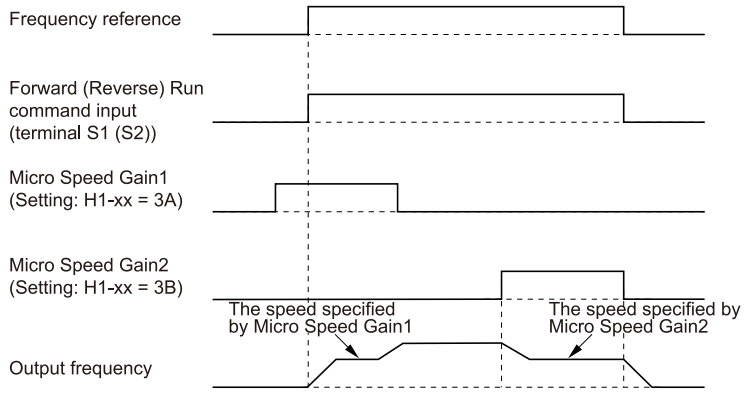
If the resulting frequency reference after having been multiplied by the gain of *S2-16* or *S2-17* is less than the frequency reference lower limit, this lower limit value will be used. The frequency reference lower limit is the maximum setting value for the following parameters.

- d2-02 [Frequency Reference Lower Limit]
- S1-01 [Brake Release Frequency(FWD)]
- S1-02 [Brake Release Frequency(REV)]
- S1-12 [Brake Hold Frequency (FWD)]
- S1-13 [Brake Hold Frequency (REV)]

■ MFDI

H1-xx Setting	Name	Description
3A	Micro Speed Gain1	When the corresponding terminal is on, the frequency reference is multiplied by the gain set to *S2-16 [Micro Speed Gain1]*.
3B	Micro Speed Gain2	When the corresponding terminal is on, the frequency reference is multiplied by the gain set to *S2-17 [Micro Speed Gain2]*. **Note:** When the frequency reduction gain 1 input is on, the gain set to *S2-16 [Micro Speed Gain1]* has priority.

■ Description of Operation



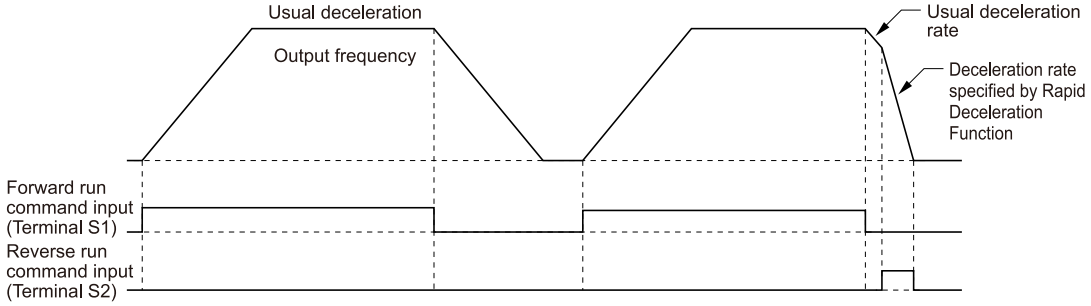
◆ Rapid Deceleration Function

The deceleration rate can be changed to rapidly stop operation by inputting a Run command in reverse to the current running direction during the ramp to stop operation. This enables quick deceleration near the target location even when using high-speed operation.

■ Description of Operation

Set *S2-18 = 1 [Rapid Deceleration Selection = Enabled]* to enable this function.

When deceleration starts after the Run command is turned off, and a Run command in reverse to the current direction of motor rotation is input, the motor rapidly decelerates per the time set to *S2-19 [Rapid Deceleration Time]*. When the Run command is turned off during rapid deceleration, rapid deceleration is turned off, and the motor continues to decelerate at the selected normal deceleration rate.



Note:
- This function does not operate when the frequency reference is negative by using an analog input. To use rapid deceleration, the frequency reference must be at least 0.
- Rapid deceleration is disabled when *b1-04 = 1 [Reverse Disabled]*.
- The deceleration time set to *C1-09 [Fast Stop Time]* has priority in the following scenarios.
  – Emergency stop operation has been executed by the detection of a fault
  – The emergency stop command has been received from MFDI.
- The setting range of acceleration/deceleration time is determined by the setting of *C1-10 [Accel/Decel Time Setting Units]*. When *C1-10 = 0* (units of 0.01 seconds), the setting range of the acceleration/deceleration time is between 0.00 and 600.00 seconds.

■ Related Parameters

No.	Name	Adjustment Method
S2-18	Rapid Deceleration Selection	Enables and disables rapid deceleration. When rapid deceleration is enabled, and a Run command in reverse to the current direction of motor rotation is input during the ramp to stop process, the motor rapidly decelerates per the time set to *S2-19 [Rapid Deceleration Time]*. 0: Disabled 1: Enabled
S2-19	Rapid Deceleration Time	Sets the rapid deceleration time.

3.11 Problems that Can Frequently Occur during Setup and Possible Solutions

If the drive or motor operate incorrectly, but the keypad does not show a fault or error code, refer to the items this section.

- Motor hunting and oscillation
- Unsatisfactory motor torque
- Unsatisfactory speed precision
- Unsatisfactory motor torque and speed response
- Motor noise

Note:

If you synchronize two drives or if you use one drive that switches between more than one motor, the method to make adjustments is different. For these applications, contact Yaskawa about drive settings and drive adjustments.

Table 3.27 Typical Problems

Classification	Problem	Ref.
Keypad Operation	Cannot Change Parameter Settings	227
	The Correct Auto-Tuning Mode Is Not Available	227
Motor Does Not Operate Correctly	Crane Sequence Does Not Operate	227
	Motor Does Not Rotate After Entering Run Command	227
	The Starting Torque Is Not Sufficient	228
	Motor Does Not Restart after Power Loss	228
	Motor Rotates in the Opposite Direction from the Run Command	229
	Motor Rotates in One Direction Only	229
	Motor Stops When Operating at the Brake Release Frequency Speed	229
	Response Is Slow at Start	229
	Motor Stalls during Acceleration or Accel/Decel Time Is Too Long	229
	Output Frequency Is Not As High As Frequency Reference	230
	Drive Frequency Reference Differs from the Controller Frequency Reference Command	231
	Large Inconsistency in Stopping Position Due to the Load Rate	231
	Deceleration Takes Longer Than Expected When Dynamic Braking Is Enabled	231
	The Motor Rotates after the Drive Output Is Shut Off	231
Suspension Drops or Load Slips	Suspension Drops (Falls)	231
	Load Slips at Start	232
	Load Slips at Stop	232
	Slipping Occurs During Extremely Fast Inching	232
	Load Falls When Brake Is Applied	232
Too Much Output Current	Excessive Current Occurs at Start	232
	Excessive Output Current at Constant Speed	233
	Too Much Output Current, Oscillation	233
	Despite Measures to Increase Flux, Brake Operation Is Slow and Peak Current at Start Take Too Long	233
	Excessive Current Flow When Starting to Hoist Immediately After Stopping Lowering	233
Brake Grinding	Brake Slips at Start	234
	Brake Grinding Occurs at Stop	234

Classification	Problem	Ref.
Impact Stop, Light-load Acceleration Does Not Operate Correctly	Impact Stop Is Not Available After the Motor Stops	234
	Motor Keeps Rotating at the Creep Frequency During Impact Stop Operation	234
	Accelerates Despite a Heavy Load When Using the Light-Load Acceleration 1 Function	234
	No Acceleration Despite a Light Load When Using the Light-Load Acceleration 1 Function	234
	Accelerates Despite a Heavy Load When Using the Light-Load Acceleration 2 Function	235
	No Acceleration Despite a Light Load When Using the Light-Load Acceleration 2 Function	235
Hunting or Oscillation	Excessive Motor Oscillation and Erratic Rotation	235
	Oscillation Occurs When Lowering in a Hoist/Lowering Crane Without a Counterweight	235
	Oscillation Occurs When Lowering in a Hoist/Lowering Crane With a Counterweight or With a Traverse Crane	235
	Unexpected Noise from Connected Machinery Occurs When Motor Rotates	235
	Oscillation or Hunting Occurs When Motor Rotates	235
The Motor Is Making an Audible Noise and Too Much Heat	The Motor Is Making an Audible Noise	236
	The Motor Is Too Hot	236
Peripheral Devices Do Not Operate Correctly	There Is Audible Noise from the Drive or Motor Cables when You Energize the Drive	236
	Residual Current Monitoring/Detection (RCM/RCD) Trips During Run	236

◆ Cannot Change Parameter Settings

Causes	Possible Solutions
The drive is operating the motor. (The drive is in Drive Mode.)	Stop the drive and switch over to Programming Mode.
A1-01 = 0 [Access Level Selection = Operation Only] is set.	Set *A1-01 = 2 [Access Level Selection = Advanced Level]* or *A1-01 = 3 [Expert Level]*.
H1-xx = 1B [MFDI Function Selection = Programming Lockout] is set.	Turn ON the terminals to which *H1-xx = 1B* is set, and then change the parameters. **Note:** You cannot change parameters when terminals to which *H1-xx = 1B* is set are turned OFF.
The wrong password was entered.	• Enter the correct password to *A1-04 [Password]* again. • If you forgot the password, set the password again with *A1-04* and *A1-05 [Password Setting]*. **Note:** If the password is set, these parameters cannot be changed unless the password matches: • *A1-01 [Access Level Selection]* • *A1-02 [Control Method Selection]* • *A1-03 [Initialize Parameters]* • *A1-06 [Application Preset]* • *A2-01 to A2-32 [User Parameter 1 to User Parameter 32]*
Uv [Undervoltage] has been detected.	• Check the power supply voltage with *U1-07 [DC Bus Voltage]*. • Check the main circuit wiring.

◆ The Correct Auto-Tuning Mode Is Not Available

Causes	Possible Solutions
The desired Auto-Tuning mode is not available for the selected control mode.	Change the motor control method with parameter *A1-02 [Control Method Selection]*.

◆ Crane Sequence Does Not Operate

Causes	Possible Solutions
b1-02 = 0 [Run Command Selection 1 = Keypad] is set.	Give the Run command from the drive control terminals by setting *b1-02 = 1 [Digital Input]*.

◆ Motor Does Not Rotate After Entering Run Command

Causes	Possible Solutions
When you use N.C. to input the external baseblock signal, the external baseblock signal is not cleared.	• Input the signal from the terminal set for the external baseblock signal. • Avoid using the external baseblock signal.
The drive is not in Drive Mode.	1. Check whether [Rdy] is displayed on the keypad. 2. If [Rdy] is not displayed, return to the Home screen.

Causes	Possible Solutions
Auto-Tuning has just completed.	Switch the keypad to the Home screen. **Note:** When Auto-Tuning completes, the drive is switched back to the Programming Mode. The Run command will not be accepted unless the drive is in the Drive Mode.
The fast stop command has been entered.	Turn off the fast stop input signal.
Settings are incorrect for the source that provides the Run command.	Set *b1-02 [Run Command Selection 1]* correctly.
The frequency reference source is not set correctly.	Set *b1-01 [Frequency Reference Selection 1]* correctly.
There is defective wiring in the control circuit terminals.	• Correctly wire the drive control circuit terminals. • Check the input terminal status using *U1-10 [Input Terminal Status]*.
The settings for voltage input and current input of the master frequency reference are incorrect.	Check the analog input terminal signal level settings. • Terminal A2: DIP switch S1 and *H3-09 [Terminal A2 Signal Level Select]*
Selection for the sinking/sourcing mode and the internal/external power supply is incorrect.	• For sinking mode, short circuit terminals SC-SP using a wire jumper. • For sourcing mode, short circuit terminals SC-SN using a wire jumper. • In the case of an external power supply, remove the wire jumper.
The frequency reference is too low.	• Check *U1-01 [Frequency Reference]*. • Make the frequency reference higher than *E1-09 [Minimum Output Frequency]*.
The MFAI setting is incorrect.	• Check if the functions set to the analog input terminals being used are correct. When *H3-02, H3-10, H3-06 = 1 [MFAI Function Selection = Frequency Gain]* has been set and voltage (current) is not input, the frequency reference will be 0. • Check if the analog input values set to terminals A1, A2, and A3 are appropriate using *U1-13 to U1-15 [Terminal A1, A2, A3 Level]*.
STOP was pushed.	Turn off the Run command from external input, and then turn it on again. **Note:** When you push STOP during operation, the drive will ramp to stop. When you set *o2-02 = 0 [STOP Key Function Selection = Disabled]*, the STOP function can be disabled.

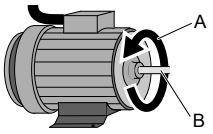
◆ The Starting Torque Is Not Sufficient

Causes	Possible Solutions
Auto-Tuning has not been done in vector control method.	Do Auto-Tuning.
The control method was changed after doing Auto-Tuning.	Do Auto-Tuning again.
Stationary Auto-Tuning for Line-to-Line Resistance was done.	Do Rotational Auto-Tuning.

◆ Motor Does Not Restart after Power Loss

Causes	Possible Solutions
The Run command was not issued again when power was restored.	Check the sequence and wiring that has been set up to enter the Run command.

◆ Motor Rotates in the Opposite Direction from the Run Command

Causes	Possible Solutions
Phase wiring between the drive and motor is incorrect.	• Check the wiring between the drive and motor. • Connect drive output terminals U/T1, V/T2, and W/T3 in the right order to match motor terminals U, V, and W. • Switch two motor cables (U, V, and W) to reverse motor direction.
The forward direction for the motor is set up incorrectly.	• Connect drive output terminals U/T1, V/T2, and W/T3 in the right order to match motor terminals U, V, and W. • Switch two motor cables (U, V, and W) to reverse motor direction.  **A - Forward direction B - Load Shaft** **Figure 3.12 Forward Rotating Motor** **Note:** • For Yaskawa motors, forward is designated as being counterclockwise when looking from the motor shaft. • Refer to the specifications of the motor being used, and confirm the forward rotation direction. The forward rotation direction of motors may differ depending on manufacturer and type.
The signal connections for forward run and reverse run on the drive control circuit terminals and control panel side are incorrect.	Correctly wire the control circuit.

◆ Motor Rotates in One Direction Only

Causes	Possible Solutions
The drive prohibits reverse rotation.	Set *b1-04 = 0 [Reverse Operation Selection = Reverse Enabled]*.

◆ Motor Stops When Operating at the Brake Release Frequency Speed

Causes	Possible Solutions
Too much motor slip.	Increase the setting value of *S1-01* and *S1-02*.
The settings of *S1-01 [Brake Release Frequency(FWD)]* and *S1-02 [Break Release Frequency(REV)]* are incorrect.	

◆ Response Is Slow at Start

Causes	Possible Solutions
The torque compensation setting is not correct while using Open Loop Vector Control, Closed Loop Vector Control, or Advanced Open Loop Vector Control.	Set *S1-09 ≒ 50 to 80 [Torque Compensation (FWD) ≒ 50% to 80%]*.
Brake release settings are not correct while using Open Loop Vector Control, Closed Loop Vector Control, or Advanced Open Loop Vector Control.	Set *S1-07 ≒ 70 to 80 [Brake Release Torque (FWD) ≒ 70% to 80%]*.
Brake release settings are not correct while using V/f Control.	• Decrease the setting values of *S1-01 [Brake Release Frequency(FWD)]* and *S1-02 [Brake Release Frequency(REV)]*. • Decrease the setting values of *S1-05 [Brake Release Current (FWD)]* and *S1-06 [Brake Release Current (REV)]*.

◆ Motor Stalls during Acceleration or Accel/Decel Time Is Too Long

Causes	Possible Solutions
The value set in *S1-04 [Brake Delay Time]* is too high.	Decrease the setting value of *S1-04*.
Torque limit has been reached or current suppression keeps the drive from accelerating.	• Decrease the load. • Use a larger motor. **Note:** Although the drive has a Stall Prevention function and a Torque Compensation Limit function, accelerating too quickly or trying to drive an excessively large load can exceed the capabilities of the motor.
Torque limit is not set correctly.	Set the torque limit correctly.
The acceleration time setting is too short.	Increase the value set in *C1-01, C1-03, C1-05, or C1-07 [Acceleration Times]*.

Causes	Possible Solutions
The load is too heavy.	• Increase the acceleration time. • Check if the mechanical brake is fully releasing as it should. • Decrease the load so that the output current remains within the motor rated current. • Use a larger motor. **Note:** • In extruder and mixer applications, the load will sometimes increase as the temperature drops. • 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.
The frequency reference is low.	• Check *E1-04 [Maximum Output Frequency]* and increase the setting if it is set too low. • Check *U1-01 [Frequency Reference]* 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 *H3-03, H3-11, H3-07 [Terminal A1, A2, A3 Gain Setting]*.
Incorrect frequency reference setting.	If *H3-02, H3-10, H3-06 = 1 [MFAI Function Selection = Frequency Reference]* has been set, check whether voltage (current) has been set. • Check the values set in *H3-02, H3-10, and H3-06*. • Check if the analog input values set to terminals A1, A2, and A3 are appropriate using *U1-13 to U1-15 [Terminal A1, A2, A3 Level]*.
Motor characteristics and drive parameter settings are incompatible with one another.	• Set the correct V/f pattern so that hit matches the characteristics of the motor being used. • Check the V/f pattern set to *E1-03 [V/f Pattern Selection]*. • Perform Rotational Auto-Tuning.
Although the drive is operating in vector control mode, Auto-Tuning has not been performed.	• Perform Auto-Tuning. • Calculate motor data and reset motor parameters. • Switch to *A1-02 = 0 [Control Method Selection = V/f Control]*.
The speed estimation response is too slow when *A1-02 = 4 [Control Method Selection = Advanced Open Loop Vector]*.	Increase the value set in *n4-65 [Flux Estimate Response@High Freq]* in increments of 0.1.
The Stall Prevention level during acceleration set too low.	Increase the value set in *L3-02 [Stall Prevent Level during Accel]*. **Note:** If *L3-02* is set too low, acceleration may be taking too long.
The Stall Prevention level during run has been set too low.	Increase the value set in *L3-06 [Stall Prevent Level during Run]*. **Note:** If *L3-06* is set too low, speed will drop as the drive outputs torque.
Drive reached the limitations of the V/f control.	• The motor cable may be long enough (over 50 m) to require Auto-Tuning for line-to-line resistance. • Change the V/f pattern to “High Starting Torque”. • Consider switching to vector control mode. **Note:** Be aware that V/f Control is comparatively limited when it comes to producing torque at low speeds.

◆ Output Frequency Is Not As High As Frequency Reference

Causes	Possible Solutions
Frequency reference is set within the range of the Jump frequency.	Adjust *d3-01 to d3-03 [Jump Frequency 1 to 3]* and *d3-04 [Jump Frequency Width]*. **Note:** Enabling the Jump frequency prevents the drive from outputting the frequencies specified in the Jump range.
Upper limit for the frequency reference has been exceeded.	Set *E1-04 [Maximum Output Frequency]* and *d2-01 [Frequency Reference Upper Limit]* to optimal values. **Note:** Use the following formula to calculate the upper value for the output frequency: *E1-04* × *d2-01* / 100
Large load triggered Stall Prevention function during acceleration.	• Decrease the load. • Adjust *L3-02 [Stall Prevent Level during Accel]*.
L3-01 = 3 [Stall Prevention during Accel = Current Limit Method] has been set.	1. Check whether the V/f pattern and motor parameter settings are appropriate, and set them correctly. 2. If this does not solve the problem, and it is not necessary to limit the current level of stall during acceleration, adjust *L3-02*. 3. If this does not solve the problem, set *L3-01 = 1 [Enabled]*.
The motor is rotating at the following speed: *b2-01 [DC Injection/Zero SpeedThreshold]* ≤ Motor Speed < *E1-09 [Minimum Output Frequency]*	Set the value of *E1-09* lower than the value of *b2-01*.

◆ Drive Frequency Reference Differs from the Controller Frequency Reference Command

Causes	Possible Solutions
The analog input gain and bias for the frequency reference input are set to incorrect values.	Check the gain and bias settings for the analog inputs that are used to set the frequency reference. • Terminal A1: *H3-03 [Terminal A1 Gain Setting]*, *H3-04 [Terminal A1 Bias Setting]* • Terminal A2: *H3-11 [Terminal A2 Gain Setting]*, *H3-12 [Terminal A2 Bias Setting]* • Terminal A3: *H3-07 [Terminal A3 Gain Setting]*, *H3-08 [Terminal A3 Bias Setting]*
Frequency bias signals are being entered via analog input terminals A1 to A3 and the sum of all signals builds the frequency reference.	• Check whether two or more of *H3-02, H3-10, H3-06 [MFAI Function Selection]* have a setting value of *0*, and change the settings if necessary. • Check if the analog input values set to terminals A1, A2, and A3 are appropriate using *U1-13 to U1-15 [Terminal A1, A2, A3 Level]*.
During low speed operation the motor rotates faster than the frequency reference.	Decrease the value set in *n4-70 [Speed Command Comp @ Low Freq]*.

◆ Large Inconsistency in Stopping Position Due to the Load Rate

Causes	Possible Solutions
The deceleration is inconsistent because of the Stall Prevention during Deceleration function.	Extend deceleration up until the Stall Prevention function no longer operates.

◆ Deceleration Takes Longer Than Expected When Dynamic Braking Is Enabled

Causes	Possible Solutions
The stall prevention during deceleration setting is incorrect.	• Examine the setting for *L3-04 [Decel Stall Prevention Selection]*. • When the drive has a dynamic braking option installed, set *L3-04 = 0 [Disabled]*. • If the drive detects *ov [Overvoltage]*, set *L3-04 = 3 [General Purpose w/ DB resistor]*.
The deceleration time setting is too long.	Set *C1-02, C1-04, C1-06, or C1-08 [Deceleration Times]* to applicable values.
The motor torque is not sufficient.	Use a larger motor. **Note:** If these items are correct, the demand on the motor is more than the motor capacity: • Parameter settings are correct. • The drive does not detect *ov [Overvoltage]*.

The drive and motor system reached the torque limit.	• Examine the values set in *L7-01 to L7-04 [Torque Limit]* and increase them if necessary.
	Note:
	If the torque limit is enabled, deceleration time can increase because the drive cannot output more torque than the limit.
	• If *H3-02, H3-10, H3-06 = 10, 11, 12, 15 [MFAI Function Select = Torque Limit]* has been set, examine the settings for the MFAIs.
	  • Examine the values set in *H3-02, H3-10, and H3-06*.
	  • Use *U1-13 to U1-15 [Terminal A1, A2, A3 Input Voltage]* to make sure that the analog input values set to terminals A1, A2, and A3 are applicable.

The load is more than the internal torque limit as specified by the drive rated current.	Replace the drive with a larger capacity model.

◆ The Motor Rotates after the Drive Output Is Shut Off

Causes	Possible Solutions
DC Injection Braking is too low and the drive cannot decelerate correctly.	• Increase the value set in *b2-02 [DC Injection Braking Current]*. • Increase the value set in *b2-04 [DC Inject Braking Time at Stop]*.
The stopping method makes the drive coast to stop.	Set *b1-03 = 0 or 2 [Stopping Method Selection = Ramp to Stop, DC Injection Braking to Stop]*.

◆ Suspension Drops (Falls)

Causes	Possible Solutions
The V/f setting is too low.	Increase the V/f setting.
Motor parameters are not adjusted while using Open Loop Vector Control, Closed Loop Vector Control, or Advanced Open Loop Vector Control.	Do the motor Auto-Tuning process.
The torque limit setting is too low while using Open Loop Vector Control, Closed Loop Vector Control, or Advanced Open Loop Vector Control.	Increase the setting values of *L7-xx [Torque Limit]*.

◆ Load Slips at Start

Causes	Possible Solutions
The setting values of *S1-05 [Brake Release Current (FWD)]*, *S1-06 [Brake Release Current (REV)]*, *S1-07 [Brake Release Torque (FWD)]*, and *S1-08 [Brake Release Torque (REV)]* are too low.	Increase the setting values of *S1-05 to S1-08*.
The V/f setting is too low.	Increase the V/f setting.
The setting value of *C4-02 [Torque Compensation Delay Time]* is too high while using Open Loop Vector Control.	Set *C4-02 ≒ 20 [20 ms]*.
The setting value of *S1-09 [Torque Compensation (FWD)]* (the amount of torque forcing) is too low while using Open Loop Vector Control, Closed Loop Vector Control, or Advanced Open Loop Vector Control.	Set *S1-09 ≒ 50 to 80 [50% to 80%]*.
The output current is more than 125% of the rated current while using Closed Loop Vector Control or Advanced Open Loop Vector Control.	Do these procedures to solve problems with starting up magnetic flux. • Set *b2-03 = 0.2 to 0.3 [DC Inject Braking Time at Start = 0.2 s to 0.3 s]*. • Set *d6-03 = 1 [Field Forcing Selection = Enabled]* and *d6-06 = 200 to 400 [Field Forcing Limit = 200% to 400%]*. • Do the initial excitation process.
The output current is more than 125% of the rated current while using Open Loop Vector Control.	Do these procedures to solve problems with starting up magnetic flux. • Set *b2-03 = 0.2 to 0.3 [DC Inject Braking Time at Start = 0.2 s to 0.3 s]*. • Set *b2-08 = 100 to 200 [Magnetic Flux Compensation Value = 100% to 200%]*. • Increase the setting value of *E1-08 [Mid Point A Voltage]* to around 20 V maximum (40 V for 400 V class drive).
The output current is more than 125% of the rated current while using V/f Control.	Do these procedures to solve problems with starting up magnetic flux. • Set *b2-03 = 0.2 to 0.3 [DC Inject Braking Time at Start = 0.2 s to 0.3 s]*. • Increase the setting value of *E1-08 [Mid Point A Voltage]* to around 20 V maximum (40 V for 400 V class drive).
Note: Refer to "Magnetic Flux Compensation (Start-up Current Suppression)" on page 236 to solve problems in flux build up.	

◆ Load Slips at Stop

Causes	Possible Solutions
The setting value of *S1-05 [Brake Release Current (FWD)]* is too low while using V/f control or OLV control.	Increase the setting value of *S1-15*.
The setting value of *b2-04 [DC Inject Braking Time at Stop]* is too low while using Closed Loop Vector Control or Advanced Open Loop Vector Control.	Set b2-04 > 0.50.
Brake hold settings are not correct.	Increase the setting values of *S1-12 [Brake Hold Frequency (FWD)]* and *S1-13 [Brake Hold Frequency (REV)]*.

◆ Slipping Occurs During Extremely Fast Inching

Causes	Possible Solutions
Drive operation and brake operation do not keep up with the inching operation.	Increase the setting value of *S2-01 [Run Cmd Minimum On Time (FWD)]* and *S2-02 [Run Cmd Minimum On Time (REV)]*.

◆ Load Falls When Brake Is Applied

Causes	Possible Solutions
The open/close timing of the brake is incorrect.	• Increase the value set in *S1-14 [Slip Prevention Frequency]*. • Increase the time set in *S1-15 [Slip Prevention Time]*.
The DC injection braking is insufficient.	Increase the value set in *b2-02 [DC Injection Braking Current]*.

◆ Excessive Current Occurs at Start

Causes	Possible Solutions
The brake sequence is not adjusted.	• Decrease the setting values of *S1-01 and S1-02 [Brake Release Frequency]*. • Decrease the setting value of *S1-03 [Brake Delay Frequency]*. • Set *S1-04 [Brake Delay Time]* to align with the machine.
The motor flux build up is not enough while using Closed Loop Vector Control or Advanced Open Loop Vector Control.	• Set *d6-03 = 1 [Field Forcing Selection = Enabled]* and *d6-06 ≒ 200 to 400 [Field Forcing Limit ≒ 200% to 400%]*. • Do the initial excitation process.
Torque settings are too low while using Open Loop Vector Control, Closed Loop Vector Control, or Advanced Open Loop Vector Control.	• Set *L7-01 to L7-04 ≒ 150 [Torque Limit ≒ 150%]*. • Set *S1-07 ≒ 70 to 80 [Brake Release Torque (FWD) ≒ 70% to 80%]*.

Causes	Possible Solutions
The motor flux build up is not enough while using Closed Loop Vector Control or Advanced Open Loop Vector Control.	• Set *b2-03 = 0.2 to 0.3 [DC Inject Braking Time at Start = 0.2 s to 0.3 s]*. • Set *d6-03 = 1 [Field Forcing Selection = Enabled]* and *d6-06 ≒ 200 to 400 [Field Forcing Limit ≒ 200% to 400%]*. • Do the initial excitation process.
The motor flux build up is not enough while using Open Loop Vector Control.	• Set *b2-03 = 0.2 to 0.3 [DC Inject Braking Time at Start = 0.2 s to 0.3 s]*. • Set *b2-08 = 100 to 200 [Magnetic Flux Compensation Value = 100% to 200%]*. • Set *E1-08 [Mid Point A Voltage]* to around 20 V maximum (40 V for 400 V class drive).
Initial motor excitation is not sufficient while using V/f Control.	• Set *b2-03 = 0.2 to 0.3 [DC Inject Braking Time at Start = 0.2 s to 0.3 s]*. • Set *E1-08 [Mid Point A Voltage]* to around 20 V maximum (40 V for 400 V class drive).
Note: Refer to "Magnetic Flux Compensation (Start-up Current Suppression)" on page 236 to solve problems in flux build up.	

◆ Excessive Output Current at Constant Speed

Causes	Possible Solutions
The drive is not appropriate.	Confirm if the drive capacity is sufficient.
No-load current and rated slip values are not set appropriately after running the Auto-Tuning process with Open Loop Vector Control or Closed Loop Vector Control.	1. Confirm the values in the motor test report. 2. Set *E2-03 [Motor No-Load Current]* (*E4-03 [Motor 2 Rated No-Load Current]* for motor 2) in accordance with test report values. 3. Set *E2-02 [Motor Rated Slip]* (*E4-02 [Motor 2 Rated Slip]* for motor 2) to a value of 60% to 80% of the test report value.

◆ Too Much Output Current, Oscillation

Causes	Possible Solutions
Gain parameters do not agree with motor parameters while using Open Loop Vector Control.	• Make sure that motor parameters *E2-xx* are not too different than the value in the test report. Do the Auto-Tuning process if it is not done. • Increase the setting value of *n2-01 [Automatic Freq Regulator Gain(F)]* in 0.05 increments. • Increase the setting value of *n2-02 [Automatic Freq Regulator Time 1]* in 50 ms increments. **Note:** Always set *n2-02 ≤ n2-03 [Automatic Freq Regulator Time 2]*. Whenever *n2-02* is adjusted, the value set for *C4-02 [Torque Compensation Delay Time]* must also be increased according to the same ratio. • Increase the setting value of *C4-02 [Torque Compensation Delay Time]* in 10 ms increments. **Note:** Always set *C4-02 ≤ C4-06 [Motor 2 Torque Comp Delay Time]*. Whenever *C4-02* is adjusted, the value set for *n2-02 [Automatic Freq Regulator Time 1]* must also be increased according to the same ratio.

◆ Despite Measures to Increase Flux, Brake Operation Is Slow and Peak Current at Start Take Too Long

Causes	Possible Solutions
S1-04 = 0.00 [Brake Delay Time = 0.00 s].	Set *S1-04 ≒ 0.30 to 0.70*.
The setting value of *S1-07 [Brake Release Torque (FWD)]* is too low while using Open Loop Vector Control, Closed Loop Vector Control, or Advanced Open Loop Vector Control.	Set *S1-07 ≒ 70 to 80*.
The V/f setting is too high.	Decrease the V/f setting.

◆ Excessive Current Flow When Starting to Hoist Immediately After Stopping Lowering

Causes	Possible Solutions
Depends on motor characteristics.	Use the following formula to set *S2-03 [Run Cmd Delay Timer (REV/FWD)]*. $\frac{\sqrt{(\text{E2-01})^2 - (\text{E2-03})^2}}{2\pi \times \text{E2-02} \times \text{E2-03}} \times 1.5\ \text{s}$ **Note:** Refer to the following parameters to get the information required for the necessary calculations. • *E2-01 [Motor Rated Current (FLA)]* • *E2-02 [Motor Rated Slip]* • *E2-03 [Motor No-Load Current]*

◆ Brake Slips at Start

Causes	Possible Solutions
S1-04 = 0.00 [Brake Delay Time = 0.00 s].	Set *S1-04* ≒ *0.30 to 0.70*.
The setting values of *S1-05 [Brake Release Current (FWD)]*, *S1-06 [Brake Release Current (REV)]*, *S1-07 [Brake Release Torque (FWD)]*, and *S1-08 [Brake Release Torque (REV)]* are too high.	Decrease the setting values of *S1-05* to *S1-08*. Set *S1-07* ≒ *70 to 80*.
The V/f setting is too high.	Decrease the V/f setting.

◆ Brake Grinding Occurs at Stop

Causes	Possible Solutions
The setting values of *S1-12 and S1-13 [Brake Hold Frequency]* are too high.	Decrease the setting values of *S1-12 and S1-13*.
The setting value of *S1-14 [Slip Prevention Frequency]* is too high.	Decrease the setting value of *S1-14*.
The setting value of *S1-15 [Slip Prevention Time]* is too high.	Decrease the setting value of *S1-15*.
The setting value of *b2-04 [DC Inject Braking Time at Stop]* is too high.	Set *b2-04 < 0.5 [DC Inject Braking Time at Stop < 0.50 s]*.

◆ Impact Stop Is Not Available After the Motor Stops

Causes	Possible Solutions
The setting values of *S3-03 [Impact Stop Detect Torque (FWD)]* and *S3-04 [Impact Stop Detect Torque (REV)]* are too low.	Increase the setting value of *S3-03* and *S3-04*.
The value set in *S3-05 [Impact Stop Detection Time]* is too low.	Increase the setting value of *S3-05*.

◆ Motor Keeps Rotating at the Creep Frequency During Impact Stop Operation

Causes	Possible Solutions
The setting values of *S3-03 [Impact Stop Detect Torque (FWD)]* and *S3-04 [Impact Stop Detect Torque (REV)]* are too high.	Decrease the setting value of *S3-03* and *S3-04*.
Torque does not increase when the transport cart impacts something.	Check the slip of the cart wheels, and if something causing mechanical friction.
The value set in *S3-02 [Impact Stop Creep Time]* is too high.	Decrease the setting value of *S3-02*.

◆ Accelerates Despite a Heavy Load When Using the Light-Load Acceleration 1 Function

Causes	Possible Solutions
The settings in *S4-04 [Light-load 1 Detect Torque (FWD)]* and *S4-05 [Light-load 1 Detect Torque (REV)]* are too high.	Decrease the setting value of *S4-04* and *S4-05*.
The value set in *S4-07 [Light-load 1 Detect Time]* is too low.	Increase the setting value of *S4-07*.

◆ No Acceleration Despite a Light Load When Using the Light-Load Acceleration 1 Function

Causes	Possible Solutions
Light-load Acceleration 1 is not enabled.	Enable Light-load Acceleration 1 by one of the following ways. • Set *H1-xx = 30 [MFDI Function Selection = Light-load Acceleration 1 Enabled]*, and have that terminal switch ON. • Set *S4-01 = 1 [Light-load Accel Ctrl Selection = Light-load Accel Ctrl 1 enabled]*.
The settings in *S4-04 [Light-load 1 Detect Torque (FWD)]* and *S4-05 [Light-load 1 Detect Torque (REV)]* are too low.	Increase the setting value of *S4-04* and *S4-05*.
The mechanical loss for the crane is greater than the value set in *S4-05* while operating in reverse.	The following procedure explains how to adjust *S4-20 [Light-load 1 Torque Bias (REV)]*. 1. Operate the drive with no load at the frequency set in *S4-06 [Light-load 1 Detect Frequency]*, and monitor the value displayed in *U1-09 [Torque Reference]*. 2. Set the reverse value of *U1-09* to *S4-20*.
Note: Refer to "Light-load Acceleration 1 Function" on page 207 for more information about Light-load Acceleration 1.	

◆ Accelerates Despite a Heavy Load When Using the Light-Load Acceleration 2 Function

Causes	Possible Solutions
The settings in *S4-09 [L-L 2 Motoring Limit Start Level]* and *S4-10 [L-L 2 Motoring Hold Level]* are too high.	Decrease the setting value of *S4-09* and *S4-10*.

◆ No Acceleration Despite a Light Load When Using the Light-Load Acceleration 2 Function

Causes	Possible Solutions
Light-load Acceleration 2 is not enabled.	Enable Light-load Acceleration 2 by one of the following ways. • Set *H1-xx = 36 [MFDI Function Selection = Light-load Acceleration 2 Enabled]*, and have that terminal switch ON. • Set *S4-01 = 2 [Light-load Accel Ctrl Selection = Light-load Accel Ctrl 2 enabled]*.
The settings in *S4-09 [L-L 2 Motoring Limit Start Level]* and *S4-10 [L-L 2 Motoring Hold Level]* are too low.	Increase the setting value of *S4-09* and *S4-10*.
Note: Refer to "Light-load Acceleration 2 Function" on page 210 for more information about Light-load Acceleration 2.	

◆ Excessive Motor Oscillation and Erratic Rotation

Causes	Possible Solutions
Poor balance between motor phases.	• Check drive input power voltage to ensure that it provides stable power. • Set *L8-05 = 0 [Input Phase Loss Protection Sel = Disabled]*.
The hunting prevention function is disabled.	• Set *n1-01 = 1 [Hunting Prevention Selection = Enabled (Normal)]*. • Increase the value of *n2-01 [Automatic Freq Regulator Gain(F)]* or *n2-02 [Automatic Freq Regulator Time 1]*.

◆ Oscillation Occurs When Lowering in a Hoist/Lowering Crane Without a Counterweight

Causes	Possible Solutions
The setting value of *S1-20 [Operation in Reverse]* is not correct.	Set *S1-20 = 1 [Regen operation in reverse]*.

◆ Oscillation Occurs When Lowering in a Hoist/Lowering Crane With a Counterweight or With a Traverse Crane

Causes	Possible Solutions
The setting value of *S1-20 [Operation in Reverse]* is not correct.	Set *S1-20 = 1 [Regen operation in reverse]*.

◆ Unexpected Noise from Connected Machinery Occurs When Motor Rotates

Causes	Possible Solutions
The carrier frequency is at the resonant frequency of the connected machinery.	• Adjust *C6-02 to C6-05 [Carrier Frequency]*. • Set *C6-02 = 1 to 6* and check whether the abnormal noise continues.
The drive output frequency is the same as the resonant frequency of the connected machinery.	• Adjust *d3-01 to d3-04 [Jump Frequency]*. • Place the motor on a rubber pad to decrease vibration.

◆ Oscillation or Hunting Occurs When Motor Rotates

Causes	Possible Solutions
The frequency reference is set to an external source and the signal is noisy.	Ensure that noise is not affecting the signal lines. • Separate main circuit wiring and control circuit wiring. • Use twisted-pair cables or shielded wiring for the control circuit. • Increase the value of *H3-13 [Analog Input FilterTime Constant]*.
The cable between the drive and motor is too long.	• Perform Auto-Tuning. • Make the wiring as short as possible.

◆ The Motor Is Making an Audible Noise

Causes	Possible Solutions
100% of the rated output current of the drive was exceeded while operating at low speeds.	• If the sound is coming from the motor, set *L8-38 = 0 [Carrier Frequency Reduction = Disabled]*. • If *oL2 [Drive Overloaded]* occurs frequently after setting *L8-38 = 0*, replace the drive with a high-capacity drive.

◆ The Motor Is Too Hot

Causes	Possible Solutions
The load is too heavy.	• Decrease the load. • Increase the acceleration and deceleration times. • Examine the values set in *L1-01 [Motor Overload (oL1) Protection]*, *L1-02 [Motor Overload Protection Time]*, and *E2-01 [Motor Rated Current (FLA)]*. • Use a larger motor. **Note:** The motor also has a short-term overload rating. Examine this rating carefully before setting drive parameters.
The motor is running continuously at a very low speed.	• Change the run speed. • Use a drive-dedicated motor.
The drive is operating in a vector control mode, but Auto-Tuning has not been done.	• Do Auto-Tuning. • Calculate motor parameter and set motor parameters. • Set *A1-02 = 0 [Control Method Selection = V/f Control]*.
The voltage insulation between motor phases is not sufficient.	• Use a motor with a voltage tolerance that is higher than the maximum voltage surge. • Use a drive-dedicated motor that is rated for use with AC drives for applications that use a motor on drives rated higher than 400 V class. • Install an AC reactor on the output side of the drive and set *C6-02 = 1 [Carrier Frequency Selection = 2.0 kHz]*. **Note:** When the motor is connected to the drive output terminals U/T1, V/T2, and W/T3, surges occur between the drive switching and the motor coils. These surges can be three times the drive input power supply voltage (600 V for a 200 V class drive, 1200 V for a 400 V class drive).
The air around the motor is too hot.	• Measure the ambient temperature. • Decrease the temperature in the area until it is in the specified temperature range.
The motor fan stopped or is clogged.	• Clean the motor fan. • Make the drive environment better.

◆ There Is Audible Noise from the Drive or Motor Cables when You Energize the Drive

Causes	Possible Solutions
The relay switching in the drive is making too much noise.	• Use *C6-02 [Carrier Frequency Selection]* to decrease the carrier frequency. • Connect a noise filter to the input side of the drive power supply. • Connect a noise filter to the output side of the drive. • Isolate the control circuit wiring from the main circuit wiring. • Use a metal cable gland to wire the drive. • Shield the periphery of the drive with metal. • Make sure that the drive and motor are grounded correctly. • Make sure that ground faults have not occurred in the wiring or motor.

◆ Residual Current Monitoring/Detection (RCM/RCD) Trips During Run

Causes	Possible Solutions
There is too much leakage current from the drive.	• Increase the RCM/RCD sensitivity or use RCM/RCD with a higher threshold. • Use *C6-02 [Carrier Frequency Selection]* to decrease the carrier frequency. • Decrease the length of the cable used between the drive and the motor. • Install a noise filter or AC reactor on the output side of the drive. Set *C6-02 = 1 [2.0 kHz]* when connecting an AC reactor. • Disable the internal EMC filter.

◆ Flux Compensation (Current Suppression at Start)

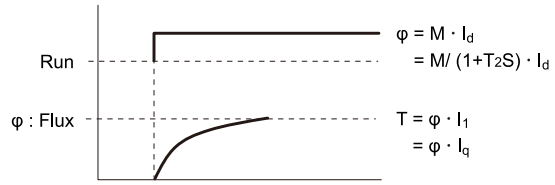
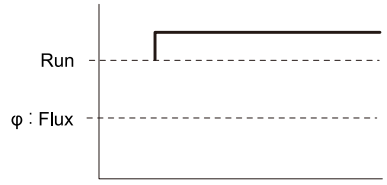
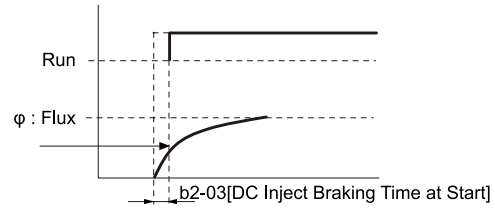
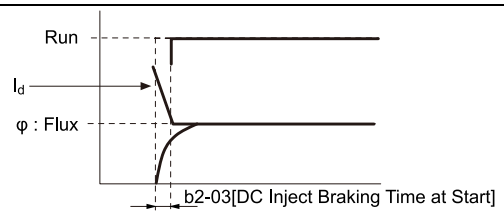
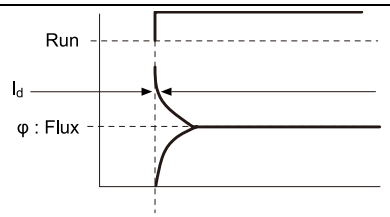
Find motor torque using the following formula.

$T = \varphi \cdot I_1$
$= \varphi \cdot I_q$

Torque and current are proportionally related when flux is constant. These are possible methods for suppressing current at start.

- Method 1: Quickly generate flux.
  - Initial excitation
  - DC Inject Braking at Start
  - Magnetic Flux Compensation
- Method 2: If using V/f control or OLV control, set the highest value possible for the V/f pattern.

Table 3.28 How To Generate Flux Quickly and its Effectiveness

Type	Description	
Basic type		There is a delay in magnetic flux developing after start. Secondary circuit time constant: The value of [T] is displayed in the drive monitor as the torque reference, so it is possible to see that the torque limit is not operating if magnetic flux compensation is active. However, the torque limit is [Iq] limit, so it is not a problem in this situation. The effectiveness of the torque limit can be confirmed by checking the current level.
Initial Excitation through an External Terminal (CLV only)		-
DC Inject Braking at Start (All control methods)		It is possible to start operating after a bit of flux has built up. However, it can take over 1 s for flux to build up in mid-sized motors. Some adjustment is necessary because waiting for over 1 s will decrease the responsiveness of the drive. **Note:** Usually, set between 0.2 s and 0.3 s.
Magnetic Flux Compensation (OLV Control)		The purpose of this function is to build up magnetic flux more quickly by allowing a large amount of flux current to flow at start using the percentage set in *b2-08 [Magnetic Flux Compensation Value]*. Magnetic flux compensation of 200% generates 1/2 for the flux build up. **Note:** Set *b2-03 [DC Inject Braking Time at Start]* to adjust this level.
Field Forcing *1		The upper limit value for *d6-06 [Field Forcing Limit]* is 400%, which allows flux current to flow at start up for the purpose of compensating for the delay in flux build up. If the value set in *d6-06* is set too high, this will increase the amount of lurching at start. Set an appropriate value between 200% and 400%. **Note:** Speed Control must be active to make these adjustments. You cannot make adjustments during DC Injection Braking at start or at stop.

*1 Field Forcing is enabled when *d6-03 = 1 [Field Forcing Selection = Enabled]*, and when using CLV control or OLV control.

3.12 Controllability Problems and Possible Solutions

The following explains the adjustment procedures to follow when issues such as hunting or oscillation attributable to control functionality occur during a test run. Adjust the relevant parameters appearing in the chart, in accordance with the control method being used and the drive status.

Note:
- In this section, only the parameters that are frequently adjusted are listed. Please consult with a Yaskawa representative if adjustments having a higher degree of precision are required.
- The method for making adjustments is different when synchronizing 2 drives, and when using a single drive that switches between multiple motors. For such installations, consult with Yaskawa before making any drive settings or drive adjustments.

◆ V/f Control and Closed Loop V/f Control

Table 3.29 Parameters for Fine Tuning the Drive (V/f Control and Closed Loop V/f Control Methods)

Issue	Parameter Number	Possible Solutions	Default	Recommended Setting
Hunting or oscillation at mid-range speeds (10 Hz to 40 Hz)	n1-02 [Hunting Prevention Gain Setting]	• If torque is not sufficient with heavy loads, decrease the setting value. • If hunting or oscillation occur with light loads, increase the setting value. • If hunting occurs with a low-inductance motor, for example a motor with a larger frame size, lower the setting value.	1.00	0.10 - 2.00
• The volume of the motor excitation sound is too high. • Hunting or oscillation at low speeds (10 Hz or lower), or at mid-range speeds (10 Hz to 40 Hz)	C6-02 [Carrier Frequency Selection]	• If the volume of the motor excitation sound is too high, increase the carrier frequency. • If hunting or oscillation occur at low or mid-range speeds, decrease the carrier frequency.	1 (2 kHz) *1	1 to upper limit value
• Unsatisfactory motor torque and speed response • Hunting or oscillation	C4-02 [Torque Compensation Delay Time]	• If torque or speed response are slow, decrease the setting value. • If hunting or oscillation occur, increase the setting value.	200 ms *2	100 ms to 1000 ms
• Torque at low speeds (10 Hz or lower) is not sufficient. • Hunting or oscillation	C4-01 [Torque Compensation Gain]	• Increase the setting value when torque is insufficient at low speeds. • If hunting or oscillation occur with light loads, decrease the setting value.	1.00	0.50 - 1.50
• Torque at low speeds (10 Hz or lower) is not sufficient. • Large initial vibration at start up.	• E1-08 [Mid Point A Voltage] • E1-10 [Minimum Output Voltage]	• Increase the setting value when torque is insufficient at low speeds. • If there is large initial vibration at start up, decrease the setting value	• E1-08: 15.0 V *3 • E1-10: 9.0 V *3	Default setting +/- 5 V *4
Speed precision is unsatisfactory. (V/f Control)	C3-01 [Slip Compensation Gain]	Set *E2-01 [Motor Rated Current], E2-02 [Motor Rated Slip], and E2-03 [Motor No-Load Current]*, then adjust *C3-01*.	0.0 (no slip compensation)	0.5 - 1.5
Speed precision is unsatisfactory. (Closed Loop V/f Control)	• C5-01 [ASR Proportional Gain 1] • C5-02 [ASR Integral Time 1] *5	Adjust *C5-01, C5-02*.	• C5-01: 0.20 • C5-02: 0.200 s	• Proportional gain = 0.10 to 1.00 • Integral time = 0.100 to 2.000 s

*1 The default setting changes when the setting for *o2-04 [Drive Model Selection]* changes.
*2 The default setting changes when the settings for *A1-02 [Control Method Selection] and o2-04 [Drive Model (KVA) Selection]* change.
*3 The default setting changes when the settings for *A1-02 [Control Method Selection] and E1-03 [V/f Pattern Selection]* change.
*4 Recommended settings are for 200 V class drives. Multiply the voltage by 2 for 400 V class drives.
*5 When you use Closed Loop V/f Control, ASR controls only the output frequency. You cannot make a high-gain setting as in Closed Loop Vector.

◆ Open Loop Vector Control Method

In Open Loop Vector Control, keep *C4-01 [Torque Compensation Gain]* at its default setting (1.00).

If you cannot get speed precision during regeneration in Open Loop Vector Control, set *C3-04 = 1 [Slip Compensation at Regen = Enabled Above 6 Hz]*.

Table 3.30 Parameters for Fine Tuning the Drive (Open Loop Vector Control Method)

Issue	Parameter Number	Possible Solutions	Default	Recommended Setting
• Unsatisfactory motor torque and speed response • Hunting or oscillation at mid-range speeds (10 Hz to 40 Hz)	n2-01 [Automatic Freq Regulator Gain(F)]	• To increase the speed of torque or speed response, decrease the setting value in 0.05-unit increments. • If hunting or oscillation occur, decrease the setting value in 0.05-unit increments.	1.00	0.50 - 2.00
	n2-02 [Automatic Freq Regulator Time 1]	• To increase the speed of torque or speed response, decrease the setting value in 10 ms increments and examine the response. • If hunting or oscillation occur or if the load inertia is too much, increase the setting value in 50 ms increments and examine the response. **Note:** Make sure that this parameter setting is: *n2-02* ≤ *n2-03 [Automatic Freq Regulator Time 2]*. When you adjust *n2-02*, you must also increase the *C4-02 [Torque Compensation Delay Time]* value by the same ratio.	50 ms	50 ms to 2000 ms
ov [Overvoltage] occurs when the drive stops accelerating, starts to decelerate, or when there are large changes in the load.	n2-03 [Automatic Freq Regulator Time 2]	• If *ov* occurs, increase the setting value in 50 ms increments and examine the response. • If the response is not sufficient, decrease the setting value in 10 ms increments and examine the response. **Note:** Make sure that this parameter setting is: *n2-02 [Automatic Freq Regulator Time 1]* ≤ *n2-03*. When you adjust *n2-03*, you must also increase the *C4-06 [Motor 2 Torque Comp Delay Time]* value by the same ratio.	750 ms	750 ms to 2000 ms
	C4-06 [Motor 2 Torque Comp Delay Time]	• If *ov* occurs, increase the setting value in 10 ms increments and examine the response. • If the response is not sufficient, decrease the setting value in 2 ms increments and examine the response. **Note:** Make sure that this parameter setting is: *C4-02 [Torque Compensation Delay Time]* ≤ *C4-06*. When you adjust *C4-06*, you must also increase the *n2-03 [Automatic Freq Regulator Time 2]* value by the same ratio.	150 ms	150 ms to 750 ms
• Unsatisfactory motor torque and speed response • Hunting or oscillation	C4-02 [Torque Compensation Delay Time]	• If torque or speed response are slow, decrease the setting value in 2 ms increments. • If hunting or oscillation occur, increase the setting value in 10 ms increments. **Note:** Make sure that this parameter setting is: *C4-02* ≤ *C4-06 [Motor 2 Torque Comp Delay Time]*. When you adjust *C4-02*, you must also increase the *n2-02 [Automatic Freq Regulator Time 1]* value by the same ratio.	20 ms **1*	20 ms - 100 ms **1*
• Speed response is slow. • Speed is not stable.	C3-02 [Slip Compensation Delay Time]	• If speed response is slow, decrease the setting value in 10 ms increments. • If speed is not stable, increase the value in 10 ms increments.	200 ms **1*	100 ms to 500 ms

Issue	Parameter Number	Possible Solutions	Default	Recommended Setting
Speed precision is unsatisfactory.	C3-01 [Slip Compensation Gain]	• If speed is too slow, increase the setting value in 0.1 unit increments. • If speed is too fast, decrease the setting value in 0.1 unit increments.	1.0 *2	0.5 - 1.5
• The volume of the motor excitation sound is too high. • Hunting or oscillation at low speeds (10 Hz or lower)	C6-02 [Carrier Frequency Selection]	• If the volume of the motor excitation sound is too high, increase the carrier frequency. • If hunting or oscillation occur at low speeds, decrease the carrier frequency.	1 (2 kHz) *3	0 to upper limit value
• Torque at low speeds is not sufficient. • Speed response is slow. • Large initial vibration at start up.	• E1-08 [Mid Point A Voltage] • E1-10 [Minimum Output Voltage]	• If torque or speed response are slow, increase the setting value. • If there is large initial vibration at start up, decrease the setting value **Note:** If you set the value too high, the drive can output a large torque reference although the load is light.	• E1-08: 14.4 *2 • E1-10: 3.0 *2	Default setting +/- 2 V *4

*1 The default setting changes when the settings for *A1-02 [Control Method Selection] and o2-04 [Drive Model (KVA) Selection]* change.
*2 The default setting changes when the settings for *A1-02 [Control Method Selection] and E1-03 [V/f Pattern Selection]* change.
*3 The default setting changes when the setting for *o2-04 [Drive Model Selection]* changes.
*4 Recommended settings are for 200 V class drives. Multiply the voltage by 2 for 400 V class drives.

◆ Closed Loop Vector Control

Table 3.31 Parameters for Fine Tuning the Drive (CLV Control)

Problem	Parameter Number	Solution	Default	Recommended Value
• Torque, speed response is slow. • Hunting, oscillation	• High speed C5-01 [ASR Proportional Gain 1] • Low speed C5-03 [ASR Proportional Gain 2] *1	• Increase setting value in increments of 5.00 when torque, speed response is slow. • If hunting, oscillation occurs, decrease the setting value.	20.00	10.00 - 50.00
	• High speed C5-02 [ASR Integral Time 1] • Low speed C5-04 [ASR Integral Time 2] *1	• Decrease setting value when torque, speed response is slow. • If hunting, oscillation occurs, increase the setting value.	0.500 s	0.300 s - 1.000 s
ASR proportional gain or integral time cannot be established for low speed or high speed.	C5-07 [ASR Gain Switchover Frequency] *1	Change the ASR proportional gain and ASR integral time in accordance with the output frequency.	0.0 Hz	0.0 Hz to maximum output frequency
Hunting, oscillation	C5-06 [ASR Delay Time] *1	• Decrease setting value in increments of 0.010 when torque, speed response is slow. • Increase setting value when vibration is likely to occur due to poor machine rigidity.	0.004 s	0.004 s - 0.020 s
• The motor excitation sound is significant. • Hunting, oscillation at low speeds (3 Hz or lower)	C6-02 [Carrier Frequency Selection]	• Increase the carrier frequency if the motor excitation sound is significant. • Decrease the carrier frequency if hunting or oscillation occurs at low speeds.	1 (2.0 kHz) *2	2.0 kHz to upper limit value

*1 For more information about speed control (ASR), refer to the section where the *C5 parameter* is explained.
*2 Differs depending on setting for *o2-04 [Drive Model (KVA) Selection]*, when at default settings.

◆ AOLV Control

Table 3.32 Parameters for Fine Tuning the Drive (AOLV Control)

Problem	Parameter Number	Solution	Default	Recommended Value
• *oS [Overspeed]* occurs. • Hunting, oscillation occurs.	T1-01 [Auto-Tuning Mode Selection]	• Confirm that the output of the drive and the motor are connected properly. • Perform Rotational Auto-Tuning for the motor by itself.	-	0
The motor excitation sound is significant.	C6-02 [Carrier Frequency Selection]	Increase the carrier frequency if the motor excitation sound is significant.	1 (2 kHz) *1	1 to upper limit value

Problem	Parameter Number	Solution	Default	Recommended Value
Improve speed accuracy	E2-02 [Motor Rated Slip]	• Decouple the motor and machinery and perform Rotational Auto-Tuning. • If the actual motor speed is slow, increase the value of *E2-02* in tiny increments (by approximately 0.1% of the default setting value). • If the actual motor speed is fast, decrease the value of *E2-02* in tiny increments (by approximately 0.1% of the default setting value).	*2	Adjust the value of *E2-02* that was automatically set as the result of Rotational Auto-Tuning within a range of ±5% of the current value.
• Torque, speed response is slow. • Hunting, oscillation	• High speed C5-01 [ASR Proportional Gain 1] • Low speed C5-03 [ASR Proportional Gain 2] *3	• Increase setting value in increments of 5.00 when torque, speed response is slow. • If hunting, oscillation occurs, decrease the setting value.	20.00	10.00 to 50.00
	• High speed C5-02 [ASR Integral Time 1] • Low speed C5-04 [ASR Integral Time 2] *3	• Decrease setting value when torque, speed response is slow. • If hunting, oscillation occurs, increase the setting value.	0.500 s	0.300 s to 1.000 s
Speed response cannot be secured for low speed or high speed.	• C5-07 [ASR Gain Switchover Frequency] *4 • High speed C5-01 [ASR Proportional Gain 1] C5-02 [ASR Integral Time 1] • Low speed C5-03 [ASR Proportional Gain 2] *3 C5-04 [ASR Integral Time 2]	Change the ASR proportional gain and ASR integral time in accordance with the output frequency.	0.0 Hz	0.0 Hz to maximum output frequency
Hunting, oscillation	C5-06 [ASR Delay Time] *4	• Decrease setting value in increments of 0.010 when torque, speed response is slow. • Increase setting value when vibration is likely to occur due to poor machine rigidity.	0.004 s	0.004 s to 0.020 s

*1 Differs depending on setting for *o2-04 [Drive Model (KVA) Selection]*, when at default settings.
*2 Differs depending on setting for *o2-04 [Drive Model (KVA) Selection]*, when at default settings.
*3 For more information about speed control (ASR), refer to the section where the *C5 parameter* is explained.
*4 The optimal values for a no-load operation can differ from the optimal values for actual loading operation.

3.13 Test Run Checklist

Review this checklist and check each item before you do a test run.

Checked	No.	Description
	1	Thoroughly read this manual before you do a test run.
	2	Check the "Wiring Checklist".
	3	Energize the drive.
	4	Set the voltage for the power supply in *E1-01 [Input AC Supply Voltage]*.

Check the applicable items as specified by your control method.

Table 3.33 V/f Control [A1-02 = 0] and Closed Loop V/f Control [A1-02 = 1]

Checked	No.	Description
	5	Select the best V/f pattern for your application and motor characteristics. Example: For a motor with a rated frequency of 60 Hz, set *E1-03 = 1 [V/f Pattern Selection = Const Trq, 60Hz base, 60Hz max]* as a standard V/f pattern.

Table 3.34 Closed Loop V/f Control [A1-02 = 1]

Checked	No.	Description
	6	Set *F1-01 [Encoder 1 Pulse Count (PPR)]* correctly and make sure that encoder pulse counting direction is correct.
	7	Set *C5-01 [ASR Proportional Gain 1] and C5-02 [ASR Integral Time 1]*.

Table 3.35 Open Loop Vector Control [A1-02 = 2], Closed Loop Vector Control [A1-02 = 3], Advanced Open Loop Vector Control [A1-02 = 4]

Checked	No.	Description
	8	Do Rotational Auto-Tuning.
	9	Decouple motor shafts and machines when you do Rotational Auto-Tuning
	10	Refer to the information on the motor nameplate and set this data correctly: • Motor rated power (kW) to *T1-02* • Motor rated voltage (V) to *T1-03* • Motor rated current (A) to *T1-04* • Motor base frequency (Hz) to *T1-05* • Number of motor poles: *T1-06* • Motor base speed (min^{-1}) to *T1-07*

Table 3.36 Closed Loop Vector Control [A1-02 = 3]

Checked	No.	Description
	11	Set *F1-01 [Encoder 1 Pulse Count (PPR)]* and F1-05 [Encoder 1 Rotation Selection].
	12	Set *C5-01 [ASR Proportional Gain 1] and C5-02 [ASR Integral Time 1]*.

Check items 5 to 12, then check these items.

Checked	No.	Description
	13	The keypad will show "Rdy" after starting to operate the motor.
	14	Make sure that you set *b1-01 [Frequency Reference Selection 1]* and *b1-02 [Run Command Selection 1]* correctly as specified by the input source of the Run command and frequency reference Example: To input the frequency reference and Run command from the keypad, set *b1-01 = 0 [Keypad]* or *b1-02 = 0 [Keypad]*.
	15	If the motor rotates in the opposite direction during test run, switch two of the motor cables (U/T1, V/T2, W/T3).
	16	Set *E2-01 [Motor Rated Current (FLA)] and L1-01 [Motor Overload (oL1) Protection]* correctly for motor thermal protection.
	17	When you use terminal A1 for the frequency reference: • Voltage input – Set *H3-01 = 0, 1 [Terminal A1 Signal Level Select = 0 to 10V (Lower Limit at 0), -10 to +10V (Bipolar Reference)]*. – Set *H3-02 = 0 [Terminal A1 Function Selection = Frequency Reference]*.

Checked	No.	Description
	18	When you use terminal A2 for the frequency reference: • Voltage input – Set DIP Switch S1 on the drive to “V”. – Set *H3-09 = 0, 1 [Terminal A2 Signal Level Select = 0 to 10V (Lower Limit at 0), -10 to 10V (Bipolar Reference)]*. – Set *H3-10 = 0 [Terminal A2 Function Selection = Frequency Reference]*. • Current input – Set DIP Switch S1 on the drive to “I”. – Set *H3-09 = 2, 3 [Terminal A2 Signal Level Select = 4 to 20 mA, 0 to 20 mA]*. – Set *H3-10 = 0 [Terminal A2 Function Selection = Frequency Reference]*.
	19	When you use terminal A3 for the frequency reference: • Voltage input – Set DIP Switch S4 on the drive to analog input side. – Set *H3-05 = 0, 1 [Terminal A3 Signal Level Select = 0 to 10V (Lower Limit at 0), -10 to +10V (Bipolar Reference)]*. – Set *H3-06 = 0 [Terminal A3 Function Selection = Frequency Reference]*.
	20	Make sure that the frequency reference gets to the necessary minimum and maximum values. **Note:** If drive operation is incorrect, make these adjustments: • Gain adjustment: Set the maximum voltage and current values, then adjust the analog input gain until the frequency reference reaches the necessary value. (For terminal A1 input: *H3-03*, for terminal A2 input: *H3-11*, for terminal A3 input: *H3-07*) • Bias adjustment: Set the maximum voltage/current values and then adjust the analog input bias until the frequency reference is at the desired minimum value. (For terminal A1 input:*H3-04*, for terminal A2 input:*H3-12*, for terminal A3 input: *H3-08*)

4

Standards Compliance

This chapter gives information about how to make the machines and devices that use this product comply with European standards and UL standards.

4.1 Section Safety 246
4.2 European Standards 248
4.3 UL Standards 273
4.4 China RoHS Compliance 293
4.5 对应中国RoHS指令 294
4.6 Safe Disable Input 295

4.1 Section Safety

⚠DANGER

Electrical Shock Hazard

Do not examine, connect, or disconnect wiring on an energized drive. Before servicing, disconnect all power to the equipment and wait for the time specified on the warning label at a minimum. The internal capacitor stays charged after the drive is de-energized. The charge indicator LED extinguishes when the DC bus voltage decreases below 50 Vdc. When all indicators are OFF, remove the covers before measuring for dangerous voltages to make sure that the drive is safe.

If you do work on the drive when it is energized, it will cause serious injury or death from electrical shock.

⚠WARNING

Electrical Shock Hazard

Do not operate the drive when covers are missing. Replace covers and shields before you operate the drive. Use the drive only as specified by the instructions.

Some figures in this section include drives without covers or safety shields to more clearly show the inside of the drive. If covers or safety shields are missing from the drive, it can cause serious injury or death.

Always ground the motor-side grounding terminal.

If you do not ground the equipment correctly, it can cause serious injury or death if you touch the motor case.

Do not remove covers or touch circuit boards while the drive is energized.

If you touch the internal components of an energized drive, it can cause serious injury or death.

Only let approved personnel install, wire, maintain, examine, replace parts, and repair the drive.

If personnel are not approved, it can cause serious injury or death.

Do not wear loose clothing or jewelry when you do work on the drive. Tighten loose clothing and remove all metal objects, for example watches or rings.

Loose clothing can catch on the drive and jewelry can conduct electricity and cause serious injury or death.

Do not modify the drive body or drive circuitry.

Modifications to drive body and circuitry can cause serious injury or death, will cause damage to the drive, and will void the warranty. Yaskawa is not responsible for modifications of the product made by the user.

Fire Hazard

Tighten all terminal screws to the correct tightening torque.

Connections that are too loose or too tight can cause incorrect operation and damage to the drive. Incorrect connections can also cause death or serious injury from fire.

Tighten screws at an angle in the specified range shown in this manual.

If you tighten the screws at an angle not in the specified range, you can have loose connections that can cause damage to the terminal block or start a fire and cause serious injury or death.

Damage to Equipment

Do not apply incorrect voltage to the main circuit of the drive. Operate the drive in the specified range of the input voltage on the drive nameplate.

Voltages that are higher than the permitted nameplate tolerance can cause damage to the drive.

Fire Hazard

Do not put flammable or combustible materials on top of the drive and do not install the drive near flammable or combustible materials. Attach the drive to metal or other noncombustible material.

Flammable and combustible materials can start a fire and cause serious injury or death.

Crush Hazard

Wear eye protection when you do work on the drive.

If you do not use correct safety equipment, it can cause serious injury or death.

NOTICE

Damage to Equipment

When you touch the drive and circuit boards, make sure that you observe correct electrostatic discharge (ESD) procedures.

If you do not follow procedures, it can cause ESD damage to the drive circuitry.

Do not break the electrical connection between the drive and the motor when the drive is outputting voltage.

Incorrect equipment sequencing can cause damage to the drive.

Before you connect a dynamic braking option to the drive, make sure that qualified personnel read and obey the Braking Unit and Braking Resistor Unit Installation Manual (TOBPC72060001).

If you do not read and obey the manual or if personnel are not qualified, it can cause damage to the drive and braking circuit.

Make sure that all connections are correct after you install the drive and connect peripheral devices.

Incorrect connections can cause damage to the drive.

Note:

Do not let unwanted objects, for example metal shavings or wire clippings, fall into the drive during drive installation. Put a temporary cover over the drive during installation. Remove the temporary cover before start-up. Unwanted objects inside of the drive can cause damage to the drive.

4.2 European Standards

Figure 4.1 CE Mark

The CE Mark indicates that the product meets environmental and safety standards in the European Union. Products manufactured, sold, or imported within the European Union are required to display the CE Mark.

European Union standards include standards for electrical appliances (Low Voltage Directive), standards for electrical noise (EMC Directive), and standards for machinery (Machinery Directive).

This product displays the CE Mark in accordance with the Low Voltage Directive, the EMC Directive, and the Machinery Directive.

Table 4.1 Harmonized Standard

European Directive	Harmonized Standard
CE Low Voltage Directive Compliance 2014/35/EU	IEC/EN 61800-5-1:2007
EMC Directive 2014/30/EU	EN 61800-3:2004/A1:2012
Machinery Directive 2006/42/EC	• ISO/EN ISO 13849-1:2015 (Cat.3, PL e) • IEC 62061/A2:2015 (SIL CL 3) • EN 62061/A2:2015 (SIL CL 3) • IEC/EN 61800-5-2:2007 (SIL3)

The customer is responsible for displaying the CE Mark on the final device containing this product. Customers must verify themselves that the final device is compliant with EU standards.

◆ CE Low Voltage Directive Compliance

It has been confirmed that this product complies with the CE Low Voltage Directive by conducting a test according to IEC/EN 61800-5-1:2007.

The following conditions must be satisfied for machines and devices incorporating this product to comply with the CE Low Voltage Directive.

■ Area of Use

Install this product in a location with Overvoltage Category III and pollution degree 2 or less as specified in IEC/CE 60664.

■ Guarding Against Debris

When you install IP20/UL Open type drives (models: 2xxxxB, 4xxxxB), use an enclosure panel that does not let unwanted material enter the drive from above or below.

■ Wiring Diagram

Refer to Figure 4.2 for an example of a drive that is wired for compliance with the CE Low Voltage Directive.

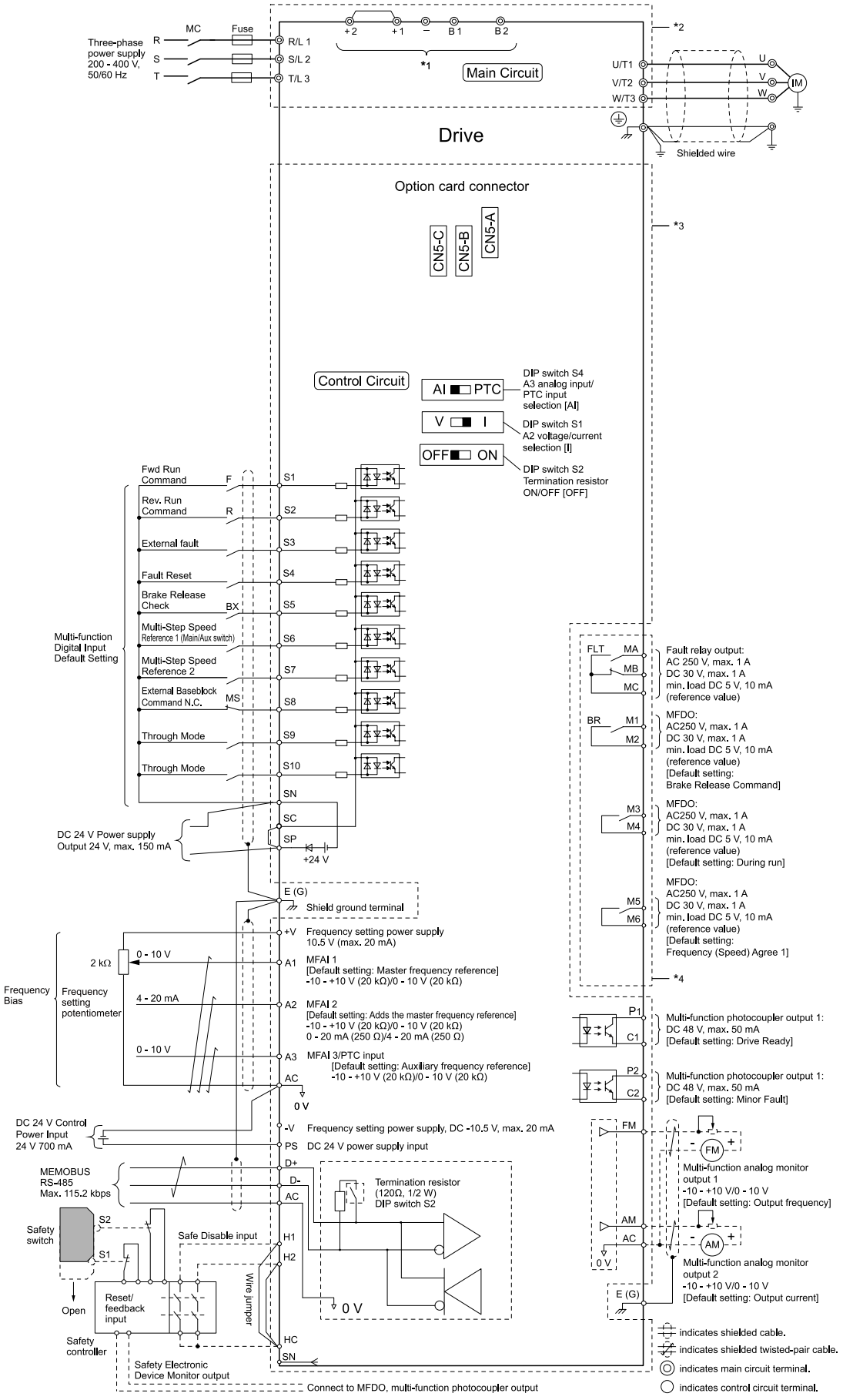


Figure 4.2 Wiring Diagram for CE Low Voltage Directive Compliance

*1 Connect peripheral options to terminals -, +1, +2, B1, and B2. Do not connect an AC power supply lines to these terminals.

*2 For circuit protection, the main circuit is separated from the surface case that would otherwise come into contact with the main circuit.

*3 The control circuit is a Safety Extra-Low Voltage circuit that must be separated from other circuits by reinforced insulation. Ensure that the Safety Extra-Low Voltage circuit is connected as required.
*4 Reinforced insulation separates the output terminals from other circuits. Users may also connect circuits that are not Safety Extra-Low Voltage circuits if the drive output is 250 Vac 1 A max. or 30 Vdc 1 A max.

■ Wire Gauges and Tightening Torques

Note:
- The recommended wire gauges based on drive continuous current ratings using 75 °C (167 °F) 600 V class 2 heat resistant indoor PVC wire. Assume the following usage conditions:
  – Ambient temperature: 40 °C (104 °F) or lower
  – Wiring distance: 100 m (3281 ft.) or shorter
  – Rated current value
- Use terminals +1, +2, +3, -, B1, and B2 to connect peripheral options such as a DC reactor or a braking resistor. Do not connect anything other than optional devices.
- Refer to the specific instruction manual of each device for wire gauges when connecting peripheral devices or options to terminals +1, +2, +3, -, B1, and B2. Contact Yaskawa or your nearest sales representative if the recommended wire gauges for the peripheral devices or options are out of the range of the applicable gauge for the drive.

Three-Phase 200 V Class

Table 4.2 Main Circuit Wire Gauges and Tightening Torques (200 V Class)

Model	Terminal	Recomm. Gauge mm²	Applicable Gauge (IP20 Applicable Gauge *1) mm²	Wire Stripping Length *2 mm	Terminal Screw		Tightening Torque N·m (lbf·in)
					Size	Shape	
2003	R/L1, S/L2, T/L3	2.5	2.5 - 10 (2.5 - 10)	10	M4	Slotted (-)	1.5 - 1.7 (13.5 - 15)
	U/T1, V/T2, W/T3	2.5	2.5 - 10 (2.5 - 10)	10	M4	Slotted (-)	1.5 - 1.7 (13.5 - 15)
	-, +1, +2	2.5	2.5 - 16 (2.5 - 16)	18	M5	Slotted (-)	2.3 - 2.5 (19.8 - 22) *3
	B1, B2	2.5	2.5 - 4 (2.5 - 4)	10	M4	Slotted (-)	1.5 - 1.7 (13.5 - 15)
	⏚	2.5 *4	2.5 - 10 (-)	-	M4	Phillips/slotted combo	1.2 - 1.5 (10.6 - 13.3)
2005	R/L1, S/L2, T/L3	2.5	2.5 - 10 (2.5 - 10)	10	M4	Slotted (-)	1.5 - 1.7 (13.5 - 15)
	U/T1, V/T2, W/T3	2.5	2.5 - 10 (2.5 - 10)	10	M4	Slotted (-)	1.5 - 1.7 (13.5 - 15)
	-, +1, +2	2.5	2.5 - 16 (2.5 - 16)	18	M5	Slotted (-)	2.3 - 2.5 (19.8 - 22) *3
	B1, B2	2.5	2.5 - 4 (2.5 - 4)	10	M4	Slotted (-)	1.5 - 1.7 (13.5 - 15)
	⏚	2.5 *4	2.5 - 10 (-)	-	M4	Phillips/slotted combo	1.2 - 1.5 (10.6 - 13.3)
2008	R/L1, S/L2, T/L3	2.5	2.5 - 10 (2.5 - 10)	10	M4	Slotted (-)	1.5 - 1.7 (13.5 - 15)
	U/T1, V/T2, W/T3	2.5	2.5 - 10 (2.5 - 10)	10	M4	Slotted (-)	1.5 - 1.7 (13.5 - 15)
	-, +1, +2	2.5	2.5 - 16 (2.5 - 16)	18	M5	Slotted (-)	2.3 - 2.5 (19.8 - 22) *3
	B1, B2	2.5	2.5 - 4 (2.5 - 4)	10	M4	Slotted (-)	1.5 - 1.7 (13.5 - 15)
	⏚	2.5 *4	2.5 - 10 (-)	-	M4	Phillips/slotted combo	1.2 - 1.5 (10.6 - 13.3)

Model	Terminal	Recomm. Gauge mm²	Applicable Gauge (IP20 Applicable Gauge *1) mm²	Wire Stripping Length *2 mm	Terminal Screw		Tightening Torque N·m (lbf·in)
					Size	Shape	
2011	R/L1, S/L2, T/L3	2.5	2.5 - 10 (2.5 - 10)	10	M4	Slotted (-)	1.5 - 1.7 (13.5 - 15)
	U/T1, V/T2, W/T3	2.5	2.5 - 10 (2.5 - 10)	10	M4	Slotted (-)	1.5 - 1.7 (13.5 - 15)
	-, +1, +2	2.5	2.5 - 16 (2.5 - 16)	18	M5	Slotted (-)	2.3 - 2.5 (19.8 - 22) *3
	B1, B2	2.5	2.5 - 4 (2.5 - 4)	10	M4	Slotted (-)	1.5 - 1.7 (13.5 - 15)
	⏚	2.5 *4	2.5 - 10 (-)	-	M4	Phillips/slotted combo	1.2 - 1.5 (10.6 - 13.3)
2014	R/L1, S/L2, T/L3	2.5	2.5 - 10 (2.5 - 10)	10	M4	Slotted (-)	1.5 - 1.7 (13.5 - 15)
	U/T1, V/T2, W/T3	2.5	2.5 - 10 (2.5 - 10)	10	M4	Slotted (-)	1.5 - 1.7 (13.5 - 15)
	-, +1, +2	4	2.5 - 16 (2.5 - 16)	18	M5	Slotted (-)	2.3 - 2.5 (19.8 - 22) *3
	B1, B2	2.5	2.5 - 4 (2.5 - 4)	10	M4	Slotted (-)	1.5 - 1.7 (13.5 - 15)
	⏚	2.5 *4	2.5 - 10 (-)	-	M4	Phillips/slotted combo	1.2 - 1.5 (10.6 - 13.3)
2018	R/L1, S/L2, T/L3	6	2.5 - 10 (2.5 - 10)	10	M4	Slotted (-)	1.5 - 1.7 (13.5 - 15)
	U/T1, V/T2, W/T3	2.5	2.5 - 10 (2.5 - 10)	10	M4	Slotted (-)	1.5 - 1.7 (13.5 - 15)
	-, +1, +2	6	2.5 - 16 (2.5 - 16)	18	M5	Slotted (-)	2.3 - 2.5 (19.8 - 22) *3
	B1, B2	2.5	2.5 - 4 (2.5 - 4)	10	M4	Slotted (-)	1.5 - 1.7 (13.5 - 15)
	⏚	6 *4	4 - 10 (-)	-	M4	Phillips/slotted combo	1.2 - 1.5 (10.6 - 13.3)
2025	R/L1, S/L2, T/L3	10	2.5 - 10 (2.5 - 10)	10	M4	Slotted (-)	1.5 - 1.7 (13.5 - 15)
	U/T1, V/T2, W/T3	6	2.5 - 10 (2.5 - 10)	10	M4	Slotted (-)	1.5 - 1.7 (13.5 - 15)
	-, +1, +2	10	2.5 - 16 (2.5 - 16)	18	M5	Slotted (-)	2.3 - 2.5 (19.8 - 22) *3
	B1, B2	2.5	2.5 - 4 (2.5 - 4)	10	M4	Slotted (-)	1.5 - 1.7 (13.5 - 15)
	⏚	10	6 - 10 (-)	-	M5	Phillips/slotted combo	2.0 - 2.5 (17.7 - 22.1)
2033	R/L1, S/L2, T/L3	10	2.5 - 10 (2.5 - 10)	10	M4	Slotted (-)	1.5 - 1.7 (13.5 - 15)
	U/T1, V/T2, W/T3	10	2.5 - 10 (2.5 - 10)	10	M4	Slotted (-)	1.5 - 1.7 (13.5 - 15)
	-, +1, +2	16	2.5 - 16 (2.5 - 16)	18	M5	Slotted (-)	2.3 - 2.5 (19.8 - 22) *3
	B1, B2	4	2.5 - 4 (2.5 - 4)	10	M4	Slotted (-)	1.5 - 1.7 (13.5 - 15)
	⏚	10	6 - 10 (-)	-	M5	Phillips/slotted combo	2.0 - 2.5 (17.7 - 22.1)

Model	Terminal	Recomm. Gauge mm²	Applicable Gauge (IP20 Applicable Gauge *1) mm²	Wire Stripping Length *2 mm	Terminal Screw		Tightening Torque N·m (lbf·in)
					Size	Shape	
2047	R/L1, S/L2, T/L3	25	2.5 - 25 (10 - 25)	18	M5	Slotted (-)	2.3 - 2.5 (19.8 - 22) *3
	U/T1, V/T2, W/T3	16	2.5 - 16 (6 - 16)	18	M5	Slotted (-)	2.3 - 2.5 (19.8 - 22) *3
	-, +1, +2	35	2.5 - 35 (10 - 35)	20	M6	Hex socket cap (WAF: 5 mm)	5 - 5.5 (45 - 49)
	B1, B2	10	2.5 - 10 (2.5 - 10)	10	M4	Slotted (-)	1.5 - 1.7 (13.5 - 15)
	⏚	16	10 - 16 (-)	-	M6	Phillips/slotted combo	5.4 - 6.0 (47.8 - 53.1)
2060	R/L1, S/L2, T/L3	35	2.5 - 35 (25 - 35)	20	M6	Hex socket cap (WAF: 5 mm)	5 - 5.5 (45 - 49)
	U/T1, V/T2, W/T3	16	2.5 - 16 (16)	20	M6	Hex socket cap (WAF: 5 mm)	5 - 5.5 (45 - 49)
	-, +1, +2	50	2.5 - 50 (35 - 50)	20	M6	Hex socket cap (WAF: 5 mm)	5 - 5.5 (45 - 49)
	B1, B2	10	2.5 - 10 (2.5 - 10)	10	M4	Slotted (-)	1.5 - 1.7 (13.5 - 15)
	⏚	16	16 - 25 (-)	-	M6	Phillips/slotted combo	5.4 - 6.0 (47.8 - 53.1)
2075	R/L1, S/L2, T/L3	35	2.5 - 35 (25 - 35)	20	M6	Hex socket cap (WAF: 5 mm)	5 - 5.5 (45 - 49)
	U/T1, V/T2, W/T3	25	2.5 - 25 (16 - 25)	20	M6	Hex socket cap (WAF: 5 mm)	5 - 5.5 (45 - 49)
	-, +1, +2	50	2.5 - 50 (35 - 50)	20	M6	Hex socket cap (WAF: 5 mm)	5 - 5.5 (45 - 49)
	B1, B2	16	2.5 - 16 (2.5 - 16)	10	M4	Slotted (-)	1.5 - 1.7 (13.5 - 15)
	⏚	16	16 - 25 (-)	-	M6	Phillips/slotted combo	5.4 - 6.0 (47.8 - 53.1)
2088	R/L1, S/L2, T/L3	35	16 - 35 (25 - 35)	27	M6	Hex socket cap (WAF: 5 mm)	8 - 9 (71 - 80)
	U/T1, V/T2, W/T3	35	16 - 35 (25 - 35)	27	M6	Hex socket cap (WAF: 5 mm)	8 - 9 (71 - 80)
	-, +1	50	25 - 50 (25 - 50)	27	M8	Hex socket cap (WAF: 6 mm)	10 - 12 (89 - 107)
	B1, B2	25	6 - 25 (6 - 25)	21	M6	Slotted (-)	3 - 3.5 (27 - 31)
	⏚	16	16 - 25 (-)	-	M6	Hex bolt (+)	5.4 - 6.0 (47.8 - 53.1)
2115	R/L1, S/L2, T/L3	50	16 - 50 (50)	27	M6	Hex socket cap (WAF: 5 mm)	8 - 9 (71 - 80)
	U/T1, V/T2, W/T3	50	16 - 50 (50)	27	M6	Hex socket cap (WAF: 5 mm)	8 - 9 (71 - 80)
	-, +1	70	25 - 70 (50 - 70)	27	M8	Hex socket cap (WAF: 6 mm)	10 - 12 (89 - 107)
	B1, B2	35	6 - 35 (6 - 35)	21	M6	Slotted (-)	3 - 3.5 (27 - 31)
	⏚	25	25 (-)	-	M6	Hex bolt (+)	5.4 - 6.0 (47.8 - 53.1)

Model	Terminal	Recomm. Gauge mm²	Applicable Gauge (IP20 Applicable Gauge *1) mm²	Wire Stripping Length *2 mm	Terminal Screw		Tightening Torque N·m (lbf·in)
					Size	Shape	
2145	R/L1, S/L2, T/L3	70	50 - 95 (95)	37	M10	Hex socket cap (WAF: 8 mm)	12 - 14 (107 - 124)
	U/T1, V/T2, W/T3	70	50 - 95 (95)	37	M10	Hex socket cap (WAF: 8 mm)	12 - 14 (107 - 124)
	-, -, +1, +1 *5 *6	35	16 - 50 (50)	28	M6	Hex socket cap (WAF: 5 mm)	8 - 9 (71 - 80)
	+3 *6	50	25 - 70 (50 - 70)	28	M8	Hex socket cap (WAF: 6 mm)	8 - 9 (71 - 80)
	⏚	35	25 - 50 (-)	-	M8	Hex bolt (slotted)	9.0 - 11 (79.7 - 97.4)
2180	R/L1, S/L2, T/L3	95	50 - 95 (95)	37	M10	Hex socket cap (WAF: 8 mm)	12 - 14 (107 - 124)
	U/T1, V/T2, W/T3	95	50 - 95 (95)	37	M10	Hex socket cap (WAF: 8 mm)	12 - 14 (107 - 124)
	-, -, +1, +1 *5 *6	50	16 - 50 (50)	28	M6	Hex socket cap (WAF: 5 mm)	8 - 9 (71 - 80)
	+3 *6	70	25 - 70 (50 - 70)	28	M8	Hex socket cap (WAF: 6 mm)	8 - 9 (71 - 80)
	⏚	50	25 - 50 (-)	-	M8	Hex bolt (slotted)	9.0 - 11 (79.7 - 97.4)
2215	R/L1, S/L2, T/L3	50 × 2P	25 - 95 × 2P (70 - 95 × 2P)	-	M10	Hex self-locking nut	20 (177)
	U/T1, V/T2, W/T3	50 × 2P	25 - 95 × 2P (70 - 95 × 2P)	-	M10	Hex self-locking nut	20 (177)
	-, +1	70 × 2P	35 - 120 × 2P (120 × 2P)	-	M10	Hex self-locking nut	20 (177)
	+3	35 × 2P	25 - 70 × 2P (70 × 2P)	-	M10	Hex self-locking nut	20 (177)
	⏚	95	95 - 240 (-)	-	M10	Hex bolt (slotted)	18 - 23 (159 - 204)
2283	R/L1, S/L2, T/L3	70 × 2P	25 - 95 × 2P (70 - 95 × 2P)	-	M10	Hex self-locking nut	20 (177)
	U/T1, V/T2, W/T3	70 × 2P	25 - 95 × 2P (70 - 95 × 2P)	-	M10	Hex self-locking nut	20 (177)
	-, +1	95 × 2P	35 - 120 × 2P (120 × 2P)	-	M10	Hex self-locking nut	20 (177)
	+3	50 × 2P	25 - 70 × 2P (70 × 2P)	-	M10	Hex self-locking nut	20 (177)
	⏚	95	95 - 240 (-)	-	M10	Hex bolt (slotted)	18 - 23 (159 - 204)
2346	R/L1, S/L2, T/L3	120 × 2P	70 - 150 × 2P (150 × 2P)	-	M12	Hex self-locking nut	35 (310)
	U/T1, V/T2, W/T3	120 × 2P	70 - 150 × 2P (150 × 2P)	-	M12	Hex self-locking nut	35 (310)
	-, +1	120 × 2P	95 - 185 × 2P (185 × 2P)	-	M12	Hex self-locking nut	35 (310)
	+3	70 × 2P	50 - 95 × 2P (-)	-	M12	Hex self-locking nut	35 (310)
	⏚	120	120 - 240 (-)	-	M12	Hex bolt (slotted)	32 - 40 (283 - 354)

Model	Terminal	Recomm. Gauge mm²	Applicable Gauge (IP20 Applicable Gauge *1) mm²	Wire Stripping Length *2 mm	Terminal Screw		Tightening Torque N·m (lbf·in)
					Size	Shape	
2415	R/L1, S/L2, T/L3	120 × 2P	70 - 150 × 2P (150 × 2P)	-	M12	Hex self-locking nut	35 (310)
	U/T1, V/T2, W/T3	120 × 2P	70 - 150 × 2P (150 × 2P)	-	M12	Hex self-locking nut	35 (310)
	-, +1	120 × 2P	95 - 185 × 2P (185 × 2P)	-	M12	Hex self-locking nut	35 (310)
	+3	70 × 2P	50 - 95 × 2P (-)	-	M12	Hex self-locking nut	35 (310)
	⏚	120	120 - 240 (-)	-	M12	Hex bolt (slotted)	32 - 40 (283 - 354)

*1 For IP20 protection, use wires that are in the range of applicable gauges.
*2 Remove insulation from the ends of wires to expose the length of wire shown.
*3 For wire gauges more than 30 mm², tighten to a tightening torque of 4.1 N·m to 4.5 N·m (36 lbf·in to 40 lbf·in).
*4 Install an ELCB with this wire gauge to maintain compliance with IEC/EN 61800-5-1:2007.
*5 Terminals - and +1 have two screws. The Recommended Gauge is the wire gauge for one terminal.
*6 A junction terminal is necessary to connect a braking unit (CDBR-series) to terminals - and +3.

Three-Phase 400 V Class

Table 4.3 Main Circuit Wire Gauges and Tightening Torques (400 V Class)

Model	Terminal	Recomm. Gauge mm²	Applicable Gauge (IP20 Applicable Gauge *1) mm²	Wire Stripping Length *2 mm	Terminal Screw		Tightening Torque N·m (lbf·in)
					Size	Shape	
4002	R/L1, S/L2, T/L3	2.5	2.5 - 10 (2.5 - 10)	10	M4	Slotted (-)	1.5 - 1.7 (13.5 - 15)
	U/T1, V/T2, W/T3	2.5	2.5 - 10 (2.5 - 10)	10	M4	Slotted (-)	1.5 - 1.7 (13.5 - 15)
	-, +1, +2	2.5	2.5 - 16 (2.5 - 16)	18	M5	Slotted (-)	2.3 - 2.5 (19.8 - 22) *3
	B1, B2	2.5	2.5 - 4 (2.5 - 4)	10	M4	Slotted (-)	1.5 - 1.7 (13.5 - 15)
	⏚	2.5 *4	2.5 - 10 (-)	-	M4	Phillips/slotted combo	1.2 - 1.5 (10.6 - 13.3)
4003	R/L1, S/L2, T/L3	2.5	2.5 - 10 (2.5 - 10)	10	M4	Slotted (-)	1.5 - 1.7 (13.5 - 15)
	U/T1, V/T2, W/T3	2.5	2.5 - 10 (2.5 - 10)	10	M4	Slotted (-)	1.5 - 1.7 (13.5 - 15)
	-, +1, +2	2.5	2.5 - 16 (2.5 - 16)	18	M5	Slotted (-)	2.3 - 2.5 (19.8 - 22) *3
	B1, B2	2.5	2.5 - 4 (2.5 - 4)	10	M4	Slotted (-)	1.5 - 1.7 (13.5 - 15)
	⏚	2.5 *4	2.5 - 10 (-)	-	M4	Phillips/slotted combo	1.2 - 1.5 (10.6 - 13.3)
4005	R/L1, S/L2, T/L3	2.5	2.5 - 10 (2.5 - 10)	10	M4	Slotted (-)	1.5 - 1.7 (13.5 - 15)
	U/T1, V/T2, W/T3	2.5	2.5 - 10 (2.5 - 10)	10	M4	Slotted (-)	1.5 - 1.7 (13.5 - 15)
	-, +1, +2	2.5	2.5 - 16 (2.5 - 16)	18	M5	Slotted (-)	2.3 - 2.5 (19.8 - 22) *3
	B1, B2	2.5	2.5 - 4 (2.5 - 4)	10	M4	Slotted (-)	1.5 - 1.7 (13.5 - 15)
	⏚	2.5 *4	2.5 - 10 (-)	-	M4	Phillips/slotted combo	1.2 - 1.5 (10.6 - 13.3)

Model	Terminal	Recomm. Gauge mm²	Applicable Gauge (IP20 Applicable Gauge *1) mm²	Wire Stripping Length *2 mm	Terminal Screw		Tightening Torque N·m (lbf·in)
					Size	Shape	
4006	R/L1, S/L2, T/L3	2.5	2.5 - 10 (2.5 - 10)	10	M4	Slotted (-)	1.5 - 1.7 (13.5 - 15)
	U/T1, V/T2, W/T3	2.5	2.5 - 10 (2.5 - 10)	10	M4	Slotted (-)	1.5 - 1.7 (13.5 - 15)
	-, +1, +2	2.5	2.5 - 16 (2.5 - 16)	18	M5	Slotted (-)	2.3 - 2.5 (19.8 - 22) *3
	B1, B2	2.5	2.5 - 4 (2.5 - 4)	10	M4	Slotted (-)	1.5 - 1.7 (13.5 - 15)
	⏚	2.5 *4	2.5 - 10 (-)	-	M4	Phillips/slotted combo	1.2 - 1.5 (10.6 - 13.3)
4007	R/L1, S/L2, T/L3	2.5	2.5 - 10 (2.5 - 10)	10	M4	Slotted (-)	1.5 - 1.7 (13.5 - 15)
	U/T1, V/T2, W/T3	2.5	2.5 - 10 (2.5 - 10)	10	M4	Slotted (-)	1.5 - 1.7 (13.5 - 15)
	-, +1, +2	2.5	2.5 - 16 (2.5 - 16)	18	M5	Slotted (-)	2.3 - 2.5 (19.8 - 22) *3
	B1, B2	2.5	2.5 - 4 (2.5 - 4)	10	M4	Slotted (-)	1.5 - 1.7 (13.5 - 15)
	⏚	2.5 *4	2.5 - 10 (-)	-	M4	Phillips/slotted combo	1.2 - 1.5 (10.6 - 13.3)
4009	R/L1, S/L2, T/L3	2.5	2.5 - 10 (2.5 - 10)	10	M4	Slotted (-)	1.5 - 1.7 (13.5 - 15)
	U/T1, V/T2, W/T3	2.5	2.5 - 10 (2.5 - 10)	10	M4	Slotted (-)	1.5 - 1.7 (13.5 - 15)
	-, +1, +2	2.5	2.5 - 16 (2.5 - 16)	18	M5	Slotted (-)	2.3 - 2.5 (19.8 - 22) *3
	B1, B2	2.5	2.5 - 4 (2.5 - 4)	10	M4	Slotted (-)	1.5 - 1.7 (13.5 - 15)
	⏚	2.5 *4	2.5 - 10 (-)	-	M4	Phillips/slotted combo	1.2 - 1.5 (10.6 - 13.3)
4015	R/L1, S/L2, T/L3	2.5	2.5 - 10 (2.5 - 10)	10	M4	Slotted (-)	1.5 - 1.7 (13.5 - 15)
	U/T1, V/T2, W/T3	2.5	2.5 - 10 (2.5 - 10)	10	M4	Slotted (-)	1.5 - 1.7 (13.5 - 15)
	-, +1, +2	4	2.5 - 16 (2.5 - 16)	18	M5	Slotted (-)	2.3 - 2.5 (19.8 - 22) *3
	B1, B2	2.5	2.5 - 4 (2.5 - 4)	10	M4	Slotted (-)	1.5 - 1.7 (13.5 - 15)
	⏚	2.5 *4	2.5 - 10 (-)	-	M5	Phillips/slotted combo	2.0 - 2.5 (17.7 - 22.1)
4018	R/L1, S/L2, T/L3	6	2.5 - 10 (2.5 - 10)	10	M4	Slotted (-)	1.5 - 1.7 (13.5 - 15)
	U/T1, V/T2, W/T3	4	2.5 - 10 (2.5 - 10)	10	M4	Slotted (-)	1.5 - 1.7 (13.5 - 15)
	-, +1, +2	6	2.5 - 16 (2.5 - 16)	18	M5	Slotted (-)	2.3 - 2.5 (19.8 - 22) *3
	B1, B2	2.5	2.5 - 4 (2.5 - 4)	10	M4	Slotted (-)	1.5 - 1.7 (13.5 - 15)
	⏚	6 *4	4 - 10 (-)	-	M5	Phillips/slotted combo	2.0 - 2.5 (17.7 - 22.1)

Model	Terminal	Recomm. Gauge mm²	Applicable Gauge (IP20 Applicable Gauge *1) mm²	Wire Stripping Length *2 mm	Terminal Screw		Tightening Torque N·m (lbf·in)
					Size	Shape	
4024	R/L1, S/L2, T/L3	10	2.5 - 25 (10 - 25)	18	M5	Slotted (-)	2.3 - 2.5 (19.8 - 22) *3
	U/T1, V/T2, W/T3	6	2.5 - 16 (6 - 16)	18	M5	Slotted (-)	2.3 - 2.5 (19.8 - 22) *3
	-, +1, +2	10	2.5 - 35 (10 - 35)	20	M6	Hex socket cap (WAF: 5 mm)	5 - 5.5 (45 - 49)
	B1, B2	2.5	2.5 - 10 (2.5 - 10)	10	M4	Slotted (-)	1.5 - 1.7 (13.5 - 15)
	⏚	10	6 - 16 (-)	-	M6	Phillips/slotted combo	5.4 - 6.0 (47.8 - 53.1)
4031	R/L1, S/L2, T/L3	10	2.5 - 25 (10 - 25)	18	M5	Slotted (-)	2.3 - 2.5 (19.8 - 22) *3
	U/T1, V/T2, W/T3	6	2.5 - 16 (6 - 16)	18	M5	Slotted (-)	2.3 - 2.5 (19.8 - 22) *3
	-, +1, +2	16	2.5 - 35 (10 - 35)	20	M6	Hex socket cap (WAF: 5 mm)	5 - 5.5 (45 - 49)
	B1, B2	4	2.5 - 10 (2.5 - 10)	10	M4	Slotted (-)	1.5 - 1.7 (13.5 - 15)
	⏚	10	6 - 16 (-)	-	M6	Phillips/slotted combo	5.4 - 6.0 (47.8 - 53.1)
4039	R/L1, S/L2, T/L3	16	2.5 - 16 (4 - 16)	18	M5	Slotted (-)	2.3 - 2.5 (19.8 - 22) *3
	U/T1, V/T2, W/T3	10	2.5 - 10 (6 - 10)	18	M5	Slotted (-)	2.3 - 2.5 (19.8 - 22) *3
	-, +1, +2	25	2.5 - 25 (6 - 25)	18	M5	Slotted (-)	2.3 - 2.5 (19.8 - 22) *3
	B1, B2	6	2.5 - 6 (2.5 - 6)	10	M4	Slotted (-)	1.5 - 1.7 (13.5 - 15)
	⏚	16	10 - 25 (-)	-	M6	Phillips/slotted combo	5.4 - 6.0 (47.8 - 53.1)
4045	R/L1, S/L2, T/L3	16	2.5 - 16 (4 - 16)	18	M5	Slotted (-)	2.3 - 2.5 (19.8 - 22) *3
	U/T1, V/T2, W/T3	16	2.5 - 16 (6 - 16)	18	M5	Slotted (-)	2.3 - 2.5 (19.8 - 22) *3
	-, +1	25	2.5 - 25 (6 - 25)	18	M5	Slotted (-)	2.3 - 2.5 (19.8 - 22) *3
	B1, B2	10	2.5 - 10 (2.5 - 10)	10	M4	Slotted (-)	1.5 - 1.7 (13.5 - 15)
	⏚	16	10 - 25 (-)	-	M6	Phillips/slotted combo	5.4 - 6.0 (47.8 - 53.1)
4060	R/L1, S/L2, T/L3	25	2.5 - 25 (2.5 - 25)	18	M5	Slotted (-)	2.3 - 2.5 (19.8 - 22) *3
	U/T1, V/T2, W/T3	25	2.5 - 25 (2.5 - 25)	18	M5	Slotted (-)	2.3 - 2.5 (19.8 - 22) *3
	-, +1	25	2.5 - 25 (4 - 25)	18	M5	Slotted (-)	2.3 - 2.5 (19.8 - 22) *3
	B1, B2	10	2.5 - 10 (2.5 - 10)	10	M4	Slotted (-)	1.5 - 1.7 (13.5 - 15)
	⏚	16	16 - 25 (-)	-	M6	Hex bolt (+)	5.4 - 6.0 (47.8 - 53.1)

Model	Terminal	Recomm. Gauge mm²	Applicable Gauge (IP20 Applicable Gauge *1) mm²	Wire Stripping Length *2 mm	Terminal Screw		Tightening Torque N·m (lbf·in)
					Size	Shape	
4075	R/L1, S/L2, T/L3	25	2.5 - 25 (10 - 25)	18	M5	Slotted (-)	2.3 - 2.5 (19.8 - 22) *3
	U/T1, V/T2, W/T3	25	2.5 - 25 (10 - 25)	18	M5	Slotted (-)	2.3 - 2.5 (19.8 - 22) *3
	-, +1	35	2.5 - 35 (16 - 35)	20	M6	Hex socket cap (WAF: 5 mm)	5 - 5.5 (45 - 49)
	B1, B2	16	2.5 - 16 (4 - 16)	18	M5	Slotted (-)	2.3 - 2.5 (19.8 - 22) *3
	⏚	16	16 - 25 (-)	-	M6	Hex bolt (+)	5.4 - 6.0 (47.8 - 53.1)
4091	R/L1, S/L2, T/L3	35	16 - 50 (50)	27	M6	Hex socket cap (WAF: 5 mm)	8 - 9 (71 - 80)
	U/T1, V/T2, W/T3	35	16 - 50 (50)	27	M6	Hex socket cap (WAF: 5 mm)	8 - 9 (71 - 80)
	-, +1	50	25 - 70 (50 - 70)	27	M8	Hex socket cap (WAF: 6 mm)	10 - 12 (89 - 107)
	B1, B2	25	6 - 35 (6 - 35)	21	M6	Slotted (-)	3 - 3.5 (27 - 31)
	⏚	16	16 - 25 (-)	-	M6	Hex bolt (+)	5.4 - 6.0 (47.8 - 53.1)
4112	R/L1, S/L2, T/L3	50	50 - 95 (95)	37	M10	Hex socket cap (WAF: 8 mm)	12 - 14 (107 - 124)
	U/T1, V/T2, W/T3	50	50 - 95 (95)	37	M10	Hex socket cap (WAF: 8 mm)	12 - 14 (107 - 124)
	-, -, +1, +1 *5	25	16 - 50 (50)	28	M6	Hex socket cap (WAF: 5 mm)	8 - 9 (71 - 80)
	B1, B2 *6	50	25 - 70 (50 - 70)	28	M8	Hex socket cap (WAF: 6 mm)	8 - 9 (71 - 80)
	⏚	25	25 - 50 (-)	-	M8	Hex bolt (slotted)	9.0 - 11 (79.7 - 97.4)
4150	R/L1, S/L2, T/L3	70	50 - 95 (95)	37	M10	Hex socket cap (WAF: 8 mm)	12 - 14 (107 - 124)
	U/T1, V/T2, W/T3	70	50 - 95 (95)	37	M10	Hex socket cap (WAF: 8 mm)	12 - 14 (107 - 124)
	-, -, +1, +1 *5	35	16 - 50 (50)	28	M6	Hex socket cap (WAF: 5 mm)	8 - 9 (71 - 80)
	B1, B2 *6	50	25 - 70 (50 - 70)	28	M8	Hex socket cap (WAF: 6 mm)	8 - 9 (71 - 80)
	⏚	35	25 - 50 (-)	-	M8	Hex bolt (slotted)	9.0 - 11 (79.7 - 97.4)
4180	R/L1, S/L2, T/L3	50 × 2P	25 - 95 × 2P (70 - 95 × 2P)	-	M10	Hex self-locking nut	20 (177)
	U/T1, V/T2, W/T3	50 × 2P	25 - 95 × 2P (70 - 95 × 2P)	-	M10	Hex self-locking nut	20 (177)
	-, +1	70 × 2P	35 - 120 × 2P (120 × 2P)	-	M10	Hex self-locking nut	20 (177)
	+3	35 × 2P	25 - 70 × 2P (70 × 2P)	-	M10	Hex self-locking nut	20 (177)
	⏚	50	50 - 240 (-)	-	M10	Hex bolt (slotted)	18 - 23 (159 - 204)

Model	Terminal	Recomm. Gauge mm²	Applicable Gauge (IP20 Applicable Gauge *1) mm²	Wire Stripping Length *2 mm	Terminal Screw		Tightening Torque N·m (lbf·in)
					Size	Shape	
4216	R/L1, S/L2, T/L3	50 × 2P	25 - 95 × 2P (70 - 95 × 2P)	-	M10	Hex self-locking nut	20 (177)
	U/T1, V/T2, W/T3	50 × 2P	25 - 95 × 2P (70 - 95 × 2P)	-	M10	Hex self-locking nut	20 (177)
	-, +1	70 × 2P	35 - 120 × 2P (120 × 2P)	-	M10	Hex self-locking nut	20 (177)
	+3	50 × 2P	25 - 70 × 2P (70 × 2P)	-	M10	Hex self-locking nut	20 (177)
	⏚	70	70 - 240 (-)	-	M10	Hex bolt (slotted)	18 - 23 (159 - 204)
4260	R/L1, S/L2, T/L3	70 × 2P	25 - 95 × 2P (70 - 95 × 2P)	-	M10	Hex self-locking nut	20 (177)
	U/T1, V/T2, W/T3	70 × 2P	25 - 95 × 2P (70 - 95 × 2P)	-	M10	Hex self-locking nut	20 (177)
	-, +1	95 × 2P	35 - 120 × 2P (120 × 2P)	-	M10	Hex self-locking nut	20 (177)
	+3	70 × 2P	25 - 70 × 2P (70 × 2P)	-	M10	Hex self-locking nut	20 (177)
	⏚	95	95 - 240 (-)	-	M10	Hex bolt (slotted)	18 - 23 (159 - 204)
4304	R/L1, S/L2, T/L3	120 × 2P	70 - 150 × 2P (150 × 2P)	-	M12	Hex self-locking nut	35 (310)
	U/T1, V/T2, W/T3	120 × 2P	70 - 150 × 2P (150 × 2P)	-	M12	Hex self-locking nut	35 (310)
	-, +1	120 × 2P	95 - 185 × 2P (185 × 2P)	-	M12	Hex self-locking nut	35 (310)
	+3	70 × 2P	50 - 95 × 2P (-)	-	M12	Hex self-locking nut	35 (310)
	⏚	120	120 - 240 (-)	-	M12	Hex bolt (slotted)	32 - 40 (283 - 354)
4371	R/L1, S/L2, T/L3	120 × 2P	70 - 150 × 2P (150 × 2P)	-	M12	Hex self-locking nut	35 (310)
	U/T1, V/T2, W/T3	120 × 2P	70 - 150 × 2P (150 × 2P)	-	M12	Hex self-locking nut	35 (310)
	-, +1	120 × 2P	95 - 185 × 2P (185 × 2P)	-	M12	Hex self-locking nut	35 (310)
	+3	95 × 2P	50 - 95 × 2P (-)	-	M12	Hex self-locking nut	35 (310)
	⏚	95	35 - 240 (-)	-	M12	Hex bolt (slotted)	32 - 40 (283 - 354)
4414	R/L1, S/L2, T/L3 R1/L11, S1/L21, T1/L31	120 × 4P	70 - 150 × 4P (150 × 4P)	-	M12	Hex self-locking nut	35 (310)
	U/T1, V/T2, W/T3	95 × 4P	70 - 150 × 4P (120 - 150 × 4P)	-	M12	Hex self-locking nut	35 (310)
	-, +1	95 × 4P	95 - 185 × 4P (185 × 4P)	-	M12	Hex self-locking nut	35 (310)
	+3	70 × 4P	35 - 95 × 4P (95 × 4P)	-	M12	Hex self-locking nut	35 (310)
	⏚	150	50 - 150 (-)	-	M12	Hex bolt (slotted)	32 - 40 (283 - 354)

Model	Terminal	Recomm. Gauge mm²	Applicable Gauge (IP20 Applicable Gauge *1) mm²	Wire Stripping Length *2 mm	Terminal Screw		Tightening Torque N·m (lbf·in)
					Size	Shape	
4453	R/L1, S/L2, T/L3 R1/L11, S1/L21, T1/L31	120 × 4P	70 - 150 × 4P (150 × 4P)	-	M12	Hex self-locking nut	35 (310)
	U/T1, V/T2, W/T3	95 × 4P	70 - 150 × 4P (120 - 150 × 4P)	-	M12	Hex self-locking nut	35 (310)
	-, +1	95 × 4P	95 - 185 × 4P (185 × 4P)	-	M12	Hex self-locking nut	35 (310)
	+3	70 × 4P	35 - 95 × 4P (95 × 4P)	-	M12	Hex self-locking nut	35 (310)
	⏚	95 × 2P	60 - 150 (-)	-	M12	Hex bolt (slotted)	32 - 40 (283 - 354)
4605	R/L1, S/L2, T/L3 R1/L11, S1/L21, T1/L31	120 × 4P	70 - 150 × 4P (150 × 4P)	-	M12	Hex self-locking nut	35 (310)
	U/T1, V/T2, W/T3	95 × 4P	70 - 150 × 4P (120 - 150 × 4P)	-	M12	Hex self-locking nut	35 (310)
	-, +1	95 × 4P	95 - 185 × 4P (185 × 4P)	-	M12	Hex self-locking nut	35 (310)
	+3	70 × 4P	35 - 95 × 4P (95 × 4P)	-	M12	Hex self-locking nut	35 (310)
	⏚	95 × 2P	60 - 150 (-)	-	M12	Hex bolt (slotted)	32 - 40 (283 - 354)

*1 For IP20 protection, use wires that are in the range of applicable gauges.
*2 Remove insulation from the ends of wires to expose the length of wire shown.
*3 For wire gauges more than 30 mm², tighten to a tightening torque of 4.1 N·m to 4.5 N·m (36 lbf·in to 40 lbf·in).
*4 Install an ELCB with this wire gauge to maintain compliance with IEC/EN 61800-5-1:2007.
*5 Terminals - and +1 have two screws. The Recommended Gauge is the wire gauge for one terminal.
*6 A junction terminal is necessary to connect a braking resistor unit (LKEB-series) to terminals B1 and B2.

■ Connect a Fuse to the Input Side (Primary Side)

The drive circuit protection must comply with IEC/EN 61800-5-1:2007 for protection against a short circuit in the internal circuitry. Connect semiconductor fuses on the input side for branch circuit protection.

WARNING! *Electrical Shock Hazard. After the drive blows a fuse or trips an RCM/RCD, do not immediately energize the drive or operate peripheral devices. Wait for the time specified on the warning label at a minimum and make sure that all indicators are OFF. Then check the wiring and peripheral device ratings to find the cause of the problem. If you do not know the cause of the problem, contact Yaskawa before you energize the drive or peripheral devices. If you do not fix the problem before you operate the drive or peripheral devices, it can cause serious injury or death.*

Three-Phase 200 V Class

Table 4.4 Factory-Recommended Branch Circuit Protection (200 V Class)

Drive Model	Semiconductor Protection Fuse Rated Current Manufacturer: EATON/Bussmann
2003	FWH-45B
2005	FWH-45B
2008	FWH-45B
2011	FWH-100B
2014	FWH-100B
2018	FWH-100B
2025	FWH-125B
2033	FWH-150B
2047	FWH-200B
2060	FWH-225A
2075	FWH-225A FWH-250A *1
2088	FWH-225A FWH-250A *1

Drive Model	Semiconductor Protection Fuse Rated Current Manufacturer: EATON/Bussmann
2115	FWH-275A FWH-300A *1
2145	FWH-275A FWH-350A *1
2180	FWH-325A FWH-450A *1
2215	FWH-600A
2283	FWH-800A
2346	FWH-1000B
2415	FWH-1000B

*1 Yaskawa recommends a fuse with a large rated current for applications with repeated loads.

Three-Phase 400 V Class

Table 4.5 Factory-Recommended Branch Circuit Protection (400 V Class)

Drive Model	Semiconductor Protection Fuse Rated Current Manufacturer: EATON/Bussmann
4002	FWH-50B
4003	FWH-50B
4005	FWH-50B
4006	FWH-60B
4007	FWH-60B
4009	FWH-60B
4015	FWH-80B
4018	FWH-90B
4024	FWH-150B
4031	FWH-200B
4039	FWH-200B
4045	FWH-225A
4060	FWH-250A
4075	FWH-275A
4091	FWH-275A
4112	FWH-300A
4150	FWH-325A FWH-400A *1
4180	FWH-500A
4216	FWH-600A
4260	FWH-700A
4304	FWH-800A
4371	FWH-1000B
4414	FWH-1200B
4453	FWH-1200B
4605	FWH-1400A FWH-1600A *1

*1 Yaskawa recommends a fuse with a large rated current for applications with repeated loads.

■ CE Standards Compliance for DC Power Supply Input

To comply with CE Standards, install a fuse for the DC power supply input.

Figure 4.3 shows a wiring example for a DC power supply with two drives connected in parallel.

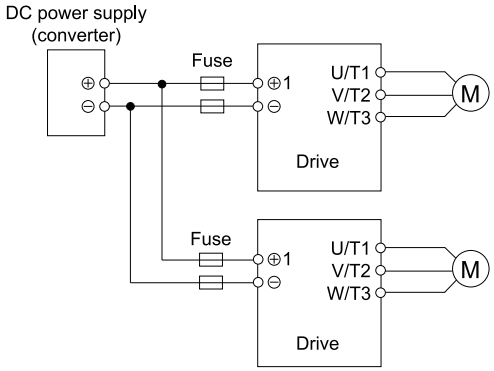


Figure 4.3 Wiring Example for DC Power Supply Input

Note:
- Install a fuse for each drive when operating more than one drive. If one fuse blows, replace all fuses.
- Install the external filter (system) to comply with the EMC Directive.
- Do not ground the main circuit bus.

Refer to Table 4.6 and Table 4.7 for the recommended fuses.

Three-Phase 200 V Class

Table 4.6 Recommended Fuse (Three-Phase 200 V Class)

Drive Model	Fuse Manufacturer: Bussmann	
	Model	Qty
2003	FWH-45B	2
2005	FWH-45B	2
2008	FWH-45B	2
2011	FWH-100B	2
2014	FWH-100B	2
2018	FWH-100B	2
2025	FWH-125B	2
2033	FWH-150B	2
2047	FWH-200B	2
2060	FWH-250A	2
2075	FWH-250A FWH-300A *1	2
2088	FWH-250A FWH-275A *1	2
2115	FWH-300A FWH-350A *1	2
2145	FWH-350A FWH-450A *1	2
2180	FWH-450A FWH-600A *1	2
2215	FWH-600A FWH-700A *1	2
2283	FWH-800A FWH-1000B *1	2
2346	FWH-1000B	2
2415	FWH-1000B	2

*1 Yaskawa recommends a fuse with a large rated current for applications with repeated loads.

Three-Phase 400 V Class

Table 4.7 Recommended Fuse (Three-Phase 400 V Class)

Drive Model	Fuse Manufacturer: Bussmann	
	Model	Qty
4002	FWH-50B	3
4003	FWH-50B	2
4005	FWH-50B	2
4006	FWH-60B	2
4007	FWH-60B	2
4009	FWH-60B	2
4015	FWH-80B	2
4018	FWH-90B	2
4024	FWH-150B	2
4031	FWH-200B	2
4039	FWH-200B	2
4045	FWH-225A	2
4060	FWH-250A	2
4075	FWH-275A	2
4091	FWH-275A	2
4112	FWH-300A FWH-325A *1	2
4150	FWH-400A FWH-450A *1	2
4180	FWH-500A FWH-600A *1	2
4216	FWH-600A FWH-700A *1	2
4260	FWH-700A FWH-800A *1	2
4304	FWH-800A FWH-1000B *1	2
4371	FWH-1000B FWH-1200B *1	2
4414	FWH-1200B FWH-1400A *1	2
4453	FWH-1200B FWH-1600A *1	2
4605	FWH-1600A	2

*1 Yaskawa recommends a fuse with a large rated current for applications with repeated loads.

◆ EMC Directive

Drives with built-in EMC filters (models 2xxxB, 4xxxB) were tested in accordance with European standard IEC/EN 61800-3:2004/A1:2012, and comply with the EMC Directive.

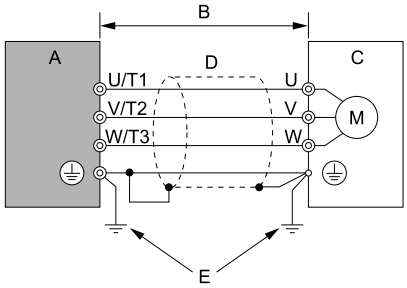
Use drives with built-in EMC filters or install external EMC filters to the drive input side to comply with the EMC Directive. Refer to *Installing the External EMC Noise Filter on page 268* for the installation of the EMC filter.

■ Install a Drive to Conform to the EMC Directive

Install drive models 2xxxB and 4xxxB with this procedure to comply with the EMC Directive when the drive is a single unit or installed in a larger device.

1. Install the drive on a grounded metal plate.

2. Wire the drive and motor.
3. Ground the wire shielding on the drive side and motor side.



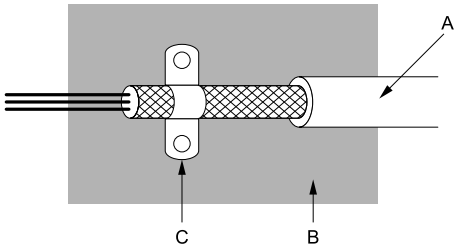
A - Drive
B - 10 m (32.8 ft) maximum
C - Motor
D - Metal conduit
E - Grounding wire

Figure 4.4 Wiring the Drive and Motor

Note:
- Use a braided shield cable for the drive and motor wiring or put the wires through a metal conduit.
- The maximum wiring length between the drive and motor is 10 m (32.8 ft). Keep the wire as short as possible.
- Keep the grounding wire as short as possible.

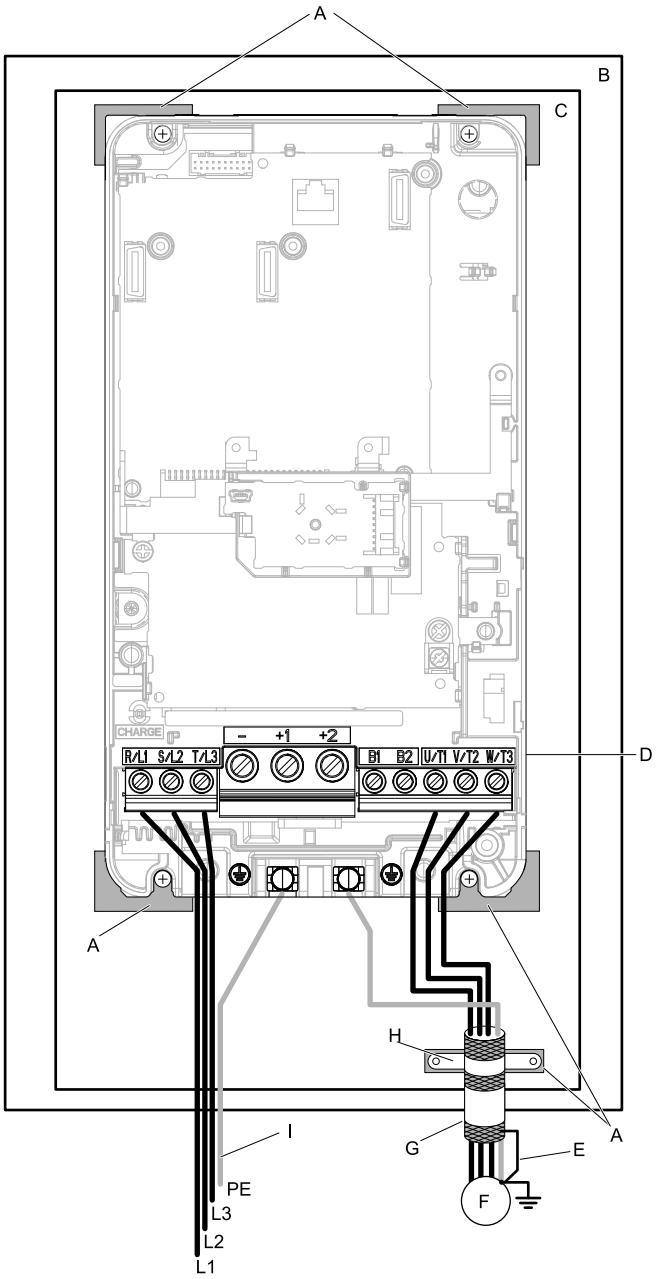
4. Use a cable clamp to ground the motor cable to the metal plate.

Note:
Make sure that the protective ground wire complies with technical specifications and local safety standards.



A - Braided shield cable
B - Metal plate
C - Cable clamp (conductive)

Figure 4.5 Ground the Shield



A - Grounding surface (Remove any paint or sealant.)
B - Enclosure panel
C - Metal plate
D - Drive
E - Shielded wire
F - Motor
G - Motor cable
H - Cable clamp
I - Grounding wire

Figure 4.6 Install a Drive with a Built-in EMC Filter

5. Connect the DC reactor to decrease harmonic distortion. Refer to *DC Reactor on page 272* to select a DC reactor.

Note:
- To maintain compliance with IEC/EN 61000-3-2 on drive models 2003, 2005, 4002, and 4003, install a DC reactor.
- The terminal block for the drive main circuit and the terminal block for the DC reactor have different shapes. The drive has a European-style terminal block, and the DC reactor has a round terminal block. Correctly prepare the ends of the wiring.

Ground Wiring

WARNING! *Electrical Shock Hazard. Do not remove covers or touch circuit boards while the drive is energized. If you touch the internal components of an energized drive, it can cause serious injury or death.*

WARNING! *Electrical Shock Hazard. Ground the neutral point on the power supply of drive models 2xxxB/C and 4xxxB/C to comply with the EMC Directive before you turn on the EMC filter. If you turn ON the EMC filter, but you do not ground the neutral point, it can cause serious injury or death.*

Enable the Internal EMC Filter

On drive models 2xxxB and 4xxxB, move the screw or screws to turn ON and OFF (enable and disable) the EMC filter.

WARNING! *Electrical Shock Hazard. Disconnect all power to the drive, wait for the time specified on the warning label, and check the drive for dangerous voltages before you remove covers or touch EMC filter screws. If you touch the screws when there are dangerous voltages, it will cause serious injury or death.*

WARNING! *Electrical Shock Hazard. Do not remove covers or touch circuit boards while the drive is energized. If you touch the internal components of an energized drive, it can cause serious injury or death.*

WARNING! *Electrical Shock Hazard. Ground the neutral point on the power supply of drive models 2xxxB/C and 4xxxB/C to comply with the EMC Directive before you turn on the EMC filter. If you turn ON the EMC filter, but you do not ground the neutral point, it can cause serious injury or death.*

WARNING! *Electrical Shock Hazard. Connect the ground cable correctly. If you touch electrical equipment that is not grounded, it can cause serious injury or death.*

NOTICE: *To disable the internal EMC filter, move the screws from ON to OFF and then tighten to the specified torque. If you fully remove the screws or tighten the screws to an incorrect torque, it can cause drive failure.*

NOTICE: *Move the EMC switch screw or screws to the OFF position for networks that are not symmetrically grounded. If the screws are not in the correct position, it can cause damage to the drive.*

Make sure that the symmetric grounding network is applied, and install the screw or screws in the ON position to enable the built-in EMC filter in compliance with the EMC Directive. The EMC filter switch screw or screws are installed in the OFF position by default.

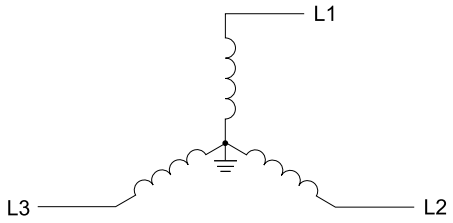


Figure 4.7 Symmetric Grounding

NOTICE: *When you use the drive with a non-grounding, high-resistance grounding, or asymmetric-grounding network, put the EMC Filter screw or screws in the OFF position to disable the built-in EMC filter. Failure to obey the instructions can damage the drive.*

Table 4.8 shows asymmetric grounding networks.

Table 4.8 Asymmetric Grounding

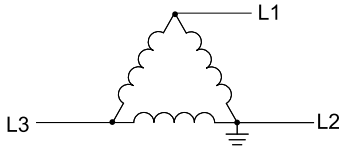
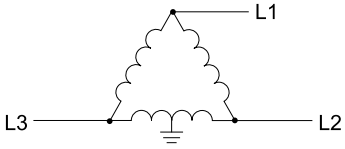
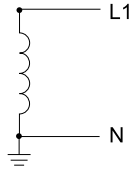
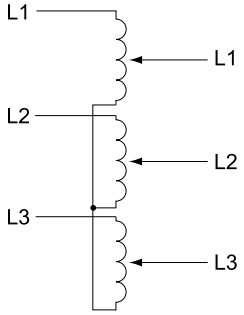
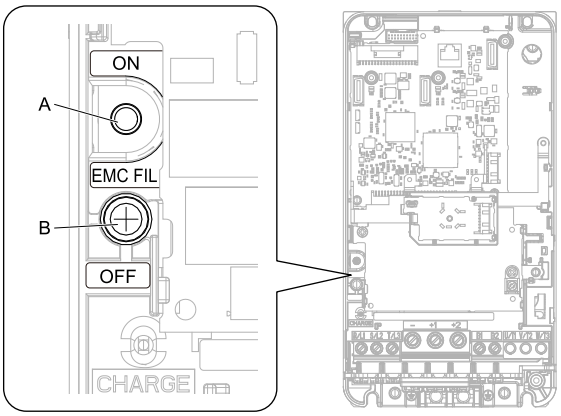
Type of Grounding	Diagram
Grounded at the corner of the delta connection	
Grounded at the middle of the side	
Single-phase, grounded at the end point	
Three-phase variable transformer without solidly grounded neutral	

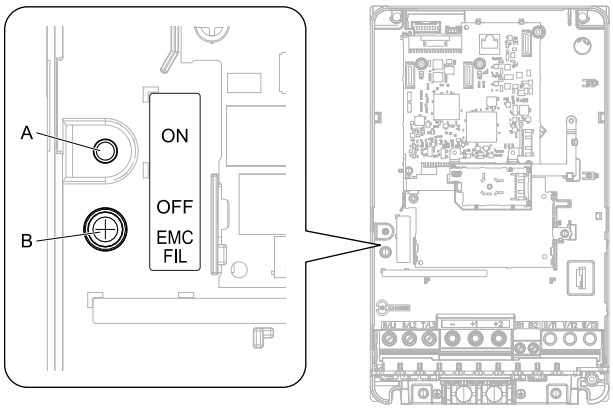
Table 4.9 EMC Filter Switch Location

Model	Switch Location Diagram
2003B - 2033B, 4002B - 4018B	Figure 4.8
2047B, 4024B, 4031B	Figure 4.9
2060B, 2075B, 4039B, 4045B	Figure 4.10
2088B, 2115B - 2180B, 4060B, 4075B - 4150B	Figure 4.11
2215B - 2283B, 4180B - 4260B	Figure 4.12
2346B, 2415B, 4304B, 4371B	Figure 4.13
4414B - 4605B	Figure 4.14



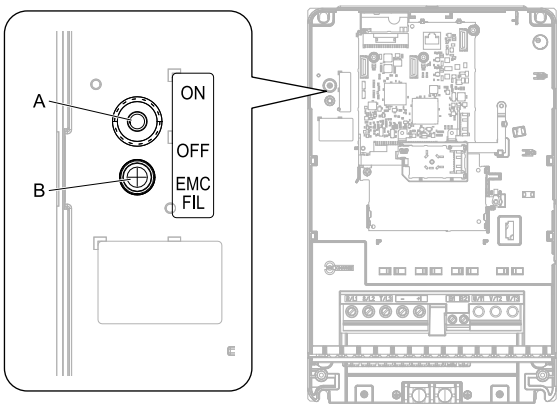
A - SW (ON) **B - Screw (OFF)**

Figure 4.8 EMC Filter Switch Location 1



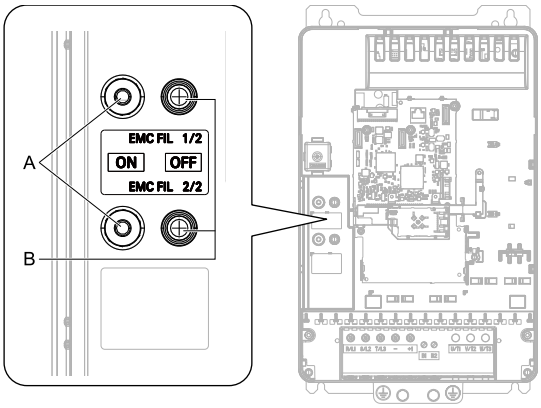
A - SW (ON) **B - Screw (OFF)**

Figure 4.9 EMC Filter Switch Location 2



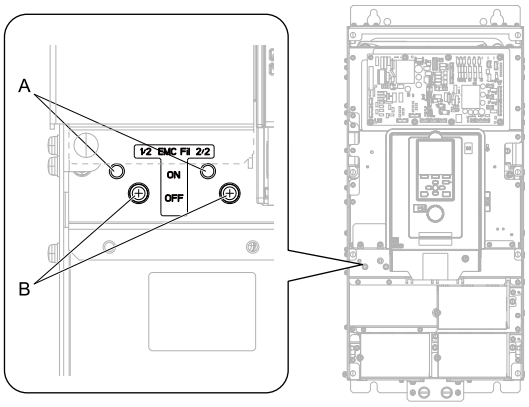
A - SW (ON) **B - Screw (OFF)**

Figure 4.10 EMC Filter Switch Location 3



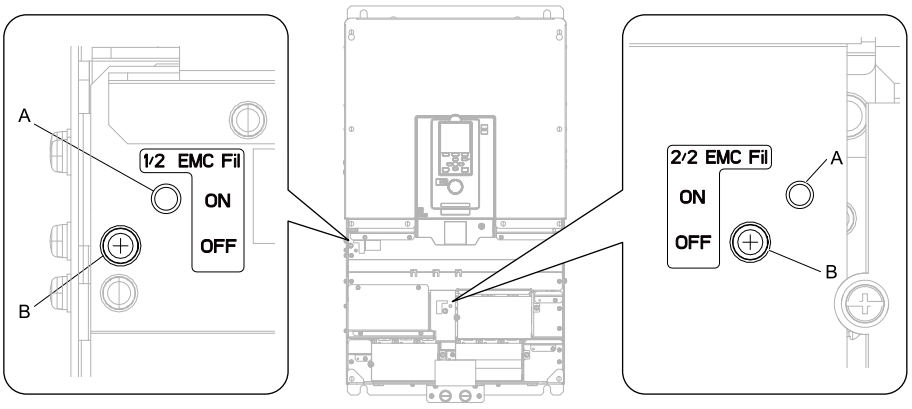
A - SW (ON) **B - Screw (OFF)**

Figure 4.11 EMC Filter Switch Location 4



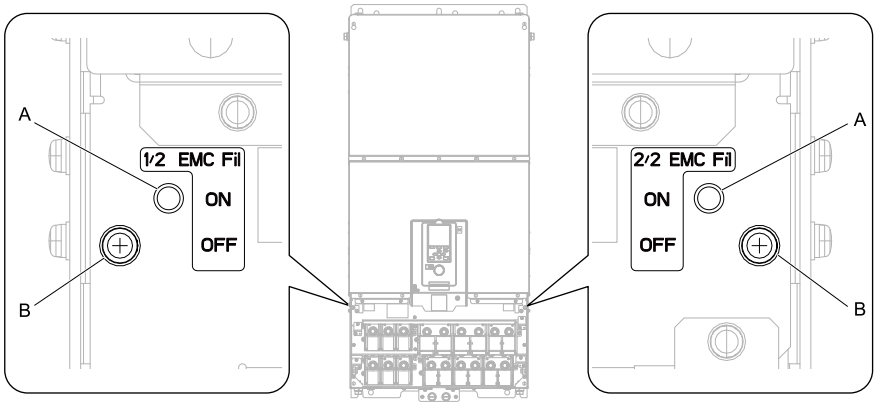
A - SW (ON) **B - Screw (OFF)**

Figure 4.12 EMC Filter Switch Location 5



A - SW (ON) **B - Screw (OFF)**

Figure 4.13 EMC Filter Switch Location 6



A - SW (ON) **B - Screw (OFF)**

Figure 4.14 EMC Filter Switch Location 7

If you lose an EMC filter switch screw, use the table to find the correct replacement screw and install the new screw with the correct tightening torque.

NOTICE: *Only use the screws specified in this manual. If you use screws that are not approved, it can cause damage to the drive.*

Table 4.10 Screw Sizes and Tightening Torques

Model	Screw Size	Tightening Torque N·m
2003 - 2075, 4002 - 4045	M4 × 20	1.0 - 1.3
2088 - 2180, 4060 - 4150	M4 × 25	1.0 - 1.3
2215 - 2415, 4180 - 4605	M5 × 25	2.0 - 2.5

■ Installing the External EMC Noise Filter

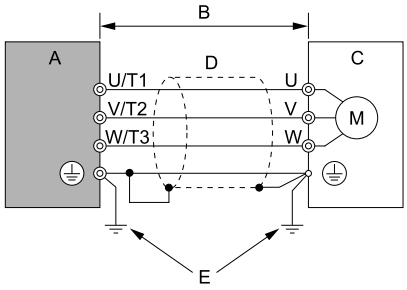
This product (model: 2xxxA, 4xxxA) must meet conditions in this section to comply with EN 61800-3:2004 +A1:2012.

Connect an EMC noise filter to the input side (primary side) that complies with European standards as specified by Yaskawa. Refer to *External EMC Noise Filter Selection on page 271* to select the correct EMC noise filter.

Use this procedure to install an EMC noise filter to make machinery and devices added to the drive comply with the EMC Directive.

1. Install the drive and EMC noise filter on the same grounded metal plate.
2. Wire the drive and motor.

3. Ground the wire shielding in the drive side and motor side.



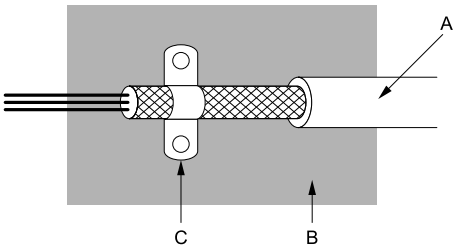
A - Drive Series
B - 10 m (32.8 ft.) maximum
C - Motor
D - Metal conduit
E - Grounding wire

Figure 4.15 Wiring the Drive and Motor

Note:
- Use a braided shield cable for the drive and motor wiring or put the wires through a metal conduit.
- The maximum wiring length between the drive and motor is 10 m (32.8 ft.). Keep the cable between the drive and motor as short as possible.
- Keep the grounding wire as short as possible.

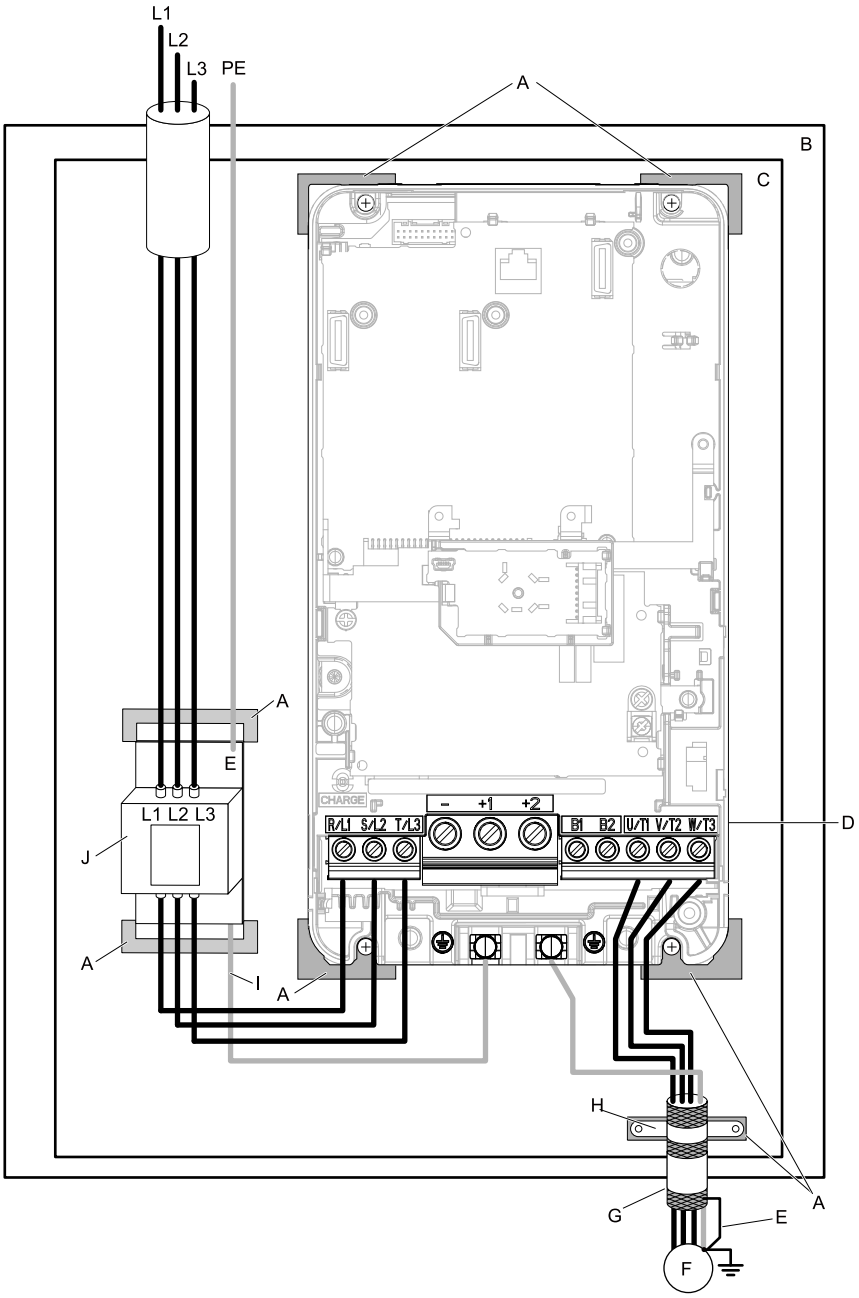
4. Use a cable clamp to ground the motor cable to the metal plate.

Note:
Make sure that the protective ground wire complies with technical specifications and local safety standards.



A - Braided shield cable
B - Metal plate
C - Cable clamp (conductive)

Figure 4.16 Ground the shield



A - Grounding surface (Remove any paint or sealant.)
B - Enclosure panel
C - Metal plate
D - Drive Series
E - Ground the shield.
F - Motor
G - Motor cable (Braided shield cable: max. 10 m (32.8 ft.))
H - Cable clamp
I - Grounding wire
J - EMC noise filter

Figure 4.17 EMC Noise Filter and Drive Installation Procedure

5. Connect the DC reactor to decrease harmonic distortion. Refer to *DC Reactor on page 272* to select a DC reactor.

Note:
- To maintain compliance with IEC/EN 61000-3-2 on drive models 2003, 2005, 4002, 4003, install a DC reactor.
- The main circuit terminal block for the drive, and the terminal blocks for the DC reactor come in different shapes. The drive has a European style terminal block, and the DC reactor has a round terminal block. Correctly prepare the ends of the wiring.

Ground Wiring

WARNING! *Electrical Shock Hazard. Do not remove covers or touch circuit boards while the drive is energized. If you touch the internal components of an energized drive, it can cause serious injury or death.*

WARNING! *Electrical Shock Hazard. Ground the neutral point on the power supply of drive models 2xxxB/C and 4xxxB/C to comply with the EMC Directive before you turn on the EMC filter. If you turn ON the EMC filter, but you do not ground the neutral point, it can cause serious injury or death.*

External EMC Noise Filter Selection

Table 4.11 External EMC Noise Filter (2xxxA)

Model	EMC Noise Filter Model	Quantity	Manufacturer
2003A	RTEN-5006	1	TDK
2005A	RTEN-5010	1	TDK
2008A	RTEN-5020	1	TDK
2011A	RTEN-5020	1	TDK
2014A	RTEN-5030	1	TDK
2018A	RTEN-5030	1	TDK
2025A	RTEN-5060	1	TDK
2033A	RTEN-5060	1	TDK
2047A	RTEN-5080	1	TDK
2060A	FS5972-100-35	1	Schaffner
2075A	FS5972-100-35	1	Schaffner
2088A	FS5972-170-40	1	Schaffner
2115A	FS5972-170-40	1	Schaffner
2145A	FS5972-170-40	1	Schaffner
2180A	FS5972-250-37	1	Schaffner
2215A	FS5972-410-99	1	Schaffner
2283A	FS5972-410-99	1	Schaffner
2346A	FS5972-410-99	1	Schaffner
2415A	FS5972-600-99	1	Schaffner

Table 4.12 External EMC Noise Filter (4xxxA)

Model	EMC Noise Filter Model	Quantity	Manufacturer
4002A	B84143A0010R106	1	TDK
4003A	B84143A0010R106	1	TDK
4005A	B84143A0010R106	1	TDK
4006A	B84143A0010R106	1	TDK
4007A	B84143A0020R106	1	TDK
4009A	B84143A0020R106	1	TDK
4015A	B84143A0035R106	1	TDK
4018A	B84143A0035R106	1	TDK
4024A	B84143A0050R106	1	TDK
4031A	B84143A0065R106	1	TDK
4039A	B84143A0065R106	1	TDK
4045A	B84143A0065R106	1	TDK
4060A	B84143A0080R106	1	TDK
4075A	FS5972-100-35	1	Schaffner
4091A	FS5972-170-40	1	Schaffner
4112A	FS5972-170-40	1	Schaffner
4150A	FS5972-170-40	1	Schaffner
4180A	FS5972-250-37	1	Schaffner
4216A	FS5972-250-37	1	Schaffner
4260A	FS5972-410-99	1	Schaffner
4304A	FS5972-410-99	1	Schaffner
4371A	FS5972-410-99	1	Schaffner
4414A	FS5972-600-99	1	Schaffner

Model	EMC Noise Filter Model	Quantity	Manufacturer
4453A	FS5972-600-99	1	Schaffner
4605A	FS5972-410-99	2	Schaffner

■ DC Reactor

Install the DC reactor listed in Table 4.13 for drive models 2003, 2005, 4002, 4003 to comply with IEC/EN 61000-3-2.

Table 4.13 DC Reactors for Harmonic Suppression

Drive Model	DC Reactor Manufacturer: Yaskawa Electric Corporation	
	Model	Rating
2003	UZDA-B	5.4 A, 8 mH
2005	UZDA-B	5.4 A, 8 mH
4002	UZDA-B	3.2 A, 28 mH
4003	UZDA-B	3.2 A, 28 mH

4.3 UL Standards

Figure 4.18 UL/cUL Mark

The UL/cUL Mark indicates that this product satisfies stringent safety standards. This mark appears on products in the United States and Canada. It shows UL approval, indicating that it has been determined that the product complies with safety standards after undergoing strict inspection and assessment.
You must use UL Listed or UL Recognized parts for all primary components that are built into electrical equipment that has UL approval.

This product has been tested in accordance with UL standard UL61800-5-1, and has been verified to be in compliance with UL standards.

Machines and devices integrated with this product must satisfy the following conditions for compliance with UL standards.

◆ Area of Use

Install this product in a location with Overvoltage Category III and pollution degree 2 or less as specified in UL61800-5-1.

■ Ambient Temperature Setting

Maintain the ambient temperature within the following ranges according to the enclosure type.

- IP20/UL Type 1: -10 °C to +40 °C (14 °F to 104 °F)
- IP20/UL Open Type: -10 °C to +50 °C (14 °F to 122 °F)

◆ Wiring to the Main Circuit Terminal

Wire the main circuit terminal block correctly in accordance with the instructions in the manual.

Be sure to use UL approved closed-loop crimp terminals for drive models 2346 to 2415 and 4304 to 4605 to maintain compliance with the UL standard. Use the tools recommend by the terminal manufacturer to crimp the closed-loop crimp terminal. Refer to *Closed-Loop Crimp Terminals on page 284* for details about closed-loop crimp terminal (UL compliant products).

Refer to *Three-Phase 200 V Class on page 275* and *Three-Phase 400 V Class on page 279* to select wire gauge.

Read the following instructions before wiring the terminal block.

■ Notes on Wiring the Main Circuit Terminal Block

- Use copper wire. Do not use alumnium or other non-copper wire.
- Remove all unwanted objects that are near the terminal block connections.
- Remove the insulation from the connection wires to the wire stripping lengths shown in the manual.
- Do not use bent or crushed wires. Remove the damaged end of the wire before you use it.
- Do not solder stranded wire.
- If you use stranded wire, make sure that all of the wire strands are in the connection. Also, do not twist the stranded wire too much.
- Put the wire all the way into the terminal block. Remove the insulation from the wire to the recommended wire stripping length to fit the wire with insulation in the plastic housing.
- The tightening torque is different for different terminals. Tighten the screws to the specified tightening torque.
- Use a torque driver, torque ratchet, or torque wrench for the screws. A slotted driver or a hex tool will be necessary to wire the screw clamp terminal. Use applicable tools as specified by the recommended conditions in the product manual.
- If you use power tools to tighten the terminal screws, use a low speed setting (300 to 400 r/min).
- Users can purchase wiring tools from Yaskawa. Contact Yaskawa or your nearest sales representative for more information.

- Wire gauges on existing drive models to be replaced may not match wire gauge ranges on new drives. Contact Yaskawa or your nearest sales representative for wire gauges that you can and cannot use.
- Do not tighten the terminal screws at an angle of 5 degrees or more.

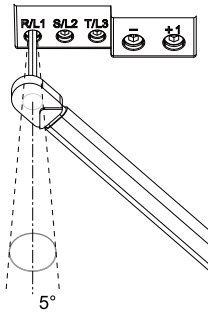


Figure 4.19 Permitted Angle

- Put the bit all the way into the hex socket to tighten the hex socket cap screw.
- When tightening straight-edge screws, hold the tip of the screwdriver in the center of the screw head. Do not let the tip of the screwdriver slip out from the groove of the screw.

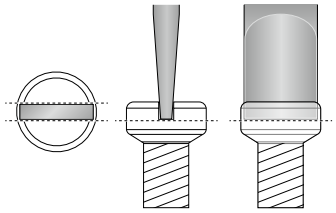
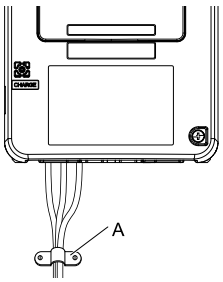


Figure 4.20 Tightening Slotted Screws

- After you connect the wires to the terminal block, lightly pull on the wires to make sure that they do not come out of the terminals.
- Remove the correct section of the wiring cover to make wiring easier.
- Regularly tighten loose terminal block screws to their specified tightening torques.
- Do not let strain on the wiring cause damage. Use a strain relief near the wiring to release the tension. Refer to Figure 4.21 for an example.



A - Strain relief

Figure 4.21 Strain Relief Example

Table 4.14 Recommended Wiring Tools

Screw Size	Screw Shape	Adapter	Bit		Torque Driver Model (Tightening Torque)	Torque Wrench
			Model	Manufacturer		
M4	Slotted (-)	Bit	SF-BIT-SL 1,0X4,0-70	PHOENIX CONTACT	TSD-M 3NM (1.2 - 3 N·m (10.6 - 26.6 lbf·in))	-
M5 *1*	Slotted (-)	Bit	SF-BIT-SL 1,2X6,5-70	PHOENIX CONTACT	Wire Gauge ≤ 25 mm² (AWG 10): TSD-M 3NM (1.2 - 3 N·m (10.6 - 26.6 lbf·in))	Wire Gauge ≤ 25 mm² (AWG 10): -
					Wire Gauge ≥ 30 mm² (AWG 8): -	Wire Gauge ≥ 30 mm² (AWG 8): 4.1 - 4.5 N·m (36.3 - 39.8 lbf·in) *2* *3*

Screw Size	Screw Shape	Adapter	Bit		Torque Driver Model (Tightening Torque)	Torque Wrench
			Model	Manufacturer		
M6	Hex socket cap (WAF: 5 mm)	Bit	SF-BIT-HEX 5-50	PHOENIX CONTACT	-	5 - 9 N·m (44.3 - 79.9 lbf·in) *2 *3
	Minus (-)	Bit	SF-BIT-SL 1,2X6,5-70	PHOENIX CONTACT	-	3 - 3.5 N·m (26.6 - 31.0 lbf·in) *2 *3
M8	Hex socket cap (WAF: 6 mm)	Bit	SF-BIT-HEX 6-50	PHOENIX CONTACT	-	8 - 12 N·m (70.8 - 106.2 lbf·in) *2 *3
M10	Hex socket cap (WAF: 8 mm)	Bit	SF-BIT-HEX 8-50	PHOENIX CONTACT	-	12 - 14 N·m (106.2 - 123.9 lbf·in) *2 *3

*1 When wiring drive models 2047, 4075, and smaller, select the correct tools for the wire gauge.
*2 Use 6.35 mm (0.25 in) bit socket holder.
*3 Use a torque wrench that can apply this torque measurement range.

■ Wire Gauges and Tightening Torques

Refer to *Three-Phase 200 V Class on page 275* and *Three-Phase 400 V Class on page 279* for the recommended wire gauges and tightening torques of the main circuit terminals.

Comply with local standards concerning appropriate wire gauges in the region where the drive is used.

Note:

- The recommended wire gauges based on drive continuous current ratings using 75 °C (167 °F) 600 V class 2 heat resistant indoor PVC wire. Assume the following usage conditions:
  - –Ambient temperature: 40 °C (104 °F) or lower
  - –Wiring distance: 100 m (3281 ft.) or shorter
  - –Rated current value
- Use terminals +1, +2, +3, -, B1, and B2 to connect peripheral options such as a DC reactor or a braking resistor. Do not connect anything other than optional devices.
- Refer to the specific instruction manual of each device for wire gauges when connecting peripheral devices or options to terminals +1, +2, +3, -, B1, and B2. Contact Yaskawa or your nearest sales representative if the recommended wire gauges for the peripheral devices or options are out of the range of the applicable gauge for the drive.
- Use UL approved closed-loop crimp terminals on the drive main circuit terminals in drive models 2215 to 2415 and 4180 to 4605. Use the tools recommend by the terminal manufacturer to ensure that the terminals are correctly fastened.

Three-Phase 200 V Class

Table 4.15 Main Circuit Wire Gauges and Tightening Torques (200 V Class)

Model	Terminal	Recomm. Gauge AWG, kcmil	Applicable Gauge (IP20 Applicable Gauge *1) AWG, kcmil	Wire Stripping Length *2 mm	Terminal Screw		Tightening Torque N·m (lbf·in)
					Terminal Screw Size	Shape	
2003	R/L1, S/L2, T/L3	14	14 - 6 (14 - 6)	10	M4	Slotted (-)	1.5 - 1.7 (13.5 - 15)
	U/T1, V/T2, W/T3	14	14 - 6 (14 - 6)	10	M4	Slotted (-)	1.5 - 1.7 (13.5 - 15)
	-, +1, +2	14	14 - 3 (14 - 3)	18	M5	Slotted (-)	2.3 - 2.5 (19.8 - 22) *3
	B1, B2	14	14 - 10 (14 - 10)	10	M4	Slotted (-)	1.5 - 1.7 (13.5 - 15)
	⏚	10	14 - 8 (-)	-	M4	Phillips/slotted combo	1.2 - 1.5 (10.6 - 13.3)
2005	R/L1, S/L2, T/L3	14	14 - 6 (14 - 6)	10	M4	Slotted (-)	1.5 - 1.7 (13.5 - 15)
	U/T1, V/T2, W/T3	14	14 - 6 (14 - 6)	10	M4	Slotted (-)	1.5 - 1.7 (13.5 - 15)
	-, +1, +2	14	14 - 3 (14 - 3)	18	M5	Slotted (-)	2.3 - 2.5 (19.8 - 22) *3
	B1, B2	14	14 - 10 (14 - 10)	10	M4	Slotted (-)	1.5 - 1.7 (13.5 - 15)
	⏚	10	14 - 8 (-)	-	M4	Phillips/slotted combo	1.2 - 1.5 (10.6 - 13.3)

Model	Terminal	Recomm. Gauge AWG, kcmil	Applicable Gauge (IP20 Applicable Gauge *1) AWG, kcmil	Wire Stripping Length *2 mm	Terminal Screw		Tightening Torque N·m (lbf·in)
					Terminal Screw Size	Shape	
2008	R/L1, S/L2, T/L3	12	14 - 6 (14 - 6)	10	M4	Slotted (-)	1.5 - 1.7 (13.5 - 15)
	U/T1, V/T2, W/T3	14	14 - 6 (14 - 6)	10	M4	Slotted (-)	1.5 - 1.7 (13.5 - 15)
	-, +1, +2	12	14 - 3 (14 - 3)	18	M5	Slotted (-)	2.3 - 2.5 (19.8 - 22) *3
	B1, B2	14	14 - 10 (14 - 10)	10	M4	Slotted (-)	1.5 - 1.7 (13.5 - 15)
	⏚	10	14 - 8 (-)	-	M4	Phillips/slotted combo	1.2 - 1.5 (10.6 - 13.3)
2011	R/L1, S/L2, T/L3	10	14 - 6 (14 - 6)	10	M4	Slotted (-)	1.5 - 1.7 (13.5 - 15)
	U/T1, V/T2, W/T3	12	14 - 6 (14 - 6)	10	M4	Slotted (-)	1.5 - 1.7 (13.5 - 15)
	-, +1, +2	10	14 - 3 (14 - 3)	18	M5	Slotted (-)	2.3 - 2.5 (19.8 - 22) *3
	B1, B2	14	14 - 10 (14 - 10)	10	M4	Slotted (-)	1.5 - 1.7 (13.5 - 15)
	⏚	10	14 - 8 (-)	-	M4	Phillips/slotted combo	1.2 - 1.5 (10.6 - 13.3)
2014	R/L1, S/L2, T/L3	10	14 - 6 (14 - 6)	10	M4	Slotted (-)	1.5 - 1.7 (13.5 - 15)
	U/T1, V/T2, W/T3	10	14 - 6 (14 - 6)	10	M4	Slotted (-)	1.5 - 1.7 (13.5 - 15)
	-, +1, +2	8	14 - 3 (14 - 3)	18	M5	Slotted (-)	2.3 - 2.5 (19.8 - 22) *3
	B1, B2	14	14 - 10 (14 - 10)	10	M4	Slotted (-)	1.5 - 1.7 (13.5 - 15)
	⏚	10	14 - 8 (-)	-	M4	Phillips/slotted combo	1.2 - 1.5 (10.6 - 13.3)
2018	R/L1, S/L2, T/L3	8	14 - 6 (14 - 6)	10	M4	Slotted (-)	1.5 - 1.7 (13.5 - 15)
	U/T1, V/T2, W/T3	10	14 - 6 (14 - 6)	10	M4	Slotted (-)	1.5 - 1.7 (13.5 - 15)
	-, +1, +2	8	14 - 3 (14 - 3)	18	M5	Slotted (-)	2.3 - 2.5 (19.8 - 22) *3
	B1, B2	14	14 - 10 (14 - 10)	10	M4	Slotted (-)	1.5 - 1.7 (13.5 - 15)
	⏚	10	12 - 8 (-)	-	M4	Phillips/slotted combo	1.2 - 1.5 (10.6 - 13.3)
2025	R/L1, S/L2, T/L3	6	14 - 6 (14 - 6)	10	M4	Slotted (-)	1.5 - 1.7 (13.5 - 15)
	U/T1, V/T2, W/T3	8	14 - 6 (14 - 6)	10	M4	Slotted (-)	1.5 - 1.7 (13.5 - 15)
	-, +1, +2	6	14 - 3 (14 - 3)	18	M5	Slotted (-)	2.3 - 2.5 (19.8 - 22) *3
	B1, B2	12	14 - 10 (14 - 10)	10	M4	Slotted (-)	1.5 - 1.7 (13.5 - 15)
	⏚	8	10 - 8 (-)	-	M5	Phillips/slotted combo	2.0 - 2.5 (17.7 - 22.1)

Model	Terminal	Recomm. Gauge AWG, kcmil	Applicable Gauge (IP20 Applicable Gauge *1) AWG, kcmil	Wire Stripping Length *2 mm	Terminal Screw		Tightening Torque N·m (lbf·in)
					Terminal Screw Size	Shape	
2033	R/L1, S/L2, T/L3	6	14 - 6 (14 - 6)	10	M4	Slotted (-)	1.5 - 1.7 (13.5 - 15)
	U/T1, V/T2, W/T3	6	14 - 6 (14 - 6)	10	M4	Slotted (-)	1.5 - 1.7 (13.5 - 15)
	-, +1, +2	3	14 - 3 (14 - 3)	18	M5	Slotted (-)	2.3 - 2.5 (19.8 - 22) *3
	B1, B2	10	14 - 10 (14 - 10)	10	M4	Slotted (-)	1.5 - 1.7 (13.5 - 15)
	⏚	8	10 - 8 (-)	-	M5	Phillips/slotted combo	2.0 - 2.5 (17.7 - 22.1)
2047	R/L1, S/L2, T/L3	3	14 - 3 (8 - 3)	18	M5	Slotted (-)	2.3 - 2.5 (19.8 - 22) *3
	U/T1, V/T2, W/T3	4	14 - 4 (10 - 4)	18	M5	Slotted (-)	2.3 - 2.5 (19.8 - 22) *3
	-, +1, +2	1	14 - 1 (8 - 1)	20	M6	Hex socket cap (WAF: 5 mm)	5 - 5.5 (45 - 49)
	B1, B2	8	14 - 8 (14 - 8)	10	M4	Slotted (-)	1.5 - 1.7 (13.5 - 15)
	⏚	6	8 - 6 (-)	-	M6	Phillips/slotted combo	5.4 - 6.0 (47.8 - 53.1)
2060	R/L1, S/L2, T/L3	1	14 - 1 (6 - 1)	20	M6	Hex socket cap (WAF: 5 mm)	5 - 5.5 (45 - 49)
	U/T1, V/T2, W/T3	3	14 - 3 (6 - 3)	20	M6	Hex socket cap (WAF: 5 mm)	5 - 5.5 (45 - 49)
	-, +1, +2	1/0	14 - 1/0 (4 - 1/0)	20	M6	Hex socket cap (WAF: 5 mm)	5 - 5.5 (45 - 49)
	B1, B2	8	14 - 8 (14 - 8)	10	M4	Slotted (-)	1.5 - 1.7 (13.5 - 15)
	⏚	6	6 - 4 (-)	-	M6	Phillips/slotted combo	5.4 - 6.0 (47.8 - 53.1)
2075	R/L1, S/L2, T/L3	1/0	14 - 1/0 (6 - 1/0)	20	M6	Hex socket cap (WAF: 5 mm)	5 - 5.5 (45 - 49)
	U/T1, V/T2, W/T3	2	14 - 2 (6 - 2)	20	M6	Hex socket cap (WAF: 5 mm)	5 - 5.5 (45 - 49)
	-, +1, +2	2/0	14 - 2/0 (4 - 2/0)	20	M6	Hex socket cap (WAF: 5 mm)	5 - 5.5 (45 - 49)
	B1, B2	6	14 - 6 (14 - 6)	10	M4	Slotted (-)	1.5 - 1.7 (13.5 - 15)
	⏚	6	6 - 4 (-)	-	M6	Phillips/slotted combo	5.4 - 6.0 (47.8 - 53.1)
2088	R/L1, S/L2, T/L3	1/0	6 - 1/0 (6 - 1/0)	27	M6	Hex socket cap (WAF: 5 mm)	8 - 9 (71 - 80)
	U/T1, V/T2, W/T3	1/0	6 - 1/0 (6 - 1/0)	27	M6	Hex socket cap (WAF: 5 mm)	8 - 9 (71 - 80)
	-, +1	2/0	2 - 2/0 (2 - 2/0)	27	M8	Hex socket cap (WAF: 6 mm)	10 - 12 (89 - 107)
	B1, B2	4	14 - 4 (10 - 4)	21	M6	Slotted (-)	3 - 3.5 (27 - 31)
	⏚	6	6 - 4 (-)	-	M6	Hex bolt (+)	5.4 - 6.0 (47.8 - 53.1)

Model	Terminal	Recomm. Gauge AWG, kcmil	Applicable Gauge (IP20 Applicable Gauge *1) AWG, kcmil	Wire Stripping Length *2 mm	Terminal Screw		Tightening Torque N·m (lbf·in)
					Terminal Screw Size	Shape	
2115	R/L1, S/L2, T/L3	2/0	6 - 2/0 (2 - 2/0)	27	M6	Hex socket cap (WAF: 5 mm)	8 - 9 (71 - 80)
	U/T1, V/T2, W/T3	2/0	6 - 2/0 (2 - 2/0)	27	M6	Hex socket cap (WAF: 5 mm)	8 - 9 (71 - 80)
	-, +1	4/0	2 - 4/0 (2 - 4/0)	27	M8	Hex socket cap (WAF: 6 mm)	10 - 12 (89 - 107)
	B1, B2	3	14 - 3 (10 - 3)	21	M6	Slotted (-)	3 - 3.5 (27 - 31)
	⏚	4	4 (-)	-	M6	Hex bolt (+)	5.4 - 6.0 (47.8 - 53.1)
2145	R/L1, S/L2, T/L3	4/0	2 - 250 (2/0 - 250)	37	M10	Hex socket cap (WAF: 8 mm)	12 - 14 (107 - 124)
	U/T1, V/T2, W/T3	4/0	2 - 300 (3/0 - 300)	37	M10	Hex socket cap (WAF: 8 mm)	12 - 14 (107 - 124)
	-, -, +1, +1 *4 *5	1	6 - 2/0 (1/0 - 2/0)	28	M6	Hex socket cap (WAF: 5 mm)	8 - 9 (71 - 80)
	+3 *5	1/0	4 - 2/0 (1 - 2/0)	28	M8	Hex socket cap (WAF: 6 mm)	8 - 9 (71 - 80)
	⏚	4	4 - 1/0 (-)	-	M8	Hex bolt (slotted)	9.0 - 11 (79.7 - 97.4)
2180	R/L1, S/L2, T/L3	250	2 - 250 (2/0 - 250)	37	M10	Hex socket cap (WAF: 8 mm)	12 - 14 (107 - 124)
	U/T1, V/T2, W/T3	300	2 - 300 (3/0 - 300)	37	M10	Hex socket cap (WAF: 8 mm)	12 - 14 (107 - 124)
	-, -, +1, +1 *4 *5	2/0	6 - 2/0 (1/0 - 2/0)	28	M6	Hex socket cap (WAF: 5 mm)	8 - 9 (71 - 80)
	+3 *5	2/0	4 - 2/0 (1 - 2/0)	28	M8	Hex socket cap (WAF: 6 mm)	8 - 9 (71 - 80)
	⏚	4	4 - 1/0 (-)	-	M8	Hex bolt (slotted)	9.0 - 11 (79.7 - 97.4)
2215	R/L1, S/L2, T/L3	2/0 × 2P	3 - 4/0 × 2P (2/0 - 4/0 × 2P)	-	M10	Hex self-locking nut	20 (177)
	U/T1, V/T2, W/T3	2/0 × 2P	3 - 4/0 × 2P (2/0 - 4/0 × 2P)	-	M10	Hex self-locking nut	20 (177)
	-, +1	4/0 × 2P	2 - 250 × 2P (4/0 - 250 × 2P)	-	M10	Hex self-locking nut	20 (177)
	+3	1/0 × 2P	4 - 1/0 × 2P (1/0 × 2P)	-	M10	Hex self-locking nut	20 (177)
	⏚	3	3 - 350 (-)	-	M10	Hex bolt (slotted)	18 - 23 (159 - 204)
2283	R/L1, S/L2, T/L3	4/0 × 2P	3 - 4/0 × 2P (2/0 - 4/0 × 2P)	-	M10	Hex self-locking nut	20 (177)
	U/T1, V/T2, W/T3	3/0 × 2P	3 - 4/0 × 2P (2/0 - 4/0 × 2P)	-	M10	Hex self-locking nut	20 (177)
	-, +1	250 × 2P	2 - 250 × 2P (4/0 - 250 × 2P)	-	M10	Hex self-locking nut	20 (177)
	+3	1/0 × 2P	4 - 1/0 × 2P (1/0 × 2P)	-	M10	Hex self-locking nut	20 (177)
	⏚	2	2 - 350 (-)	-	M10	Hex bolt (slotted)	18 - 23 (159 - 204)

Model	Terminal	Recomm. Gauge AWG, kcmil	Applicable Gauge (IP20 Applicable Gauge *1) AWG, kcmil	Wire Stripping Length *2 mm	Terminal Screw		Tightening Torque N·m (lbf·in)
					Terminal Screw Size	Shape	
2346	R/L1, S/L2, T/L3	250 × 2P	2/0 - 300 × 2P (250 - 300 × 2P)	-	M12	Hex self-locking nut	35 (310)
	U/T1, V/T2, W/T3	250 × 2P	2/0 - 300 × 2P (250 - 300 × 2P)	-	M12	Hex self-locking nut	35 (310)
	-, +1	350 × 2P	4/0 - 400 × 2P (300 - 400 × 2P)	-	M12	Hex self-locking nut	35 (310)
	+3	3/0 × 2P	1/0 - 4/0 × 2P (-)	-	M12	Hex self-locking nut	35 (310)
	⏚	1	1 - 350 (-)	-	M12	Hex bolt (slotted)	32 - 40 (283 - 354)
2415	R/L1, S/L2, T/L3	250 × 2P	2/0 - 300 × 2P (250 - 300 × 2P)	-	M12	Hex self-locking nut	35 (310)
	U/T1, V/T2, W/T3	300 × 2P	2/0 - 300 × 2P (250 - 300 × 2P)	-	M12	Hex self-locking nut	35 (310)
	-, +1	350 × 2P	4/0 - 400 × 2P (300 - 400 × 2P)	-	M12	Hex self-locking nut	35 (310)
	+3	3/0 × 2P	1/0 - 4/0 × 2P (-)	-	M12	Hex self-locking nut	35 (310)
	⏚	1	1 - 350 (-)	-	M12	Hex bolt (slotted)	32 - 40 (283 - 354)

*1 For IP20 protection, use wires that are in the range of applicable gauges.
*2 Remove insulation from the ends of wires to expose the length of wire shown.
*3 For wire gauges more than AWG 8, tighten to a tightening torque of 4.1 N·m to 4.5 N·m (36 lbf·in to 40 lbf·in).
*4 Terminals - and +1 have two screws. The Recommended Gauge is the wire gauge for one terminal.
*5 A junction terminal is necessary to connect a braking unit (CDBR-series) to terminals - and +3.

Three-Phase 400 V Class

Table 4.16 Main Circuit Wire Gauges and Tightening Torques (400 V Class)

Model	Terminal	Recomm. Gauge AWG, kcmil	Applicable Gauge (IP20 Applicable Gauge *1) AWG, kcmil	Wire Stripping Length *2 mm	Terminal Screw		Tightening Torque N·m (lbf·in)
					Size	Shape	
4002	R/L1, S/L2, T/L3	14	14 - 6 (14 - 6)	10	M4	Slotted (-)	1.5 - 1.7 (13.5 - 15)
	U/T1, V/T2, W/T3	14	14 - 6 (14 - 6)	10	M4	Slotted (-)	1.5 - 1.7 (13.5 - 15)
	-, +1, +2	14	14 - 3 (14 - 3)	18	M5	Slotted (-)	2.3 - 2.5 (19.8 - 22) *3
	B1, B2	14	14 - 10 (14 - 10)	10	M4	Slotted (-)	1.5 - 1.7 (13.5 - 15)
	⏚	12	14 - 8 (-)	-	M4	Phillips/slotted combo	1.2 - 1.5 (10.6 - 13.3)
4003	R/L1, S/L2, T/L3	14	14 - 6 (14 - 6)	10	M4	Slotted (-)	1.5 - 1.7 (13.5 - 15)
	U/T1, V/T2, W/T3	14	14 - 6 (14 - 6)	10	M4	Slotted (-)	1.5 - 1.7 (13.5 - 15)
	-, +1, +2	14	14 - 3 (14 - 3)	18	M5	Slotted (-)	2.3 - 2.5 (19.8 - 22) *3
	B1, B2	14	14 - 10 (14 - 10)	10	M4	Slotted (-)	1.5 - 1.7 (13.5 - 15)
	⏚	12	14 - 8 (-)	-	M4	Phillips/slotted combo	1.2 - 1.5 (10.6 - 13.3)

Model	Terminal	Recomm. Gauge AWG, kcmil	Applicable Gauge (IP20 Applicable Gauge *1) AWG, kcmil	Wire Stripping Length *2 mm	Terminal Screw		Tightening Torque N·m (lbf·in)
					Size	Shape	
4005	R/L1, S/L2, T/L3	14	14 - 6 (14 - 6)	10	M4	Slotted (-)	1.5 - 1.7 (13.5 - 15)
	U/T1, V/T2, W/T3	14	14 - 6 (14 - 6)	10	M4	Slotted (-)	1.5 - 1.7 (13.5 - 15)
	-, +1, +2	14	14 - 3 (14 - 3)	18	M5	Slotted (-)	2.3 - 2.5 (19.8 - 22) *3
	B1, B2	14	14 - 10 (14 - 10)	10	M4	Slotted (-)	1.5 - 1.7 (13.5 - 15)
	⏚	10	14 - 8 (-)	-	M4	Phillips/slotted combo	1.2 - 1.5 (10.6 - 13.3)
4006	R/L1, S/L2, T/L3	14	14 - 6 (14 - 6)	10	M4	Slotted (-)	1.5 - 1.7 (13.5 - 15)
	U/T1, V/T2, W/T3	14	14 - 6 (14 - 6)	10	M4	Slotted (-)	1.5 - 1.7 (13.5 - 15)
	-, +1, +2	14	14 - 3 (14 - 3)	18	M5	Slotted (-)	2.3 - 2.5 (19.8 - 22) *3
	B1, B2	14	14 - 10 (14 - 10)	10	M4	Slotted (-)	1.5 - 1.7 (13.5 - 15)
	⏚	10	14 - 8 (-)	-	M4	Phillips/slotted combo	1.2 - 1.5 (10.6 - 13.3)
4007	R/L1, S/L2, T/L3	14	14 - 6 (14 - 6)	10	M4	Slotted (-)	1.5 - 1.7 (13.5 - 15)
	U/T1, V/T2, W/T3	14	14 - 6 (14 - 6)	10	M4	Slotted (-)	1.5 - 1.7 (13.5 - 15)
	-, +1, +2	12	14 - 3 (14 - 3)	18	M5	Slotted (-)	2.3 - 2.5 (19.8 - 22) *3
	B1, B2	14	14 - 10 (14 - 10)	10	M4	Slotted (-)	1.5 - 1.7 (13.5 - 15)
	⏚	10	14 - 8 (-)	-	M4	Phillips/slotted combo	1.2 - 1.5 (10.6 - 13.3)
4009	R/L1, S/L2, T/L3	12	14 - 6 (14 - 6)	10	M4	Slotted (-)	1.5 - 1.7 (13.5 - 15)
	U/T1, V/T2, W/T3	14	14 - 6 (14 - 6)	10	M4	Slotted (-)	1.5 - 1.7 (13.5 - 15)
	-, +1, +2	10	14 - 3 (14 - 3)	18	M5	Slotted (-)	2.3 - 2.5 (19.8 - 22) *3
	B1, B2	14	14 - 10 (14 - 10)	10	M4	Slotted (-)	1.5 - 1.7 (13.5 - 15)
	⏚	10	14 - 8 (-)	-	M4	Phillips/slotted combo	1.2 - 1.5 (10.6 - 13.3)
4015	R/L1, S/L2, T/L3	10	14 - 6 (14 - 6)	10	M4	Slotted (-)	1.5 - 1.7 (13.5 - 15)
	U/T1, V/T2, W/T3	10	14 - 6 (14 - 6)	10	M4	Slotted (-)	1.5 - 1.7 (13.5 - 15)
	-, +1, +2	8	14 - 3 (14 - 3)	18	M5	Slotted (-)	2.3 - 2.5 (19.8 - 22) *3
	B1, B2	14	14 - 10 (14 - 10)	10	M4	Slotted (-)	1.5 - 1.7 (13.5 - 15)
	⏚	10	14 - 8 (-)	-	M5	Phillips/slotted combo	2.0 - 2.5 (17.7 - 22.1)

Model	Terminal	Recomm. Gauge AWG, kcmil	Applicable Gauge (IP20 Applicable Gauge *1) AWG, kcmil	Wire Stripping Length *2 mm	Terminal Screw		Tightening Torque N·m (lbf·in)
					Size	Shape	
4018	R/L1, S/L2, T/L3	8	14 - 6 (14 - 6)	10	M4	Slotted (-)	1.5 - 1.7 (13.5 - 15)
	U/T1, V/T2, W/T3	10	14 - 6 (14 - 6)	10	M4	Slotted (-)	1.5 - 1.7 (13.5 - 15)
	-, +1, +2	8	14 - 3 (14 - 3)	18	M5	Slotted (-)	2.3 - 2.5 (19.8 - 22) *3
	B1, B2	12	14 - 10 (14 - 10)	10	M4	Slotted (-)	1.5 - 1.7 (13.5 - 15)
	⏚	10	12 - 8 (-)	-	M5	Phillips/slotted combo	2.0 - 2.5 (17.7 - 22.1)
4024	R/L1, S/L2, T/L3	6	14 - 3 (8 - 3)	18	M5	Slotted (-)	2.3 - 2.5 (19.8 - 22) *3
	U/T1, V/T2, W/T3	8	14 - 4 (10 - 4)	18	M5	Slotted (-)	2.3 - 2.5 (19.8 - 22) *3
	-, +1, +2	6	14 - 1 (8 - 1)	20	M6	Hex socket cap (WAF: 5 mm)	5 - 5.5 (45 - 49)
	B1, B2	10	14 - 8 (14 - 8)	10	M4	Slotted (-)	1.5 - 1.7 (13.5 - 15)
	⏚	8	10 - 6 (-)	-	M6	Phillips/slotted combo	5.4 - 6.0 (47.8 - 53.1)
4031	R/L1, S/L2, T/L3	6	14 - 3 (8 - 3)	18	M5	Slotted (-)	2.3 - 2.5 (19.8 - 22) *3
	U/T1, V/T2, W/T3	8	14 - 4 (10 - 4)	18	M5	Slotted (-)	2.3 - 2.5 (19.8 - 22) *3
	-, +1, +2	4	14 - 1 (8 - 1)	20	M6	Hex socket cap (WAF: 5 mm)	5 - 5.5 (45 - 49)
	B1, B2	10	14 - 8 (14 - 8)	10	M4	Slotted (-)	1.5 - 1.7 (13.5 - 15)
	⏚	6	10 - 6 (-)	-	M6	Phillips/slotted combo	5.4 - 6.0 (47.8 - 53.1)
4039	R/L1, S/L2, T/L3	4	14 - 4 (10 - 4)	18	M5	Slotted (-)	2.3 - 2.5 (19.8 - 22) *3
	U/T1, V/T2, W/T3	6	14 - 6 (10 - 6)	18	M5	Slotted (-)	2.3 - 2.5 (19.8 - 22) *3
	-, +1, +2	3	14 - 3 (10 - 3)	18	M5	Slotted (-)	2.3 - 2.5 (19.8 - 22) *3
	B1, B2	8	14 - 8 (14 - 8)	10	M4	Slotted (-)	1.5 - 1.7 (13.5 - 15)
	⏚	6	8 - 4 (-)	-	M6	Phillips/slotted combo	5.4 - 6.0 (47.8 - 53.1)
4045	R/L1, S/L2, T/L3	4	14 - 4 (10 - 4)	18	M5	Slotted (-)	2.3 - 2.5 (19.8 - 22) *3
	U/T1, V/T2, W/T3	4	14 - 4 (10 - 4)	18	M5	Slotted (-)	2.3 - 2.5 (19.8 - 22) *3
	-, +1	3	14 - 3 (10 - 3)	18	M5	Slotted (-)	2.3 - 2.5 (19.8 - 22) *3
	B1, B2	8	14 - 8 (14 - 8)	10	M4	Slotted (-)	1.5 - 1.7 (13.5 - 15)
	⏚	6	8 - 4 (-)	-	M6	Phillips/slotted combo	5.4 - 6.0 (47.8 - 53.1)

Model	Terminal	Recomm. Gauge AWG, kcmil	Applicable Gauge (IP20 Applicable Gauge *1) AWG, kcmil	Wire Stripping Length *2 mm	Terminal Screw		Tightening Torque N·m (lbf·in)
					Size	Shape	
4060	R/L1, S/L2, T/L3	3	14 - 3 (12 - 3)	18	M5	Slotted (-)	2.3 - 2.5 (19.8 - 22) *3
	U/T1, V/T2, W/T3	3	14 - 3 (12 - 3)	18	M5	Slotted (-)	2.3 - 2.5 (19.8 - 22) *3
	-, +1	2	14 - 2 (10 - 2)	18	M5	Slotted (-)	2.3 - 2.5 (19.8 - 22) *3
	B1, B2	6	14 - 6 (14 - 6)	10	M4	Slotted (-)	1.5 - 1.7 (13.5 - 15)
	⏚	6	6 - 4 (-)	-	M6	Hex bolt (+)	5.4 - 6.0 (47.8 - 53.1)
4075	R/L1, S/L2, T/L3	2	14 - 2 (10 - 2)	18	M5	Slotted (-)	2.3 - 2.5 (19.8 - 22) *3
	U/T1, V/T2, W/T3	2	14 - 2 (10 - 2)	18	M5	Slotted (-)	2.3 - 2.5 (19.8 - 22) *3
	-, +1	1/0	14 - 1/0 (6 - 1/0)	20	M6	Hex socket cap (WAF: 5 mm)	5 - 5.5 (45 - 49)
	B1, B2	6	14 - 6 (14 - 6)	18	M5	Slotted (-)	2.3 - 2.5 (19.8 - 22) *3
	⏚	4	6 - 4 (-)	-	M6	Hex bolt (+)	5.4 - 6.0 (47.8 - 53.1)
4091	R/L1, S/L2, T/L3	1/0	6 - 2/0 (2 - 2/0)	27	M6	Hex socket cap (WAF: 5 mm)	8 - 9 (71 - 80)
	U/T1, V/T2, W/T3	1	6 - 2/0 (2 - 2/0)	27	M6	Hex socket cap (WAF: 5 mm)	8 - 9 (71 - 80)
	-, +1	2/0	2 - 4/0 (2 - 4/0)	27	M8	Hex socket cap (WAF: 6 mm)	10 - 12 (89 - 107)
	B1, B2	3	14 - 3 (10 - 3)	21	M6	Slotted (-)	3 - 3.5 (27 - 31)
	⏚	4	6 - 4 (-)	-	M6	Hex bolt (+)	5.4 - 6.0 (47.8 - 53.1)
4112	R/L1, S/L2, T/L3	3/0	2 - 250 (2/0 - 250)	37	M10	Hex socket cap (WAF: 8 mm)	12 - 14 (107 - 124)
	U/T1, V/T2, W/T3	2/0	2 - 300 (3/0 - 300)	37	M10	Hex socket cap (WAF: 8 mm)	12 - 14 (107 - 124)
	-, -, +1, +1 *4	2	6 - 2/0 (1/0 - 2/0)	28	M6	Hex socket cap (WAF: 5 mm)	8 - 9 (71 - 80)
	B1, B2 *5	1	4 - 2/0 (1 - 2/0)	28	M8	Hex socket cap (WAF: 6 mm)	8 - 9 (71 - 80)
	⏚	4	4 - 1/0 (-)	-	M8	Hex bolt (slotted)	9.0 - 11 (79.7 - 97.4)
4150	R/L1, S/L2, T/L3	4/0	2 - 250 (2/0 - 250)	37	M10	Hex socket cap (WAF: 8 mm)	12 - 14 (107 - 124)
	U/T1, V/T2, W/T3	4/0	2 - 300 (3/0 - 300)	37	M10	Hex socket cap (WAF: 8 mm)	12 - 14 (107 - 124)
	-, -, +1, +1 *4	1/0	6 - 2/0 (1/0 - 2/0)	28	M6	Hex socket cap (WAF: 5 mm)	8 - 9 (71 - 80)
	B1, B2 *5	1/0	4 - 2/0 (1 - 2/0)	28	M8	Hex socket cap (WAF: 6 mm)	8 - 9 (71 - 80)
	⏚	4	4 - 1/0 (-)	-	M8	Hex bolt (slotted)	9.0 - 11 (79.7 - 97.4)

Model	Terminal	Recomm. Gauge AWG, kcmil	Applicable Gauge (IP20 Applicable Gauge *1) AWG, kcmil	Wire Stripping Length *2 mm	Terminal Screw		Tightening Torque N·m (lbf·in)
					Size	Shape	
4180	R/L1, S/L2, T/L3	1/0 × 2P	3 - 4/0 × 2P (2/0 - 4/0 × 2P)	-	M10	Hex self-locking nut	20 (177)
	U/T1, V/T2, W/T3	1/0 × 2P	3 - 4/0 × 2P (2/0 - 4/0 × 2P)	-	M10	Hex self-locking nut	20 (177)
	-, +1	3/0 × 2P	2 - 250 × 2P (4/0 - 250 × 2P)	-	M10	Hex self-locking nut	20 (177)
	+3	1/0 × 2P	4 - 1/0 × 2P (1/0 × 2P)	-	M10	Hex self-locking nut	20 (177)
	⏚	4	4 - 350 (-)	-	M10	Hex bolt (slotted)	18 - 23 (159 - 204)
4216	R/L1, S/L2, T/L3	2/0 × 2P	3 - 4/0 × 2P (2/0 - 4/0 × 2P)	-	M10	Hex self-locking nut	20 (177)
	U/T1, V/T2, W/T3	2/0 × 2P	3 - 4/0 × 2P (2/0 - 4/0 × 2P)	-	M10	Hex self-locking nut	20 (177)
	-, +1	3/0 × 2P	2 - 250 × 2P (4/0 - 250 × 2P)	-	M10	Hex self-locking nut	20 (177)
	+3	1/0 × 2P	4 - 1/0 × 2P (1/0 × 2P)	-	M10	Hex self-locking nut	20 (177)
	⏚	2	2 - 350 (-)	-	M10	Hex bolt (slotted)	18 - 23 (159 - 204)
4260	R/L1, S/L2, T/L3	3/0 × 2P	3 - 4/0 × 2P (2/0 - 4/0 × 2P)	-	M10	Hex self-locking nut	20 (177)
	U/T1, V/T2, W/T3	3/0 × 2P	3 - 4/0 × 2P (2/0 - 4/0 × 2P)	-	M10	Hex self-locking nut	20 (177)
	-, +1	4/0 × 2P	2 - 250 × 2P (4/0 - 250 × 2P)	-	M10	Hex self-locking nut	20 (177)
	+3	1/0 × 2P	4 - 1/0 × 2P (1/0 × 2P)	-	M10	Hex self-locking nut	20 (177)
	⏚	2	2 - 350 (-)	-	M10	Hex bolt (slotted)	18 - 23 (159 - 204)
4304	R/L1, S/L2, T/L3	250 × 2P	2/0 - 300 × 2P (250 - 300 × 2P)	-	M12	Hex self-locking nut	35 (310)
	U/T1, V/T2, W/T3	250 × 2P	2/0 - 300 × 2P (250 - 300 × 2P)	-	M12	Hex self-locking nut	35 (310)
	-, +1	350 × 2P	4/0 - 400 × 2P (300 - 400 × 2P)	-	M12	Hex self-locking nut	35 (310)
	+3	3/0 × 2P	1 - 4/0 × 2P (-)	-	M12	Hex self-locking nut	35 (310)
	⏚	1	1 - 350 (-)	-	M12	Hex bolt (slotted)	32 - 40 (283 - 354)
4371	R/L1, S/L2, T/L3	300 × 2P	2/0 - 300 × 2P (250 - 300 × 2P)	-	M12	Hex self-locking nut	35 (310)
	U/T1, V/T2, W/T3	300 × 2P	2/0 - 300 × 2P (250 - 300 × 2P)	-	M12	Hex self-locking nut	35 (310)
	-, +1	400 × 2P	4/0 - 400 × 2P (300 - 400 × 2P)	-	M12	Hex self-locking nut	35 (310)
	+3	4/0 × 2P	1 - 4/0 × 2P (-)	-	M12	Hex self-locking nut	35 (310)
	⏚	1	1 - 350 (-)	-	M12	Hex bolt (slotted)	32 - 40 (283 - 354)

Model	Terminal	Recomm. Gauge AWG, kcmil	Applicable Gauge (IP20 Applicable Gauge *1) AWG, kcmil	Wire Stripping Length *2 mm	Terminal Screw		Tightening Torque N·m (lbf·in)
					Size	Shape	
4414	R/L1, S/L2, T/L3, R1/L11, S1/L21, T1/L31	250 × 4P	2/0 - 300 × 4P (250 - 300 × 4P)	-	M12	Hex self-locking nut	35 (310)
	U/T1, V/T2, W/T3	4/0 × 4P	2/0 - 300 × 4P (250 - 300 × 4P)	-	M12	Hex self-locking nut	35 (310)
	-, +1	4/0 × 4P	3/0 - 400 × 4P (300 - 400 × 4P)	-	M12	Hex self-locking nut	35 (310)
	+3	3/0 × 4P	2 - 4/0 (4/0 × 4P)	-	M12	Hex self-locking nut	35 (310)
	⏚	1/0	1/0 - 300 (-)	-	M12	Hex bolt (slotted)	32 - 40 (283 - 354)
4453	R/L1, S/L2, T/L3, R1/L11, S1/L21, T1/L31	250 × 4P	2/0 - 300 × 4P (250 - 300 × 4P)	-	M12	Hex self-locking nut	35 (310)
	U/T1, V/T2, W/T3	4/0 × 4P	2/0 - 300 × 4P (250 - 300 × 4P)	-	M12	Hex self-locking nut	35 (310)
	-, +1	300 × 4P	3/0 - 400 × 4P (300 - 400 × 4P)	-	M12	Hex self-locking nut	35 (310)
	+3	3/0 × 4P	2 - 4/0 × 4P (4/0 × 4P)	-	M12	Hex self-locking nut	35 (310)
	⏚	2/0	2/0 - 300 (-)	-	M12	Hex bolt (slotted)	32 - 40 (283 - 354)
4605	R/L1, S/L2, T/L3, R1/L11, S1/L21, T1/L31	300 × 4P	2/0 - 300 × 4P (250 - 300 × 4P)	-	M12	Hex self-locking nut	35 (310)
	U/T1, V/T2, W/T3	300 × 4P	2/0 - 300 × 4P (250 - 300 × 4P)	-	M12	Hex self-locking nut	35 (310)
	-, +1	400 × 4P	3/0 - 400 × 4P (300 - 400 × 4P)	-	M12	Hex self-locking nut	35 (310)
	+3	4/0 × 4P	2 - 4/0 × 4P (4/0 × 4P)	-	M12	Hex self-locking nut	35 (310)
	⏚	2/0	2/0 - 300 (-)	-	M12	Hex bolt (slotted)	32 - 40 (283 - 354)

*1 For IP20 protection, use wires that are in the range of applicable gauges.
*2 Remove insulation from the ends of wires to expose the length of wire shown.
*3 For wire gauges more than AWG 8, tighten to a tightening torque of 4.1 N·m to 4.5 N·m (36 lbf·in to 40 lbf·in).
*4 Terminals - and +1 have two screws. The Recommended Gauge is the wire gauge for one terminal.
*5 A junction terminal is necessary to connect a braking resistor unit (LKEB-series) to terminals B1 and B2.

■ Closed-Loop Crimp Terminals

To comply with UL standards on drive models 2215 to 2415 and 4180 to 4605, use UL-approved closed-loop crimp terminals. Use the tools recommend by the terminal manufacturer to crimp the closed-loop crimp terminal. Yaskawa recommends closed-loop crimp terminals from JST Mfg. Co., Ltd. and insulation caps from Tokyo DIP Co., Ltd. Contact Yaskawa or your nearest sales representative to make an order.

Refer to Table 4.17 to select crimp terminals as specified by drive model and wire gauge.

Note:

To comply with UL standards, use only insulated crimp terminals or crimp terminals with insulation tubing. Use UL-Listed, vinyl-coated insulated copper wires for operation with a continuous maximum permitted temperature of 75 °C at 600 V.

Table 4.17 Closed-Loop Crimp Terminals and Insulation Caps

Model	Recomm. Gauge (AWG, kcmil)					Terminal Screw Size	Crimp Terminal Model	Crimping Tool		Insulation Cap Model
	R/L1, S/L2, T/L3	U/T1, V/T2, W/T3	-, +1	+3	⏚			Tool Model	Die Jaw	
2003 - 2018	-	-	-	-	10	M4	R5.5-4	YA-4	AD-900	TP-005
2025, 2033	-	-	-	-	8	M5	R8-5	YA-4	AD-901	TP-008
2047	-	-	-	-	6	M6	R14-6	YA-4	AD-902	TP-014
2060 - 2088	-	-	-	-	6	M6	R14-6	YA-4	AD-902	TP-014
2115	-	-	-	-	4	M6	R22-6	YA-5	AD-953	TP-022

Model	Recomm. Gauge (AWG, kcmil)					Terminal Screw Size	Crimp Terminal Model	Crimping Tool		Insulation Cap Model
	R/L1, S/L2, T/L3	U/T1, V/T2, W/T3	-, +1	+3	⏚			Tool Model	Die Jaw	
2145, 2180	-	-	-	-	4	M8	R22-8	YA-5	AD-953	TP-022
2215	-	-	-	-	-	M10	R38-10	YF-1 YET-150-1	TD-224, TD-212	TP-038
	-	-	-	1/0 × 2P	-		R60-10		TD-225, TD-213	TP-060
	2/0 × 2P	2/0 × 2P	-	-	-		80-10		TD-227, TD-214	TP-080
	-	-	4/0 × 2P	-	-		R100-10		TD-228, TD-214	TP-100
2283	-	-	-	-	2	M10	R38-10	YF-1 YET-150-1	TD-224, TD-212	TP-038
	-	-	-	1/0 × 2P	-		R60-10		TD-225, TD-213	TP-060
	-	3/0 × 2P	-	-	-		80-10		TD-227, TD-214	TP-080
	4/0 × 2P	-	-	-	-		R100-10		TD-228, TD-214	TP-100
	-	-	250 × 2P	-	-		R150-10		TD-229, TD-215	TP-150
2346	-	-	-	-	1	M12	R60-12	YF-1 YET-300-1	TD-321, TD-311	TP-060
	-	-	-	3/0 × 2P	-		80-10		TD-323, TD-312	TP-080
	250 × 2P	250 × 2P	-	-	-		R150-10		TD-325, TD-313	TP-150
	-	-	350 × 2P	-	-		R200-10		TD-327, TD-314	TP-200
2415	-	-	-	-	1	M12	R60-10	YF-1 YET-300-1	TD-321, TD-311	TP-060
	-	-	-	3/0 × 2P	-		80-10		TD-323, TD-312	TP-080
	250 × 2P	-	-	-	-		R150-10		TD-325, TD-313	TP-150
	-	300 × 2P								
	-	-	350 × 2P	-	-		R200-10		TD-327, TD-314	TP-200
4002, 4003	-	-	-	-	12	M4	R5.5-4	YA-4	AD-900	TP-005
4005 - 4009	-	-	-	-	10	M4	R5.5-4	YA-4	AD-900	TP-005
4015, 4018	-	-	-	-	10	M5	R5.5-5	YA-4	AD-900	TP-005
4024	-	-	-	-	8	M6	R8-6	YA-4	AD-901	TP-008
4031	-	-	-	-	6	M6	R14-6	YA-4	AD-902	TP-014
4039, 4045	-	-	-	-	6	M6	R14-6	YA-4	AD-902	TP-014
4060	-	-	-	-	6	M6	R14-6	YA-4	AD-902	TP-014
4075, 4091	-	-	-	-	4	M6	R22-6	YA-5	AD-953	TP-022
4112, 4150	-	-	-	-	4	M8	R22-8	YA-5	AD-953	TP-022
4180	-	-	-	-	4	M10	R22-10	YF-1 YET-150-1	TD-223, TD-212	TP-022
	1/0 × 2P	1/0 × 2P	-	1/0 × 2P	-		R60-10		TD-225, TD-213	TP-060
	-	-	3/0 × 2P	-	-		80-10		TD-227, TD-214	TP-080
4216	-	-	-	-	2	M10	R38-10	YF-1 YET-150-1	TD-224, TD-212	TP-038
	-	-	-	1/0 × 2P	-		R60-10		TD-225, TD-213	TP-060
	2/0 × 2P	2/0 × 2P	-	-	-		80-10		TD-227, TD-214	TP-080
	-	-	3/0 × 2P							

Model	Recomm. Gauge (AWG, kcmil)					Terminal Screw Size	Crimp Terminal Model	Crimping Tool		Insulation Cap Model
	R/L1, S/L2, T/L3	U/T1, V/T2, W/T3	-, +1	+3	⏚			Tool Model	Die Jaw	
4260	-	-	-	-	2	M10	R38-10	YF-1 YET-150-1	TD-224, TD-212	TP-038
	-	-	-	1/0 × 2P	-		R60-10		TD-225, TD-213	TP-060
	3/0 × 2P	3/0 × 2P	-	-	-		80-10		TD-227, TD-214	TP-080
	-	-	4/0 × 2P	-	-		R100-10		TD-228, TD-214	TP-100
4304	-	-	-	-	1	M12	R60-12	YF-1 YET-300-1	TD-321, TD-311	TP-060
	-	-	-	3/0 × 2P	-		80-12		TD-323, TD-312	TP-080
	250 × 2P	250 × 2P	-	-	-		R150-12		TD-325, TD-313	TP-150
	-	-	350 × 2P	-	-		R200-12		TD-327, TD-314	TP-200
4371	-	-	-	-	1	M12	R60-12	YF-1 YET-300-1	TD-321, TD-311	TP-060
	-	-	-	4/0 × 2P	-		R100-12		TD-324, TD-312	TP-100
	300 × 2P	300 × 2P	-	-	-		R150-12		TD-325, TD-313	TP-150
	-	-	400 × 2P	-	-		R200-12		TD-327, TD-314	TP-200
4414	-	-	-	-	1/0	M12	R60-12	YF-1 YET-300-1	TD-321, TD-311	TP-060
	-	-	-	3/0 × 4P	-		80-12		TD-323, TD-312	TP-080
	-	4/0 × 4P	4/0 × 4P	-	-		R100-12		TD-324, TD-312	TP-100
	250 × 4P	-	-	-	-		R150-12		TD-325, TD-313	TP-150
4453	-	-	-	-	2/0	M12	80-12	YF-1 YET-300-1	TD-323, TD-312	TP-080
				3/0 × 4P	-					
	-	4/0 × 4P	-	-	-		R100-12		TD-324, TD-312	TP-100
	250 × 4P	-	-	-	-		R150-12		TD-325, TD-313	TP-150
	-		300 × 4P							
4605	-	-	-	-	2/0	M12	80-12	YF-1 YET-300-1	TD-323, TD-312	TP-080
	-	-	-	4/0 × 4P	-		R100-12		TD-324, TD-312	TP-100
	300 × 4P	300 × 4P	-	-	-		R150-12		TD-325, TD-313	TP-150
	-	-	400 × 4P	-	-		R200-12		TD-327, TD-314	TP-200

*1 Contact Yaskawa or your nearest sales representative for more information.

■ Factory-Recommended Branch Circuit Protection

Use branch circuit protection to protect against short circuits and to maintain compliance with UL61800-5-1. Yaskawa recommends connecting semiconductor protection fuses on the input side for branch circuit protection. Refer to Table 4.18 to Table 4.19for the recommended fuses.

WARNING! *Electrical Shock Hazard. After the drive blows a fuse or trips an RCM/RCD, do not immediately energize the drive or operate peripheral devices. Wait for the time specified on the warning label at a minimum and make sure that all indicators are OFF. Then check the wiring and peripheral device ratings to find the cause of the problem. If you do not know the cause of the problem, contact Yaskawa before you energize the drive or peripheral devices. If you do not fix the problem before you operate the drive or peripheral devices, it can cause serious injury or death.*

- 200 V Class
  Use the fuses specified in this document to prepare the drive for use on a circuit that supplies not more than 100,000 RMS and not more than 240 Vac when there is a short circuit in the power supply.
- 400 V Class

Use the fuses specified in this document to prepare the drive for use on a circuit that supplies not more than 100,000 RMS and not more than 480 Vac when there is a short circuit in the power supply.

The built-in short circuit protection of the drive does not provide branch circuit protection. The user must provide branch circuit protection as specified by the National Electric (NEC), the Canadian Electric Code, Part I (CEC), and local codes.

Three-Phase 200 V Class

Table 4.18 Factory-Recommended Branch Circuit Protection

Drive Model	Maximum Applicable Motor Output kW (HP)	Input Current Rating A	Semiconductor Protection Fuse Rated Current Manufacturer: EATON/Bussmann
2003	0.55 (0.5)	3.6	FWH-45B
2005	0.75 (1)	4.8	FWH-45B
2008	1.5 (2)	8.9	FWH-45B
2011	2.2 (3)	12.7	FWH-50B
2014	3.0 (4)	17	FWH-80B
2018	4.0 (5)	20.7	FWH-80B
2025	5.5 (7.5)	30	FWH-125B
2033	7.5 (10)	40.3	FWH-150B
2047	11 (15)	58.2	FWH-200B
2060	15 (20)	78.4	FWH-225A
2075	18.5 (25)	96	FWH-225A FWH-250A *1
2088	22 (30)	82	FWH-225A FWH-250A *1
2115	30 (40)	111	FWH-275A FWH-300A *1
2145	37 (50)	136	FWH-275A FWH-350A *1
2180	45 (60)	164	FWH-325A FWH-450A *1
2215	55 (75)	200	FWH-600A
2283	75 (100)	271	FWH-800A
2346	90 (125)	324	FWH-1000A
2415	110 (150)	394	FWH-1400A

*1 Yaskawa recommends a fuse with a large rated current for applications with repeated loads.

Three-Phase 400 V Class

Table 4.19 Factory-Recommended Branch Circuit Protection

Drive Model	Maximum Applicable Motor Output kW (HP)	Input Current Rating A	Semiconductor Protection Fuse Rated Current Manufacturer: EATON/Bussmann
4002	0.55 (0.75)	1.9	FWH-50B
4003	1.1 (1)	3.5	FWH-50B
4005	1.5 (2)	4.7	FWH-50B
4006	2.2 (3)	6.7	FWH-60B
4007	3.0 (4)	8.9	FWH-60B
4009	4.0 (5)	11.7	FWH-60B
4015	5.5 (7.5)	15.8	FWH-80B
4018	7.5 (10)	21.2	FWH-90B
4024	11 (15)	30.6	FWH-150B
4031	15 (20)	41.3	FWH-200B
4039	18.5 (25)	50.5	FWH-200B
4045	22 (30)	43.1	FWH-225A

Drive Model	Maximum Applicable Motor Output kW (HP)	Input Current Rating A	Semiconductor Protection Fuse Rated Current Manufacturer: EATON/Bussmann
4060	30 (40)	58.3	FWH-250A
4075	37 (50)	71.5	FWH-275A
4091	45 (60)	86.5	FWH-275A
4112	55 (75)	105	FWH-300A
4150	75 (100)	142	FWH-325A FWH-400A *1
4180	90 (125)	170	FWH-500A
4216	110 (150)	207	FWH-600A
4260	132 (175)	248	FWH-700A
4304	160 (200)	300	FWH-800A
4371	200 (250)	373	FWH-1000A
4414	220 (300)	410	FWH-1200A
4453	250 (335)	465	FWH-1200A
4605	315 (400)	584	FWH-1400A FWH-1600A *1

*1 Yaskawa recommends a fuse with a large rated current for applications with repeated loads.

◆ Low Voltage Wiring for Control Circuit Terminals

Low voltage wiring must be provided in accordance with the NEC (National Electric Code), the CEC (Canadian Electric Code, Part I), and any additional local codes. The NEC class 1 circuit conductor is recommended. Use the UL approved class 2 power supply for external power supply.

Table 4.20 Power Supply Used for Control Circuit Terminals

Input/Output	Terminal Sign	Power Supply Specifications
Digital inputs	S1 to S10, SN, SC, SP	The LVLC power supply in the drive is used. Use the UL approved class 2 power supply for external power supply.
Analog input	A1 to A3, AC, +V, -V	The LVLC power supply in the drive is used. Use the UL approved class 2 power supply for external power supply.
Analog output	FM, AM, AC	The LVLC power supply in the drive is used.
Safe disable Input	H1, H2, HC	The LVLC power supply in the drive is used. Use the UL approved class 2 power supply for external power supply.
Open-collector output	P1, C1, P2, C2	Use the UL approved class 2 power supply.
Serial communication input/output	D+, D-, AC	The LVLC power supply in the drive is used. Use the UL approved class 2 power supply for external power supply.
24 V external power supply	PS, AC	Use the UL approved class 2 power supply.

◆ Drive Motor Overload and Overheat Protection

The drive motor overload and overheat protection function complies with the NEC (National Electric Code) and the CEC (Canadian Electric Code, Part I).

Set the *Motor Rated Current* and *L1-01 to L1-04 [Motor Overload Protection Select]* properly to enable motor overload and overheat protection.

Set the motor rated current with *E2-01 [Motor Rated Current (FLA)]*.

■ E2-01: Motor Rated Current (FLA)

No. (Hex.)	Name	Description	Default (Range)
E2-01 (030E)	Motor Rated Current (FLA)	V/f CL-V/f OLV CLV AOLV Sets the motor rated current in amps.	Determined by o2-04 (10% to 200% of the drive rated current)

Note:
- If parameter *E2-01 < E2-03 [Motor No-Load Current]* is set, *oPE02 [Parameter Range Setting Error]* will be detected.
- The units for the default setting and setting range vary depending on the model of the drive.
  – 2003 to 2033, 4002 to 4018: 0.01 A units
  – 2047 to 2415, 4024 to 4605: 0.1 A units

The value set for *E2-01* becomes the reference value for motor protection and the torque limit. Enter the motor rated current as shown on the motor nameplate. The value of *E2-01* is automatically set to the value input for "Motor Rated Current" by the Auto-Tuning process.

■ L1-01: Motor Overload (oL1) Protection

No. (Hex.)	Name	Description	Default (Range)
L1-01 (0480)	Motor Overload (oL1) Protection	V/f CL-V/f OLV CLV AOLV Sets the motor overload protection with electronic thermal protectors.	Determined by A1-02 (0 - 3, 6)

Parameter *L1-01* enables and disables the motor overload protection with electronic thermal protectors.

The cooling capability of the motor changes when the speed control range of the motor changes. Use an electronic thermal protector that aligns with the permitted load characteristics of the motor to select motor protection.

The electronic thermal protector of the drive uses Output current, Output frequency, Motor thermal characteristics, and Time characteristics to calculate motor overload tolerance and supply overload protection for the motor. If the drive detects motor overload, the drive will trigger an *oL1 [Motor Overload]* and stop the drive output.

You can set a motor overload alarm. Set *H2-02 = 1F [Term M3-M4 Function Selection = Motor Overload Alarm (oL1)]* to enable this function. If the motor overload level is more than 90% of the *oL1* detection level, the output terminal activates and triggers an overload alarm.

Note:

When you connect only one motor to a drive, set *L1-01 = 1 to 3 or 6 [Enabled]*. External thermal relays are not necessary in these conditions.

0 : Disable

Disable motor protection when motor overload protection is not necessary or when the drive is operating more than one motor.

Refer to the figure for an example of the circuit configuration to connect more than one motor to one drive.

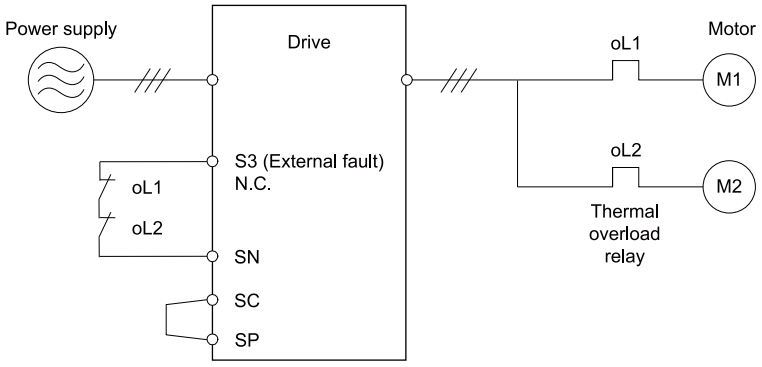


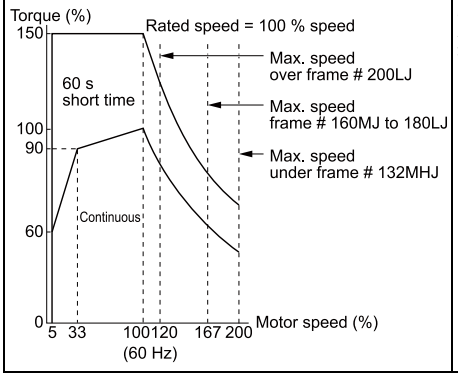
Figure 4.22 Protection Circuit Configuration to Connect More than One Motor to One Drive

NOTICE: *When you connect more than one motor to one drive or when the motor amp rating is higher than the drive amp rating, set L1-01 =0 [Motor Overload (oL1) Protection = Disabled] and install thermal overload relays for each motor. The electronic thermal protection of the drive will not function and it can cause damage to the motor.*

1 : Variable Torque

Use this setting for general-purpose motors with a 60 Hz base frequency.

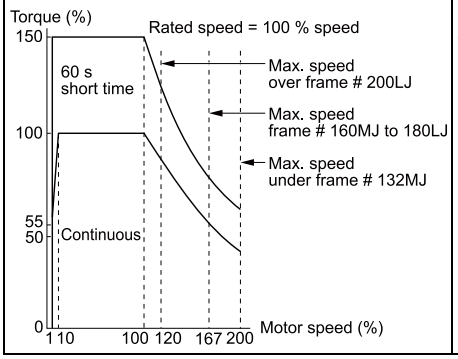
The overload tolerance decreases as Run decreases because the cooling fan speed decreases and the ability of the motor to cool decreases in the low speed range. The overload tolerance characteristics of the motor change the trigger point for the electronic thermal protector. This provides motor overheat protection from low speed to high speed across the full speed range.

Load Tolerance	Cooling Capability	Overload Characteristics (at 100% motor load)
	This motor is designed to operate with commercial line power. Operate at a 60 Hz base frequency to maximize the motor cooling ability.	If the motor operates at frequencies less than 60 Hz, the drive will detect *oL1*. The drive triggers a fault relay output and the motor coasts to stop.

2 : Constant Torque 10:1 Speed Range

Use this setting for drive-dedicated motors with a speed range for constant torque of 1:10.

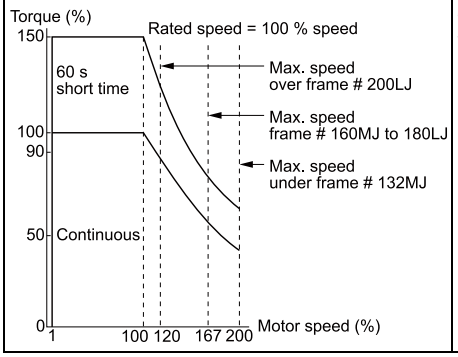
The speed control for this motor is 10% to 100% when at 100% load. Operating slower than 10% speed at 100% load will cause motor overload.

Load Tolerance	Cooling Capability	Overload Characteristics (at 100% motor load)
	This motor is designed to withstand increased temperatures during continuous operation in the low speed range (10% base frequency).	The motor operates continuously at 10% to 100% base frequency.

3 : Constant Torque 100:1 SpeedRange

Use this setting for vector motors with a speed range for constant torque of 1:100.

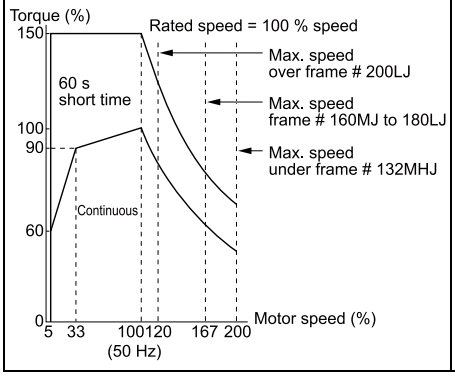
The speed control for this motor is 1% to 100% when at 100% load. Operating slower than 1% speed at 100% load will cause motor overload.

Load Tolerance	Cooling Capability	Overload Characteristics (at 100% motor load)
	This motor is designed to withstand increased temperatures during continuous operation in the more low speed range (1% base frequency).	The motor operates continuously at 1% to 100% base frequency. Operating slower than 1% speed at 100% load will cause motor overload.

6 : Variable Torque (50Hz)

Use this setting for general-purpose motors with a 50 Hz base frequency.

The overload tolerance decreases as Run decreases because the cooling fan speed decreases and the ability of the motor to cool decreases in the low speed range. The overload tolerance characteristics of the motor change the trigger point for the electronic thermal protector. This provides motor overheat protection from low speed to high speed across the full speed range.

Load Tolerance	Cooling Capability	Overload Characteristics (at 100% motor load)
	This motor is designed to operate with commercial line power. Operate at a 50 Hz base frequency to maximize the motor cooling ability.	If the motor operates at frequencies less than commercial line power, the drive will detect *oL1*. The drive triggers a fault relay output and the motor coasts to stop.

■ L1-02: Motor Overload Protection Time

No. (Hex.)	Name	Description	Default (Range)
L1-02 (0481)	Motor Overload Protection Time	V/f CL-V/f OLV CLV AOLV Sets the operation time for the electronic thermal protector of the drive to prevent damage to the motor. Usually it is not necessary to change this setting.	1.0 min (0.1 - 5.0 min)

Set the overload tolerance time to the length of time that the motor can operate at 150% load from continuous operation at 100% load.

When the motor operates at 150% load continuously for 1 minute after continuous operation at 100% load (hot start), the default setting triggers the electronic thermal protector.

Figure 4.23 shows an example of the electronic thermal protector operation time. Motor overload protection operates in the range between a cold start and a hot start.

This example shows a general-purpose motor operating at the base frequency with *L1-02* set to 1.0 min.

- Cold start
  Shows the motor protection operation time characteristics when the overload occurs immediately after starting operation from a complete stop.
- Hot start
  Shows the motor protection operation time characteristics when overload occurs from continuous operation below the motor rated current.

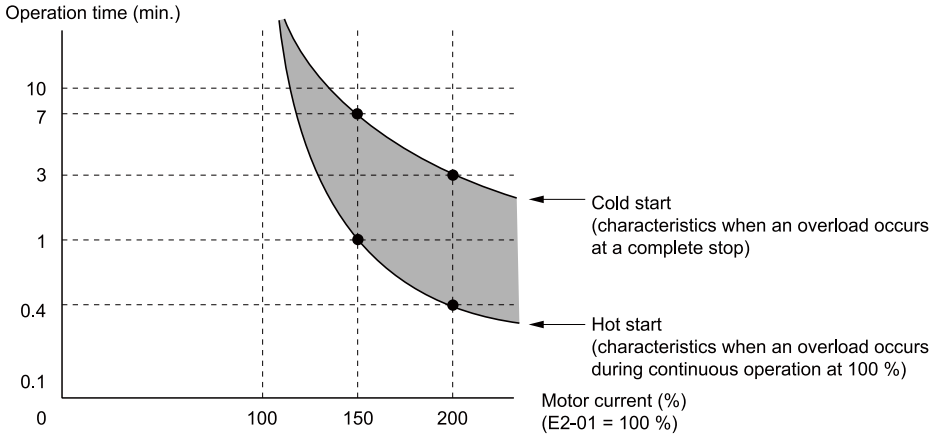


Figure 4.23 Protection Operation Time for a General-purpose Motor at Rated Output Frequency

■ L1-03: Motor Thermistor oH Alarm Select

No. (Hex.)	Name	Description	Default (Range)
L1-03 (0482)	Motor Thermistor oH Alarm Select	V/f CL-V/f OLV CLV AOLV Sets the drive operation when the PTC input signal to the drive is at the *oH3 [Motor Overheat (PTC Input)]* detection level.	3 (0 - 3)

0 : Ramp to Stop

The drive ramps the motor to stop according to the deceleration time. Fault relay output terminal MA-MC will turn ON, and MB-MC will turn OFF.

1 : Coast to Stop

The drive output shuts off and the motor coasts to stop. Fault relay output terminal MA-MC will turn ON, and MB-MC will turn OFF.

2 : Fast Stop (Use C1-09)

The drive stops the motor using the deceleration time set in *C1-09 [Fast Stop Time]*. Fault relay output terminal MA-MC will turn ON, and MB-MC will turn OFF.

3 : Alarm Only

oH3 appears on the keypad, and operation continues. The output terminal set for *Alarm [H2-01 to H2-05 = 10]* switches ON.

■ L1-04: Motor Thermistor oH Fault Select

No. (Hex.)	Name	Description	Default (Range)
L1-04 (0483)	Motor Thermistor oH Fault Select	V/f CL-V/f OLV CLV AOLV Sets the drive operation when the PTC input signal to the drive is at the *oH4 [Motor Overheat Fault (PTC Input)]* detection level.	1 (0 - 2)

0 : Ramp to Stop

The drive ramps the motor to stop in the deceleration time. Fault relay output terminal MA-MC turns ON, and MB-MC turns OFF.

1 : Coast to Stop

The output turns OFF and the motor coasts to stop. Fault relay output terminal MA-MC turns ON, and MB-MC turns OFF.

2 : Fast Stop (Use C1-09)

The drive stops the motor in the deceleration time set in *C1-09 [Fast Stop Time]*. Fault relay output terminal MA-MC turns ON, and MB-MC turns OFF.

4.4 China RoHS Compliance

Figure 4.24 China RoHS Mark

The China RoHS mark is displayed on products containing six specified hazardous substances that are in excess of regulatory limits, based on the “Administrative Measures for the Restriction of the Use of Hazardous Substances in Electrical and Electronic Products” and “Marking for the Restricted Use of Hazardous Substances in Electronic and Electrical Products” (SJ/T 11364-2014), which were promulgated on January 26, 2016. The number displayed in the center of the mark indicates the environment-friendly use period (number of years) in which electrical and electronic products that are being produced, sold, or imported to China can be used. The date of manufacture of the electrical and electronic product is the starting date of the environment-friendly use period for the product. The six specified hazardous substances contained in the product will not leak outside of the product during normal use within this period and will have no serious impact on the environment, the human body, or property.

The environment-friendly use period for this product is 15 years. This period is not the product warranty period.

◆ Information on Hazardous Substances in This Product

Table 4.21 shows the details on hazardous substances contained in this product.

Table 4.21 Contents of Hazardous Substances in This Product

Parts Name	Hazardous Substances					
	Lead (Pb)	Mercury (Hg)	Cadmium (Cd)	Hexavalent Chromium (Cr(VI))	Polybrominated Biphenyls (PBB)	Polybrominated Diphenyl Ethers (PBDE)
Circuit Board	×	○	○	○	○	○
Electronic Parts	×	○	○	○	○	○
Brass Screw	×	○	○	○	○	○
Aluminum Die Casting	×	○	○	○	○	○

This table has been prepared in accordance with the provisions outlined in SJ/T 11364.

○: Indicates that said hazardous substance contained in all of the homogeneous materials for this part is below or equal to the limit requirement of GB/T 26572.

×: Indicates that said hazardous substance contained in at least one of the homogeneous materials used for this part is above the limit requirement of GB/T 26572.

Note:

This product complies with EU RoHS directives. In this table, "×" indicates that hazardous substances that are exempt from EU RoHS directives are contained.

4.5 对应中国RoHS指令

图 4.25 中国RoHS标志

中国RoHS标志依据2016年1月26日公布的《电器电子产品有害物质限制使用管理办法》，以及《电子电气产品有害物质限制使用标识要求》（SJ/T 11364-2014）作成。电子电气产品中特定6种有害物质的含量超过规定值时，应标识此标志。中间的数字为在中国生产销售以及进口的电子电气产品的环保使用期限（年限）。电子电气产品的环保使用期限从生产日期算起。在期限内，正常使用产品的过程中，不会有特定的6种有害物质外泄进而对环境、人和财产造成深刻影响。

本产品的环保使用期限为15年。但需要注意的是环保使用期限并非产品的质量保证期限。

◆ 本产品中含有有害物质的信息

本产品中所含有害物质的详细信息如表 4.22所示。

表 4.22 本产品中有害物质的名称及含量

部件名称	有害物质					
	铅 (Pb)	汞 (Hg)	镉 (Cd)	六价铬 (Cr(VI))	多溴联苯 (PBB)	多溴二苯醚 (PBDE)
实装基板	×	○	○	○	○	○
电子元件	×	○	○	○	○	○
黄铜螺钉	×	○	○	○	○	○
铝压铸	×	○	○	○	○	○

本表格依据SJ/T 11364的规定编制。
○:表示该有害物质在该部件所有均质材料中的含量均在GB/T 26572规定的限量要求以下。
×:表示该有害物质至少在该部件的某一均质材料中的含量超出GB/T 26572规定的限量要求。
（注） 本产品符合欧盟RoHS指令。上表中的“×”表示含有欧盟RoHS指令豁免的有害物质。

4.6 Safe Disable Input

Figure 4.26 TUV Mark

The TUV mark identifies that the product complies with the safety standards.

This section gives precautions to support the Safe Disable input. Contact Yaskawa for more information.

The safety function complies with the standards shown in Table 4.23.

Table 4.23 Applied Safety Standards and Unified Standards

Safety Standards	Unified Standards
Functional Safety	IEC/EN 61508:2010 (SIL3)
	IEC/EN 62061/A2:2015 (SILCL3)
	IEC/EN 61800-5-2:2007 (SIL3)
Machine Safety	ISO/EN ISO 13849-1:2015 (Cat.3, PL e)
EMC	IEC/EN 61000-6-7:2015, IEC/EN61326-3-1:2008

Note:

SIL = Safety Integrity Level.

◆ Safe Disable Specifications

The Safe Disable input provides the stop function that complies with “Safe Torque Off” as specified by IEC/EN 61800-5-2:2007. The Safe Disable input meets the requirements of EN ISO 13849-1 and IEC/EN 61508. It also has a safety status monitor to detect safety circuit errors.

When you install the drive as a component in a system, you must make sure that the system complies with the applicable safety standards.

Refer to Table 4.24 for safety function specifications.

Table 4.24 Safe Disable Specifications

Item		Description
Input/Output		• Input: 2 Safe Disable input (H1, H2) Signal ON level: 18 Vdc to 28 Vdc Signal OFF level: -4 Vdc to +4 Vdc • Output: 1 MFDO safety monitor output for external device monitor (EDM)
Response time from when the input opens to when the drive output stops		3 ms or less
Response time from when the H1 and H2 terminal inputs open to when the EDM signal operates		20 ms or less
Failure probability	Less frequent operation request mode	PFD = $4.65E^{-6}$
	Frequent operation request mode or continuous mode	PFH = $1.11E^{-9}$
Performance level		The Safe Disable input complies with the performance level requirements of EN ISO 13849-1.
HFT (hardware fault tolerance)		N = 1
Type of subsystem		Type B

Note:

EDM = External Device Monitoring

PFD = Probability of Failure on Demand

PFH = Probability of Dangerous Failure per Hour

◆ Precautions

DANGER! *Sudden Movement Hazard. When you use the Safe Disable function in the safety system of a machine, do a full risk assessment for the system to make sure that all parts of the system comply with applicable safety standards. Incorrect application of the Safe Disable function can cause serious injury or death.*

DANGER! *Sudden Movement Hazard. If the output circuit of the drive is damaged and the Safe Disable function turns OFF the drive output to a permanent magnet (PM) motor, the motor can rotate 180 electrical degrees. Prevent damage to equipment and injury to personnel during this condition. Sudden motor movement can cause serious injury or death. It is possible for current to flow through the motor winding in these conditions.*

DANGER! *Electrical Shock Hazard. You cannot depend on the Safe Disable function to prevent electrical shock. Disconnect all power to the drive and wait for the time specified on the warning label before you remove covers. Check the drive for dangerous voltages before servicing or repair work. If you do work on the drive when it is energized and there is no cover over the electronic circuits, it can cause serious injury or death.*

WARNING! *Sudden Movement Hazard. To use the Safe Disable inputs, remove the jumpers between terminals H1-HC and H2-HC. If the Safe Disable circuit does not work correctly, it can cause serious injury or death.*

WARNING! *Sudden Movement Hazard. Regularly examine the Safe Disable input and all other safety features. A system that does not operate correctly can cause serious injury or death.*

WARNING! *Sudden Movement Hazard. Only let approved personnel who know about the drive, instruction manual, and safety standards wire, examine, and maintain the Safe Disable input. If personnel are not approved, it can cause serious injury or death.*

WARNING! *Sudden Movement Hazard. Do not use the drive output signals to control external holding brakes or dynamic brakes for functional safety. Use a system that conforms to the functional safety requirements. Incorrect application of the Safe Disable function can cause serious injury or death. Systems that use drive output signals (including EDM) for safety are not safe because drive output signals are not safety components.*

WARNING! *Sudden Movement Hazard. Connect the Safe Disable inputs to the devices as specified by the safety requirements. If you connect the Safe Disable inputs incorrectly, it can cause serious injury or death.*

WARNING! *Sudden Movement Hazard. Although the Safe Disable function is in operation, gravity or other external forces in the vertical axis can move the motor. Incorrect application of the Safe Disable function can cause serious injury or death.*

Note:

- When terminals H1 or H2 deactivate, it will be a maximum of 3 ms before the drive will switch to "Safe Torque Off" status. Set the OFF status for terminals H1 and H2 to hold for 2 ms minimum. If terminals H1 and H2 are activated for less than 2 ms, it is possible that the drive will not switch to “Safe Torque Off” status.
- Only use the Safe Disable Monitor (multi-function output terminal set to the EDM function) to monitor the Safe Disable status or to find a malfunction in the Safe Disable inputs. The monitor output is not a safety output.
- Drives that have a built-in safety function must be replaced 10 years after the first use.

◆ Using the Safe Disable Function

■ Safe Disable Circuit

The Safe Disable circuit has two isolated channels (terminals H1 and H2). The input channels block the output transistors. The input can use the internal power supply of the drive.

Set the EDM function to one of the MFDO terminals *[H2-xx = 51 or 151]* to monitor the status of the Safe Disable function. This is the “Safe Disable monitor output function.”

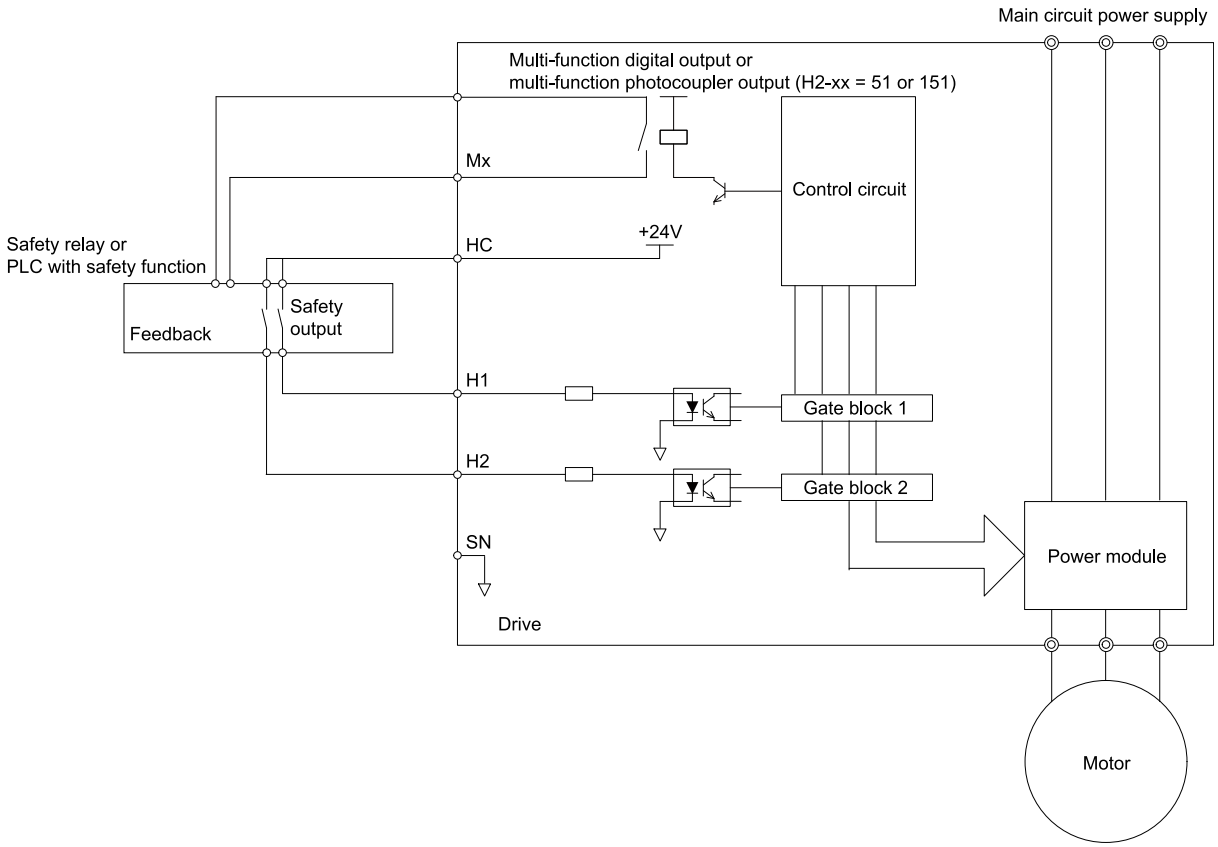


Figure 4.27 Safe Disable Function Wiring Example

■ Enabling and Disabling the Drive Output ("Safe Torque Off")

Refer to Figure 4.28 for an example of drive operation when the drive changes from "Safe Torque Off" status to usual operation.

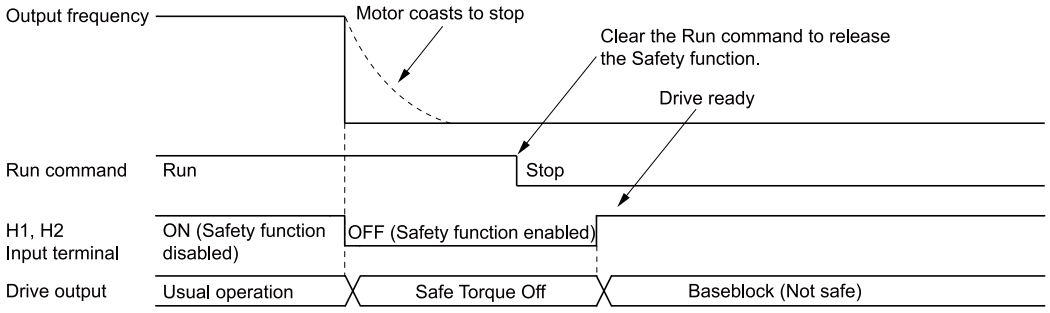


Figure 4.28 Safe Disable Operation

Switching from Usual Operation to "Safe Torque Off"

Turn OFF (open) safety input terminal H1 or H2 to enable the Safe Disable function. When the Safe Disable function is enabled while the motor is operating, the drive output and motor torque turn off and the motor always coasts to stop. The *b1-03 [Stopping Method Selection]* setting does not have an effect on the stopping method.

The "Safe Torque Off" status is only possible with the Safe Disable function. Clear the Run command to stop the drive. Turning off drive output (a baseblock condition) ≠ "Safe Torque Off".

Note:
- When it is necessary to ramp to stop the motor, do not turn off terminals H1 and H2 until the motor fully stops. This will prevent the motor from coasting to stop during usual operation.
- A maximum of 3 ms will elapse from when terminals H1 or H2 shut off until the drive switches to the "Safe Torque Off" status. Set the OFF status for terminals H1 and H2 to hold for at least 3 ms. The drive may not be able to switch to the "Safe Torque Off" status if terminals H1 and H2 are only open for less than 3 ms.

Going from "Safe Torque Off" to Usual Operation

The safety input will only release when there is no Run command.

- During Stop

When the Safe Disable function is triggered during stop, close the circuit between terminals H1-HC and H2-HC to disable “Safe Torque Off”. Enter the Run command after the drive stops correctly.

- During Run
  If you trigger the Safe Disable function during run, clear the Run command, then close the circuit between terminals H1-HC and H2-HC to disable “Safe Torque Off”. Enter the Stop command, then enter the Run command when terminals H1 and H2 are activated.

■ Safe Disable Monitor Output Function and Keypad Display

Refer to Table 4.25 for information about the relation between the input channel status, Safety monitor output status, and drive output status.

Table 4.25 Safe Disable Input and EDM Terminal Status

Input Channel Status		Safety Monitor Output		Drive Output Status	Keypad Display	LED Status Ring
Input 1 (H1 - HC)	Input 2 (H2 - HC)	MFDO Terminal (H2-xx = 51)	MFDO Terminal (H2-xx = 151)			
ON (Close the circuit)	ON (Close the circuit)	OFF	ON	Baseblock (Drive ready)	Normally displayed	Ready: Illuminated
OFF (Open)	ON (Close the circuit)	OFF	ON	Safety status (STo)	SToF (Flashing)	ALM/ERR: Flashing
ON (Close the circuit)	OFF (Open)	OFF	ON	Safety status (STo)	SToF (Flashing)	ALM/ERR: Flashing
OFF (Open)	OFF (Open)	ON	OFF	Safety status (STo)	STo (Flashing)	Ready: Flashing

Safety Function Status Monitor

The drive Safety monitor output sends a feedback signal about the status of the Safety function. The Safety monitor output is one of the possible settings available for the MFDO terminals. If there is damage to the Safe Disable circuit, a controller (PLC or safety relay) must read this signal as an input signal to hold the "Safe Torque Off" status. Refer to the manual for the safety device for more information about the Safety function.

It is possible to switch polarity of the Safety monitor output signal with the MFDO function settings. Refer to Table 4.25 for setting instructions.

Keypad Display

If the two input channels are OFF (Open), the keypad will flash *STo [Safe Torque OFF]*.

The keypad flashes *SToF [Safe Torque OFF Hardware]* when one input channel is OFF (Open), and the other is ON (Close the circuit). This indicates that either the Safe disable circuit or the drive are damaged. When you use the Safe disable circuit correctly, the keypad will not show *SToF*. Refer to the chapter on Troubleshooting for more information.

The keypad will show *SCF [Safety Circuit Fault]* when the drive detects a fault in the Safe disable circuit. This indicates that the drive is damaged. Refer to the chapter on Troubleshooting for more information.

■ Validating the Safe Disable Function

After you replace parts or do maintenance on the drive, first complete all necessary wiring to start the drive, then test the Safe Disable input with these steps. Keep a record of the test results.

1. When the two input channels are OFF (Open), make sure that the keypad flashes *STo [Safe Torque OFF]*, and make sure that the motor is not running.
2. Monitor the ON/OFF status of the input channels and make sure that MFDO set to the EDM function operates as shown in *Safe Disable Monitor Output Function and Keypad Display on page 298*.
   If one or more of the these items are true, the ON/OFF status of the MFDO may not display correctly on the keypad:
   - Incorrect parameter settings.
   - A problem with an external device.
   - The external wiring has a short circuit or is disconnected.
   - There is damage to the device.

   Find the cause and repair the problem to correctly display the status.
3. Make sure that the EDM signal operates during usual operation as shown in *Safe Disable Monitor Output Function and Keypad Display on page 298*.

5

Network Communications

5.1 Section Safety 300
5.2 Field Bus Network Support 301
5.3 MEMOBUS/Modbus Communications 302

5.1 Section Safety

⚠DANGER

Do not ignore the safety messages in this manual.

If you ignore the safety messages in this manual, it will cause serious injury or death. The manufacturer is not responsible for injuries or damage to equipment.

5.2 Field Bus Network Support

The user can control and monitor the drive through the network from the PLC. This product comes standard with a RS-485 interface (MEMOBUS/Modbus communications). If a separately sold communication option is mounted to the drive, it will enable the drive to support various other network communications.

◆ Standard Internal Communication Interfaces

The following communication interfaces are built into this product as standard.

- MEMOBUS/Modbus(RS-485)

◆ Communication Option

The following table lists the field bus networks compatible with this product. Contact Yaskawa or your nearest sales representative to place a communication option order.

Type of Communications	Option Model
CC-Link	SI-C3
MECHATROLINK-II	SI-T3
MECHATROLINK-III	SI-ET3
PROFIBUS-DP	SI-P3
CANopen	SI-S3

Type of Communications	Option Model
DeviceNet	SI-N3
Modbus TCP/IP	SI-EM3
PROFINET	SI-EP3
EtherNet/IP	SI-EN3

5.3 MEMOBUS/Modbus Communications

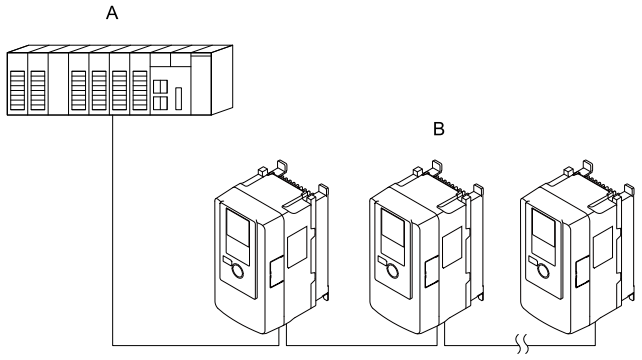
This section gives detailed information about the parameters, error codes and communication procedures for MEMOBUS/Modbus communications.

◆ Configure Master/Slave

You can use the MEMOBUS/Modbus protocol for serial communication with programmable controllers (PLC).

The MEMOBUS/Modbus communication uses one master (PLC) and a maximum of 31 slave drives. Serial communications usually starts with a signal from the master to the slave drives.

A slave drive that receives a command from the master does the specified function and then sends a response back to the master. You must set the address number for each slave drive before you start signal communications to make sure that the master uses the correct address numbers.



A - Master (PLC) **B - Slave (drive)**

Figure 5.1 PLC and Drive Connection Example

◆ Communication Specifications

Table 5.1 lists the specifications for the MEMOBUS/Modbus communications.

Table 5.1 MEMOBUS/Modbus Specifications

Item	Specification
Interface	RS-485
Synchronization method	Asynchronous (start-stop synchronization)
Communication parameter	Communications speed:1.2, 2.4, 4.8, 9.6, 19.2, 38.4, 57.6, 76.8, 115.2 kbps
	Data length: 8 bit (fixed)
	Parity: even, odd, none
	Stop bit 1 bit (fixed)
Communication protocol	MEMOBUS/Modbus standard (RTU mode only)
Number of possible units to connect	Maximum: 31 units

◆ Communication with the PLC

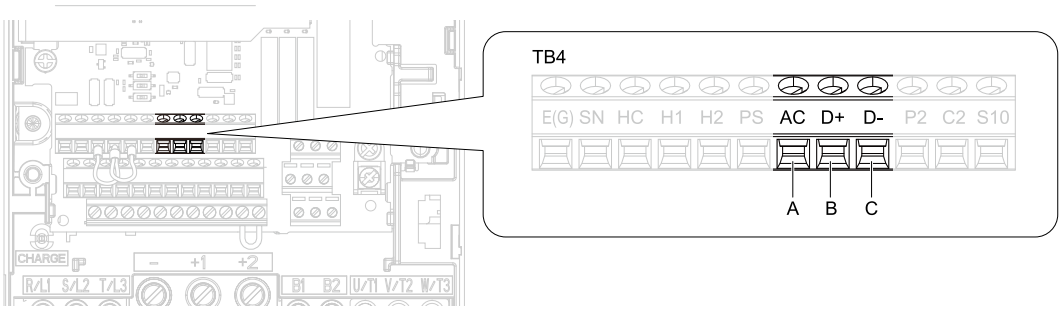
This section gives information about the settings for the termination resistor and how to connect to MEMOBUS/Modbus communications. MEMOBUS/Modbus communications uses an RS-485 interface (2-wire sequence).

■ Connect Communications Cable

This section describes the settings for the termination resistor and how to connect to MEMOBUS/Modbus communications. It operates using RS-485 interface (2-wire seq).

To initiate communication between the PLC and drive, follow the procedure below.

1. Connect the communications cable between the PLC and drive when the drive is de-energized. The connection terminal of the MEMOBUS/Modbus communications cable is TB4.



A - Terminal AC: Shield ground
B - Terminal D+: Communication input/output (+)
C - Terminal D-: Communication input/output (-)

Figure 5.2 Communications Cable Connection Terminal (TB4)

Note:
Separate the communications wiring from the main circuit wiring, other wiring and power lines. Use shielded wires for the communications wiring and connect cable sheaths to the ground terminal of the drive. This prevents malfunction due to noise.

2. Confirm that the termination resistor is installed to the network termination slave. Enable the termination resistor for the drive by setting the DIP switch S2 to the ON position.
3. Turn on the power.
4. Set necessary communications parameters *H5-01 to H5-11* using the keypad.
   - *H5-01 [Drive Node Address]*
   - *H5-02 [Communication Speed Selection]*
   - *H5-03 [Communication Parity Selection]*
   - *H5-04 [Communication Error Stop Method]*
   - *H5-05 [Comm Fault Detection Selection]*
   - *H5-06 [Drive Transmit Wait Time]*
   - *H5-09 [CE Detection Time]*
   - *H5-10 [Modbus Register 0025H Unit Sel]*
   - *H5-11 [Comm ENTER Command Mode]*
5. Shut the power off and wait for the keypad display to go out completely.
6. Turn the power back on.
7. The drive is ready to begin communicating with the PLC.

■ Set the Termination Resistor

In MEMOBUS/Modbus communications, the termination resistor for the drive needs to be enabled on the slave terminal. The termination resistor built in this product can be turned ON and OFF with DIP switch S2 on the terminal block. If the drive is installed in the terminal of the communication line, set DIP switch S2 to ON. Also, confirm that DIP switch S2 is OFF for other drives. Setting the DIP switch S2 as shown in the following drawing. Use the tip of tweezers or a jig with a tip width of 0.8 mm to set the DIP switch.

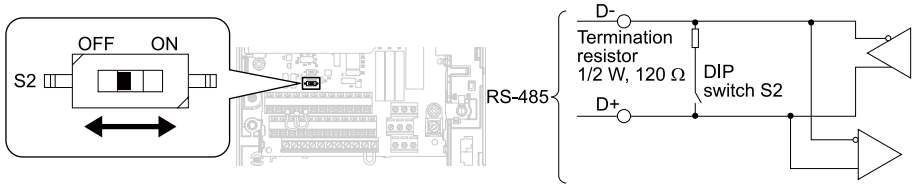


Figure 5.3 MEMOBUS/Modbus Communication Terminal and DIP Switch S2

■ Wiring Diagram for More than One Drive

Figure 5.4 shows how to wire more than one connected drive with using MEMOBUS/Modbus communications.

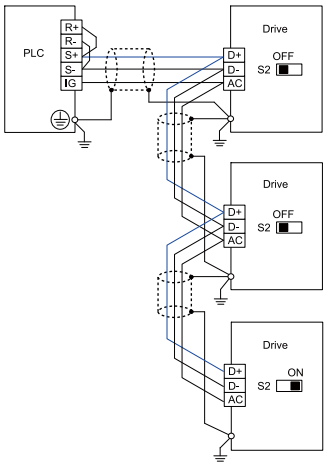


Figure 5.4 Wiring Diagram for More than One Drive

Note:

Set DIP switch S2 to the ON position on the last drive of the MEMOBUS/Modbus communication network to enable the termination resistor.

◆ Drive Operations by MEMOBUS/Modbus

The drive parameters apply to the settings even if the drive is run during MEMOBUS/Modbus communications. This section describes the types of usable functions and their related parameters.

■ Executable Function

A PLC can perform the following operations with MEMOBUS/Modbus communications at any time regardless of parameter settings (except for *H5-xx*).

- Observe the drive status and operate the drive from a PLC
- Set and view parameters
- Fault Reset Procedure
- Multi-function input setting (The input command from MEMOBUS/Modbus communications and MFDI terminals (S1 to S10) are linked by a logical OR operation.)

■ Drive Control

Select the external command for setting the frequency references and the motor run/stop using MEMOBUS/Modbus communications, and set the parameters according to the application using the following table.

Table 5.2 Required Parameter Setting for Drive Control from MEMOBUS/Modbus

LOCAL Control Selected	No.	Name	Setting Value
External reference 1	b1-01	Frequency Reference Selection 1	*2 [Memobus/Modbus Communications]*
	b1-02	Run Command Selection 1	*2 [Memobus/Modbus Communications]*
External reference 2	b1-15	Frequency Reference Selection 2	*2 [Memobus/Modbus Communications]*
	b1-16	Run Command Selection 2	*2 [Memobus/Modbus Communications]*

For more information about operation mode selection, refer to *b1-01 [Frequency Reference Selection 1]* and *b1-02 [Run Command Selection 1]*. Refer to *H1-xx = 2 [MFDI Function Selection = External Reference 1/2 Selection]* for more information about external command.

◆ Communications Timing

To prevent overrun of the slave side, the master cannot send a message to the same drive for a certain amount of time. Similarly, to prevent overrun of the master side, the slave cannot send a response message to the master for a certain amount of time. This section explains the message send/receive timing.

■ Command Message from Master to Slave

To prevent data loss and overrun, after the master receives a message from the slave, the master cannot send the same type of command message to the same slave for a certain amount of time. The minimum wait time differs depending on the type of message. Check by referencing the following table.

Table 5.3 Minimum Wait Time until Message Transmitted

Command type	Example	Minimum Wait Time
1	• Operation commands (Run command, stop command) • I/O settings • Reading the motor and parameter setting values	5 ms *1
2	Parameter writing	50 ms *1
3	Writing of modified data with the Enter command	3 to 5 s *1

*1 If the drive receives a message within the minimum wait time, it executes command type 1 and sends a response message. If the drive receives command type 2 and command type 3 messages within the minimum wait time, a communications error is generated or the drive disregards the command it received.

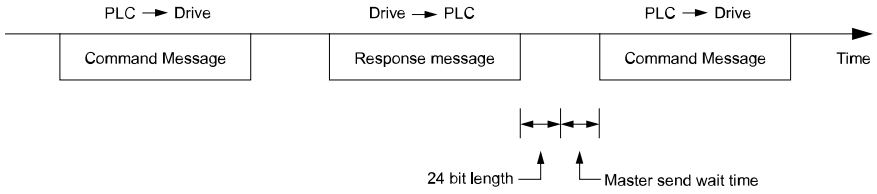


Figure 5.5 Minimum Wait Time Until Transmit

The timer within the master must be set to check how long it takes for the slave to respond to the master. If the timer is set and a response message is not returned back from the slave within a certain amount of time, the master retransmits the message.

■ Response Message from Slave

When the slave receives the command message from the master, it processes the data that was sent. When the wait time set in *H5-06 [Drive Transmit Wait Time]* passes, it sends a response message to the master. Increase the wait time set in *H5-06* when overrun occurs on the master.

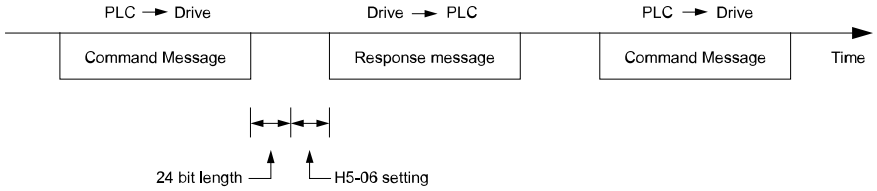


Figure 5.6 Response Wait Time

◆ Message Format

■ Communication Message Description

In MEMOBUS/Modbus communications, the master sends commands to the slave, then the slave responds. The master and slave send their messages in the configuration in Figure 5.7. The length of the data changes when the description of the command (function) changes.

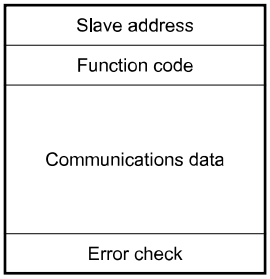


Figure 5.7 Message Format

■ Slave Address

Set the slave address of the drive to 00 to FF (Hex.). When the slave address is 00 (Hex), the master sends the command and all slaves receive the command.

The slave will not send a response message to the master.

■ Function Code

There are five function codes that set commands. Table 5.4 shows the different codes.

Table 5.4 Function Codes

Function Code (Hex.)	Subfunction Code (Hex.)	Function	Command Message		Response Message	
			Minimum Data Length (byte)	Maximum Data Length (byte)	Minimum Data Length (byte)	Maximum Data Length (byte)
03	-	Read Multiple Holding Registers	8	8	7	37
08	-	Loopback Test	8	8	8	8
10	-	Writing to Multiple Holding Registers	11	41	8	8
5A	-	Writing to Multiple Holding Registers / Reading the Register Indicated	11	41	17	17
67	010D	Reading the Contents of Non-Consecutive Holding Registers	10	248	10	248
	010E	Writing to Non-Consecutive Holding Registers	14	250	8	8

■ Communications Data

Communications data is a series of data that uses the combination of the communications register number and the data for these registers. The data length changes when the description of the command changes. For a loopback test, it switches to test code.

The communications register for the drive has a 2-byte length. Data that is written to the register for the drive is usually 2 bytes. Register data that is read from the drive is also 2 bytes.

■ Error Check

Error check uses the CRC-16 method to detect transmission errors. Use the procedure in this section to calculate CRC-16.

Command Data

When the drive receives data, it will make sure that there are no errors in the data. The drive uses the procedure below to calculate CRC-16, then the drive compares that data with the CRC-16 value in the message. If the CRC-16 values do not agree, the drive will not execute a command message.

When you calculate CRC-16 in MEMOBUS/Modbus communications, make sure that you set the start value as FFFF (Hex.). All 16 bits must be 1.

Use this procedure to calculate CRC-16:

1. Make sure that the start value is FFFF (Hex.).
2. Calculate the FFFF (Hex.) start value and the XOR of the slave address (exclusive OR).
3. Move the step 2 results one column to the right. Do this shift until the carry bit is 1.
4. When the carry bit is 1, calculate XOR via the result from the above step 3 and A001 (Hex.).
5. Do steps 3 and 4 until the 8th shift to the right.
6. Use the result of step 5 to calculate the XOR and the data of the following messages (function code, register address, data). Do steps 3 to 5 until the last data, then calculate.
7. The result of the last right shift or the value of the last XOR calculation is the result for CRC-16.

Table 5.5 lists examples of the CRC-16 calculation of slave address 02 (Hex.) and function code 03 (Hex.). The calculated results of CRC-16 for this section is D140 (Hex.).

Note:

The calculation example only gives information about some error checks with CRC-16. The drive will do the same error checks for the next data.

Table 5.5 CRC-16 Calculation Example

Description	Calculation	Overflow	Description	Calculation	Overflow
Initial value (FFFF (Hex.))	1111 1111 1111 1111	-	Function code 03 (Hex.)	0000 0011	-
Address 02 (Hex.)	0000 0010	-	XOR w result	1000 0001 0011 1101	-

Description	Calculation	Overflow	Description	Calculation	Overflow
XOR w initial value	1111 1111 1111 1101		Shift 1	0100 0000 1001 1110	1
Shift 1	0111 1111 1111 1110	1	XOR w A001 (Hex.)	1010 0000 0000 0001	-
XOR w A001 (Hex.)	1010 0000 0000 0001	-	XOR result	1110 0000 1001 1111	-
XOR result	1101 1111 1111 1111	-	Shift 2	0111 0000 0100 1111	1
Shift 2	0110 1111 1111 1111	1	XOR w A001 (Hex.)	1010 0000 0000 0001	-
XOR w A001 (Hex.)	1010 0000 0000 0001	-	XOR result	1101 0000 0100 1110	-
XOR result	1100 1111 1111 1110	-	Shift 3	0110 1000 0010 0111	0
Shift 3	0110 0111 1111 1111	0	Shift 4	0011 0100 0001 0011	1
Shift 4	0011 0011 1111 1111	1	XOR w A001 (Hex.)	1010 0000 0000 0001	-
XOR w A001 (Hex.)	1010 0000 0000 0001	-	XOR result	1001 0100 0001 0010	-
XOR result	1001 0011 1111 1110	-	Shift 5	0100 1010 0000 1001	0
Shift 5	0100 1001 1111 1111	0	Shift 6	0010 0101 0000 0100	1
Shift 6	0010 0100 1111 1111	1	XOR w A001 (Hex.)	1010 0000 0000 0001	-
XOR w A001 (Hex.)	1010 0000 0000 0001	-	XOR result	1000 0101 0000 0101	-
XOR result	1000 0100 1111 1110	-	Shift 7	0100 0010 1000 0010	1
Shift 7	0100 0010 0111 1111	0	XOR w A001 (Hex.)	1010 0000 0000 0001	-
Shift 8	0010 0001 0011 1111	1	XOR result	1110 0010 1000 0011	-
XOR w A001 (Hex.)	1010 0000 0000 0001	-	Shift 8	0111 0001 0100 0001	1
XOR result	1000 0001 0011 1110	-	XOR w A001 (Hex.)	1010 0000 0000 0001	-
Perform operations with next data (function code)			XOR result	1101 0001 0100 0000	-
			CRC-16	1101 0001 0100 0000	-
				D 1 4 0 (Lower) (Upper)	-
			Continue from here with next data.		

Response Data

The drive does the CRC-16 calculation for the response message and makes sure that the data does not have errors. Make sure that the calculated value is the same value as the CRC-16 in the response message.

◆ Examples of Messages for Commands/Responses

The items in this section are examples of messages for commands/responses.

■ Read Multiple Holding Registers

Uses function code 03 (Hex.) to read the contents of a maximum of 16 holding registers.

Table 5.6 shows example messages when the drive reads status signal from the drive of slave 2, the error contents, fault contents, and frequency references.

Table 5.6 Message Example When Reading the Contents of Holding Register

Byte	Command Message		Setting Data (Hex.)	Response Message (Normal)		Setting Data (Hex.)	Response Message (Fault)		Setting Data (Hex.)
0	Slave address		02	Slave address		02	Slave address		02
1	Function code		03	Function code		03	Function code		83
2	Starting No.	Upper	00	Data Qty		08	Error code		03
3		Lower	20	First storage register	Upper	00	CRC-16	Upper	F1
4	Data Qty	Upper	00		Lower	65		Lower	31
5		Lower	04	Next storage register	Upper	00	-		
6	CRC-16	Upper	45		Lower	00	-		
7		Lower	F0	Next storage register	Upper	00	-		
8	-				Lower	00	-		

Byte	Command Message	Setting Data (Hex.)	Response Message (Normal)		Setting Data (Hex.)	Response Message (Fault)	Setting Data (Hex.)
9	-		Next storage register	Upper	01	-	
10	-			Lower	F4	-	
11	-		CRC-16	Upper	AF	-	
12	-			Lower	82	-	

■ Loopback Test

The loopback test uses function code 08 (Hex.) and returns the command message as a response message. This test checks communication between the master and slave. The test code and data can use desired values.

Table 5.7 shows examples of messages given out when the loopback test is done with the drive of slave 1.

Table 5.7 Message Examples from the Loopback Test

Byte	Command Message		Setting Data (Hex.)	Response Message (Normal)		Setting Data (Hex.)
0	Slave address		01	Slave address		01
1	Function code		08	Function code		08
2	Test code	Upper	00	Test code	Upper	00
3		Lower	00		Lower	00
4	Data	Upper	A5	Data	Upper	A5
5		Lower	37		Lower	37
6	CRC-16	Upper	DA	CRC-16	Upper	DA
7		Lower	8D		Lower	8D

■ Writing to Multiple Holding Registers

You can write the data that you set to the number of holding registers set in function code 10 (hex). You must configure the number of the holding registers and each 8 higher bits and 8 lower bits in order in the command message for the write data. You can write to a maximum of 16 holding registers.

Table 5.8 shows example messages when you use the PLC to set Forward run in the drive of slave 1 with a 60.00 Hz frequency reference.

When you rewrite the parameter value with the write command through the *H5-11 [Comm ENTER Command Mode]* setting, you must use the Enter command to save and enable the contents of the changes. Refer to *H5-11: Comm ENTER Command Mode on page 739* and *Enter Command on page 311* for more information.

Table 5.8 Message Example When Writing to Multiple Holding Registers

Byte	Command Message		Setting Data (Hex.)	Response Message (When Normal)		Setting Data (Hex.)	Response Message (When There is a Fault)		Setting Data (Hex.)
0	Slave address		01	Slave address		01	Slave address		01
1	Function code		10	Function code		10	Function code		90
2	Starting No.	Upper	00	Starting No.	Upper	00	Error code		02
3		Lower	01		Lower	01	CRC-16	Upper	CD
4	Data Quantity	Upper	00	Data Quantity	Upper	00		Lower	C1
5		Lower	02		Lower	02	-		
6	Byte No.		04	CRC-16	Upper	10	-		
7	First data Data Quantity	Upper	00		Lower	08	-		
8		Lower	01	-			-		
9	Next data	Upper	17	-			-		
10		Lower	70	-			-		
11	CRC-16	Upper	6D	-			-		
12		Lower	B7	-			-		

Note:

The number of bytes set in the command message set the data quantity × 2 during the command message. The response message uses the same formula.

■ Writing to More than One Holding Register/Reading the Indicated Register

The drive uses function code 5A (Hex.) to write to more than one register, then it reads the contents of four holding registers at the same time.

The function for writing to more than one register is the same as the function for function code 10 (Hex.). You can write to a maximum of 16 holding registers.

The four holding registers to be read from are specified in *H5-25 to H5-28 [Function 5A Register x Selection]*.

Table 5.9 shows example messages when you write to more than one holding register or when you read more than one command register. Table 5.9 uses this register data for the examples:

- The drive for slave 1 is set for Forward run with a frequency reference of 60.00 Hz.
- The setting in *H5-25* to *H5-28* and the data in the specified holding registers are as follows.
  - *H5-25* = 0044H: *U1-05 [Motor Speed]* = 60.00 Hz (6000 = 1770H)
  - *H5-26* = 0045H: *U1-06 [Output Voltage Ref]* = 200.0 V (2000 = 07D0H)
  - *H5-27* = 0042H: *U1-03 [Output Current]* = 50% of drive rated current (100% = 8192, 50% = 4096 = 1000H)
  - *H5-28* = 0049H: *U1-10 [Input Terminal Status]* = 00H

When you rewrite the parameter value with the write command through the *H5-11 [Comm ENTER Command Mode]* setting, you must use the Enter command to save and enable the contents of the changes. Refer to *H5-11: Comm ENTER Command Mode on page 739* and *Enter Command on page 311* for more information.

Table 5.9 Message Example When Writing to More than One Holding Register/Reading the Indicated Register

Byte	Command Message			Response Message (When Normal)			Response Message (When There is a Fault)		
			Setting Data (Hex.)			Setting Data (Hex.)			Setting Data (Hex.)
0	Slave address		01	Slave address		01	Slave address		01
1	Function code		5A	Function code		5A	Function code		DA
2	Starting No.	Upper	00	Register status		0F	Register status		0F
3		Lower	01	Data in holding register 1 selected with *H5-25*	Upper	17	Data in holding register 1 selected with *H5-25*	Upper	17
4	Data Quantity	Upper	00		Lower	70		Lower	70
5		Lower	02	Data in holding register 2 selected with *H5-26*	Upper	07	Data in holding register 2 selected with *H5-26*	Upper	07
6	Byte No.		04		Lower	D0		Lower	D0
7	First data	Upper	00	Data in holding register 3 selected with *H5-27*	Upper	10	Data in holding register 3 selected with *H5-27*	Upper	10
8		Lower	01		Lower	00		Lower	00
9	Next data	Upper	17	Data in holding register 4 selected with *H5-28*	Upper	00	Data in holding register 4 selected with *H5-28*	Upper	00
10		Lower	70		Lower	00		Lower	00
11	CRC-16	Upper	4F	Starting No.	Upper	00	Error code		02
12		Lower	43		Lower	01	CRC-16	Upper	E9
13	-			Data Quantity	Upper	00		Lower	6C
14	-				Lower	02	-		
15	-			CRC-16	Upper	AC	-		
16	-				Lower	D0	-		

Note:
The number of bytes set in the command message set the data quantity × 2 during the command message.

Register status	
bit 0	Data in register 1 selected with *H5-25* 1: Successfully read the register 0: Register read error
bit 1	Data in register 2 selected with *H5-26* 1: Successfully read the register 0: Register read error
bit 2	Data in register 3 selected with *H5-27* 1: Successfully read the register 0: Register read error
bit 3	Data in register 4 selected with *H5-28* 1: Successfully read the register 0: Register read error
bit 4	Not used
bit 5	Not used
bit 6	Not used
bit 7	Not used

■ Reading the Contents of Non-Consecutive Holding Registers

The drive uses function code 67 (Hex.) and subfunction code 010D (Hex.) to read data with a maximum of 120 holding registers.

You must give the holding register number from which to read separately.

Table 5.10 shows example messages when you read the frequency reference and torque limit from the drive for slave 1. Table 5.10 uses this register data for the examples.

- 0024H: *U1-01 [Frequency Reference]* = 60.00 Hz (6000 = 1770H)
- 0028H: *U1-09 [Torque Reference]* = 100.0% (1000 = 03E8H)

Table 5.10 Message Example When Reading the Contents of Non-Consecutive Holding Registers

Byte	Command Message			Response Message (When Normal)			Response Message (When There is a Fault)		
			Setting Data (Hex.)			Setting Data (Hex.)			Setting Data (Hex.)
0	Slave address		01	Slave address		01	Slave address		01
1	Function code		67	Function code		67	Function code		E7
2	Subfunction Code	Upper	01	Subfunction Code	Upper	01	Error code		02
3		Lower	0D		Lower	0D	CRC-16	Upper	EA
4	Data Quantity	Upper	00	Byte No.	Upper	00		Lower	31
5		Lower	02		Lower	04	-		
6	Holding register 1 No.	Upper	00	Holding register 1 data	Upper	17	-		
7		Lower	24		Lower	70	-		
8	Holding register 2 No.	Upper	00	Holding register 2 data	Upper	03	-		
9		Lower	28		Lower	E8	-		
10	CRC-16	Upper	8B	CRC-16	Upper	47	-		
11		Lower	29		Lower	ED	-		

Note:
The number of bytes set in the command message set the data quantity × 2 during the command message.

■ Writing to Non-Consecutive Holding Registers

The drive uses function code 67 (Hex.) and subfunction code 010E (Hex.) to read data with a maximum of 60 holding registers.

You must give the holding register number from which to write separately.

Table 5.11 shows example messages when you write the frequency reference and torque limit from the drive for slave 1. Table 5.11 uses these specified holding registers data for the examples.

- 0002H: Frequency Reference = 60.00 Hz (6000 = 1770H)
- 0004H: Torque Limit = 150.0% (1500 = 05DCH)

When you rewrite the parameter value with the write command through the *H5-11 [Comm ENTER Command Mode]* setting, you must use the Enter command to save and enable the contents of the changes. Refer to *H5-11: Comm ENTER Command Mode on page 739* and *Enter Command on page 311* for more information.

Table 5.11 Message Example When Writing to Non-Consecutive Holding Registers

Byte	Command Message			Response Message (when normal)			Response Message (when there is a fault)		
			Setting Data (Hex.)			Setting Data (Hex.)			Setting Data (Hex.)
0	Slave address		01	Slave address		01	Slave address		01
1	Function Code		67	Function Code		67	Function Code		E7
2	Subfunction Code	Upper	01	Subfunction Code	Upper	01	Error Codes		02
3		Lower	0E		Lower	0E	CRC-16	Upper	EA
4	Data Qty	Upper	00	Data Qty	Upper	00		Lower	31
5		Lower	02		Lower	02	-		
6	Byte No.	Upper	00	CRC-16	Upper	D5	-		
7		Lower	04		Lower	FC	-		
8	Holding register 1 No.	Upper	00	-			-		
9		Lower	02	-			-		
10	Holding register 1 data	Upper	17	-			-		
11		Lower	70	-			-		
12	Holding register 2 No.	Upper	00	-			-		
13		Lower	04	-			-		
14	Holding register 2 data	Upper	05	-			-		
15		Lower	DC	-			-		
16	CRC-16	Upper	55	-			-		
17		Lower	59	-			-		

Note:
The number of bytes set in the command message set the data quantity × 2 during the command message.

◆ Enter Command

When you use MEMOBUS/Modbus communications to write parameters from the PLC to the drive, *H5-11 [Comm ENTER Command Mode]* lets you use the Enter command to enable these parameters. This section gives information about the Enter command.

■ Types of Enter Commands

The drive supports the two Enter commands shown in Table 5.12.

Write 0 to register number 0900 or 0910 (Hex.) to enable the Enter command. You can only write to these registers. If you read to these registers, it will cause an error.

Table 5.12 Types of Enter Commands

Register No. (Hex.)	Description
0900	When you write parameter data to the EEPROM, you will enable the data on the RAM at the same time. This process saves the parameter changes even if you de-energize the drive.
0910	This updates the data on the RAM, but does not write data to the EEPROM. If you de-energize the drive, you will lose the parameter changes.

Note:
- You can write the EEPROM to the drive a maximum of 100,000 times. Do not frequently execute the Enter command (0900 (Hex.)) that is written to EEPROM.
- The Enter command register is write-only. If this register is read, it will cause a Register Number Error (02 (Hex.)).
- When the command data or broadcast message is transmitted to the drive, the Enter command is not necessary.

■ Functions of the Enter Command when Replacing a Previous Generation Drive

When you replace a previous generation Yaskawa drive with this product, you must set the Enter command function for this product the same as the previous product. The Enter command function is different for Yaskawa G7, F7-series, and V7-series drives.

Use *H5-11* to set the Enter command function:

- When replacing G7 and F7 series drives, set *H5-11 = 0 [ENTER Command Required]*.
- When replacing V7 series drives, set *H5-11 = 1 [ENTER Command Not Required]*.
- When replacing 1000-series drives, set *H5-11* to the same value as the drive you replaced.

Table 5.13 Enter Command Function Differences

H5-11 Settings	H5-11 = 0	H5-11 = 1
The drive you replaced	G7, F7	V7
Time when the parameter settings are enabled	When the drive receives the Enter command from the master	When you change the parameter settings
Upper and lower limit check	Checks the upper and lower limits and considers the related parameter settings.	Checks the upper and lower limit of the changed parameter only.
Default setting of related parameters	Will not change related parameter settings. You must change the parameters manually.	Automatically changes the default settings for the related parameters.
Fault detection when you set more than one parameter	Accepts and responds as usual to correct setting data if the data contains parameter setting errors. The drive discards the disabled setting data, but will not return an error message.	If there is a setting error in a parameter, the drive responds with a fault. The drive discards the data that was sent.

◆ Self-Diagnostics

The drive is capable of self-diagnosing the operation of the serial communications interface circuit. This function is called Self-Diagnostics. Self-Diagnostics connects the transmission terminal of the communication part with the reception terminal and transmits the data that the drive has sent, checking whether the drive is able to communicate usually.

Follow the procedure below to perform Self-Diagnostics.

1. Energize the drive.
2. Set *H1-06 = 67 [Terminal S6 Function Selection = Communications Test Mode]*.
3. De-energize the drive.
4. Connect the control circuit terminal S6 to SN.

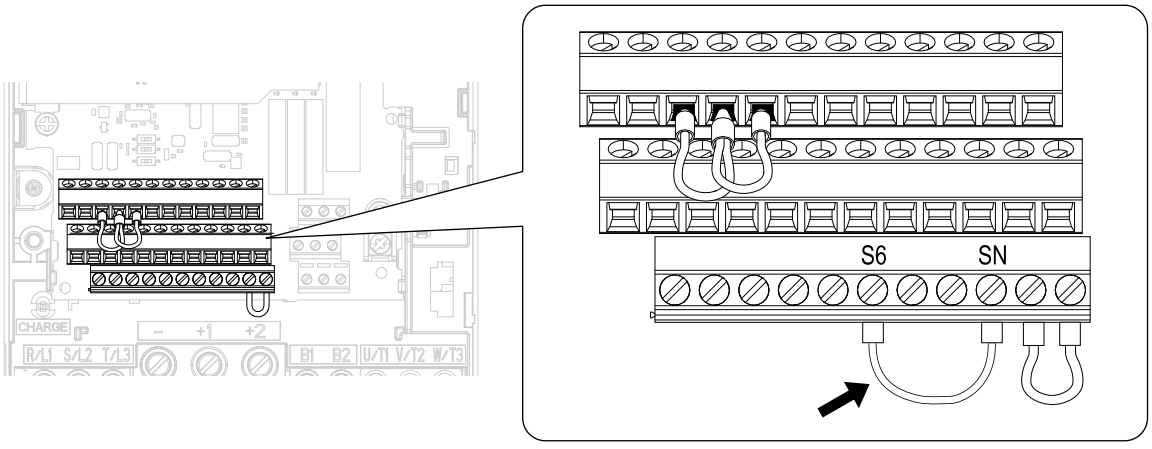


Figure 5.8 Terminal Connection of the Communication Part when Performing Self-Diagnostics

5. Energize the drive.
6. When normal, *PASS [Modbus Communication Test]* is displayed on the keypad.
   When there is an error, *CE [Modbus Communication Error]* is displayed on the keypad.
7. De-energize the drive.
8. Disconnect the wire jumper from terminal S6-SN. Also, set terminal S6 to its original function.
9. Self-Diagnostics is completed and returns to normal functionality.

◆ Communications Data Table

Command Data on page 313, *Monitor Data on page 315*, and *Broadcast Messages on page 328* list the communications data. The data types are command data, monitor data, and broadcast message.

Refer to the Parameter List for parameters and the corresponding communications registers.

■ Command Data

The command data can be read and written.

Note:
Set the reserved bit to 0. Also, do not write the data in the reserved register and the monitor register.

Table 5.14 MEMOBUS/Modbus Communications Command Data

Register No. (Hex.)	Description	
0000	Reserved	
0001	Run command, multi-function input command	
	bit 0	Forward run/Stop 1: Forward run, 0: Stop
	bit 1	Reverse run/Stop 1: Reverse run, 0: Stop
	bit 2	External Fault 1: EF0 [Option Card External Fault]
	bit 3	Fault Reset 1: Reset command
	bit 4	Multi-function input 1 When *H1-01 = 40 [Forward RUN (2-Wire)]*, the multi-function input command is "ComRef". **Note:** When the bit is switched ON as ComRef, the frequency reference source changes to MEMOBUS/Modbus communications. However, the frequency reference source gives priority to the communications option when the communication option is connected to the drive.
	bit 5	Multi-function input 2 When the multi-function input command is *H1-02 = 41 [Reverse RUN (2-Wire)]*, bit 5 is "ComCtrl". **Note:** When the bit is switched ON as ComCtrl, the Run command source changes to MEMOBUS/Modbus communications. However, the Run command source gives priority to the communications option when the communication option is connected to the drive.
	bit 6	Multi-function input 3
	bit 7	Multi-function input 4
	bit 8	Multi-function input 5
	bit 9	Multi-function input 6
	bit A	Multi-function input 7
	bit B	Multi-function input 8
	bit C	Multi-function input 9
	bit D	Multi-function input 10
	bit E - F	Reserved
0002	Frequency Reference	The units are determined by *o1-03 [Frequency Display Unit Selection]* (unsigned).
0003	Output voltage gain	Units: 0.1 % Setting range: 20 (2.0%) to 2000 (200.0%), the default value at power up: 1000 (100.0%)
0004	Torque reference/torque limit (0.1% signed)	
0005	Torque compensation (0.1% signed)	
0006	Reserved	
0007	Setting for the multi-function analog monitor output terminal 1 (10 V/4000 H)	
0008	Setting for the multi-function analog monitor output terminal 2 (10 V/4000 H)	

Register No. (Hex.)	Description	
0009	MFDO setting	
	bit 0	MFDO (terminal M1-M2) 1: ON, 0: OFF
	bit 1	MFDO (terminal M3-M4) 1: ON, 0: OFF
	bit 2	MFDO (terminal M5-M6) 1: ON, 0: OFF
	bit 3 - 5	Reserved
	bit 6	1: bit 7 function is enabled
	bit 7	Fault relay output (terminal MA/MB-MC) 1: ON, 0: OFF
	bit 8 - F	Reserved
000A - 000E	Reserved	
000F	Command selection setting	
	bit 0 - 1	Reserved
	bit 2	Torque limit function input 1: Setting values from the MEMOBUS/Modbus are enabled
	bit 3	Torque Compensation Input 1: Setting values from the MEMOBUS/Modbus are enabled
	bit 4 - B	Reserved
	bit C	Terminal S5 input of broadcast message 1: Enabled, 0: Disabled
	bit D	Terminal S6 input of broadcast message 1: Enabled, 0: Disabled
	bit E	Terminal S7 input of broadcast message 1: Enabled, 0: Disabled
	bit F	Terminal S8 input of broadcast message 1: Enabled, 0: Disabled
0010 - 001A	Reserved	
001B	Analog monitor option AO-A3 analog output 1 value (10 V/4000 (Hex.))	
001C	Analog monitor option AO-A3 analog output 2 value (10 V/4000 (Hex.))	
001D	Digital output option DO-A3 output value (binary)	
001E - 001F	Reserved	
15C0	bit 0	Extended multi-function input command 1
	bit 1	Extended multi-function input command 2
	bit 2	Extended multi-function input command 3
	bit 3 - F	Reserved
3004	Time Setting Setting range: 0000 to 2359 (decimal), the default value at power up: 0000 Set the hour and the minute in HHMM format. • HH: 00 to 23 (decimal) • MM: 00 to 59 (decimal)	
3005	Year and Day Setting Setting range: 1600 to 9906 (decimal), the default value at power up: 1600 Set the year and the day of the week in YYDW format. • YY: the last two digits of the year from 16 to 99 (decimal) • DW: the day of the week – Sunday: 00 – Monday: 01 – Tuesday: 02 – Wednesday: 03 – Thursday: 04 – Friday: 05 – Saturday: 06	

Register No. (Hex.)	Description
3006	Date Setting Setting range: 101 to 1231 (decimal), the default value at power up: 101 Set the month and the date in MMDD format. • MM: 01 to 12 (decimal) • DD: 01 to 31 (decimal)
3007	Set the Date Information Setting range: 0 to 8 (decimal), the default value at power up: 8 Set the values specified in 3004H to 3006H as the date and time. • Command Data: 1 • Response Data: 0 (normal), 8 (fault)

■ Monitor Data

Monitor data can only be read.

Table 5.15 Monitor Data for MEMOBUS/Modbus Communication

Register No. (Hex.)	Description	
0020	Drive Status 1	
	bit 0	During Run 1: During run, 0: During stop
	bit 1	During Reverse 1: During reverse, 0: Forward run
	bit 2	Drive ready 1: Ready, 0: Not ready
	bit 3	Fault 1: Fault
	bit 4	Data Setting Error 1: oPExx error
	bit 5	MFDO (terminal M1-M2) 1: ON, 0: OFF
	bit 6	MFDO (terminal M3-M4) 1: ON, 0: OFF
	bit 7	MFDO (terminal M5-M6) 1: ON, 0: OFF
	bit 8 - D	Reserved
	bit E	ComRef status 1: Enabled
	bit F	ComCtrl status 1: Enabled
0021	Fault Description 1	
	bit 0	oC [Overcurrent], GF [Ground Fault]
	bit 1	ov [Overvoltage]
	bit 2	oL2 [Drive Overload]
	bit 3	oH1 [Heatsink Overheat], oH2 [External Overheat (H1-XX=B)]
	bit 4	rH [Braking Resistor Overheat], rr [Dynamic Braking Transistor Fault]
	bit 5 - 6	Reserved
	bit 7	EF0 [Option Card External Fault], EF1 to EF10 [External Fault]
	bit 8	CPFxx [Hardware Fault] **Note:** Includes *oFx*.
	bit 9	oL1 [Motor Overload], oL3, oL4 [Overtorque Detection 1/2]
	bit A	PGo [Encoder (PG) Feedback Loss], PGoH [Encoder (PG) Hardware Fault], oS [Overspeed], dEv [Speed Deviation]
	bit B	During Uv [Undervoltage] detection
	bit C	Uv1 [DC Bus Undervoltage], Uv2 [Control Power Undervoltage], Uv3 [Soft Charge Answerback Fault]
	bit D	LF [Output Phase Loss], PF [Input Phase Loss]
	bit E	CE [Modbus Communication Error], bUS [Option Communication Error]
	bit F	oPr [Keypad Connection Fault]

Register No. (Hex.)	Description	
0022	Fault Contents	
	bit 0	1: During data writing, during motor switching
	bit 1	Reserved
	bit 2	
	bit 3	1: Upper/Lower Limit Fault
	bit 4	1: Data Integrity Fault
	bit 5	1: During EEPROM writing
	bit 6	0: EEPROM writing 1: Change data only on the RAM **Note:** Enabled when *H5-17 = 1 [ENTER command response @CPU BUSY = Write to RAM Only]*.
	bit 7 - F	Reserved
0023	U1-01 [Frequency Reference] **Note:** The unit changes depending on the setting of *o1-03 [Frequency Display Unit Selection]*.	
0024	U1-02 [Output Frequency] **Note:** The unit changes depending on the setting of *o1-03 [Frequency Display Unit Selection]*.	
0025	U1-06 [Output Voltage Ref] (units: 0.1 V) **Note:** Able to replace the setting unit with *H5-10 [Modbus Register 0025H Unit Sel]*.	
0026	U1-03 [Output Current] (units: 0.1 A)	
0027	U1-08 [Output Power]	
0028	U1-09 [Torque Reference]	
0029	Fault Description 2	
	bit 0	Reserved
	bit 1	GF [Ground Fault]
	bit 2	PF [Input Phase Loss]
	bit 3	LF [Output Phase Loss]
	bit 4	rH [Braking Resistor Overheat]
	bit 5	Reserved
	bit 6	oH4 [Motor Overheat Fault (PTC Input)]
	bit 7 - F	Reserved
002A	Minor Fault Description 1	
	bit 0 - 1	Reserved
	bit 2	EF [FWD/REV Run Command Input Error]
	bit 3	bb [Baseblock]
	bit 4	oL3 [Overtorque 1], oL4 [Overtorque 2]
	bit 5	oH [Heatsink Overheat]
	bit 6	ov [DC Bus Overvoltage]
	bit 7	Uv [Undervoltage]
	bit 8	FAn [Internal Fan Fault]
	bit 9	CE [Modbus Communication Error]
	bit A	bUS [Option Communication Error]
	bit B	Reserved
	bit C	oH3 [Motor Overheat (PTC Input)]
	bit D - E	Reserved
	bit F	CALL [Serial Comm Transmission Error]

Register No. (Hex.)	Description	
002B	U1-10 [Input Terminal Status]	
	bit 0	1: Control circuit terminal S1 ON
	bit 1	1: Control circuit terminal S2 ON
	bit 2	1: Control circuit terminal S3 ON
	bit 3	1: Control circuit terminal S4 ON
	bit 4	1: Control circuit terminal S5 ON
	bit 5	1: Control circuit terminal S6 ON
	bit 6	1: Control circuit terminal S7 ON
	bit 7	1: Control circuit terminal S8 ON
	bit 8	1: Control circuit terminal S9 ON
	bit 9	1: Control circuit terminal S10 ON
	bit A - F	Reserved
002C	Drive Status 2	
	bit 0	During Run 1: During run
	bit 1	During zero speed 1: During zero speed
	bit 2	Speed agreement 1: During agreement
	bit 3	User-defined speed agreement 1: During agreement
	bit 4	Frequency Detection 1 1: Output frequency ≤ L4-01
	bit 5	Frequency Detection 2 1: Output frequency ≥ L4-01
	bit 6	Drive ready 1: Run ready
	bit 7	During low voltage detection 1: During detection
	bit 8	During baseblock 1: Drive output during baseblock
	bit 9	Frequency reference mode 1: No communication option, 0: Communication option
	bit A	Run command mode 1: No communication option, 0: Communication option
	bit B	During Overtorque Detection 1, 2
	bit C	Frequency reference loss 1: Loss
	bit D	Reserved
	bit E	Fault 1: Fault generated
	bit F	MEMOBUS/Modbus communications timeout 1: At Timeout

Register No. (Hex.)	Description	
002D	U1-11 [Output Terminal Status]	
	bit 0	MFDO (terminal M1-M2) 1: ON, 0: OFF
	bit 1	MFDO (terminal M3-M4) 1: ON, 0: OFF
	bit 2	MFDO (terminal M5-M6) 1: ON, 0: OFF
	bit 3 - 6	Reserved
	bit 7	Fault relay output (terminal MA-MC / MB-MC) 1: ON, 0: OFF
	bit 8 - F	Reserved
002E - 0030	Reserved	
0031	U1-07 [DC Bus Voltage] (unit: 1 V)	
0032	U1-09 [Torque Reference] (unit: 1%)	
0033	Reserved	
0034		
0035	Product code 2 [ASCII], region	
0036 - 003C	Reserved	
003D	Communications error description **Note:** The description of the communications error is saved until the fault is reset.	
	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 - F	Reserved
003E	Output frequency	Units: min^{-1} or r/min **Note:** Set *E2-04, E4-04 [Motor Poles]*.
003F		0.01% units
0040 - 004A	Used with *U1-xx [Operation Status Monitors]*. Refer to the *U Monitors* for parameter details.	

Register No. (Hex.)	Description	
004B	U1-12 [Drive Status]	
	bit 0	1: During run
	bit 1	1: During zero speed
	bit 2	1: During reverse
	bit 3	1: During reset signal input
	bit 4	1: During speed agreement
	bit 5	1: Drive operation ready
	bit 6	1: Minor Fault
	bit 7	1: Fault
	bit 8	1: oPExx [Operation Error] generation
	bit 9	1: Momentary power loss ride-thru
	bit A	1: Motor 2 Selection
	bit B	Reserved
	bit C	1: Motor 3 Selection
	bit D	Reserved
	bit E	ComRef status/ NetRef status
	bit F	ComCtrl status/ NetCtrl status
004C - 007E	Use with *U1-xx, U4-xx, U6-xx [Monitors]*. Refer to “U2: Fault Trace” and “U3: Fault History” for details.	
007F	Minor fault code (Refer to “Minor Fault Description” for more information about the minor fault codes.)	
0080 - 0097	Use with *U2-xx, U3-xx [Monitors]*. Refer to “U Monitor” for details, and refer to “Fault Trace/Fault History Descriptions” for details about register values.	
0098 - 0099	U4-01 [Cumulative Ope Time] Example: When *U4-01 [Cumulative Ope Time]* is 12345, 0098 (Hex.) = 1234 and 0099 (Hex.) = 5.	
009A - 009B	U4-03 [Cooling Fan Ope Time] Example: When *U4-03 [Cooling Fan Ope Time]* is 12345, 009A (Hex.) = 1234 and 009B (Hex.) = 5.	
009C - 00AA	Reserved	
00AB	Drive rated current **Note:** The unit of display varies depending on the model. 2003 to 2033, 4002 to 4018: 0.01 A 2047 to 2415, 4024 to 4605: 0.1 A	
00AC	U1-05 [Motor Speed]	Units: min^{-1} or r/min **Note:** Set *E2-04, E4-04 [Motor Poles]*.
00AD		Units: 0.01%
00AE, 00AF	Reserved	
00B0	Optional codes connected to CN5-A	Optional connected codes are stored in the register. AI-A3 = 0003 (Hex.) AO-A3 = 0004 (Hex.) DI-A3 = 0001 (Hex.) DO-A3 = 0002 (Hex.) PG-B3 = 0011 (Hex.) PG-RT3 = 0023 (Hex.) PG-X3 = 0012 (Hex.) SI-C3 = 5343 (Hex.) SI-EM3 = 1005 (Hex.) SI-EN3 = 1006 (Hex.) SI-EP3 = 1007 (Hex.) SI-ET3 = 1004 (Hex.) SI-N3 = 534E (Hex.) SI-P3 = 5350 (Hex.) SI-S3 = 5353 (Hex.) SI-T3 = 5354 (Hex.)
00B1	Reserved	
00B2	Optional codes connected to CN5-B	
00B3	Optional codes connected to CN5-C	

Register No. (Hex.)	Description	
00B4	Reserved	
00B5	U1-16 [SFS Output Frequency]	Units: min-1 or r/min **Note:** Set *E2-04, E4-04 [Motor Poles]*.
00B6		Units: 0.01%
00B7	Frequency reference monitor	Units: min-1 or r/min **Note:** Set *E2-04, E4-04 [Motor Poles]*.
00B8		Units: 0.01%
00B9 - 00BE	Reserved	
00BF	Operation error number xx of *oPExx* is displayed.	
00C0	Fault Description 3	
	bit 0	Reserved
	bit 1	Uv1 [DC Bus Undervoltage]
	bit 2	Uv2 [Control Power Undervoltage]
	bit 3	Uv3 [Soft Charge Answerback Fault]
	bit 4	SC [Short Circuit/IGBT Failure]
	bit 5	GF [Ground Fault]
	bit 6	oC [Overcurrent]
	bit 7	ov [Overvoltage]
	bit 8	oH [Heatsink Overheat]
	bit 9	oH1 [Heatsink Overheat]
	bit A	oL1 [Motor Overload]
	bit B	oL2 [Drive Overload]
	bit C	oL3 [Overtorque Detection 1]
	bit D	oL4 [Overtorque Detection 2]
	bit E	rr [Dynamic Braking Transistor Fault]
	bit F	rH [Braking Resistor Overheat]
00C1	Fault Description 4	
	bit 0	EF3 [External Fault (Terminal S3)]
	bit 1	EF4 [External Fault (Terminal S4)]
	bit 2	EF5 [External Fault (Terminal S5)]
	bit 3	EF6 [External Fault (Terminal S6)]
	bit 4	EF7 [External Fault (Terminal S7)]
	bit 5	EF8 [External Fault (Terminal S8)]
	bit 6	FAn [Internal Fan Fault]
	bit 7	oS [Overspeed]
	bit 8	dEv [Speed Deviation]
	bit 9	PGo [Encoder (PG) Feedback Loss]
	bit A	PF [Input Phase Loss]
	bit B	LF [Output Phase Loss]
	bit C	oH3 [Motor Overheat (PTC Input)]
	bit D	oPr [Keypad Connection Fault]
	bit E	Err [EEPROM Write Error]
	bit F	oH4 [Motor Overheat Fault (PTC Input)]

Register No. (Hex.)	Description	
00C2	Fault Description 5	
	bit 0	CE [Modbus Communication Error]
	bit 1	bUS [Option Communication Error]
	bit 2 - 3	Reserved
	bit 4	CF [Control Fault]
	bit 5	SvE [Zero Servo Fault]
	bit 6	EF0 [Option Card External Fault]
	bit 7 - A	Reserved
	bit B	EF9 [External Fault (Terminal S9)]
	bit C	EF10 [External Fault (Terminal S10)]
	bit D - E	Reserved
	bit F	Hardware Fault (includes *oFx* fault)
00C3	Fault Description 6	
	bit 0 - 6	Reserved
	bit 7	PGoH [Encoder (PG) Hardware Fault]
	bit 8	E5 [MECHATROLINK Watchdog Timer Err]
	bit 9 - F	Reserved
00C4	Fault Description 7	
	bit 0	Reserved
	bit 1	EF1 [External Fault (Terminal S1)]
	bit 2	EF2 [External Fault (Terminal S2)]
	bit 3 - 4	Reserved
	bit 5	CoF [Current Offset Fault]
	bit 6 - C	Reserved
	bit D	rF [Braking Resistor Fault]
	bit E	boL [BrakingTransistor Overload Fault]
	bit F	Reserved
00C5	Fault Description 8	
	bit 0	Reserved
	bit 1	nSE [Node Setup Error]
	bit 2 - F	Reserved
00C6	Reserved	
00C7	Fault Description 10	
	bit 0	SE1 [Brake Sequence Fault 1 (SE1)]
	bit 1	SE2 [Brake Sequence Fault 2 (SE2)]
	bit 2	SE3 [Brake Sequence Fault 3 (SE3)]
	bit 3	SE4 [Brake Sequence Fault 4 (SE4)]
	bit 4 - 5	Reserved
	bit 6	oL5 [Overload Detection (oL5)]
	bit 7	oL6 [Light-load Accel 2 Fault (oL6)]
	bit 8 - F	Reserved

Register No. (Hex.)	Description	
00C8	Minor Fault Description 2	
	bit 0	Uv [Undervoltage]
	bit 1	ov [DC Bus Overvoltage]
	bit 2	oH [Heatsink Overheat]
	bit 3	oH2 [External Overheat (H1-XX=B)]
	bit 4	oL3 [Overtorque 1]
	bit 5	oL4 [Overtorque 2]
	bit 6	EF [FWD/REV Run Command Input Error]
	bit 7	bb [Baseblock]
	bit 8	EF3 [External Fault (Terminal S3)]
	bit 9	EF4 [External Fault (Terminal S4)]
	bit A	EF5 [External Fault (Terminal S5)]
	bit B	EF6 [External Fault (Terminal S6)]
	bit C	EF7 [External Fault (Terminal S7)]
	bit D	EF8 [External Fault (Terminal S8)]
	bit E	FAn [Internal Fan Fault]
	bit F	oS [Overspeed]
00C9	Minor Fault Description 3	
	bit 0	dEv [Speed Deviation]
	bit 1	PGo [Encoder (PG) Feedback Loss]
	bit 2	oPr [Keypad Connection Fault]
	bit 3	CE [Modbus Communication Error]
	bit 4	bUS [Option Communication Error]
	bit 5	CALL [Serial Comm Transmission Error]
	bit 6	oL1 [Motor Overload]
	bit 7	oL2 [Drive Overload]
	bit 8	Reserved
	bit 9	EF0 [Option Card External Fault]
	bit A	rUn [Motor Switch during Run]
	bit B	Reserved
	bit C	CALL [Serial Comm Transmission Error]
	bit D - E	Reserved
	bit F	SE [Modbus Test Mode Error]
00CA	Minor Fault Description 4	
	bit 0	Reserved
	bit 1	oH3 [Motor Overheat (PTC Input)]
	bit 2	EF9 [External Fault (Terminal S9)]
	bit 3	EF10 [External Fault (Terminal S10)]
	bit 4 - 9	Reserved
	bit A	PGoH [Encoder (PG) Hardware Fault]
	bit B - F	Reserved

Register No. (Hex.)	Description	
00CB	Minor Fault Description 5	
	bit 0	E5 [MECHATROLINK Watchdog Timer Err]
	bit 1	AEr [Station Address Setting Error]
	bit 2	CyC [MECHATROLINK CommCycleSettingErr]
	bit 3	HCA [High Current Alarm]
	bit 4	LT-1 [Cooling Fan Maintenance Time]
	bit 5	LT-2 [Capacitor Maintenance Time]
	bit 6 - 7	Reserved
	bit 8	EF1 [External Fault (Terminal S1)]
	bit 9	EF2 [External Fault (Terminal S2)]
	bit A	SToF [Safe Torque OFF Hardware]
	bit B	STo [Safe Torque OFF]
	bit C - F	Reserved
00CC	Minor Fault Description 6	
	bit 0	Reserved
	bit 1	TrPC [IGBT Maintenance Time (90%)]
	bit 2	LT-3 [SoftChargeBypassRelay MainteTime]
	bit 3	LT-4 [IGBT Maintenance Time (50%)]
	bit 4	boL [Braking Transistor Overload]
	bit 5 - F	Reserved
00CD - 00CE	Reserved	
00CF	Minor Fault Description 7	
	bit 0	FWdL [Fwd Limit (FWdL)]
	bit 1	rEvL [Rev Limit (rEvL)]
	bit 2 - 3	Reserved
	bit 4	oL5 [Overload Detection (oL5)]
	bit 5	oL6 [Light-load Accel 2 Fault (oL6)]
	bit 6 - F	Reserved
00D0	CPF Contents 1	
	bit 0 - 1	Reserved
	bit 2	CPF02 [A/D Conversion Failure]
	bit 3	CPF03 [Control Board Connection Error]
	bit 4 - 5	Reserved
	bit 6	CPF06 [EEPROM Memory Data Error]
	bit 7	CPF07 [Terminal Board Connection Error]
	bit 8	CPF08 [Terminal Board Connection Error]
	bit 9	Reserved
	bit A	CPF10 [ASIC Verify Error]
	bit B	CPF11 [Option RAM Error]
	bit C	CPF12 [FLASH Memory Fault]
	bit D	CPF13 [Watchdog Circuit Exception]
	bit E	CPF14 [Control Circuit Fault]
	bit F	Reserved

Register No. (Hex.)	Description	
00D1	CPF Contents 2	
	bit 0	CPF16 [Clock Fault]
	bit 1	CPF17 [Timing Fault]
	bit 2	CPF18 [Control Circuit Fault]
	bit 3	CPF19 [Control Circuit Fault]
	bit 4	CPF20 [Control Circuit Error]
	bit 5	CPF21 [Control Circuit Error]
	bit 6	CPF22 [Hybrid IC Error]
	bit 7	CPF23 [Control Board Connection Error]
	bit 8	CPF24 [Drive Unit Signal Fault]
	bit 9	CPF25 [Terminal Board not Connected]
	bit A	CPF26 [BB Circuit Error]
	bit B	CPF27 [PWM Set Reg Error]
	bit C	CPF28 [PWM Pattern Error]
	bit D	CPF29 [On-Delay Error]
	bit E	CPF30 [BB On Error]
	bit F	CPF31 [ASIC Code Error]
00D2	CPF Contents 3	
	bit 0	CPF32 [ASIC Startup Error]
	bit 1	CPF33 [Watch-dog Error]
	bit 2	CPF34 [Power/Clock Error]
	bit 3	CPF35 [Ext A/D Conv Error]
	bit 4	CPU36 [ASIC COM Error]
	bit 5	CPU37 [ASIC COM Error]
	bit 6	CPU38 [EEPROM Data Error]
	bit 7	CPU39 [CPU-ASIC Communication Error]
	bit 8	CPF40 [Control Circuit Error]
	bit 9	CPF41 [Control Circuit Error]
	bit A	CPF42 [Control Circuit Error]
	bit B	CPF43 [Control Circuit Error]
	bit C	CPF44 [Control Circuit Error]
	bit D	CPF45 [Control Circuit Error]
	bit E - F	Reserved
00D3 - 00D7	Reserved	
00D8	oFA0x Description (CN5-A)	
	bit 0	oFA00 [Option Not Compatible with Port]
	bit 1	oFA01 [Option Fault/Connection Error]
	bit 2 - 4	Reserved
	bit 5	oFA05 [Option A/D Error]
	bit 6	oFA06 [Option Communication Error]
	bit 7 - F	Reserved

Register No. (Hex.)	Description	
00D9	oFA1x Description (CN5-A)	
	bit 0	oFA10 [Option RAM Error]
	bit 1	oFA11 [Option Ope Mode Error]
	bit 2	oFA12 [Drive Receive CRC Error]
	bit 3	oFA13 [Drive Receive Frame Error]
	bit 4	oFA14 [Drive Receive Abort Error]
	bit 5	oFA15 [Option Receive CRC Error]
	bit 6	oFA16 [Option Receive Frame Error]
	bit 7	oFA17 [Option Receive Abort Error]
	bit 8 - F	Reserved
00DA	Reserved	
00DB	oFA3x Description (CN5-A)	
	bit 0	oFA30 [COM ID Error]
	bit 1	oFA31 [Type Code Error]
	bit 2	oFA32 [SUM Check Error]
	bit 3	oFA33 [Option Receive Time Over]
	bit 4	oFA34 [Memobus Time Over]
	bit 5	oFA35 [Drive Receive Time Over 1]
	bit 6	oFA36 [CI Check Error]
	bit 7	oFA37 [Drive Receive Time Over 2]
	bit 8	oFA38 [Control Reference Error]
	bit 9	oFA39 [Drive Receive Time Over 3]
	bit A	oFA40 [CtrlResSel 1Err]
	bit B	oFA41 [Drive Receive Time Over 4]
	bit C	oFA42 [CtrlResSel 2Err]
	bit D	oFA43 [Drive Receive Time Over 5]
	bit E - F	Reserved
00DC	oFb0x Description (CN5-B)	
	bit 0	oFb00 [Option Not Compatible with Port]
	bit 1	oFb01 [Option Fault/Connection Error]
	bit 2	oFb02 [Duplicate Options]
	bit 3 - 4	Reserved
	bit 5	oFb05 [Option A/D Error]
	bit 6	oFb06 [Option Communication Error]
	bit 7 - F	Reserved
00DD	oFb1x Description (CN5-B)	
	bit 0	oFb10 [Option RAM Error]
	bit 1	oFb11 [Option Ope Mode Error]
	bit 2	oFb12 [Drive Receive CRC Error]
	bit 3	oFb13 [Drive Receive Frame Error]
	bit 4	oFb14 [Drive Receive Abort Error]
	bit 5	oFb15 [Option Receive CRC Error]
	bit 6	oFb16 [Option Receive Frame Error]
	bit 7	oFb17 [Option Receive Abort Error]
	bit 8 - F	Reserved
00DE - 00DF	Reserved	

Register No. (Hex.)	Description	
00E0	oFb3x Description (CN5-B)	
	bit 0	oFb30 [COM ID Error]
	bit 1	oFb31 [Type Code Error]
	bit 2	oFb32 [SUM Check Error]
	bit 3	oFb33 [Option Receive Time Over]
	bit 4	oFb34 [Memobus Time Over]
	bit 5	oFb35 [Drive Receive Time Over 1]
	bit 6	oFb36 [CI Check Error]
	bit 7	oFb37 [Drive Receive Time Over 2]
	bit 8	oFb38 [Control Reference Error]
	bit 9	oFb39 [Drive Receive Time Over 3]
	bit A	oFb40 [CtrlResSel 1Err]
	bit B	oFb41 [Drive Receive Time Over 4]
	bit C	oFb42 [CtrlResSel 2Err]
	bit D	oFb43 [Drive Receive Time Over 5]
	bit E - F	Reserved
00E1	oFC0x Description (CN5-C)	
	bit 0	oFC00 [Option Not Compatible with Port]
	bit 1	oFC01 [Option Fault/Connection Error]
	bit 2	oFC02 [Duplicate Options]
	bit 3 - 4	Reserved
	bit 5	oFC05 [Option A/D Error]
	bit 6	oFC06 [Option Communication Error]
	bit 7 - F	Reserved
00E2	oFC1x Description (CN5-C)	
	bit 0	oFC10 [Option RAM Error]
	bit 1	oFC11 [Option Ope Mode Error]
	bit 2	oFC12 [Drive Receive CRC Error]
	bit 3	oFC13 [Drive Receive Frame Error]
	bit 4	oFC14 [Drive Receive Abort Error]
	bit 5	oFC15 [Option Receive CRC Error]
	bit 6	oFC16 [Option Receive Frame Error]
	bit 7	oFC17 [Option Receive Abort Error]
	bit 8 - F	Reserved
00E3	Reserved	
00E4	oFC5x Description (CN5-C)	
	bit 0	oFC50 [Encoder Option A/D Conv Error]
	bit 1	oFC51 [EncOpAnlgCrctErr]
	bit 2	oFC52 [Encoder Option Comm Timeout]
	bit 3	oFC53 [Encoder Option Comm Data Fault]
	bit 4	oFC54 [Encoder Error]
	bit 5	oFC55 [Resolver Error]
	bit 6 - F	Reserved

Register No. (Hex.)	Description	
00E5	Minor Fault Description 9	
	bit 0	EP24v [External Power 24V Supply]
	bit 1 - 3	Reserved
	bit 4	bAT [Keypad Battery Low Voltage]
	bit 5	Reserved
	bit 6	CP1 [Comparator 1 Limit Error]
	bit 7	CP2 [Comparator 2 Limit Error]
	bit 8	TiM [Keypad Time Not Set]
	bit 9	bCE [Bluetooth Communication Error]
	bit A - F	Reserved
00E6 - 00E9	Reserved	
00EA	Fault Description 11	
	bit 0	TiM [Keypad Time Not Set]
	bit 1	bAT [Keypad Battery Low Voltage]
	bit 2- D	Reserved
	bit E	SCF [Safety Circuit Fault]
	bit F	Reserved
00EB - 00ED	Reserved	
00EE	Fault Description 12	
	bit 0 - 2	Reserved
	bit 3	CP1 [Comparator 1 Limit Fault]
	bit 4	CP2 [Comparator 2 Limit Fault]
	bit 5	bCE [Bluetooth Communication Fault]
	bit 6 - F	Reserved
00EF - 00FA	Reserved	
00FB	Output current **Note:** The unit of display varies depending on the model. 2003 to 2033, 4002 to 4018: 0.01 A 2047 to 2415, 4024 to 4605: 0.1 A	

■ Broadcast Messages

The broadcast data function is available as write-only.

The undefined bit signal in the broadcast operation signal continues using the local data signal.

Table 5.16 Broadcast Messages for MEMOBUS/Modbus Communication

Register No. (Hex.)	Description	
0001	Operation signal	
	bit 0	Run command 1: Run, 0: Stop
	bit 1	Reverse run command 1: Reverse, 0: Forward run
	bit 2 - 3	Reserved
	bit 4	External Fault 1: EF0 [Option Card External Fault]
	bit 5	Fault Reset 1: Reset command
	bit 6 - B	Reserved
	bit C	MFDI terminal S5 input
	bit D	MFDI terminal S6 input
	bit E	MFDI terminal S7 input
	bit F	MFDI terminal S8 input
0002	Frequency Reference	30000/100%

■ Fault Trace/Fault History Contents

The following table lists the fault codes read using the commands from monitors *[U2-xx, U3-xx]*.

Table 5.17 Fault Trace/Fault History Contents

Fault Code (Hex.)	Name
0002	Uv1 [DC Bus Undervoltage]
0003	Uv2 [Control Power Undervoltage]
0004	Uv3 [Soft Charge Answerback Fault]
0005	SC [Short Circuit/IGBT Failure]
0006	GF [Ground Fault]
0007	oC [Overcurrent]
0008	ov [Overvoltage]
0009	oH [Heatsink Overheat]
000A	oH1 [Heatsink Overheat]
000B	oL1 [Motor Overload]
000C	oL2 [Drive Overload]
000F	rr [Dynamic Braking Transistor Fault]
0010	rH [Braking Resistor Overheat]
0011	EF3 [External Fault (Terminal S3)]
0012	EF4 [External Fault (Terminal S4)]
0013	EF5 [External Fault (Terminal S5)]
0014	EF6 [External Fault (Terminal S6)]
0015	EF7 [External Fault (Terminal S7)]
0016	EF8 [External Fault (Terminal S8)]
0017	FAn [Internal Fan Fault]
0018	oS [Overspeed]
0019	dEv [Speed Deviation]
001A	PGo [Encoder (PG) Feedback Loss]
001B	PF [Input Phase Loss]
001C	LF [Output Phase Loss]

Fault Code (Hex.)	Name
001D	oH3 [Motor Overheat (PTC Input)]
001E	oPr [Keypad Connection Fault]
001F	Err [EEPROM Write Error]
0020	oH4 [Motor Overheat Fault (PTC Input)]
0021	CE [Modbus Communication Error]
0022	bUS [Option Communication Error]
0025	CF [Control Fault]
0026	SvE [Zero Servo Fault]
0027	EF0 [Option Card External Fault]
002C	EF9 [External Fault (Terminal S9)]
002D	EF10 [External Fault (Terminal S10)]
0030	Includes oFx Fault [Hardware Fault]
0038	PGoH [Encoder (PG) Hardware Fault]
0039	E5 [MECHATROLINK Watchdog Timer Err]
0042	EF1 [External Fault (Terminal S1)]
0043	EF2 [External Fault (Terminal S2)]
0046	CoF [Current Offset Fault]
004E	rF [Braking Resistor Fault]
004F	boL [BrakingTransistor Overload Fault]
0052	nSE [Node Setup Error]
0071	SE1 [Brake Sequence Fault 1 (SE1)]
0072	SE2 [Brake Sequence Fault 2 (SE2)]
0073	SE3 [Brake Sequence Fault 3 (SE3)]
0074	SE4 [Brake Sequence Fault 4 (SE4)]
0075	oL3 [Overtorque Detection 1]

Fault Code (Hex.)	Name
0076	oL4 [Overtorque Detection 2]
0077	oL5 [Overload Detection (oL5)]
0078	oL6 [Light-load Accel 2 Fault (oL6)]
0083	CPF02 [A/D Conversion Failure]
0084	CPF03 [Control Board Connection Error]
0087	CPF06 [EEPROM Memory Data Error]
0088	CPF07 [Terminal Board Connection Error]
0089	CPF08 [Terminal Board Connection Error]
008C	CPF11 [Option RAM Error]
008D	CPF12 [FLASH Memory Fault]
008E	CPF13 [Watchdog Circuit Exception]
008F	CPF14 [Control Circuit Fault]
0091	CPF16 [Clock Fault]
0092	CPF17 [Timing Fault]
0093	CPF18 [Control Circuit Fault]
0094	CPF19 [Control Circuit Fault]
0095	CPF20 [Control Circuit Error]
0096	CPF21 [Control Circuit Error]
0097	CPF22 [Hybrid IC Error]
0098	CPF23 [Control Board Connection Error]
0099	CPF24 [Drive Unit Signal Fault]
009A	CPF25 [Terminal Board not Connected]
009B	CPF26 [BB Circuit Error]
009C	CPF27 [PWM Set Reg Error]
009D	CPF28 [PWM Pattern Error]
009E	CPF29 [On-Delay Error]
009F	CPF30 [BB On Error]
00A0	CPF31 [ASIC Code Error]
00A1	CPF32 [ASIC Startup Error]
00A2	CPF33 [Watch-dog Error]
00A3	CPF34 [Power/Clock Error]
00A4	CPF35 [Ext A/D Conv Error]
00A5	CPF36 [ASIC COM Error]
00A6	CPF37 [ASIC COM Error]
00A7	CPF38 [EEPROM Data Error]
00A9	CPF40 [Control Circuit Error]
00AA	CPF41 [Control Circuit Error]
00AB	CPF42 [Control Circuit Error]
00AC	CPF43 [Control Circuit Error]
00AD	CPF44 [Control Circuit Error]
00AE	CPF45 [Control Circuit Error]
0101	oFA00 [Option Not Compatible with Port]
0102	oFA01 [Option Fault/Connection Error]
0106	oFA05 [Option A/D Error]
0107	oFA06 [Option Communication Error]
0111	oFA10 [Option RAM Error]

Fault Code (Hex.)	Name
0112	oFA11 [Option Ope Mode Error]
0113	oFA12 [Drive Receive CRC Error]
0114	oFA13 [Drive Receive Frame Error]
0115	oFA14 [Drive Receive Abort Error]
0116	oFA15 [Option Receive CRC Error]
0117	oFA16 [Option Receive Frame Error]
0118	oFA17 [Option Receive Abort Error]
0131	oFA30 [COM ID Error]
0132	oFA31 [Type Code Error]
0133	oFA32 [SUM Check Error]
0134	oFA33 [Option Receive Time Over]
0135	oFA34 [Memobus Time Over]
0136	oFA35 [Drive Receive Time Over 1]
0137	oFA36 [CI Check Error]
0138	oFA37 [Drive Receive Time Over 2]
0139	oFA38 [Control Reference Error]
013A	oFA39 [Drive Receive Time Over 3]
013B	oFA40 [CtrlResSel 1Err]
013C	oFA41 [Drive Receive Time Over 4]
013D	oFA42 [CtrlResSel 2Err]
013E	oFA43 [Drive Receive Time Over 5]
0201	oFb00 [Option Not Compatible with Port]
0202	oFb01 [Option Fault/Connection Error]
0203	oFb02 [Duplicate Options]
0206	oFb05 [Option A/D Error]
0207	oFb06 [Option Communication Error]
0211	oFb10 [Option RAM Error]
0212	oFb11 [Option Ope Mode Error]
0213	oFb12 [Drive Receive CRC Error]
0214	oFb13 [Drive Receive Frame Error]
0215	oFb14 [Drive Receive Abort Error]
0216	oFb15 [Option Receive CRC Error]
0217	oFb16 [Option Receive Frame Error]
0218	oFb17 [Option Receive Abort Error]
0231	oFb30 [COM ID Error]
0232	oFb31 [Type Code Error]
0233	oFb32 [SUM Check Error]
0234	oFb33 [Option Receive Time Over]
0235	oFb34 [Memobus Time Over]
0236	oFb35 [Drive Receive Time Over 1]
0237	oFb36 [CI Check Error]
0238	oFb37 [Drive Receive Time Over 2]
0239	oFb38 [Control Reference Error]
023A	oFb39 [Drive Receive Time Over 3]
023B	oFb40 [CtrlResSel 1Err]
023C	oFb41 [Drive Receive Time Over 4]

Fault Code (Hex.)	Name
023D	oFb42 [CtrlResSel 2Err]
023E	oFb43 [Drive Receive Time Over 5]
0301	oFC00 [Option Not Compatible with Port]
0302	oFC01 [Option Fault/Connection Error]
0303	oFC02 [Duplicate Options]
0306	oFC05 [Option A/D Error]
0307	oFC06 [Option Communication Error]
0311	oFC10 [Option RAM Error]
0312	oFC11 [Option Ope Mode Error]
0313	oFC12 [Drive Receive CRC Error]
0314	oFC13 [Drive Receive Frame Error]
0315	oFC14 [Drive Receive Abort Error]
0316	oFC15 [Option Receive CRC Error]
0317	oFC16 [Option Receive Frame Error]

Fault Code (Hex.)	Name
0318	oFC17 [Option Receive Abort Error]
0351	oFC50 [Encoder Option A/D Conv Error]
0352	oFC51 [EncOpAnlgCrctErr]
0353	oFC52 [Encoder Option Comm Timeout]
0354	oFC53 [Encoder Option Comm Data Fault]
0355	oFC54 [Encoder Error]
0356	oFC55 [Resolver Error]
0401	TiM [Keypad Time Not Set]
0402	bAT [Keypad Battery Low Voltage]
040F	SCF [Safety Circuit Fault]
0413	FAn1 [Drive Cooling Fan Fault]
0414	CP1 [Comparator 1 Limit Fault]
0415	CP2 [Comparator 2 Limit Fault]
0416	bCE [Bluetooth Communication Fault]

■ Minor Fault Contents

The following table lists the minor fault codes read using the communications register (007 (Hex.)).

Table 5.18 Minor Fault Contents (007 (Hex.))

Minor Fault Code (Hex.)	Name
0001	Uv [Undervoltage]
0002	ov [DC Bus Overvoltage]
0003	oH [Heatsink Overheat]
0004	oH2 [External Overheat (H1-XX=B)]
0007	EF [FWD/REV Run Command Input Error]
0008	bb [Baseblock]
0009	EF3 [External Fault (Terminal S3)]
000A	EF4 [External Fault (Terminal S4)]
000B	EF5 [External Fault (Terminal S5)]
000C	EF6 [External Fault (Terminal S6)]
000D	EF7 [External Fault (Terminal S7)]
000E	EF8 [External Fault (Terminal S8)]
000F	FAn [Internal Fan Fault]
0010	oS [Overspeed]
0011	dEv [Speed Deviation]
0012	PGo [Encoder (PG) Feedback Loss]
0014	CE [Modbus Communication Error]
0015	bUS [Option Communication Error]
0016	CALL [Serial Comm Transmission Error]
0017	oL1 [Motor Overload]
0018	oL2 [Drive Overload]
001A	EF0 [Option Card External Fault]
001B	rUn [Motor Switch during Run]
001D	CALL [Serial Comm Transmission Error]
0020	SE [Modbus Test Mode Error]
0021	L24v [Loss of External Power 24 Supply]
0022	oH3 [Motor Overheat (PTC Input)]

Minor Fault Code (Hex.)	Name
0023	EF9 [External Fault (Terminal S9)]
0024	EF10 [External Fault (Terminal S10)]
002B	PGoH [Encoder (PG) Hardware Fault]
0031	E5 [MECHATROLINK Watchdog Timer Err]
0032	AEr [Station Address Setting Error]
0033	CyC [MECHATROLINK CommCycleSettingErr]
0034	HCA [High Current Alarm]
0035	LT-1 [Cooling Fan Maintenance Time]
0036	LT-2 [Capacitor Maintenance Time]
0039	EF1 [External Fault (Terminal S1)]
003A	EF2 [External Fault (Terminal S2)]
003B	SToF [Safe Torque OFF Hardware]
003C	STo [Safe Torque OFF]
0042	TrPC [IGBT Maintenance Time (90%)]
0043	LT-3 [SoftChargeBypassRelay MainteTime]
0044	LT-4 [IGBT Maintenance Time (50%)]
0045	boL [Braking Transistor Overload]
0071	FWdL [Fwd Limit (FWdL)]
0072	rEvL [Rev Limit (rEvL)]
0073	oL3 [Overtorque Detection 1]
0074	oL4 [Overtorque Detection 2]
0075	oL5 [Overload Detection (oL5)]
0076	oL6 [Light-load Accel 2 Fault (oL6)]
0081	EP24v [External Power 24V Supply]
0085	bAT [Keypad Battery Low Voltage]
0087	CP1 [Comparator 1 Limit Error]
0088	CP2 [Comparator 2 Limit Error]

Minor Fault Code (Hex.)	Name
0089	TiM [Keypad Time Not Set]

Minor Fault Code (Hex.)	Name
008A	bCE [Bluetooth Communication Error]

◆ Error Codes

■ MEMOBUS/Modbus Communications Error Code List

The following table lists the MEMOBUS/Modbus communications error codes.

When an error occurs, remove the cause of the error and restart communications.

Table 5.19 MEMOBUS/Modbus Communications Error Codes

Error Code (Hex.)	Name	Cause
01	Function Code Error	The PLC set a function code that was not 03, 08, 10, 5A, or 67 (Hex.).
02	Register Number Error	• The register number that is trying to access is not registered. • A starting number that was not 0001 or 0002 (Hex.) was set when broadcasting.
03	Bit Count Error	• Read and write data quantities are more than the 1 to 16 range. (Command message data quantity is disabled.) • The data that was read from non-consecutive holding registers contained more than 120 bytes. • The data to be written to non-consecutive holding registers contained more than 60 bytes. • In the write mode, the number of bytes in the message is not the number of data × 2.
21	Data Setting Error	• Writing control data or parameters made the settings go out of the permitted setting range. • A parameter setting error occurred when writing a parameter.
22	Write Mode Error	• Tried to write a disabled parameter during run. • When there was a *CPF06 [EEPROM Memory Data Error]*, the master tried to write a parameter other than one of these: – *A1-00 [Language Selection]* – *A1-01 [Access Level Selection]* – *A1-02 [Control Method Selection]* – *A1-03 [Initialize Parameters]* – *A1-04 [Password]* – *A1-05 [Password Setting]* – *E1-03 [V/f Pattern Selection]* – *o2-04 [Drive Model (KVA) Selection]* • Writes the read-only data.
23	DC Bus Undervoltage Write Error	During *Uv [Undervoltage]*, a *Uv* write disabled parameter was written.
24	Error Writing Data During Parameter Processing	Tried to write a parameter from the master during parameter processing on the drive side.
25	Writing into EEPROM Disabled	Writing into EEPROM write is disabled, but EEPROM write was executed from MEMOBUS/Modbus communications. When this error occurs, the keypad shows a message and the drive continues operation.

■ No Response from Slave

The slave ignores the command message from the master and will not send a response message in these conditions:

- When a communications error (overrun, framing, parity, CRC-16) is detected in the command message
- When the slave address in the command message and the slave address for the drive side do not agree (Use *H5-01 [Drive Node Address]* to set the slave address of the drive)
- When the time interval between the data of which the message is composed is longer than 24 bit
- When the data length for the command message is not accurate

Note:

- If the keypad shows CALL [Serial Comm Transmission Error], refer to "Troubleshooting" to remove the cause of the error, and try to do communications again. If the keypad does not show CALL, check *U1-19 [MEMOBUS/Modbus Error Code]* for the error and error type.
- If you execute the write function code when the slave address in the command message is 00 (Hex.), all of the slaves will execute the write command, but they will not send response messages to the master.

6

Troubleshooting

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6.1 Section Safety

⚠DANGER

Electrical Shock Hazard

Do not examine, connect, or disconnect wiring on an energized drive. Before servicing, disconnect all power to the equipment and wait for the time specified on the warning label at a minimum. The internal capacitor stays charged after the drive is de-energized. The charge indicator LED extinguishes when the DC bus voltage decreases below 50 Vdc. When all indicators are OFF, remove the covers before measuring for dangerous voltages to make sure that the drive is safe.

If you do work on the drive when it is energized, it will cause serious injury or death from electrical shock.

⚠WARNING

Electrical Shock Hazard

Do not operate the drive when covers are missing. Replace covers and shields before you operate the drive. Use the drive only as specified by the instructions.

Some figures in this section include drives without covers or safety shields to more clearly show the inside of the drive. If covers or safety shields are missing from the drive, it can cause serious injury or death.

Always ground the motor-side grounding terminal.

If you do not ground the equipment correctly, it can cause serious injury or death if you touch the motor case.

After the drive blows a fuse or trips an RCM/RCD, do not immediately energize the drive or operate peripheral devices. Wait for the time specified on the warning label at a minimum and make sure that all indicators are OFF. Then check the wiring and peripheral device ratings to find the cause of the problem. If you do not know the cause of the problem, contact Yaskawa before you energize the drive or peripheral devices.

If you do not fix the problem before you operate the drive or peripheral devices, it can cause serious injury or death.

Only let approved personnel install, wire, maintain, examine, replace parts, and repair the drive.

If personnel are not approved, it can cause serious injury or death.

Do not wear loose clothing or jewelry when you do work on the drive. Tighten loose clothing and remove all metal objects, for example watches or rings.

Loose clothing can catch on the drive and jewelry can conduct electricity and cause serious injury or death.

Do not remove covers or touch circuit boards while the drive is energized.

If you touch the internal components of an energized drive, it can cause serious injury or death.

Fire Hazard

Tighten all terminal screws to the correct tightening torque.

Connections that are too loose or too tight can cause incorrect operation and damage to the drive. Incorrect connections can also cause death or serious injury from fire.

Tighten screws at an angle in the specified range shown in this manual.

If you tighten the screws at an angle not in the specified range, you can have loose connections that can cause damage to the terminal block or start a fire and cause serious injury or death.

Damage to Equipment

Do not apply incorrect voltage to the main circuit of the drive. Operate the drive in the specified range of the input voltage on the drive nameplate.

Voltages that are higher than the permitted nameplate tolerance can cause damage to the drive.

Fire Hazard

Do not put flammable or combustible materials on top of the drive and do not install the drive near flammable or combustible materials. Attach the drive to metal or other noncombustible material.

Flammable and combustible materials can start a fire and cause serious injury or death.

⚠WARNING

Crush Hazard

Wear eye protection when you do work on the drive.

If you do not use correct safety equipment, it can cause serious injury or death.

Use a crane or hoist to move large drives when necessary.

If you try to move a large drive without a crane or hoist, it can cause serious injury or death.

Electrical Shock Hazard

Do not modify the drive body or drive circuitry.

Modifications to drive body and circuitry can cause serious injury or death, will cause damage to the drive, and will void the warranty. Yaskawa is not responsible for modifications of the product made by the user.

NOTICE

Damage to Equipment

When you touch the drive and circuit boards, make sure that you observe correct electrostatic discharge (ESD) procedures.

If you do not follow procedures, it can cause ESD damage to the drive circuitry.

Do not break the electrical connection between the drive and the motor when the drive is outputting voltage.

Incorrect equipment sequencing can cause damage to the drive.

Make sure that all connections are correct after you install the drive and connect peripheral devices.

Incorrect connections can cause damage to the drive.

Note:

- Do not let unwanted objects, for example metal shavings or wire clippings, fall into the drive during drive installation. Put a temporary cover over the drive during installation. Remove the temporary cover before start-up. Unwanted objects inside of the drive can cause damage to the drive.

6.2 Types of Faults, Minor Faults, Alarms, and Errors

Check the drive keypad for a code or message if the drive or motor do not operate correctly.

If problems occur that are not covered in this manual, contact the nearest Yaskawa representative with the following information:

- Drive model
- Drive software version
- Date of purchase
- Description of the problem (such as failure conditions)

The following table contains descriptions of the various types of faults, minor faults, alarms, and errors that may occur while operating the drive.

Contact Yaskawa Electric Engineering Corporation if the drive is damaged. The contact information appears on the back cover of the manual.

Table 6.1 Types of Faults, Minor Faults, Alarms, and Errors

Mode	Drive Response
Fault	When the drive detects a fault, it will cause these conditions: The drive will not operate until you clear the fault with a Fault Reset and the drive goes back to usual status. • The keypad shows the fault code and and ALM/ERR of the LED Status Ring illuminate continuously. • The drive shuts off output, and the motor coasts to a stop. Some faults let the user select a motor stopping method. **Note:** If *S1-54 = 1 [Brake Sequence Selection = Enabled]*, then the drive output will be interrupted while the Brake release command is simultaneously shut OFF, closing the brake. • Fault relay output MA-MC will turn ON, and MB-MC will turn OFF.
Minor Faults/Alarms	When the drive detects a minor fault or an alarm, it will cause these conditions: It is not necessary to do Fault Reset. • The keypad shows the alarm code and and ALM/ERR on the LED Status Ring flash. • The drive will continue to operate the motor. Some alarms let the user select a motor stopping method. **Note:** The drive will coast to stop when it detects *bb [Baseblock]* or *STo [Safe Torque OFF]*. If *S1-54 = 1*, then the drive output will be interrupted while the Brake release command is simultaneously shut OFF, closing the brake. • If the drive detects a minor fault, the terminal set to *H2-01 to H2-05 = 10 [MFDO Function Selection = Alarm]* will switch ON. If you do not set *H2-01 to H2-05*, the drive will not trigger MFDO terminals when it detects a minor fault. • The drive will not output a minor fault signal when it detects an alarm.
Operation Errors	An error occurs when parameter settings do not agree or a parameter combination is incorrect. The drive will not operate until you set the parameters correctly. When the drive detects an operation error, these conditions will result: Find the parameters that caused the error, and correct the settings. • The keypad shows the error code. • Multi-function outputs do not output an alarm signal.
Auto-Tuning Errors	An error occurs during Auto-Tuning. When the drive detects a tuning error, it will cause these conditions: Remove the cause of the error and do Auto-Tuning again. • The keypad shows the error code. • Multi-function outputs do not output an alarm signal. • The motor coasts to stop.
Copy Function Error	An error occurs when you use the keypad for a backup, restore, or verify operation. When the drive detects a copy function error, it will cause these conditions: • The keypad shows the error code. • Multi-function outputs do not output an alarm signal. Push a key on the keypad to clear the error. Remove the cause of the error and try the backup, restore, or verify operation again.

6.3 List of Fault, Minor Fault, Alarm, and Error Codes

Table 6.2 shows the possible fault, minor fault, alarm, and error codes.

The display codes are in alphabetical order. Search the table for the code shown on the keypad, and identify its causes and possible solutions.

Note:

The number in parentheses adjacent to the code in the table identifies the fault code or minor fault code (hex. number) that was read during MEMOBUS/Modbus communications.

Example: AEr (0032)

Table 6.2 List of Fault, Minor Fault, Alarm, and Error Codes

Display (Hex.)	Name	ALM LED	Type	Ref.
AEr (0032)	Station Address Setting Error	Flashing	Alarm	363
bAT (0085)	Keypad Battery Low Voltage	Flashing	Alarm	363
bAT (0402)	Keypad Battery Low Voltage	Illuminated	Fault	342
bb (0008)	Baseblock	Flashing	Alarm	363
bCE (008A)	Bluetooth Communication Error	Flashing	Alarm	363
bCE (0416)	Bluetooth Communication Fault	Illuminated	Fault	342
boL (0045)	Braking Transistor Overload	Flashing	Alarm	363
boL (004F)	BrakingTransistor Overload Fault	Illuminated	Fault	342
bUS (0015)	Option Communication Error	Flashing	Alarm	363
bUS (0022)	Option Communication Error	Illuminated	Fault	342
CALL (001D)	Serial Comm Transmission Error	Flashing	Alarm	364
CE (0014)	Modbus Communication Error	Flashing	Alarm	364
CE (0021)	Modbus Communication Error	Illuminated	Fault	343
CF (0025)	Control Fault	Illuminated	Fault	343
CnT1	Number of Driving Over	Flashing	Alarm	364
CnT1	Number of Driving Over	Illuminated	Fault	343
CnT2	Number of Driving Over	Flashing	Alarm	364
CnT2	Number of Driving Over	Illuminated	Fault	343
CnT3	Number of Driving Over	Flashing	Alarm	364
CnT3	Number of Driving Over	Illuminated	Fault	343
CoF (0046)	Current Offset Fault	Illuminated	Fault	343
CP1 (0087)	Comparator 1 Limit Error	Flashing	Alarm	365
CP1 (0414)	Comparator 1 Limit Fault	Illuminated	Fault	344
CP2 (0088)	Comparator 2 Limit Error	Flashing	Alarm	365
CP2 (0415)	Comparator 2 Limit Fault	Illuminated	Fault	344
CPEr	Control Mode Mismatch	-	Copy Function Error	381
CPF00, CPF01 CPF02, CPF03 (0083, 0084) CPF07, CPF08 (0088, 0089) CPF11 to CPF14 (008C to 008F) CPF16 to CPF24 (0091 to 0099) CPF26 to CPF38 (009B to 00A7) CPF40 to CPF45 (00A9 to 00AE)	Control Circuit Error	Illuminated	Fault	344
CPF06 (0087)	Control Circuit Error	Illuminated	Fault	344
CPF25 (009A)	Terminal Board not Connected	Illuminated	Fault	344
CPyE	Error Writing Data	-	Copy Function Error	381
CrST	Remove RUN Command to Reset	Flashing	Not an alarm.	365
CSEr	Control Mode Mismatch	-	Copy Function Error	381
CyC (0033)	MECHATROLINK CommCycleSettingErr	Flashing	Alarm	365
dEv (0011)	Speed Deviation	Flashing	Alarm	365

Display (Hex.)	Name	ALM LED	Type	Ref.
dEv (0019)	Speed Deviation	Illuminated	Fault	344
dFPS	Drive Model Mismatch	-	Copy Function Error	381
E5 (0031)	MECHATROLINK Watchdog Timer Err	Flashing	Alarm	365
E5 (0039)	MECHATROLINK Watchdog Timer Err	Illuminated	Fault	344
EF (0007)	FWD/REV Run Command Input Error	Flashing	Alarm	365
EF0 (001A)	Option Card External Fault	Flashing	Alarm	365
EF0 (0027)	Option Card External Fault	Illuminated	Fault	345
EF1 (0039)	External Fault (Terminal S1)	Flashing	Alarm	366
EF1 (0042)	External Fault (Terminal S1)	Illuminated	Fault	345
EF2 (003A)	External Fault (Terminal S2)	Flashing	Alarm	366
EF2 (0043)	External Fault (Terminal S2)	Illuminated	Fault	345
EF3 (0009)	External Fault (Terminal S3)	Flashing	Alarm	366
EF3 (0011)	External Fault (Terminal S3)	Illuminated	Fault	345
EF4 (000A)	External Fault (Terminal S4)	Flashing	Alarm	366
EF4 (0012)	External Fault (Terminal S4)	Illuminated	Fault	345
EF5 (000B)	External Fault (Terminal S5)	Flashing	Alarm	366
EF5 (0013)	External Fault (Terminal S5)	Illuminated	Fault	345
EF6 (000C)	External Fault (Terminal S6)	Flashing	Alarm	366
EF6 (0014)	External Fault (Terminal S6)	Illuminated	Fault	345
EF7 (000D)	External Fault (Terminal S7)	Flashing	Alarm	366
EF7 (0015)	External Fault (Terminal S7)	Illuminated	Fault	346
EF8 (000E)	External Fault (Terminal S8)	Flashing	Alarm	367
EF8 (0016)	External Fault (Terminal S8)	Illuminated	Fault	346
EF9 (000F)	External Fault (Terminal S9)	Flashing	Alarm	367
EF9 (0017)	External Fault (Terminal S9)	Illuminated	Fault	346
EF10 (000G)	External Fault (Terminal S10)	Flashing	Alarm	367
EF10 (0018)	External Fault (Terminal S10)	Illuminated	Fault	346
End1	Excessive Rated Voltage Setting	Flashing	Auto-Tuning Error	377
End2	Iron Core Saturation Coefficient	Flashing	Auto-Tuning Error	377
End3	Rated Current Setting Alarm	Flashing	Auto-Tuning Error	377
End4	Adjusted Slip Calculation Error	Flashing	Auto-Tuning Error	377
End5	Resistance Tuning Error	Flashing	Auto-Tuning Error	377
End6	Leakage Inductance Alarm	Flashing	Auto-Tuning Error	377
End7	No-Load Current Alarm	Flashing	Auto-Tuning Error	377
EP24v (0081)	External Power 24V Supply	Flashing	Alarm	367
Er-01	Motor Data Error	Flashing	Auto-Tuning Error	377
Er-02	Drive in an Alarm State	Flashing	Auto-Tuning Error	378
Er-03	STOP Button was Pressed	Flashing	Auto-Tuning Error	378
Er-04	Line-to-Line Resistance Error	Flashing	Auto-Tuning Error	378
Er-05	No-Load Current Error	Flashing	Auto-Tuning Error	378
Er-08	Rated Slip Error	Flashing	Auto-Tuning Error	378
Er-09	Acceleration Error	Flashing	Auto-Tuning Error	379
Er-10	Motor Direction Error	Flashing	Auto-Tuning Error	379
Er-11	Motor Speed Error	Flashing	Auto-Tuning Error	379
Er-12	Current Detection Error	Flashing	Auto-Tuning Error	379
Er-13	Leakage Inductance Error	Flashing	Auto-Tuning Error	379

Display (Hex.)	Name	ALM LED	Type	Ref.
Er-14	Motor Speed Error 2	Flashing	Auto-Tuning Error	379
Er-15	Torque Saturation Error	Flashing	Auto-Tuning Error	379
Er-16	Inertia ID Error	Flashing	Auto-Tuning Error	379
Er-17	Reverse Prohibited Error	Flashing	Auto-Tuning Error	380
Err (001F)	EEPROM Write Error	Illuminated	Fault	346
FAn (000F)	Internal Fan Fault	Flashing	Alarm	367
FAn (0017)	Internal Fan Fault	Illuminated	Fault	346
FAn1 (0413)	Drive Cooling Fan Fault	Illuminated	Fault	346
(0071)	Input During Forward run Limit	Flashing	Alarm	367
GF (0006)	Ground Fault	Illuminated	Fault	347
HCA (0034)	High Current Alarm	Flashing	Alarm	367
iFEr	Communication Err	-	Copy Function Error	381
L24v (0021)	Loss of External Power 24 Supply	Flashing	Alarm	368
LF (001C)	Output Phase Loss	Illuminated	Fault	347
LoG	Log Com Error	Flashing	Alarm	368
LT-1 (0035)	Cooling Fan Maintenance Time	Flashing	Alarm	368
LT-2 (0036)	Capacitor Maintenance Time	Flashing	Alarm	368
LT-3 (0043)	SoftChargeBypassRelay MainteTime	Flashing	Alarm	368
LT-4 (0044)	IGBT Maintenance Time (50%)	Flashing	Alarm	368
ndAT	Error Received Data	-	Copy Function Error	381
nSE (0052)	Node Setup Error	Illuminated	Fault	347
oC (0007)	Overcurrent	Illuminated	Fault	347
oFA00 (0101)	Option Not Compatible with Port	Illuminated	Fault	348
oFA01 (0102)	Option Fault/Connection Error	Illuminated	Fault	348
oFA02 (0103)	Duplicate Options	Illuminated	Fault	348
oFA03 to oFA06 (0104 to 0107)	Option Card Error at Option Port (CN5-A)	Illuminated	Fault	348 - 349
oFA10, oFA11 (0111, 0112)	Option Card Error at Option Port (CN5-A)	Illuminated	Fault	349, 349
oFA12 to oFA17 (0113 to 0118)	Option Card Error at Option Port (CN5-A)	Illuminated	Fault	349 - 349
oFA30 to oFA43 (0131 to 013E)	Communication Option Card Connection Error (CN5-A)	Illuminated	Fault	350 - 351
oFb00 (0201)	Option Not Compatible with Port	Illuminated	Fault	351
oFb01 (0202)	Option Fault/Connection Error	Illuminated	Fault	351
oFb02 (0203)	Duplicate Options	Illuminated	Fault	351
oFb03 to oFb11 (0204 to 0212)	Option Card Error at Option Port (CN5-B)	Illuminated	Fault	351 - 352
oFb12 to oFb17 (0213 to 0218)	Option Card Error at Option Port (CN5-B)	Illuminated	Fault	352 - 353
oFC00 (0301)	Option Not Compatible with Port	Illuminated	Fault	353
oFC01 (0302)	Option Fault/Connection Error	Illuminated	Fault	353
oFC02 (0303)	Duplicate Options	Illuminated	Fault	353
oFC03 to oFC11 (0304 to 0312)	Option Card Error at Option Port (CN5-C)	Illuminated	Fault	353 - 354
oFC12 to oFC17 (0313 to 0318)	Option Card Error at Option Port (CN5-C)	Illuminated	Fault	354 - 355
oFC50 to oFC55 (0351 to 0356)	Option Card Error at Option Port (CN5-C)	Illuminated	Fault	355 - 355
oH (0003)	Heatsink Overheat	Flashing	Alarm	368
oH (0009)	Heatsink Overheat	Illuminated	Fault	355
oH1 (000A)	Heatsink Overheat	Illuminated	Fault	356
oH2 (0004)	External Overheat (H1-XX=B)	Flashing	Alarm	369
oH3 (0022)	Motor Overheat (PTC Input)	Flashing	Alarm	369
oH3 (001D)	Motor Overheat (PTC Input)	Illuminated	Fault	356

Display (Hex.)	Name	ALM LED	Type	Ref.
oH4 (0020)	Motor Overheat Fault (PTC Input)	Illuminated	Fault	356
oL1 (000B)	Motor Overload	Illuminated	Fault	356
oL2 (000C)	Drive Overload	Illuminated	Fault	357
oL3 (0073)	Overtorque Detection 1	Flashing	Alarm	369
oL3 (0075)	Overtorque Detection 1	Illuminated	Fault	358
oL4 (0074)	Overtorque Detection 2	Flashing	Alarm	369
oL4 (0076)	Overtorque Detection 2	Illuminated	Fault	358
oL5 (0075)	Overload Detection (oL5)	Flashing	Alarm	370
oL5 (0077)	Overload Detection (oL5)	Illuminated	Fault	358
oL6 (0076)	Light-load Accel 2 Fault (oL6)	Flashing	Alarm	370
oL6 (0078)	Light-load Accel 2 Fault (oL6)	Illuminated	Fault	358
oPE01	Drive Capacity Setting Fault	Flashing	Parameter Setting Error	373
oPE02	Parameter Range Setting Error	Flashing	Parameter Setting Error	373
oPE03	Multi-Function Input Setting Err	Flashing	Parameter Setting Error	373
oPE05	Run Cmd/Freq Ref Source Sel Err	Flashing	Parameter Setting Error	374
oPE06	Control Method Selection Error	Flashing	Parameter Setting Error	374
oPE07	Analog Input Selection Error	Flashing	Parameter Setting Error	374
oPE08	Parameter Selection Error	Flashing	Parameter Setting Error	375
oPE10	V/f Data Setting Error	Flashing	Parameter Setting Error	375
oPE11	Carrier Frequency Setting Error	Flashing	Parameter Setting Error	375
oPE18	Online Tuning Param Setting Err	Flashing	Parameter Setting Error	375
oPE22	Parameter Setting Error	Flashing	Parameter Setting Error	375
oPE23	Parameter Setting Error	Flashing	Parameter Setting Error	376
oPE24	Parameter Setting Fault	Flashing	Parameter Setting Error	376
oPE25	Parameter Setting Error	Flashing	Parameter Setting Error	376
oPr (001E)	Keypad Connection Fault	Illuminated	Fault	358
oS (0010)	Overspeed	Flashing	Alarm	370
oS (0018)	Overspeed	Illuminated	Fault	358
ov (0002)	Overvoltage	Flashing	Alarm	370
ov (0008)	Overvoltage	Illuminated	Fault	358
PASS	Modbus Communication Test	Flashing	Not an alarm.	370
PF (001B)	Input Phase Loss	Illuminated	Fault	359
PF (0047)	Input Phase Loss	Flashing	Alarm	370
PGo (0012)	Encoder (PG) Feedback Loss	Flashing	Alarm	371
PGo (001A)	Encoder (PG) Feedback Loss	Illuminated	Fault	359
PGoH (002B)	Encoder (PG) Hardware Fault	Flashing	Alarm	371
PGoH (0038)	Encoder (PG) Hardware Fault	Illuminated	Fault	360
rdEr	Error Reading Data	-	Copy Function Error	381
rEvL (0072)	Rev Limit (rEvL)	Flashing	Alarm	371
rF (004E)	Braking Resistor Fault	Illuminated	Fault	360
rH (0010)	Braking Resistor Overheat	Illuminated	Fault	360
rr (000F)	Dynamic Braking Transistor Fault	Illuminated	Fault	360
rUn (001B)	Motor Switch during Run	Flashing	Alarm	371
SC (0005)	Short Circuit/IGBT Failure	Illuminated	Fault	360
SCF (040F)	Safety Circuit Fault	Illuminated	Fault	360
SE (0020)	Modbus Test Mode Error	Flashing	Alarm	371

Display (Hex.)	Name	ALM LED	Type	Ref.
SE1 (0071)	Brake Sequence Fault 1 (SE1)	Illuminated	Fault	361
SE2 (0072)	Brake Sequence Fault 2 (SE2)	Illuminated	Fault	361
SE3 (0073)	Brake Sequence Fault 3 (SE3)	Illuminated	Fault	361
SE4 (0074)	Brake Sequence Fault 4 (SE4)	Illuminated	Fault	361
STo (003C)	Safe Torque OFF	Flashing	Alarm	371
SToF (003B)	Safe Torque OFF	Flashing	Alarm	371
SvE (0026)	Zero Servo Fault	Illuminated	Fault	361
TiM (0089)	Keypad Time Not Set	Flashing	Alarm	372
TiM (0401)	Keypad Time Not Set	Illuminated	Fault	361
TrPC (0042)	IGBT Maintenance Time (90%)	Flashing	Alarm	372
Uv (0001)	DC Bus Undervoltage	Flashing	Alarm	372
Uv1 (0002)	DC Bus Undervoltage	Illuminated	Fault	361
Uv2 (0003)	Control Power Undervoltage	Illuminated	Fault	362
Uv3 (0004)	Soft Charge Answerback Fault	Illuminated	Fault	362
vAEr	Voltage Class, Capacity Mismatch	-	Copy Function Error	381
vFyE	Parameters do not Match	-	Copy Function Error	381

6.4 Fault

This section gives information about some of the causes and possible solutions of faults. You must use the Fault Reset operation to remove the fault before you can operate the drive. Use the information in this table to remove the cause of the fault.

Code	Name	Causes	Possible Solutions
bAT	Keypad Battery Low Voltage	The keypad battery voltage is low.	Replace the keypad battery.
Note: Use *o4-24 [bAT Detection Selection]* to enable/disable *bAT* detection.			
Code	**Name**	**Causes**	**Possible Solutions**
bCE	Bluetooth Communication Fault	The smartphone or tablet with DriveWizard Mobile installed is too far from the keypad.	Use the smartphone or tablet 10 m (32.8 ft) or nearer to the keypad. **Note:** *bCE* can occur when the smartphone or tablet is 10 m (32.8 ft) or nearer to the keypad depending on the specifications of the smartphone or tablet.
		Radio waves from a different device are causing interference with communications between the smartphone or tablet and keypad.	Make sure that no device around the keypad uses the same radio bandwidth (2400 MHz to 2480 MHz), and prevent radio interference.
Note: • The drive detects this error when you use the Bluetooth LCD keypad and operate the drive with a smartphone or tablet. • Do a Fault Reset to clear the fault. • Set the stopping method for this fault in *o2-27 [bCE Detection Selection]*.			
Code	**Name**	**Causes**	**Possible Solutions**
boL	BrakingTransistor Overload Fault	The duty cycle of the braking transistor is high (the regeneration power or repetition frequency is high).	• Install a braking unit (CDBR-series). • Install a regenerative converter. • Increase the deceleration time.
		You enabled the protective function for the braking transistor when you have a regenerative converter.	Set *L8-55 = 0 [Internal DB TransistorProtection = Disable]*.
		The braking transistor in the drive is broken.	Replace the entire drive.
Note: Do a Fault Reset to clear the fault.			
Code	**Name**	**Causes**	**Possible Solutions**
bUS	Option Communication Error	The drive did not receive a signal from the controller.	Correct wiring errors.
		The communications cable wiring is incorrect.	
		There is a short-circuit in the communications cable or the communications cable is not connected.	• Repair short circuits and connect cables. • Replace the defective communications cable.
		Electrical interference caused a communication data error.	• Examine the control circuit lines, main circuit lines, and ground wiring, and decrease the effects of electrical interference. • Make sure that a magnetic contactor is not the source of the electrical interference, then use a Surge Protective Device if necessary. • Use only the recommended cables or other shielded line. Ground the shield on the controller side or the drive input power side. • Separate the communication wiring from drive power lines, and install a noise filter to the input side of the power supply for communication. • Decrease the effects of electrical interference from the controller.
		The option is incorrectly installed to the drive.	Correctly install the option to the drive.
		The option is damaged.	If the fault continues and the wiring is correct, replace the option.
Note: • The drive detects this error if the Run command or frequency reference is assigned to the option card. • Do a Fault Reset to clear the fault. • If the drive detects this error, the drive will operate the motor as specified by the stopping method set in *F6-01 [Communication Error Selection]*.			
Code	**Name**	**Causes**	**Possible Solutions**
CE	Modbus Communication Error	The communications cable wiring is incorrect.	Correct wiring errors.
		There is a short circuit in the communications cable or the communications cable is not connected.	• Repair short circuits and connect cables. • Replace the defective communications cable.

Code	Name	Causes	Possible Solutions
		Electrical interference caused a communication data error.	• Examine the control circuit lines, main circuit lines, and ground wiring, and decrease the effects of electrical interference. • Make sure that a magnetic contactor is not the source of the electrical interference, then use a Surge Protective Device if necessary. • Use only the recommended cables or other shielded line. Ground the shield on the controller side or the drive input power side. • Separate the communication wiring from drive power lines, and install a noise filter to the input side of the power supply for communication. • Decrease the effects of electrical interference from the controller.

Note:
• The drive detects this error if it does not correctly receive control data for the *CE* detection time set to *H5-09 [CE Detection Time]*.
• Do a Fault Reset to clear the fault.
• If the drive detects this error, the drive will operate the motor as specified by the stopping method set in *H5-04 [Communication Error Stop Method]*.

Code	Name	Causes	Possible Solutions
CF	Control Fault	Motor parameters are set improperly.	Correctly set the motor parameters and do Auto-Tuning again.
		The torque limit is too low.	Adjust *L7-01 to L7-04 [Torque Limit]*.
		The load inertia is too big.	• Adjust *C1-02, C1-04, C1-06, and C1-08 [Deceleration Times]*. • Set the frequency reference to the minimum output frequency, and stop the Run command when the drive stops deceleration.
		The drive is trying to ramp to stop a machine that cannot do ramp to stop or on a machine for which deceleration is not necessary.	Correctly set *b1-03 [Stopping Method Selection]*.
		The motor and drive are connected incorrectly.	Correct wiring errors.
		Line-to-line Resistance Tuning is not done.	Do Stationary Auto-Tuning for Line-to-Line Resistance.
		The drive received a Run command while the motor was coasting.	Reevaluate the sequence to ensure that the Run command is input after the motor has come to a complete stop.

Note:
• The drive detects this error if the torque reference is more than the torque limit for 3 seconds or longer while the drive ramps to stop.
• Do a Fault Reset to clear the fault.

Code	Name	Causes	Possible Solutions
CnT1	Number of Driving Over	*U4-53 [Num of Driv 1 (Low)]* or *U4-54 [Num of Driv 1 (High)]* is more than the setting value of *S2-13 [Motor1 Number of Driving Limit]*.	1. Adjust *S2-09 [Motor1 Number of Driving start]* so that the number of motor 1 operation starts does not trigger the output of the warning. 2. Input the fault reset signal.

Note:
• Do a Fault Reset to clear the fault.
• The operation of the drive when this fault is detected is determined by *S2-12 [MentenanceTimer Output Selection]*.

Code	Name	Causes	Possible Solutions
CnT2	Number of Driving Over	*U4-55 [Num of Driv 2 (Low)]* or *U4-56 [Num of Driv 2 (High)]* is more than the setting value of *S2-14 [Motor2 Number of Driving Limit]*.	1. Adjust *S2-10 [Motor2 Number of Driving start]* so that the number of motor 2 operation starts does not trigger the output of the warning. 2. Input the fault reset signal.

Note:
• Do a Fault Reset to clear the fault.
• The operation of the drive when this fault is detected is determined by *S2-12 [MentenanceTimer Output Selection]*.

Code	Name	Causes	Possible Solutions
CnT3	Number of Driving Over	*U4-57 [Num of Driv 3 (Low)]* or *U4-58 [Num of Driv 3 (High)]* is more than the setting value of *S2-15 [Motor3 Number of Driving Limit]*.	1. Adjust *S2-11 [Motor3 Number of Driving start]* so that the number of motor 3 operation starts does not trigger the output of the warning. 2. Input the fault reset signal.

Note:
• Do a Fault Reset to clear the fault.
• The operation of the drive when this fault is detected is determined by *S2-12 [MentenanceTimer Output Selection]*.

Code	Name	Causes	Possible Solutions
CoF	Current Offset Fault	Drive starts operation while the induced voltage remains in the motor (during coasting to a stop or after rapid deceleration).	Specify a sequence in which operation is not restarted when induced voltage remains in the motor.
		A drive hardware problem occurred.	Replace the drive.

Note:
• Detected if the current offset value exceeds the allowable setting range while the drive automatically adjusts the current offset.
• Perform Fault Reset to clear the fault.

Code	Name	Causes	Possible Solutions
CP1	Comparator 1 Limit Fault	The monitor value set in *H2-20 [Comparator 1 Monitor Selection]* was within the range of *H2-21 [Comparator 1 Lower Limit]* and *H2-22 [Comparator 1 Upper Limit]*.	Examine the monitor value setting and remove the cause of the fault.

Note:
• This fault is detected when the terminal is assigned to *H2-01 to H2-05 = 66 [MFDO Function Select = Comparator1]*.
• Do a Fault Reset to clear the fault.
• Set the stopping method for this fault in *H2-33 [Comparator1 Protection Selection]*.

Code	Name	Causes	Possible Solutions
CP2	Comparator 2 Limit Fault	The monitor value set in *H2-26 [Comparator 2 Monitor Selection]* was outside the range of *H2-27 [Comparator 2 Lower Limit]* and *H2-28 [Comparator 2 Upper Limit]*.	Examine the monitor value setting and remove the cause of the fault.

Note:
• This fault is detected when the terminal is assigned to *H2-01 to H2-05 = 67 [MFDO Function Select = Comparator2]*.
• Do a Fault Reset to clear the fault.
• Set the stopping method for this fault in *H2-35 [CP2 Protection Selection]*.

Code	Name	Causes	Possible Solutions
CPF00 to CPF03, CPF07 to CPF08, CPF11 to CPF14, CPF16 to CPF24, and CPF26 to CPF39	Control Circuit Error	A drive hardware problem occurred.	• Re-energize the drive. • If the fault stays, replace the control board or the drive. For information about replacing the control board, contact Yaskawa or your nearest sales representative.

Note:
• Do a Fault Reset to clear the fault.
• Fault trace is not available for these faults.

Code	Name	Causes	Possible Solutions
CPF06	EEPROM Memory Data Error	The drive power supply was switched off while the parameter Write command was entered from a communications option card.	Set *A1-03 = 2220 [Initialize Parameters = 2-Wire initialization]* and initialize the drive.
		An EEPROM peripheral circuit error occurred.	• Re-energize the drive and check if the fault still remains. • If the fault stays, replace the control board or the drive. For instructions on replacing the control board, contact Yaskawa or your nearest sales representative.

Note:
• Detected if there is an error in the data written to the EEPROM of the drive.
• Do a Fault Reset to clear the fault.
• Fault trace is not available for this fault.

Code	Name	Causes	Possible Solutions
CPF25	Terminal Board not Connected	The terminal board is not correctly connected to the drive.	1. De-energize the drive. 2. Correctly connect the terminal board to the drive. 3. Re-energize the drive.

Note:
Do a Fault Reset to clear the fault.

Code	Name	Causes	Possible Solutions
dEv	Speed Deviation	The load is too heavy.	Decrease the load.
		Acceleration and deceleration times are set too short.	Increase the values set in *C1-01 to C1-08 [Acceleration/ Deceleration Time]*.
		The *dEv* detection level settings are incorrect.	Adjust *F1-10 [Speed Deviation Detection Level]* and *F1-11 [Speed Deviation Detect DelayTime]*.
		The load is locked up.	Examine the machine.
		The holding brake is stopping the motor.	Release the holding brake.

Note:
• The drive detects this error if the difference between the detected speed and the speed reference is more than the setting of *F1-10* for longer than *F1-11*.
• Do a Fault Reset to clear the fault.
• If the drive detects this error, the drive will operate the motor as specified by the stopping method set in *F1-04 [Speed Deviation Detection Select]*.

Code	Name	Causes	Possible Solutions
E5	MECHATROLINK Watchdog Timer Err	The drive detected a watchdog circuit exception while it received data from the controller.	Examine the MECHATROLINK cable connection. If this error occurs frequently, examine the wiring and decrease the effects of electrical interference as specified by these manuals: • MECHATROLINK-II Installation Guide (MECHATROLINK Members Association, manual number MMATDEP011) • MECHATROLINK-III Installation Manual (MECHATROLINK Members Association, publication number MMATDEP018)

Note:
• Do a Fault Reset to clear the fault.
• If the drive detects this fault, it will operate the motor as specified by the stop method set in *F6-25 [MECHATROLINK Watchdog Error Sel]*.

Code	Name	Causes	Possible Solutions
EF0	Option Card External Fault	The communication option received an external fault from the controller.	1. Find the device that caused the external fault and remove the cause. 2. Clear the external fault input from the controller.
		A programming error occurred on the controller side.	Examine the operation of the controller program.

Note:
• The drive detects this fault if the alarm function on the external device side is operating.
• Do a Fault Reset to clear the fault.
• If the drive detects this fault, it will operate the motor as specified by the stop method set in *F6-03 [Comm External Fault (EF0) Select]*.

Code	Name	Causes	Possible Solutions
EF1	External Fault (Terminal S1)	MFDI terminal S1 caused an external fault through an external device.	1. Find the device that caused the external fault and remove the cause. 2. Clear the external fault input in the MFDI.
		The wiring is incorrect.	Correctly connect the signal line to MFDI terminal S1.
		External Fault [H1-01 = 20 to 2B] is set to MFDI terminal S1, but the terminal is not in use.	Correctly set the MFDI.

Note:
Do a Fault Reset to clear the fault.

Code	Name	Causes	Possible Solutions
EF2	External Fault (Terminal S2)	MFDI terminal S2 caused an external fault through an external device.	1. Find the device that caused the external fault and remove the cause. 2. Clear the external fault input in the MFDI.
		The wiring is incorrect.	Correctly connect the signal line to MFDI terminal S2.
		External Fault [H1-02 = 20 to 2B] is set to MFDI terminal S2, but the terminal is not in use.	Correctly set the MFDI.

Note:
Do a Fault Reset to clear the fault.

Code	Name	Causes	Possible Solutions
EF3	External Fault (Terminal S3)	MFDI terminal S3 caused an external fault through an external device.	1. Find the device that caused the external fault and remove the cause. 2. Clear the external fault input in the MFDI.
		The wiring is incorrect.	Correctly connect the signal line to MFDI terminal S3.
		External Fault [H1-03 = 20 to 2B] is set to MFDI terminal S3, but the terminal is not in use.	Correctly set the MFDI.

Note:
Do a Fault Reset to clear the fault.

Code	Name	Causes	Possible Solutions
EF4	External Fault (Terminal S4)	MFDI terminal S4 caused an external fault through an external device.	1. Find the device that caused the external fault and remove the cause. 2. Clear the external fault input in the MFDI.
		The wiring is incorrect.	Correctly connect the signal line to MFDI terminal S4.
		External Fault [H1-04 = 20 to 2B] is set to MFDI terminal S4, but the terminal is not in use.	Correctly set the MFDI.

Note:
Do a Fault Reset to clear the fault.

Code	Name	Causes	Possible Solutions
EF5	External Fault (Terminal S5)	MFDI terminal S5 caused an external fault through an external device.	1. Find the device that caused the external fault and remove the cause. 2. Clear the external fault input in the MFDI.
		The wiring is incorrect.	Correctly connect the signal line to MFDI terminal S5.
		External Fault [H1-05 = 20 to 2B] is set to MFDI terminal S5, but the terminal is not in use.	Correctly set the MFDI.

Note:
Do a Fault Reset to clear the fault.

Code	Name	Causes	Possible Solutions
EF6	External Fault (Terminal S6)	MFDI terminal S6 caused an external fault through an external device.	1. Find the device that caused the external fault and remove the cause. 2. Clear the external fault input in the MFDI.
		The wiring is incorrect.	Correctly connect the signal line to MFDI terminal S6.
		External Fault [H1-06 = 20 to 2B] is set to MFDI terminal S6, but the terminal is not in use.	Correctly set the MFDI.

Note:
Do a Fault Reset to clear the fault.

Code	Name	Causes	Possible Solutions
EF7	External Fault (Terminal S7)	MFDI terminal S7 caused an external fault through an external device.	1. Find the device that caused the external fault and remove the cause. 2. Clear the external fault input in the MFDI.
		The wiring is incorrect.	Correctly connect the signal line to MFDI terminal S7.
		External Fault [H1-07 = 20 to 2B] is set to MFDI terminal S7, but the terminal is not in use.	Correctly set the MFDI.
Note: Do a Fault Reset to clear the fault.			

Code	Name	Causes	Possible Solutions
EF8	External Fault (Terminal S8)	MFDI terminal S8 caused an external fault through an external device.	1. Find the device that caused the external fault and remove the cause. 2. Clear the external fault input in the MFDI.
		The wiring is incorrect.	Correctly connect the signal line to MFDI terminal S8.
		External Fault [H1-08 = 20 to 2B] is set to MFDI terminal S8, but the terminal is not in use.	Correctly set the MFDI.
Note: Do a Fault Reset to clear the fault.			

Code	Name	Causes	Possible Solutions
EF9	External Fault (Terminal S9)	MFDI terminal S9 caused an external fault through an external device.	1. Find the device that caused the external fault and remove the cause. 2. Clear the external fault input in the MFDI.
		The wiring is incorrect.	Correctly connect the signal line to MFDI terminal S9.
		External fault [H1-09 = 20 to 2B] is assigned to MFDI terminal S9 that is not in use.	Correctly set the MFDI.
Note: Do a Fault Reset to clear the fault.			

Code	Name	Causes	Possible Solutions
EF10	External Fault (Terminal S10)	MFDI terminal S10 caused an external fault through an external device.	1. Find the device that caused the external fault and remove the cause. 2. Clear the external fault input in the MFDI.
		The wiring is incorrect.	Correctly connect the signal line to MFDI terminal S10.
		External fault [H1-10 = 20 to 2B] is assigned to MFDI terminal S10 that is not in use.	Correctly set the MFDI.
Note: Do a Fault Reset to clear the fault.			

Code	Name	Causes	Possible Solutions
Err	EEPROM Write Error	There was a problem with the EEPROM hardware.	• Re-energize the drive. • If the fault stays, replace the control board or the drive. Contact Yaskawa or your nearest sales representative to replace the board.
		Electrical interference corrupted the data while it was writing to the EEPROM of the drive.	• Push ENTER Key. • Set the parameters again.
Note: Do a Fault Reset to clear the fault.			

Code	Name	Causes	Possible Solutions
FAn	Internal Fan Fault	The circulation fan stopped operating correctly.	• Examine circulation fan operation. • Re-energize the drive. • Examine *U4-03 [Cooling Fan Ope Time]* and *U4-04 [Cool Fan Maintenance]*. If the performance life of the circulation fan is expired or if there is damage to the fan, replace the fan.

Code	Name	Causes	Possible Solutions
FAn1	Drive Cooling Fan Fault	The cooling fan stopped operating correctly.	• Examine cooling fan operation. • Re-energize the drive. • Examine *U4-03 [Cooling Fan Ope Time]* and *U4-04 [Cool Fan Maintenance]*. If the performance life of the cooling fan is expired or if there is damage to the fan, replace the fan.
		The circulation fan is damaged.	• Examine circulation fan operation. • Re-energize the drive. • Examine *U4-03 [Cooling Fan Ope Time]* and *U4-04 [Cool Fan Maintenance]*. If there is damage to the circulation fan or if the performance life of the fan is expired, replace the fan.
Note: Do a Fault Reset to clear the fault.			

Code	Name	Causes	Possible Solutions
GF	Ground Fault	The motor is damaged from overheat or the motor insulation is deteriorated.	Measure the motor insulation resistance, and replace the motor if there is electrical conduction or unserviceable insulation.
		The motor main circuit cable is contacting ground to make a short circuit.	• Examine the motor main circuit cable for damage, and repair short circuits. • Measure the resistance between the motor main circuit cable and the ground terminal. If there is electrical conduction, replace the cable.
		An increase in the stray capacitance of the cable and the ground terminal caused an increase in the leakage current.	• If the wiring length of the cable is more than 100 m, decrease the carrier frequency. • Decrease the stray capacitance.
		There was a problem with the drive hardware.	Replace the control board or the drive. For information about replacing the control board, contact Yaskawa or your nearest sales representative.

Note:
• The drive detects this fault if a current short to ground was more than 50% of rated current on the output side of the drive.
• Do a Fault Reset to clear the fault.

Code	Name	Causes	Possible Solutions
LF	Output Phase Loss	The motor main circuit cable is disconnected.	Connect motor main circuit cable wiring. Correct wiring errors in the main circuit drive input power.
		There is a disconnection in the motor coil winding.	If a coil is disconnected, measure the motor Line-to-Line Resistance and replace the motor.
		The screws on the drive output terminals are loose.	Tighten the terminal screws to the correct tightening torque.
		The rated output current of the motor is less than 5% of the drive rated current.	Examine the drive capacity or the motor output to be applied.
		You are trying to use a single-phase motor.	The drive cannot operate a single-phase motor.
		The output transistor in the drive is damaged.	• Re-energize the drive. • If the fault stays, replace the control board or the drive. For information about replacing the control board, contact Yaskawa or your nearest sales representative.

Note:
• The drive detects this fault if phase loss occurs on the output side of the drive.
• Do a Fault Reset to clear the fault.
• Set *L8-07 [Output Phase Loss Protection Sel]* to enable and disable *LF* detection.

Code	Name	Causes	Possible Solutions
nSE	Node Setup Error	The *H1-xx = 47 [Node Setup (CANopen)]* terminal was activated during run.	Stop the drive when the Node Setup function is in use.
		The drive received a Run command while the Node Setup function was active.	

Note:
Do a Fault Reset to clear the fault.

Code	Name	Causes	Possible Solutions
oC	Overcurrent	The load is too heavy.	• Measure the current flowing into the motor. • Replace the drive with a larger capacity model if the current value exceeds the drive rated current. • Reduce the load or switch to a larger drive to avoid sudden changes in the current level.
		The motor is damaged from overheat or the motor insulation is deteriorated.	Measure the motor insulation resistance, and replace the motor if there is electrical conduction or unserviceable insulation.
		The motor main circuit cable is contacting ground to make a short circuit.	• Examine the motor main circuit cable for damage, and repair short circuits. • Measure the resistance between the motor main circuit cable and the ground terminal. If there is electrical conduction, replace the cable.
		The output transistor of the drive has been damaged due to a short circuit or ground fault on the drive output side.	• Make sure terminal B1 and terminals U/T1, V/T2, and W/T3 are not shorted. Also make sure terminal - and terminals U/T1, V/T2, and W/T3 are not shorted. • If a short circuit has occurred, contact Yaskawa or your nearest sales representative.
		The acceleration/deceleration time is too short.	• Calculate the torque necessary during acceleration related to the load inertia and the specified acceleration time. • Increase the value set in *C1-01, C1-03, C1-05, or C1-07 [Acceleration Time]* until the necessary torque is achieved. • Increase the value set in *C2-01 to C2-04 [S-Curve Characteristics]* until the necessary torque is achieved. • Replace the drive with a larger capacity model.
		The drive is trying to operate a specialized motor or a motor that is larger than the maximum applicable motor output of the drive.	• Examine the motor nameplate and reevaluate the motor and drive to make sure that the drive rated current is larger than the motor rated current. • Replace the drive with a larger capacity model.
		A magnetic contactor was switched at the output.	Set up the operation sequence so the magnetic contactor is not turned ON/OFF while the drive is outputting voltage.

Code	Name	Causes	Possible Solutions
		The V/f pattern settings are incorrect.	• Examine the ratios between the V/f pattern frequency and voltage. Decrease the voltage if it is too high compared to the frequency. • Adjust *E1-xx [V/f Pattern Parameters]* settings. For motor 2, adjust *E3-xx [V/f Pattern for Motor 2]* settings. For motor 3, adjust *E7-xx [V/f Pattern for Motor]* settings.
		Torque compensation gain is too large.	Decrease the value set in *C4-01 [Torque Compensation Gain]* so that the motor does not stall.
		A malfunction occurred due to noise.	Check the control circuit lines, main circuit lines, and ground wiring, and minimize the effects of electrical interference.
		The gain during overexcitation operation is set too large.	• Identify the timing under which the fault occurs. • If the fault occurs simultaneously with overexcitation operation, reduce the value set in *n3-13 [Overexcitation Deceleration Gain]*, considering the motor flux saturation.
		The drive received a Run command while the motor was coasting.	Reevaluate the sequence to ensure that the stop command is input after the motor has come to a complete stop.
		The control method is not set correctly for the motor being used.	Set *A1-02 [Control Method Selection]* correctly.
		The motor main circuit cable is too long.	Replace the drive with a larger capacity model.
Note: • Occurs if the drive sensors detect a drive output current exceeding the specified overcurrent detection level. • Do a Fault Reset to clear the fault.			
Code	**Name**	**Causes**	**Possible Solutions**
oFA00	Option Not Compatible with Port	The option connected to connector CN5-A is not compatible.	Connect the option to the correct connector. **Note:** Encoder options are not compatible with connector CN5-A.
Note: • Do a Fault Reset to clear the fault. • Fault trace is not available for these faults.			
Code	**Name**	**Causes**	**Possible Solutions**
oFA01	Option Fault/Connection Error	The option card connected to connector CN5-A is not compatible.	1. De-energize the drive. 2. Refer to the option card manual and correctly connect the option card to the connector on the drive.
Note: Do a Fault Reset to clear the fault.			
Code	**Name**	**Causes**	**Possible Solutions**
oFA02	Duplicate Options	The same option cards or the same type of option cards are connected to connectors CN5-A, B, and C.	Connect the option card to the correct connector. **Note:** Use connectors CN5-C and CN5-B to connect two encoder option cards.
Note: Do a Fault Reset to clear the fault.			
Code	**Name**	**Causes**	**Possible Solutions**
oFA03	Diagnostic Error	A fault occurred in the option card.	1. De-energize the drive. 2. Make sure that the option card is correctly connected to the connector. 3. If the problem continues, replace the option card.
Note: Do a Fault Reset to clear the fault.			
Code	**Name**	**Causes**	**Possible Solutions**
oFA04	Flash Write Mode	A fault occurred in the option card.	1. De-energize the drive. 2. Make sure that the option card is correctly connected to the connector. 3. If the problem continues, replace the option card.
Note: Do a Fault Reset to clear the fault.			
Code	**Name**	**Causes**	**Possible Solutions**
oFA05	Option A/D Error	A fault occurred in the option card.	1. De-energize the drive. 2. Make sure that the option card is correctly connected to the connector. 3. If the problem continues, replace the option card.
Note: Do a Fault Reset to clear the fault.			

Code	Name	Causes	Possible Solutions
oFA06	Option Communication Error	A fault occurred in the option card.	1. De-energize the drive. 2. Make sure that the option card is correctly connected to the connector. 3. If the problem continues, replace the option card.
Note: Do a Fault Reset to clear the fault.			
Code	**Name**	**Causes**	**Possible Solutions**
oFA10	Option RAM Error	A fault occurred in the option card.	1. De-energize the drive. 2. Make sure that the option card is correctly connected to the connector. 3. If the problem continues, replace the option card.
Note: Do a Fault Reset to clear the fault.			
Code	**Name**	**Causes**	**Possible Solutions**
oFA11	Option Ope Mode Error	A fault occurred in the option card.	1. De-energize the drive. 2. Make sure that the option card is correctly connected to the connector. 3. If the problem continues, replace the option card.
Note: Do a Fault Reset to clear the fault.			
Code	**Name**	**Causes**	**Possible Solutions**
oFA12	Drive Receive CRC Error	A fault occurred in the option card.	1. De-energize the drive. 2. Make sure that the option card is correctly connected to the connector. 3. If the problem continues, replace the option card.
Note: Do a Fault Reset to clear the fault.			
Code	**Name**	**Causes**	**Possible Solutions**
oFA13	Drive Receive Frame Error	A fault occurred in the option card.	1. De-energize the drive. 2. Make sure that the option card is correctly connected to the connector. 3. If the problem continues, replace the option card.
Note: Do a Fault Reset to clear the fault.			
Code	**Name**	**Causes**	**Possible Solutions**
oFA14	Drive Receive Abort Error	A fault occurred in the option card.	1. De-energize the drive. 2. Make sure that the option card is correctly connected to the connector. 3. If the problem continues, replace the option card.
Note: Do a Fault Reset to clear the fault.			
Code	**Name**	**Causes**	**Possible Solutions**
oFA15	Option Receive CRC Error	A fault occurred in the option card.	1. De-energize the drive. 2. Make sure that the option card is correctly connected to the connector. 3. If the problem continues, replace the option card.
Note: Do a Fault Reset to clear the fault.			
Code	**Name**	**Causes**	**Possible Solutions**
oFA16	Option Receive Frame Error	A fault occurred in the option card.	1. De-energize the drive. 2. Make sure that the option card is correctly connected to the connector. 3. If the problem continues, replace the option card.
Note: Do a Fault Reset to clear the fault.			
Code	**Name**	**Causes**	**Possible Solutions**
oFA17	Option Receive Abort Error	A fault occurred in the option card.	1. De-energize the drive. 2. Make sure that the option card is correctly connected to the connector. 3. If the problem continues, replace the option card.
Note: Do a Fault Reset to clear the fault.			

Code	Name	Causes	Possible Solutions
oFA30	COM ID Error	A fault occurred in the option card.	1. De-energize the drive. 2. Make sure that the option card is correctly connected to the connector. 3. If the problem continues, replace the option card.
Note: Do a Fault Reset to clear the fault.			
Code	**Name**	**Causes**	**Possible Solutions**
oFA31	Type Code Error	A fault occurred in the option card.	1. De-energize the drive. 2. Make sure that the option card is correctly connected to the connector. 3. If the problem continues, replace the option card.
Note: Do a Fault Reset to clear the fault.			
Code	**Name**	**Causes**	**Possible Solutions**
oFA32	SUM Check Error	A fault occurred in the option card.	1. De-energize the drive. 2. Make sure that the option card is correctly connected to the connector. 3. If the problem continues, replace the option card.
Note: Do a Fault Reset to clear the fault.			
Code	**Name**	**Causes**	**Possible Solutions**
oFA33	Option Receive Time Over	A fault occurred in the option card.	1. De-energize the drive. 2. Make sure that the option card is correctly connected to the connector. 3. If the problem continues, replace the option card.
Note: Do a Fault Reset to clear the fault.			
Code	**Name**	**Causes**	**Possible Solutions**
oFA34	Memobus Time Over	A fault occurred in the option card.	1. De-energize the drive. 2. Make sure that the option card is correctly connected to the connector. 3. If the problem continues, replace the option card.
Note: Do a Fault Reset to clear the fault.			
Code	**Name**	**Causes**	**Possible Solutions**
oFA35	Drive Receive Time Over 1	A fault occurred in the option card.	1. De-energize the drive. 2. Make sure that the option card is correctly connected to the connector. 3. If the problem continues, replace the option card.
Note: Do a Fault Reset to clear the fault.			
Code	**Name**	**Causes**	**Possible Solutions**
oFA36	CI Check Error	A fault occurred in the option card.	1. De-energize the drive. 2. Make sure that the option card is correctly connected to the connector. 3. If the problem continues, replace the option card.
Note: Do a Fault Reset to clear the fault.			
Code	**Name**	**Causes**	**Possible Solutions**
oFA37	Drive Receive Time Over 2	A fault occurred in the option card.	1. De-energize the drive. 2. Make sure that the option card is correctly connected to the connector. 3. If the problem continues, replace the option card.
Note: Do a Fault Reset to clear the fault.			
Code	**Name**	**Causes**	**Possible Solutions**
oFA38	Control Reference Error	A fault occurred in the option card.	1. De-energize the drive. 2. Make sure that the option card is correctly connected to the connector. 3. If the problem continues, replace the option card.
Note: Do a Fault Reset to clear the fault.			

Code	Name	Causes	Possible Solutions
oFA39	Drive Receive Time Over 3	A fault occurred in the option card.	1. De-energize the drive. 2. Make sure that the option card is correctly connected to the connector. 3. If the problem continues, replace the option card.
Note: Do a Fault Reset to clear the fault.			
Code	**Name**	**Causes**	**Possible Solutions**
oFA40	CtrlResSel 1Err	A fault occurred in the option card.	1. De-energize the drive. 2. Make sure that the option card is correctly connected to the connector. 3. If the problem continues, replace the option card.
Note: Do a Fault Reset to clear the fault.			
Code	**Name**	**Causes**	**Possible Solutions**
oFA41	Drive Receive Time Over 4	A fault occurred in the option card.	1. De-energize the drive. 2. Make sure that the option card is correctly connected to the connector. 3. If the problem continues, replace the option card.
Note: Do a Fault Reset to clear the fault.			
Code	**Name**	**Causes**	**Possible Solutions**
oFA42	CtrlResSel 2Err	A fault occurred in the option card.	1. De-energize the drive. 2. Make sure that the option card is correctly connected to the connector. 3. If the problem continues, replace the option card.
Note: Do a Fault Reset to clear the fault.			
Code	**Name**	**Causes**	**Possible Solutions**
oFA43	Drive Receive Time Over 5	A fault occurred in the option card.	1. De-energize the drive. 2. Make sure that the option card is correctly connected to the connector. 3. If the problem continues, replace the option card.
Note: Do a Fault Reset to clear the fault.			
Code	**Name**	**Causes**	**Possible Solutions**
oFb00	Option Not Compatible with Port	The option connected to connector CN5-B is not compatible.	Connect the option to the correct connector. **Note:** DO-A3, AO-A3, PG-B3, and PG-X3 options can connect to connector CN5-B. To connect only one PG option card, use the CN5-C connector.
Note: • Do a Fault Reset to clear the fault. • Fault trace is not available for these faults.			
Code	**Name**	**Causes**	**Possible Solutions**
oFb01	Option Fault/Connection Error	The option card connected to connector CN5-B was changed during operation.	1. De-energize the drive. 2. Refer to the option card manual and correctly connect the option card to the connector on the drive.
Note: Do a Fault Reset to clear the fault.			
Code	**Name**	**Causes**	**Possible Solutions**
oFb02	Duplicate Options	The same option cards or the same type of option cards are connected to connectors CN5-A, B, and C.	Connect the option card to the correct connector.
Note: Do a Fault Reset to clear the fault.			
Code	**Name**	**Causes**	**Possible Solutions**
oFb03	Diagnostic Error	A fault occurred in the option card.	1. De-energize the drive. 2. Make sure that the option card is correctly connected to the connector. 3. If the problem continues, replace the option card.
Note: Do a Fault Reset to clear the fault.			

Code	Name	Causes	Possible Solutions
oFb04	Flash Write Mode	A fault occurred in the option card.	1. De-energize the drive. 2. Make sure that the option card is correctly connected to the connector. 3. If the problem continues, replace the option card.
Note: Do a Fault Reset to clear the fault.			
Code	**Name**	**Causes**	**Possible Solutions**
oFb05	Option A/D Error	A fault occurred in the option card.	1. De-energize the drive. 2. Make sure that the option card is correctly connected to the connector. 3. If the problem continues, replace the option card.
Note: Do a Fault Reset to clear the fault.			
Code	**Name**	**Causes**	**Possible Solutions**
oFb06	Option Communication Error	A fault occurred in the option card.	1. De-energize the drive. 2. Make sure that the option card is correctly connected to the connector. 3. If the problem continues, replace the option card.
Note: Do a Fault Reset to clear the fault.			
Code	**Name**	**Causes**	**Possible Solutions**
oFb10	Option RAM Error	A fault occurred in the option card.	1. De-energize the drive. 2. Make sure that the option card is correctly connected to the connector. 3. If the problem continues, replace the option card.
Note: Do a Fault Reset to clear the fault.			
Code	**Name**	**Causes**	**Possible Solutions**
oFb11	Option Ope Mode Error	A fault occurred in the option card.	1. De-energize the drive. 2. Make sure that the option card is correctly connected to the connector. 3. If the problem continues, replace the option card.
Note: Do a Fault Reset to clear the fault.			
Code	**Name**	**Causes**	**Possible Solutions**
oFb12	Drive Receive CRC Error	A fault occurred in the option card.	1. De-energize the drive. 2. Make sure that the option card is correctly connected to the connector. 3. If the problem continues, replace the option card.
Note: Do a Fault Reset to clear the fault.			
Code	**Name**	**Causes**	**Possible Solutions**
oFb13	Drive Receive Frame Error	A fault occurred in the option card.	1. De-energize the drive. 2. Make sure that the option card is correctly connected to the connector. 3. If the problem continues, replace the option card.
Note: Do a Fault Reset to clear the fault.			
Code	**Name**	**Causes**	**Possible Solutions**
oFb14	Drive Receive Abort Error	A fault occurred in the option card.	1. De-energize the drive. 2. Make sure that the option card is correctly connected to the connector. 3. If the problem continues, replace the option card.
Note: Do a Fault Reset to clear the fault.			
Code	**Name**	**Causes**	**Possible Solutions**
oFb15	Option Receive CRC Error	A fault occurred in the option card.	1. De-energize the drive. 2. Make sure that the option card is correctly connected to the connector. 3. If the problem continues, replace the option card.
Note: Do a Fault Reset to clear the fault.			

Code	Name	Causes	Possible Solutions
oFb16	Option Receive Frame Error	A fault occurred in the option card.	1. De-energize the drive. 2. Make sure that the option card is correctly connected to the connector. 3. If the problem continues, replace the option card.
Note: Do a Fault Reset to clear the fault.			
Code	**Name**	**Causes**	**Possible Solutions**
oFb17	Option Receive Abort Error	A fault occurred in the option card.	1. De-energize the drive. 2. Make sure that the option card is correctly connected to the connector. 3. If the problem continues, replace the option card.
Note: Do a Fault Reset to clear the fault.			
Code	**Name**	**Causes**	**Possible Solutions**
oFC00	Option Not Compatible with Port	The option connected to connector CN5-C is not compatible.	Connect the option to the correct connector. **Note:** AI-A3, DI-A3, and communication options cannot be connected to the CN5-C connector.
Note: • Do a Fault Reset to clear the fault. • Fault trace is not available for these faults.			
Code	**Name**	**Causes**	**Possible Solutions**
oFC01	Option Fault/Connection Error	The option card connected to connector CN5-C was changed during operation.	1. De-energize the drive. 2. Refer to the option card manual and correctly connect the option card to the connector on the drive.
Note: Do a Fault Reset to clear the fault.			
Code	**Name**	**Causes**	**Possible Solutions**
oFC02	Duplicate Options	The same option cards or the same type of option cards are connected to connectors CN5-A, B, and C.	Connect the option card to the correct connector.
Note: Do a Fault Reset to clear the fault.			
Code	**Name**	**Causes**	**Possible Solutions**
oFC03	Diagnostic Error	A fault occurred in the option card.	1. De-energize the drive. 2. Make sure that the option card is correctly connected to the connector. 3. If the problem continues, replace the option card.
Note: Do a Fault Reset to clear the fault.			
Code	**Name**	**Causes**	**Possible Solutions**
oFC04	Flash Write Mode	A fault occurred in the option card.	1. De-energize the drive. 2. Make sure that the option card is correctly connected to the connector. 3. If the problem continues, replace the option card.
Note: Do a Fault Reset to clear the fault.			
Code	**Name**	**Causes**	**Possible Solutions**
oFC05	Option A/D Error	A fault occurred in the option card.	1. De-energize the drive. 2. Make sure that the option card is correctly connected to the connector. 3. If the problem continues, replace the option card.
Note: Do a Fault Reset to clear the fault.			

Code	Name	Causes	Possible Solutions
oFC06	Option Card Error Occurred at Option Port (CN5-C)	A fault occurred in the option.	1. De-energize the drive. 2. Make sure that the option is correctly connected to the connector. 3. Re-energize the drive. If the problem continues, replace the option.
		You re-energized the drive when: • There is an encoder option installed the drive • The drive main circuit power supply is energized • There is an external 24 V power supply connected to terminals PS-AC.	1. De-energize the drive main circuit power supply and the external 24 V power supply to terminals PS-AC. 2. After the keypad display goes out, energize the drive main circuit power supply again. 3. Supply the external 24 V power to terminals PS-AC.
			When you use an encoder, de-energize the drive main circuit power supply.
Note: Do a Fault Reset to clear the fault.			
Code	**Name**	**Causes**	**Possible Solutions**
oFC10	Option RAM Error	A fault occurred in the option card.	1. De-energize the drive. 2. Make sure that the option card is correctly connected to the connector. 3. If the problem continues, replace the option card.
Note: Do a Fault Reset to clear the fault.			
Code	**Name**	**Causes**	**Possible Solutions**
oFC11	Option Ope Mode Error	A fault occurred in the option card.	1. De-energize the drive. 2. Make sure that the option card is correctly connected to the connector. 3. If the problem continues, replace the option card.
Note: Do a Fault Reset to clear the fault.			
Code	**Name**	**Causes**	**Possible Solutions**
oFC12	Drive Receive CRC Error	A fault occurred in the option card.	1. De-energize the drive. 2. Make sure that the option card is correctly connected to the connector. 3. If the problem continues, replace the option card.
Note: Do a Fault Reset to clear the fault.			
Code	**Name**	**Causes**	**Possible Solutions**
oFC13	Drive Receive Frame Error	A fault occurred in the option card.	1. De-energize the drive. 2. Make sure that the option card is correctly connected to the connector. 3. If the problem continues, replace the option card.
Note: Do a Fault Reset to clear the fault.			
Code	**Name**	**Causes**	**Possible Solutions**
oFC14	Drive Receive Abort Error	A fault occurred in the option card.	1. De-energize the drive. 2. Make sure that the option card is correctly connected to the connector. 3. If the problem continues, replace the option card.
Note: Do a Fault Reset to clear the fault.			
Code	**Name**	**Causes**	**Possible Solutions**
oFC15	Option Receive CRC Error	A fault occurred in the option card.	1. De-energize the drive. 2. Make sure that the option card is correctly connected to the connector. 3. If the problem continues, replace the option card.
Note: Do a Fault Reset to clear the fault.			
Code	**Name**	**Causes**	**Possible Solutions**
oFC16	Option Receive Frame Error	A fault occurred in the option card.	1. De-energize the drive. 2. Make sure that the option card is correctly connected to the connector. 3. If the problem continues, replace the option card.
Note: Do a Fault Reset to clear the fault.			

Code	Name	Causes	Possible Solutions
oFC17	Option Receive Abort Error	A fault occurred in the option card.	1. De-energize the drive. 2. Make sure that the option card is correctly connected to the connector. 3. If the problem continues, replace the option card.
Note: Do a Fault Reset to clear the fault.			
Code	**Name**	**Causes**	**Possible Solutions**
oFC50	Option Card Error Occurred at Option Port (CN5-C)	A fault occurred in the option.	Refer to the manual for the PG-RT3 option card.
Note: Do a Fault Reset to clear the fault.			
Code	**Name**	**Causes**	**Possible Solutions**
oFC51	Option Card Error Occurred at Option Port (CN5-C)	A fault occurred in the option.	Refer to the manual for the PG-RT3 option card.
Note: Do a Fault Reset to clear the fault.			
Code	**Name**	**Causes**	**Possible Solutions**
oFC52	Option Card Error Occurred at Option Port (CN5-C)	A fault occurred in the option.	Refer to the manual for the PG-RT3 option card.
Note: Do a Fault Reset to clear the fault.			
Code	**Name**	**Causes**	**Possible Solutions**
oFC53	Option Card Error Occurred at Option Port (CN5-C)	A fault occurred in the option.	Refer to the manual for the PG-RT3 option card.
Note: Do a Fault Reset to clear the fault.			
Code	**Name**	**Causes**	**Possible Solutions**
oFC54	Option Card Error Occurred at Option Port (CN5-C)	A fault occurred in the option.	Refer to the manual for the PG-RT3 option card.
Note: Do a Fault Reset to clear the fault.			
Code	**Name**	**Causes**	**Possible Solutions**
oFC55	Resolver Error	A fault occurred in the option card.	Refer to the manual for the PG-RT3 or PG-F3 option card.
Note: Do a Fault Reset to clear the fault.			
Code	**Name**	**Causes**	**Possible Solutions**
oH	Heatsink Overheat	The ambient temperature is high and the heatsink temperature of the drive is more than the value set in *L8-02 [Overheat Alarm Level]*.	• Measure the ambient temperature. • Increase the airflow in the control panel. • Install a cooling device (cooling fan or air conditioner) to lower the ambient temperature. • Remove objects near the drive that are producing too much heat.
		The load is too heavy.	• Measure the output current. • Decrease the load. • Decrease the value set in *C6-02 [Carrier Frequency Selection]*.
		The internal cooling fan of the drive stopped.	1. Use the procedures in this manual to replace the cooling fan. 2. Set *o4-03 = 0 [Fan Operation Time Setting = 0 h]*.
Note: • The drive detects this fault if the heatsink temperature of the drive is more than the value set in *L8-02*. • Do a Fault Reset to clear the fault. • If the drive detects this fault, it will operate the motor as specified by the Stopping Method set in *L8-03 [Overheat Pre-Alarm Selection]*.			

Code	Name	Causes	Possible Solutions
oH1	Heatsink Overheat	The ambient temperature is high and the heatsink temperature of the drive is more than the *oH1* detection level.	• Measure the ambient temperature. • Increase the airflow in the control panel. • Install a cooling device (cooling fan or air conditioner) to lower the ambient temperature. • Remove objects near the drive that are producing too much heat.
		The load is too heavy.	• Measure the output current. • Decrease the load. • Decrease the value set in *C6-02 [Carrier Frequency Selection]*.

Note:
• The drive detects this fault if the heatsink temperature of the drive is more than the *oH1* detection level. *o2-04 [Drive Model (KVA) Selection]* determines the *oH1* detection level.
• Do a Fault Reset to clear the fault.

Code	Name	Causes	Possible Solutions
oH3	Motor Overheat (PTC Input)	The thermistor wiring that detects motor temperature is defective.	Correct wiring errors.
		A fault occurred on the machine. Example: The machine is locked.	Examine the machine and remove the cause of the fault.
		The motor has overheated.	• Examine the load level, acceleration/deceleration times, and motor start/stop frequency (cycle time). • Decrease the load. • Increase the values set in *C1-01 to C1-08 [Acceleration/ Deceleration Time]*. • Set *E2-01 [Motor Rated Current (FLA)]* correctly to the value specified by the motor nameplate. • Make sure that the motor cooling system is operating correctly, and repair or replace it if it is damaged. • Adjust *E1-04 to E1-10 [V/f Pattern Parameters]*. For motor 2, adjust *E3-xx [V/f Pattern for Motor 2]* settings. For motor 3, adjust *E7-xx [V/f Pattern for Motor 3]* settings. Decrease the values set in *Ex-08 [Mid Point A Voltage]* and *Ex-10 [Minimum Output Voltage]*. **Note:** If *Ex-08* and *Ex-10* are set too low, the overload tolerance will decrease at low speeds.

Note:
• The drive detects this fault if the motor overheat signal that was entered to an analog input terminals A1, A2, or A3 is more than the alarm detection level. (If *H3-02, H3-10, or H3-06 = E [MFAI Function Select = Motor Temperature (PTC Input)]* was set.)
• Do a Fault Reset to clear the fault.
• If the drive detects this fault, it will operate the motor as specified by the Stopping Method set in *L1-03 [Motor Thermistor oH Alarm Select]*.

Code	Name	Causes	Possible Solutions
oH4	Motor Overheat Fault (PTC Input)	The motor has overheated.	• Examine the load level, acceleration/deceleration times, and motor start/stop frequency (cycle time). • Decrease the load. • Increase the values set in *C1-01 to C1-08 [Acceleration/ Deceleration Time]*. • Set *E2-01 [Motor Rated Current (FLA)]* correctly to the value specified by the motor nameplate. • Make sure that the motor cooling system is operating correctly, and repair or replace it if it is damaged. • Adjust *E1-04 to E1-10 [V/f Pattern Parameters]*. For motor 2, adjust *E3-xx [V/f Pattern for Motor 2]* settings. For motor 3, adjust *E7-xx [V/f Pattern for Motor 3]* settings. Decrease the values set in *Ex-08 [Mid Point A Voltage]* and *Ex-10 [Minimum Output Voltage]*. **Note:** If *Ex-08* and *Ex-10* are set too low, the overload tolerance will decrease at low speeds.

Note:
• The drive detects this fault if the motor overheat signal that was entered to an analog input terminals A1, A2, or A3 is more than the fault detection level. (If *H3-02, H3-10, or H3-06 = E [MFAI Function Select = Motor Temperature (PTC Input)]* was set.)
• Do a Fault Reset to clear the fault.

Code	Name	Causes	Possible Solutions
oL1	Motor Overload	The load is too heavy	Decrease the load. **Note:** The value set in *U4-16 [Motor Overload Estimate(oL1)]* must be less than 100 before *oL1* can be reset.
		The acceleration/deceleration time or cycle time is too short.	• Examine the acceleration/deceleration times and the motor start/stop frequency (cycle time). • Increase the values set in *C1-01 to C1-08 [Acceleration/ Deceleration Time]*.

Code	Name	Causes	Possible Solutions
		Overload occurred while running at low speed.	• Decrease the load when running at low speed. • Raise the motor speed. • If the motor is run frequently at low speeds, either replace it with one that is a size larger or use a drive dedicated motor. **Note:** If a general-purpose motor is used, overload may occur while running at low speed even when operating at below the rated current.
		L1-01 [Motor Overload Protection Select] is not set correctly.	Set *L1-01* in accordance with the motor characteristics if a drive dedicated motor is used.
		The V/f pattern does not fit the motor qualities.	• Examine the ratios between the V/f pattern frequency and voltage. Decrease the voltage if it is too high compared to the frequency. • Adjust *E1-04 to E1-10 [V/f Pattern Parameters]*. For motor 2, adjust *E3-04 to E3-10 [V/f Pattern for Motor 2]*. Decrease the values set in *E1-08 [Mid Point A Voltage]* and *E1-10 [Minimum Output Voltage]*. **Note:** If *E1-08* and *E1-10* are set too low, the overload tolerance will decrease at low speeds.
		Set *E1-06 [Base Frequency]* correctly.	Set *E1-06* correctly to the rated frequency that indicated on the motor nameplate.
		Multiple motors are running off the same drive.	Set *L1-01 = 0 [Motor Overload Protection Select = Disabled]*, and then configure a circuit to protect the motors by connecting a thermal overload relay to each motor.
		The characteristics of the electronic thermal protector and the characteristics of the motor overload do not match.	• Examine the motor characteristics and set *L1-01 [Motor Overload (oL1) Protection]* correctly. • Connect a thermal overload relay to the motor.
		The electronic thermal protector is operating at the wrong level.	Set *E2-01 [Motor Rated Current (FLA)]* correctly to the value specified by the motor nameplate.
		Motor loss due to overexcitation operation is increasing.	• Lower the value set in *n3-13 [Overexcitation Deceleration Gain]*. • Set *L3-04 ≠ 4 [Decel Stall Prevention Selection ≠ Overexcitation/High Flux]*. • Set *n3-23 = 0 [Overexcitation Operation Select = Enabled in both directions]*.
		The output current is fluctuating due to input power supply phase loss.	Make sure that there is no phase loss, and repair problems.

Note:
• The drive detects this fault if the electronic thermal protector of the drive triggered the motor overload protection.
• Do a Fault Reset to clear the fault.

Code	Name	Causes	Possible Solutions
oL2	Drive Overload	The load is too heavy.	Decrease the load.
		The acceleration/deceleration time or cycle time is too short.	• Examine the acceleration/deceleration times and the motor start/stop frequency (cycle time). • Increase the values set in *C1-01 to C1-08 [Acceleration/ Deceleration Time]*.
		The V/f pattern does not fit the motor qualities.	• Examine the ratios between the V/f pattern frequency and voltage. Decrease the voltage if it is too high compared to the frequency. • Adjust *E1-xx [V/f Pattern Parameters]* settings. Decrease the values set in *E1-08 [Mid Point A Voltage]* and *E1-10 [Minimum Output Voltage]*. For motor 2, adjust *E3-xx [V/f Pattern for Motor 2]* settings. Decrease the values set in *E3-08 [Motor 2 Mid Point A Voltage]* and *E3-10 [Motor 2 Minimum Output Voltage]*. For motor 3, adjust *E7-xx [V/f Pattern for Motor 3]* settings. Decrease the values set in *E7-08 [Motor 3 Mid Point A Voltage]* and *E7-10 [Motor 3 Minimum Output Voltage]*. **Note:** If *Ex-08* and *Ex-10* are set too low, the overload tolerance will decrease at low speeds.
		The drive capacity is too small.	Replace the drive with a larger capacity model.
		Overload occurred while running at low speed.	• Decrease the load when running at low speed. • Replace the drive with a larger capacity model. • Decrease the value set in *C6-02 [Carrier Frequency Selection]*.
		Torque compensation gain is too large.	Decrease the value set in *C4-01 [Torque Compensation Gain]* so that the motor does not stall.
		The output current is fluctuating due to input power supply phase loss.	• Examine for wiring errors or disconnected wires in main circuit drive input power, and repair problems. • Make sure that there is no phase loss, and repair problems.

Note:
• The drive detects this fault if the electronic thermal protector of the drive started the motor overload protection.
• Do a Fault Reset to clear the fault.

Code	Name	Causes	Possible Solutions
oL3	Overtorque Detection 1	A fault occurred on the machine. Example: The machine is locked.	Examine the machine and remove the cause of the fault.
		The parameters are incorrect for the load.	Adjust the overtorque detection parameters.

Note:
• Detected if the motor current and torque exceeded the value set in *S6-02 [Overtorque Detection Level 1]* for longer than *S6-03 [Overtorque Detection Time 1]*.
• Do a Fault Reset to clear the fault.
• Set the conditions that trigger the fault using *S6-01 [OverT Detect Operation Select 1]*.

Code	Name	Causes	Possible Solutions
oL4	Overtorque Detection 2	A fault occurred on the machine. Example: The machine is locked.	Examine the machine and remove the cause of the fault.
		The parameters are incorrect for the load.	Adjust the overtorque detection parameters.

Note:
• The drive detects this fault if the motor current and torque are more than the value set in *S6-05 [Overtorque Detection Level 2]* for longer than *S6-06 [Overtorque Detection Time 2]*.
• Do a Fault Reset to clear the fault.
• Set the conditions that trigger the fault using *S6-04 [OverT Detect Operation Select 2]*.

Code	Name	Causes	Possible Solutions
oL5	Overload Detection (oL5)	A fault occurred on the machine. Example: Overload occurred.	Examine the machine and remove the cause of the fault.
		The parameters are incorrect for the load.	Adjust the overload detection parameters.

Note:
• Detects the fault in these conditions:
– The drive detects this fault if the motor current and torque are more than the value set in *S5-02 [OverL Detect Operation Select 1]* for longer than *S5-03 [Overload Detection Time 1]*.
– The drive detects this fault if the motor current and torque are more than the value set in *S5-05 [OverL Detect Operation Select 2]* for longer than *S5-06 [Overload Detection Time 2]*.
• Do a Fault Reset to clear the fault.
• Set the conditions that trigger detection using *S5-01 [OverL Detect Operation Select 1]* and *S5-04 [OverL Detect Operation Select 2]*.

Code	Name	Causes	Possible Solutions
oL6	Light-load Accel 2 Fault (oL6)	The setting for hold level and fault detection level of Light-load 2 functions are not appropriate.	Adjust *S4-10 [L-L 2 Motoring Hold Level]*, *S4-12 [L-L 2 Regen Hold Level]*, and *S4-15 [L-L 2 Fault Detection Level]* settings.
		Output frequency > *S4-08 [Light-load 2 Activation Freq]*.	

Note:
• The drive detects this fault if the motor speed is more than the value set in *S4-15* for longer than *S4-16 [L-L 2 Fault Detection Time]*.
• Do a Fault Reset to clear the fault.
• Set the conditions that trigger detection of a fault using *S4-14 [L-L 2 Fault Operation Selection]*.

Code	Name	Causes	Possible Solutions
oPr	Keypad Connection Fault	The keypad is not securely connected to the connector on the drive.	Examine the connection between the keypad and the drive.
		The connection cable between the drive and the keypad is disconnected.	• Remove the keypad and then reconnect it. • Replace the cable if damaged.

Note:
• The drive detects this fault if these conditions are correct:
– *o2-06 = 1 [Keypad Disconnect Detection = Enabled]*.
– *b1-02 = 0 [Run Command Selection 1 = Keypad]*, or the drive is operating in LOCAL Mode with the keypad.
• Do a Fault Reset to clear the fault.

Code	Name	Causes	Possible Solutions
oS	Overspeed	Overshoot is occurring.	Reduce *C5-01 [ASR Proportional Gain 1]* and increase *C5-02 [ASR Integral Time 1]*.

Note:
• Detected if the motor speed remains above the value set in *F1-08 [Overspeed Detection Level]* for longer than *F1-09 [Overspeed Detection Delay Time]*.
• Perform Fault Reset to clear the fault.
• If detected, the drive will operate the motor according to the stop method set in *F1-03 [Operation Select at Overspeed]*.

Code	Name	Causes	Possible Solutions
ov	Overvoltage	Deceleration time is too short and regenerative energy is flowing from the motor into the drive.	• Set *L3-04 = 1 [Stall Prevention during Decel = General Purpose]* to enable stall prevention. • Increase the value set in *C1-02, C1-04, C1-06, or C1-08 [Deceleration Time]*. • Connect a dynamic braking option to the drive. • Perform Deceleration Rate Auto-Tuning.
		The acceleration time is too short.	• Examine if sudden drive acceleration causes an overvoltage fault. • Increase the value set in *C1-01, C1-03, C1-05, or C1-07 [Acceleration Time]*. • Increase the value set in *C2-02 [S-Curve Time @ End of Accel]*.

Code	Name	Causes	Possible Solutions
		The braking load is too large.	Connect a dynamic braking option to the drive.
		Surge voltages are entered into input power supply.	Connect a DC reactor to the drive. **Note:** Within the same power supply system, turning phase advancing capacitors on and off, and operating thyristor converters may apply surge voltages and cause the input voltage to rise abnormally.
		The drive output cable or motor is shorted to ground (the current short to ground is charging the main circuit capacitor of the drive through the power supply).	1. Examine the motor main circuit cable, terminals, and motor terminal box, and then remove ground faults. 2. Re-energize the drive.
		The power supply voltage is too high.	Decrease the power supply voltage so that it matches the drive rated voltage.
		The braking resistor or braking resistor unit wiring is incorrect.	Correct wiring errors in the connection to the braking resistor or braking resistor unit.
		The encoder cable is incorrectly wired or disconnected.	Examine for wiring errors or disconnected wires in the encoder cable, and repair problems.
		Noise interference along the encoder cable.	Separate the encoder cable from the source of the noise such as the drive output line.
		A drive malfunction occurred due to electrical interference.	• Examine the control circuit lines, main circuit lines, and ground wiring, and decrease the effects of electrical interference. • Make sure that a magnetic contactor is not the source of the electrical interference, then use a Surge Protective Device if necessary.
		The load inertia is not set correctly.	• Examine the load inertia settings when using Stall Prevention during Deceleration function. • Adjust *L3-25 [Load Inertia Ratio]* settings in accordance with the machine.
		Motor hunting occurs.	• Adjust the parameters that control hunting. • Adjust *n1-02 [Hunting Prevention Gain Setting]* settings. • Adjust *n2-02 [Automatic Freq Regulator Time 1]* and *n2-03 [Automatic Freq Regulator Time 2]* settings.

Note:
• The drive detects this fault if the DC bus voltage is more than the *ov* detection level while the drive is running.
• The *ov* detection level is approximately 410 V with 200 V class drives. The detection level is approximately 820 V with 400 V class drives.
• Do a Fault Reset to clear the fault.

Code	Name	Causes	Possible Solutions
PF	Input Phase Loss	There is a phase loss in the drive input power.	Correct errors with the wiring for main circuit drive input power.
		There is loose wiring in the drive input power terminals.	Tighten the terminal screws to the correct tightening torque.
		The drive input power voltage is changing too much.	• Examine the input power for problems. • Make the drive input power stable. • If the input power supply is good, examine the magnetic contactor on the main circuit side for problems.
		There is unsatisfactory balance between voltage phases.	• Examine the input power for problems. • Make the drive input power stable. • Set *L8-05 = 0 [Input Phase Loss Protection Sel = Disabled]*.
		The main circuit capacitors have become unserviceable.	• Examine the capacitor maintenance time in monitor *U4-05 [CapacitorMaintenance]*. If *U4-05* is more than 90%, replace the control board or the drive. For information about replacing the control board, contact Yaskawa or your nearest sales representative. • If drive input power is correct and the fault stays, replace the control board or the drive. For information about replacing the control board, contact Yaskawa or your nearest sales representative.

Note:
• The drive detects this error if the DC bus voltage changes irregularly without regeneration.
• Do a Fault Reset to clear the fault.
• Use *L8-05* to enable and disable *PF* detection.

Code	Name	Causes	Possible Solutions
PGo	Encoder (PG) Feedback Loss	The encoder cable is disconnected or wired incorrectly.	Examine for wiring errors or disconnected wires in the encoder cable, and repair problems.
		The encoder is not receiving power.	Examine the encoder power supply.
		The holding brake is stopping the motor.	Release the holding brake.

Note:
• The drive detects this error if it does not receive the speed detection pulse signal from the encoder in the detection time set in *F1-14 [Encoder Open-Circuit Detect Time]*.
• Do a Fault Reset to clear the fault.
• If the drive detects this error, it will operate the motor as specified by the Stopping Method set in *F1-02 [PG Open Circuit Detection Select]*.

Code	Name	Causes	Possible Solutions
PGoH	Encoder (PG) Hardware Fault	The encoder cable is disconnected.	Connect any disconnected wires in the encoder cable.

Note:
• Do a Fault Reset to clear the fault.
• Parameter *F1-20 [Encoder 1 PCB Disconnect Detect]* or *F1-36 [Encoder 2 PCB Disconnect Detect]* enables and disables *PGoH* detection.
• If the drive detects this error, it will operate the motor as specified by the Stopping Method set in *F1-02 [PG Open Circuit Detection Select]*.

Code	Name	Causes	Possible Solutions
rF	Braking Resistor Fault	The resistance of the dynamic braking option that is connected to the drive is too low.	Use a dynamic braking option that fits the model and duty rating of the drive.
		A regenerative converter, regenerative unit, or braking unit is connected to the drive.	Set *L8-55 = 0 [Internal DB TransistorProtection = Disable]*.

Note:
Do a Fault Reset to clear the fault.

Code	Name	Causes	Possible Solutions
rH	Braking Resistor Overheat	The deceleration time is too short and excessive regenerative energy is flowing back into the drive.	• Check the load level, deceleration time, and speed. • Decrease the load. • Increase the values set in *C1-02, C1-04, C1-06, or C1-08 [Deceleration Times]*. • Use a dynamic braking option that lets you use more power.
		The duty cycle is too high.	Examine the duty cycle. **Note:** When *L8-01 = 1 [3% ERF DB Resistor Protection = Enabled]*, the maximum braking duty cycle is 3%.
		The braking load is too heavy.	• Calculate the braking load and braking power again, and decrease the braking load. • Use a braking resistor that improves braking power.
		The braking resistor is not sufficient.	Use the braking resistor specifications to select a sufficient braking resistor.

Note:
• The drive detects this error if the braking resistor overheat protective function is active.
• The magnitude of the braking load causes the braking resistor overheat alarm, NOT the surface temperature. If the duty cycle is higher than the braking resistor rating, the drive will show the alarm.
• Do a Fault Reset to clear the fault.
• Parameter *L8-01* enables and disables *rH* detection.

Code	Name	Causes	Possible Solutions
rr	Dynamic Braking Transistor Fault	The drive control circuit is damaged.	• Re-energize the drive. • If the fault stays, replace the control board or the drive. For information about replacing the control board, contact Yaskawa or your nearest sales representative.
		There is a malfunction in the internal braking transistor of the drive.	

Note:
Do a Fault Reset to clear the fault.

Code	Name	Causes	Possible Solutions
SC	Short Circuit/IGBT Failure	Overheating caused damage to the motor or the motor insulation is not satisfactory.	Measure the motor insulation resistance, and replace the motor if there is electrical conduction or unserviceable insulation.
		The motor main circuit cable is contacting ground to make a short circuit.	• Examine the motor main circuit cable for damage, and repair short circuits. • Measure the resistance between the motor main circuit cable and the ground terminal. If there is electrical conduction, replace the cable.
		A short circuit or ground fault on the drive output side caused damage to the output transistor of the drive.	• Make sure that there is not a short circuit in terminal B1 and terminals U/T1, V/T2, and W/T3. Make sure that there is not a short circuit in terminals - and terminals U/T1, V/T2, and W/T3. • If there is a short circuit, contact Yaskawa or your nearest sales representative.
		When *A1-02 = 5, 6, 7 [Control Method Selection = OLV/PM, AOLV/PM, or CLV/PM]*, the output current is more than the value set in *L8-27 [Overcurrent Detection Gain]*.	Set *L8-27* correctly.

Note:
• The drive detects this error if there is a short circuit or ground fault on the drive output side, or an IGBT failure.
• Do a Fault Reset to clear the fault.

Code	Name	Causes	Possible Solutions
SCF	Safety Circuit Fault	The safety circuit is broken.	Replace the control board or the drive. For information about replacing the control board, contact Yaskawa or your nearest sales representative.

Note:
Do a Fault Reset to clear the fault.

Code	Name	Causes	Possible Solutions
SE1	Brake Sequence Fault 1 (SE1)	A forward and a reverse command were input simultaneously.	Examine the forward and reverse command sequence circuit.

Note:
• Detected if the status that a forward a reverse command were input simultaneously reaches the detection time set in *S1-16 [Sequence Fault SE1 Detect Time]*.
• Do a Fault Reset to clear the fault.

Code	Name	Causes	Possible Solutions
SE2	Brake Sequence Fault 2 (SE2)	The motor is not connected and the current does not flow. The break release command (BR) does not turn ON.	Examine the motor circuit.
		The brake release current and torque setting value is too high.	Decrease the parameter setting values appropriately for the load.
		Brake grinding occurs and it does not reach the brake release torque.	Examine the brake torque.

Note:
• Detected if the status that there is no brake release command signal (BX) reaches the detection time set in *S1-17 [Sequence Fault SE2 Detect Time]*.
• Do a Fault Reset to clear the fault.

Code	Name	Causes	Possible Solutions
SE3	Brake Sequence Fault 3 (SE3)	Sequence Error of the Brake Circuit.	Examine the sequence circuit of brake release check signal (BX).
		The response (scan) of the Sequence circuit is slow.	
		Loose connection or disconnection of the relay, electromagnetic contactor and brake.	Examine the relay, electromagnetic contactor and brake.

Note:
• Detected if the status that there is no brake release check signal (BX) from the sequence circuit reaches the detection time set in *S1-18 [Sequence Fault SE3 Detect Time]*.
• Do a Fault Reset to clear the fault.

Code	Name	Causes	Possible Solutions
SE4	Brake Sequence Fault 4 (SE4)	The break release check (BX) turns ON when the break release command (BR) is OFF.	Examine the sequence circuit of brake release check signal (BX).
		Loose connection or disconnection of the relay, electromagnetic contactor and brake.	Examine the relay, electromagnetic contactor and brake.

Note:
• Detected if the status that there is no response from the sequence circuit reaches the detection time set in *S1-19 [Sequence Fault SE4 Detect Time]*.
• Do a Fault Reset to clear the fault.

Code	Name	Causes	Possible Solutions
SvE	Zero Servo Fault	The value set in the torque limit is too small.	Adjust torque limit-related parameters *L7-01 to L7-04*.
		The load torque is too large.	Decrease the load torque.
		Noise interference along the encoder cable	Isolate the encoder cable from the drive output line or a different source of electrical interference.

Note:
• The drive detects this error if motor rotation position moves during Zero Servo.
• Do a Fault Reset to clear the fault.

Code	Name	Causes	Possible Solutions
TiM	Keypad Time Not Set	There is a battery in the keypad, but the date and time are not set.	Use the keypad to set the date and time.

Note:
• Do a Fault Reset to clear the fault.
• Parameter *o4-24 [bAT Detection Selection]* enables and disables *TiM* detection.

Code	Name	Causes	Possible Solutions
Uv1	DC Bus Undervoltage	There is a phase loss in the drive input power.	Examine for wiring errors or disconnected wires in main circuit drive input power, and repair problems.
		There is loose wiring in the drive input power terminals.	Tighten the terminal screws to the correct tightening torque.
		The drive input power voltage is changing too much.	• Review the power supply voltage so that it matches the drive rated voltage. • Make the drive input power stable. • If the input power supply is good, examine the magnetic contactor on the main circuit side for problems.
		There was a loss of power.	Improve the power supply.
		The main circuit capacitors have become unserviceable.	Examine the capacitor maintenance time in monitor *U4-05 [CapacitorMaintenance]*. If *U4-05* is more than 90%, replace the control board or the drive. For more information about replacing the control board, contact Yaskawa or your nearest sales representative.

Code	Name	Causes	Possible Solutions
		The relay or contactor on the soft-charge bypass relay is damaged.	Examine the soft-charge bypass relay maintenance time in monitor *U4-06 [PreChargeRelayMainte]*. If *U4-06* is more than 90%, replace the control board or the drive. For more information about replacing the control board, contact Yaskawa or your nearest sales representative.

Note:
- The drive detects this error if the DC bus voltage decreases below the level set in *L2-05 [Undervoltage Detection Lvl (Uv1)]* while the drive is running.
- The *Uv1* detection level is approximately 190 V for a 200 V class drives. The detection level is approximately 380 V with 400 V class drives. The detection level is approximately 350 V when *E1-01 [Input AC Supply Voltage]* is set lower than 400.
- Do a Fault Reset to clear the fault.
- Fault trace is not available for this fault.

Code	Name	Causes	Possible Solutions
Uv2	Control Power Undervoltage	A drive hardware problem occurred.	• Re-energize the drive and check if the fault still remains. • Replace the control board or the entire drive if the fault continues. Contact Yaskawa or your nearest sales representative for instructions on replacing the control board.

Note:
- Detected if the control power supply voltage has dropped.
- Perform Fault Reset to clear the fault.
- Fault tracing cannot be executed.

Code	Name	Causes	Possible Solutions
Uv3	Soft Charge Answerback Fault	The relay or contactor on the soft-charge bypass relay is damaged.	• Re-energize the drive. • If the fault stays, replace the control board or the drive. • Check monitor *U4-06 [PreChargeRelayMainte]* shows the performance life of the soft-charge bypass relay. If *U4-06* is more than 90%, replace the board or the drive. For information about replacing the control board, contact Yaskawa or your nearest sales representative.

Note:
- Do a Fault Reset to clear the fault.
- Fault trace is not available for these faults.

6.5 Minor Faults/Alarms

This section gives information about the causes and possible solutions when a minor fault or alarm occurs. Use the information in this table to remove the cause of the minor fault or alarm.

Code	Name	Causes	Possible Solutions
AEr	Station Address Setting Error (CC-Link, CANopen, MECHATROLINK)	Option card node address is outside of the acceptable setting range.	• For CC-Link communication, set *F6-10 [CC-Link Node Address]* correctly. • For MECHATROLINK communication, set *F6-20 [MECHATROLINK Station Address]* correctly. • For CANopen communication, set *F6-35 [CANopen Node ID Selection]* correctly.
Note: If the drive detects this error, the terminal assigned to *H2-01 to H2-05 = 10 [MFDO Function Select = Alarm]* will be ON.			
Code	**Name**	**Causes**	**Possible Solutions**
bAT	Keypad Battery Low Voltage	The voltage of keypad battery is decreased.	Replace the keypad battery.
Note: • If the drive detects this error, the terminal assigned to *H2-01 to H2-05 = 10 [MFDO Function Selection = Alarm]* will be ON. • Set *o4-24 [bAT Detection Selection]* to enable/disable *bAT* detection.			
Code	**Name**	**Causes**	**Possible Solutions**
bb	Baseblock	An external baseblock command was entered through MFDI terminal S1 to S10, and the drive output stopped as shown by an external baseblock command.	Examine the external sequence and timing of the baseblock command input.
Note: A minor fault signal will not be output even if the drive detects an alarm.			
Code	**Name**	**Causes**	**Possible Solutions**
bCE	Bluetooth Communication Error	The smart device with DriveWizard Mobile installed is too far from the keypad.	Move the smart device to 10 m or nearer from the keypad. **Note:** *bCE* can occur when the smart device is 10 m or nearer to the keypad depending on the specifications of the smart device.
		Radio waves from a different device are causing interference with communications between the smart device and keypad.	Make sure that no device around the keypad uses the same radio bandwidth (2400 MHz to 2480 MHz), and prevent radio interference.
Note: • The drive detects this error when operating the drive with a smart device using the Bluetooth LCD keypad. • If the drive detects this error, the terminal assigned to *H2-01 to H2-05 = 10 [MFDO Function Select = Alarm]* will be ON. • Use *o2-27 [bAT Detection selection]* to enable/disable *bCE* detection.			
Code	**Name**	**Causes**	**Possible Solutions**
boL	Braking Transistor Overload	The duty cycle of the braking transistor is high (the regeneration power or repetition frequency is high).	• Install a braking unit (CDBR series). • Install a regenerative converter. • Increase the deceleration time.
		The braking transistor protective function is enabled when a regenerative converter is being used.	Set *L8-55 = 0 [InternalBrakingTransistorProtect = Disable]*.
		The built-in braking transistor is damaged.	Replace the drive.
Note: If the drive detects this error, the terminal assigned to *H2-01 to H2-05 = 10 [MFDO Function Select = Alarm]* will be ON.			
Code	**Name**	**Causes**	**Possible Solutions**
bUS	Option Communication Error	The communications cable wiring is incorrect.	Correct wiring errors.
		There is a short circuit or disconnection in the communications cable.	• Repair disconnected cables and short circuits for proper wiring. • Replace a faulty communications cable with a normal one.
		Communication data error occurred due to noise.	• Examine the control circuit lines, main circuit lines, and ground wiring, and decrease the effects of electrical interference. • Make sure that a magnetic contactor is not the source of the electrical interference, then use a Surge Protective Device if necessary. • Use only recommended cables or other shielded line. Ground the shield on the controller side or the drive input power side. • Separate all communication wiring from drive power lines, and install a noise filter to the input side of the power supply for communication. • Minimize the effects of controller noise.
		The option card is not correctly connected to the drive.	Mount the option card to the drive correctly.

Code	Name	Causes	Possible Solutions
		The option card is damaged.	if there are no problems with the wiring and the error continues to occur, replace the option card.

Note:
• The drive detects this error if the Run command or frequency reference is assigned to the option card.
• If the drive detects this error, the terminal assigned to *H2-01 to H2-05 = 10 [MFDO Function Select = Alarm]* will be ON.
• Set the stopping method for this fault in *F6-01 [Communication Error Selection]*.

Code	Name	Causes	Possible Solutions
CALL	Serial Comm Transmission Error	The communications cable wiring is incorrect.	Correct wiring errors.
		There is a short circuit or disconnection in the communications cable.	• Repair disconnected cables and short circuits for proper wiring. • Replace a faulty communications cable with a normal one.
		Programming error occurred on the controller side.	Examine communications at start-up and correct programming errors.
		Communications circuitry is damaged.	• Perform a self-diagnostics check. • If the problem continues, replace the control board or the entire drive. For information about replacing the control board, contact Yaskawa or your nearest sales representative.
		Termination resistor setting for MEMOBUS/ Modbus communications is incorrect.	Enable the termination resistor in the last drive in a MEMOBUS/ Modbus network by setting DIP switch S2 to the ON position.

Note:
• Detects if control data cannot be received from the controller correctly when energizing the drive.
• If the drive detects this error, the terminal assigned to *H2-01 to H2-05 = 10 [MFDO Function Select = Alarm]* will be ON.

Code	Name	Causes	Possible Solutions
CE	Modbus Communication Error	The communications cable wiring is incorrect.	Correct wiring errors.
		There is a short circuit or disconnection in the communications cable.	• Repair disconnected cables and short circuits for proper wiring. • Replace a faulty communications cable with a normal one.
		Communication data error occurred due to noise.	• Examine the control circuit lines, main circuit lines, and ground wiring, and decrease the effects of electrical interference. • Make sure that a magnetic contactor is not the source of the electrical interference, then use a Surge Protective Device if necessary. • Use only recommended cables or other shielded line. Ground the shield on the controller side or the drive input power side. • Separate all communication wiring from drive power lines, and install a noise filter to the input side of the power supply for communication. • Minimize the effects of controller noise.
		Communication protocol is incompatible.	• Examine the values set in *H5-xx*. • Examine the settings on the controller side and correct the difference in communication conditions.
		The time set in *H5-09 [CE Detection Time]* is too short for the communications cycle.	• Change the controller software settings. • Increase the value set in *H5-09*.
		Something in the controller software or hardware is causing a communication problem.	Examine the controller and remove the cause of the error.

Note:
• Detected if control data was not received correctly for the CE detection time set to *H5-09*.
• If the drive detects this error, the terminal assigned to *H2-01 to H2-05 = 10 [MFDO Function Select = Alarm]* will be ON.
• Set the stopping method for this fault in *H5-04 [Stopping Method after Com Error]*.

Code	Name	Causes	Possible Solutions
CnT1	Number of Driving Over	The number of accumulated motor 1 starts is more than the setting value of *S2-13 [Motor1 Number of Driving Limit]*.	1. Inspect peripheral devices as necessary. 2. Set *S2-09 [Motor1 Number of Driving start] = 0* to reset the accumulated number of motor 1 starts.

Code	Name	Causes	Possible Solutions
CnT2	Number of Driving Over	The number of accumulated motor 2 starts is more than the setting value of *S2-14 [Motor2 Number of Driving Limit]*.	1. Inspect peripheral devices as necessary. 2. Set *S2-10 [Motor2 Number of Driving start] = 0* to reset the accumulated number of motor 2 starts.

Code	Name	Causes	Possible Solutions
CnT3	Number of Driving Over	The number of accumulated motor 3 starts is more than the setting value of *S2-15 [Motor3 Number of Driving Limit]*.	1. Inspect peripheral devices as necessary. 2. Set *S2-11 [Motor3 Number of Driving start] = 0* to reset the accumulated number of motor 3 starts.

Code	Name	Causes	Possible Solutions
CP1	Comparator 1 Limit Fault	The monitor value set in *H2-20 [Comparator 1 Monitor Selection]* was within the range of *H2-21 [Comparator 1 Lower Limit]* and *H2-22 [Comparator 1 Upper Limit]*.	Examine the monitor value and remove the cause of the error.

Note:
• This fault is detected when the terminal is assigned to *H2-01 to H2-05 = 66 [MFDO Function Select = Comparator1]*.
• If the drive detects this error, the terminal assigned to *H2-01 to H2-05 = 10 [MFDO Function Select = Alarm]* will be ON.
• Use *H2-33 [CP1 Protection Selection]* to enable/disable *CP1* detection.

Code	Name	Causes	Possible Solutions
CP2	Comparator 2 Limit Fault	The monitor value set in *H2-26 [Comparator 2 Monitor Selection]* was outside the range of *H2-27 [Comparator 2 Lower Limit]* and *H2-28 [Comparator 2 Upper Limit]*.	Examine the monitor value and remove the cause of the error.

Note:
• This fault is detected when the terminal is assigned to *H2-01 to H2-05 = 67 [MFDO Function Select = Comparator2]*.
• If the drive detects this error, the terminal assigned to *H2-01 to H2-05 = 10 [MFDO Function Select = Alarm]* will be ON.
• Use *H2-35 [CP2 Protection Selection]* to enable/disable *CP2* detection.

Code	Name	Causes	Possible Solutions
CrST	Cannot Reset	The drive received a fault reset command when a Run command was active.	Turn off the Run command then de-energize and re-energize the drive.

Code	Name	Causes	Possible Solutions
CyC	MECHATROLINK CommCycleSettingErr	The communications cycle of the controller was set outside the allowable range of the MECHATROLINK interface option card.	Set the communications cycle of the controller so that it falls within the allowable range of the MECHATROLINK interface option card.

Note:
If the drive detects this error, the terminal assigned to *H2-01 to H2-05 = 10 [MFDO Function Select = Alarm]* will be ON.

Code	Name	Causes	Possible Solutions
dEv	Speed Deviation	The load is too heavy	Decrease the load.
		The acceleration/deceleration time is too short.	Increase the values set in *C1-01 to C1-08 [Acceleration/ Deceleration Time]*.
		The *dEv* detection level settings are incorrect.	Adjust *F1-10 [Speed Deviation Detection Level]* and *F1-11 [Speed Deviation Detect DelayTime]*.
		The load is locked up.	Examine the machine.
		The holding brake is stopping the motor.	Release the holding brake.

Note:
• Detected if the deviation between the detected speed and the speed reference is greater than the setting in *F1-10* for longer than *F1-11*.
• If the drive detects this error, the terminal assigned to *H2-01 to H2-05 = 10 [MFDO Function Select = Alarm]* will be ON.
• Set the stopping method for this fault in *F1-04 [Speed Deviation Detection Select]*.

Code	Name	Causes	Possible Solutions
E5	MECHATROLINK Watchdog Timer Err	A watchdog circuit exception was detected while receiving data from the controller.	Examine the MECHATROLINK cable connection. If this error occurs frequently, check the wiring and minimize the effects of noise in accordance with the following manuals: • MECHATROLINK-II Installation Guide (MECHATROLINK Members Association, manual number MMATDEP011) • MECHATROLINK-III Installation Manual (MECHATROLINK Members Association, publication number MMATDEP018)

Note:
• If the drive detects this error, the terminal assigned to *H2-01 to H2-05 = 10 [MFDO Function Select = Alarm]* will be ON.
• Set the stopping method for this fault in *F6-25 [MECHATROLINK Watchdog Error Sel]*.

Code	Name	Causes	Possible Solutions
EF	FWD/REV Run Command Input Error	A forward command and a reverse command were input simultaneously for longer than 0.5 s.	Examine the forward and reverse command sequence and correct the problem.

Note:
• The motor ramps to stop when *EF* is detected.
• If the drive detects this error, the terminal assigned to *H2-01 to H2-05 = 10 [MFDO Function Select = Alarm]* will be ON.

Code	Name	Causes	Possible Solutions
EF0	Option Card External Fault	The communication option card received an external fault from the controller.	1. Find the device that caused the external fault and remove the cause. 2. Clear the external fault input from the controller.
		Programming error occurred on the controller side.	Examine the operation of the controller program.

Note:
• The drive detects this error if the alarm function on the external device side is operating.
• If the drive detects this error, the terminal assigned to *H2-01 to H2-05 = 10 [MFDO Function Select = Alarm]* will be ON.
• Set the stopping method for this fault in *F6-03 [Comm External Fault (EF0) Select]*.

Code	Name	Causes	Possible Solutions
EF1	External Fault (Terminal S1)	MFDI terminal S1 caused an external fault through an external device.	1. Find the device that caused the external fault and remove the cause. 2. Clear the external fault input in the MFDI.
		The wiring is incorrect.	Correctly connect the signal line to MFDI terminal S1.
		External fault [H1-01 = 2C to 2F] is set to MFDI terminal S1, but the terminal is not in use.	Correctly set the MFDI.
Note: If the drive detects this error, the terminal assigned to *H2-01 to H2-05 = 10 [MFDO Function Select = Alarm]* will be ON.			
Code	**Name**	**Causes**	**Possible Solutions**
EF2	External Fault (Terminal S2)	MFDI terminal S2 caused an external fault through an external device.	1. Find the device that caused the external fault and remove the cause. 2. Clear the external fault input in the MFDI.
		The wiring is incorrect.	Correctly connect the signal line to MFDI terminal S2.
		External fault [H1-02 = 2C to 2F] is set to MFDI terminal S2, but the terminal is not in use.	Correctly set the MFDI.
Note: If the drive detects this error, the terminal assigned to *H2-01 to H2-05 = 10 [MFDO Function Select = Alarm]* will be ON.			
Code	**Name**	**Causes**	**Possible Solutions**
EF3	External Fault (Terminal S3)	MFDI terminal S3 caused an external fault through an external device.	1. Find the device that caused the external fault and remove the cause. 2. Clear the external fault input in the MFDI.
		The wiring is incorrect.	Correctly connect the signal line to MFDI terminal S3.
		External fault [H1-03 = 2C to 2F] is set to MFDI terminal S3, but the terminal is not in use.	Correctly set the MFDI.
Note: If the drive detects this error, the terminal assigned to *H2-01 to H2-05 = 10 [MFDO Function Select = Alarm]* will be ON.			
Code	**Name**	**Causes**	**Possible Solutions**
EF4	External Fault (Terminal S4)	MFDI terminal S4 caused an external fault through an external device.	1. Find the device that caused the external fault and remove the cause. 2. Clear the external fault input in the MFDI.
		The wiring is incorrect.	Correctly connect the signal line to MFDI terminal S4.
		External fault [H1-04 = 2C to 2F] is set to MFDI terminal S4, but the terminal is not in use.	Correctly set the MFDI.
Note: If the drive detects this error, the terminal assigned to *H2-01 to H2-05 = 10 [MFDO Function Select = Alarm]* will be ON.			
Code	**Name**	**Causes**	**Possible Solutions**
EF5	External Fault (terminal S5)	MFDI terminal S5 caused an external fault through an external device.	1. Find the device that caused the external fault and remove the cause. 2. Clear the external fault input in the MFDI.
		The wiring is incorrect.	Correctly connect the signal line to MFDI terminal S5.
		External fault [H1-05 = 2C to 2F] is assigned to MFDI terminal S5 that is not in use.	Correctly set the MFDI.
Note: If the drive detects this error, the terminal assigned to *H2-01 to H2-05 = 10 [MFDO Function Select = Alarm]* will be ON.			
Code	**Name**	**Causes**	**Possible Solutions**
EF6	External Fault (terminal S6)	MFDI terminal S6 caused an external fault through an external device.	1. Find the device that caused the external fault and remove the cause. 2. Clear the external fault input in the MFDI.
		The wiring is incorrect.	Correctly connect the signal line to MFDI terminal S6.
		External fault [H1-06 = 2C to 2F] is assigned to MFDI terminal S6 that is not in use.	Correctly set the MFDI.
Note: If the drive detects this error, the terminal assigned to *H2-01 to H2-05 = 10 [MFDO Function Select = Alarm]* will be ON.			
Code	**Name**	**Causes**	**Possible Solutions**
EF7	External Fault (terminal S7)	MFDI terminal S7 caused an external fault through an external device.	1. Find the device that caused the external fault and remove the cause. 2. Clear the external fault input in the MFDI.
		The wiring is incorrect.	Correctly connect the signal line to MFDI terminal S7.
		External fault [H1-07 = 2C to 2F] is assigned to MFDI terminal S7 that is not in use.	Correctly set the MFDI.
Note: If the drive detects this error, the terminal assigned to *H2-01 to H2-05 = 10 [MFDO Function Select = Alarm]* will be ON.			

Code	Name	Causes	Possible Solutions
EF8	External Fault (terminal S8)	MFDI terminal S8 caused an external fault through an external device.	1. Find the device that caused the external fault and remove the cause. 2. Clear the external fault input in the MFDI.
		The wiring is incorrect.	Correctly connect the signal line to MFDI terminal S8.
		External fault [H1-08 = 2C to 2F] is assigned to MFDI terminal S8 that is not in use.	Correctly set the MFDI.

Note:
If the drive detects this error, the terminal assigned to *H2-01 to H2-05 = 10 [MFDO Function Select = Alarm]* will be ON.

Code	Name	Causes	Possible Solutions
EF9	External Fault (Terminal S9)	MFDI terminal S9 caused an external fault through an external device.	1. Find the device that caused the external fault and remove the cause. 2. Clear the external fault input in the MFDI.
		The wiring is incorrect.	Correctly connect the signal line to MFDI terminal S9.
		*External fault [H1-09 = 2C to 2F]*is set to MFDI terminal S9, but the terminal is not in use.	Correctly set the MFDI.

Note:
If the drive detects this error, the terminal assigned to *H2-01 to H2-05 = 10 [MFDO Function Select = Alarm]* will be ON.

Code	Name	Causes	Possible Solutions
EF10	External Fault (Terminal S10)	MFDI terminal S10 caused an external fault through an external device.	1. Find the device that caused the external fault and remove the cause. 2. Clear the external fault input in the MFDI.
		The wiring is incorrect.	Correctly connect the signal line to MFDI terminal S10.
		External fault [H1-10 = 2C to 2F] is set to MFDI terminal S10, but the terminal is not in use.	Correctly set the MFDI.

Note:
If the drive detects this error, the terminal assigned to *H2-01 to H2-05 = 10 [MFDO Function Select = Alarm]* will be ON.

Code	Name	Causes	Possible Solutions
EP24v	External Power 24V Supply	The voltage of the main circuit power supply decreased, and the 24 V power supply is supplying power to the drive.	• Examine the main circuit power supply. • Turn ON the main circuit power supply to run the drive.

Note:
• Set *o2-26 [Ext. Power 24V Supply Display]* to enable or disable *EP24v* detection.
• The drive will not output an alarm signal for this alarm.

Code	Name	Causes	Possible Solutions
FAn	Internal Fan Fault	The circulation fan has malfunctioned.	• Examine circulation fan operation. • Re-energize the drive and check if the fault still remains. • Examine *U4-03 [Cooling Fan Ope Time]* and *U4-04 [Cool Fan Maintenance]*. If the performance life of the circulation fan is expired or if there is damage to the fan, replace the fan.
		There is a problem with the power supply of the electromagnetic contactor and the circulation fan.	• Re-energize the drive and check if the fault still remains. • If the fault stays, replace the control board or the drive. For information about replacing the control board, contact Yaskawa or your nearest sales representative.

Note:
If the drive detects this error, the terminal assigned to *H2-01 to H2-05 = 10 [MFDO Function Select = Alarm]* will be ON.

Code	Name	Causes	Possible Solutions
FWdL	Fwd Limit (FWdL)	The terminal assigned to *H1-xx = 31, 32 [MFDI Function Select = Forward Travel Limit (N.O.), Forward Travel Limit (N.C.)]* is input, the Run command has been disabled.	Turn OFF the Travel Limit to input the Reverse run command.

Note:
If the drive detects this error, the terminal assigned to *H2-01 to H2-05 = 10 [MFDO Function Select = Alarm]* will be ON.

Code	Name	Causes	Possible Solutions
HCA	High Current Alarm	The load is too heavy.	• Decrease the load for applications with repetitive starts and stops. • Replace the drive with a larger capacity model.
		The acceleration/deceleration time is too short.	• Calculate the torque necessary during acceleration related to the load inertia and the specified acceleration time. • Increase the values set in *C1-01 to C1-08 [Acceleration/ Deceleration Time]* until you get the necessary torque. • Replace the drive with a larger capacity model.

Code	Name	Causes	Possible Solutions
		The drive is trying to operate a specialized motor or a motor that is larger than the maximum applicable motor output of the drive.	• Examine the motor nameplate and reevaluate the motor and drive to make sure that the drive rated current is larger than the motor rated current. • Replace the drive with a larger capacity model.

Note:
• The drive detects this error if the drive output current is more than the overcurrent alarm level (150% of the rated current).
• If the drive detects this error, the terminal assigned to *H2-01 to H2-05 = 10 [MFDO Function Select = Alarm]* will be ON.

Code	Name	Causes	Possible Solutions
L24v	Loss of External Power 24 Supply	The voltage of the backup 24 V power supply has decreased. The main circuit power supply is operating correctly.	• Examine the external 24 V power supply for disconnected wires and wiring errors and repair the problems. • Examine the external 24 V power supply for problems.

Note:
• Set *o2-23 [External 24V Powerloss Detection]* to enable or disable *L24v* detection.
• The drive will not output an alarm signal for this alarm.

Code	Name	Causes	Possible Solutions
LoG	Log Com Error	There is not a micro SD in the keypad.	Put a micro SD card in the keypad.
		• USB connected • The number of log communication files is more than 1000. • The capacity of the micro SD card has been exceeded. • The line number data in a log communication file is incorrect. • A communication error between the keypad and drive occurred during a log communication.	Set *o5-01 = 0 [Log Start/Stop Selection = OFF]*.

Note:
If the drive detects this error, the terminal assigned to *H2-01 to H2-05 = 6A [MFDO Function Select = Data Logger Error]* will be ON.

Code	Name	Causes	Possible Solutions
LT-1	Cooling Fan Maintenance Time	The cooling fan is at 90% of its expected performance life.	1. Use the procedures in this manual to replace the cooling fan. 2. Set *o4-03 = 0 [Fan Operation Time Setting = 0 h]* to reset the cooling fan operation time.

Note:
When the estimated performance life is expired, the terminal assigned to *H2-01 to H2-05 = 2F [MFDO Function Select = Maintenance Notification]* will be ON.

Code	Name	Causes	Possible Solutions
LT-2	Capacitor Maintenance Time	The capacitors for the main circuit and control circuit are at 90% of expected performance life.	Replace the control board or the drive. For information about replacing the control board, contact Yaskawa or your nearest sales representative.

Note:
When the estimated performance life is expired, the terminal assigned to *H2-01 to H2-05 = 2F [MFDO Function Select = Maintenance Notification]* will be ON.

Code	Name	Causes	Possible Solutions
LT-3	SoftChargeBypassRelay MainteTime	The soft charge bypass relay is at 90% of its expected performance life.	Replace the control board or the drive. For information about replacing the control board, contact Yaskawa or your nearest sales representative.

Note:
When the estimated performance life is expired, the terminal assigned to *H2-01 to H2-05 = 2F [MFDO Function Select = Maintenance Notification]* will be ON.

Code	Name	Causes	Possible Solutions
LT-4	IGBT Maintenance Time (50%)	The IGBT is at 50% of its expected performance life.	Check the load, carrier frequency, and output frequency.

Note:
When the estimated performance life is expired, the terminal assigned to *H2-01 to H2-05 = 2F [MFDO Function Select = Maintenance Notification]* will be ON.

Code	Name	Causes	Possible Solutions
oH	Heatsink Overheat	The ambient temperature is high and the heatsink temperature is more than *L8-02 [Overheat Alarm Level]*.	• Measure the ambient temperature. • Increase the airflow in the control panel. • Install a cooling device (cooling fan or air conditioner) to lower the ambient temperature. • Remove objects near the drive that are producing too much heat.
		There is not sufficient airflow around the drive.	• Give the drive the correct installation space as shown in the manual. • Make sure that there is sufficient circulation around the control panel. • Examine the drive for dust or other unwanted materials that could clog the cooling fan. • Remove unwanted materials that prevent air circulation.

Code	Name	Causes	Possible Solutions
		The internal cooling fan or fans have stopped.	1. Use the procedures in this manual to replace the cooling fan. 2. Set *o4-03 = 0 [CoolingFan OperationTime Setting = 0 h]* to reset the cooling fan operation time.

Note:
• The drive detects this error if the heatsink temperature of the drive is more than *L8-02*.
• If the drive detects this error, the terminal assigned to *H2-01 to H2-05 = 10 [MFDO Function Select = Alarm]* will be ON.
• Set the stopping method for this error in *L8-03 [Overheat Pre-Alarm Selection]*.

Code	Name	Causes	Possible Solutions
oH2	External Overheat (H1-XX=B)	*oH2 [External Overheat (H1-XX=B)]* signal was input from an external device.	1. Identify the external device that output the overheat alarm and remove the cause of the problem. 2. Clear the *Overheat Alarm (oH2) [H1-xx = B]* that was set to MFDI terminals S1 to S10.

Note:
If the drive detects this error, the terminal assigned to *H2-01 to H2-05 = 10 [MFDO Function Select = Alarm]* will be ON.

Code	Name	Causes	Possible Solutions
oH3	Motor Overheat (PTC Input)	The thermistor wiring that detects motor temperature is defective.	Correct wiring errors.
		A fault occurred on the machine. Example: The machine is locked.	Examine the machine and remove the cause of the fault.
		The motor has overheated.	• Examine the load level, acceleration/deceleration times, and motor start/stop frequency (cycle time). • Decrease the load. • Increase the values set in *C1-01 to C1-08 [Acceleration/Deceleration Time]*. • Set *E2-01 [Motor Rated Current (FLA)]* correctly to the value specified by the motor nameplate. • Make sure that the motor cooling system is operating correctly, and repair or replace it if it is damaged. • Adjust *E1-xx [V/f Pattern Parameters]* settings. Decrease the values set in *E1-08 [Mid Point A Voltage]* and *E1-10 [Minimum Output Voltage]*. For motor 2, adjust *E3-xx [V/f Pattern for Motor 2]* settings. Decrease the values set in *E3-08 [Motor 2 Mid Point A Voltage]* and *E3-10 [Motor 2 Minimum Output Voltage]*. For motor 3, adjust *E7-xx [V/f Pattern for Motor 3]* settings. Decrease the values set in *E7-08 [Motor 3 Mid Point A Voltage]* and *E7-10 [Motor 3 Minimum Output Voltage]*. **Note:** If *Ex-08* and *Ex-10* are set too low, the overload tolerance will decrease at low speeds.

Note:
• The drive detects this error if the motor overheat signal that was entered to an analog input terminals A1, A2, or A3 is more than the alarm detection level. (If *H3-02, H3-10, or H3-06 = E [MFAI Function Select = Motor Temperature (PTC input)]* was set.)
• If the drive detects this error, the terminal assigned to *H2-01 to H2-05 = 10 [MFDO Function Select = Alarm]* will be ON.
• If the drive detects this error, it will operate the motor as specified by the Stopping Method set in *L1-03 [Motor Thermistor oH Alarm Select]*.

Code	Name	Causes	Possible Solutions
oL3	Overtorque 1	A fault occurred on the machine. Example: The machine is locked.	Examine the machine and remove the cause of the fault.
		The parameters are incorrect for the load.	Adjust the overtorque detection parameters.

Note:
• The drive detects this error if the motor current and torque are more than the value set in *S6-02* for longer than *S6-03*.
• If the drive detects this error, the terminal assigned to *H2-01 to H2-05 = 10 [MFDO Function Select = Alarm]* will be ON.
• Set the conditions that trigger the minor fault using *S6-01 [OverT Detect Operation Select 1]*.

Code	Name	Causes	Possible Solutions
oL4	Overtorque 2	A fault occurred on the machine. Example: The machine is locked.	Examine the machine and remove the cause of the fault.
		The parameters are incorrect for the load.	Adjust the overtorque detection parameters.

Note:
• The drive detects this error if the motor current and torque are more than the value set in *S6-05 [Overtorque Detection Level 2]* for longer than *S6-06 [Overtorque Detection Time 2]*.
• If the drive detects this error, the terminal assigned to *H2-01 to H2-05 = 10 [MFDO Function Select = Alarm]* will be ON.
• Set the conditions that trigger the minor fault using *S6-04 [OverT Detect Operation Select 2]*.

Code	Name	Causes	Possible Solutions
oL5	Overload Detection (oL5)	A fault occurred on the machine. Example: Overload occurred.	Examine the machine and remove the cause of the fault.
		The parameters are incorrect for the load.	Adjust the overload detection parameters.

Note:
- The drive detects this error in these conditions.
  - The drive detects this fault if the motor current and torque are more than the value set in *S5-02 [OverL Detect Operation Select 1]* for longer than *S5-03 [Overload Detection Time 1]*.
  - The drive detects this fault if the motor current and torque are more than the value set in *S5-05 [OverL Detect Operation Select 2]* for longer than *S5-06 [Overload Detection Time 2]*.
- If the drive detects this error, the terminal assigned to *H2-01 to H2-05 = 10 [MFDO Function Select = Alarm]* will be ON.
- Set the conditions that trigger detection of a minor fault using *S5-01 [OverL Detect Operation Select 1]* and *S5-04 [OverL Detect Operation Select 2]*.

Code	Name	Causes	Possible Solutions
oL6	Light-load Accel 2 Fault (oL6)	The setting for hold level and fault detection level of Light-load 2 functions are not appropriate.	Adjust *S4-10 [L-L 2 Motoring Hold Level]*, *S4-12 [L-L 2 Regen Hold Level]*, and *S4-15 [L-L 2 Fault Detection Level]* settings.
		Output frequency > *S4-08 [Light-load 2 Activation Freq]*.	

Note:
- The drive detects this fault if the output current is more than the value set in *S4-15* for longer than *S4-16 [L-L 2 Fault Detection Time]*.
- If the drive detects this error, the terminal assigned to *H2-01 to H2-05 = 10 [MFDO Function Select = Alarm]* will be ON.
- Set the conditions that trigger detection of a minor fault using *S4-14 [L-L 2 Fault Operation Selection]*.

Code	Name	Causes	Possible Solutions
oS	Overspeed	Overshoot is occurring.	Decrease *C5-01 [ASR Proportional Gain 1]* and increase *C5-02 [ASR Integral Time 1]*.

Note:
- The drive detects this error if the motor speed is more than the value set in *F1-08 [Overspeed Detection Level]* for longer than *F1-09 [Overspeed Detection Delay Time]*.
- If the drive detects this error, the terminal assigned to *H2-01 to H2-05 = 10 [MFDO Function Select = Alarm]* will be ON.
- Set the stopping method for this fault in *F1-03 [Operation Select at Overspeed]*.

Code	Name	Causes	Possible Solutions
ov	DC Bus Overvoltage	There are surge voltages in the input power supply.	Connect a DC reactor to the drive. **Note:** If you turn the phase advancing capacitors ON and OFF and use thyristor converters in the same power supply system, there can be surge voltages that irregularly increase the input voltage.
		The drive output cable or motor is shorted to ground. (The current short to ground is charging the main circuit capacitor of the drive through the power supply.)	1. Examine the motor main circuit cable, terminals, and motor terminal box, and then remove ground faults. 2. Re-energize the drive.
		The power supply voltage is too high.	Decrease the power supply voltage so that it matches the drive rated voltage.
		A drive malfunction occurred due to electrical interference.	• Check the control circuit lines, main circuit lines, and ground wiring, and minimize the effects of electrical interference. • Check whether a magnetic contactor is the electrical interference source, and use Surge Protective Device if necessary.

Note:
- The drive detects this error if the DC bus voltage is more than the *ov* detection level when the Run command has not been input (while the drive is stopped).
- The *ov* detection level is approximately 410 V with 200 V class drives. The detection level is approximately 820 V with 400 V class drives.
- If the drive detects this error, the terminal assigned to *H2-01 to H2-05 = 10 [MFDO Function Select = Alarm]* will be ON.

Code	Name	Causes	Possible Solutions
PASS	Modbus Communication Test	The MEMOBUS/Modbus communications test is complete.	The *PASS* display will turn off after communications test mode is cleared.

Code	Name	Causes	Possible Solutions
PF	Input Phase Loss	There is a phase loss in the drive input power.	Examine for wiring errors or disconnected wires in main circuit drive input power, and repair problems.
		Loose wiring in the input power terminals.	Correctly tighten the terminals according to the specified tightening torque.
		The drive input power voltage is changing too much.	Examine the voltage from the drive input power and review the possible solutions for stabilizing the drive input power.
		Unsatisfactory balance between voltage phases.	• Examine the voltage from the drive input power and review the possible solutions for stabilizing the drive input power. • Disable input phase loss detection.

Code	Name	Causes	Possible Solutions
		The main circuit capacitors have become unserviceable.	Examine *U4-05 [CapacitorMaintenance]*, and do maintenance on the drive if its value is more than 90%.
			• Examine the input power for problems. • The alarm occurs frequently despite there being no problem with the power supply, replace the control board or the drive. For more information on replacing the control board, contact Yaskawa or your nearest sales representative.

Note:
• The drive detects this error if the DC bus voltage fluctuates abnormally while the motor is stopped.
• If the drive detects this error, the terminal assigned to *H2-01 to H2-05 = 10 [MFDO Function Select = Alarm]* will be ON.
• Use *L8-05 [Input Phase Loss Protect Sel]* to enable/disable *PF* detection.

Code	Name	Causes	Possible Solutions
PGo	Encoder (PG) Feedback Loss	The encoder cable is incorrectly wired or disconnected.	Examine for wiring errors or disconnected wires in the encoder cable, and repair problems.
		The encoder is not receiving power.	Examine the encoder power supply.
		The holding brake is stopping the motor.	Release the holding brake.

Note:
• The drive detects this error if no encoder pulses for speed detection are received for a time longer than setting in *F1-14 [Encoder Open-Circuit Detect Time]*.
• If the drive detects this error, the terminal assigned to *H2-01 to H2-05 = 10 [MFDO Function Select = Alarm]* will be ON.
• If the drive detects this error, it will operate the motor as specified by the Stopping Method set in *F1-02 [PG Open Circuit Detection Select]*.

Code	Name	Causes	Possible Solutions
PGoH	Encoder (PG) Hardware Fault	The encoder cable is disconnected.	Correct any disconnected wires in the encoder cable.

Note:
• If the drive detects this error, the terminal assigned to *H2-01 to H2-05 = 10 [MFDO Function Select = Alarm]* will be ON.
• If the drive detects this error, it will operate the motor as specified by the Stopping Method set in *F1-02 [PG Open Circuit Detection Select]*.

Code	Name	Causes	Possible Solutions
rEvL	Rev Limit (rEvL)	The terminal assigned to *H1-xx = 33, 34 [MFDI Function Select = Rev Limit (rEvL), Reverse Travel Limit (N.C.)]* is input, the Run command has been disabled.	Turn OFF the Travel Limit to input the Forward run command.

Note:
If the drive detects this error, the terminal assigned to *H2-01 to H2-05 = 10 [MFDO Function Select = Alarm]* will be ON.

Code	Name	Causes	Possible Solutions
rUn	Motor Switch during Run	The drive received a *Motor 2/3 Selection [H1-xx = 16 or 39]* during run.	Review the sequence to ensure that Motor 2/3 Selection is input while the drive is stopped.

Note:
If the drive detects this error, the terminal assigned to *H2-01 to H2-05 = 10 [MFDO Function Select = Alarm]* will be ON.

Code	Name	Causes	Possible Solutions
SE	Modbus Test Mode Error	MEMOBUS/Modbus communications self-diagnostics *[H1-xx = 67]* was done while the drive was running.	Stop the drive and do MEMOBUS/Modbus communications self-diagnostics.

Note:
If the drive detects this error, the terminal assigned to *H2-01 to H2-05 = 10 [MFDO Function Select = Alarm]* will be ON.

Code	Name	Causes	Possible Solutions
STo	Safe Torque OFF	Safe Disable inputs H1-HC and H2-HC are open.	• Make sure that the Safe Disable signal is input from an external source to terminal H1-HC and H2-HC. • When the Safe Disable function is not in use, connect terminals H1-HC and H2-HC.
		There is internal damage to the two Safe Disable channels.	Replace the control board or the drive. For information about replacing the control board, contact Yaskawa or your nearest sales representative.

Note:
If the drive detects this error, the terminal assigned to *H2-01 to H2-05 = 10 [MFDO Function Select = Alarm]* will be ON.

Code	Name	Causes	Possible Solutions
SToF	Safe Torque OFF Hardware	One of the two terminals H1-HC or H2-HC received the Safe Disable input signal.	• Make sure that the Safe Disable signal is input from an external source to terminal H1-HC or H2-HC. • When the Safe Disable function is not in use, connect terminals H1-HC and H2-HC.
		The Safe Disable input signal is wired incorrectly.	
		There is internal damage to one Safe Disable channel.	Replace the control board or the drive. For information about replacing the control board, contact Yaskawa or your nearest sales representative.

Note:
If the drive detects this error, the terminal assigned to *H2-01 to H2-05 = 10 [MFDO Function Select = Alarm]* will be ON.

Code	Name	Causes	Possible Solutions
TiM	Keypad Time Not Set	There is a battery in the LCD keypad, but the date and time are not set.	Set the date and time with the LCD keypad.
Note: • Use *o4-24 [bAT Detection Selection]* to enable/disable *TiM* detection. • If the drive detects this error, the terminal assigned to *H2-01 to H2-05 = 10 [MFDO Function Select = Alarm]* will be ON.			
Code	**Name**	**Causes**	**Possible Solutions**
TrPC	IGBT Maintenance Time (90%)	The IGBT is at 90% of its expected performance life.	Replace the IGBT or the drive. For information about replacing the control board, contact Yaskawa or your nearest sales representative.
Note: If the drive detects this error, the terminal assigned to *H2-01 to H2-05 = 10 [MFDO Function Select = Alarm]* will be ON.			
Code	**Name**	**Causes**	**Possible Solutions**
Uv	Undervoltage	The drive input power voltage is changing too much.	• Review the power supply voltage so that it matches the drive rated voltage. • Make the drive input power stable. • If the input power supply is good, examine the magnetic contactor on the main circuit side for problems.
		There is a phase loss in the drive input power.	Examine for wiring errors or disconnected wires in main circuit drive input power, and repair problems.
		There is loose wiring in the drive input power terminals.	Tighten the terminal screws to the correct tightening torque.
		There was a loss of power.	Improve the power supply.
		The main circuit capacitors have become unserviceable.	Examine the capacitor maintenance time in monitor *U4-05 [CapacitorMaintenance]*. If *U4-05* is more than 90%, replace the control board or the drive. For information about replacing the control board, contact Yaskawa or your nearest sales representative.
		The drive input power transformer is too small and voltage drops when the power is switched on.	• Examine for an alarm when a molded-case circuit breaker, Leakage Breaker (ELCB, GFCI, or RCM/RCD) (with overcurrent protective function), or magnetic contactor is ON. • Check the capacity of the drive power supply transformer.
		Air inside the drive is too hot.	Measure the ambient temperature of the drive.
		The Charge LED is broken.	Replace the control board or the drive. For information about replacing the control board, contact Yaskawa or your nearest sales representative.
Note: • The drive detects this error if one of these conditions is correct when the Run command has not been input while the drive is stopped. –The DC bus voltage decreased lower than *L2-05 [Undervoltage Detection Lvl (Uv1)]* setting value. –The Contactor that prevents inrush current in the drive was opened. –There is low voltage in the control drive input power. • If the drive detects this error, the terminal assigned to *H2-01 to H2-05 = 10 [MFDO Function Select = Alarm]* will be ON.			

6.6 Parameter Setting Errors

Parameter setting errors occur when multiple parameter settings do not agree, or when parameter setting values are not correct. Refer to the table in this section, examine the parameter setting that caused the error, and remove the cause of the error. You must first correct the parameter setting errors before you can operate the drive. The drive will not send notification signals for the faults and alarms when these parameter setting errors occur.

Code	Name	Causes	Possible Solutions
oPE01	Drive Capacity Setting Error	The value set in *o2-04 [Drive Model (KVA) Selection]* does not agree with the drive model.	Set *o2-04* to the correct value.
Code	**Name**	**Causes**	**Possible Solutions**
oPE02	Parameter Range Setting Error	Parameter settings are not in the applicable setting range.	1. Push ↵ to show *U1-18 [oPE Fault Parameter]*, and find parameters that are not in the applicable setting range. 2. Correct the parameter settings. **Note:** If more than one error occurs at the same time, other *oPExx* errors have priority over *oPE02*.
		Set *E2-01* ≤ *E2-03 [Motor Rated Current (FLA)* ≤ *Motor No-Load Current]*.	Make sure that *E2-01* > *E2-03*. **Note:** If it is necessary to set *E2-01* < *E2-03*, first lower the value set in *E2-03*, and then set *E2-01*.
Code	**Name**	**Causes**	**Possible Solutions**
oPE03	Multi-Function Input Setting Err	A function assigned to these parameters conflicts. • *H1-01 to H1-10 [Terminal Sx Function Selection]* • *F3-10 to F3-25 [Terminal Dx Function Selection]* • *H7-01 to H7-04 [Virtual Multi-Function Input]*	Set the parameters correctly.
		The settings for MFDI overlap. **Note:** *H1-xx = 20 to 2F [External Fault]*and *[Reserved]*are excluded.	Set the parameters correctly so that the functions assigned to MFDI do not overlap.
		*H1-xx = 2 [MFDI Function Select = External Reference 1/2 Selection]*When xx is set, these parameters are set at the same time while: • *S1-20 = 1 [Operation in Reverse = Regen operation in reverse]* • *H1-xx = 38 [Counterweight Selection]*	Set the parameters correctly.
		*H1-xx = 16 [Motor 2 Selection]*is not set, but*H1-xx = 39 [Motor 3 Selection]*is set.	Set the parameters correctly.
		Digital Inputs (*H1-01 to H1-10 [Terminal Sx Function Selection]*,*F3-10 to F3-25 [Terminal Dx Function Selection]*, and*H7-01 to H7-04 [Virtual Multi-Function Input]*) do not set these two functions at the same time. • Setting Value*10 [Up Command]*and*11 [Down Command]*	Assign the remaining MFDI.
		Digital Inputs (*H1-01 to H1-10 [Terminal Sx Function Selection]*,*F3-10 to F3-25 [Terminal Dx Function Selection]*, and*H7-01 to H7-04 [Virtual Multi-Function Input]*) are set these two or more of the function combinations are assigned at the same time. • Setting Value*10 [Up Command]*and*11 [Down Command]* • Setting Value*A [Accel/Decel Ramp Hold]* • Setting Value*1E [Reference Sample Hold]* • Setting Value*44 to 46 [Add Offset Frequency]*	Remove the function assignments that will not be used.
		Digital Inputs (*H1-01 to H1-10 [Terminal Sx Function Selection]*,*F3-10 to F3-25 [Terminal Dx Function Selection]*, and*H7-01 to H7-04 [Virtual Multi-Function Input]*) are set these two or more of the function combinations are assigned at the same time. • Setting Value*61 [Speed Search from Fmax]* and*62 [Speed Search from Fref]* • Setting Value*16 [Motor 2 Selection]*and*1A [Accel/Decel Time Selection 2]* • Setting Value*40, 41 [Forward RUN (2-Wire), Reverse RUN (2-Wire)]*and*42, 43 [Run Command (2-Wire Sequence 2), FWD/REV (2-Wire Sequence 2)]*	Remove the function assignments that will not be used.

Code	Name	Causes	Possible Solutions
		MFDI*[H1-xx]*Settings for N.C. and N.O. input [H1-xx] for the following functions are selected at the same time: • Setting Value*15 [Fast Stop (N.O.)]* • Setting Value*17 [Fast Stop (N.C.)]*	Remove one of the function assignments.
		*H1-xx = 2 [External Reference 1/2 Selection]*is set at the same time with these parameters. • *b1-15 = 3 [Frequency Reference Selection 2 = Option PCB]*or*b1-16 = 3 [Run Command Selection 2 = Option PCB]* • No option card is connected to the drive.	Connect an input option card to the drive.
		*H1-xx = 2 [External Reference 1/2 Selection]*When xx is set, these parameters are set at the same time while: • *b1-15 = 1 [Frequency Reference Selection 2 = Analog Input]* • *H3-02 ≠ 0 [Terminal A1 Function Selection ≠ Frequency Reference]*or*H3-10 ≠ 0 [Terminal A2 Function Selection ≠ Frequency Reference]*	*H3-02 = 0*or*H3-10 = 0*Set
		The settings are contradictory in these ways: • A PG-RT3 is attached to the drive. • *H1-xx = 16 [Motor 2 Selection]*is set.	Set the parameters correctly. **Note:** Motor Switch function is not available when using the PG-RT3.

Code	Name	Causes	Possible Solutions
oPE05	Run Cmd/Freq Ref Source Sel Err	The setting to assign the Run command or frequency reference to an option card is incorrect.	Set the parameters correctly.
		Parameter *b1-01 = 3 [Frequency Reference Selection 1 = Option PCB]* has been set, but an option card is not connected to the drive.	Connect an option card to the drive.
		Parameter *b1-02 = 3 [Run Command Selection 1 = Option PCB]* has been set, but an option card is not connected to the drive.	
		The following parameters are set at the same time: • *F3-01 = 6 [Digital Input Function Selection = BCD (5-digit), 0.01 Hz]* • *F3-03 = 0, 1 [DI Data Length Selection = 8bit, 12bit]*	Set *F3-03 = 2 [16bit]*.
		The following parameters have been set while the AI-A3 option card is installed: • *H1-xx = 2 [External Reference 1/2 Selection]* • *b1-15 = 3 [Frequency Reference Selection 2 = Option PCB]* • *F2-01 = 0 [Analog Input Function Selection = 3 channel individual]*	Set the parameters correctly.

Code	Name	Causes	Possible Solutions
oPE06	Control Method Selection Error	*A1-02 = 1 or 3 [Control Method Selection = CL-V/f, CLV]* is set, but there is no encoder option connected to the drive.	• Connect an encoder option to the drive. • Set *A1-02* correctly.
		You supplied external 24 V power to terminals PS-AC when: • There is an encoder option installed the drive • The drive main circuit power supply is de-energized	1. De-energize the drive main circuit power supply and the external 24 V power supply to terminals PS-AC. 2. After the keypad display goes out, energize the drive main circuit power supply again. 3. Supply the external 24 V power to terminals PS-AC.
			When you use an encoder option, energize the drive main circuit power supply.

Code	Name	Causes	Possible Solutions
oPE07	Analog Input Selection Error	The settings for *H3-02, H3-06, and H3-10 [MFAI Function Select]* and *H7-30 [Virtual Analog Input Selection]* overlap.	Change the settings to *H3-02, H3-06, H3-10, and H7-30* so that the functions assigned to them no longer overlap. **Note:** These functions can be set to multiple analog input terminals at the same time: • Setting value *0 [Frequency Reference]* • Setting values *F and 1F [Not Used]*

Code	Name	Causes	Possible Solutions
oPE08	Parameter Selection Error	A function was set that is not compatible with the control method selected in *A1-02 [Control Method Selection]*.	1. Push ↵ to show *U1-18 [oPE Fault Parameter]*, and find parameters that are not in the applicable setting range. 2. Set the parameters correctly. **Note:** If more than one error occurs at the same time, other *oPExx* errors have priority over *oPE02*.
		These parameters were set in OLV Control: • *n2-02 > n2-03 [Automatic Freq Regulator Time 1 > Automatic Freq Regulator Time 2]* • *C4-02 > C4-06 [Torque Compensation Delay Time > Motor 2 Torque Comp Delay Time]*	• Set *n2-02 < n2-03*. • Set *C4-02 < C4-06*.
Code	**Name**	**Causes**	**Possible Solutions**
oPE10	V/f Data Setting Error	The parameters that set the V/f pattern do not satisfy the following conditions: • For motor 1: *E1-09 ≤ E1-07 < E1-06 ≤ E1-11 ≤ E1-04 [Minimum Output Frequency ≤ Mid Point A Frequency < Base Frequency ≤ Mid Point B Frequency ≤ Maximum Output Frequency]* • For motor 2: *E3-09 ≤ E3-07 < E3-06 ≤ E3-11 ≤ E3-04 [Minimum Output Frequency ≤ Mid Point A Frequency < Base Frequency ≤ Mid Point B Frequency ≤ Maximum Output Frequency]* • For motor 3: *E7-09 ≤ E7-07 < E7-06 ≤ E7-11 ≤ E7-04 [Minimum Output Frequency ≤ Mid Point A Frequency < Base Frequency ≤ Mid Point B Frequency ≤ Maximum Output Frequency]*	Set the parameters correctly to satisfy the conditions.
Code	**Name**	**Causes**	**Possible Solutions**
oPE11	Carrier Frequency Setting Error	These parameters are set at the same time: • *C6-05 > 6 [Carrier Freq Proportional Gain > 6]* • *C6-04 > C6-03 [Carrier Frequency Lower Limit > Carrier Frequency Upper Limit]* **Note:** When *C6-05 < 7*, *C6-04* becomes disabled. The drive sets the carrier frequency to the value set to *C6-03*.	Set *C6-02 to C6-05* correctly.
		C6-02 to C6-05 settings are not in the applicable setting range.	
Code	**Name**	**Causes**	**Possible Solutions**
oPE18	Online Tuning Param Setting Err	The parameters that control online tuning are set incorrectly. In OLV control, one of these parameters was set when *n6-01 = 2 [Online Tuning Selection = Voltage Correction Tuning]*: • *E2-02 [Motor Rated Slip]* is set to 30% of the default setting or lower. • *E2-06 [Motor Leakage Inductance]* is set to 50% of the default setting or lower. • *E2-03 = 0 [Motor No-Load Current = 0 A]* has been set.	Set *E2-02, E2-03, and E2-06* correctly.
Code	**Name**	**Causes**	**Possible Solutions**
oPE22	Parameter Setting Error	The crane sequence parameter (frequency) setting error for motor 1.	Set the parameters correctly.
		When *S1-04 ≠ 0 [Brake Delay Time ≠ 0.00 s]*, set in these ways. • *S1-01 or S1-02 > S1-03 [Brake Release Frequency > Brake Delay Frequency]* • *S1-03 > E1-06 [Brake Delay Frequency > Base Frequency]* • *S1-03 > S4-06 [Brake Delay Frequency > Light-load 1 Detect Frequency]*	Set the parameters correctly so that these conditions are satisfied. • *S1-02 and S1-02 ≦ S1-03* • *S1-03 ≦ E1-06* • *S1-03 ≦ S4-06*
		When *S1-04 = 0*, set in these ways. • *S1-01 or S1-02 > E1-06 [Brake Release Frequency > Base Frequency]* • *S1-01 or S1-02 > S4-06 [Brake Release Frequency > Light-load 1 Detect Frequency]*	Set the parameters correctly so that these conditions are satisfied. • *S1-01 and S1-02 ≦ E1-06* • *S1-01 and S1-02 ≦ S4-06*
		When *S1-15 ≠ 0 [Slip Prevention Time ≠ 0.00 s]*, set in these ways. • *S1-12 or S1-13 < S1-14 [Brake Hold Frequency < Slip Prevention Frequency]* • *S1-12 or S1-13 = E1-09 = S1-14 [Brake Hold Frequency = Minimum Output Frequency = Slip Prevention Frequency]*	Set the parameters correctly so that these conditions are satisfied. • *S1-12 or S1-13 ≧ S1-14 [Brake Hold Frequency ≧ Slip Prevention Frequency]* • *S1-12 and S1-13 ≠ E1-09 ≠ S1-14 [Brake Hold Frequency ≠ Minimum Output Frequency ≠ Slip Prevention Frequency]*
		When *H1-xx = 35 [MFDI Function Select = Impact Stop Enable]*, set *S3-01 ≦ S1-12 or S1-13 [Impact Stop Creep Frequency ≦ Brake Hold Frequency]*.	Make sure that *S3-01 > S1-12 and S1-13*.

Code	Name	Causes	Possible Solutions
		When *H1-xx = 0 [MFDI Function Select = Brake Release Check]*, set *H2-xx ≠ 21 [MFDO Function Select ≠ Brake Release Command]*	Set the parameters correctly.
		This relation is not established or not set. • When *S4-22 = 1 [L-L 2 Freq Upper Limit Select = Enabled]*,set *S4-08 [Light-load 2 Activation Freq] < 3 Hz*.	Set the parameters correctly.
Code	**Name**	**Causes**	**Possible Solutions**
oPE23	Parameter Setting Error	When Vector control, set *L7-01 and L7-02 < S1-07 and S1-08 [Torque Limit < Brake Release Torque]*.	Make sure that *L7-01 and L7-02 ≧ S1-07 and S1-08*.
		When each function of crane sequence enables, set larger value than *L7-01 and L7-02* to these parameters. • *S3-03 and S3-04 [Impact Stop Detect Torque]* • *S4-04 and S4-05 [Light-load 1 Detect Torque]* • *S5-02 and S5-05 [Overload Detection Torque]* • *S6-02 and S6-05 [Overtorque Detection Level]*	Set the value smaller than *L7-01 and L7-02*.
Code	**Name**	**Causes**	**Possible Solutions**
oPE24	Light-load Accel 2 Fault (oL6)	The following commands are set in *H1-xx [MFDI Function Select]* simultaneously: • *Setting value 30 [Light-load Accel 1 Enabled]* and *setting value 36 [Light-load Accel 1 Enabled]*	Remove the function settings that are not in use.
Code	**Name**	**Causes**	**Possible Solutions**
oPE25	Parameter Setting Error	The crane sequence parameter (frequency) setting error for motor 2 and motor 3.	Set the parameters correctly.
		When *S1-26 ≠ 0 [Motor2 Brake Delay Time ≠ 0.00 s]*, set in these ways. • *S1-23 or S1-24 > S1-25 [Motor2 Brake Release Freq > Motor2 Brake Delay Frequency]* • *S1-25 > E3-06 [Motor2 Brake Delay Frequency > Motor 2 Base Frequency]* • *S1-25 > S4-06 [Motor2 Brake Delay Frequency > Light-load 1 Detect Frequency]*	Set the parameters correctly so that these conditions are satisfied. • *S1-23 or S1-24 ≦ S1-25* • *S1-25 ≦ E3-06* • *S1-25 ≦ S4-06*
		When *S1-26 = 0*, set in these ways. • *S1-23 or S1-24 > E3-06 [Motor2 Brake Release Freq > Motor 2 Base Frequency]* • *S1-23 or S1-24 > S4-06 [Motor2 Brake Release Freq > Light-load 1 Detect Frequency]*	Set the parameters correctly so that these conditions are satisfied. • *S1-23 and S1-24 ≦ E3-06* • *S1-23 and S1-24 ≦ S4-06*
		When *S1-37 ≠ 0 [Motor2 Slip Prevention Time ≠ 0.00 s]*, set in these ways. • *S1-34 or S1-35 < S1-36 [Motor2 Brake Hold Freq < Motor2 Slip Prevention Frequency]* • *S1-34 or S1-35 = E3-09 = S1-36 [Motor2 Brake Hold Freq = Motor 2 Minimum Output Frequency = Motor2 Slip Prevention Frequency]*	Set the parameters correctly so that these conditions are satisfied. • *S1-34 or S1-35 ≧ S1-36* • *S1-34 or S1-35 ≠ E3-09 ≠ S1-36*
		When *H1-xx = 35 [MFDI Function Select = Impact Stop Enable]*, set *S3-01 ≦ S1-34 or S1-35 [Impact Stop Creep Frequency ≦ Motor2 Brake Hold Freq]*.	Make sure that *S3-01 > S1-34 and S1-35*.

6.7 Auto-Tuning Errors

This table gives information about errors detected during Auto-Tuning. If the drive detects an Auto-Tuning error, the keypad will show the error and the motor will coast to stop. The drive will not send notification signals for faults and alarms when Auto-Tuning errors occur.

Two types of Auto-Tuning errors are: *Endx* and *Erx*. *Endx* identifies that Auto-Tuning has successfully completed with calculation errors. Find and repair the cause of the error and do Auto-Tuning again, or set the motor parameters manually. You can use the drive in the application if you cannot find the cause of the *Endx* error.

Erx identifies that Auto-Tuning was not successful. Find and repair the cause of the error and do Auto-Tuning again.

Code	Name	Causes	Possible Solutions
End1	Excessive Rated Voltage Setting	The torque reference was more than 20% during Auto-Tuning or the no-load current that was measured after Auto-Tuning is more than 80%.	• Make sure that the input motor nameplate data is correct. • Do Auto-Tuning again and correctly set the motor nameplate data. • If you can uncouple the motor and load, remove the motor from the machine and do Rotational Auto-Tuning again. • If you cannot uncouple the motor and load, use the results from Auto-Tuning.
Code	**Name**	**Causes**	**Possible Solutions**
End2	Iron Core Saturation Coefficient	The motor nameplate data entered during Auto-Tuning is incorrect.	• Make sure that the input motor nameplate data is correct. • Do Auto-Tuning again and correctly set the motor nameplate data.
		Auto-Tuning results were not in the applicable parameter setting range, and *E2-07* or *E2-08 [Motor Saturation Coefficient 2]* have temporary values.	• Examine and repair damaged motor wiring. • If you can uncouple the motor and load, remove the motor from the machine and do Rotational Auto-Tuning again.
Code	**Name**	**Causes**	**Possible Solutions**
End3	Rated Current Setting Alarm	The rated current value is incorrect.	Do Auto-Tuning again and set the correct rated current shown on the motor nameplate.
Code	**Name**	**Causes**	**Possible Solutions**
End4	Adjusted Slip Calculation Error	The Auto-Tuning results were not in the applicable parameter setting range.	• Make sure the input motor nameplate data is correct. • Do Rotational Auto-Tuning again and correctly set the motor nameplate data. • If you cannot uncouple the motor and load, do Stationary Auto-Tuning 2.
		The motor rated slip that was measured after Stationary Auto-Tuning was 0.2 Hz or lower.	
		The motor rated slip that was measured after compensation with *E2-08 [Motor Saturation Coefficient 2]* is not in the applicable range.	
		The secondary resistor measurement results were not in the applicable range.	
Code	**Name**	**Causes**	**Possible Solutions**
End5	Resistance Tuning Error	The Auto-Tuning results of the Line-to-Line Resistance were not in the applicable range.	• Make sure that the input motor nameplate data is correct. • Examine and repair damaged motor wiring.
Code	**Name**	**Causes**	**Possible Solutions**
End6	Leakage Inductance Alarm	The Auto-Tuning results were not in the applicable parameter setting range.	Make sure that the input motor nameplate data is correct, and do Auto-Tuning again.
		A1-02 [Control Method Selection] setting is not applicable.	• Examine the value set in *A1-02*. • Make sure that the input motor nameplate data is correct, and do Auto-Tuning again.
Code	**Name**	**Causes**	**Possible Solutions**
End7	No-Load Current Alarm	The Auto-Tuning results of the motor no-load current value were not in the applicable range.	Examine and repair damaged motor wiring.
		Auto-Tuning results were less than 5% of the motor rated current.	Make sure that the input motor nameplate data is correct, and do Auto-Tuning again.
Code	**Name**	**Causes**	**Possible Solutions**
Er-01	Motor Data Error	The motor nameplate data entered during Auto-Tuning is incorrect.	• Make sure that the motor nameplate data is correct. • Do Auto-Tuning again and correctly set the motor nameplate data.
		The combination of the motor rated power and motor rated current do not match.	• Examine the combination of drive capacity and motor output. • Do Auto-Tuning again, and correctly set the motor rated power and motor rated current.

Code	Name	Causes	Possible Solutions
		The combination of the motor rated current that was entered during Auto-Tuning and *E2-03 [Motor No-Load Current]* do not match.	• Examine the motor rated current and the no-load current. • Set *E2-03* correctly. • Do Auto-Tuning again, and correctly set the motor rated current.
		The combination of the setting values of Motor Base Frequency and Motor Base Speed do not match.	Do Auto-Tuning again, and correctly set the Motor Base Frequency and Motor Base Speed.
Code	**Name**	**Causes**	**Possible Solutions**
Er-02	Drive in an Alarm State	The motor nameplate data entered during Auto-Tuning is incorrect.	• Make sure that the motor nameplate data entered in Auto-Tuning is correct. • Do Auto-Tuning again and correctly set the motor nameplate data.
		You did Auto-Tuning while the drive had a minor fault or alarm.	Clear the minor fault or alarm and do Auto-Tuning again.
		There is a defective motor cable or cable connection.	Examine and repair motor wiring.
		The load is too large.	• Decrease the load. • Examine the machine area to see if, for example, the motor shaft is locked.
		The drive detected a minor fault during Auto-Tuning.	1. Stop Auto-Tuning. 2. Examine the minor fault code and remove the cause of the problem. 3. Do Auto-Tuning again.
Code	**Name**	**Causes**	**Possible Solutions**
Er-03	STOP Button was Pressed	During Auto-Tuning, STOP was pushed.	Auto-Tuning did not complete correctly. Do Auto-Tuning again.
Code	**Name**	**Causes**	**Possible Solutions**
Er-04	Line-to-Line Resistance Error	The Auto-Tuning results were not in the applicable parameter setting range.	• Examine and repair motor wiring. • Disconnect the machine from the motor and do Rotational Auto-Tuning again.
		Auto-Tuning did not complete in a pre-set length of time.	
		There is a defective motor cable or cable connection.	
		The motor nameplate data entered during Auto-Tuning is incorrect.	• Make sure that the input motor nameplate data is correct. • Do Auto-Tuning again and correctly set the motor nameplate data.
Code	**Name**	**Causes**	**Possible Solutions**
Er-05	No-Load Current Error	The Auto-Tuning results were not in the applicable parameter setting range.	• Examine and repair motor wiring. • Disconnect the machine from the motor and do Rotational Auto-Tuning again.
		Auto-Tuning did not complete in a pre-set length of time.	
		The motor nameplate data entered during Auto-Tuning is incorrect.	• Make sure that the input motor nameplate data is correct. • Do Auto-Tuning again and correctly set the motor nameplate data.
		Rotational Auto-Tuning was done with a load that was more than 30% of the rating connected to the motor.	• Disconnect the machine from the motor and do Rotational Auto-Tuning again. • If you cannot uncouple the motor and load, make sure that the load is less than 30% of the motor rating. If a mechanical brake is installed in the motor, release the brake during Rotational Auto-Tuning.
Code	**Name**	**Causes**	**Possible Solutions**
Er-08	Rated Slip Error	The motor nameplate data entered during Auto-Tuning is incorrect.	• Make sure that the input motor nameplate data is correct. • Do Auto-Tuning again and correctly set the motor nameplate data.
		Auto-Tuning did not complete in a pre-set length of time.	• Examine and repair the motor wiring. • If the motor and machine are connected during Rotational Auto-Tuning, decouple the motor from the machinery.
		The Auto-Tuning results were not in the applicable parameter setting range.	
		Rotational Auto-Tuning was done with a load that was more than 30% of the rating connected to the motor.	• Disconnect the machine from the motor and do Rotational Auto-Tuning again. • If you cannot uncouple the motor and load, make sure that the load is less than 30% of the motor rating. If a mechanical brake is installed in the motor, release the brake during Rotational Auto-Tuning.

Code	Name	Causes	Possible Solutions
Er-09	Acceleration Error	The motor did not accelerate for the specified acceleration time.	1. Increase the value set in *C1-01 [Acceleration Time 1]*. 2. Disconnect the machine from the motor and do Rotational Auto-Tuning again.
		The value of *L7-01 or L7-02 [Forward/Reverse Torque Limit]* is small.	Increase the value set in *L7-01 or L7-02*.
		Rotational Auto-Tuning was done with a load that was more than 30% of the rating connected to the motor.	• Disconnect the machine from the motor and do Rotational Auto-Tuning again. • If you cannot uncouple the motor and load, make sure that the load is less than 30% of the motor rating. If a mechanical brake is installed in the motor, release the brake during Rotational Auto-Tuning.
Code	**Name**	**Causes**	**Possible Solutions**
Er-10	Motor Direction Error	There is defective drive and motor wiring.	Examine and repair motor wiring.
		There is defective drive and encoder wiring.	Examine and repair the wiring to the encoder.
		The direction of the motor and the setting of *F1-05 [PG 1 Rotation Selection]* are opposite.	Set *F1-05* correctly.
		The machine pulled the motor to rotate in the opposite direction.	Disconnect the machine from the motor and do Rotational Auto-Tuning again.
		When the torque reference is 100% or higher, the sign of the speed reference was opposite of the detected speed.	
Code	**Name**	**Causes**	**Possible Solutions**
Er-11	Motor Speed Error	The torque reference during acceleration is too high (100%).	• Increase the value set in *C1-01 [Acceleration Time 1]*. • Disconnect the machine from the motor and do Rotational Auto-Tuning again.
Code	**Name**	**Causes**	**Possible Solutions**
Er-12	Current Detection Error	There is a phase loss in the drive input power. (U/T1, V/T2, W/T3)	Examine and repair motor wiring.
		The current exceeded the current rating of the drive.	• Check the motor wiring for any short circuits between the wires. • Check and turn ON any magnetic contactors used between motors. • Replace the control board or the drive. For information about replacing the control board, contact Yaskawa or your nearest sales representative.
		The output current is too low.	
		You tried Auto-Tuning without a motor connected to the drive.	Connect the motor and do Auto-Tuning.
		There was a current detection signal error.	Replace the control board or the drive. For information about replacing the control board, contact Yaskawa or your nearest sales representative.
Code	**Name**	**Causes**	**Possible Solutions**
Er-13	Leakage Inductance Alarm	The motor rated current value is incorrect.	Correctly set the rated current indicated on the motor nameplate and perform Auto-Tuning again.
		The drive could not complete tuning for leakage inductance in fewer than 300 seconds.	Examine and repair motor wiring.
Code	**Name**	**Causes**	**Possible Solutions**
Er-14	Motor Speed Error 2	The motor speed was more than two times the amplitude of speed reference during Inertia Tuning.	Decrease the value set in *C5-01 [ASR Proportional Gain 1]*.
Code	**Name**	**Causes**	**Possible Solutions**
Er-15	Torque Saturation Error	During Inertia Tuning, the output torque was more than the value set in *L7-01 to L7-04 [Torque Limit]*.	• Increase the value set in *L7-01 to L7-04 [Torque Limit]* as much as possible. • Decrease the values set for the frequency and amplitude of the test signals used when doing inertia tuning. First, decrease the test signal amplitude, and then do Inertia Tuning. If the error continues, decrease the test signal frequency and do Inertia Tuning again.
Code	**Name**	**Causes**	**Possible Solutions**
Er-16	Inertia ID Error	The inertia found by the drive was too small or too large during Inertia Tuning (10% or less, or 50000% or more).	• Decrease the values set for the frequency and amplitude of the test signals used when doing inertia tuning. First, decrease the test signal amplitude, and then do Inertia Tuning. If the error continues, decrease the test signal frequency and do Inertia Tuning again • Correctly set the motor inertia as specified by the motor, and do Inertia Tuning again.

Code	Name	Causes	Possible Solutions
Er-17	Reverse Prohibited Error	*b1-04 = 1 [Reverse Operation Selection = Reverse Disabled]* **Note:** You cannot do Inertia Tuning if the drive cannot rotate the motor in reverse.	1. Enable reverse in the target machine. 2. Set *b1-04 = 0 [Reverse Enabled]*. 3. Do Inertia Tuning again.

6.8 Backup Function Operating Mode Display and Errors

◆ Operating Mode Display

When you use the LCD keypad to do the backup function, the keypad shows the running operation on the LCD display. These indicators do not show that an error has occurred.

Keypad Display	Name	Display	Status
Drive and Keypad mismatch. Should the parameters be restored?	Detection of inconsistency between the drive and keypad	Normally displayed	The drive detected the connection of a keypad from a different drive. Select [Yes] to copy parameters backed up in the keypad to the connected drive.
Restore Restore from keypad	Restoring parameters	Flashing	The parameters stored in the keypad have been restored to the drive.
End	Backup/restore/verify operation ended normally	Normally displayed	The parameter backup, restore, or verify operation ended normally.
Backup Backup from Drive	Backing up parameters	Flashing	The parameters stored in the drive are being backed up to the keypad.
Verify Keypad & Drive	Verifying parameters	Flashing	The parameter settings stored in the keypad and the parameter settings in the drive match or are being compared.

◆ Backup Function Runtime Errors

When an error occurs, the keypad shows a code to identify the error.

The table in this section show the error codes. If there are errors, refer to these tables:

Note:

Push any key on the keypad to clear an error.

Code	Name	Causes	Possible Solutions
CPEr	Control Mode Mismatch	The keypad setting and drive setting for *A1-02 [Control Method Selection]* do not agree.	1. Set *A1-02* on the drive to the same value that is on the keypad. 2. Restore the parameters.
Code	**Name**	**Causes**	**Possible Solutions**
CPyE	Error Writing Data	Parameter restore did not end correctly.	Restore the parameters.
Code	**Name**	**Causes**	**Possible Solutions**
CSEr	Control Mode Mismatch	The keypad is broken.	Replace the keypad.
Code	**Name**	**Causes**	**Possible Solutions**
dFPS	Drive Model Mismatch	You tried to restore parameters to a different drive model than the one that you backed up.	1. Examine the drive model that you used to back up the parameters. 2. Restore the parameters.
Code	**Name**	**Causes**	**Possible Solutions**
iFEr	Keypad Communication Error	There was a communications error between the keypad and the drive.	Examine the connector or cable connection.
Code	**Name**	**Causes**	**Possible Solutions**
ndAT	Error Received Data	The parameter settings for model and specifications (power supply voltage and capacity) are different between the keypad and the drive.	1. Make sure that drive model and the value set in *o2-04 [Drive Model (KVA) Selection]* agree. 2. Restore the parameters.
		The parameters are not stored in the keypad.	1. Connect a keypad that has the correct parameters. 2. Restore the parameters.
Code	**Name**	**Causes**	**Possible Solutions**
rdEr	Error Reading Data	You tried to back up the data when *o3-02 = 0 [Copy Allowed Selection = Disabled]*.	Set *o3-02 = 1 [Enabled]* and back up again.
Code	**Name**	**Causes**	**Possible Solutions**
vAEr	Voltage Class, Capacity Mismatch	The power supply specifications or drive capacity parameter settings are different between the keypad and the drive.	1. Make sure that drive model and the value set in *o2-04 [Drive Model (KVA) Selection]* agree. 2. Restore the parameters.
Code	**Name**	**Causes**	**Possible Solutions**
vFyE	Parameters do not Match	The parameters that are backed up in the keypad and the parameters in the drive are not the same.	1. Restore or backup the parameter again. 2. Verify the parameters.

6.9 Diagnosing and Resetting Faults

When a fault occurs and the drive stops, do the procedures in this section to remove the cause of the fault, then re-energize the drive.

◆ Fault and Power Loss Occur at the Same Time

WARNING! *Crush Hazard. Wear eye protection when you do work on the drive. If you do not use correct safety equipment, it can cause serious injury or death.*

1. Supply power to the control circuit from the external 24 V input.
2. Use monitor parameters *U2-xx* to display the fault code and data on the operating status of the drive just before the fault occurred.
3. Use the information in the Troubleshooting tables to remove the fault.

Note:

1. To find the faults that the drive detected, check the fault history in *U2-02 [Previous Fault]*. To find information about drive status (for example. frequency, current, and voltage) when the drive detected the faults, check *U2-03 to U2-20*.
2. If the fault display stays after you re-energize the drive, remove the cause of the fault and reset.

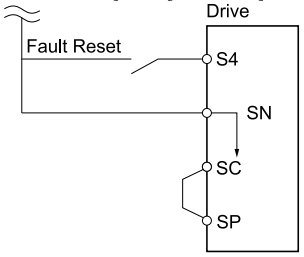
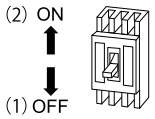
◆ Fault Occurs Without Power Loss

1. Examine the fault code shown on the keypad.
2. Use the information in the Troubleshooting tables to remove the fault.
3. Do a fault reset.

◆ Fault Reset Procedure

If a fault occurs, you must remove the cause of the fault and re-energize the drive. The table below lists the different methods to reset the drive after a fault.

Table 6.3 Fault Reset Methods

Methods	Description
Method 1	While the keypad is showing the fault or alarm code, push RESET on the keypad.
Method 2	Switch ON the MFDI terminal set to *H1-xx = 14 [MFDI Function Selection = Fault Reset]*. **Note:** The default setting for *H1-04 [Terminal S4 Function Selection]* is *14 [Fault Reset]*. 
Method 3	1. De-energize the drive main circuit power supply. **Note:** If you use an external 24 V power supply, also de-energize the control power supply. 2. Energize the drive again after the keypad display goes out. 

Note:

If the drive receives a Run command from a communication option card or control circuit terminal, you cannot use fault reset method 1 and method 2. Remove the Run command then try to clear the fault. If you do a fault reset when the drive has a Run command, the keypad will show minor fault *CrST [Cannot Reset]*.

7

Periodic Inspection and Maintenance

This chapter gives information about how to examine and maintain drives in use, how to replace cooling fans and other parts, and how to store drives.

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7.1 Section Safety

⚠DANGER

Electrical Shock Hazard

Do not examine, connect, or disconnect wiring on an energized drive. Before servicing, disconnect all power to the equipment and wait for the time specified on the warning label at a minimum. The internal capacitor stays charged after the drive is de-energized. The charge indicator LED extinguishes when the DC bus voltage decreases below 50 Vdc. When all indicators are OFF, remove the covers before measuring for dangerous voltages to make sure that the drive is safe.

If you do work on the drive when it is energized, it will cause serious injury or death from electrical shock.

Disconnect all power to the drive and wait for the time specified on the warning label before you remove covers. Check the drive for dangerous voltages before servicing or repair work.

If you do work on the drive when it is energized and there is no cover over the electronic circuits, it will cause serious injury or death from electrical shock. The drive has internal capacitors that stay charged after you de-energize the drive.

⚠WARNING

Electrical Shock Hazard

Do not operate the drive when covers are missing. Replace covers and shields before you operate the drive. Use the drive only as specified by the instructions.

Some figures in this section include drives without covers or safety shields to more clearly show the inside of the drive. If covers or safety shields are missing from the drive, it can cause serious injury or death.

Always ground the motor-side grounding terminal.

If you do not ground the equipment correctly, it can cause serious injury or death if you touch the motor case.

Only let approved personnel install, wire, maintain, examine, replace parts, and repair the drive.

If personnel are not approved, it can cause serious injury or death.

Do not wear loose clothing or jewelry when you do work on the drive. Tighten loose clothing and remove all metal objects, for example watches or rings.

Loose clothing can catch on the drive and jewelry can conduct electricity and cause serious injury or death.

Fire Hazard

Tighten all terminal screws to the correct tightening torque.

Connections that are too loose or too tight can cause incorrect operation and damage to the drive. Incorrect connections can also cause death or serious injury from fire.

Damage to Equipment

Do not apply incorrect voltage to the main circuit of the drive. Operate the drive in the specified range of the input voltage on the drive nameplate.

Voltages that are higher than the permitted nameplate tolerance can cause damage to the drive.

Fire Hazard

Do not put flammable or combustible materials on top of the drive and do not install the drive near flammable or combustible materials. Attach the drive to metal or other noncombustible material.

Flammable and combustible materials can start a fire and cause serious injury or death.

Electrical Shock Hazard

Do not modify the drive body or drive circuitry.

Modifications to drive body and circuitry can cause serious injury or death, will cause damage to the drive, and will void the warranty. Yaskawa is not responsible for modifications of the product made by the user.

Sudden Movement Hazard

Make sure that you align the phase order for the drive and motor when you connect the motor to drive output terminals U/T1, V/T2, and W/T3.

If the phase order is incorrect, it can cause the motor to run in reverse. If the motor accidentally runs in reverse, it can cause serious injury or death.

⚠CAUTION

Burn Hazard

Do not touch a hot drive heatsink. De-energize the drive, wait for a minimum of 15 minutes, then make sure that the heatsink is cool before you replace the cooling fans.

If you touch a hot drive heatsink, it can burn you.

NOTICE

Damage to Equipment

When you touch the drive and circuit boards, make sure that you observe correct electrostatic discharge (ESD) procedures.

If you do not follow procedures, it can cause ESD damage to the drive circuitry.

Use the instructions in this manual to replace the cooling fans. When you do maintenance on the fans, replace all the fans to increase product life.

If you install the fans incorrectly, it can cause damage to the drive.

Make sure that all connections are correct after you install the drive and connect peripheral devices.

Incorrect connections can cause damage to the drive.

Do not energize and de-energize the drive more frequently than one time each 30 minutes.

If you frequently energize and de-energize the drive, it can cause drive failure.

Do not operate a drive or connected equipment that has damaged or missing parts.

You can cause damage to the drive and connected equipment.

Note:

Do not let unwanted objects, for example metal shavings or wire clippings, fall into the drive during drive installation. Put a temporary cover over the drive during installation. Remove the temporary cover before start-up. Unwanted objects inside of the drive can cause damage to the drive.

7.2 Inspection

Power electronics have limited life and can show changes in performance and deterioration of performance after years of use in usual conditions. To help prevent these problems, it is important to do preventive maintenance and regular inspection, and replace parts on the drive.

Drives contain different types of power electronics, for example power transistors, semiconductors, capacitors, resistors, fans, and relays. The electronics in the drive are necessary for correct motor control.

Follow the inspection lists in this chapter as a part of a regular maintenance program.

Note:

Examine the drive one time each year at a minimum.

The operating conditions, environmental conditions, and use conditions will have an effect on the examination frequency for connected equipment.

Examine the drive more frequently if you use the drive in bad conditions or in these conditions:

- High ambient temperatures
- Frequent starting and stopping
- Changes in the AC power supply or load
- Too much vibration or shock loading
- Dust, metal dust, salt, sulfuric acid, or chlorine atmospheres
- Unsatisfactory storage conditions.

◆ Recommended Daily Inspection

Table 7.1 gives information about the recommended daily inspection for Yaskawa drives. Examine the items in Table 7.1 each day to make sure that the components do not become unserviceable or fail. Make a copy of this checklist and put a check mark in the “Checked” column after each inspection.

Table 7.1 Daily Inspection Checklist

Inspection Area	Inspection Points	Corrective Action	Checked
Motor	Examine for unusual oscillation or noise coming from the motor.	• Check the load coupling. • Measure motor vibration. • Tighten all loose components.	
Cooling System	Examine for unusual heat from the drive or motor and visible discoloration.	• Check for a load that is too heavy. • Tighten loose screws. • Check for a dirty heatsink or motor. • Measure the ambient temperature.	
	Examine the cooling fans, circulation fans, and circuit board cooling fans.	• Check for a clogged or dirty fan. • Use the performance life monitor to check for correct fan operation.	
Surrounding Environment	Make sure that the installation environment is applicable.	Remove the source of contamination or correct unsatisfactory environment.	
Load	Make sure that the drive output current is not more than the motor or drive rating for an extended period of time.	• Check for a load that is too heavy. • Check the correct motor parameter settings.	
Power Supply Voltage	Examine main power supply and control voltages.	• Correct the voltage or power supply to agree with nameplate specifications. • Verify all main circuit phases.	

◆ Recommended Periodic Inspection

The table gives information about the recommended periodic inspections for Yaskawa drives. Examine the drive one time each year at a minimum. The operating conditions, environmental conditions, and use conditions will have an effect on the examination frequency for connected equipment. You must use your experience with the application to select the correct inspection frequency for each drive installation Periodic inspections will help to prevent performance deterioration and product failure. Copy this checklist and mark the “Checked” column after each inspection.

DANGER! *Electrical Shock Hazard. Do not examine, connect, or disconnect wiring on an energized drive. Before servicing, disconnect all power to the equipment and wait for the time specified on the warning label at a minimum. The internal capacitor stays charged after the drive is de-energized. The charge indicator LED extinguishes when the DC bus voltage decreases below 50 Vdc. When all indicators are OFF, remove the covers before measuring for dangerous voltages to make sure that the drive is safe. If you do work on the drive when it is energized, it will cause serious injury or death from electrical shock.*

Table 7.2 Main Circuit Periodic Inspection Checklist

Inspection Area	Inspection Points	Corrective Action	Checked
General	• Examine equipment for discoloration from too much heat or deterioration. • Examine for damaged parts.	• Replace damaged components as necessary. • The drive does not have many serviceable parts and it could be necessary to replace the drive.	
	Examine for dirt, unwanted particles, or dust on components.	• Examine enclosure door seal. • Use a vacuum cleaner to remove unwanted particles and dust without touching the components. • If you cannot remove unwanted particles and dust with a vacuum cleaner, replace the components.	
Conductors and Wiring	• Examine wiring and connections for discoloration or damage. Examine wiring and connections for discoloration from too much heat. • Examine wire insulation and shielding for discoloration and wear.	Repair or replace damaged wiring.	
Terminal Block	Examine terminals for stripped, damaged, or loose connections.	• Tighten loose screws. • Replace damaged screws or terminals. **Note:** On drive models, 2047, 2060, 4024, and 4031, you cannot replace the hex screws.	
Electromagnetic Contactors and Relays	• Examine contactors and relays for too much noise during operation. • Examine coils for signs of too much heat, such as melted or broken insulation.	• Check coil voltage for overvoltage or undervoltage conditions. • Replace broken relays, contactors, or circuit boards that you can remove.	
Dynamic Braking Option	Examine the insulation for discoloration from too much heat.	If there is discoloration in the option, check to make sure that there is not damage to the wiring. A small quantity of discoloration is not a problem.	

Table 7.3 Motor Periodic Inspection Checklist

Inspection Area	Inspection Points	Corrective Action	Checked
Operation Check	Check for increased vibration or unusual noise.	Stop the motor and contact approved maintenance personnel as necessary.	

Table 7.4 Control Circuit Periodic Inspection Checklist

Inspection Area	Inspection Points	Corrective Action	Checked
General	• Examine terminals for stripped, damaged, or loose connections. • Tighten loose screws.	• Tighten loose screws. • Replace damaged screws or terminals. • If terminals are integral to a circuit board, it could be necessary to replace the control board or the drive.	
Circuit Boards	• Check for odor, discoloration, or rust. • Make sure that all connections are correctly fastened. • Make sure that the surface of the circuit board does not have dust or oil mist.	• Tighten loose connections. • If you cannot remove unwanted particles and dust with a vacuum cleaner or anti-static cloth, replace the components. • Do not use solvents to clean the board. • Use a vacuum cleaner to remove unwanted particles and dust without touching the components. • The drive does not have many serviceable parts and it could be necessary to replace the drive.	

Table 7.5 Cooling System Periodic Inspection Checklist

Inspection Area	Inspection Points	Corrective Action	Checked
Cooling fans	• Check for unusual oscillation or unusual noise. • Check for damaged or missing fan blades.	Clean or replace the fans as necessary.	
Heatsink	• Examine for dust or other unwanted material collected on the surface. • Examine for dirt.	Use a vacuum cleaner to remove unwanted particles and dust without touching the components.	
Air Duct	Examine air intake, exhaust openings and make sure that there are no unwanted materials on the surface.	Clear blockages and clean air duct as necessary.	

Table 7.6 Keypad Periodic Inspection Checklist

Inspection Area	Inspection Points	Corrective Action	Checked
General	• Make sure that the keypad shows the data correctly. • Examine for dust or other unwanted material that collected on components in the area.	• Contact Yaskawa or your nearest sales representative if you have any problems with the display or key. • Clean the keypad.	

7.3 Maintenance

The drive Maintenance Monitors keep track of component wear and tell the user when the end of the estimated performance life is approaching. The Maintenance Monitors prevent the need to shut down the full system for unexpected problems. Users can set alarm notifications for the maintenance periods for these drive components:

- Cooling fan
- Electrolytic Capacitor
- Soft charge bypass relay
- IGBT

Contact Yaskawa or your nearest sales representative for more information about part replacement.

7.4 Replace Cooling Fans and Circulation Fans

CAUTION! *Injury to Personnel. Some fan units are not easily accessible from a standing position. Make sure that you can safely and comfortably remove and replace the fan. If you try to remove a fan that you cannot easily access, the fan unit can fall and cause minor to moderate injury.*

NOTICE: *Use the instructions in this manual to replace the cooling fans. When you do maintenance on the fans, replace all the fans to increase product life. If you install the fans incorrectly, it can cause damage to the drive.*

◆ Number of Cooling Fans and Circulation Fans Used

Table 7.7 Cooling Fans and Circulation Fans (Three-Phase 200 V)

Model	Cooling Fan	Circulation Fans	Replacement Procedure
2003 to 2011	-	-	-
2014, 2018	1	-	Procedure A
2025, 2033	2	-	Procedure B
2047	2	-	Procedure C
2060 to 2088	2	-	Procedure D
2115 to 2283	2	-	Procedure E
2346, 2415	3	1	Procedure F

Table 7.8 Cooling Fans and Circulation Fans (Three-Phase 400 V)

Model	Cooling Fan	Circulation Fans	Circuit Board Cooling Fans	Replacement Procedure
4002 to 4005	-	-	-	-
4006 to 4009	1	-	-	Procedure A
4015, 4018	2	-	-	Procedure B
4024, 4031	2	-	-	Procedure C
4039 to 4060	2	-	-	Procedure D
4075 to 4260	2	-	-	Procedure E
4304	2	1	-	Procedure F
4371	3	1	-	Procedure F
4414 to 4605	2	1	2	Procedure G

◆ Fan Replacement (Procedure A)

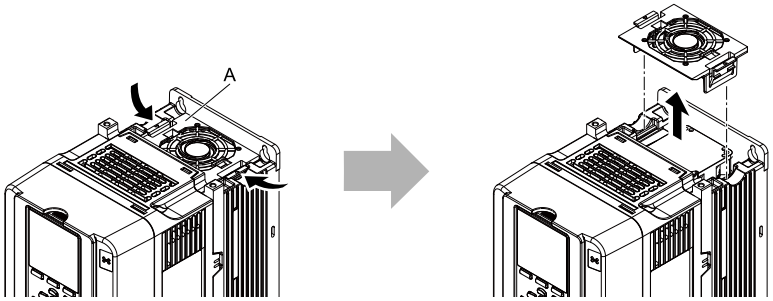
DANGER! *Electrical Shock Hazard. Do not examine, connect, or disconnect wiring on an energized drive. Before servicing, disconnect all power to the equipment and wait for the time specified on the warning label at a minimum. The internal capacitor stays charged after the drive is de-energized. The charge indicator LED extinguishes when the DC bus voltage decreases below 50 Vdc. When all indicators are OFF, remove the covers before measuring for dangerous voltages to make sure that the drive is safe. If you do work on the drive when it is energized, it will cause serious injury or death from electrical shock.*

CAUTION! *Burn Hazard. Do not touch a hot drive heatsink. De-energize the drive, wait for a minimum of 15 minutes, then make sure that the heatsink is cool before you replace the cooling fans. If you touch a hot drive heatsink, it can burn you.*

NOTICE: *Use the instructions in this manual to replace the cooling fans. When you do maintenance on the fans, replace all the fans to increase product life. If you install the fans incorrectly, it can cause damage to the drive.*

■ Fan Removal

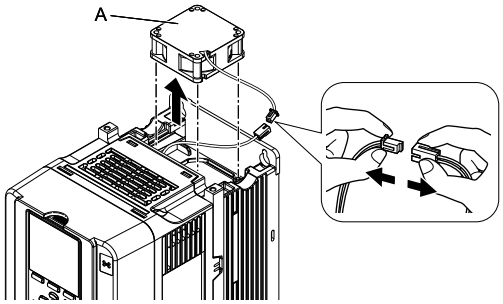
1. To remove the fan finger guard from the drive, push the hooks on the left and right sides of it and pull up.



A - Fan finger guard

Figure 7.1 Remove the Fan Finger Guard

2. Pull the cooling fan straight up from the drive. Disconnect the relay connector and remove the fan from the drive.



A - Cooling fan

Figure 7.2 Remove the Cooling Fan

■ Fan Installation

Reverse the removal procedure for fan installation.

1. Connect the relay connector between the drive and cooling fan.

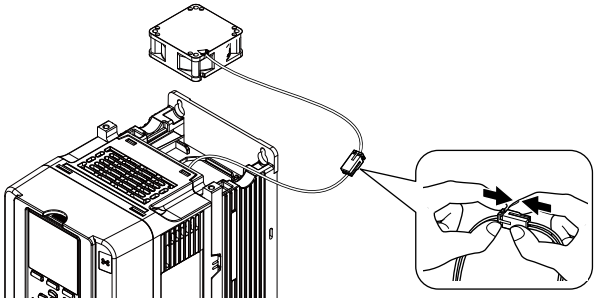
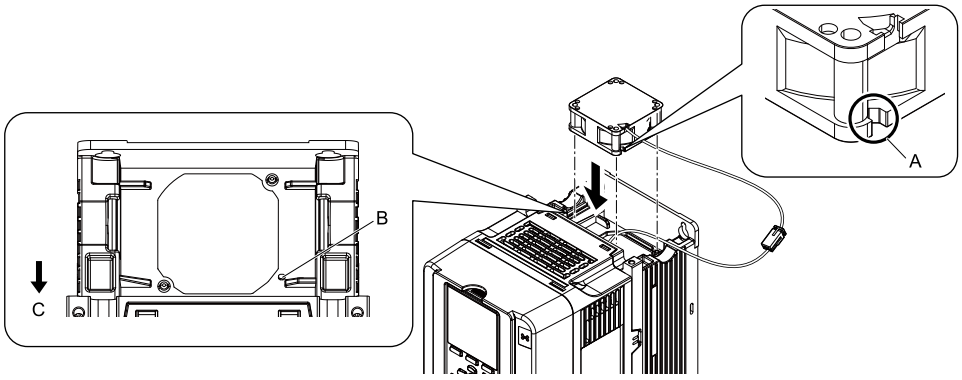


Figure 7.3 Connect the Relay Connector

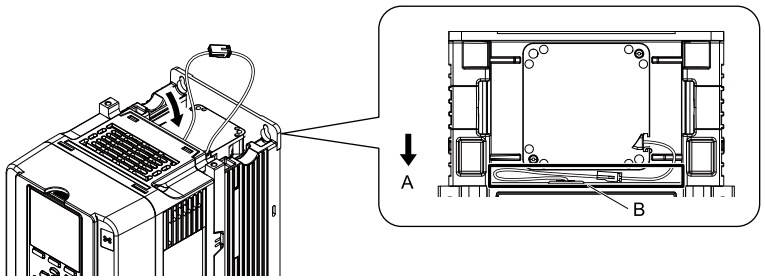
2. Align the notch on the fan with the pin on the drive and install the cooling fan in the drive.



A - Notch on fan
B - Alignment pin on drive
C - Front of drive

Figure 7.4 Install the Cooling Fan

3. Put the cable and connector in the recess of the drive.



A - Front of drive
B - Space for cable *1

Figure 7.5 Put the Cable and Connector in the Drive Recess

*1 Make sure that the cable and connector are in the correct space.

4. Insert the fan finger guard straight until the hooks click into place.

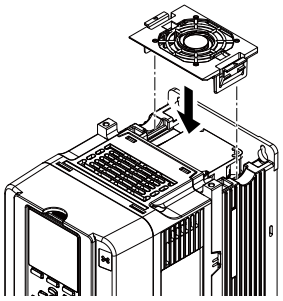


Figure 7.6 Reattach the Fan Finger Guard

5. Energize the drive and set *o4-03 = 0 [Fan Operation Time Setting = 0 h]* to reset the fan operation time.

◆ Fan Replacement (Procedure B)

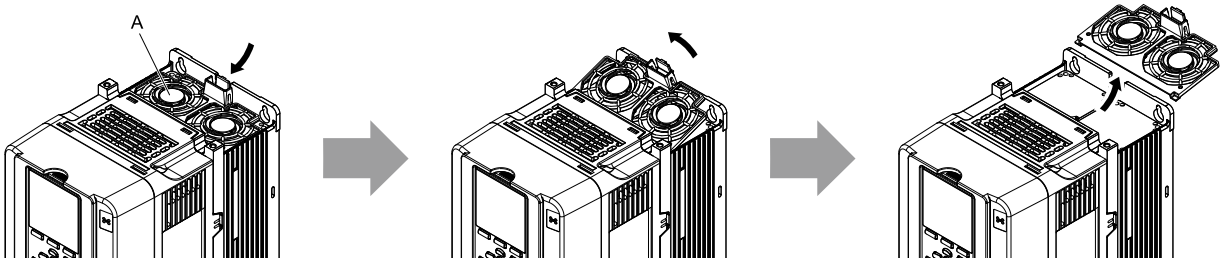
DANGER! *Electrical Shock Hazard. Do not examine, connect, or disconnect wiring on an energized drive. Before servicing, disconnect all power to the equipment and wait for the time specified on the warning label at a minimum. The internal capacitor stays charged after the drive is de-energized. The charge indicator LED extinguishes when the DC bus voltage decreases below 50 Vdc. When all indicators are OFF, remove the covers before measuring for dangerous voltages to make sure that the drive is safe. If you do work on the drive when it is energized, it will cause serious injury or death from electrical shock.*

CAUTION! *Burn Hazard. Do not touch a hot drive heatsink. De-energize the drive, wait for a minimum of 15 minutes, then make sure that the heatsink is cool before you replace the cooling fans. If you touch a hot drive heatsink, it can burn you.*

NOTICE: *Use the instructions in this manual to replace the cooling fans. When you do maintenance on the fans, replace all the fans to increase product life. If you install the fans incorrectly, it can cause damage to the drive.*

■ Fan Removal

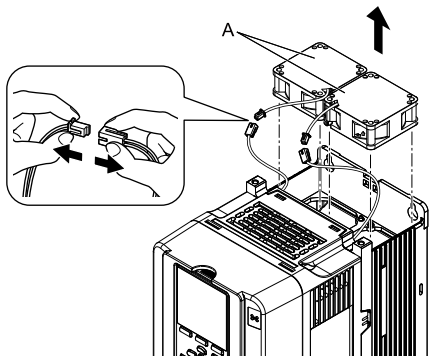
1. To remove the fan finger guard from the drive, push the hook on the back side of the fan finger guard and pull up.



A - Fan finger guard

Figure 7.7 Remove the Fan Finger Guard

2. Pull the cooling fans straight up from the drive. Disconnect the relay connectors and remove the fans from the drive.



A - Cooling fans

Figure 7.8 Remove the Cooling Fans

■ Fan Installation

Reverse the removal procedure for fan installation.

1. Connect the relay connectors between the drive and cooling fans.

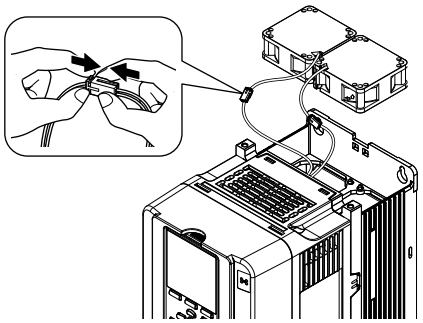
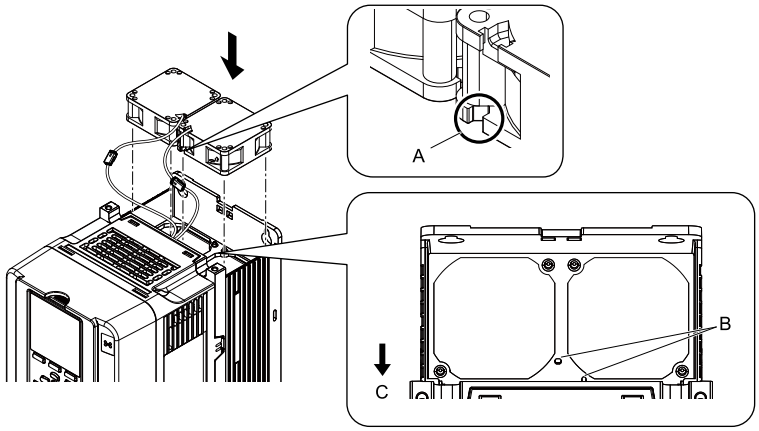


Figure 7.9 Connect the Relay Connectors

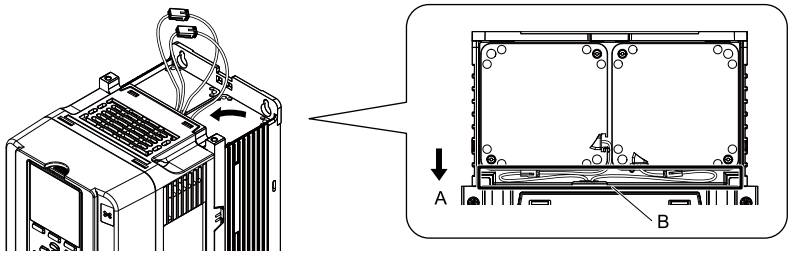
2. Align the notches on the fans with the pins on the drive and install the cooling fans in the drive.



A - Notch on fan
B - Alignment pins on drive
C - Front of drive

Figure 7.10 Install the Cooling Fans

3. Put the cables in the recess of the drive.

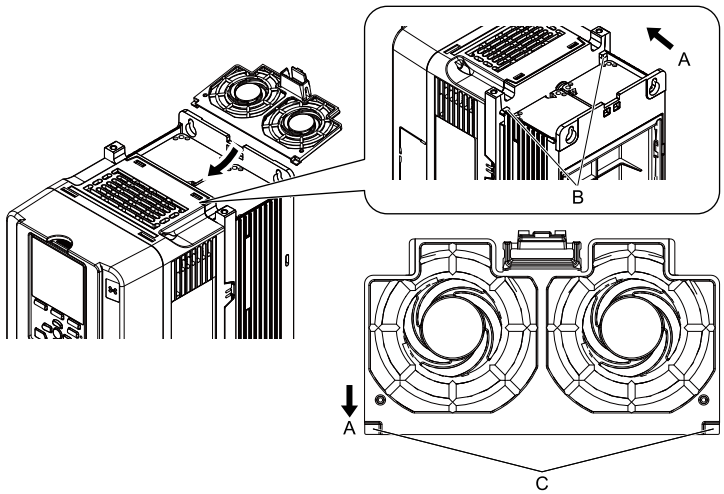


A - Front of drive
B - Space for cables *1

Figure 7.11 Put the Cables and Connectors in the Drive Recess

*1 Make sure that the cables and connectors are in the correct space.

4. Hold the fan finger guard at an angle and put the connector tabs on the fan finger guard into the holes on the drive.



A - Front of drive
B - Drive holes
C - Connector tabs

Figure 7.12 Reattach the Fan Finger Guard

5. Push the hook on the back side of the fan finger guard and click it into place on the drive.

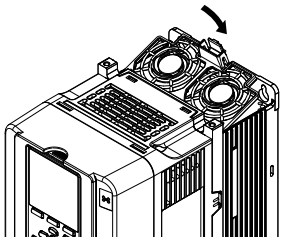


Figure 7.13 Reattach the Fan Finger Guard

6. Energize the drive and set *o4-03 = 0 [Fan Operation Time Setting = 0 h]* to reset the fan operation time.

◆ Fan Replacement (Procedure C)

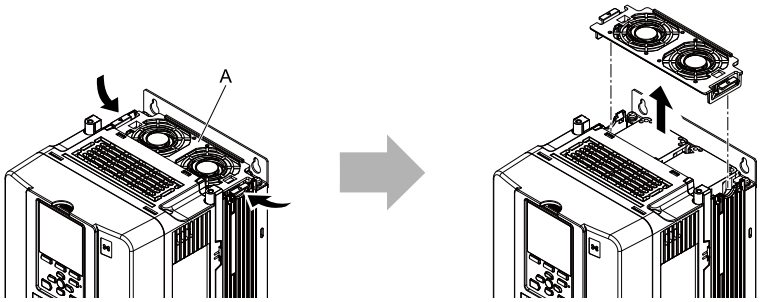
DANGER! *Electrical Shock Hazard. Do not examine, connect, or disconnect wiring on an energized drive. Before servicing, disconnect all power to the equipment and wait for the time specified on the warning label at a minimum. The internal capacitor stays charged after the drive is de-energized. The charge indicator LED extinguishes when the DC bus voltage decreases below 50 Vdc. When all indicators are OFF, remove the covers before measuring for dangerous voltages to make sure that the drive is safe. If you do work on the drive when it is energized, it will cause serious injury or death from electrical shock.*

CAUTION! *Burn Hazard. Do not touch a hot drive heatsink. De-energize the drive, wait for a minimum of 15 minutes, then make sure that the heatsink is cool before you replace the cooling fans. If you touch a hot drive heatsink, it can burn you.*

NOTICE: *Use the instructions in this manual to replace the cooling fans. When you do maintenance on the fans, replace all the fans to increase product life. If you install the fans incorrectly, it can cause damage to the drive.*

■ Fan Removal

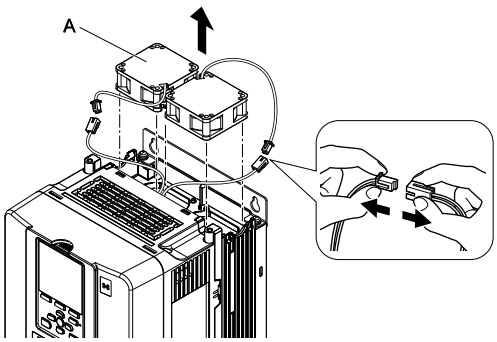
1. To remove the fan finger guard from the drive, push the hooks on the left and right sides of it and pull up.



A - Fan finger guard

Figure 7.14 Remove the Fan Finger Guard

2. Pull the cooling fans straight up from the drive. Disconnect the relay connectors and remove the fans from the drive.



A - Cooling fans

Figure 7.15 Remove the Cooling Fans

■ Fan Installation

Reverse the removal procedure for fan installation.

1. Connect the relay connectors between the drive and cooling fans.

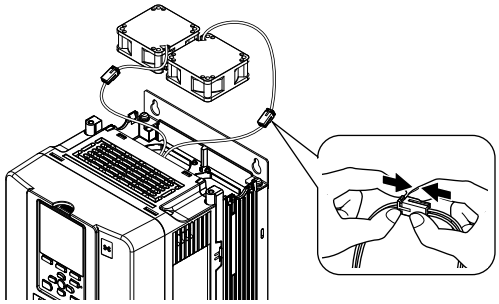
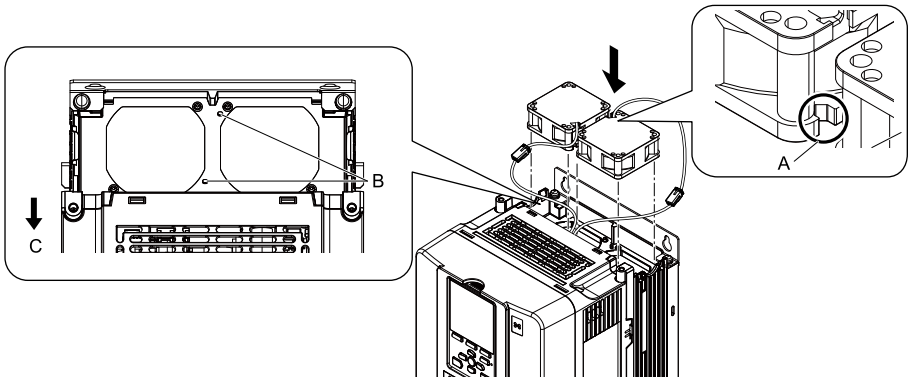


Figure 7.16 Connect the Relay Connectors

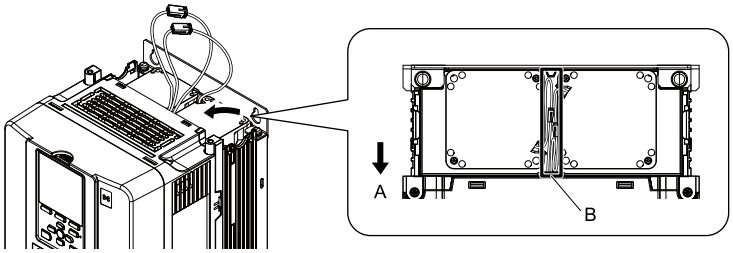
2. Align the notches on the fans with the pins on the drive and install the cooling fans in the drive.



A - Notch on fan
B - Alignment pins on drive
C - Front of drive

Figure 7.17 Install the Cooling Fans

3. Put the cables and connectors in the recess of the drive.



A - Front of drive
B - Space for cables *1*

Figure 7.18 Put the Cables and Connectors in the Drive Recess

*1 Make sure that the cables and connectors are in the correct space.

4. Insert the fan finger guard straight until the hooks click into place.

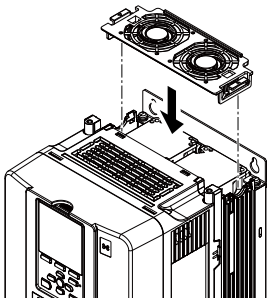


Figure 7.19 Reattach the Fan Finger Guard

5. Energize the drive and set *o4-03 = 0 [Fan Operation Time Setting = 0 h]* to reset the fan operation time.

◆ Fan Replacement (Procedure D)

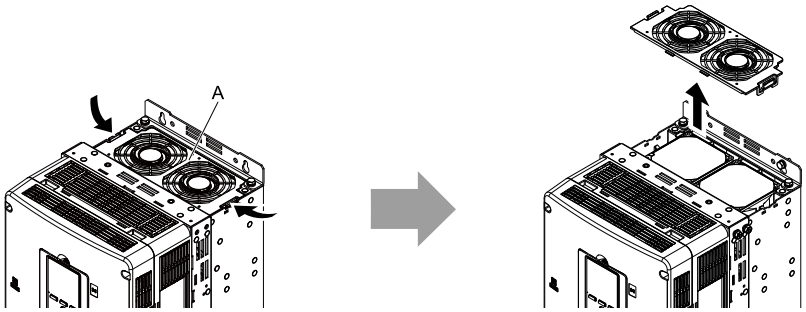
DANGER! *Electrical Shock Hazard. Do not examine, connect, or disconnect wiring on an energized drive. Before servicing, disconnect all power to the equipment and wait for the time specified on the warning label at a minimum. The internal capacitor stays charged after the drive is de-energized. The charge indicator LED extinguishes when the DC bus voltage decreases below 50 Vdc. When all indicators are OFF, remove the covers before measuring for dangerous voltages to make sure that the drive is safe. If you do work on the drive when it is energized, it will cause serious injury or death from electrical shock.*

CAUTION! *Burn Hazard. Do not touch a hot drive heatsink. De-energize the drive, wait for a minimum of 15 minutes, then make sure that the heatsink is cool before you replace the cooling fans. If you touch a hot drive heatsink, it can burn you.*

NOTICE: *Use the instructions in this manual to replace the cooling fans. When you do maintenance on the fans, replace all the fans to increase product life. If you install the fans incorrectly, it can cause damage to the drive.*

■ Fan Removal

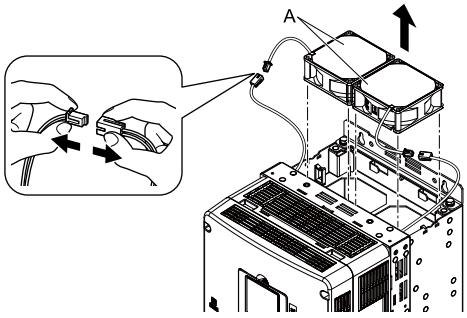
1. To remove the fan finger guard from the drive, push the hooks on the left and right sides of it and pull up.



A - Fan finger guard

Figure 7.20 Remove the Fan Finger Guard

2. Pull the cooling fans straight up from the drive. Disconnect the relay connectors and remove the fans from the drive.



A - Cooling fans

Figure 7.21 Remove the Cooling Fans

■ Fan Installation

Reverse the removal procedure for fan installation.

1. Connect the relay connectors between the drive and cooling fans.

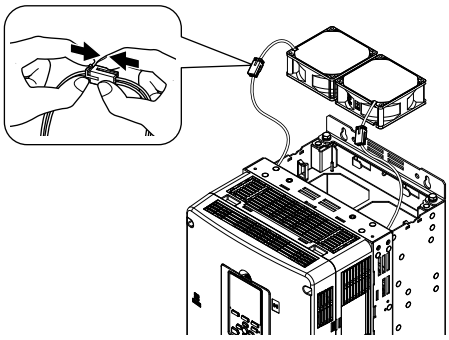
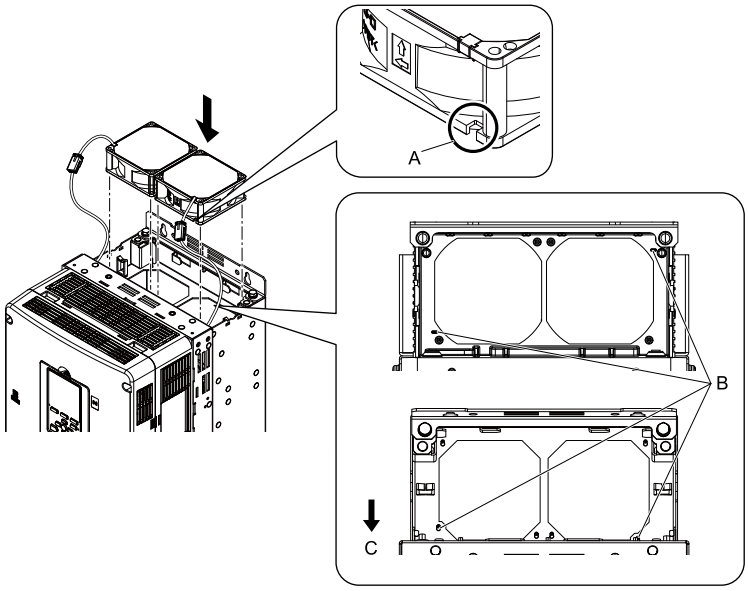


Figure 7.22 Connect the Relay Connectors

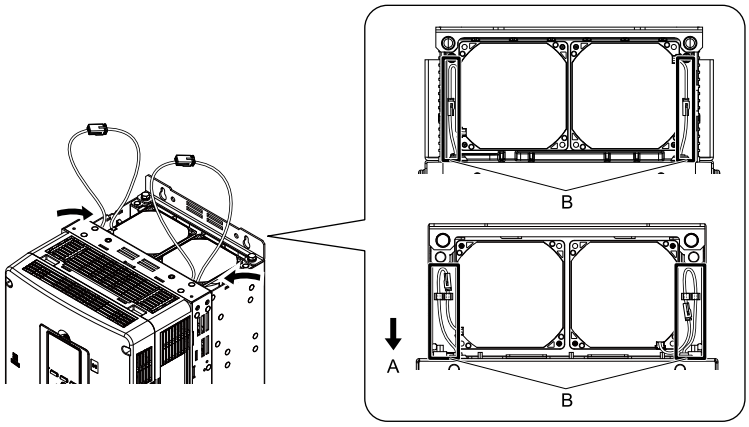
2. Align the notches on the fans with the pins on the drive and install the cooling fans in the drive.



A - Notch on fan
B - Alignment pins on drive
C - Front of drive

Figure 7.23 Install the Cooling Fans

3. Put the cables and connectors in the recess of the drive.



A - Front of drive
B - Space for cables *1

Figure 7.24 Put the Cables and Connectors in the Drive Recess

*1 Make sure that the cables and connectors are in the correct space.

4. Push the hooks on the left and right sides of the fan finger guard and click it into place on the drive.

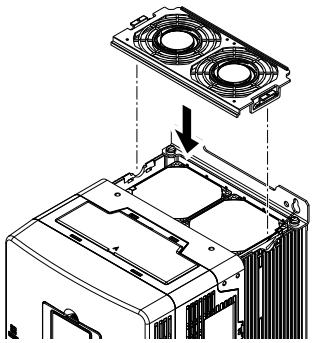


Figure 7.25 Reattach the Fan Finger Guard

5. Energize the drive and set *o4-03 = 0 [Fan Operation Time Setting = 0 h]* to reset the fan operation time.

◆ Fan Replacement (Procedure E)

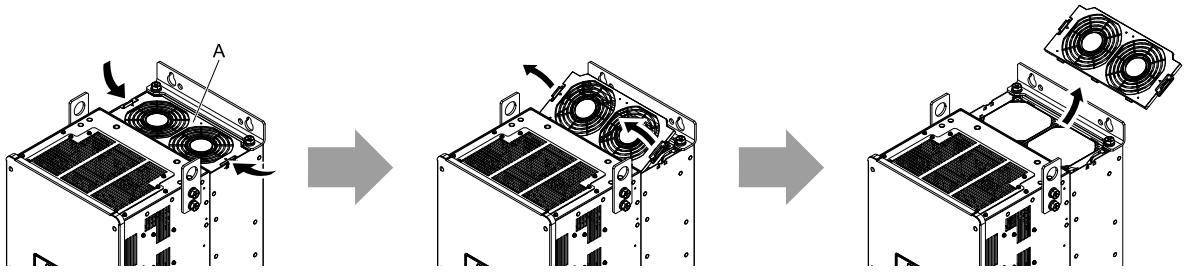
DANGER! *Electrical Shock Hazard. Do not examine, connect, or disconnect wiring on an energized drive. Before servicing, disconnect all power to the equipment and wait for the time specified on the warning label at a minimum. The internal capacitor stays charged after the drive is de-energized. The charge indicator LED extinguishes when the DC bus voltage decreases below 50 Vdc. When all indicators are OFF, remove the covers before measuring for dangerous voltages to make sure that the drive is safe. If you do work on the drive when it is energized, it will cause serious injury or death from electrical shock.*

CAUTION! *Burn Hazard. Do not touch a hot drive heatsink. De-energize the drive, wait for a minimum of 15 minutes, then make sure that the heatsink is cool before you replace the cooling fans. If you touch a hot drive heatsink, it can burn you.*

NOTICE: *Use the instructions in this manual to replace the cooling fans. When you do maintenance on the fans, replace all the fans to increase product life. If you install the fans incorrectly, it can cause damage to the drive.*

■ Fan Removal

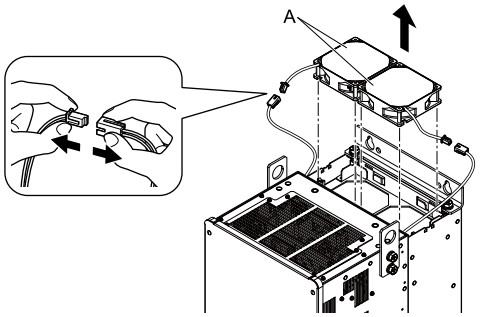
1. To remove the fan finger guard from the drive, push the tabs on the left and right sides of it and pull up the back side of the guard.



A - Fan finger guard

Figure 7.26 Remove the Fan Finger Guard

2. Pull the cooling fans straight up from the drive. Disconnect the relay connectors and remove the fans from the drive.



A - Cooling fans

Figure 7.27 Remove the Cooling Fans

■ Fan Installation

Reverse the removal procedure for fan installation.

1. Connect the relay connectors between the drive and cooling fans.

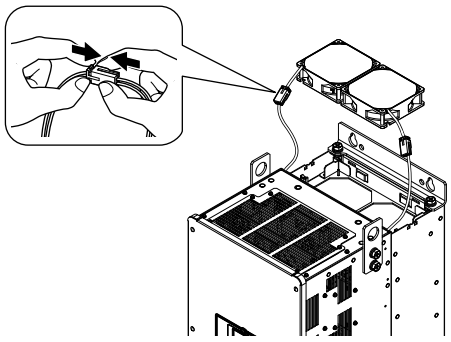
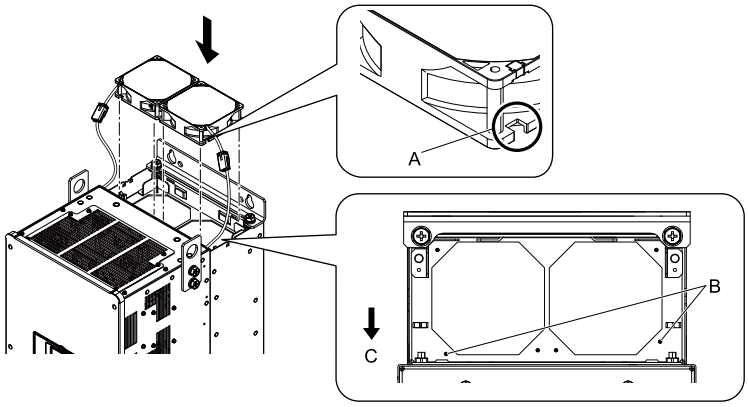


Figure 7.28 Connect the Relay Connectors

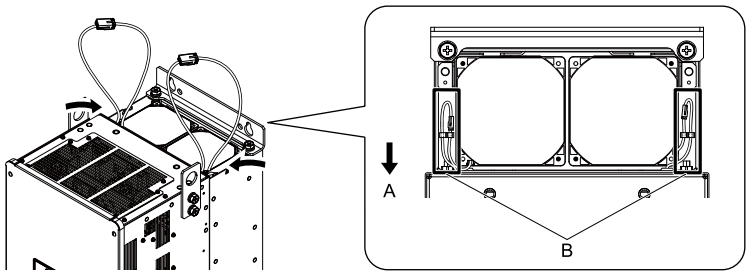
2. Align the notches on the fans with the pins on the drive and install the cooling fans in the drive.



A - Notch on fan
B - Alignment pins on drive
C - Front of drive

Figure 7.29 Install the Cooling Fans

3. Put the cables and connectors in the recess of the drive.

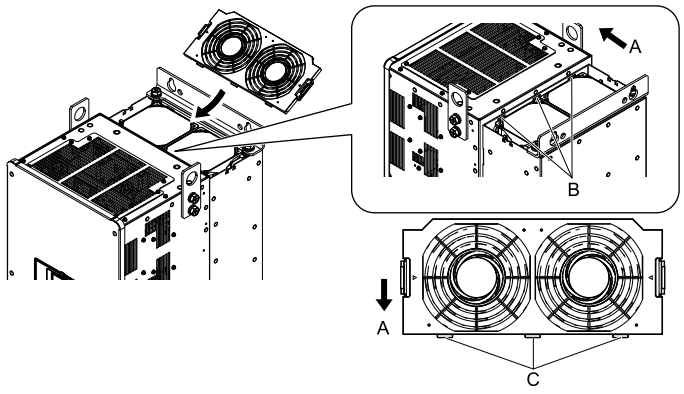


A - Front of drive
B - Space for cables *1

Figure 7.30 Put the Cables and Connectors in the Drive Recess

*1 Make sure that the cables and connectors are in the correct space.

4. Hold the fan finger guard at an angle and put the connector tabs on the fan finger guard into the holes on the drive.



A - Front of drive
B - Drive holes
C - Connector tabs

Figure 7.31 Reattach the Fan Finger Guard

5. Push the hooks on the left and right sides of the fan finger guard and click it into place on the drive.

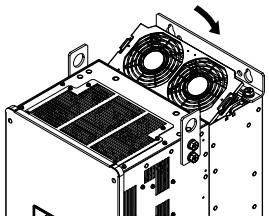


Figure 7.32 Reattach the Fan Finger Guard

6. Energize the drive and set *o4-03 = 0 [Fan Operation Time Setting = 0 h]* to reset the fan operation time.

◆ Fan Replacement (Procedure F)

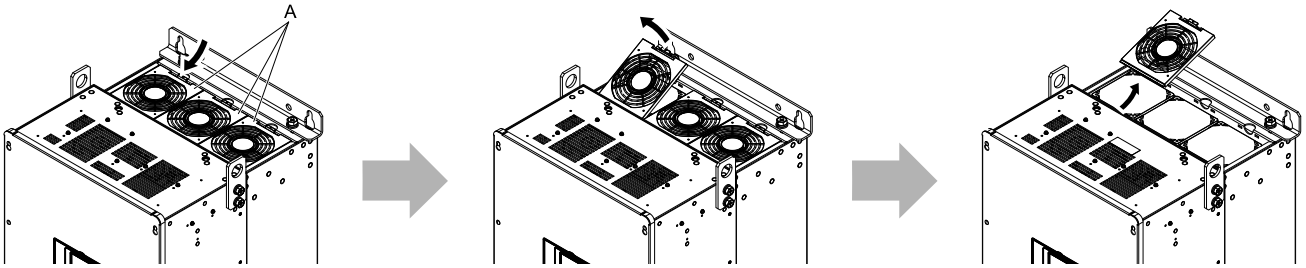
DANGER! *Electrical Shock Hazard. Do not examine, connect, or disconnect wiring on an energized drive. Before servicing, disconnect all power to the equipment and wait for the time specified on the warning label at a minimum. The internal capacitor stays charged after the drive is de-energized. The charge indicator LED extinguishes when the DC bus voltage decreases below 50 Vdc. When all indicators are OFF, remove the covers before measuring for dangerous voltages to make sure that the drive is safe. If you do work on the drive when it is energized, it will cause serious injury or death from electrical shock.*

CAUTION! *Burn Hazard. Do not touch a hot drive heatsink. De-energize the drive, wait for a minimum of 15 minutes, then make sure that the heatsink is cool before you replace the cooling fans. If you touch a hot drive heatsink, it can burn you.*

NOTICE: *Use the instructions in this manual to replace the cooling fans. When you do maintenance on the fans, replace all the fans to increase product life. If you install the fans incorrectly, it can cause damage to the drive.*

■ Fan Removal

1. To remove the fan finger guards from the drive, push the hook on the back side of each guard and pull up.

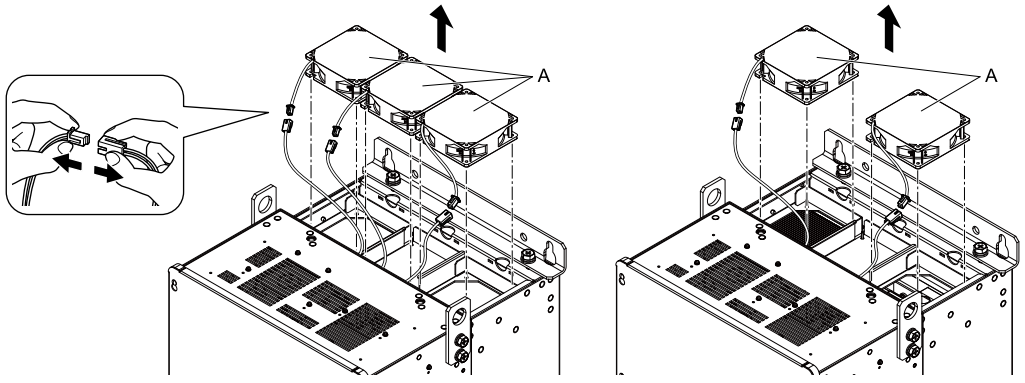


A - Fan finger guards

Figure 7.33 Remove the Fan Finger Guards

2. Pull the cooling fans straight up from the drive. Disconnect the relay connectors and remove the fans from the drive.

Note:
The number of fans is different for different drive models.



A - Cooling fans

Figure 7.34 Remove the Cooling Fans

■ Fan Installation

Reverse the removal procedure for fan installation.

1. Connect the relay connectors between the drive and cooling fans.

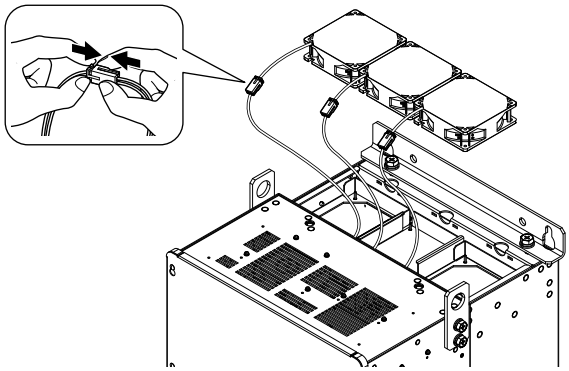
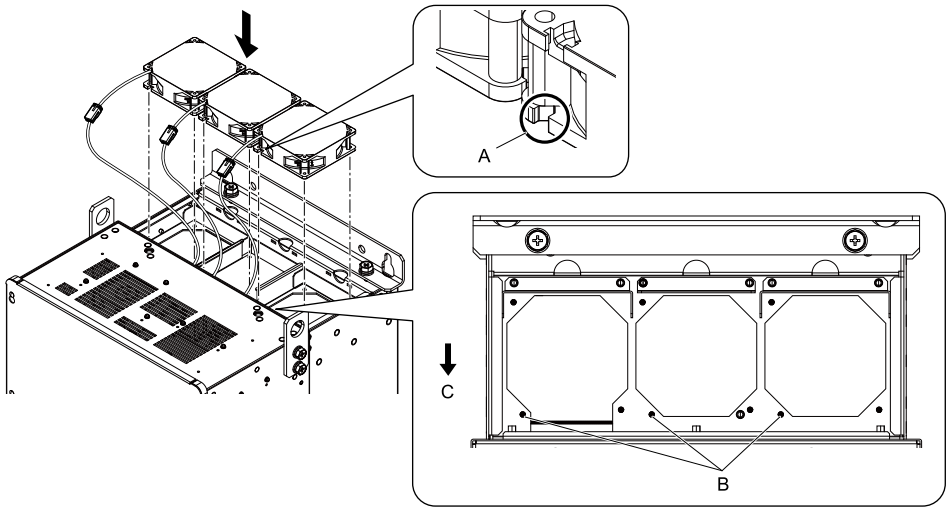


Figure 7.35 Connect the Relay Connectors

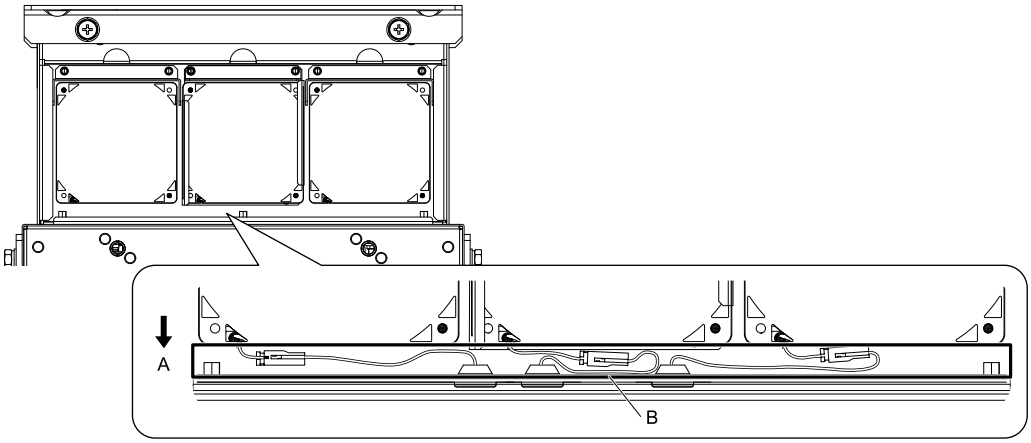
2. Align the notches on the fans with the pins on the drive and install the cooling fans in the drive.



A - Notch on fan
B - Alignment pins on drive
C - Front of drive

Figure 7.36 Install the Cooling Fans

3. Put the cables and connectors in the recess of the drive.



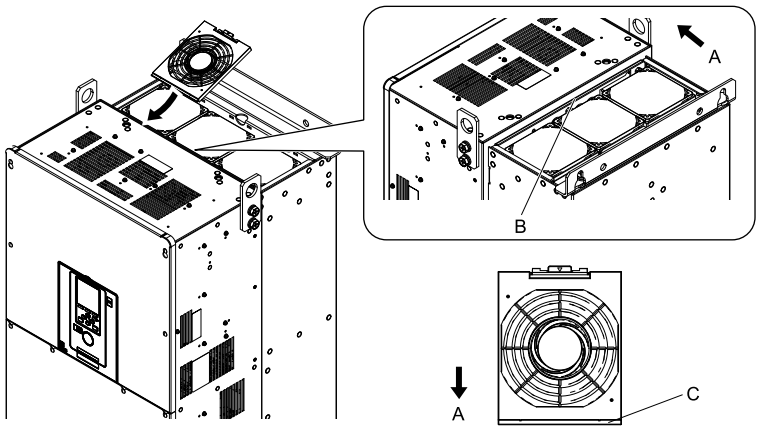
A - Front of drive
B - Space for cables *1

Figure 7.37 Put the Cables and Connectors in the Drive Recess

*1 Make sure that the cables and connectors are in the correct space.

4. Hold the fan finger guards at an angle and put the connector tabs on the fan finger guards into the holes on the drive.

Note:
When you install the cooling fans, make sure that you do not pinch cables between the fan finger guards and the drive.



A - Front of drive
B - Insertion area
C - Connector tab

Figure 7.38 Reattach the Fan Finger Guards

5. Push the hooks on the back side of the fan finger guards and click them into place on the drive.

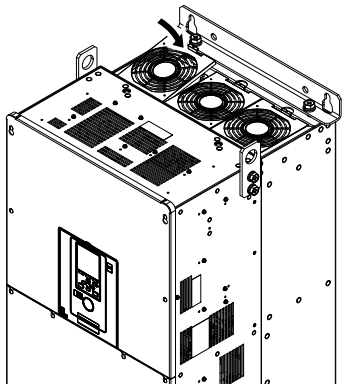


Figure 7.39 Reattach the Fan Finger Guards

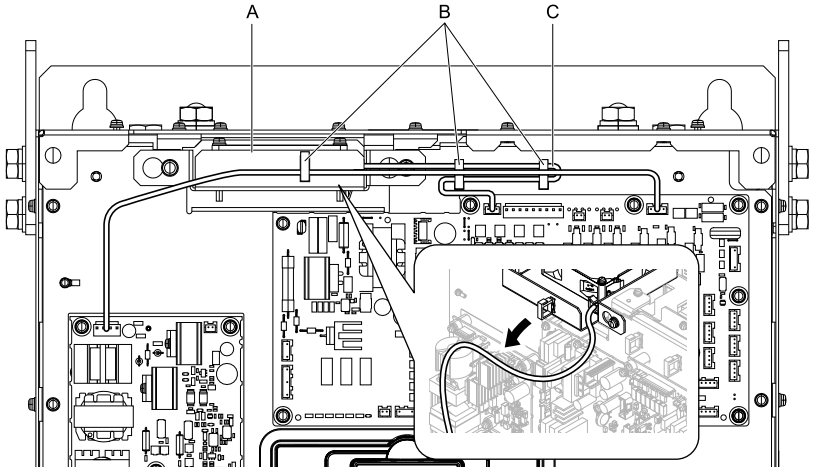
6. Energize the drive and set *o4-03 = 0 [Fan Operation Time Setting = 0 h]* to reset the fan operation time.

■ Circulation Fan Removal

Remove the drive cover before you start this procedure.

CAUTION! *Crush Hazard. Loosen the cover screws. Do not fully remove them. If you fully remove the cover screws, the terminal cover can fall and cause moderate injury.*

1. Remove the cable from the clamps.

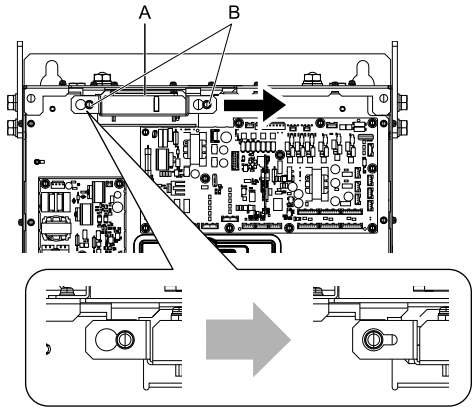


A - Fan unit
B - Clamps
C - Fan cable

Figure 7.40 Remove the Fan Cable

2. Loosen the screws that safety the fan unit and slide the fan unit to the right.

Note:
To remove the fan unit, it is only necessary to loosen the screws.



A - Fan unit
B - Screws

Figure 7.41 Slide the Fan Unit

3. Disconnect the relay connector and remove the fan unit.

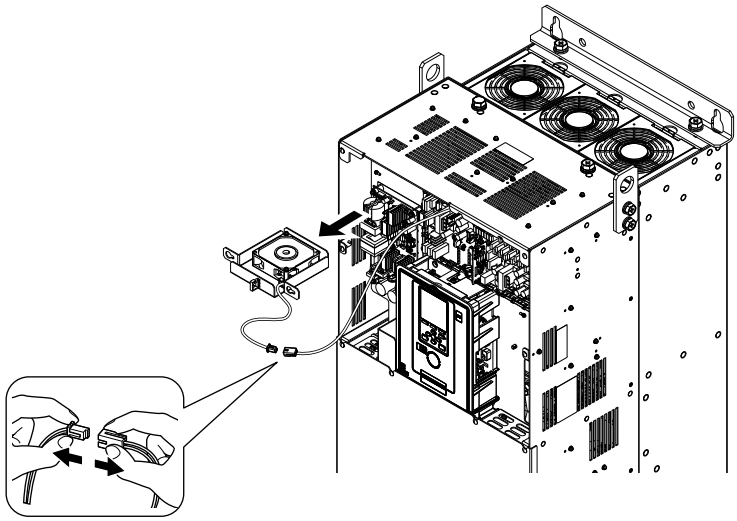
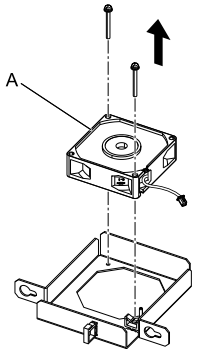


Figure 7.42 Remove the Fan Unit

4. Remove the screws that safety the circulation fan and remove the fan.



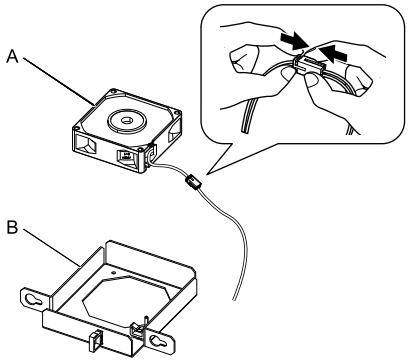
A - Circulation fan

Figure 7.43 Remove the Circulation Fan

■ Circulation Fan Installation

Reverse the removal procedure for fan installation.

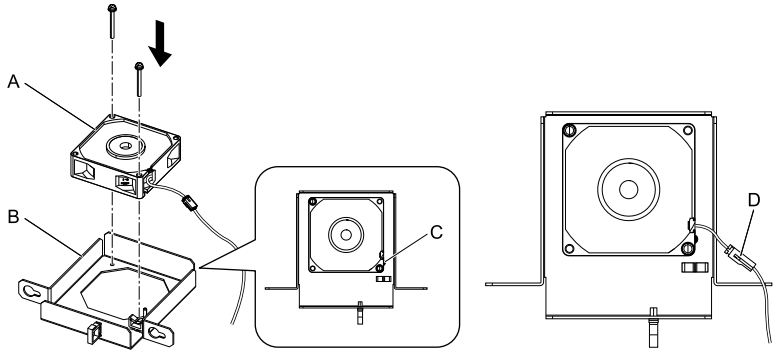
1. Connect the relay connector between the drive and circulation fan.



A - Circulation Fan **B - Fan unit base**

Figure 7.44 Connect the Relay Connectors

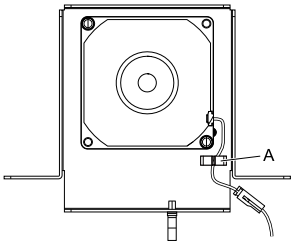
2. Align the pins on the fan unit base with the notches on the fans and put the fans in the fan unit base, then use the screws to safety them.
   Tighten the screws to a correct tightening torque:
   - 0.98 N·m to 1.33 N·m (8.67 lbf·in to 11.77 lbf·in)



A - Circulation Fan
B - Fan unit base
C - Alignment pin on fan unit base
D - Circulation fan connector

Figure 7.45 Install the Circulation Fan

3. Safety the fan cable through the clamp.



A - Clamps

Figure 7.46 Safety the Fan Cable

4. Put the fan unit into the specified location and slide it to the left, then use screws to safety it to the drive. Tighten the screws to a correct tightening torque:
   - 0.98 N·m to 1.33 N·m (8.67 lbf·in to 11.77 lbf·in)

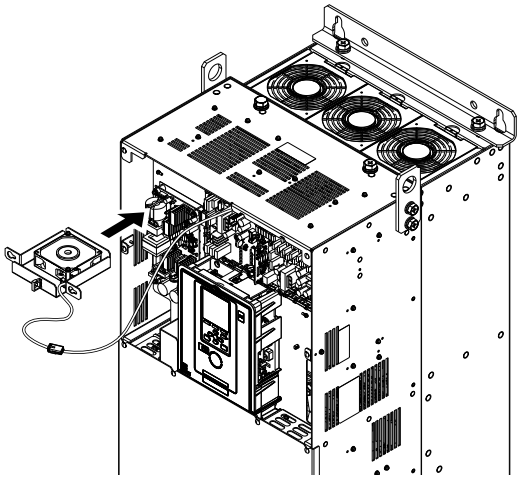
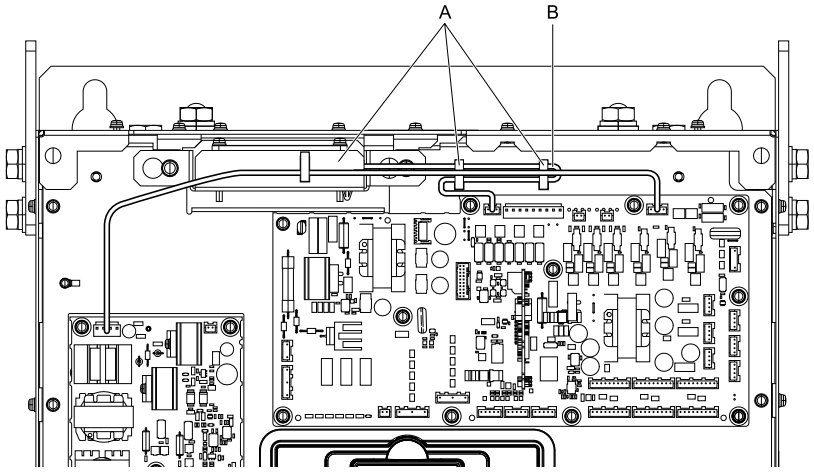


Figure 7.47 Install the Fan Unit

5. Safety the cable through the clamps.



A - Clamps **B - Fan cable**

Figure 7.48 Safety the Fan Cables through the Clamps

6. Install the drive cover.
7. Energize the drive and set *o4-03 = 0 [Fan Operation Time Setting = 0 h]* to reset the fan operation time.

◆ Fan Replacement (Procedure G)

DANGER! *Electrical Shock Hazard. Do not examine, connect, or disconnect wiring on an energized drive. Before servicing, disconnect all power to the equipment and wait for the time specified on the warning label at a minimum. The internal capacitor stays charged after the drive is de-energized. The charge indicator LED extinguishes when the DC bus voltage decreases below 50 Vdc. When all indicators are OFF, remove the covers before measuring for dangerous voltages to make sure that the drive is safe. If you do work on the drive when it is energized, it will cause serious injury or death from electrical shock.*

CAUTION! *Burn Hazard. Do not touch a hot drive heatsink. De-energize the drive, wait for a minimum of 15 minutes, then make sure that the heatsink is cool before you replace the cooling fans. If you touch a hot drive heatsink, it can burn you.*

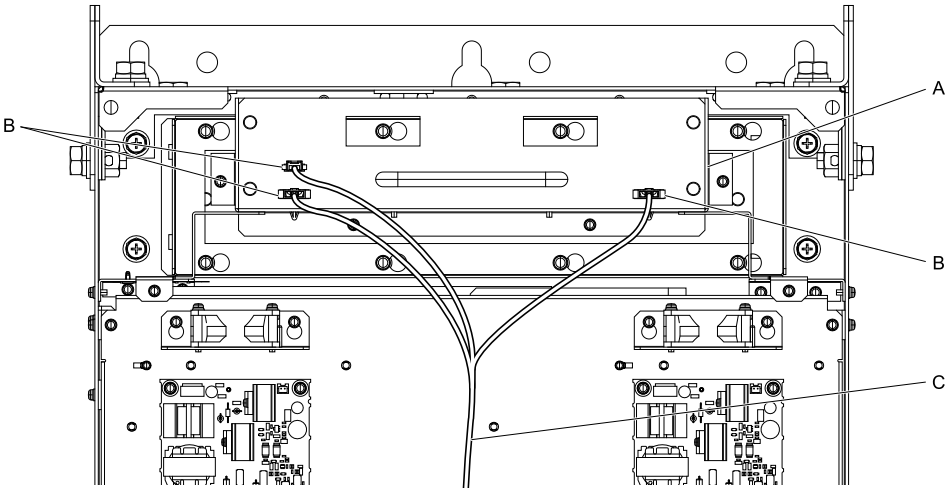
NOTICE: *Use the instructions in this manual to replace the cooling fans. When you do maintenance on the fans, replace all the fans to increase product life. If you install the fans incorrectly, it can cause damage to the drive.*

■ Fan Removal

1. Remove the drive cover.

   CAUTION! *Crush Hazard. Loosen the cover screws. Do not fully remove them. If you fully remove the cover screws, the terminal cover can fall and cause moderate injury.*

2. Unplug the fan cable from the fan connectors.

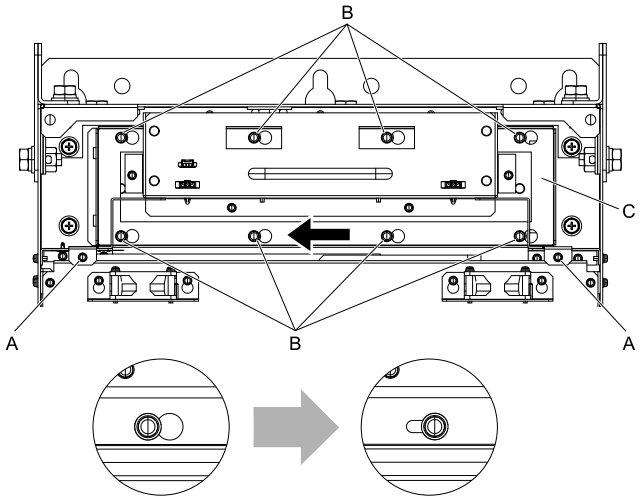


A - Fan unit
B - Fan connectors
C - Fan cable

Figure 7.49 Remove the Fan Cable

3. Loosen the screws that safety the fan unit and slide the slide panel to the left.

Note:
To remove the fan unit, it is only necessary to loosen the screws in position B.
Remove the screws in position A.



A - Screw position A
B - Screw position B
C - Slide panel

Figure 7.50 Slide the Slide Panel

4. Remove the fan unit and the slide panel at the same time.

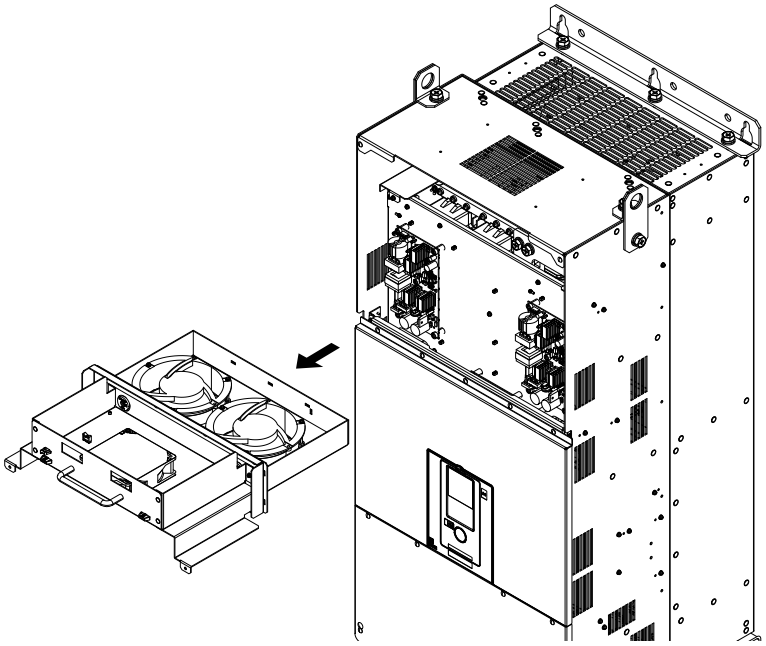
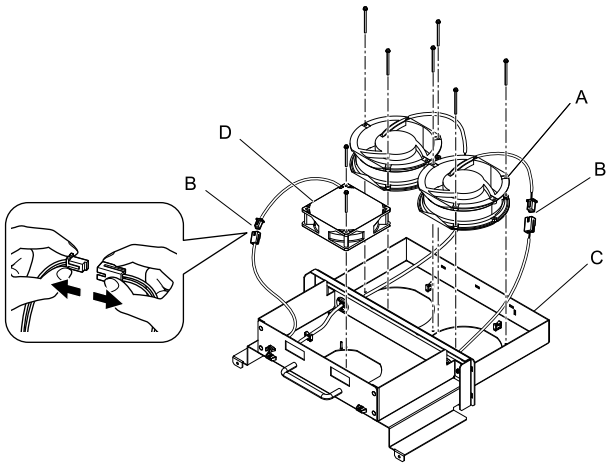


Figure 7.51 Remove the Fan Unit

5. Unplug the relay connectors, remove the screws that safety the cooling fans and circulation fan, and then remove the fans.



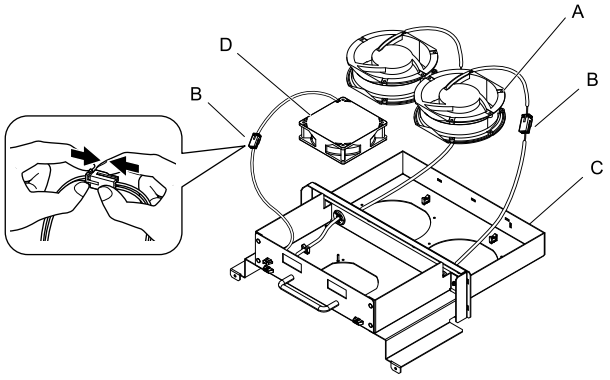
A - Cooling fans
B - Relay connectors
C - Fan unit base
D - Circulation fan

Figure 7.52 Remove the Cooling Fans and Circulation Fan

■ Fan Installation

Reverse the removal procedure for fan installation.

1. Connect the relay connectors on the fan unit base to the cooling fans and the circulation fan.



A - Cooling fans
B - Relay connectors
C - Fan unit base
D - Circulation fan

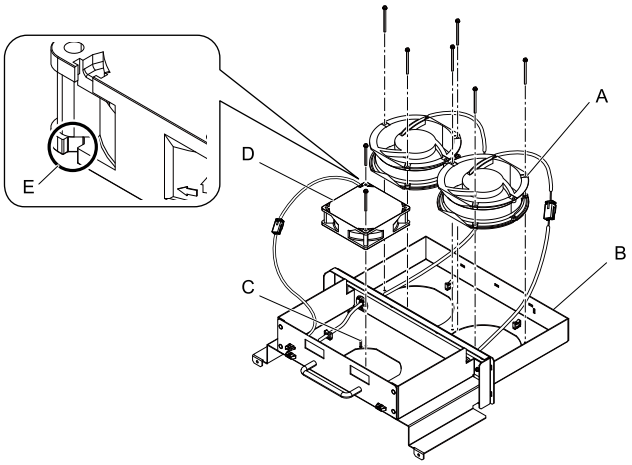
Figure 7.53 Connect the Relay Connectors

2. Align the pins on the fan unit base with the notches on the fans and put the fans in the fan unit base, then use the screws to safety them.

   Tighten the screws to a correct tightening torque:

   • 0.98 N·m to 1.33 N·m (8.67 lbf·in to 11.77 lbf·in)

Note:
Make sure that you do not pinch cables between the fans and the fan unit base.

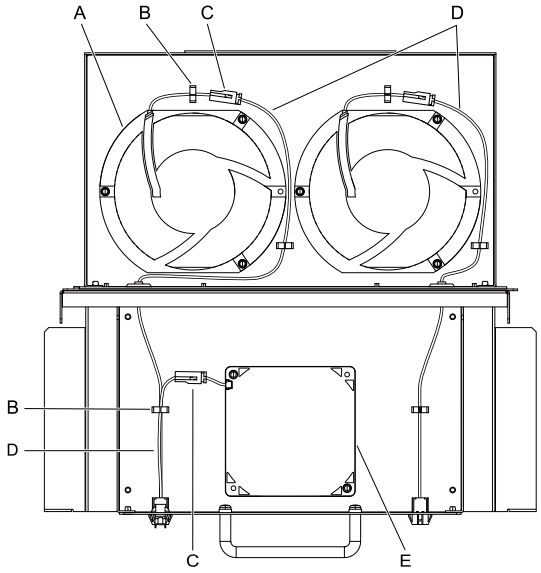


A - Cooling fans
B - Fan unit base
C - Alignment pin on fan unit base
D - Circulation fan
E - Notch on fan

Figure 7.54 Install the Cooling Fans and Circulation Fan

3. Put the cables and connectors in the recess of the drive.

Note:
Safety the relay cables to the hooks.



A - Cooling fans
B - Cable hooks
C - Relay connectors
D - Relay cables
E - Circulation fan

Figure 7.55 Put the Cables and Connectors in the Drive Recess

4. Put the fan unit into the specified location.

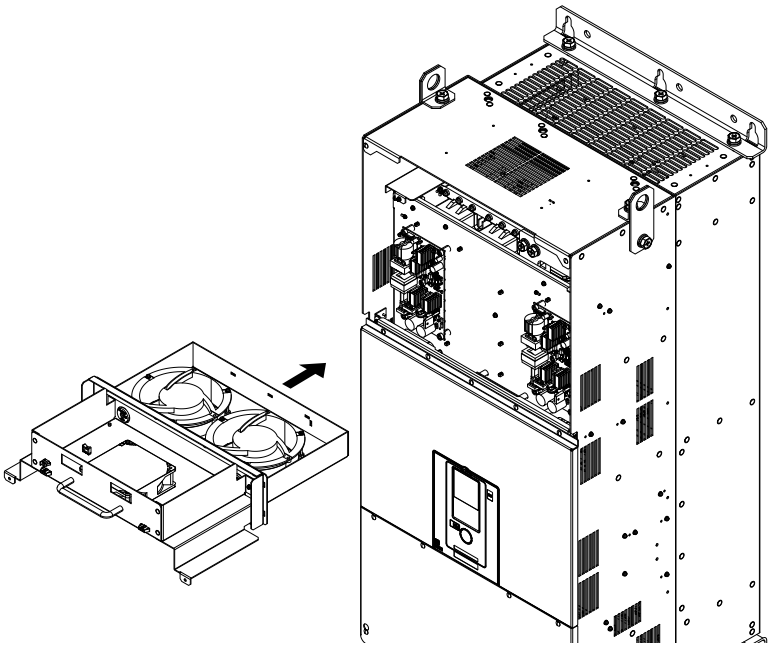
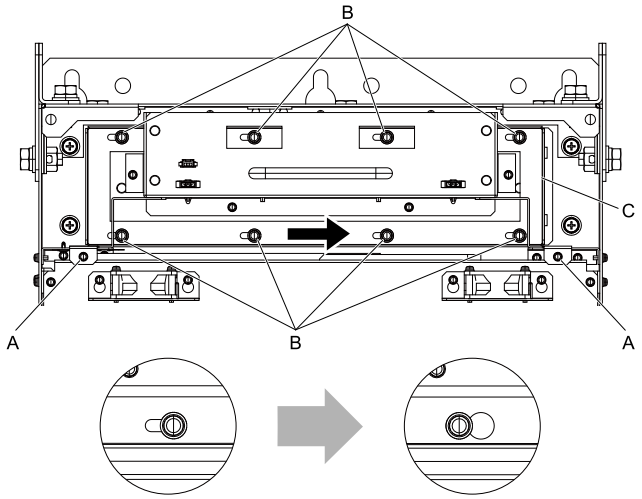


Figure 7.56 Install the Fan Unit

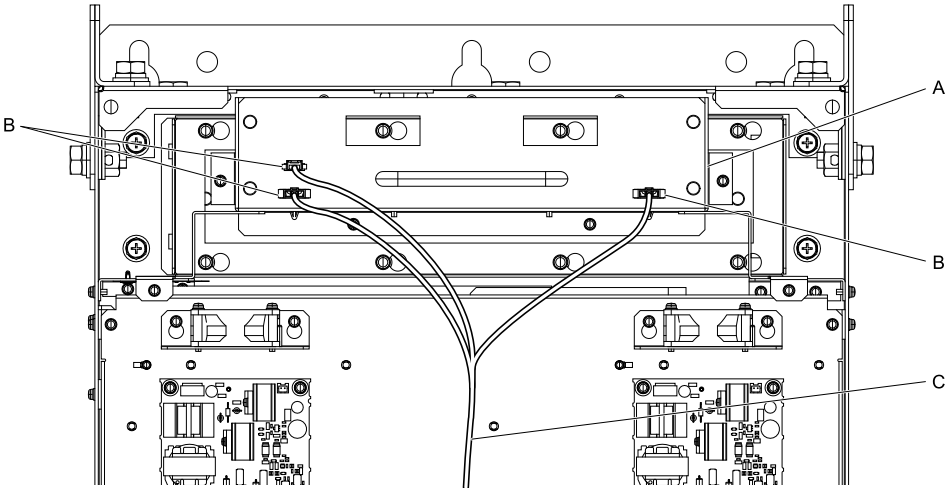
5. Slide the fan unit to the right and use the screws to safety it to the drive.
   Tighten the screws to a correct tightening torque:
   - Screws in Position A: 0.98 N·m to 1.33 N·m (8.67 lbf·in to 11.77 lbf·in)
   - Screws in Position B: 1.96 N·m to 2.53 N·m (17.35 lbf·in to 22.39 lbf·in)



A - Screw position A
B - Screw position B
C - Fan unit

Figure 7.57 Slide the Fan Unit

6. Connect the fan cable to the fan connectors.



A - Fan unit
B - Fan connectors
C - Fan cable

Figure 7.58 Connect Cooling Fan Connectors

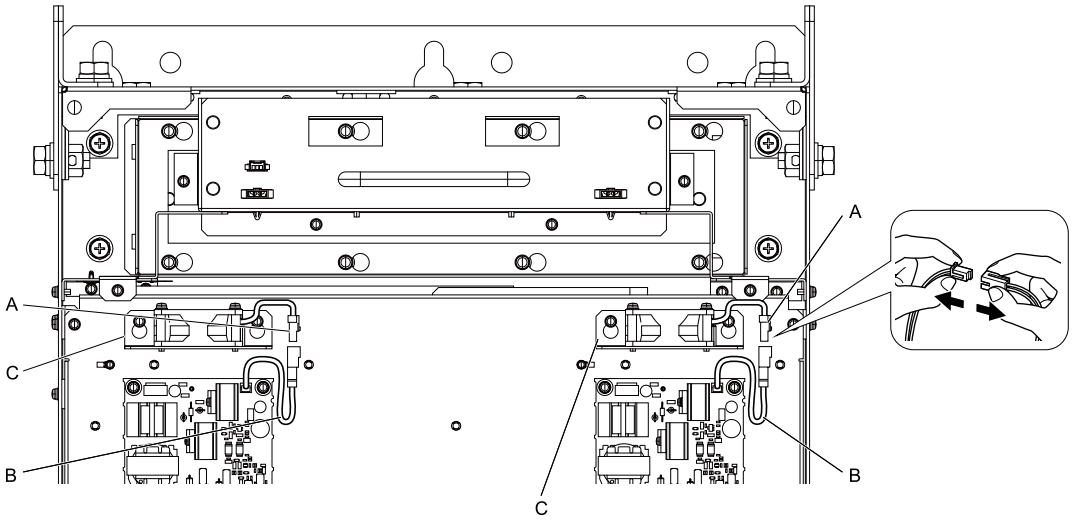
7. Install the drive cover.
8. Energize the drive and set *o4-03 = 0 [Fan Operation Time Setting = 0 h]* to reset the fan operation time.

■ Circuit Board Cooling Fan Removal

Remove the drive cover before you start this procedure.

CAUTION! *Crush Hazard. Loosen the cover screws. Do not fully remove them. If you fully remove the cover screws, the terminal cover can fall and cause moderate injury.*

1. Unplug the fan cables from the fan connectors.

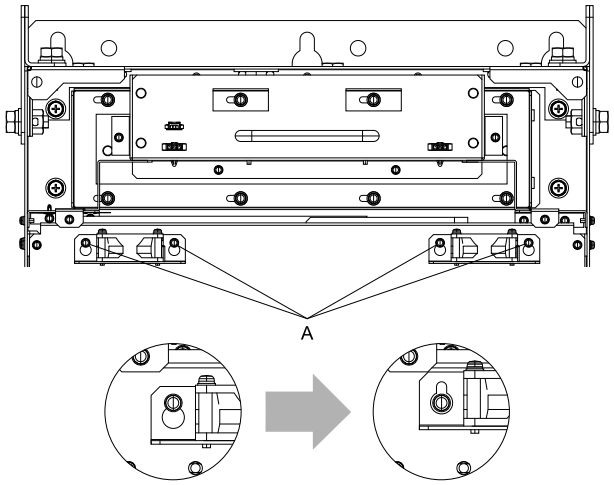


A - Fan connectors
B - Fan cables
C - Circuit board cooling fan units

Figure 7.59 Unplug the Fan Cables

2. Loosen the screws that safety the circuit board cooling fan unit and slide the circuit board cooling fan unit up.

Note:
To remove the fan unit, it is only necessary to loosen the screws.



A - Screws

Figure 7.60 Slide the Circuit Board Cooling Fan Units

3. Remove the circuit board cooling fan units.

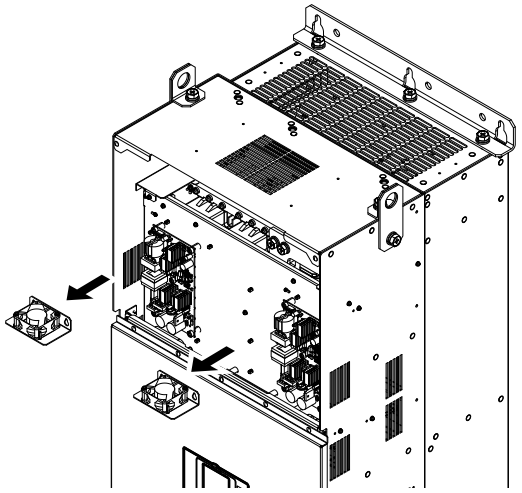
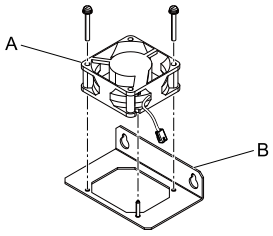


Figure 7.61 Remove the Circuit Board Cooling Fan Units

4. Remove the screws that safety the circuit board cooling fans and remove the fans.



A - Circuit board cooling fan **B - Fan unit base**

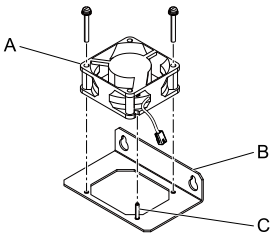
Figure 7.62 Remove the Circuit Board Cooling Fans

■ Circuit Board Cooling Fan Installation

Reverse the removal procedure for fan installation.

1. Align the pin on the fan unit base with the notch on the fan and put the circuit board cooling fan in the fan unit, then use the screws to safety the circuit board cooling fan to the fan unit base.
   Tighten the screws to a correct tightening torque:
   - 0.98 N·m to 1.33 N·m (8.67 lbf·in to 11.77 lbf·in)

Note:
Make sure that you do not pinch cables between the circuit board cooling fan and the fan unit base.



A - Circuit board cooling fan **C - Alignment pin on fan unit base**
B - Fan unit base

Figure 7.63 Install the Circuit Board Cooling Fan

2. Put the circuit board cooling fan unit into the specified location and slide it down, then use the screws to safety it to the drive.
   Tighten the screws to a correct tightening torque:
   - 0.98 N·m to 1.33 N·m (8.67 lbf·in to 11.77 lbf·in)

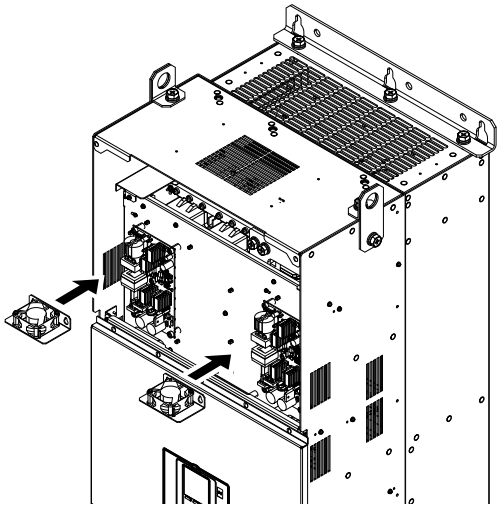
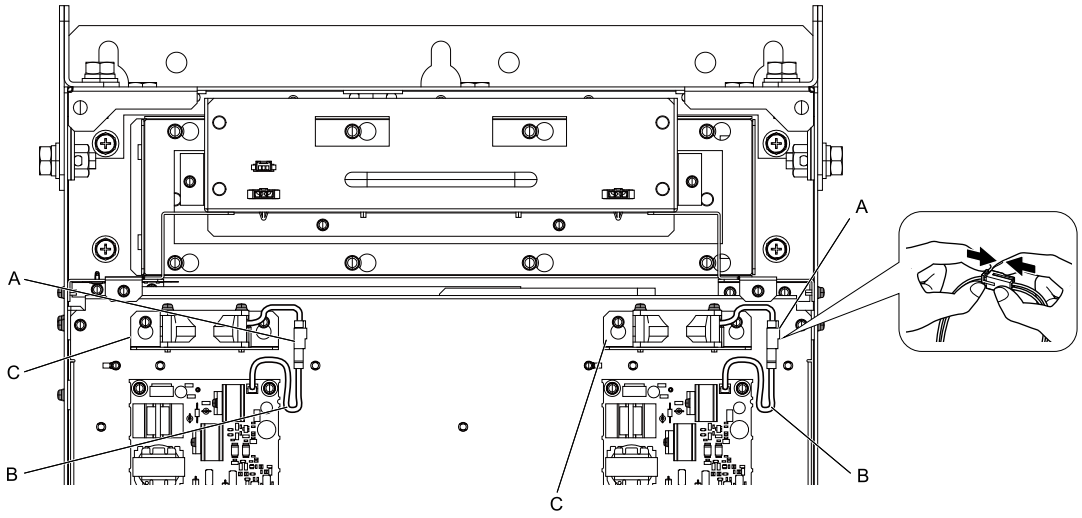


Figure 7.64 Install the Circuit Board Cooling Fan Unit

3. Connect the fan cable to the fan connectors.



A - Fan connectors
B - Fan cable
C - Circuit board cooling fan units

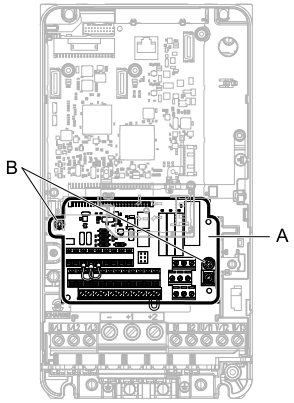
Figure 7.65 Fan Connect Cooling Fan Connectors

4. Install the drive cover.
5. Energize the drive and set *o4-03 = 0 [Fan Operation Time Setting = 0 h]* to reset the fan operation time.

7.5 Replace the Drive

◆ About the Control Circuit Terminal Block

You can remove the control circuit terminal block of the drive and install a new terminal block. If there is a failure in the drive, you can use this feature to easily replace the control circuit terminal block.



A - Control circuit terminal block **B - Control circuit terminal block fastening screw**

Figure 7.66 Control Circuit Terminal Block

◆ Replace the Drive

DANGER! *Electrical Shock Hazard. Disconnect all power to the drive and wait for the time specified on the warning label before you remove covers. Check the drive for dangerous voltages before servicing or repair work. If you do work on the drive when it is energized and there is no cover over the electronic circuits, it will cause serious injury or death from electrical shock. The drive has internal capacitors that stay charged after you de-energize the drive.*

WARNING! *Electrical Shock Hazard. Only let approved personnel install, wire, maintain, examine, replace parts, and repair the drive. If personnel are not approved, it can cause serious injury or death.*

DANGER! *Electrical Shock Hazard. Do not examine, connect, or disconnect wiring on an energized drive. Before servicing, disconnect all power to the equipment and wait for the time specified on the warning label at a minimum. The internal capacitor stays charged after the drive is de-energized. The charge indicator LED extinguishes when the DC bus voltage decreases below 50 Vdc. When all indicators are OFF, remove the covers before measuring for dangerous voltages to make sure that the drive is safe. If you do work on the drive when it is energized, it will cause serious injury or death from electrical shock.*

NOTICE: *Damage to Equipment. When you touch the drive and circuit boards, make sure that you observe correct electrostatic discharge (ESD) procedures. If you do not follow procedures, it can cause ESD damage to the drive circuitry.*

■ Notes on Wiring the Main Circuit Terminal Block

- Use copper wire. Do not use alumnium or other non-copper wire.
- Remove all unwanted objects that are near the terminal block connections.
- Remove the insulation from the connection wires to the wire stripping lengths shown in the manual.
- Do not use bent or crushed wires. Remove the damaged end of the wire before you use it.
- Do not solder stranded wire.
- If you use stranded wire, make sure that all of the wire strands are in the connection. Also, do not twist the stranded wire too much.
- Put the wire all the way into the terminal block. Remove the insulation from the wire to the recommended wire stripping length to fit the wire with insulation in the plastic housing.
- The tightening torque is different for different terminals. Tighten the screws to the specified tightening torque.
- Use a torque driver, torque ratchet, or torque wrench for the screws. A slotted driver or a hex tool will be necessary to wire the screw clamp terminal. Use applicable tools as specified by the recommended conditions in the product manual.
- If you use power tools to tighten the terminal screws, use a low speed setting (300 to 400 r/min).
- Users can purchase wiring tools from Yaskawa. Contact Yaskawa or your nearest sales representative for more information.
- Wire gauges on existing drive models to be replaced may not match wire gauge ranges on new drives. Contact Yaskawa or your nearest sales representative for wire gauges that you can and cannot use.
- Do not tighten the terminal screws at an angle of 5 degrees or more.

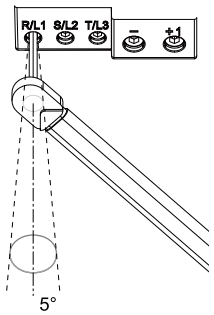


Figure 7.67 Permitted Angle

- Put the bit all the way into the hex socket to tighten the hex socket cap screw.
- When tightening straight-edge screws, hold the tip of the screwdriver in the center of the screw head. Do not let the tip of the screwdriver slip out from the groove of the screw.

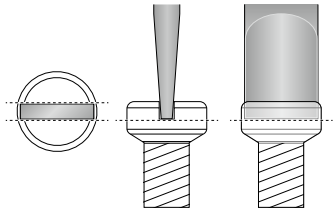
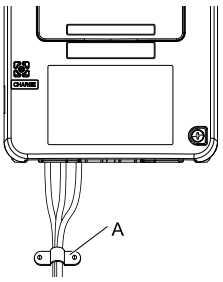


Figure 7.68 Tightening Slotted Screws

- After you connect the wires to the terminal block, lightly pull on the wires to make sure that they do not come out of the terminals.
- Remove the correct section of the wiring cover to make wiring easier.
- Regularly tighten loose terminal block screws to their specified tightening torques.
- Do not let strain on the wiring cause damage. Use a strain relief near the wiring to release the tension. Refer to Figure 7.69 for an example.



A - Strain relief

Figure 7.69 Strain Relief Example

Table 7.9 Recommended Wiring Tools

Screw Size	Screw Shape	Adapter	Bit		Torque Driver Model (Tightening Torque)	Torque Wrench
			Model	Manufacturer		
M4	Slotted (-)	Bit	SF-BIT-SL 1,0X4,0-70	PHOENIX CONTACT	TSD-M 3NM (1.2 - 3 N·m (10.6 - 26.6 lbf·in))	-
M5 *1	Slotted (-)	Bit	SF-BIT-SL 1,2X6,5-70	PHOENIX CONTACT	Wire Gauge ≤ 25 mm² (AWG 10): TSD-M 3NM (1.2 - 3 N·m (10.6 - 26.6 lbf·in))	Wire Gauge ≤ 25 mm² (AWG 10): -
					Wire Gauge ≥ 30 mm² (AWG 8): -	Wire Gauge ≥ 30 mm² (AWG 8): 4.1 - 4.5 N·m (36.3 - 39.8 lbf·in) *2 *3

Screw Size	Screw Shape	Adapter	Bit		Torque Driver Model (Tightening Torque)	Torque Wrench
			Model	Manufacturer		
M6	Hex socket cap (WAF: 5 mm)	Bit	SF-BIT-HEX 5-50	PHOENIX CONTACT	-	5 - 9 N·m (44.3 - 79.9 lbf·in) *2 *3
	Minus (-)	Bit	SF-BIT-SL 1,2X6,5-70	PHOENIX CONTACT	-	3 - 3.5 N·m (26.6 - 31.0 lbf·in) *2 *3
M8	Hex socket cap (WAF: 6 mm)	Bit	SF-BIT-HEX 6-50	PHOENIX CONTACT	-	8 - 12 N·m (70.8 - 106.2 lbf·in) *2 *3
M10	Hex socket cap (WAF: 8 mm)	Bit	SF-BIT-HEX 8-50	PHOENIX CONTACT	-	12 - 14 N·m (106.2 - 123.9 lbf·in) *2 *3

*1 When wiring drive models 2047, 4075, and smaller, select the correct tools for the wire gauge.
*2 Use 6.35 mm (0.25 in) bit socket holder.
*3 Use a torque wrench that can apply this torque measurement range.

■ Remove the Control Circuit Terminal Block

Remove the keypad and the drive front cover before doing these steps.

1. Loosen the screws on the control circuit terminal block.

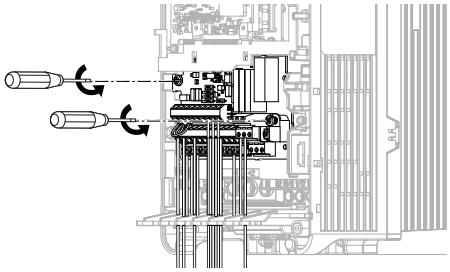


Figure 7.70 Loosen the Screws

2. Slide the wired control circuit terminal block down and remove it.

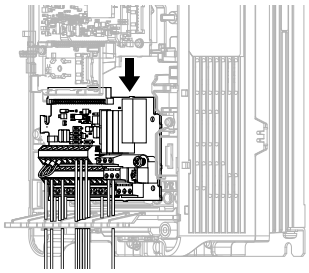
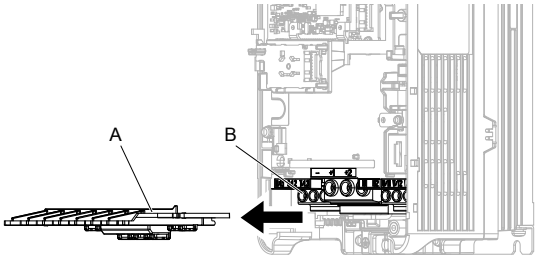


Figure 7.71 Remove the Control Circuit Terminal Block

■ Wire a New Drive

Remove the keypad, front cover, and control circuit terminal block of the new drive. Wire the drive to the main circuit terminal block before you install a wired control circuit terminal block.

1. Pull the wiring cover away from the drive to remove it.



A - Wiring cover **B - Main circuit terminal block**

Figure 7.72 Remove the Wiring Cover

2. Loosen the main circuit terminal block screws to fully open the terminal block opening.

Note:
The terminal block openings ship from the factory as fully open.

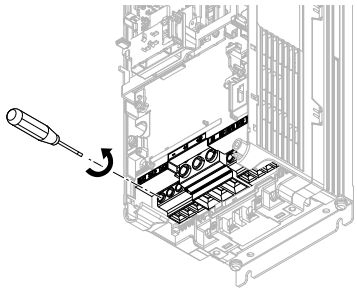


Figure 7.73 Loosen Terminal Block Screws

3. Put wires with prepared ends into the main circuit terminal block.

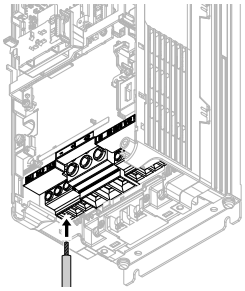


Figure 7.74 Install the Electrical Wire

Note:
If there is a jumper between terminals +1 and +2, loosen the terminal block screws to remove the jumper before you wire to terminals +1 and +2.

4. Tighten the screws to the specified torque.

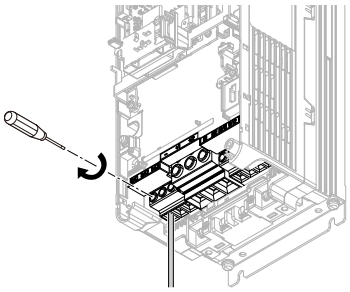
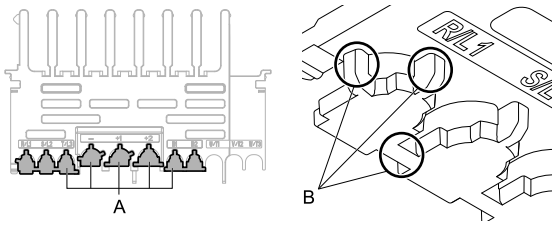


Figure 7.75 Tighten Terminal Block Screws

5. Check the terminal sign that you wired and use a nipper as shown in Figure 7.76 to clip the specified cutaway section of the wiring cover.



A - Cutaway sections **B - Clip here with nippers**

Figure 7.76 Clip the Cutaway Section of the Wiring Cover

Note:
- Different drive models have different wiring cover shapes.
- Only clip the section of the wiring cover that applies to the wired terminal. If you clip areas that do not apply to wired terminals, the protective enclosure will not keep its IP20 protective level.
- Be careful when clipping the cutaway section of the wiring cover, as the section may fly out in unpredictable directions.
- Make sure that the clipped section does not cause damage to the wires.
- If you use wires that are not specified by Yaskawa, the protective enclosure could lose its IP20 protective level, although the wiring cover is correct. Contact Yaskawa or your nearest sales representative for more information.

6. Put the wiring cover in its initial position. Put the cables through the holes that you cut out of the wiring cover.

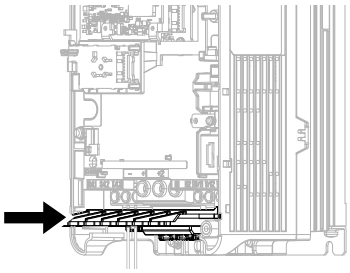
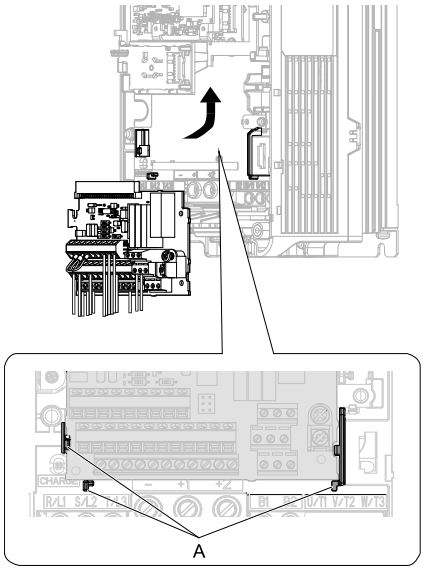


Figure 7.77 Reattach the Wiring Cover

■ Connect the Control Circuit Terminal Block

1. To put a wired control circuit terminal block in the drive, align it with the guides and move it straight up.



A - Guides

Figure 7.78 Put the Terminal Block into the Connector

2. Use M3 screws to safety the terminal block.
   Tighten the screws to a correct tightening torque:
   - M3 screws: 0.5 N·m to 0.6 N·m (4.4 lbf·in to 5.3 lbf·in)

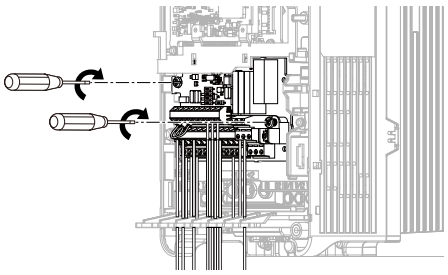


Figure 7.79 Safety the Terminal Block

3. Install the front cover and the keypad to their initial positions.
4. Check *o2-04 [Drive Model (KVA) Selection]*.

Note:
- When you save parameter information in a keypad that you installed before you replaced the terminal block, make sure that you use that keypad to restore the parameter data.
- To reset the performance life monitors for the components, set *o4-01 to o4-13 [Maintenance Period]*.

7.6 Replace the Keypad Battery

When the keypad battery is expired, the date and time go back to the default settings. Use this procedure to replace the battery.

WARNING! *Fire Hazard. Handle keypad batteries properly. Do not charge the battery or disassemble the keypad. If the battery explodes, it can cause a fire.*

To replace the battery, use a Hitachi Maxell "CR2016 Lithium Manganese Dioxide Lithium Battery" or an equivalent battery with these properties:

- Nominal voltage: 3 V
- Operating temperature range: -20 °C to + 85°C (-4 °F to +185 °F)

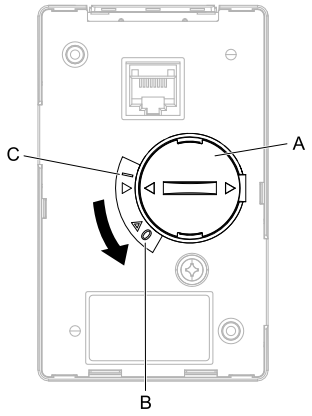
WARNING! *Fire Hazard. Do not disassemble batteries. Do not expose batteries to heat or fire. If the battery explodes, it can cause a fire.*

NOTICE: *Damage to Equipment. The keypad battery stays in use after you de-energize the drive. When you will keep the drive de-energized for long periods of time, remove the battery from the keypad. When the expected life of the battery is complete, replace the battery immediately. A dead battery in the keypad can leak and cause damage to the keypad and drive.*

The performance life estimate of a new battery is:

- Ambient temperature 20 °C (68 °F): 5 years
- Ambient temperature -10 °C to +50 °C (14 °F to 122 °F): 3.5 years

1. De-energize the drive and remove the keypad.
2. Use a slotted screwdriver or other tool to turn the battery cover counterclockwise and remove the cover.

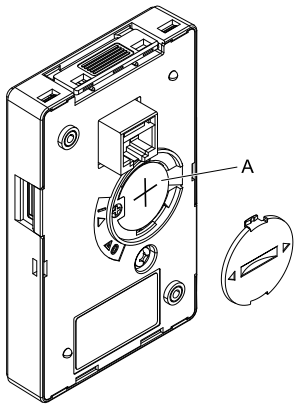


A - Battery cover
B - Opened
C - Closed

Figure 7.80 Remove the Battery Cover

3. Remove the used battery from the keypad.
4. Insert the new battery.

Note:
- The battery cover side is the positive pole. Make sure that the polarity is correct when you put the battery in the keypad.
- Discard the used battery as specified by local regulations.



A - Battery

Figure 7.81 Insert the New Battery

5. Put the battery cover on the keypad and use a slotted screwdriver to turn the battery cover clockwise to close it.
6. Install the keypad on the drive.

7.7 Storage Guidelines

The chemicals in the electrolytic capacitors and other electronic parts of the drive change over time. When you store the drive for long periods of time, use the information in this section to help keep the performance life estimates.

◆ Storage Location

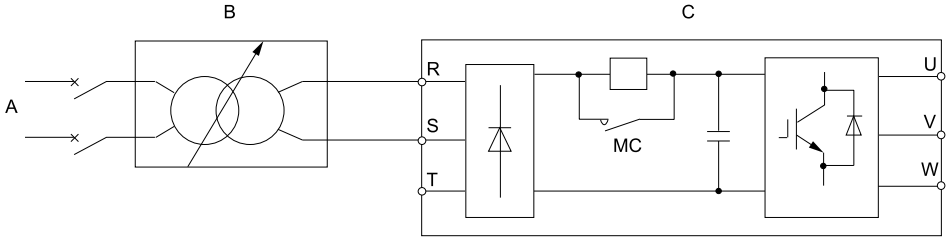
- Temperature and Humidity
  When you store the drive for approximately one month, for example during shipping, you can put the drive in a location where the temperature is -20 °C to +70 °C (-4 °F to +158 °F). Correctly package and store the drive during shipping to prevent vibration and impact damage.
  Do not put the drive in direct sunlight or where there will be condensation or ice. Put the drive in a location where the relative humidity is 95% or less.
- Dust and Oil Mist
  Do not keep the drive locations with dust or oil mist. For example, cement factories and cotton mills.
- Corrosive Gas
  Do not keep the drive in locations with corrosive gas. For example, chemical plants, refineries, and sewage plants.
- Salt Damage
  Do not keep the drive in salty locations. For example, locations near the ocean, and salt damage-designated locations.

Do not keep the drive in unsatisfactory locations. Keep all drives in storage rooms that are safe from unsatisfactory elements.

◆ Regular Application of Power

To prevent deterioration of the capacitors, Yaskawa recommends that you apply power to the drive a minimum of one time each year for a minimum of 30 minutes.

If you store the drive for longer than two years and do not apply power, Yaskawa recommends that you use a variable power source and gradually increase the power from 0 V to the rated drive voltage over a period of 2 to 3 minutes. Apply power for a minimum of 1 hour with no load to reform the main circuit electrolytic capacitor. When you operate the drive after you apply power, wire the drive correctly and check for drive faults, overcurrents, motor vibration, motor speed differences, and other defects during operation.



A - AC power supply
B - Variable power source
C - Drive

Figure 7.82 Power Distribution Method

8

Disposal

8.1 Section Safety 424
8.2 Disposal Instructions 425

8.1 Section Safety

⚠WARNING

Electrical Shock Hazard

De-energize the drive and wait 5 minutes minimum until the Charge LED turns off. Remove the front cover and terminal cover to do work on wiring, circuit boards, and other parts. Use terminals for their correct function only.

Incorrect wiring, incorrect ground connections, and incorrect repair of protective covers can cause death or serious injury.

Only let approved personnel install, wire, maintain, examine, replace parts, and repair the drive.

If personnel are not approved, it can cause serious injury or death.

Do not wear loose clothing or jewelry when you do work on the drive. Tighten loose clothing and remove all metal objects, for example watches or rings.

Loose clothing can catch on the drive and jewelry can conduct electricity and cause serious injury or death.

Fire Hazard

Handle keypad batteries properly. Do not charge the battery or disassemble the keypad.

If the battery explodes, it can cause a fire.

Do not disassemble batteries. Do not expose batteries to heat or fire.

If the battery explodes, it can cause a fire.

Crush Hazard

Wear eye protection when you do work on the drive.

If you do not use correct safety equipment, it can cause serious injury or death.

Only approved personnel can operate a crane or hoist to move the drive.

If unapproved personnel operate a crane or hoist, it can cause serious injury or death from falling equipment.

Use a crane or hoist to move large drives when necessary.

If you try to move a large drive without a crane or hoist, it can cause serious injury or death.

⚠CAUTION

Crush Hazard

Tighten terminal cover screws and hold the case safely when you move the drive.

If the drive or covers fall, it can cause moderate injury.

NOTICE

Damage to Equipment

The keypad battery stays in use after you de-energize the drive. When you will keep the drive de-energized for long periods of time, remove the battery from the keypad. When the expected life of the battery is complete, replace the battery immediately.

A dead battery in the keypad can leak and cause damage to the keypad and drive.

8.2 Disposal Instructions

Correctly discard the drive, packing material, battery, and microSD card as specified by regional, local, and municipal laws and regulations for this product.

Note:

- Remove the battery and microSD card from the keypad before you discard the drive.
- You cannot recycle the battery. Discard used batteries as specified by the battery manufacturer.
- Customers are responsible for microSD card data protection.
  PC functions that format and delete the data may not be sufficient to fully erase the microSD card data. Yaskawa recommends that customers physically destroy the microSD card in a shredder or use data wipe software to fully erase the card.

9

Specifications

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9.1 Section Safety

DANGER

Do not ignore the safety messages in this manual.

If you ignore the safety messages in this manual, it will cause serious injury or death. The manufacturer is not responsible for injuries or damage to equipment.

9.2 Model Specifications (200 V Class)

Table 9.1 Rating (200 V Class)

Model			2003	2005	2008	2011	2014	2018	2025	2033	2047	2060	2075
Maximum Applicable Motor Output *1 (kW)			0.55	0.75	1.5	2.2	3	4.0	5.5	7.5	11	15	18.5
Input	Rated Input Current *2 (A)	AC	3.6	4.8	8.9	12.7	17	20.7	30	40.3	58.2	78.4	96
		DC	4.5	5.9	11	16	21	25	37	49	71	96	118
Output	Rated Output Capacity *3 (kVA)		1.2	1.9	3.0	4.2	5.3	6.7	9.5	12.6	17.9	22.9	28.6
	Rated Output Current (A)		3.2	5	8	11	14	17.5	25	33	47	60	75
	Overload Tolerance		150% of the rated output current for 60 s **Note:** Derating can be necessary for applications that start and stop frequently.										
	Carrier Frequency		8 kHz without derating the drive capacity. Derate the drive capacity to use values to 15 kHz maximum.										
	Maximum Output Voltage		Three-phase 200 V to 240 V **Note:** The maximum output voltage is proportional to the input voltage.										
	Maximum Output Frequency		• AOLV (Advanced Open Loop Vector): 120 Hz • CL-V/f (Closed Loop V/f Control), CLV (Closed Loop Vector): 400 Hz • V/f (V/f Control), OLV (Open Loop Vector): 590 Hz										
Measures for Harmonics	DC reactor		External options										
Braking Device	Braking Transistor		Standard internal characteristics										
EMC Filter	EMC Filter IEC61800-3, C3		Factory option • Models 2xxxB: There is a category C3 EMC filter in the drive.										
Power Supply	Rated Voltage/Rated Frequency		• Three-phase AC power supply 200 V to 240 V at 50/60 Hz • DC power supply 270 V to 340 V										
	Permitted Voltage Fluctuation		-15% to +10%										
	Permitted Frequency Fluctuation		±5%										
	Input Power *4 (kVA)		1.5	2.0	3.7	5.3	7.1	8.6	12.5	16.8	24.2	32.6	39.9

*1 The maximum applicable motor output complies with 208 V motor ratings as specified in NEC Table 430.250. The rated output current of the drive output amps must be equal to or more than the motor rated current.
*2 Assumes the value at the rated output current. The input current rating changes when the power supply transformer, input reactor, wiring connections, or power supply impedance change.
*3 The rated output capacity is calculated with a rated output voltage of 208 V.
*4 The power supply capacity is calculated with the voltage between lines at 240 V.

Table 9.2 Rating (200 V Class)

Model			2088	2115	2145	2180	2215	2283	2346	2415
Maximum Applicable Motor Output *1 (kW)			22	30	37	45	55	75	90	110
Input	Rated Input Current *2 (A)	AC	82	111	136	164	200	271	324	394
		DC	101	136	167	202	245	332	397	483

Model		2088	2115	2145	2180	2215	2283	2346	2415
Output	Rated Output Capacity *3 (kVA)	33.5	43.8	55.3	68.6	81.9	108	132	158
	Rated Output Current (A)	88	115	145	180	215	283	346	415
	Overload Tolerance	150% of the rated output current for 60 s **Note:** Derating can be necessary for applications that start and stop frequently.							
	Carrier Frequency	5 kHz without derating the drive capacity. Derate the drive capacity to use values to 10 kHz maximum.							
	Maximum Output Voltage	Three-phase 200 V to 240 V **Note:** The maximum output voltage is proportional to the input voltage.							
	Maximum Output Frequency	• AOLV (Advanced Open Loop Vector): 120 Hz • CL-V/f (Closed Loop V/f Control), CLV (Closed Loop Vector): 400 Hz • V/f (V/f Control), OLV (Open Loop Vector): 590 Hz							
Measures for Harmonics	DC reactor	Standard internal characteristics							
Braking Device	Braking Transistor	Standard internal characteristics		External options					
EMC Filter	EMC Filter IEC61800-3, C3	Factory option • Models 2xxxB: There is a category C3 EMC filter in the drive.							
Power Supply	Rated Voltage/Rated Frequency	• Three-phase AC power supply 200 V to 240 V at 50/60 Hz • DC power supply 270 V to 340 V							
	Permitted Voltage Fluctuation	-15% to +10%							
	Permitted Frequency Fluctuation	±5%							
	Input Power *4 (kVA)	34.1	46.1	56.5	68.2	83.1	113	135	164

*1 The maximum applicable motor output complies with 208 V motor ratings as specified in NEC Table 430.250. The rated output current of the drive output amps must be equal to or more than the motor rated current.
*2 Assumes the value at the rated output current. The input current rating changes when the power supply transformer, input reactor, wiring connections, or power supply impedance change.
*3 The rated output capacity is calculated with a rated output voltage of 208 V.
*4 The power supply capacity is calculated with the voltage between lines at 240 V.

9.3 Model Specifications (400 V Class)

Table 9.3 Rating (400 V Class)

Model			4002	4003	4005	4006	4007	4009	4015	4018	4024	4031	4039
Maximum Applicable Motor Output *1 (kW)			0.55	1.1	1.5	2.2	3	4.0	5.5	7.5	11	15	18.5
Input	Rated Input Current *2 (A)	AC	1.9	3.5	4.7	6.7	8.9	11.7	15.8	21.2	30.6	41.3	50.5
		DC	2.3	4.3	5.8	8.2	11	15	20	26	38	51	62
Output	Rated Output Capacity *3 (kVA)		1.2	2.2	3.2	3.6	4.7	6.1	10	12	16	20	26
	Rated Output Current (A)		1.8	3.4	4.8	5.5	7.2	9.2	14.8	18	24	31	39
	Overload Tolerance		150% of the rated output current for 60 s **Note:** Derating can be necessary for applications that start and stop frequently.										
	Carrier Frequency		8 kHz without derating the drive capacity. Derate the drive capacity to use values to 15 kHz maximum.										
	Maximum Output Voltage		Three-phase 380 V to 480 V **Note:** The maximum output voltage is proportional to the input voltage.										
	Maximum Output Frequency		• AOLV (Advanced Open Loop Vector): 120 Hz • CL-V/f (Closed Loop V/f Control), CLV (Closed Loop Vector): 400 Hz • V/f (V/f Control), OLV (Open Loop Vector): 590 Hz										
Measures for Harmonics	DC reactor		External options										
Braking Device	Braking Transistor		Standard internal characteristics										
EMC Filter	EMC Filter IEC61800-3, C3		Factory option • Models 4xxxB: There is a category C3 EMC filter in the drive.										
Power Supply	Rated Voltage/Rated Frequency		• Three-phase AC power supply 380 V to 480 V at 50/60 Hz • DC power supply 513 V to 679 V										
	Permitted Voltage Fluctuation		-15% to +10%										
	Permitted Frequency Fluctuation		±5%										
	Input Power *4 (kVA)		1.5	2.8	3.7	5.3	7.1	9.3	13	17	24	33	40

*1 The maximum applicable motor output complies with 380 V motor ratings as specified in Annex G of IEC 60947-4-1. The rated output current of the drive output amps must be equal to or more than the motor rated current.
*2 Assumes the value at the rated output current. The input current rating changes when the power supply transformer, input reactor, wiring connections, or power supply impedance change.
*3 The rated output capacity is calculated with a rated output voltage of 380 V.
*4 The power supply capacity is calculated with the voltage between lines at 480 V.

Table 9.4 Rating (400 V Class)

Model			4045	4060	4075	4091	4112	4150	4180	4216	4260	4304	4371
Maximum Applicable Motor Output *1 (kW)			22	30	37	45	55	75	90	110	132	160	200
Input	Rated Input Current *2 (A)	AC	43.1	58.3	71.5	86.5	105	142	170	207	248	300	373
		DC	53	72	88	106	129	174	209	254	304	367	457

Model		4045	4060	4075	4091	4112	4150	4180	4216	4260	4304	4371
Output	Rated Output Capacity *3 (kVA)	30	39	49	60	74	99	118	142	171	200	244
	Rated Output Current (A)	45	60	75	91	112	150	180	216	260	304	371
	Overload Tolerance	150% of the rated output current for 60 s **Note:** Derating can be necessary for applications that start and stop frequently.										
	Carrier Frequency	5 kHz without derating the drive capacity. Derate the drive capacity to use values to 10 kHz maximum.										
	Maximum Output Voltage	Three-phase 380 V to 480 V **Note:** The maximum output voltage is proportional to the input voltage.										
	Maximum Output Frequency	• AOLV (Advanced Open Loop Vector): 120 Hz • CL-V/f (Closed Loop V/f Control), CLV (Closed Loop Vector): 400 Hz • V/f (V/f Control), OLV (Open Loop Vector): 590 Hz										
Measures for Harmonics	DC reactor	Standard internal characteristics										
Braking Device	Braking Transistor	Standard internal characteristics						External options				
EMC Filter	EMC Filter IEC61800-3, C3	Factory option • Models 4xxxB: There is a category C3 EMC filter in the drive.										
Power Supply	Rated Voltage/Rated Frequency	• Three-phase AC power supply 380 V to 480 V at 50/60 Hz • DC power supply 513 V to 679 V										
	Permitted Voltage Fluctuation	-15% to +10%										
	Permitted Frequency Fluctuation	±5%										
	Input Power *4 (kVA)	34	46	57	69	84	113	136	165	198	239	297

*1 The maximum applicable motor output complies with 380 V motor ratings as specified in Annex G of IEC 60947-4-1. The rated output current of the drive output amps must be equal to or more than the motor rated current.
*2 Assumes the value at the rated output current. The input current rating changes when the power supply transformer, input reactor, wiring connections, or power supply impedance change.
*3 The rated output capacity is calculated with a rated output voltage of 380 V.
*4 The power supply capacity is calculated with the voltage between lines at 480 V.

Table 9.5 Rating (400 V Class)

Model			4414	4453	4605
Maximum Applicable Motor Output *1 (kW)			220	250	315
Input	Rated Input Current *2 (A)	AC	410	465	584
		DC	502	569	715
Output	Rated Output Capacity *3 (kVA)		272	298	398
	Rated Output Current (A)		414	453	605
	Overload Tolerance		150% of the rated output current for 60 s **Note:** Derating can be necessary for applications that start and stop frequently.		
	Carrier Frequency		2 kHz without derating the drive capacity. Derate the drive capacity to use values to 5 kHz maximum.		
	Maximum Output Voltage		Three-phase 380 V to 480 V **Note:** The maximum output voltage is proportional to the input voltage.		
	Maximum Output Frequency		• AOLV (Advanced Open Loop Vector): 120 Hz • CL-V/f (Closed Loop V/f Control), CLV (Closed Loop Vector): 400 Hz • V/f (V/f Control), OLV (Open Loop Vector): 590 Hz		
Measures for Harmonics	DC reactor		Standard internal characteristics		
Braking Device	Braking Transistor		External options		
EMC Filter	EMC Filter IEC61800-3, C3		Factory option • Models 4xxxB: There is a category C3 EMC filter in the drive.		

Model		4414	4453	4605
Power Supply	Rated Voltage/Rated Frequency	• Three-phase AC power supply 380 V to 480 V at 50/60 Hz • DC power supply 513 V to 679 V		
	Permitted Voltage Fluctuation	-15% to +10%		
	Permitted Frequency Fluctuation	±5%		
	Input Power *4 (kVA)	327	370	465

*1 The maximum applicable motor output complies with 380 V motor ratings as specified in Annex G of IEC 60947-4-1. The rated output current of the drive output amps must be equal to or more than the motor rated current.
*2 Assumes the value at the rated output current. The input current rating changes when the power supply transformer, input reactor, wiring connections, or power supply impedance change.
*3 The rated output capacity is calculated with a rated output voltage of 380 V.
*4 The power supply capacity is calculated with the voltage between lines at 480 V.

9.4 Drive Specifications

Note:
- Perform Rotational Auto-Tuning to achieve the specifications listed for OLV, CLV, and AOLV.
- Install the drive in an environment that meets the required specifications for optimum product life.

Table 9.6 Control Characteristics

Item	Specification
Control Method	• V/f Control • V/f Control w/ PG • Open Loop Vector Control • Closed Loop Vector • Advanced Open Loop Vector
Frequency Control Range	• Advanced Open Loop Vector Control (AOLV): 0.01Hz - 120 Hz • Closed Loop V/f Control(CL-V/f), Closed Loop Vector Control (CLV): 0.01Hz - 400 Hz • V/f Control (V/f), Open Loop Vector Control (OLV): 0.01 Hz - 590 Hz
Frequency Accuracy (Temperature Fluctuation)	Digital inputs: Within ±0.01% of the maximum output frequency (-10 °C to +40 °C (14 °F to 104 °F)) Analog inputs: Within ±0.1% of the maximum output frequency (25 °C ±10 °C (77 °F ±18 °F))
Frequency Setting Resolution	Digital inputs: 0.01 Hz Analog inputs: 1/2048 of the maximum output frequency (11-bit signed)
Output Frequency Resolution	0.001 Hz
Frequency Setting Signal	Main speed frequency reference: -10 Vdc to +10 Vdc (20 kΩ), 0 Vdc to 10 Vdc (20 kΩ), 4 mA to 20 mA (250 Ω), 0 mA to 20 mA (250 Ω)
Starting Torque	• V/f Control (V/f): 150%/3 Hz • Closed Loop V/f Control (CL-V/f): 150%/3 Hz • Open Loop Vector Control (OLV): 200%/0.3 Hz • Closed Loop Vector Control (CLV): 200%/0 min^{-1} • Advanced Open Loop Vector (AOLV): 200%/0.3 Hz **Note:** Drive capacity must selected appropriately to obtain this starting torque under Open Loop Vector Control (OLV), Closed Loop Vector Control (CLV), and Advanced Open Loop Vector Control (AOLV).
Speed Control Range	• V/f Control (V/f): 1:40 • Closed V/f Control (CL-V/f): 1:40 • Open Loop Vector Control (OLV): 1:200 • Closed Loop Vector Control (CLV): 1:1500 • Advanced Open Loop Vector Control (AOLV): 1:200
Zero Speed Control	Possible in Closed Loop Vector Control (CLV).
Torque Limits	Parameter settings allow separate limits in four quadrants in Open Loop Vector Control (OLV), Closed Loop Vector Control (CLV), and Advanced Open Loop Vector Control (AOLV).
Accel & Decel Time	0.0 s to 6000.0 s The drive allows four selectable combinations of independent acceleration and deceleration settings.
Braking Torque	Approx. 20% Approx. 125% with a dynamic braking option • Short-time average deceleration torque Motor output 0.4/0.75 kW: over 100% Motor output 1.5 kW: over 50% Motor output 2.2 kW and larger: over 20%, approximately 40% with overexcitation braking • Continuous regenerative torque: Approx. 20%. Dynamic braking option allows for approximately 125%, 10% ED, 10 s **Note:** • Models 2003 to 2115 and 4002 to 4150 have a braking transistor. • Set *L3-04 = 0 [Stall Prevention during Decel = Disabled]* when using a regenerative converter, regenerative unit, braking unit, braking resistor, or braking resistor unit. The drive may not stop within the designated deceleration time if *L3-04 = 0*. • Short-time average deceleration torque refers to the torque required to decelerate the motor (uncoupled from the load) from the rated speed to zero. Actual specifications may vary depending on motor characteristics. • Continuous regenerative torque and short-time average deceleration torque for motors 2.2 kW and larger vary depending on motor characteristics.
V/f Characteristics	Select from 15 predefined V/f patterns, or a user-set V/f pattern.
Main Control Functions	Droop Control, Feed Forward Control, Zero Servo Function, Torque Limit, 9 Step Speed (max.), Accel/Decel Switch, S-curve Accel/Decel, Auto-Tuning (Rotational and Stationary), Cooling Fan ON/OFF Switch, Slip Compensation, Torque Compensation, Frequency Jump, Upper/lower Limits for Frequency Reference, DC Injection Braking at Start and Stop, Overexcitation Braking, MEMOBUS/Modbus Communication (RS-485: max. 115.2 kbps), Removable Terminal Block with Parameter Backup Function, Online Tuning, Overexcitation Deceleration, Inertia (ASR) Tuning, Crane Sequence.

Table 9.7 Protection Function

Item	Specification
Motor Protection	Electronic thermal overload protection
Momentary Overcurrent Protection	Drive stops when the output current is more than 200% of the rated output current.

Item	Specification
Overload Protection	Drive stops when the output current is more than 150% of the rated output current for 60 s. **Note:** The drive may trigger the overload protection function at 150% of the drive rated output in under 60 s if the output frequency is less than 6 Hz.
Overvoltage Protection	200 V class: Stops when the DC bus voltage is more than approximately 410 V 400 V class: Stops when the DC bus voltage is more than approximately 820 V
Undervoltage Protection	200 V class: Stops when the DC bus voltage decreases to less than approximately 190 V 400 V class: Stops when the DC bus voltage decreases to less than approximately 380 V
Heatsink Overheat Protection	Thermistor
Braking Resistor Overheat Protection	Overheat detection for braking resistor (optional ERF-type, 3% ED)
Stall Prevention	Stall prevention is available during acceleration, deceleration, and during run.
Ground Fault Protection	Electronic circuit protection **Note:** This protection detects any ground faults during run. The drive will not provide protection when: • There is a low-resistance ground fault for the motor cable or terminal block • Energizing the drive when there is a ground fault present.
DC Bus Charge LED	Charge LED illuminates when DC bus voltage is above 50 V.

Table 9.8 Environment

Environment	Conditions
Area of Use	Indoors • Noxious Fumes: IEC60721-3-3:3C2 • Dust: IEC60721-3-3:3S2
Power Supply	Overvoltage Category III
Ambient Temperature	Open chassis type (IP20): -10°C to +50 °C (14 °F to 122 °F) Enclosed wall-mounted type (UL Type 1): -10 °C to +40 °C (14 °F to 104 °F) • Do not use the drive in a location where the temperature changes suddenly to improve the drive reliability. • When installing the drive in an enclosure, use a cooling fan or air conditioner to keep the internal air temperature in the permitted range. • Do not let the drive freeze. • Derate the output current and output voltage to install the drive in areas with ambient temperatures ≤ 60 °C (140 °F).
Humidity	95% RH or less Do not let condensation form on the drive.
Storage Temperature	-20 °C to +70 °C (-4 °F to +158 °F) (short-term temperature during transportation)
Surrounding Area	Pollution degree 2 or less Install the drive in an area without: • Oil mist, corrosive or flammable gas, or dust • Metal powder, oil, water, or other unwanted materials • Radioactive materials or flammable materials, including wood • Harmful gas or fluids • Salt • Direct sunlight Keep wood or other flammable materials away from the drive.
Altitude	1000 m (3281 ft.) maximum **Note:** Derate the output current by 1% for each 100 m (328 ft.) to install the drive in altitudes between 1000 m to 4000 m (3281 ft. to 13123 ft.). It is not necessary to derate the rated voltage in these conditions: • Installing the drive at 2000 m (6562 ft.) or lower • Installing the drive between 2000 m to 4000 m (6562 ft. to 13123 ft.) and grounding the neutral point on the power supply. Contact Yaskawa or your nearest sales representative when not grounding the neutral point.
Vibration	• 10 Hz to 20 Hz: 1 G (9.8 m/s^2, 32.15 ft/s^2) • 20 Hz to 55 Hz: 2003 to 2180, 4002 to 4150: 0.6 G (5.9 m/s^2, 19.36 ft/s^2) 2215 to 2415, 4180 to 4605: 0.2 G (2.0 m/s^2, 6.56 ft/s^2)
Installation Orientation	Install the drive vertically for sufficient cooling airflow.

Table 9.9 Standard

Item	Specification
Harmonized Standard	• UL61800-5-1 • EN61800-3 • IEC/EN61800-5-1 • Two Safe Disable inputs and one EDM output according to ISO/EN13849-1 Cat.III PLe, IEC/EN61508 SIL3
Protection Design	Open-chassis type (IP20) Enclosed wall-mounted type (UL Type 1) **Note:** Installing UL Type 1 kit on an open-chassis type (IP20) drive to convert the drive to a wall-mount enclosure (UL Type 1).

9.5 Drive Derating

You must derate the drive capacity to operate the drive above the rated temperature, altitude, and default carrier frequency.

◆ Carrier Frequency Settings and Rated Current Values

Table 9.10 Table 9.11 show how the drive rated output current changes when the *C6-02 [Carrier Frequency Selection]* value changes. The output current value changes linearly as the carrier frequency changes. You can use the values from the tables to calculate a frequency that is not shown.

Table 9.10 Carrier Frequency and Rated Current Derating (200 V Class)

Model	Rated Current (A)					
	2 kHz	5 kHz	8 kHz	10 kHz	12.5 kHz	15 kHz
2003	3.2	3.2	3.2	3.1	2.9	2.78
2005	5.0	5.0	5.0	4.8	4.6	4.3
2008	8.0	8.0	8.0	7.4	6.6	5.8
2011	11.0	11.0	11.0	10.4	9.6	8.8
2014	14.0	14.0	14.0	12.6	10.8	9.1
2018	17.5	17.5	17.5	16.1	14.3	12.6
2025	25.0	25.0	25.0	23.0	20.5	18.0
2033	33.0	33.0	33.0	29.3	24.8	20.2
2047	47.0	47.0	47.0	43.4	38.9	34.4
2060	60.0	60.0	60.0	56.0	51.0	46
2075	75.0	75.0	75.0	68.6	60.5	53
2088	88.0	88.0	88.0	80.5	71.0	62
2115	115.0	115.0	115.0	105.1	92.8	81
2145	145.0	145.0	125.2	112.0	-	-
2180	180.0	180.0	155.2	138.6	-	-
2215	215.0	215.0	184.8	164.7	-	-
2283	283.0	283.0	249.0	226.4	-	-
2346	346.0	346.0	294.3	259.8	-	-
2415	415.0	415.0	365.2	332.0	-	-

Table 9.11 Carrier Frequency and Rated Current Derating (400 V Class)

Model	Rated Current (A)					
	2 kHz	5 kHz	8 kHz	10 kHz	12.5 kHz	15 kHz
4002	1.8	1.8	1.8	1.6	1.3	1.0
4003	3.4	3.4	3.4	2.9	2.3	1.7
4005	4.8	4.8	4.8	4.3	3.7	3.0
4006	5.5	5.5	5.5	4.9	4.1	3.2
4007	7.2	7.2	7.2	6.5	5.6	4.8
4009	9.2	9.2	9.2	8.1	6.8	5.4
4015	14.8	14.8	14.8	13.1	11.0	8.9
4018	18.0	18.0	18.0	15.9	13.4	10.8
4024	24.0	24.0	24.0	21.2	17.7	14.1
4031	31.0	31.0	31.0	27.5	23.0	18.6
4039	39.0	39.0	39.0	34.5	29.0	23.4
4045	45.0	45.0	45.0	39.1	31.8	24.4
4060	60.0	60.0	60.0	53.1	44.6	36.0
4075	75.0	75.0	75.0	66.4	55.7	45.0

Model	Rated Current (A)					
	2 kHz	5 kHz	8 kHz	10 kHz	12.5 kHz	15 kHz
4091	91.0	91.0	91.0	80.6	67.6	54.6
4112	112.0	112.0	91.8	78.4	-	-
4150	150.0	150.0	123.0	105.0	-	-
4180	180.0	180.0	147.6	126.0	-	-
4216	216.0	216.0	177.1	151.2	-	-
4260	260.0	260.0	213.2	182.0	-	-
4304	304.0	304.0	249.3	212.8	-	-
4371	371.0	371.0	304.2	259.7	-	-
4414	389.0	324.8	-	-	-	-
4453	453.0	378.3	-	-	-	-
4605	605.0	505.2	-	-	-	-

◆ Altitude Derating

Install the drive in a location that has an altitude of 1000 m (3281 ft) or lower.

Derate the output current by 1% for each 100 m (328 ft) to install the drive in altitudes between 1000 to 4000 m (3281 to 13123 ft).

It is not necessary to derate the rated voltage in these conditions:

- Installing the drive at 2000 m (6562 ft) or lower
- Installing the drive between 2000 to 4000 m (6562 to 13123 ft) and grounding the neutral point on the power supply.
  If you do not ground the drive with a neutral network, contact Yaskawa or your nearest sales representative.

9.6 Drive Exterior and Mounting Dimensions

Note:

The estimated weights in this document are for drives with hardware revision D or later. For estimated weights of drives with hardware revision C or earlier, contact Yaskawa or your nearest sales representative. The “REV” column on the nameplate on the right side of the drive identifies the hardware revision. Refer to *Nameplate on page 22* for more information.

◆ IP20/UL Open Type

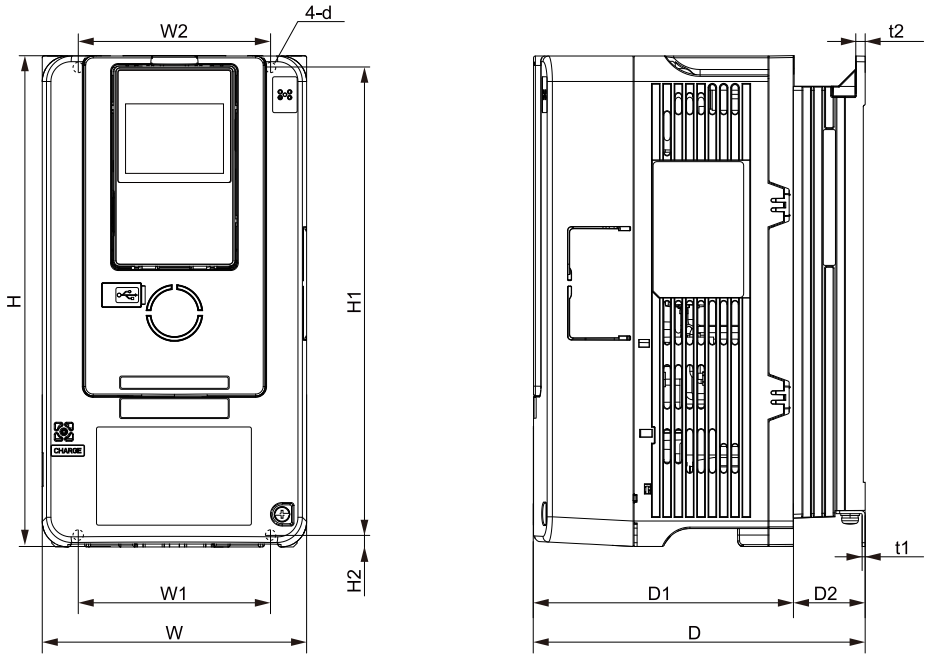

Figure 9.1 Dimension Diagram 1

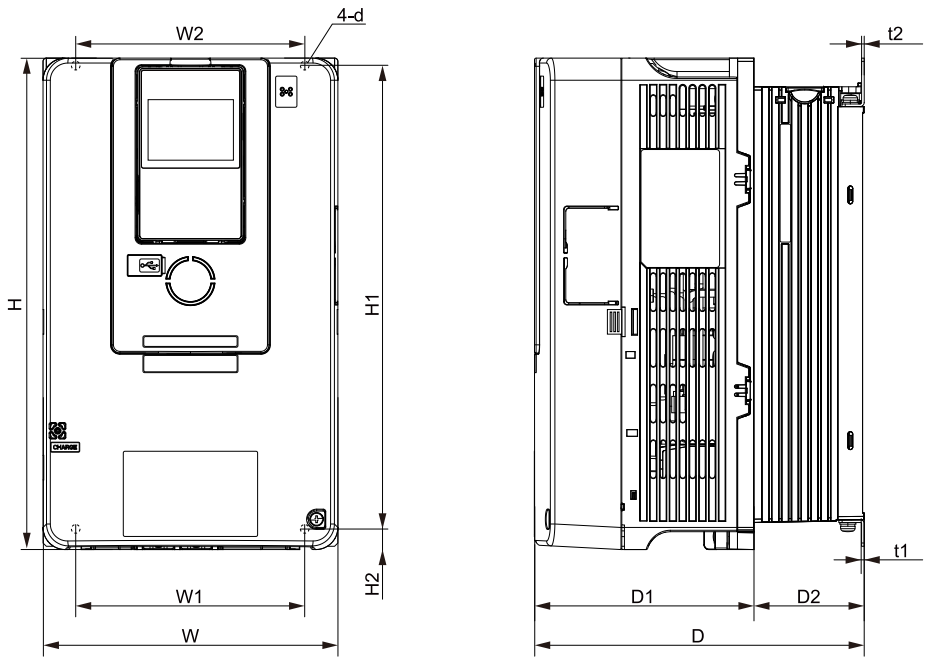

Figure 9.2 Dimension Diagram 2

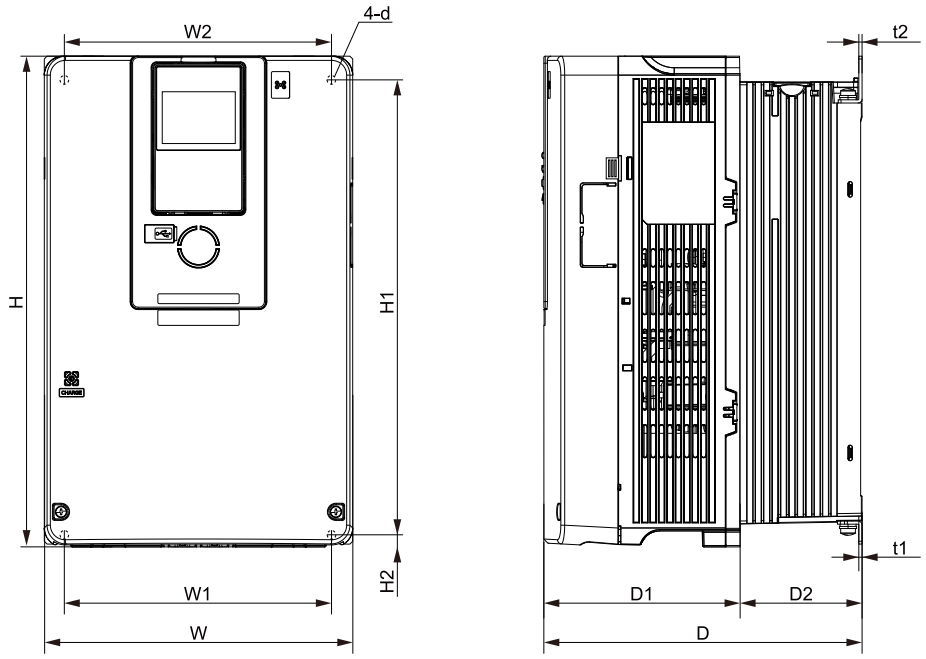

Figure 9.3 Dimension Diagram 3

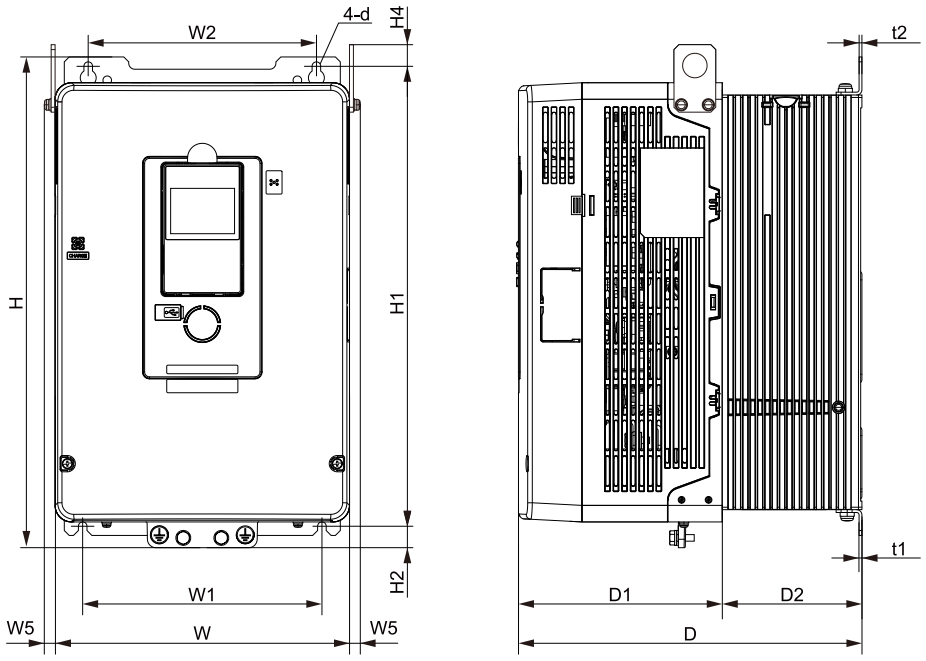

Figure 9.4 Dimension Diagram 4

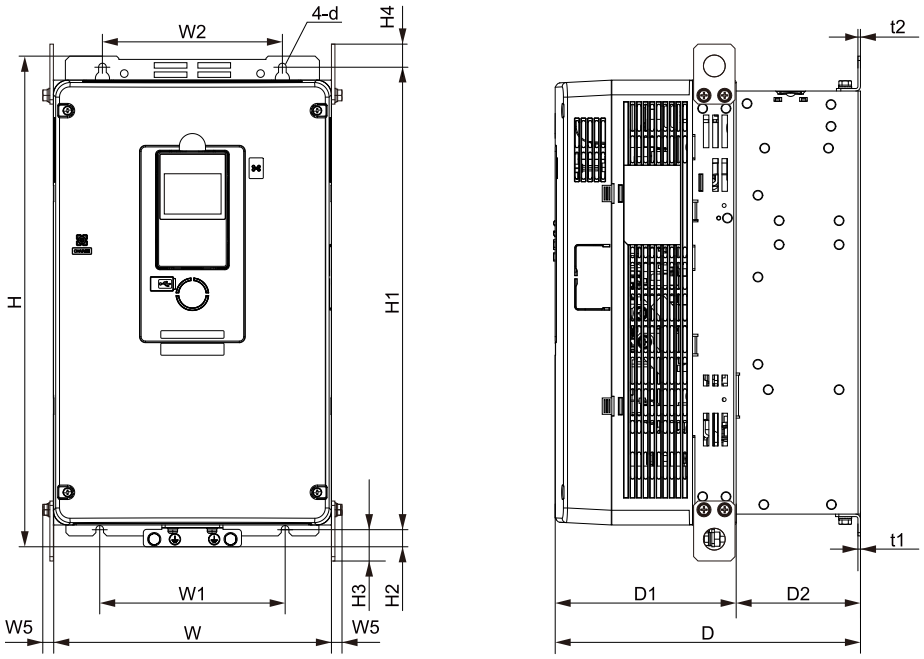

Figure 9.5 Dimension Diagram 5

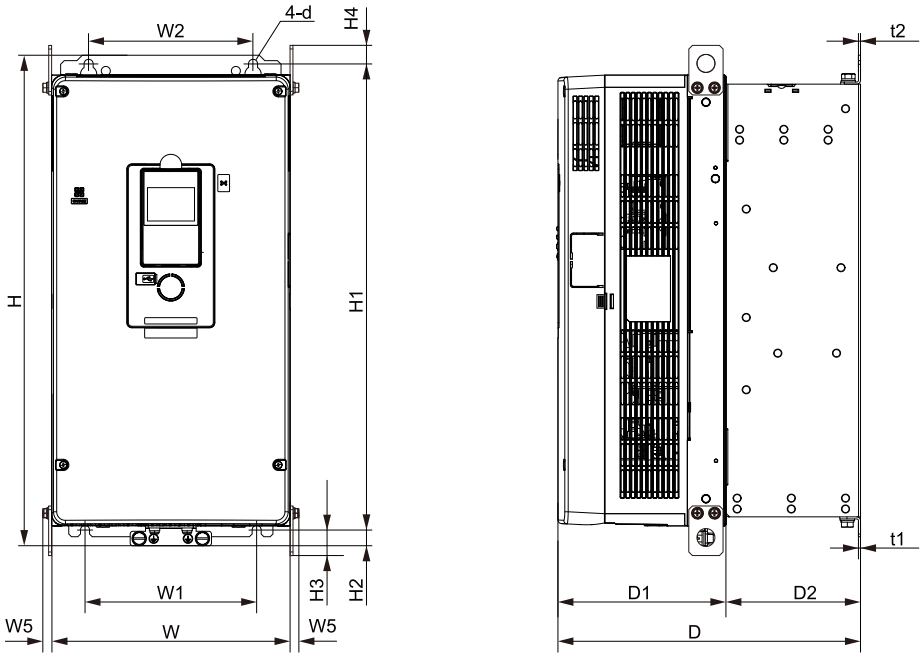

Figure 9.6 Dimension Diagram 6

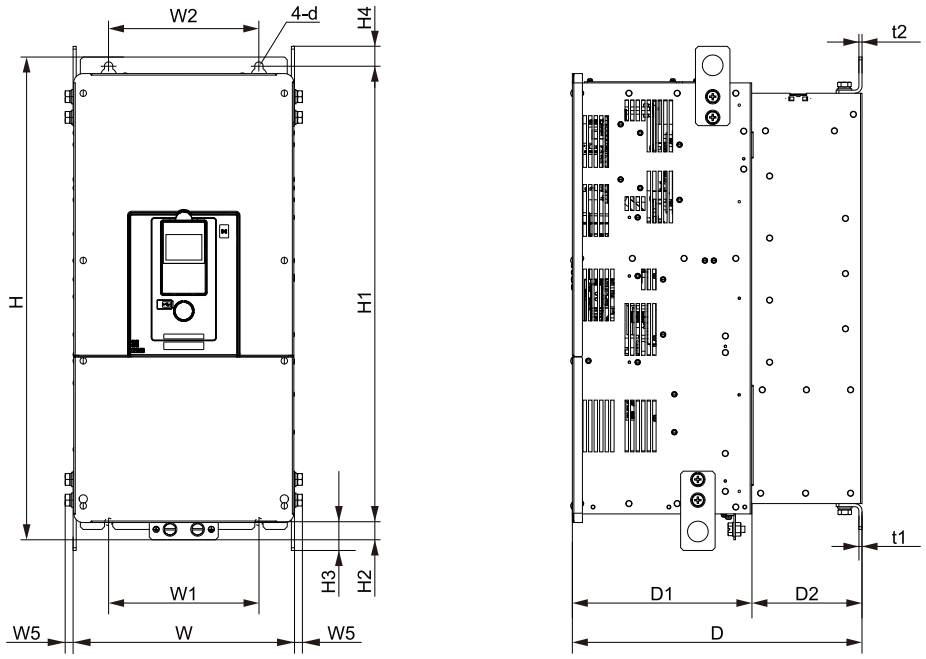

Figure 9.7 Dimension Diagram 7

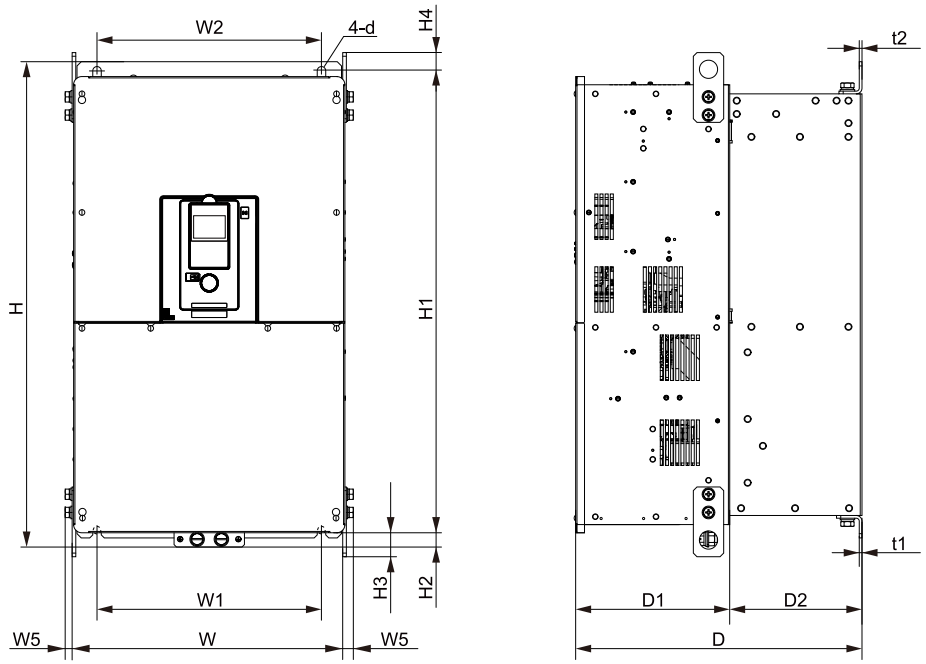

Figure 9.8 Dimension Diagram 8

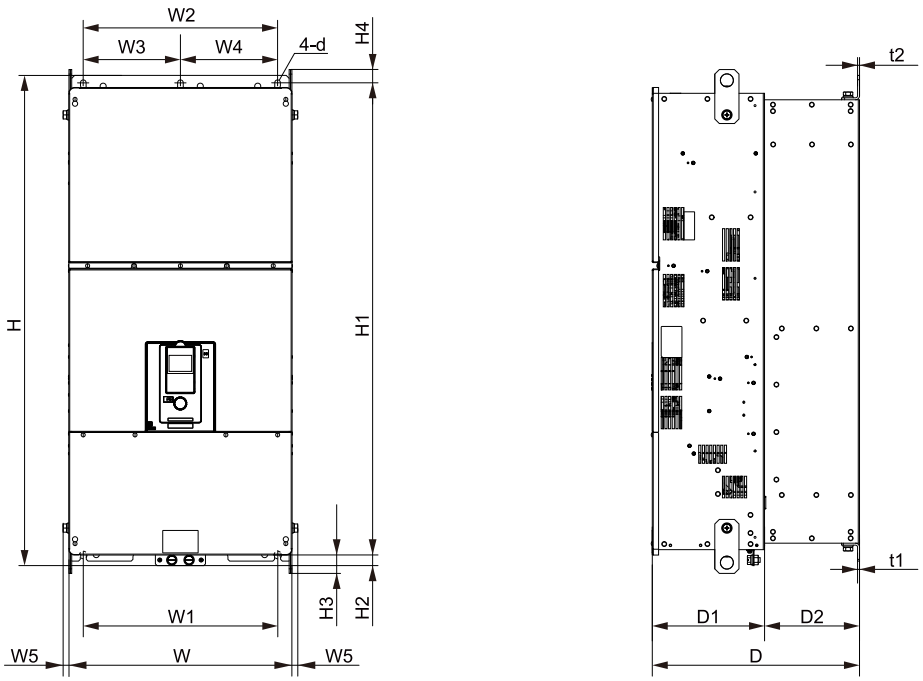

Figure 9.9 Dimension Diagram 9

Table 9.12 200 V Class (IP20/UL Open Type, No Internal EMC Filter)

Model	Exterior and Mounting Dimensions	Dimensions mm (in)																	Est. Weight kg (lb)
		W	H	D	D1	D2	W1	W2	W3	W4	W5 (Maximum)	H1	H2	H3	H4	t1	t2	d	
2003	Figure 9.1	140 (5.51)	260 (10.24)	176 (6.93)	138 (5.43)	38 (1.50)	102 (4.02)	102 (4.02)	-	-	-	248 (9.76)	6 (0.24)	-	-	1.6 (0.06)	5 (0.20)	M5	3.5 (7.72)
2005		140 (5.51)	260 (10.24)	176 (6.93)	138 (5.43)	38 (1.50)	102 (4.02)	102 (4.02)	-	-	-	248 (9.76)	6 (0.24)	-	-	1.6 (0.06)	5 (0.20)	M5	3.5 (7.72)
2008		140 (5.51)	260 (10.24)	176 (6.93)	138 (5.43)	38 (1.50)	102 (4.02)	102 (4.02)	-	-	-	248 (9.76)	6 (0.24)	-	-	1.6 (0.06)	5 (0.20)	M5	3.5 (7.72)
2011		140 (5.51)	260 (10.24)	176 (6.93)	138 (5.43)	38 (1.50)	102 (4.02)	102 (4.02)	-	-	-	248 (9.76)	6 (0.24)	-	-	1.6 (0.06)	5 (0.20)	M5	3.5 (7.72)
2014		140 (5.51)	260 (10.24)	211 (8.31)	138 (5.43)	73 (2.87)	102 (4.02)	102 (4.02)	-	-	-	248 (9.76)	6 (0.24)	-	-	1.6 (0.06)	5 (0.20)	M5	3.8 (8.38)
2018		140 (5.51)	260 (10.24)	211 (8.31)	138 (5.43)	73 (2.87)	102 (4.02)	102 (4.02)	-	-	-	248 (9.76)	6 (0.24)	-	-	1.6 (0.06)	5 (0.20)	M5	3.8 (8.38)
2025		140 (5.51)	260 (10.24)	211 (8.31)	138 (5.43)	73 (2.87)	102 (4.02)	102 (4.02)	-	-	-	248 (9.76)	6 (0.24)	-	-	1.6 (0.06)	5 (0.20)	M5	4.2 (9.26)
2033		140 (5.51)	260 (10.24)	211 (8.31)	138 (5.43)	73 (2.87)	102 (4.02)	102 (4.02)	-	-	-	248 (9.76)	6 (0.24)	-	-	1.6 (0.06)	5 (0.20)	M5	4.2 (9.26)
2047	Figure 9.2	180 (7.09)	300 (11.81)	202 (7.95)	134 (5.28)	68 (2.68)	140 (5.51)	140 (5.51)	-	-	-	284 (11.18)	8 (0.32)	-	-	1.6 (0.06)	1.6 (0.06)	M5	6 (13.23)
2060	Figure 9.3	220 (8.66)	350 (13.78)	227 (8.94)	140 (5.51)	87 (3.43)	192 (7.56)	192 (7.56)	-	-	-	335 (13.19)	8 (0.32)	-	-	2.3 (0.09)	2.3 (0.09)	M6	8.5 (18.74)
2075		220 (8.66)	350 (13.78)	227 (8.94)	140 (5.51)	87 (3.43)	192 (7.56)	192 (7.56)	-	-	-	335 (13.19)	8 (0.32)	-	-	2.3 (0.09)	2.3 (0.09)	M6	9.5 (20.95)
2088	Figure 9.4	240 (9.45)	400 (15.75)	280 (11.02)	166 (6.54)	114 (4.49)	195 (7.68)	186 (7.32)	-	-	12 (0.47)	375 (14.76)	17.5 (0.69)	-	17.5 (0.69)	2.3 (0.09)	2.3 (0.09)	M6	18 (39.69)

Model	Exterior and Mounting Dimensions	Dimensions mm (in)																	Est. Weight kg (lb)
		W	H	D	D1	D2	W1	W2	W3	W4	W5 (Maximum)	H1	H2	H3	H4	t1	t2	d	
2115	Figure 9.5	255 (10.04)	450 (17.72)	280 (11.02)	166 (6.54)	114 (4.49)	170 (6.69)	165 (6.50)	-	-	12 (0.47)	424 (16.69)	16 (0.63)	29 (1.14)	21 (0.83)	2.3 (0.09)	2.3 (0.09)	M6	21 (46.31)
2145	Figure 9.6	264 (10.39)	543 (21.38)	335 (13.19)	186 (7.32)	149 (5.87)	190 (7.48)	182 (7.17)	-	-	12 (0.47)	516 (20.31)	17.5 (0.69)	28.5 (1.12)	20.5 (0.81)	2.3 (0.09)	2.3 (0.09)	M8	34 (74.97)
2180		264 (10.39)	543 (21.38)	335 (13.19)	186 (7.32)	149 (5.87)	190 (7.48)	182 (7.17)	-	-	12 (0.47)	516 (20.31)	17.5 (0.69)	28.5 (1.12)	20.5 (0.81)	2.3 (0.09)	2.3 (0.09)	M8	35 (77.18)
2215	Figure 9.7	312 (12.28)	700 (27.56)	420 (16.54)	260 (10.24)	160 (6.30)	218 (8.58)	218 (8.58)	-	-	18 (0.709)	659 (25.94)	28 (1.10)	43.5 (1.71)	28.5 (1.12)	4.5 (0.18)	4.5 (0.18)	M10	58 (127.89)
2283		312 (12.28)	700 (27.56)	420 (16.54)	260 (10.24)	160 (6.30)	218 (8.58)	218 (8.58)	-	-	18 (0.71)	659 (25.94)	28 (1.10)	43.5 (1.71)	28.5 (1.12)	4.5 (0.18)	4.5 (0.18)	M10	61 (134.51)
2346	Figure 9.8	440 (17.32)	800 (31.50)	472 (18.58)	254 (10.00)	218 (8.58)	370 (14.57)	370 (14.57)	-	-	20 (0.79)	757 (29.80)	28 (1.10)	44 (1.73)	30 (1.18)	4.5 (0.18)	4.5 (0.18)	M12	100 (220.5)
2415		440 (17.32)	800 (31.50)	472 (18.58)	254 (10.00)	218 (8.58)	370 (14.57)	370 (14.57)	-	-	20 (0.79)	757 (29.80)	28 (1.10)	44 (1.73)	30 (1.18)	4.5 (0.18)	4.5 (0.18)	M12	106 (233.73)

Table 9.13 200 V Class (IP20/UL Open Type, with Internal EMC Filter)

Model	Exterior and Mounting Dimensions	Dimensions mm (in)																	Est. Weight kg (lb)
		W	H	D	D1	D2	W1	W2	W3	W4	W5 (Maximum)	H1	H2	H3	H4	t1	t2	d	
2003	Figure 9.1	140 (5.51)	260 (10.24)	176 (6.93)	138 (5.43)	38 (1.50)	102 (4.02)	102 (4.02)	-	-	-	248 (9.76)	6 (0.24)	-	-	1.6 (0.06)	5 (0.20)	M5	3.5 (7.72)
2005		140 (5.51)	260 (10.24)	176 (6.93)	138 (5.43)	38 (1.50)	102 (4.02)	102 (4.02)	-	-	-	248 (9.76)	6 (0.24)	-	-	1.6 (0.06)	5 (0.20)	M5	3.5 (7.72)
2008		140 (5.51)	260 (10.24)	176 (6.93)	138 (5.43)	38 (1.50)	102 (4.02)	102 (4.02)	-	-	-	248 (9.76)	6 (0.24)	-	-	1.6 (0.06)	5 (0.20)	M5	3.5 (7.72)
2011		140 (5.51)	260 (10.24)	176 (6.93)	138 (5.43)	38 (1.50)	102 (4.02)	102 (4.02)	-	-	-	248 (9.76)	6 (0.24)	-	-	1.6 (0.06)	5 (0.20)	M5	3.5 (7.72)
2014		140 (5.51)	260 (10.24)	211 (8.31)	138 (5.43)	73 (2.87)	102 (4.02)	102 (4.02)	-	-	-	248 (9.76)	6 (0.24)	-	-	1.6 (0.06)	5 (0.20)	M5	3.8 (8.38)
2018		140 (5.51)	260 (10.24)	211 (8.31)	138 (5.43)	73 (2.87)	102 (4.02)	102 (4.02)	-	-	-	248 (9.76)	6 (0.24)	-	-	1.6 (0.06)	5 (0.20)	M5	3.8 (8.38)
2025		140 (5.51)	260 (10.24)	211 (8.31)	138 (5.43)	73 (2.87)	102 (4.02)	102 (4.02)	-	-	-	248 (9.76)	6 (0.24)	-	-	1.6 (0.06)	5 (0.20)	M5	4.2 (9.26)
2033		140 (5.51)	260 (10.24)	211 (8.31)	138 (5.43)	73 (2.87)	102 (4.02)	102 (4.02)	-	-	-	248 (9.76)	6 (0.24)	-	-	1.6 (0.06)	5 (0.20)	M5	4.2 (9.26)
2047	Figure 9.2	180 (7.09)	300 (11.81)	202 (7.95)	134 (5.28)	68 (2.68)	140 (5.51)	140 (5.51)	-	-	-	284 (11.18)	8 (0.32)	-	-	1.6 (0.06)	1.6 (0.06)	M5	6 (13.23)
2060	Figure 9.3	220 (8.66)	350 (13.78)	227 (8.94)	140 (5.51)	87 (3.43)	192 (7.56)	192 (7.56)	-	-	-	335 (13.19)	8 (0.32)	-	-	2.3 (0.09)	2.3 (0.09)	M6	8.5 (18.74)
2075		220 (8.66)	350 (13.78)	227 (8.94)	140 (5.51)	87 (3.43)	192 (7.56)	192 (7.56)	-	-	-	335 (13.19)	8 (0.32)	-	-	2.3 (0.09)	2.3 (0.09)	M6	9.5 (20.95)

Model	Exterior and Mounting Dimensions	Dimensions mm (in)																	Est. Weight kg (lb)
		W	H	D	D1	D2	W1	W2	W3	W4	W5 (Maximum)	H1	H2	H3	H4	t1	t2	d	
2088	Figure 9.4	240 (9.45)	400 (15.75)	280 (11.02)	166 (6.54)	114 (4.49)	195 (7.68)	186 (7.32)	-	-	12 (0.47)	375 (14.76)	17.5 (0.69)	-	17.5 (0.69)	2.3 (0.09)	2.3 (0.09)	M6	19 (41.90)
2115	Figure 9.5	255 (10.04)	450 (17.72)	280 (11.02)	166 (6.54)	114 (4.49)	170 (6.69)	165 (6.50)	-	-	12 (0.47)	424 (16.69)	16 (0.63)	29 (1.14)	21 (0.83)	2.3 (0.09)	2.3 (0.09)	M6	22 (48.51)
2145	Figure 9.6	264 (10.39)	543 (21.38)	335 (13.19)	186 (7.32)	149 (5.87)	190 (7.48)	182 (7.17)	-	-	12 (0.47)	516 (20.31)	17.5 (0.69)	28.5 (1.12)	20.5 (0.81)	2.3 (0.09)	2.3 (0.09)	M8	35 (77.18)
2180		264 (10.39)	543 (21.38)	335 (13.19)	186 (7.32)	149 (5.87)	190 (7.48)	182 (7.17)	-	-	12 (0.47)	516 (20.31)	17.5 (0.69)	28.5 (1.12)	20.5 (0.81)	2.3 (0.09)	2.3 (0.09)	M8	36 (79.38)
2215	Figure 9.7	312 (12.28)	700 (27.56)	420 (16.54)	260 (10.24)	160 (6.30)	218 (8.58)	218 (8.58)	-	-	18 (0.709)	659 (25.94)	28 (1.10)	43.5 (1.71)	28.5 (1.12)	4.5 (0.18)	4.5 (0.18)	M10	59 (130.10)
2283		312 (12.28)	700 (27.56)	420 (16.54)	260 (10.24)	160 (6.30)	218 (8.58)	218 (8.58)	-	-	18 (0.71)	659 (25.94)	28 (1.10)	43.5 (1.71)	28.5 (1.12)	4.5 (0.18)	4.5 (0.18)	M10	61 (134.51)
2346	Figure 9.8	440 (17.32)	800 (31.50)	472 (18.58)	254 (10.00)	218 (8.58)	370 (14.57)	370 (14.57)	-	-	20 (0.79)	757 (29.80)	28 (1.10)	44 (1.73)	30 (1.18)	4.5 (0.18)	4.5 (0.18)	M12	106 (233.73)
2415		440 (17.32)	800 (31.50)	472 (18.58)	254 (10.00)	218 (8.58)	370 (14.57)	370 (14.57)	-	-	20 (0.79)	757 (29.80)	28 (1.10)	44 (1.73)	30 (1.18)	4.5 (0.18)	4.5 (0.18)	M12	112 (246.96)

Table 9.14 400 V Class (IP20/UL Open Type, No Internal EMC Filter)

Model	Exterior and Mounting Dimensions	Dimensions mm (in)																	Est. Weight kg (lb)
		W	H	D	D1	D2	W1	W2	W3	W4	W5 (Maximum)	H1	H2	H3	H4	t1	t2	d	
4002	Figure 9.1	140 (5.51)	260 (10.24)	176 (6.93)	138 (5.43)	38 (1.50)	102 (4.02)	102 (4.02)	-	-	-	248 (9.76)	6 (0.24)	-	-	1.6 (0.06)	5 (0.20)	M5	3.4 (7.50)
4003		140 (5.51)	260 (10.24)	176 (6.93)	138 (5.43)	38 (1.50)	102 (4.02)	102 (4.02)	-	-	-	248 (9.76)	6 (0.24)	-	-	1.6 (0.06)	5 (0.20)	M5	3.4 (7.50)
4005		140 (5.51)	260 (10.24)	176 (6.93)	138 (5.43)	38 (1.50)	102 (4.02)	102 (4.02)	-	-	-	248 (9.76)	6 (0.24)	-	-	1.6 (0.06)	5 (0.20)	M5	3.4 (7.50)
4006		140 (5.51)	260 (10.24)	211 (8.31)	138 (5.43)	73 (2.87)	102 (4.02)	102 (4.02)	-	-	-	248 (9.76)	6 (0.24)	-	-	1.6 (0.06)	5 (0.20)	M5	3.7 (8.16)
4007		140 (5.51)	260 (10.24)	211 (8.31)	138 (5.43)	73 (2.87)	102 (4.02)	102 (4.02)	-	-	-	248 (9.76)	6 (0.24)	-	-	1.6 (0.06)	5 (0.20)	M5	3.7 (8.16)
4009		140 (5.51)	260 (10.24)	211 (8.31)	138 (5.43)	73 (2.87)	102 (4.02)	102 (4.02)	-	-	-	248 (9.76)	6 (0.24)	-	-	1.6 (0.06)	5 (0.20)	M5	3.7 (8.16)
4015		140 (5.51)	260 (10.24)	211 (8.31)	138 (5.43)	73 (2.87)	102 (4.02)	102 (4.02)	-	-	-	248 (9.76)	6 (0.24)	-	-	1.6 (0.06)	5 (0.20)	M5	4.0 (8.82)
4018		140 (5.51)	260 (10.24)	211 (8.31)	138 (5.43)	73 (2.87)	102 (4.02)	102 (4.02)	-	-	-	248 (9.76)	6 (0.24)	-	-	1.6 (0.06)	5 (0.20)	M5	4.0 (8.82)
4024	Figure 9.2	180 (7.09)	300 (11.81)	202 (7.95)	134 (5.28)	68 (2.68)	140 (5.51)	140 (5.51)	-	-	-	284 (11.18)	8 (0.32)	-	-	1.6 (0.06)	1.6 (0.06)	M5	5.5 (12.13)
4031		180 (7.09)	300 (11.81)	202 (7.95)	134 (5.28)	68 (2.68)	140 (5.51)	140 (5.51)	-	-	-	284 (11.18)	8 (0.32)	-	-	1.6 (0.06)	1.6 (0.06)	M5	5.5 (12.13)
4039	Figure 9.3	220 (8.66)	350 (13.78)	227 (8.94)	140 (5.51)	87 (3.43)	192 (7.56)	192 (7.56)	-	-	-	335 (13.19)	8 (0.32)	-	-	2.3 (0.09)	2.3 (0.09)	M6	8 (17.64)
4045		220 (8.66)	350 (13.78)	246 (9.69)	140 (5.51)	106 (4.17)	192 (7.56)	192 (7.56)	-	-	-	335 (13.19)	8 (0.32)	-	-	2.3 (0.09)	2.3 (0.09)	M6	13 (28.67)

Model	Exterior and Mounting Dimensions	Dimensions mm (in)																	Est. Weight kg (lb)
		W	H	D	D1	D2	W1	W2	W3	W4	W5 (Maximum)	H1	H2	H3	H4	t1	t2	d	
4060	Figure 9.4	240 (9.45)	400 (15.75)	280 (11.02)	166 (6.54)	114 (4.49)	195 (7.68)	186 (7.32)	-	-	12 (0.47)	375 (14.76)	17.5 (0.69)	-	17.5 (0.69)	2.3 (0.09)	2.3 (0.09)	M6	15 (33.08)
4075	Figure 9.5	255 (10.04)	450 (17.72)	280 (11.02)	166 (6.54)	114 (4.49)	170 (6.69)	165 (6.50)	-	-	12 (0.47)	424 (16.69)	16 (0.63)	29 (1.14)	21 (0.83)	2.3 (0.09)	2.3 (0.09)	M6	20 (44.10)
4091		255 (10.04)	450 (17.72)	280 (11.02)	166 (6.54)	114 (4.49)	170 (6.69)	165 (6.50)	-	-	12 (0.47)	424 (16.69)	16 (0.63)	29 (1.14)	21 (0.83)	2.3 (0.09)	2.3 (0.09)	M6	24 (52.92)
4112	Figure 9.6	264 (10.39)	543 (21.38)	335 (13.19)	186 (7.32)	149 (5.87)	190 (7.48)	182 (7.17)	-	-	12 (0.47)	516 (20.31)	17.5 (0.69)	28.5 (1.12)	20.5 (0.81)	2.3 (0.09)	2.3 (0.09)	M8	36 (79.38)
4150		264 (10.39)	543 (21.38)	335 (13.19)	186 (7.32)	149 (5.87)	190 (7.48)	182 (7.17)	-	-	12 (0.47)	516 (20.31)	17.5 (0.69)	28.5 (1.12)	20.5 (0.81)	2.3 (0.09)	2.3 (0.09)	M8	37 (81.59)
4180	Figure 9.7	312 (12.28)	700 (27.56)	420 (16.54)	260 (10.24)	160 (6.30)	218 (8.58)	218 (8.58)	-	-	18 (0.709)	659 (25.94)	28 (1.10)	43.5 (1.71)	28.5 (1.12)	4.5 (0.18)	4.5 (0.18)	M10	60 (132.30)
4216		312 (12.28)	700 (27.56)	420 (16.54)	260 (10.24)	160 (6.30)	218 (8.58)	218 (8.58)	-	-	18 (0.709)	659 (25.94)	28 (1.10)	43.5 (1.71)	28.5 (1.12)	4.5 (0.18)	4.5 (0.18)	M10	62 (136.71)
4260		312 (12.28)	700 (27.56)	420 (16.54)	260 (10.24)	160 (6.30)	218 (8.58)	218 (8.58)	-	-	18 (0.709)	659 (25.94)	28 (1.10)	43.5 (1.71)	28.5 (1.12)	4.5 (0.18)	4.5 (0.18)	M10	65 (143.33)
4304	Figure 9.8	440 (17.32)	800 (31.50)	472 (18.58)	254 (10.00)	218 (8.58)	370 (14.57)	370 (14.57)	-	-	20 (0.787)	757 (29.80)	28 (1.10)	44 (1.73)	30 (1.18)	4.5 (0.18)	4.5 (0.18)	M12	106 (233.73)
4371		440 (17.32)	800 (31.50)	472 (18.58)	254 (10.00)	218 (8.58)	370 (14.57)	370 (14.57)	-	-	20 (0.787)	757 (29.80)	28 (1.10)	44 (1.73)	30 (1.18)	4.5 (0.18)	4.5 (0.18)	M12	112 (246.96)
4414	Figure 9.9	510 (20.08)	1136 (44.72)	480 (18.90)	260 (10.24)	220 (8.66)	450 (17.72)	450 (17.72)	225 (8.86)	225 (8.86)	20 (0.787)	1093 (43.03)	25.5 (1.00)	43.5 (1.71)	30.5 (1.20)	4.5 (0.18)	4.5 (0.18)	M12	198 (436.5)
4453		510 (20.08)	1136 (44.72)	480 (18.90)	260 (10.24)	220 (8.66)	450 (17.72)	450 (17.72)	225 (8.86)	225 (8.86)	20 (0.787)	1093 (43.03)	25.5 (1.00)	43.5 (1.71)	30.5 (1.20)	4.5 (0.18)	4.5 (0.18)	M12	198 (436.5)
4605		510 (20.08)	1136 (44.72)	480 (18.90)	260 (10.24)	220 (8.66)	450 (17.72)	450 (17.72)	225 (8.86)	225 (8.86)	20 (0.787)	1093 (43.03)	25.5 (1.00)	43.5 (1.71)	30.5 (1.20)	4.5 (0.18)	4.5 (0.18)	M12	207 (456.44)

Table 9.15 400 V Class (IP20/UL Open Type, with Internal EMC Filter)

Model	Exterior and Mounting Dimensions	Dimensions mm (in)																	Est. Weight kg (lb)
		W	H	D	D1	D2	W1	W2	W3	W4	W5 (Maximum)	H1	H2	H3	H4	t1	t2	d	
4002	Figure 9.1	140 (5.51)	260 (10.24)	176 (6.93)	138 (5.43)	38 (1.50)	102 (4.02)	102 (4.02)	-	-	-	248 (9.76)	6 (0.24)	-	-	1.6 (0.06)	5 (0.20)	M5	3.4 (7.50)
4003		140 (5.51)	260 (10.24)	176 (6.93)	138 (5.43)	38 (1.50)	102 (4.02)	102 (4.02)	-	-	-	248 (9.76)	6 (0.24)	-	-	1.6 (0.06)	5 (0.20)	M5	3.4 (7.50)
4005		140 (5.51)	260 (10.24)	176 (6.93)	138 (5.43)	38 (1.50)	102 (4.02)	102 (4.02)	-	-	-	248 (9.76)	6 (0.24)	-	-	1.6 (0.06)	5 (0.20)	M5	3.4 (7.50)
4006		140 (5.51)	260 (10.24)	211 (8.31)	138 (5.43)	73 (2.87)	102 (4.02)	102 (4.02)	-	-	-	248 (9.76)	6 (0.24)	-	-	1.6 (0.06)	5 (0.20)	M5	3.7 (8.16)
4007		140 (5.51)	260 (10.24)	211 (8.31)	138 (5.43)	73 (2.87)	102 (4.02)	102 (4.02)	-	-	-	248 (9.76)	6 (0.24)	-	-	1.6 (0.06)	5 (0.20)	M5	3.7 (8.16)
4009		140 (5.51)	260 (10.24)	211 (8.31)	138 (5.43)	73 (2.87)	102 (4.02)	102 (4.02)	-	-	-	248 (9.76)	6 (0.24)	-	-	1.6 (0.06)	5 (0.20)	M5	3.7 (8.16)
4015		140 (5.51)	260 (10.24)	211 (8.31)	138 (5.43)	73 (2.87)	102 (4.02)	102 (4.02)	-	-	-	248 (9.76)	6 (0.24)	-	-	1.6 (0.06)	5 (0.20)	M5	4.0 (8.82)
4018		140 (5.51)	260 (10.24)	211 (8.31)	138 (5.43)	73 (2.87)	102 (4.02)	102 (4.02)	-	-	-	248 (9.76)	6 (0.24)	-	-	1.6 (0.06)	5 (0.20)	M5	4.0 (8.82)
4024	Figure 9.2	180 (7.09)	300 (11.81)	202 (7.95)	134 (5.28)	68 (2.68)	140 (5.51)	140 (5.51)	-	-	-	284 (11.18)	8 (0.32)	-	-	1.6 (0.06)	1.6 (0.06)	M5	5.5 (12.13)
4031		180 (7.09)	300 (11.81)	202 (7.95)	134 (5.28)	68 (2.68)	140 (5.51)	140 (5.51)	-	-	-	284 (11.18)	8 (0.32)	-	-	1.6 (0.06)	1.6 (0.06)	M5	5.5 (12.13)
4039	Figure 9.3	220 (8.66)	350 (13.78)	227 (8.94)	140 (5.51)	87 (3.43)	192 (7.56)	192 (7.56)	-	-	-	335 (13.19)	8 (0.32)	-	-	2.3 (0.09)	2.3 (0.09)	M6	8 (17.64)
4045		220 (8.66)	350 (13.78)	246 (9.69)	140 (5.51)	106 (4.17)	192 (7.56)	192 (7.56)	-	-	-	335 (13.19)	8 (0.32)	-	-	2.3 (0.09)	2.3 (0.09)	M6	13 (28.67)
4060	Figure 9.4	240 (9.45)	400 (15.75)	280 (11.02)	166 (6.54)	114 (4.49)	195 (7.68)	186 (7.32)	-	-	12 (0.47)	375 (14.76)	17.5 (0.69)	-	17.5 (0.69)	2.3 (0.09)	2.3 (0.09)	M6	15 (33.08)
4075	Figure 9.5	255 (10.04)	450 (17.72)	280 (11.02)	166 (6.54)	114 (4.49)	170 (6.69)	165 (6.50)	-	-	12 (0.47)	424 (16.69)	16 (0.63)	29 (1.14)	21 (0.83)	2.3 (0.09)	2.3 (0.09)	M6	21 (46.31)
4091		255 (10.04)	450 (17.72)	280 (11.02)	166 (6.54)	114 (4.49)	170 (6.69)	165 (6.50)	-	-	12 (0.47)	424 (16.69)	16 (0.63)	29 (1.14)	21 (0.83)	2.3 (0.09)	2.3 (0.09)	M6	25 (55.13)
4112	Figure 9.6	264 (10.39)	543 (21.38)	335 (13.19)	186 (7.32)	149 (5.87)	190 (7.48)	182 (7.17)	-	-	12 (0.47)	516 (20.31)	17.5 (0.69)	28.5 (1.12)	20.5 (0.81)	2.3 (0.09)	2.3 (0.09)	M8	37 (81.59)
4150		264 (10.39)	543 (21.38)	335 (13.19)	186 (7.32)	149 (5.87)	190 (7.48)	182 (7.17)	-	-	12 (0.47)	516 (20.31)	17.5 (0.69)	28.5 (1.12)	20.5 (0.81)	2.3 (0.09)	2.3 (0.09)	M8	38 (83.79)
4180	Figure 9.7	312 (12.28)	700 (27.56)	420 (16.54)	260 (10.24)	160 (6.30)	218 (8.58)	218 (8.58)	-	-	18 (0.709)	659 (25.94)	28 (1.10)	43.5 (1.71)	28.5 (1.12)	4.5 (0.18)	4.5 (0.18)	M10	61 (134.51)
4216		312 (12.28)	700 (27.56)	420 (16.54)	260 (10.24)	160 (6.30)	218 (8.58)	218 (8.58)	-	-	18 (0.709)	659 (25.94)	28 (1.10)	43.5 (1.71)	28.5 (1.12)	4.5 (0.18)	4.5 (0.18)	M10	63 (138.92)
4260		312 (12.28)	700 (27.56)	420 (16.54)	260 (10.24)	160 (6.30)	218 (8.58)	218 (8.58)	-	-	18 (0.709)	659 (25.94)	28 (1.10)	43.5 (1.71)	28.5 (1.12)	4.5 (0.18)	4.5 (0.18)	M10	66 (145.53)
4304	Figure 9.8	440 (17.32)	800 (31.50)	472 (18.58)	254 (10.00)	218 (8.58)	370 (14.57)	370 (14.57)	-	-	20 (0.787)	757 (29.80)	28 (1.10)	44 (1.73)	30 (1.18)	4.5 (0.18)	4.5 (0.18)	M12	111 (244.76)
4371		440 (17.32)	800 (31.50)	472 (18.58)	254 (10.00)	218 (8.58)	370 (14.57)	370 (14.57)	-	-	20 (0.787)	757 (29.80)	28 (1.10)	44 (1.73)	30 (1.18)	4.5 (0.18)	4.5 (0.18)	M12	117 (257.99)

Model	Exterior and Mounting Dimensions	Dimensions mm (in)																	Est. Weight kg (lb)
		W	H	D	D1	D2	W1	W2	W3	W4	W5 (Maximum)	H1	H2	H3	H4	t1	t2	d	
4414	Figure 9.9	510 (20.08)	1136 (44.72)	480 (18.90)	260 (10.24)	220 (8.66)	450 (17.72)	450 (17.72)	225 (8.86)	225 (8.86)	20 (0.787)	1093 (43.03)	25.5 (1.00)	43.5 (1.71)	30.5 (1.20)	4.5 (0.18)	4.5 (0.18)	M12	198 (436.5)
4453		510 (20.08)	1136 (44.72)	480 (18.90)	260 (10.24)	220 (8.66)	450 (17.72)	450 (17.72)	225 (8.86)	225 (8.86)	20 (0.787)	1093 (43.03)	25.5 (1.00)	43.5 (1.71)	30.5 (1.20)	4.5 (0.18)	4.5 (0.18)	M12	198 (436.5)
4605		510 (20.08)	1136 (44.72)	480 (18.90)	260 (10.24)	220 (8.66)	450 (17.72)	450 (17.72)	225 (8.86)	225 (8.86)	20 (0.787)	1093 (43.03)	25.5 (1.00)	43.5 (1.71)	30.5 (1.20)	4.5 (0.18)	4.5 (0.18)	M12	207 (456.44)

◆ IP20/UL Type 1

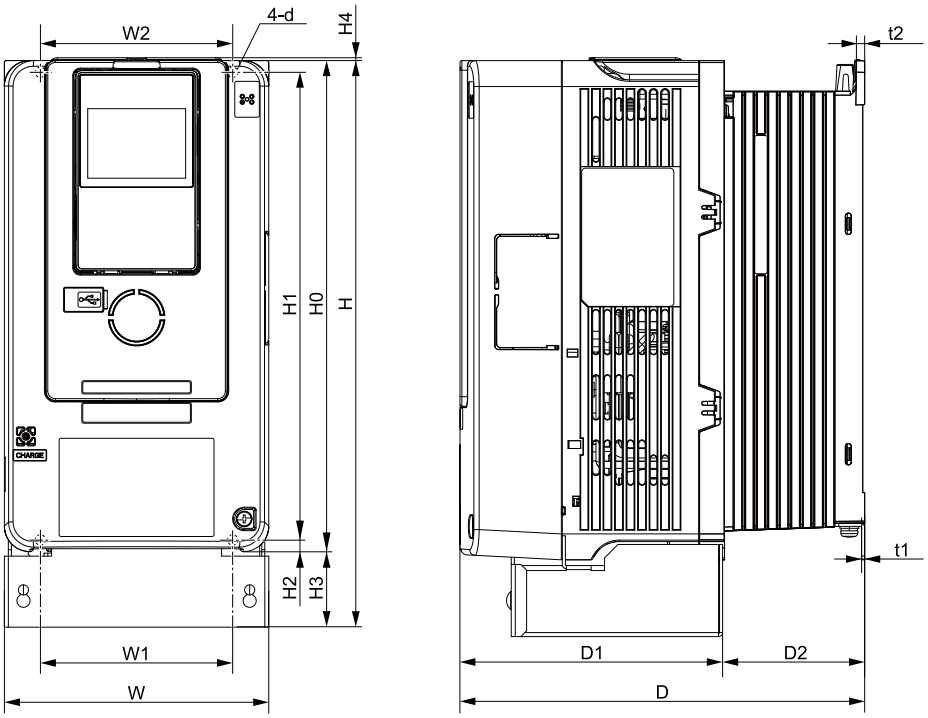

Figure 9.10 Dimension Diagram 1

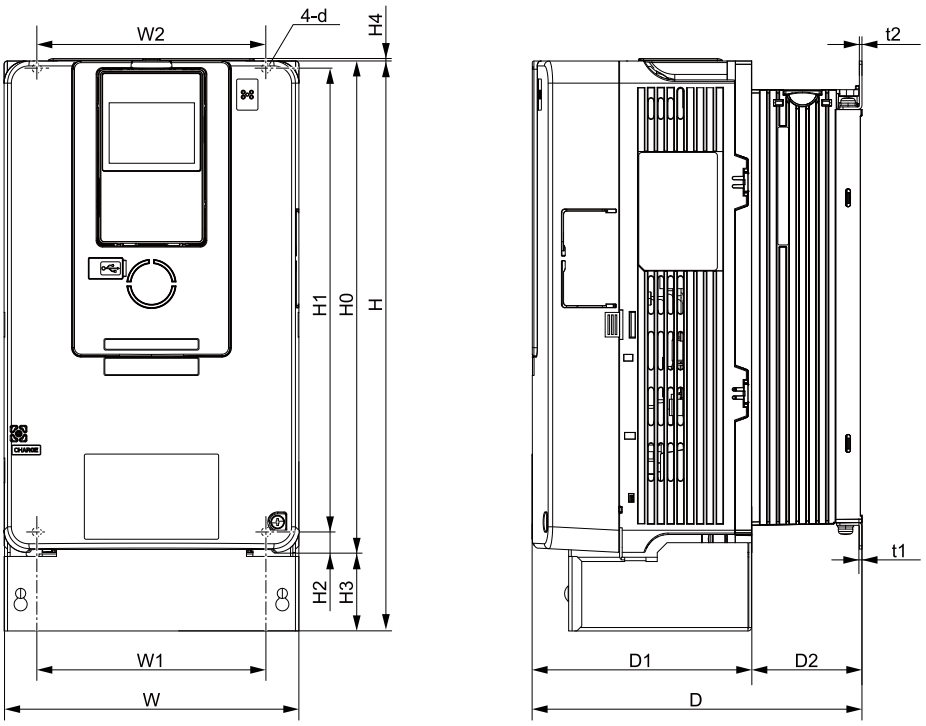

Figure 9.11 Dimension Diagram 2

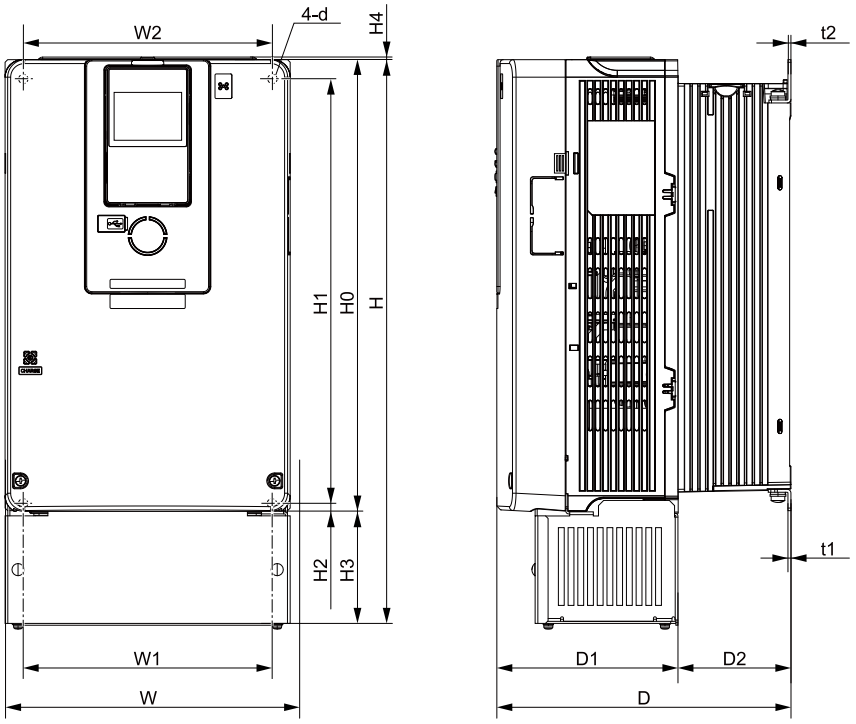

Figure 9.12 Dimension Diagram 3

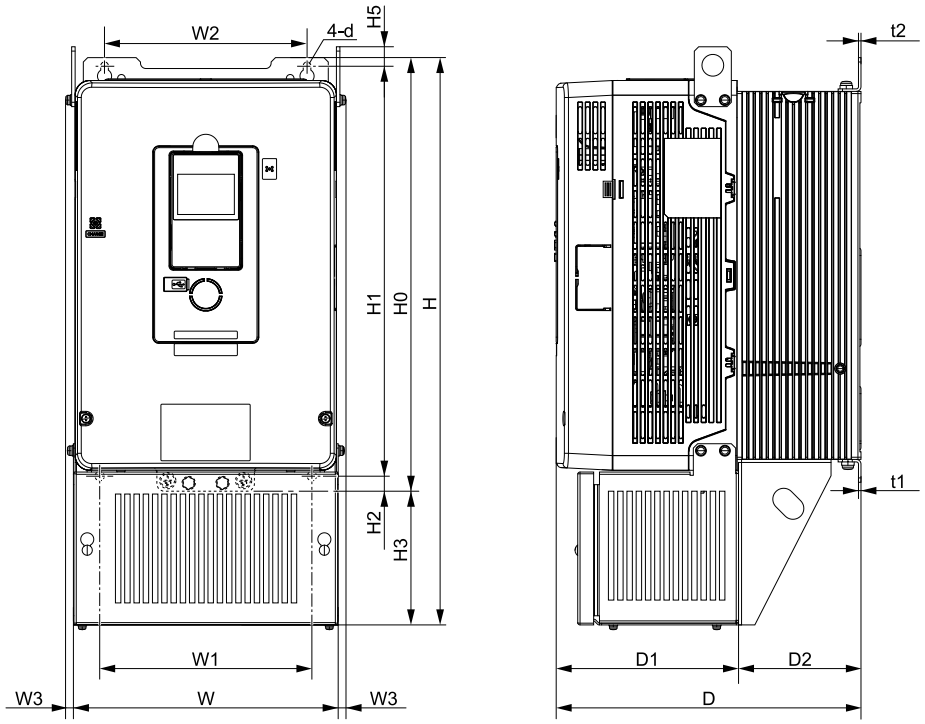

Figure 9.13 Dimension Diagram 4

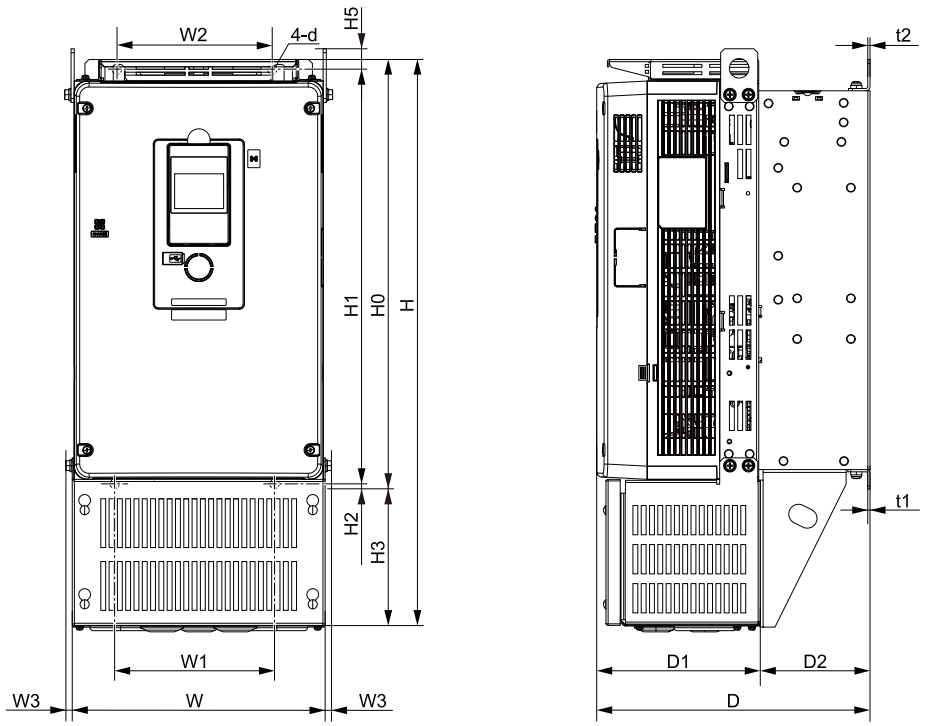

Figure 9.14 Dimension Diagram 5

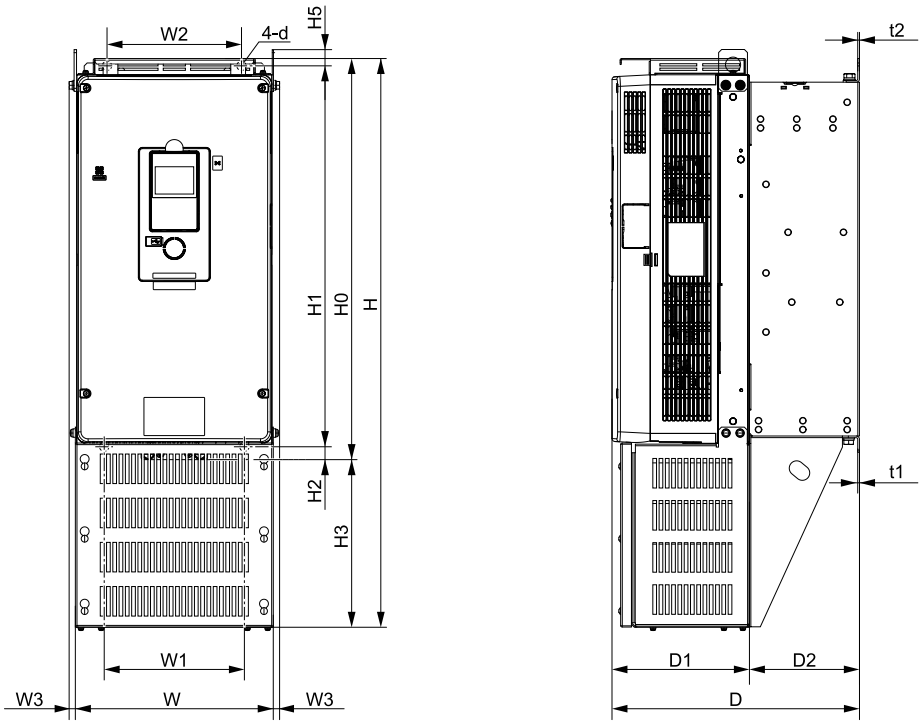

Figure 9.15 Dimension Diagram 6

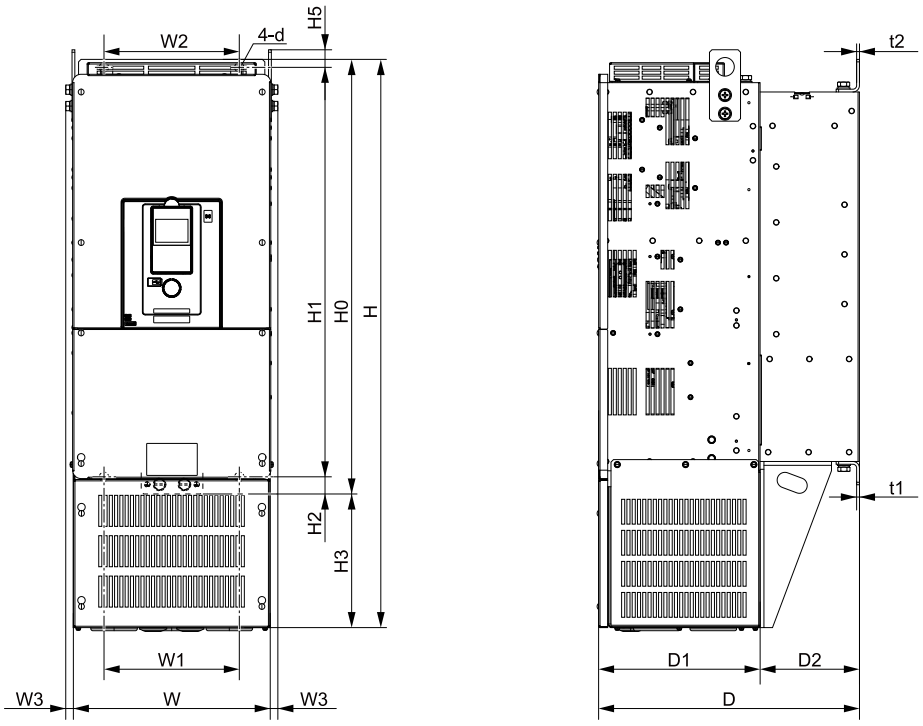

Figure 9.16 Dimension Diagram 7

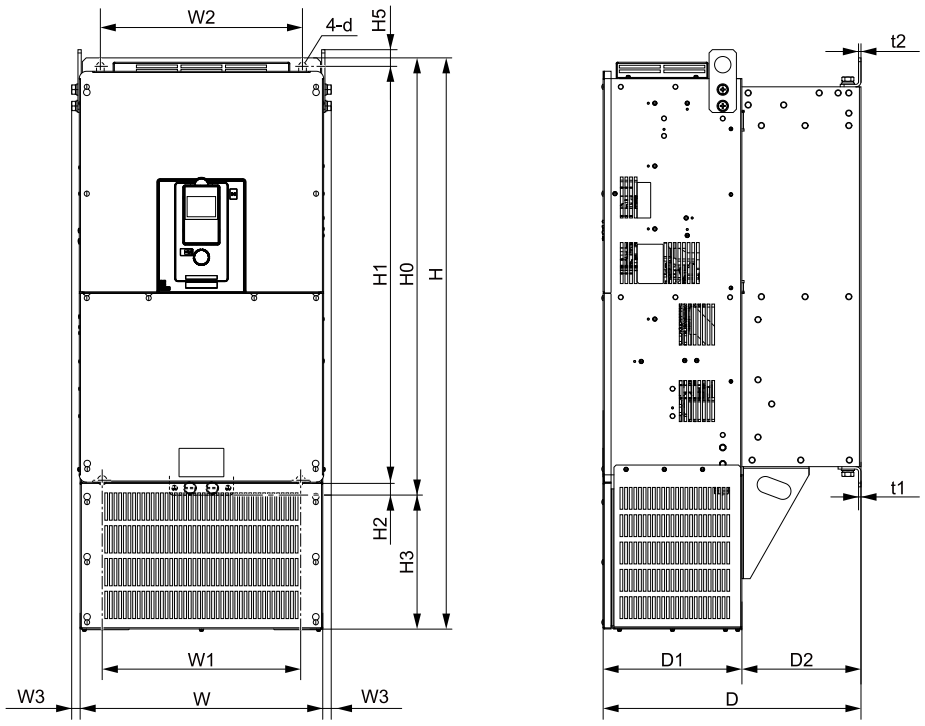

Figure 9.17 Dimension Diagram 8

Table 9.16 200 V Class (IP20/UL Type 1, No Internal EMC Filter)

Model	Exterior and Mounting Dimensions	Dimensions mm (in)																	Est. Weight kg (lb)
		W	H	D	D1	D2	W1	W2	W3 (Maximum)	H0	H1	H2	H3	H4	H5	t1	t2	d	
2003	Figure 9.10	140 (5.51)	300 (11.81)	176 (6.93)	138 (5.43)	38 (1.50)	102 (4.02)	102 (4.02)	-	260 (10.24)	248 (9.76)	6 (0.24)	40 (1.57)	1.5 (0.06)	-	1.6 (0.06)	5 (0.20)	M5	4.1 (9.04)
2005		140 (5.51)	300 (11.81)	176 (6.93)	138 (5.43)	38 (1.50)	102 (4.02)	102 (4.02)	-	260 (10.24)	248 (9.76)	6 (0.24)	40 (1.57)	1.5 (0.06)	-	1.6 (0.06)	5 (0.20)	M5	4.1 (9.04)
2008		140 (5.51)	300 (11.81)	176 (6.93)	138 (5.43)	38 (1.50)	102 (4.02)	102 (4.02)	-	260 (10.24)	248 (9.76)	6 (0.24)	40 (1.57)	1.5 (0.06)	-	1.6 (0.06)	5 (0.20)	M5	4.1 (9.04)
2011		140 (5.51)	300 (11.81)	176 (6.93)	138 (5.43)	38 (1.50)	102 (4.02)	102 (4.02)	-	260 (10.24)	248 (9.76)	6 (0.24)	40 (1.57)	1.5 (0.06)	-	1.6 (0.06)	5 (0.20)	M5	4.1 (9.04)
2014		140 (5.51)	300 (11.81)	211 (8.31)	138 (5.43)	73 (2.87)	102 (4.02)	102 (4.02)	-	260 (10.24)	248 (9.76)	6 (0.24)	40 (1.57)	1.5 (0.06)	-	1.6 (0.06)	5 (0.20)	M5	4.4 (9.70)
2018		140 (5.51)	300 (11.81)	211 (8.31)	138 (5.43)	73 (2.87)	102 (4.02)	102 (4.02)	-	260 (10.24)	248 (9.76)	6 (0.24)	40 (1.57)	1.5 (0.06)	-	1.6 (0.06)	5 (0.20)	M5	4.4 (9.70)
2025		140 (5.51)	300 (11.81)	211 (8.31)	138 (5.43)	73 (2.87)	102 (4.02)	102 (4.02)	-	260 (10.24)	248 (9.76)	6 (0.24)	40 (1.57)	1.5 (0.06)	-	1.6 (0.06)	5 (0.20)	M5	4.8 (10.58)
2033		140 (5.51)	300 (11.81)	211 (8.31)	138 (5.43)	73 (2.87)	102 (4.02)	102 (4.02)	-	260 (10.24)	248 (9.76)	6 (0.24)	40 (1.57)	1.5 (0.06)	-	1.6 (0.06)	5 (0.20)	M5	4.8 (10.58)
2047	Figure 9.11	180 (7.09)	340 (13.39)	202 (7.95)	134 (5.28)	68 (2.68)	140 (5.51)	140 (5.51)	-	300 (11.81)	284 (11.18)	8 (0.32)	40 (1.57)	1.5 (0.06)	-	1.6 (0.06)	1.6 (0.06)	M5	7 (15.43)
2060	Figure 9.12	220 (8.66)	400 (15.75)	227 (8.94)	140 (5.51)	87 (3.43)	192 (7.56)	192 (7.56)	-	350 (13.78)	335 (13.19)	8 (0.32)	50 (1.97)	1.5 (0.06)	-	2.3 (0.09)	2.3 (0.09)	M6	9 (19.84)
2075		220 (8.66)	435 (17.13)	227 (8.94)	140 (5.51)	87 (3.43)	192 (7.56)	192 (7.56)	-	350 (13.78)	335 (13.19)	8 (0.32)	85 (3.35)	1.5 (0.06)	-	2.3 (0.09)	2.3 (0.09)	M6	10.5 (23.15)

Model	Exterior and Mounting Dimensions	Dimensions mm (in)																	Est. Weight kg (lb)
		W	H	D	D1	D2	W1	W2	W3 (Maximum)	H0	H1	H2	H3	H4	H5	t1	t2	d	
2088	Figure 9.13	244 (9.61)	500 (19.69)	280 (11.02)	166 (6.54)	114 (4.49)	195 (7.68)	186 (7.32)	10 (0.39)	400 (15.75)	375 (14.76)	17.5 (0.69)	100 (3.94)	-	17.5 (0.69)	2.3 (0.09)	2.3 (0.09)	M6	20 (44.10)
2115	Figure 9.14	259 (10.20)	580 (22.83)	280 (11.02)	166 (6.54)	114 (4.49)	170 (6.69)	165 (6.50)	10 (0.39)	450 (17.72)	424 (16.69)	16 (0.63)	130 (5.12)	-	21 (0.83)	2.3 (0.09)	2.3 (0.09)	M6	24 (52.92)
2145	Figure 9.15	268 (10.55)	700 (27.56)	335 (13.19)	186 (7.32)	149 (5.87)	190 (7.48)	182 (7.17)	10 (0.39)	543 (21.38)	516 (20.31)	17.5 (0.69)	157 (6.18)	-	20.5 (0.81)	2.3 (0.09)	2.3 (0.09)	M8	39 (86.00)
2180		268 (10.55)	770 (30.31)	335 (13.19)	186 (7.32)	149 (5.87)	190 (7.48)	182 (7.17)	10 (0.39)	543 (21.38)	516 (20.31)	17.5 (0.69)	227 (8.94)	-	20.5 (0.81)	2.3 (0.09)	2.3 (0.09)	M8	41 (90.41)
2215	Figure 9.16	316 (12.44)	915 (36.02)	420 (16.54)	260 (10.24)	160 (6.30)	218 (8.58)	218 (8.58)	16 (0.63)	700 (27.56)	659 (25.94)	28 (1.10)	215 (8.46)	-	28.5 (1.12)	4.5 (0.18)	4.5 (0.18)	M10	63 (138.92)
2283		316 (12.44)	915 (36.02)	420 (16.54)	260 (10.24)	160 (6.30)	218 (8.58)	218 (8.58)	16 (0.63)	700 (27.56)	659 (25.94)	28 (1.10)	215 (8.46)	-	28.5 (1.12)	4.5 (0.18)	4.5 (0.18)	M10	66 (145.53)
2346	Figure 9.17	444 (17.48)	1045 (41.14)	472 (18.58)	254 (10.00)	218 (8.58)	370 (14.57)	370 (14.57)	18 (0.71)	800 (31.50)	757 (29.80)	28 (1.10)	245 (9.65)	-	30 (1.18)	4.5 (0.18)	4.5 (0.18)	M12	109 (240.35)

Table 9.17 200 V Class (IP20/UL Type 1, with Internal EMC Filter)

Model	Exterior and Mounting Dimensions	Dimensions mm (in)																	Est. Weight kg (lb)
		W	H	D	D1	D2	W1	W2	W3 (Maximum)	H0	H1	H2	H3	H4	H5	t1	t2	d	
2003	Figure 9.10	140 (5.51)	300 (11.81)	176 (6.93)	138 (5.43)	38 (1.50)	102 (4.02)	102 (4.02)	-	260 (10.24)	248 (9.76)	6 (0.24)	40 (1.57)	1.5 (0.06)	-	1.6 (0.06)	5 (0.20)	M5	4.1 (9.04)
2005		140 (5.51)	300 (11.81)	176 (6.93)	138 (5.43)	38 (1.50)	102 (4.02)	102 (4.02)	-	260 (10.24)	248 (9.76)	6 (0.24)	40 (1.57)	1.5 (0.06)	-	1.6 (0.06)	5 (0.20)	M5	4.1 (9.04)
2008		140 (5.51)	300 (11.81)	176 (6.93)	138 (5.43)	38 (1.50)	102 (4.02)	102 (4.02)	-	260 (10.24)	248 (9.76)	6 (0.24)	40 (1.57)	1.5 (0.06)	-	1.6 (0.06)	5 (0.20)	M5	4.1 (9.04)
2011		140 (5.51)	300 (11.81)	176 (6.93)	138 (5.43)	38 (1.50)	102 (4.02)	102 (4.02)	-	260 (10.24)	248 (9.76)	6 (0.24)	40 (1.57)	1.5 (0.06)	-	1.6 (0.06)	5 (0.20)	M5	4.1 (9.04)
2014		140 (5.51)	300 (11.81)	211 (8.31)	138 (5.43)	73 (2.87)	102 (4.02)	102 (4.02)	-	260 (10.24)	248 (9.76)	6 (0.24)	40 (1.57)	1.5 (0.06)	-	1.6 (0.06)	5 (0.20)	M5	4.4 (9.70)
2018		140 (5.51)	300 (11.81)	211 (8.31)	138 (5.43)	73 (2.87)	102 (4.02)	102 (4.02)	-	260 (10.24)	248 (9.76)	6 (0.24)	40 (1.57)	1.5 (0.06)	-	1.6 (0.06)	5 (0.20)	M5	4.4 (9.70)
2025		140 (5.51)	300 (11.81)	211 (8.31)	138 (5.43)	73 (2.87)	102 (4.02)	102 (4.02)	-	260 (10.24)	248 (9.76)	6 (0.24)	40 (1.57)	1.5 (0.06)	-	1.6 (0.06)	5 (0.20)	M5	4.8 (10.58)
2033		140 (5.51)	300 (11.81)	211 (8.31)	138 (5.43)	73 (2.87)	102 (4.02)	102 (4.02)	-	260 (10.24)	248 (9.76)	6 (0.24)	40 (1.57)	1.5 (0.06)	-	1.6 (0.06)	5 (0.20)	M5	4.8 (10.58)
2047	Figure 9.11	180 (7.09)	340 (13.39)	202 (7.95)	134 (5.28)	68 (2.68)	140 (5.51)	140 (5.51)	-	300 (11.81)	284 (11.18)	8 (0.32)	40 (1.57)	1.5 (0.06)	-	1.6 (0.06)	1.6 (0.06)	M5	7 (15.43)
2060	Figure 9.12	220 (8.66)	400 (15.75)	227 (8.94)	140 (5.51)	87 (3.43)	192 (7.56)	192 (7.56)	-	350 (13.78)	335 (13.19)	8 (0.32)	50 (1.97)	1.5 (0.06)	-	2.3 (0.09)	2.3 (0.09)	M6	9 (19.84)
2075		220 (8.66)	435 (17.13)	227 (8.94)	140 (5.51)	87 (3.43)	192 (7.56)	192 (7.56)	-	350 (13.78)	335 (13.19)	8 (0.32)	85 (3.35)	1.5 (0.06)	-	2.3 (0.09)	2.3 (0.09)	M6	10.5 (23.15)
2088	Figure 9.13	244 (9.61)	500 (19.69)	280 (11.02)	166 (6.54)	114 (4.49)	195 (7.68)	186 (7.32)	10 (0.39)	400 (15.75)	375 (14.76)	17.5 (0.69)	100 (3.94)	-	17.5 (0.69)	2.3 (0.09)	2.3 (0.09)	M6	21 (46.31)

Model	Exterior and Mounting Dimensions	Dimensions mm (in)																	Est. Weight kg (lb)
		W	H	D	D1	D2	W1	W2	W3 (Maximum)	H0	H1	H2	H3	H4	H5	t1	t2	d	
2115	Figure 9.14	259 (10.20)	580 (22.83)	280 (11.02)	166 (6.54)	114 (4.49)	170 (6.69)	165 (6.50)	10 (0.39)	450 (17.72)	424 (16.69)	16 (0.63)	130 (5.12)	-	21 (0.83)	2.3 (0.09)	2.3 (0.09)	M6	25 (55.13)
2145	Figure 9.15	268 (10.55)	700 (27.56)	335 (13.19)	186 (7.32)	149 (5.87)	190 (7.48)	182 (7.17)	10 (0.39)	543 (21.38)	516 (20.31)	17.5 (0.69)	157 (6.18)	-	20.5 (0.81)	2.3 (0.09)	2.3 (0.09)	M8	40 (88.20)
2180		268 (10.55)	770 (30.31)	335 (13.19)	186 (7.32)	149 (5.87)	190 (7.48)	182 (7.17)	10 (0.39)	543 (21.38)	516 (20.31)	17.5 (0.69)	227 (8.94)	-	20.5 (0.81)	2.3 (0.09)	2.3 (0.09)	M8	42 (92.61)
2215	Figure 9.16	316 (12.44)	915 (36.02)	420 (16.54)	260 (10.24)	160 (6.30)	218 (8.58)	218 (8.58)	16 (0.63)	700 (27.56)	659 (25.94)	28 (1.10)	215 (8.46)	-	28.5 (1.12)	4.5 (0.18)	4.5 (0.18)	M10	64 (141.12)
2283		316 (12.44)	915 (36.02)	420 (16.54)	260 (10.24)	160 (6.30)	218 (8.58)	218 (8.58)	16 (0.63)	700 (27.56)	659 (25.94)	28 (1.10)	215 (8.46)	-	28.5 (1.12)	4.5 (0.18)	4.5 (0.18)	M10	66 (145.53)
2346	Figure 9.17	444 (17.48)	1045 (41.14)	472 (18.58)	254 (10.00)	218 (8.58)	370 (14.57)	370 (14.57)	18 (0.71)	800 (31.50)	757 (29.80)	28 (1.10)	245 (9.65)	-	30 (1.18)	4.5 (0.18)	4.5 (0.18)	M12	115 (253.58)

Table 9.18 400 V Class (IP20/UL Type 1, No Internal EMC Filter)

Model	Exterior and Mounting Dimensions	Dimensions mm (in)																	Est. Weight kg (lb)
		W	H	D	D1	D2	W1	W2	W3 (Maximum)	H0	H1	H2	H3	H4	H5	t1	t2	d	
4002	Figure 9.10	140 (5.51)	300 (11.81)	176 (6.93)	138 (5.43)	38 (1.50)	102 (4.02)	102 (4.02)	-	260 (10.24)	248 (9.76)	6 (0.24)	40 (1.57)	1.5 (0.06)	-	1.6 (0.06)	5 (0.20)	M5	4.0 (8.82)
4003		140 (5.51)	300 (11.81)	176 (6.93)	138 (5.43)	38 (1.50)	102 (4.02)	102 (4.02)	-	260 (10.24)	248 (9.76)	6 (0.24)	40 (1.57)	1.5 (0.06)	-	1.6 (0.06)	5 (0.20)	M5	4.0 (8.82)
4005		140 (5.51)	300 (11.81)	176 (6.93)	138 (5.43)	38 (1.50)	102 (4.02)	102 (4.02)	-	260 (10.24)	248 (9.76)	6 (0.24)	40 (1.57)	1.5 (0.06)	-	1.6 (0.06)	5 (0.20)	M5	4.0 (8.82)
4006		140 (5.51)	300 (11.81)	211 (8.31)	138 (5.43)	73 (2.87)	102 (4.02)	102 (4.02)	-	260 (10.24)	248 (9.76)	6 (0.24)	40 (1.57)	1.5 (0.06)	-	1.6 (0.06)	5 (0.20)	M5	4.3 (9.48)
4007		140 (5.51)	300 (11.81)	211 (8.31)	138 (5.43)	73 (2.87)	102 (4.02)	102 (4.02)	-	260 (10.24)	248 (9.76)	6 (0.24)	40 (1.57)	1.5 (0.06)	-	1.6 (0.06)	5 (0.20)	M5	4.3 (9.48)
4009		140 (5.51)	300 (11.81)	211 (8.31)	138 (5.43)	73 (2.87)	102 (4.02)	102 (4.02)	-	260 (10.24)	248 (9.76)	6 (0.24)	40 (1.57)	1.5 (0.06)	-	1.6 (0.06)	5 (0.20)	M5	4.3 (9.48)
4015		140 (5.51)	300 (11.81)	211 (8.31)	138 (5.43)	73 (2.87)	102 (4.02)	102 (4.02)	-	260 (10.24)	248 (9.76)	6 (0.24)	40 (1.57)	1.5 (0.06)	-	1.6 (0.06)	5 (0.20)	M5	4.6 (10.14)
4018		140 (5.51)	300 (11.81)	211 (8.31)	138 (5.43)	73 (2.87)	102 (4.02)	102 (4.02)	-	260 (10.24)	248 (9.76)	6 (0.24)	40 (1.57)	1.5 (0.06)	-	1.6 (0.06)	5 (0.20)	M5	4.6 (10.14)
4024	Figure 9.11	180 (7.09)	340 (13.39)	202 (7.95)	134 (5.28)	68 (2.68)	140 (5.51)	140 (5.51)	-	300 (11.81)	284 (11.18)	8 (0.32)	40 (1.57)	1.5 (0.06)	-	1.6 (0.06)	1.6 (0.06)	M5	6.5 (14.33)
4031		180 (7.09)	340 (13.39)	202 (7.95)	134 (5.28)	68 (2.68)	140 (5.51)	140 (5.51)	-	300 (11.81)	284 (11.18)	8 (0.32)	40 (1.57)	1.5 (0.06)	-	1.6 (0.06)	1.6 (0.06)	M5	6.5 (14.33)
4039	Figure 9.12	220 (8.66)	400 (15.75)	227 (8.94)	140 (5.51)	87 (3.43)	192 (7.56)	192 (7.56)	-	350 (13.78)	335 (13.19)	8 (0.32)	50 (1.97)	1.5 (0.06)	-	2.3 (0.09)	2.3 (0.09)	M6	9.0 (19.85)
4045		220 (8.66)	400 (15.75)	246 (9.69)	140 (5.51)	106 (4.17)	192 (7.56)	192 (7.56)	-	350 (13.78)	335 (13.19)	8 (0.32)	50 (1.97)	1.5 (0.06)	-	2.3 (0.09)	2.3 (0.09)	M6	14 (30.87)
4060	Figure 9.13	244 (9.61)	500 (19.69)	280 (11.02)	166 (6.54)	114 (4.49)	195 (7.68)	186 (7.32)	10 (0.39)	400 (15.75)	375 (14.76)	17.5 (0.69)	100 (3.94)	-	17.5 (0.69)	2.3 (0.09)	2.3 (0.09)	M6	18 (39.69)
4075	Figure 9.14	259 (10.20)	580 (22.83)	280 (11.02)	166 (6.54)	114 (4.49)	170 (6.69)	165 (6.50)	10 (0.39)	450 (17.72)	424 (16.69)	16 (0.63)	130 (5.12)	-	21 (0.83)	2.3 (0.09)	2.3 (0.09)	M6	23 (50.72)
4091		259 (10.20)	580 (22.83)	280 (11.02)	166 (6.54)	114 (4.49)	170 (6.69)	165 (6.50)	10 (0.39)	450 (17.72)	424 (16.69)	16 (0.63)	130 (5.12)	-	21 (0.83)	2.3 (0.09)	2.3 (0.09)	M6	28 (61.74)

Model	Exterior and Mounting Dimensions	Dimensions mm (in)																	Est. Weight kg (lb)
		W	H	D	D1	D2	W1	W2	W3 (Maximum)	H0	H1	H2	H3	H4	H5	t1	t2	d	
4112	Figure 9.15	268 (10.55)	700 (27.56)	335 (13.19)	186 (7.32)	149 (5.87)	190 (7.48)	182 (7.17)	10 (0.39)	543 (21.38)	516 (20.31)	17.5 (0.69)	157 (6.18)	-	20.5 (0.81)	2.3 (0.09)	2.3 (0.09)	M8	41 (90.41)
4150		268 (10.55)	700 (27.56)	335 (13.19)	186 (7.32)	149 (5.87)	190 (7.48)	182 (7.17)	10 (0.39)	543 (21.38)	516 (20.31)	17.5 (0.69)	157 (6.18)	-	20.5 (0.81)	2.3 (0.09)	2.3 (0.09)	M8	42 (92.61)
4180	Figure 9.16	316 (12.44)	915 (36.02)	420 (16.54)	260 (10.24)	160 (6.30)	218 (8.58)	218 (8.58)	16 (0.63)	700 (27.56)	659 (25.94)	28 (1.10)	215 (8.46)	-	28.5 (1.12)	4.5 (0.18)	4.5 (0.18)	M10	65 (143.33)
4216		316 (12.44)	915 (36.02)	420 (16.54)	260 (10.24)	160 (6.30)	218 (8.58)	218 (8.58)	16 (0.63)	700 (27.56)	659 (25.94)	28 (1.10)	215 (8.46)	-	28.5 (1.12)	4.5 (0.18)	4.5 (0.18)	M10	67 (147.74)
4260		316 (12.44)	915 (36.02)	420 (16.54)	260 (10.24)	160 (6.30)	218 (8.58)	218 (8.58)	16 (0.63)	700 (27.56)	659 (25.94)	28 (1.10)	215 (8.46)	-	28.5 (1.12)	4.5 (0.18)	4.5 (0.18)	M10	70 (154.35)
4304	Figure 9.17	444 (17.48)	1045 (41.14)	472 (18.58)	254 (10.00)	218 (8.58)	370 (14.57)	370 (14.57)	18 (0.71)	800 (31.50)	757 (29.80)	28 (1.10)	245 (9.65)	-	30 (1.18)	4.5 (0.18)	4.5 (0.18)	M12	114 (251.37)

Table 9.19 400 V Class (IP20/UL Type 1, with Internal EMC Filter)

Model	Exterior and Mounting Dimensions	Dimensions mm (in)																	Est. Weight kg (lb)
		W	H	D	D1	D2	W1	W2	W3 (Maximum)	H0	H1	H2	H3	H4	H5	t1	t2	d	
4002	Figure 9.10	140 (5.51)	300 (11.81)	176 (6.93)	138 (5.43)	38 (1.50)	102 (4.02)	102 (4.02)	-	260 (10.24)	248 (9.76)	6 (0.24)	40 (1.57)	1.5 (0.06)	-	1.6 (0.06)	5 (0.20)	M5	4.0 (8.82)
4003		140 (5.51)	300 (11.81)	176 (6.93)	138 (5.43)	38 (1.50)	102 (4.02)	102 (4.02)	-	260 (10.24)	248 (9.76)	6 (0.24)	40 (1.57)	1.5 (0.06)	-	1.6 (0.06)	5 (0.20)	M5	4.0 (8.82)
4005		140 (5.51)	300 (11.81)	176 (6.93)	138 (5.43)	38 (1.50)	102 (4.02)	102 (4.02)	-	260 (10.24)	248 (9.76)	6 (0.24)	40 (1.57)	1.5 (0.06)	-	1.6 (0.06)	5 (0.20)	M5	4.0 (8.82)
4006		140 (5.51)	300 (11.81)	211 (8.31)	138 (5.43)	73 (2.87)	102 (4.02)	102 (4.02)	-	260 (10.24)	248 (9.76)	6 (0.24)	40 (1.57)	1.5 (0.06)	-	1.6 (0.06)	5 (0.20)	M5	4.3 (9.48)
4007		140 (5.51)	300 (11.81)	211 (8.31)	138 (5.43)	73 (2.87)	102 (4.02)	102 (4.02)	-	260 (10.24)	248 (9.76)	6 (0.24)	40 (1.57)	1.5 (0.06)	-	1.6 (0.06)	5 (0.20)	M5	4.3 (9.48)
4009		140 (5.51)	300 (11.81)	211 (8.31)	138 (5.43)	73 (2.87)	102 (4.02)	102 (4.02)	-	260 (10.24)	248 (9.76)	6 (0.24)	40 (1.57)	1.5 (0.06)	-	1.6 (0.06)	5 (0.20)	M5	4.3 (9.48)
4015		140 (5.51)	300 (11.81)	211 (8.31)	138 (5.43)	73 (2.87)	102 (4.02)	102 (4.02)	-	260 (10.24)	248 (9.76)	6 (0.24)	40 (1.57)	1.5 (0.06)	-	1.6 (0.06)	5 (0.20)	M5	4.6 (10.14)
4018		140 (5.51)	300 (11.81)	211 (8.31)	138 (5.43)	73 (2.87)	102 (4.02)	102 (4.02)	-	260 (10.24)	248 (9.76)	6 (0.24)	40 (1.57)	1.5 (0.06)	-	1.6 (0.06)	5 (0.20)	M5	4.6 (10.14)
4024	Figure 9.11	180 (7.09)	340 (13.39)	202 (7.95)	134 (5.28)	68 (2.68)	140 (5.51)	140 (5.51)	-	300 (11.81)	284 (11.18)	8 (0.32)	40 (1.57)	1.5 (0.06)	-	1.6 (0.06)	1.6 (0.06)	M5	6.5 (14.33)
4031		180 (7.09)	340 (13.39)	202 (7.95)	134 (5.28)	68 (2.68)	140 (5.51)	140 (5.51)	-	300 (11.81)	284 (11.18)	8 (0.32)	40 (1.57)	1.5 (0.06)	-	1.6 (0.06)	1.6 (0.06)	M5	6.5 (14.33)
4039	Figure 9.12	220 (8.66)	400 (15.75)	227 (8.94)	140 (5.51)	87 (3.43)	192 (7.56)	192 (7.56)	-	350 (13.78)	335 (13.19)	8 (0.32)	50 (1.97)	1.5 (0.06)	-	2.3 (0.09)	2.3 (0.09)	M6	9.0 (19.85)
4045		220 (8.66)	400 (15.75)	246 (9.69)	140 (5.51)	106 (4.17)	192 (7.56)	192 (7.56)	-	350 (13.78)	335 (13.19)	8 (0.32)	50 (1.97)	1.5 (0.06)	-	2.3 (0.09)	2.3 (0.09)	M6	14 (30.87)
4060	Figure 9.13	244 (9.61)	500 (19.69)	280 (11.02)	166 (6.54)	114 (4.49)	195 (7.68)	186 (7.32)	10 (0.39)	400 (15.75)	375 (14.76)	17.5 (0.69)	100 (3.94)	-	17.5 (0.69)	2.3 (0.09)	2.3 (0.09)	M6	18 (39.69)
4075	Figure 9.14	259 (10.20)	580 (22.83)	280 (11.02)	166 (6.54)	114 (4.49)	170 (6.69)	165 (6.50)	10 (0.39)	450 (17.72)	424 (16.69)	16 (0.63)	130 (5.12)	-	21 (0.83)	2.3 (0.09)	2.3 (0.09)	M6	24 (52.92)
4091		259 (10.20)	580 (22.83)	280 (11.02)	166 (6.54)	114 (4.49)	170 (6.69)	165 (6.50)	10 (0.39)	450 (17.72)	424 (16.69)	16 (0.63)	130 (5.12)	-	21 (0.83)	2.3 (0.09)	2.3 (0.09)	M6	29 (63.95)

Model	Exterior and Mounting Dimensions	Dimensions mm (in)																	Est. Weight kg (lb)
		W	H	D	D1	D2	W1	W2	W3 (Maximum)	H0	H1	H2	H3	H4	H5	t1	t2	d	
4112	Figure 9.15	268 (10.55)	700 (27.56)	335 (13.19)	186 (7.32)	149 (5.87)	190 (7.48)	182 (7.17)	10 (0.39)	543 (21.38)	516 (20.31)	17.5 (0.69)	157 (6.18)	-	20.5 (0.81)	2.3 (0.09)	2.3 (0.09)	M8	42 (92.61)
4150		268 (10.55)	700 (27.56)	335 (13.19)	186 (7.32)	149 (5.87)	190 (7.48)	182 (7.17)	10 (0.39)	543 (21.38)	516 (20.31)	17.5 (0.69)	157 (6.18)	-	20.5 (0.81)	2.3 (0.09)	2.3 (0.09)	M8	43 (94.82)
4180	Figure 9.16	316 (12.44)	915 (36.02)	420 (16.54)	260 (10.24)	160 (6.30)	218 (8.58)	218 (8.58)	16 (0.63)	700 (27.56)	659 (25.94)	28 (1.10)	215 (8.46)	-	28.5 (1.12)	4.5 (0.18)	4.5 (0.18)	M10	66 (145.53)
4216		316 (12.44)	915 (36.02)	420 (16.54)	260 (10.24)	160 (6.30)	218 (8.58)	218 (8.58)	16 (0.63)	700 (27.56)	659 (25.94)	28 (1.10)	215 (8.46)	-	28.5 (1.12)	4.5 (0.18)	4.5 (0.18)	M10	68 (149.94)
4260		316 (12.44)	915 (36.02)	420 (16.54)	260 (10.24)	160 (6.30)	218 (8.58)	218 (8.58)	16 (0.63)	700 (27.56)	659 (25.94)	28 (1.10)	215 (8.46)	-	28.5 (1.12)	4.5 (0.18)	4.5 (0.18)	M10	71 (156.56)
4304	Figure 9.17	444 (17.48)	1045 (41.14)	472 (18.58)	254 (10.00)	218 (8.58)	370 (14.57)	370 (14.57)	18 (0.71)	800 (31.50)	757 (29.80)	28 (1.10)	245 (9.65)	-	30 (1.18)	4.5 (0.18)	4.5 (0.18)	M12	119 (262.40)

9.7 Knock-out Hole Dimensions (UL Type 1)

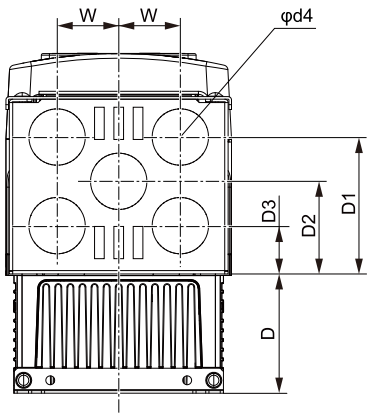

Figure 9.18 Exterior and Mounting Dimensions Diagram 1 (Models: 2003 to 2033 and 4002 to 4018)

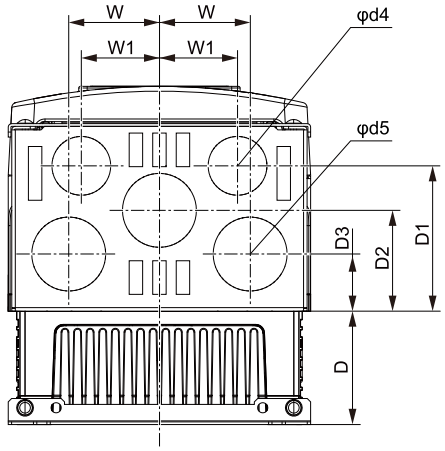

Figure 9.19 Exterior and Mounting Dimensions Diagram 2 (Models: 2047, 4024, and 4031)

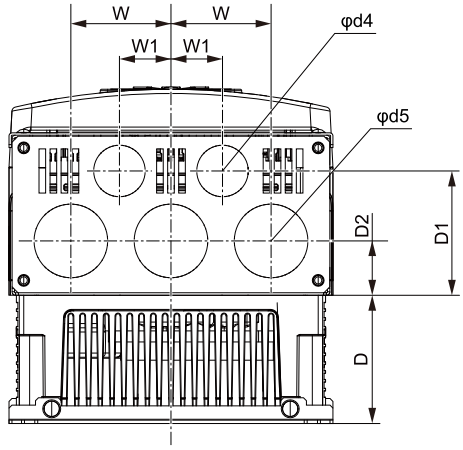

Figure 9.20 Exterior and Mounting Dimensions Diagram 3 (Models: 2060, 2075, 4039, and 4045)

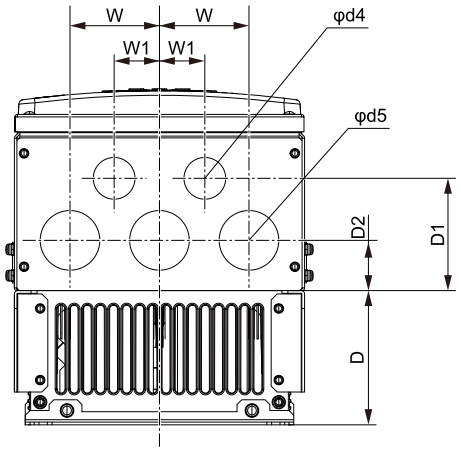

Figure 9.21 Exterior and Mounting Dimensions Diagram 4 (Models: 2088 and 4060)

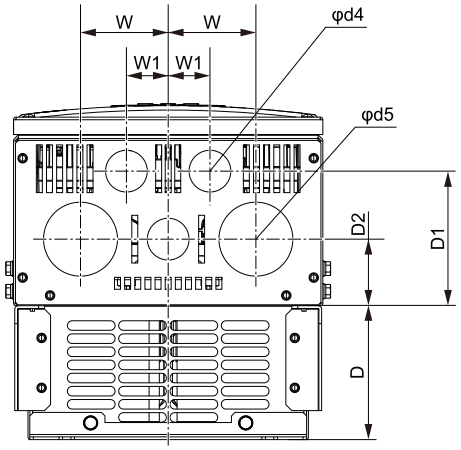

Figure 9.22 Exterior and Mounting Dimensions Diagram 5 (Models: 2115, 4075, and 4091)

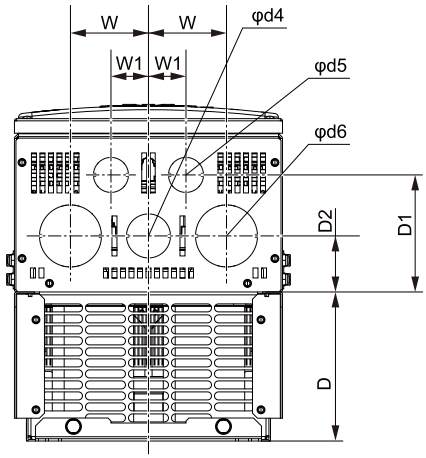

Figure 9.23 Exterior and Mounting Dimensions Diagram 6 (Models: 2145, 4112, and 4150)

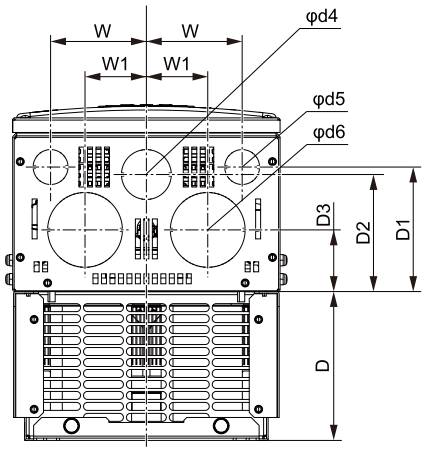

Figure 9.24 Exterior and Mounting Dimensions Diagram 7 (Models: 2180)

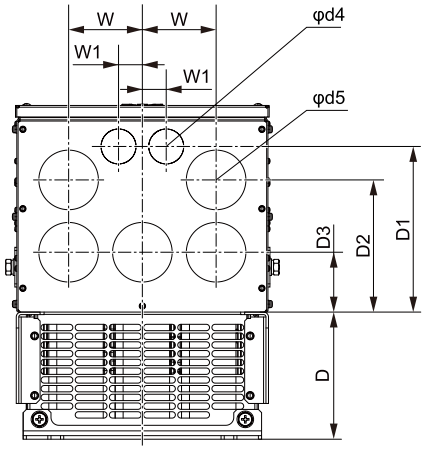

Figure 9.25 Exterior and Mounting Dimensions Diagram 8 (Models: 2215, 2283, 4180, 4216, and 4260)

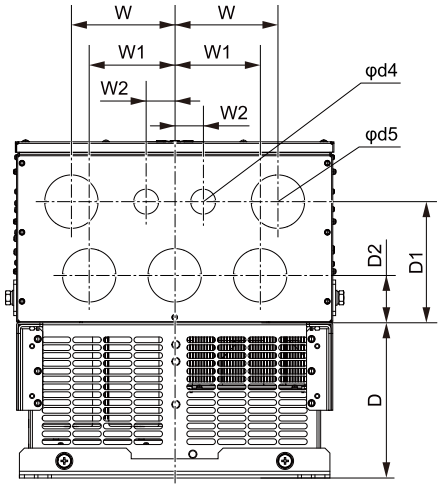

Figure 9.26 Exterior and Mounting Dimensions Diagram 9 (Models: 2346 and 4304)

Model	Diagram	Dimensions mm (in.)									
		D	D1	D2	D3	W	W1	W2	φd4	φd5	φd6
2003 to 2011 4002 to 4005	Figure 9.18	39 (1.54)	85 (3.35)	57.5 (2.26)	30 (1.18)	38.2 (1.50)	-	-	35 (1.38)	-	-
2014 to 2033 4006 to 4018		74 (2.91)	85 (3.35)	57.5 (2.26)	30 (1.18)	38.2 (1.50)	-	-	35 (1.38)	-	-
2047 4024, 4031	Figure 9.19	67.5 (2.66)	86.5 (3.41)	60 (2.36)	34 (1.34)	54 (2.13)	46.5 (1.83)	-	35 (1.38)	44 (1.73)	-

Model	Diagram	Dimensions mm (in.)									
		D	D1	D2	D3	W	W1	W2	φd4	φd5	φd6
2060, 2075 4039	Figure 9.20	87.2 (3.43)	84.3 (3.32)	36.8 (1.45)	-	68 (2.68)	35 (1.38)	-	35 (1.38)	50 (1.97)	-
4045		106.2 (4.18)	84.3 (3.32)	36.8 (1.45)	-	68 (2.68)	35 (1.38)	-	35 (1.38)	50 (1.97)	-
2088 4060	Figure 9.21	112.5 (4.43)	96 (3.78)	48.5 (1.91)	-	73 (2.87)	38 (1.50)	-	35 (1.38)	50 (1.97)	-
2115 4075, 4091	Figure 9.22	112.4 (4.43)	112.8 (4.44)	55.8 (2.20)	-	73.5 (2.89)	35 (1.38)	-	35 (1.38)	62 (2.44)	-
2145 4112, 4150	Figure 9.23	149 (5.87)	117 (4.61)	56 (2.20)	-	78 (3.07)	37.5 (1.48)	-	44 (1.73)	35 (1.38)	62 (2.44)
2180	Figure 9.24	149 (5.87)	124.8 (4.91)	117.3 (4.62)	61.8 (2.43)	96 (3.78)	61.5 (2.42)	-	50 (1.97)	35 (1.38)	75 (2.95)
2215, 2283 4180, 4216, 4260	Figure 9.25	160 (6.30)	208.4 (8.20)	166.3 (6.55)	75.3 (2.96)	92.8 (3.65)	27.5 (1.08)	-	35 (1.38)	62 (2.44)	-
2346 4304	Figure 9.26	218 (8.58)	170 (6.69)	66.6 (2.62)	-	145 (5.71)	40 (1.57)	120 (4.72)	35 (1.38)	75 (2.95)	-

9.8 Peripheral Devices and Options

The following tables show the available peripheral devices and options for the drive. Contact Yaskawa or your nearest sales representative to place an order.

- Selection: Refer to the drive catalog for information about available products.
- Installation and wiring: Refer to the instruction manual for each option.

Table 9.20 Main Circuit Option

Name	Model	Purpose
DC Reactor	UZDA series	To improve the drive input power factor. • To prevent damage to the drive when the power supply capacity is large. You must only use this option when the power supply capacity is more than 600 kVA. • To decrease harmonic current. • To improve the power supply total power factor.
AC Reactor	UZBA series	To improve the drive input power factor. • To prevent damage to the drive when the power supply capacity is large. You must only use this option when the power supply capacity is more than 600 kVA. • To decrease harmonic current. • To improve the power supply total power factor.
Braking Resistor	ERF-150WJ Series	To decrease the regenerative energy of the motor and decrease the deceleration time (duty cycle of 3% ED). You must also use the installation attachment.
Braking resistor with fuse	CF120-B579 Series	To decrease the regenerative energy of the motor and decrease the deceleration time (duty cycle of 3% ED). You must also use the installation attachment.
Braking Resistor Unit	LKEB series	To decrease the regenerative energy of the motor and decrease the deceleration time (duty cycle of 10% ED). The unit contains a thermal overload relay.
Braking Unit	CDBR series	Use with a braking resistor unit to decrease motor deceleration times.
Molded-Case Circuit Breaker (MCCB)	NF series	To prevent short circuit damage to the power supply system and provide overload protection for wiring.
Earth Leakage Circuit Breaker (ELCB)	NV and NS series	To prevent short circuit damage to the power supply system, provide overload protection for wiring, prevent electrical shock, and provide ground fault protection against earth leakage fires. **Note:** • You can use a molded-case circuit breaker as a replacement for an ELCB that is upstream in the power supply system. • When you use a high frequency ELCB at the power input side of the drive, make sure that each drive has a minimum cumulative sensitivity amperage of 30 mA.
Input Side Magnetic Contactor (MC)	SC series	To prevent burn damage when connecting a braking resistor. This option fully opens the circuit between the power supply and drive.
Surge Protective Device	200 V class: DCR2-xA 400 V class: RFN3AL-504KD	To absorb open/close surges from the magnetic contactor and control relay. You must connect this option to magnetic contactors, control relays, magnetic valves, or magnetic brake coils.
Zero-Phase Reactor	F6045GB F11080GB F200160PB	To decrease wiring noise. You can use this option on the input side and the output side of the drive. **Note:** Install this option around the drive input power system and as near to the drive as possible.
Fuse Fuse Holder	200 V class: CR2LS series, CR2L series, or FWX series 400 V class: CR6L series, CS5F series, or FWH series	To prevent part failure, Yaskawa recommends that you connect a fuse to the input side of the drive.
Input Side Noise Filter	LNFB, LNFD, and FN series	To decrease wiring noise. Install this option around the drive input power system and as near to the drive as possible.
Output Side Noise Filter	LF series	This option decreases noise emitted from wiring for the output side of the drive. Install this option around the drive input power system and as near to the drive as possible.
Capacitor-type Noise Filter	3XYG 1003	To decrease wiring noise. This option can also be used with the zero-phase reactor. **Note:** You must only use this option around the drive input power system. Do not connect this option to the output side.

Table 9.21 Frequency Settings and Monitor Options

Name	Model	Purpose
Frequency Meter and Ammeter	DCF-6A	To use analog signals from the drive to monitor the output frequency and current.
Output Voltmeter	SCF-12NH	To use analog signals from the drive to monitor the output voltage.
Frequency Setting Potentiometer (2 kΩ)	RV30YN20S: 2 kΩ	To use an analog input to set the frequency.
Frequency Meter Scale Correction Resistor (20 kΩ)	RV30YN20S: 20 kΩ	To adjust the frequency scaling.
Control Dial for Frequency Setting Potentiometer	CM-3S	Use this option with the frequency setting potentiometer.

Name	Model	Purpose
Potential Transformer	UPN-B	To adjust the meter voltage.
Scale Plate	NPJT41561-1	Use this option with the frequency setting potentiometer.

Table 9.22 Keypad

Name	Model	Purpose
LED keypad	JVOP-KPLEA04xxx	The display is composed of LEDs. This keypad is used for remote operation. Use connection cables that are 3 m long maximum to connect this keypad for remote operation.
LCD Operator Extension Cable	WV001 WV003	To connect the keypad and drive (1 m or 3 m). This option is an RJ-45, 8-pin straight-through UTP CAT5e cable.
Installation Support Set A	900-192-933-001	To attach the keypad to the control panel. This option uses screws.
Installation Support Set B	900-192-933-002	To attach the keypad to the control panel. This option uses nut clamps. Use this option when weld studs are located in the control panel.

Table 9.23 Attachments

Name	Model	Purpose
External Heatsink Mount Kit	900-193-209-001 900-193-209-002 900-193-209-003	Use this option to install the heatsink outside of the control panel. **Note:** When you use external heatsink mounting, it may be necessary to decrease the current.
UL Type 1 Kit	900-192-121-001 900-192-121-002 900-192-121-003 900-192-121-004 900-192-121-005	To change an open chassis type (IP20) drive to an enclosed wall-mounted type (UL Type 1) drive.
Braking Resistor Installation Attachment	EZZ020805A	To install a braking resistor to a drive.
External Mounting Attachment for Braking Unit Fin	EZZ021711A	To install the heatsink for the braking unit outside of the control panel.

Table 9.24 Engineering Tools

Name	Model	Purpose
	-	To use a PC to set drives and manage parameters.
	-	To use a PC to do advanced drive programming.

Table 9.25 Option PCB

Name	Model	Purpose	Document No.
Complementary Type PG	PG-B3	This option is for use with CLV control and CL-V/f control. The drive detects motor rotation speed from the pulse generator as feedback. The drive can then enable control of the output frequency keep a constant motor speed. • Complementary output PG support • A, B, and Z pulse (Three-phase pulse) input • Maximum input frequency: 50 kHz • Pulse monitor output: Open-collector (24 V, maximum of 30 mA) • Encoder power supply: 12 V, maximum current of 200 mA	TOBPC73060075
Motor PG Feedback Line Driver Interface	PG-X3	This option is for use with CLV control and CL-V/f control. The drive detects motor rotation speed from the pulse generator as feedback. The drive can then enable control of the output frequency keep a constant motor speed. • RS-422 output encoder support • A, B, and Z pulse (differential pulse) input • Maximum input frequency: 300 kHz • Pulse monitor: Equivalent to RS-422 level • Encoder voltage output: 5 V or 12V, maximum current of 200 mA	TOBPC73060076
Resolver Interface	PG-RT3	This option is for use with CLV control. To connect resolvers that are electrically compatible with resolver model TS2640N321E64 from Tamagawa Seiki Co., Ltd. These are the typical electrical characteristics of model TS2640N321E64: • Resolver motor excitation voltage: 10 Vac rms at 10 kHz • Transformation ratio [K]: 0.5 ±5% • Resolver input current: 100 mA rms • Cable length: Up to 10 m (or up to 100 m when using SS5 or SS7 series motors from Yaskawa Motor Co., Ltd. and encoder cables from Yaskawa Controls Co., Ltd.)	TOBPC73060087

Name	Model	Purpose	Document No.
Analog Input	AI-A3	To set very accurate analog references at high resolution. • Input signal level: -10 Vdc to +10 Vdc (20 kΩ) at 4 mA to 20 mA (250 Ω) • Input channel: 3 channels Use a DIP switch to select voltage input or current input. • Input resolution – Voltage input: 13 bits (1/8192) + encoding – Current input: 1/4096	TOBPC73060078
Analog Monitor	AO-A3	To use analog signals to monitor the drive output frequency and output current. • Output resolution: 11 bits (1/2048) + encoding • Output voltage: -10 Vdc to +10 Vdc (non-insulated) • Output channels: 2 channels	TOBPC73060079
Digital Inputs	DI-A3	To use digital speed references and MFDI with a maximum 16 bits of resolution. • Input signals: Binary, 16 bits: BCD4 digits + SIGN signal + SET signal Use parameters to select 6 bits, 8 bits, or 12 bits. • Input voltage: 24 V (insulated) • Input current: 8 mA	TOBPC73060080
Digital Output	DO-A3	To output insulated digital signals and monitor the operation status of the drive (alarm signals and detecting zero speed). Type of output: • Photocoupler relays: 6 channels (48 V, 50 mA maximum) • Relay contact output: 2 channels (250 Vac at 1 A or less, 30 Vdc at 1 A or less)	TOBPC73060081
PROFIBUS-DP	SI-P3	This option uses the host controller over PROFIBUS-DP communication to: • Operate and stop the drive • Set and view parameters • Monitor output frequency, output current, and other statuses	*1
CC-Link	SI-C3	This option uses the host controller over CC-Link communication to: • Operate and stop the drive • Set and view parameters • Monitor output frequency, output current, and other statuses	*1
DeviceNet	SI-N3	This option uses the host controller over DeviceNet communication to: • Operate and stop the drive • Set and view parameters • Monitor output frequency, output current, and other statuses **Note:** The drive is compatible with option software versions 1114 and later.	*1
CANopen	SI-S3	This option uses the host controller over CANopen communication to: • Operate and stop the drive • Set and view parameters • Monitor output frequency, output current, and other statuses	*1
MECHATROLINK-II	SI-T3	This option uses the host controller over MECHATROLINK-II communication to: • Operate and stop the drive • Set and view parameters • Monitor output frequency, output current, and other statuses **Note:** The drive is compatible with option software versions 6108 and later.	*1
MECHATROLINK-III	SI-ET3	This option uses the host controller over MECHATROLINK-III communication to: • Operate and stop the drive • Set and view parameters • Monitor output frequency, output current, and other statuses **Note:** The drive is compatible with option software versions 6202 and later.	*1
EtherNet/IP	SI-EN3	This option uses the host controller over EtherNet/IP communication to: • Operate and stop the drive • Set and view parameters • Monitor output frequency, output current, and other statuses	*1
Modbus TCP/IP	SI-EM3	This option is used to perform the following operations using the host controller over Modbus TCP/IP communication. • Operate and stop the drive • Set and view parameters • Monitor output frequency, output current, and other statuses	*1
PROFINET	SI-EP3	This option uses the host controller over PROFINET communication to: • Operate and stop the drive • Set and view parameters • Monitor output frequency, output current, and other statuses	*1

*1 Contact Yaskawa or your nearest sales representative for details.

Table 9.26 Types of Option Cards and Connectors

Option PCB	Available Connector Ports	Number of Options Permitted
PG-B3, PG-X3	CN5-C (CN5-B)	2 *1
PG-RT3 *2	CN5-C	1
AO-A3, DO-A3	CN5-A, B, and C	1
AI-A3 *3, DI-A3 *3, SI-C3, SI-EM3, SI-EN3, SI-EP3, SI-ET3, SI-N3, SI-P3, SI-S3, SI-T3	CN5-A	1

*1 To connect only one PG option card, use the CN5-C connector. To connect two PG option cards, use the CN5-C and CN5-B connectors.
*2 If you use the motor switching function, you cannot use this option.
*3 To use AI-A3 and DI-A3 input statuses as monitors, connect the option cards to one of CN5-A, CN5-B, or CN5-C. Use U1-21, U1-22, and U1-23 to confirm the AI-A3 input status. Use U1-17 to confirm the DI-A3 input status.

10

Parameter List

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10.1 Section Safety

⚠DANGER

Do not ignore the safety messages in this manual.

If you ignore the safety messages in this manual, it will cause serious injury or death. The manufacturer is not responsible for injuries or damage to equipment.

10.2 How to Read the Parameter List

◆ Icons and Terms that Identify Parameters and Control Methods

The table lists terms and icons.

Icon	Description
V/f	The parameter is available when operating the drive with V/f Control.
CL-V/f	The parameter is available when operating the drive with Closed Loop V/f Control.
OLV	The parameter is available when operating the drive with Open Loop Vector Control.
CLV	The parameter is available when operating the drive with Closed Loop Vector Control.
AOLV	The parameter is available when operating the drive with Advanced Open Loop Vector Control.
Hex.	Hexadecimal numbers that represent MEMOBUS addresses to change parameters over network communication.
RUN	You can change the parameter setting during drive operation.
Expert	The parameter is available in Expert Mode only. *1

*1 Set *A1-01 = 3 [Access Level Selection = Expert Level]* to show and set Expert Mode parameters on the keypad.

Note:
Gray icons identify parameters that are not available in the specified control method.

10.3 Parameter Groups

Represents the type of product parameters.

Parameters	Name
A1	Initialization
A2	User Parameters
b1	Operation Mode Selection
b2	DC Injection Braking
b4	Timer Function
b7	Droop Control
b9	Zero Servo
C1	Accel & Decel Time
C2	S-Curve Characteristics
C3	Slip Compensation
C4	Torque Compensation
C5	Auto Speed Regulator (ASR)
C6	Duty & Carrier Frequency
d1	Frequency Reference
d2	Reference Limits
d3	Jump Frequency
d4	Frequency Ref Up/Down & Hold
d6	Field Forcing
d7	Offset Frequency
E1	V/f Pattern for Motor 1
E2	Motor Parameters
E3	V/f Pattern for Motor 2
E4	Motor 2 Parameters
E7	Motor 3 Parameters
F1	PG Option Setup (Encoder)
F2	Analog Input Option
F3	Digital Input Option
F4	Analog Output Option
F5	Digital Output Option
F6	Communication Options
F7	Ethernet Options
H1	Digital Inputs
H2	Digital Outputs
H3	Analog Inputs
H4	Analog Outputs

Parameters	Name
H5	Modbus Communication
H7	Virtual Inputs / Outputs
L1	Motor Protection
L2	Power Loss Ride Through
L3	Stall Prevention
L4	Speed Detection
L7	Torque Limit
L8	Hardware Protection
L9	Drive Protection 2
n1	Hunting Prevention
n2	Auto Freq Regulator (AFR)
n3	Overexcitation Braking
n4	Adv Open Loop Vector Tune
n5	Feed Forward Control
n6	Online Tuning
o1	Keypad Display
o2	Keypad Operation
o3	Copy Keypad Function
o4	Maintenance Monitors
o5	Log Function
S1	Brake Sequence
S2	Run Cmd Tuning
S3	Impact Stop
S4	Light-load Acceleration
S5	Overload Detection
S6	Overtorque Detection
T0	Tuning Mode Selection
T1	Induction Motor Auto-Tuning
T3	ASR and Inertia Tuning
U1	Operation Status Monitors
U2	Fault Trace
U3	Fault History
U4	Maintenance Monitors
U6	Operation Status Monitors

10.4 A: Initialization Parameters

◆ A1: Initialization

No. (Hex.)	Name	Description	Default (Range)	Ref.
A1-00 (0100) RUN	Language Selection	V/f CL-V/f OLV CLV AOLV Sets the language for the LCD keypad. **Note:** When you use *A1-03 [Initialize Parameters]* to initialize the drive, the drive will not reset this parameter. 0 : English 1 : Japanese 7 : Chinese	0 (0, 1, 7)	569
A1-01 (0101) RUN	Access Level Selection	V/f CL-V/f OLV CLV AOLV Sets user access to parameters. The access level controls the parameters shown on the keypad and which parameters you can set. 0 : Operation Only 1 : User Parameter 2 : Advanced Level 3 : Expert Level	2 (0 - 3)	569
A1-02 (0102)	Control Method Selection	V/f CL-V/f OLV CLV AOLV Sets the control method for the drive application and the motor. 0 : V/f Control 1 : V/f Control with Encoder 2 : Open Loop Vector 3 : Closed Loop Vector 4 : Advanced Open Loop Vector	2 (0 - 4)	570
A1-03 (0103)	Initialize Parameters	V/f CL-V/f OLV CLV AOLV Sets parameters to default values. 0 : No Initialization 1110 : User Initialization 2220 : 2-Wire Initialization	0 (0 - 2220)	570
A1-04 (0104)	Password	V/f CL-V/f OLV CLV AOLV Enter the correct password set in *A1-05 [Password Setting]* to unlock parameters. You can view parameter settings. Monitors are locked Enter the password in *A1-04 [Password]* to unlock and change the settings.	0000 (0000 - 9999)	571
A1-05 (0105)	Password Setting	V/f CL-V/f OLV CLV AOLV Set the password to lock parameters and prevent changes to parameter settings. The following parameters can be changed when the user enters the correct password in *A1-04 [Password]* that matches the password set in *A1-05*.	0000 (0000 - 9999)	572
A1-06 (0127)	Application Preset	V/f CL-V/f OLV CLV AOLV Sets the drive to operate in selected application conditions. 0 : General-purpose 1 : Crane (Hoist) 2 : Crane (Traveling) 3 : Closed Loop Crane (Hoist)	0 (0 - 3)	572
A1-11 (111D) Expert	Firmware Update Lock	V/f CL-V/f OLV CLV AOLV Protects the drive firmware. When you enable the protection, you cannot update the drive firmware. 0 : Disabled 1 : Enabled	0 (0, 1)	582
A1-12 (1564)	Bluetooth ID	V/f CL-V/f OLV CLV AOLV Sets the password necessary to use Bluetooth to control the drive with a smartphone or tablet.	1915 (0000 - 9999)	582
A1-13 (156F)	All Function Parameter Display	V/f CL-V/f OLV CLV AOLV Shows and hides applicable parameters. 0 : Disabled 1 : Enabled	1 (0, 1)	582

◆ A2: User Parameters

No. (Hex.)	Name	Description	Default (Range)	Ref.
A2-01 to A2-32 (0106 - 0125)	User Parameters 1 to 32	V/f CL-V/f OLV CLV AOLV The user can select up to 32 parameters for the drive and assign them to parameters *A2-01 to A2-32*. The [User Parameters] section of the keypad main menu shows the set parameters. You can immediately access these saved parameters. **Note:** When the *A1-06 [Application Preset]* value changes, the settings for *A2-01 to A2-32* change.	Determined by A1-06 (A1-00 to S-xx)	582
A2-33 (0126)	User Parameter Auto Selection	V/f CL-V/f OLV CLV AOLV Sets the automatic save feature for changes to parameters *A2-17 to A2-32 [User Parameters 17 to 32]*. 0 : Disabled: Manual Entry Required 1 : Enabled: Auto Save Recent Parms	1 (0, 1)	583

10.5 b: Application

◆ b1: Operation Mode Selection

No. (Hex.)	Name	Description	Default (Range)	Ref.
b1-01 (0180)	Frequency Reference Selection 1	V/f CL-V/f OLV CLV AOLV Sets the input method for the frequency reference. 0 : Keypad 1 : Analog Input 2 : Memobus/Modbus Communications 3 : Option PCB	0 (0 - 3)	584
b1-02 (0181)	Run Command Selection 1	V/f CL-V/f OLV CLV AOLV Sets the input method for the Run command. 0 : Keypad 1 : Analog Input 2 : Memobus/Modbus Communications 3 : Option PCB	1 (0 - 3)	585
b1-03 (0182)	Stopping Method Selection	V/f CL-V/f OLV CLV AOLV Sets the method to stop the motor after removing a Run command or entering a Stop command. **Note:** When *A1-02 = 3, 4 [Control Method Selection = CLV, AOLV]*, the setting range is 0, 1, 3. 0 : Ramp to Stop 1 : Coast to Stop 2 : DC Injection Braking to Stop 3 : Coast to Stop with Timer	0 (0 - 3)	586
b1-04 (0183)	Reverse Operation Selection	V/f CL-V/f OLV CLV AOLV Sets the reverse operation function. 0 : Reverse Enabled 1 : Reverse Disabled	0 (0, 1)	588
b1-05 (0184)	Operation Below Minimum Freq	V/f CL-V/f OLV CLV AOLV Sets the operation to perform when the frequency reference falls below the value set in *E1-09 [Minimum Output Frequency]*. 0 : Operate at Frequency Reference 1 : Coast to Stop 2 : Operate at Minimum Frequency 3 : Operate at Zero Speed	0 (0 - 3)	589
b1-06 (0185)	Digital Input Reading	V/f CL-V/f OLV CLV AOLV Sets the number of times that the drive reads the sequence input command to prevent malfunction because of electrical interference. 0 : Single Scan 1 : Double Scan	1 (0, 1)	590
b1-14 (01C3)	Phase Order Selection	V/f CL-V/f OLV CLV AOLV Sets the phase order for output terminals U/T1, V/T2, and W/T3. This parameter can align the Forward Run command from the drive and the forward direction of the motor without changing wiring. 0 : Standard 1 : Switch Phase Order	0 (0, 1)	590
b1-15 (01C4)	Frequency Reference Selection 2	V/f CL-V/f OLV CLV AOLV Sets the input method for frequency reference 2. 0 : Keypad 1 : Analog Input 2 : Memobus/Modbus Communications 3 : Option PCB	0 (0 - 3)	590
b1-16 (01C5)	Run Command Selection 2	V/f CL-V/f OLV CLV AOLV Sets the input method for Run Command 2 when the user switches the control circuit terminals ON/OFF to change the Run command source. 0 : Keypad 1 : Analog Input 2 : Memobus/Modbus Communications 3 : Option PCB	0 (0 - 3)	592
b1-17 (01C6)	Run Command at Power Up	V/f CL-V/f OLV CLV AOLV Sets drive response when the CPU changes from de-energized to energized and there is an active Run command. Set this parameter in applications where energizing or de-energizing the drive enables the Run command. 0 : Disregard Existing RUN Command 1 : Accept Existing RUN Command	0 (0, 1)	592

No. (Hex.)	Name	Description	Default (Range)	Ref.
b1-21 (0748) Expert	CLV Start Selection	V/f CL-V/f OLV **CLV** AOLV Sets the conditions for the drive to accept the Run command when the motor speed is at least the setting value of *b2-01* or less than the setting value of *E1-09*. Usually it is not necessary to change this setting. 0 : Reject RUN if b2-01<U1-05<E1-09 1 : Accept RUN Command at Any Speed	0 (0, 1)	593
b1-23 (0B1D)	Selection REV Parameters	**V/f CL-V/f OLV** CLV **AOLV** Sets the operation of reverse parameters. 0 : Disable 1 : Enabled	0 (0, 1)	593
b1-35 (1117) Expert	Digital Input Deadband Time	**V/f CL-V/f OLV CLV AOLV** Sets the deadband time for MFDIs.	0.0 ms (0.0 to 100.0 ms)	593

◆ b2: DC Injection Braking

No. (Hex.)	Name	Description	Default (Range)	Ref.
b2-01 (0189)	DC Injection/Zero SpeedThreshold	**V/f CL-V/f OLV CLV AOLV** Sets the frequency to start DC Circuit Braking and Zero Servo. **Note:** This parameter is available when *b1-03 = 0 [Stopping Method Selection = Ramp to Stop]*.	0.5 (0.0 - 10.0 Hz)	593
b2-02 (018A)	DC Injection Braking Current	**V/f CL-V/f OLV** CLV **AOLV** Sets the DC Injection Braking current as a percentage of the drive rated current.	50% (0 - 100%)	594
b2-03 (018B)	DC Inject Braking Time at Start	**V/f CL-V/f OLV CLV AOLV** Sets the DC Injection Braking Time at stop. Sets the zero speed control at start in CLV.	0.00 s (0.00 - 10.00 s)	594
b2-04 (018C)	DC Inject Braking Time at Stop	**V/f CL-V/f OLV CLV AOLV** Sets the DC Injection Braking Time at stop. Sets the zero speed control at stop in CLV.	Determined by A1-02 (0.00 - 10.00 s)	594
b2-08 (0190)	Magnetic Flux Compensation Value	V/f CL-V/f **OLV** CLV AOLV Sets how much current the drive injects when DC Injection Braking at Start starts (Initial Excitation) as a percentage of *E2-03 [Motor No-Load Current]*.	0% (0 - 1000%)	595

◆ b4: Timer Function

No. (Hex.)	Name	Description	Default (Range)	Ref.
b4-03 (0B30) Expert	Terminal M1-M2 ON-Delay Time	**V/f CL-V/f OLV CLV AOLV** Sets the delay time to activate the contact after the function set in *H2-01* activates.	0 ms (0 - 65000 ms)	596
b4-04 (0B31) Expert	Terminal M1-M2 OFF-Delay Time	**V/f CL-V/f OLV CLV AOLV** Sets the delay time to deactivate the contact after the function set in *H2-01* deactivates.	0 ms (0 - 65000 ms)	596
b4-05 (0B32) Expert	Terminal M3-M4 ON-Delay Time	**V/f CL-V/f OLV CLV AOLV** Sets the delay time to activate the contact after the function set in *H2-02* activates.	0 ms (0 - 65000 ms)	596
b4-06 (0B33) Expert	Terminal M3-M4 OFF-Delay Time	**V/f CL-V/f OLV CLV AOLV** Sets the delay time to deactivate the contact after the function set in *H2-02* deactivates.	0 ms (0 - 65000 ms)	596
b4-07 (0B34) Expert	Terminal P2 ON-Delay Time	**V/f CL-V/f OLV CLV AOLV** Sets the delay time to activate the contact after the function set in *H2-03* activates.	0 ms (0 - 65000 ms)	596
b4-08 (0B35) Expert	Terminal P2 OFF-Delay Time	**V/f CL-V/f OLV CLV AOLV** Sets the delay time to deactivate the contact after the function set in *H2-03* deactivates.	0 ms (0 - 65000 ms)	596
b4-09 (0B36) Expert	Terminal P2-C2 ON-Delay Time	**V/f CL-V/f OLV CLV AOLV** Sets the delay time to activate the contact after the function set in *H2-04* activates.	0 ms (0 - 65000 ms)	596
b4-10 (0B37) Expert	Terminal P2-C2 OFF-Delay Time	**V/f CL-V/f OLV CLV AOLV** Sets the delay time to deactivate the contact after the function set in *H2-04* deactivates.	0 ms (0 - 65000 ms)	596

No. (Hex.)	Name	Description	Default (Range)	Ref.
b4-11 (0B38) Expert	Terminal P2-C2 ON-Delay Time	V/f CL-V/f OLV CLV AOLV Sets the delay time to activate the contact after the function set in *H2-05* activates.	0 ms (0 - 65000 ms)	597
b4-12 (0B39) Expert	Terminal P2-C2 OFF-Delay Time	V/f CL-V/f OLV CLV AOLV Sets the delay time to deactivate the contact after the function set in *H2-05* deactivates.	0 ms (0 - 65000 ms)	597

◆ b7: Droop Control

No. (Hex.)	Name	Description	Default (Range)	Ref.
b7-01 (01CA) RUN	Droop Control Gain	V/f CL-V/f OLV CLV AOLV Sets the amount of deceleration when the torque reference is at 100% as a percentage of *E1-04 [Maximum Output Frequency]*.	0.0% (0.0 - 100.0%)	597
b7-02 (01CB) RUN	Droop Control Delay Time	V/f CL-V/f OLV CLV AOLV Sets the responsiveness of Droop control. Decrease this setting when drive response is slow. Increase this setting when hunting or oscillation occur.	0.05 s (0.03 - 2.00 s)	598
b7-03 (017E)	Droop Control Limit Selection	V/f CL-V/f OLV CLV AOLV Sets the Droop control limit function. 0 : Disabled 1 : Enabled	1 (0, 1)	598

◆ b9: Zero Servo

No. (Hex.)	Name	Description	Default (Range)	Ref.
b9-01 (01DA)	Zero Servo Gain	V/f CL-V/f OLV CLV AOLV Sets the responsiveness for the Zero Servo function.	5 (0 - 100)	599
b9-02 (01DB)	Zero Servo Completion Window	V/f CL-V/f OLV CLV AOLV Sets the range to trigger an output terminal set for “Zero Servo Complete” during Zero Servo operation. Be sure to set the deviation from the Zero Servo start position.	10 (0 - 16383)	599

10.6 C: Tuning

◆ C1: Accel & Decel Time

No. (Hex.)	Name	Description	Default (Range)	Ref.
C1-01 (0200) RUN	Acceleration Time 1	V/f CL-V/f OLV CLV AOLV Sets the length of time to accelerate from zero to maximum output frequency.	3.0 s (0.0 - 6000.0 s)	601
C1-02 (0201) RUN	Deceleration Time 1	V/f CL-V/f OLV CLV AOLV Sets the length of time to decelerate from maximum output frequency to zero.	3.0 s (0.0 - 6000.0 s)	602
C1-03 (0202) RUN	Acceleration Time 2	V/f CL-V/f OLV CLV AOLV Sets the length of time to accelerate from zero to maximum output frequency.	10.0 s (0.0 - 6000.0 s)	602
C1-04 (0203) RUN	Deceleration Time 2	V/f CL-V/f OLV CLV AOLV Sets the length of time to decelerate from maximum output frequency to zero.	10.0 s (0.0 - 6000.0 s)	602
C1-05 (0204) RUN	Acceleration Time 3	V/f CL-V/f OLV CLV AOLV Sets the length of time to accelerate from zero to maximum output frequency.	10.0 s (0.0 - 6000.0 s)	602
C1-06 (0205) RUN	Deceleration Time 3	V/f CL-V/f OLV CLV AOLV Sets the length of time to decelerate from maximum output frequency to zero.	10.0 s (0.0 - 6000.0 s)	602
C1-07 (0206) RUN	Acceleration Time 4	V/f CL-V/f OLV CLV AOLV Sets the length of time to accelerate from zero to maximum output frequency.	10.0 s (0.0 - 6000.0 s)	602
C1-08 (0207) RUN	Deceleration Time 4	V/f CL-V/f OLV CLV AOLV Sets the length of time to decelerate from maximum output frequency to zero.	10.0 s (0.0 - 6000.0 s)	603
C1-09 (0208) RUN	Fast Stop Time	V/f CL-V/f OLV CLV AOLV Sets the length of time that the drive will decelerate to zero for a Fast Stop. **Note:** If you decelerate the drive too quickly, the drive will detect an *ov [Overvoltage]* fault. When the drive detects an *ov*, the drive shuts off the output, and the motor coasts to stop. To prevent motor coasting and stop the motor quickly and safely, set a Fast Stop time in *C1-09*.	2.0 s (0.0 - 6000.0 s)	603
C1-10 (0209)	Accel/Decel Time Setting Units	V/f CL-V/f OLV CLV AOLV Sets the setting units for *C1-01 to C1-08 [Accel/Decel Times 1 to 4]* and *C1-09 [Fast Stop Time]*. 0 : 0.01 s (0.00 to 600.00 s) 1 : 0.1 s (0.0 to 6000.0 s)	1 (0, 1)	603
C1-11 (020A)	Accel/Decel Time Switchover Freq	V/f CL-V/f OLV CLV AOLV Sets the frequency at which the drive will automatically change acceleration and deceleration times.	Determined by A1-02 (0.0 - 590.0 Hz)	603
C1-22 (155F) RUN	Acceleration Time 1	V/f CL-V/f OLV CLV AOLV Sets the first length of time 3 to accelerate for motor from zero to the maximum output frequency.	10.0 s (0.0 - 6000.0 s)	604
C1-23 (1560) RUN	Deceleration Time 1	V/f CL-V/f OLV CLV AOLV Sets the first length of time to decelerate for motor 3 from maximum output frequency to zero.	10.0 s (0.0 - 6000.0 s)	604
C1-24 (1561) RUN	Acceleration Time 2	V/f CL-V/f OLV CLV AOLV Sets the second length of time to accelerate for motor 3 from zero to the maximum output frequency.	10.0 s (0.0 - 6000.0 s)	604
C1-25 (1562) RUN	Deceleration Time 2	V/f CL-V/f OLV CLV AOLV Sets the second length of time to decelerate for motor 3 from maximum output frequency to zero.	10.0 s (0.0 - 6000.0 s)	604

◆ C2: S-Curve Characteristics

No. (Hex.)	Name	Description	Default (Range)	Ref.
C2-01 (020B)	S-Curve Time @ Start of Accel	V/f CL-V/f OLV CLV AOLV Sets the S-curve acceleration time at start.	Determined by A1-02 (0.00 - 10.00 s)	605
C2-02 (020C)	S-Curve Time @ End of Accel	V/f CL-V/f OLV CLV AOLV Sets the S-curve acceleration time at completion.	0.20 s (0.00 - 10.00 s)	605
C2-03 (020D)	S-Curve Time @ Start of Decel	V/f CL-V/f OLV CLV AOLV Sets the S-curve deceleration time at start.	0.20 s (0.00 - 10.00 s)	605
C2-04 (020E)	S-Curve Time @ End of Decel	V/f CL-V/f OLV CLV AOLV Sets the S-curve deceleration time at completion.	0.00 s (0.00 - 10.00 s)	605

◆ C3: Slip Compensation

No. (Hex.)	Name	Description	Default (Range)	Ref.
C3-01 (020F) RUN	Slip Compensation Gain	V/f CL-V/f OLV CLV AOLV Sets the gain for the slip compensation function. Usually it is not necessary to change this setting. **Note:** • Correctly set these parameters before you change the slip compensation gain: When *A1-02 = 2 [Control Method Selection = Open Loop Vector]*, you can use Auto-Tuning to set *E2-02 [Motor Rated Slip]*. –*E2-01 [Motor Rated Current (FLA)]* –*E2-02 [Motor Rated Slip]* –*E2-03 [Motor No-Load Current]* • When *A1-02 = 4 [Advanced Open Loop Vector]*, you cannot change the setting while the drive is running.	Determined by A1-02 (0.0 - 2.5)	605
C3-02 (0210) RUN	Slip Compensation Delay Time	V/f CL-V/f OLV CLV AOLV Sets the slip compensation delay time when speed is unstable or when the slip compensation response is too slow. Usually it is not necessary to change this setting.	Determined by A1-02 (0 - 10000 ms)	606
C3-03 (0211)	Slip Compensation Limit	V/f CL-V/f OLV CLV AOLV Sets the upper limit for the slip compensation function as a percentage of the motor rated slip.	200% (0 - 250%)	606
C3-04 (0212)	Slip Compensation at Regen	V/f CL-V/f OLV CLV AOLV Sets the slip compensation function during regenerative operation. 0 : Disabled 1 : Enabled Above 6Hz 2 : Enabled Above C3-15	0 (0 - 2)	606
C3-05 (0213)	Output Voltage Limit Selection	V/f CL-V/f OLV CLV AOLV Sets the automatic reduction of motor magnetic flux when the output voltage is saturated. 0 : Disabled 1 : Enabled	0 (0, 1)	607
C3-16 (0261) Expert	Vout Modulation Limit Start Lvl	V/f CL-V/f OLV CLV AOLV Sets the modulation factor that starts the output voltage limit operation when *C3-05 = 1 [Output Voltage Limit Selection = Enabled]*.	90.0% (70.0 - 90.0%)	607
C3-17 (0262) Expert	Vout Modulation Limit Max Level	V/f CL-V/f OLV CLV AOLV Sets the modulation factor used with *C3-18 [Output Voltage Limit Level]* for the output voltage limit operation when *C3-05 = 1 [Output Voltage Limit Selection = Enabled]*.	100.0% (85.0 - 100.0%)	607
C3-18 (0263) Expert	Output Voltage Limit Level	V/f CL-V/f OLV CLV AOLV Sets the maximum drop width of the voltage reference when *C3-05 = 1 [Output Voltage Limit Selection = Enabled]*.	90.0% (50.0 - 100.0%)	607
C3-21 (033E) RUN	Motor 2 Slip Compensation Gain	V/f CL-V/f OLV CLV AOLV Sets the gain for the motor 2 slip compensation function. Usually it is not necessary to change this setting. **Note:** Correctly set these parameters before changing the slip compensation gain: • *E4-01 [Motor 2 Rated Current]* • *E4-02 [Motor 2 Rated Slip]* • *E4-03 [Motor 2 Rated No-Load Current]*	Determined by E3-01 (0.0 - 2.5)	608
C3-22 (0241) RUN	Motor 2 Slip Comp Delay Time	V/f CL-V/f OLV CLV AOLV Sets the slip compensation delay time for motor 2 when speed is unstable or when the slip compensation response is too slow. Usually it is not necessary to change this setting.	Determined by E3-01 (0 - 10000 ms)	608

No. (Hex.)	Name	Description	Default (Range)	Ref.
C3-23 (0242)	Motor 2 Slip Compensation Limit	V/f CL-V/f OLV CLV AOLV Sets the upper limit for the slip compensation function as a percentage of the motor 2 rated slip.	200% (0 - 250%)	608
C3-24 (0243)	Motor 2 Slip Comp during Regen	V/f CL-V/f OLV CLV AOLV Sets the slip compensation during regenerative operation function for motor 2. 0 : Disabled 1 : Enabled Above 6Hz 2 : Enabled Above C3-15	0 (0 - 2)	608
C3-28 (1B5B) Expert	Adaptive Slip Control Mode	V/f CL-V/f OLV CLV AOLV Sets the slip compensation function mode. 0 : Normal 1 : Advanced	0 (0, 1)	609

◆ C4: Torque Compensation

No. (Hex.)	Name	Description	Default (Range)	Ref.
C4-01 (0215) RUN	Torque Compensation Gain	V/f CL-V/f OLV CLV AOLV Sets the gain for the torque compensation function. Use this parameter value for motor 1 when operating multiple motors.	Determined by A1-02 (0.00 - 2.50)	609
C4-02 (0216) RUN	Torque Compensation Delay Time	V/f CL-V/f OLV CLV AOLV Sets the torque compensation delay time. Usually it is not necessary to change this setting.	Determined by A1-02 (0 - 60000 ms)	610
C4-06 (021A)	Motor 2 Torque Comp Delay Time	V/f CL-V/f OLV CLV AOLV Sets the value if *ov [Overvoltage]* occurs with sudden changes in the load, at the end of acceleration, or at the start of deceleration.	150 ms (0 - 10000 ms)	610
C4-07 (0341) RUN	Motor 2 Torque Compensation Gain	V/f CL-V/f OLV CLV AOLV Sets the gain for motor 2 torque compensation function when using the Motor Switch function.	1.00 (0.00 - 2.50)	610
C4-08 (1110) RUN	M2 Torque Comp Delay Time	V/f CL-V/f OLV CLV AOLV Sets the primary delay time for motor 2 torque compensation.	Determined by E3-01 (0 - 60000 ms)	610
C4-13 (1115) RUN	Torque Comp Delay Time Select 1	V/f CL-V/f OLV CLV AOLV Sets the primary delay time constant for torque compensation when the drive receives a Reverse run command and *b1-23 = 1 [Selection REV Parameters = Enabled]*.	Determined by A1-02 (0 - 60000 ms)	610
C4-14 (1116) RUN	M2 Torque Comp Delay Time Sel 1	V/f CL-V/f OLV CLV AOLV Sets the primary delay time constant for torque compensation for motor 2 when the drive receives a Reverse run command and *b1-23 = 1 [Selection REV Parameters = Enabled]*.	Determined by E3-01 (0 - 60000 ms)	611
C4-15 (111B) RUN	Torque Comp Delay Time Select 2	V/f CL-V/f OLV CLV AOLV Sets the primary delay time constant for torque compensation that the drive uses when *b1-23 = 0 [Selection REV Parameters = Disabled]* or *b1-23 = 1 [Enabled]*, and the MFDI "Counterweight Selection" setting is ON for the Forward run command.	Determined by A1-02 (0 - 60000 ms)	611
C4-16 (111C) RUN	Torque Comp Delay Time Select 3	V/f CL-V/f OLV CLV AOLV Sets the primary delay time constant for torque compensation that the drive uses when the reverse command activates, *b1-23 = 1 [Selection REV Parameters = Enabled]*, and the MFDI "Counterweight Selection" setting activates.	Determined by A1-02 (0 - 60000 ms)	611
C4-19 (0B8D) Expert	Torque Ripple Suppress Min Freq	V/f CL-V/f OLV CLV AOLV If there is slow oscillation at low speeds, adjust this setting. Usually it is not necessary to change this setting. Increase this parameter in 1.0 Hz increments when current ripples and torque ripples occur during low-speed operation. Set this parameter to 0.0 to disable the function if increasing the value does not fix the problem.	0.1 Hz (0.0 - 10.0 Hz)	611
C4-20 (0BCB) Expert	Voltage Compensation Adjust 1	V/f CL-V/f OLV CLV AOLV Sets voltage precision compensation. Usually it is not necessary to change this setting.	120 Hz (0 - 200 Hz)	611
C4-21 (0BCC) Expert	Voltage Compensation Adjust 2	V/f CL-V/f OLV CLV AOLV Sets voltage precision compensation. Usually it is not necessary to change this parameter.	Determined by o2-04 (0 - 10)	611
C4-23 (1583) Expert	Current Control Gain	V/f CL-V/f OLV CLV AOLV Sets the Current control gain. Usually it is not necessary to change this parameter.	1.00 (0.50 - 2.50)	611

◆ C5: Auto Speed Regulator (ASR)

No. (Hex.)	Name	Description	Default (Range)	Ref.
C5-01 (021B) RUN	ASR Proportional Gain 1	V/f CL-V/f OLV CLV AOLV Sets the gain to adjust ASR response.	Determined by A1-02 (0.00 - 300.00)	615
C5-02 (021C) RUN	ASR Integral Time 1	V/f CL-V/f OLV CLV AOLV Sets the ASR integral time. **Note:** If *A1-02 = 0 [Control Method Selection = V/f]*, you must set *H6-01 = 3 [Terminal RP Pulse Train Function = Speed Feedback (V/F Control)]* to enable this parameter.	Determined by A1-02 (0.000 - 60.000 s)	615
C5-03 (021D) RUN	ASR Proportional Gain 2	V/f CL-V/f OLV CLV AOLV Sets the gain to adjust ASR response. **Note:** If *A1-02 = 0 [Control Method Selection = V/f]*, you must set *H6-01 = 3 [Terminal RP Pulse Train Function = Speed Feedback (V/F Control)]* to enable this parameter.	Determined by A1-02 (0.00 - 300.00)	615
C5-04 (021E) RUN	ASR Integral Time 2	V/f CL-V/f OLV CLV AOLV Sets the ASR integral time. **Note:** If *A1-02 = 0 [Control Method Selection = V/f]*, you must set *H6-01 = 3 [Terminal RP Pulse Train Function = Speed Feedback (V/F Control)]* to enable this parameter.	Determined by A1-02 (0.000 - 60.000 s)	616
C5-05 (021F)	ASR Limit	V/f CL-V/f OLV CLV AOLV Set the ASR output limit as a percentage of *E1-04 [Maximum Output Frequency]*.	5.0% (0.0 - 20.0%)	616
C5-06 (0220)	ASR Delay Time	V/f CL-V/f OLV CLV AOLV Sets the filter time constant of the torque reference output from the speed loop. Usually it is not necessary to change this setting.	Determined by A1-02 (0.000 - 0.500 s)	616
C5-07 (0221)	ASR Gain Switchover Frequency	V/f CL-V/f OLV CLV AOLV Sets the frequency where the drive should switch between *C5-01 [ASR Proportional Gain 1] and C5-03 [ASR Proportional Gain 2]* as well as between integral time 1 and 2 (C5-02, C5-04). Sets the frequency where the drive should switch between *C5-02 [ASR Integral Time 1] and C5-04 [ASR Integral Time 2]*.	Determined by A1-02 (Determined by A1-02)	616
C5-08 (0222)	ASR Integral Limit	V/f CL-V/f OLV CLV AOLV Set the upper limit of the ASR integral amount as a percentage of the rated load.	400% (0 - 400%)	616
C5-12 (0386)	Integral Operation @ Accel/Decel	V/f CL-V/f OLV CLV AOLV Sets ASR integral operation during acceleration and deceleration. 0 : Disabled 1 : Enabled **Note:** If *A1-02 = 0 [Control Method Selection = V/f]*, you must set *H6-01 = 3 [Terminal RP Pulse Train Function = Speed Feedback (V/F Control)]* to enable this parameter.	0 (0, 1)	616
C5-17 (0276) Expert	Motor Inertia	V/f CL-V/f OLV CLV AOLV Sets the motor inertia.	Determined by o2-04 (0.0001 - 6.0000 kgm^2)	617
C5-18 (0277) Expert	Load Inertia Ratio	V/f CL-V/f OLV CLV AOLV Sets the load inertia ratio for the motor inertia.	1.0 (0.0 - 6000.0)	617
C5-21 (0356) RUN	Motor 2 ASR Proportional Gain 1	V/f CL-V/f OLV CLV AOLV Sets the gain to adjust ASR response.	Determined by E3-01 (0.00 - 300.00)	617
C5-22 (0357) RUN	Motor 2 ASR Integral Time 1	V/f CL-V/f OLV CLV AOLV Sets the ASR integral time.	Determined by E3-01 (0.000 - 60.000 s)	617
C5-23 (0358) RUN	Motor 2 ASR Proportional Gain 2	V/f CL-V/f OLV CLV AOLV Sets the gain to adjust ASR response.	Determined by E3-01 (0.00 - 300.00)	618
C5-24 (0359) RUN	Motor 2 ASR Integral Time 2	V/f CL-V/f OLV CLV AOLV Sets the ASR integral time.	Determined by E3-01 (0.000 - 60.000 s)	618
C5-25 (035A)	Motor 2 ASR Limit	V/f CL-V/f OLV CLV AOLV Set the motor 2 ASR output limit as a percentage of *E1-04 [Maximum Output Frequency]*.	5.0% (0.0 - 20.0%)	618
C5-26 (035B)	Motor 2 ASR Delay Time	V/f CL-V/f OLV CLV AOLV Sets the filter time constant of the torque reference output from the ASR. Usually it is not necessary to change this parameter.	Determined by E3-01 (0.000 - 0.500 s)	618

No. (Hex.)	Name	Description	Default (Range)	Ref.
C5-27 (035C)	Motor 2 ASR Gain Switchover Freq	V/f CL-V/f OLV **CLV** AOLV Sets the frequency where the drive should switch between *C5-21 [Motor 2 ASR Proportional Gain 1] and C5-23 [Motor 2 ASR Proportional Gain 2]*. Sets the frequency where the drive should switch between *C5-22 [Motor 2 ASR Integral Time 1] and C5-24 [Motor 2 ASR Integral Time 2]*.	0.0 Hz (0.0 - 400.0 Hz)	618
C5-28 (035D)	Motor 2 ASR Integral Limit	V/f CL-V/f OLV **CLV** AOLV Set the upper limit of the motor 2 ASR integral amount as a percentage of the rated load.	400% (0 - 400%)	619
C5-29 (0B18) Expert	Speed Control Response	**V/f CL-V/f OLV CLV AOLV** Sets the level of speed control responsiveness. Usually it is not necessary to change this setting. 0 : Standard 1 : High Performance 1	0 (0, 1)	619
C5-32 (0361)	Motor 2 Integral Oper at Acc/Dec	V/f **CL-V/f** OLV CLV AOLV Sets ASR integral operation during acceleration and deceleration for motor 2. 0 : Disabled 1 : Enabled	0 (0, 1)	619
C5-37 (0278) Expert	Motor 2 Inertia	V/f CL-V/f OLV **CLV** AOLV Sets the motor inertia.	Determined by o2-04 (0.0001 - 6.0000 kgm²)	619
C5-38 (0279) Expert	Motor 2 Load Inertia Ratio	V/f CL-V/f OLV **CLV** AOLV Sets the load inertia ratio for the motor 2 inertia.	1.0 (0.0 - 6000.0)	619
C5-50 (0B14) Expert	Notch Filter Frequency	V/f CL-V/f OLV **CLV** AOLV Sets the machine resonance frequency. **Note:** Set *C5-50 = 0 [0 Hz]* to disable the notch filter.	0 Hz (0, or 2 to 100 Hz)	620
C5-51 (0B15) Expert	Notch Filter Bandwidth	V/f CL-V/f OLV **CLV** AOLV Sets the notch width of the notch filter. **Note:** Set *C5-50 = 0 [Notch Filter Frequency = 0 Hz]* to disable the notch filter.	1.0 (0.5 - 5.0)	620

◆ C6: Carrier Frequency

No. (Hex.)	Name	Description	Default (Range)	Ref.
C6-02 (0224)	Carrier Frequency Selection	**V/f CL-V/f OLV CLV AOLV** Sets the switching frequency (carrier frequency) for the transistors in the drive. 1 : 2.0 kHz 2 : 5.0 kHz 3 : 8.0 kHz 4 : 10.0 kHz 5 : 12.5 kHz 6 : 15.0 kHz F : User Defined (C6-03 to C6-05)	Determined by A1-02 and o2-04 (1 - 6, F)	620
C6-03 (0225)	Carrier Frequency Upper Limit	**V/f CL-V/f OLV CLV AOLV** Sets the upper limit of the carrier frequency. Set *C6-02 = F [Carrier Frequency Selection = User Defined (C6-03 to C6-05)]* to set this parameter.	Determined by C6-02 (1.0 - 15.0 kHz)	621
C6-04 (0226)	Carrier Frequency Lower Limit	**V/f CL-V/f** OLV CLV AOLV Sets the lower limit of the carrier frequency. Set *C6-02 = F [Carrier Frequency Selection = User Defined (C6-03 to C6-05)]* to set this parameter.	Determined by C6-02 (1.0 - 15.0 kHz)	621
C6-05 (0227)	Carrier Freq Proportional Gain	**V/f CL-V/f** OLV CLV AOLV Sets the proportional gain for the carrier frequency. Set *C6-02 = F [Carrier Frequency Selection = User Defined (C6-03 to C6-05)]* to set this parameter.	Determined by C6-02 (0 - 99)	621

10.7 d: Reference Settings

◆ d1: Frequency Reference

No. (Hex.)	Name	Description	Default (Range)	Ref.
d1-01 (0280) RUN	Reference 1	V/f CL-V/f OLV CLV AOLV Sets the frequency reference in the units from *o1-03 [Frequency Display Unit Selection*.	0.00 Hz (0.00 - 590.00 Hz)	624
d1-02 (0281) RUN	Reference 2	V/f CL-V/f OLV CLV AOLV Sets the frequency reference in the units from *o1-03 [Frequency Display Unit Selection*.	0.00 Hz (0.00 - 590.00 Hz)	624
d1-03 (0282) RUN	Reference 3	V/f CL-V/f OLV CLV AOLV Sets the frequency reference in the units from *o1-03 [Frequency Display Unit Selection*.	0.00 Hz (0.00 - 590.00 Hz)	625
d1-04 (0283) RUN	Reference 4	V/f CL-V/f OLV CLV AOLV Sets the frequency reference in the units from *o1-03 [Frequency Display Unit Selection*.	0.00 Hz (0.00 - 590.00 Hz)	625
d1-05 (0284) RUN	Reference 5	V/f CL-V/f OLV CLV AOLV Sets the frequency reference in the units from *o1-03 [Frequency Display Unit Selection*.	0.00 Hz (0.00 - 590.00 Hz)	625
d1-06 (0285) RUN	Reference 6	V/f CL-V/f OLV CLV AOLV Sets the frequency reference in the units from *o1-03 [Frequency Display Unit Selection*.	0.00 Hz (0.00 - 590.00 Hz)	625
d1-07 (0286) RUN	Reference 7	V/f CL-V/f OLV CLV AOLV Sets the frequency reference in the units from *o1-03 [Frequency Display Unit Selection*.	0.00 Hz (0.00 - 590.00 Hz)	625
d1-08 (0287) RUN	Reference 8	V/f CL-V/f OLV CLV AOLV Sets the frequency reference in the units from *o1-03 [Frequency Display Unit Selection*.	0.00 Hz (0.00 - 590.00 Hz)	626
d1-09 (0288) RUN	Reference 9	V/f CL-V/f OLV CLV AOLV Sets the frequency reference in the units from *o1-03 [Frequency Display Unit Selection*. **Note:** On drives with software versions PRG: 01021 and later, this function is enabled.	0.00 Hz (0.00 - 590.00 Hz)	626
d1-10 (028B) RUN	Reference 10	V/f CL-V/f OLV CLV AOLV Sets the frequency reference in the units from *o1-03 [Frequency Display Unit Selection*. **Note:** On drives with software versions PRG: 01021 and later, this function is enabled.	0.00 Hz (0.00 - 590.00 Hz)	626
d1-11 (028C) RUN	Reference 11	V/f CL-V/f OLV CLV AOLV Sets the frequency reference in the units from *o1-03 [Frequency Display Unit Selection*. **Note:** On drives with software versions PRG: 01021 and later, this function is enabled.	0.00 Hz (0.00 - 590.00 Hz)	626
d1-12 (028D) RUN	Reference 12	V/f CL-V/f OLV CLV AOLV Sets the frequency reference in the units from *o1-03 [Frequency Display Unit Selection*. **Note:** On drives with software versions PRG: 01021 and later, this function is enabled.	0.00 Hz (0.00 - 590.00 Hz)	626
d1-13 (028E) RUN	Reference 13	V/f CL-V/f OLV CLV AOLV Sets the frequency reference in the units from *o1-03 [Frequency Display Unit Selection*. **Note:** On drives with software versions PRG: 01021 and later, this function is enabled.	0.00 Hz (0.00 - 590.00 Hz)	627
d1-14 (028F) RUN	Reference 14	V/f CL-V/f OLV CLV AOLV Sets the frequency reference in the units from *o1-03 [Frequency Display Unit Selection*. **Note:** On drives with software versions PRG: 01021 and later, this function is enabled.	0.00 Hz (0.00 - 590.00 Hz)	627
d1-15 (0290) RUN	Reference 15	V/f CL-V/f OLV CLV AOLV Sets the frequency reference in the units from *o1-03 [Frequency Display Unit Selection*. **Note:** On drives with software versions PRG: 01021 and later, this function is enabled.	0.00 Hz (0.00 - 590.00 Hz)	627

No. (Hex.)	Name	Description	Default (Range)	Ref.
d1-16 (0291) RUN	Reference 16	V/f CL-V/f OLV CLV AOLV Sets the frequency reference in the units from *o1-03 [Frequency Display Unit Selection*. **Note:** On drives with software versions PRG: 01021 and later, this function is enabled.	0.00 Hz (0.00 - 590.00 Hz)	627
d1-17 (0292) RUN	Jog Reference	V/f CL-V/f OLV CLV AOLV Sets the frequency reference in the units from *o1-03 [Frequency Display Unit Selection]*. Set *H1-xx = 6 [MFDI Function Select = Jog Reference Selection]* to use the Jog frequency reference.	6.00 Hz (0.00 - 590.00 Hz)	628

◆ d2: Reference Limits

No. (Hex.)	Name	Description	Default (Range)	Ref.
d2-01 (0289)	Frequency Reference Upper Limit	V/f CL-V/f OLV CLV AOLV Sets maximum limit for all frequency references. The maximum output frequency is 100%.	100.0% (0.0 - 110.0%)	628
d2-02 (028A)	Frequency Reference Lower Limit	V/f CL-V/f OLV CLV AOLV Sets minimum limit for all frequency references. The maximum output frequency is 100%.	0.0% (0.0 - 110.0%)	628
d2-03 (0293)	Analog Frequency Ref Lower Limit	V/f CL-V/f OLV CLV AOLV Sets the lower limit for the master frequency reference (the first frequency of the multi-step speed reference) as a percentage. The maximum output frequency is 100%.	0.0% (0.0 - 110.0%)	628

◆ d3: Jump Frequency

No. (Hex.)	Name	Description	Default (Range)	Ref.
d3-01 (0294)	Jump Frequency 1	V/f CL-V/f OLV CLV AOLV Sets the median value of the frequency band that the drive will avoid.	0.0 Hz (Determined by A1-02)	629
d3-02 (0295)	Jump Frequency 2	V/f CL-V/f OLV CLV AOLV Sets the median value of the frequency band that the drive will avoid.	0.0 Hz (Determined by A1-02)	629
d3-03 (0296)	Jump Frequency 3	V/f CL-V/f OLV CLV AOLV Sets the median value of the frequency band that the drive will avoid.	0.0 Hz (Determined by A1-02)	630
d3-04 (0297)	Jump Frequency Width	V/f CL-V/f OLV CLV AOLV Sets the width of the frequency band that the drive will avoid.	1.0 Hz (Determined by A1-02)	630

◆ d4: Frequency Ref Up/Down & Hold

No. (Hex.)	Name	Description	Default (Range)	Ref.
d4-01 (0298)	Freq Reference Hold Selection	V/f CL-V/f OLV CLV AOLV Sets the drive to save the frequency reference when the Stop command is entered or the drive is de-energized. Set *H1-xx [MFDI Function Select]* to one of the these values to operate this parameter: • *H1-xx = A [Accel/Decel Ramp Hold]* • *H1-xx = 10/11 [Up/Down Command]* The Frequency Reference Hold function depends on which function it is combined with. 0 : Disable 1 : Enabled	0 (0, 1)	630
d4-10 (02B6)	Up/Down Freq Lower Limit Select	V/f CL-V/f OLV CLV AOLV Sets the lower frequency limit for the Up/Down function. 0 : Greater of d2-02 or Analog 1 : d2-02	0 (0, 1)	631

◆ d6: Field Forcing

No. (Hex.)	Name	Description	Default (Range)	Ref.
d6-03 (02A2)	Field Forcing Selection	V/f CL-V/f OLV CLV AOLV Sets the field forcing function. 0 : Disabled 1 : Enabled	0 (0, 1)	631
d6-06 (02A5)	Field Forcing Limit	V/f CL-V/f OLV CLV AOLV Sets the limit value for field forcing to increase the motor excitation current reference as a percentage of *E2-03 [Motor No-Load Current]*. Usually it is not necessary to change this setting.	400% (100 - 400%)	632

◆ d7: Offset Frequency

No. (Hex.)	Name	Description	Default (Range)	Ref.
d7-01 (02B2) RUN	Offset Frequency 1	V/f CL-V/f OLV CLV AOLV Sets the value to add to or subtract from the frequency reference when *H1-xx = 44 [MFDI Function Select = Add Offset Frequency 1 (d7-01)]* as a percentage of the maximum output frequency.	0.0% (-100.0 - +100.0%)	632
d7-02 (02B3) RUN	Offset Frequency 2	V/f CL-V/f OLV CLV AOLV Sets the value to add to or subtract from the frequency reference when *H1-xx = 45 [MFDI Function Select = Add Offset Frequency 2 (d7-01)]* as a percentage of the maximum output frequency.	0.0% (-100.0 - +100.0%)	632
d7-03 (02B4) RUN	Offset Frequency 3	V/f CL-V/f OLV CLV AOLV Sets the value to add to or subtract from the frequency reference when *H1-xx = 46 [MFDI Function Select = Add Offset Frequency 3 (d7-01)]* as a percentage of the maximum output frequency.	0.0% (-100.0 - +100.0%)	632

10.8 E: Motor Parameters

◆ E1: V/f Pattern for Motor 1

No. (Hex.)	Name	Description	Default (Range)	Ref.
E1-01 (0300)	Input AC Supply Voltage	V/f CL-V/f OLV CLV AOLV Sets the drive input voltage. **NOTICE:** *Set parameter E1-01 [Input AC Supply Voltage] to align with the drive input voltage (not motor voltage). If this parameter is incorrect, the protective functions of the drive will not operate correctly and it can cause damage to the drive.*	200 V Class: 230 V, 400 V Class: 400 V (200 V Class: 155 to 255 V, 400 V Class: 310 to 510 V)	634
E1-03 (0302)	V/f Pattern Selection	V/f CL-V/f OLV CLV AOLV Sets the V/f pattern for the drive and motor from 15 predefined patterns (settings: 0 to E) or creates a custom V/f pattern (setting: F). 0 : Const Trq, 50Hz base, 50Hz max 1 : Const Trq, 60Hz base, 50Hz max 2 : Const Trq, 50Hz base, 60Hz max 3 : Const Trq, 60Hz base, 72Hz max 4 : VT, 50Hz, 65% Vmid reduction 5 : VT, 50Hz, 50% Vmid reduction 6 : VT, 60Hz, 65% Vmid reduction 7 : VT, 60Hz, 50% Vmid reduction 8 : High Trq, 50 Hz, 25% Vmin Boost 9 : High Trq, 50 Hz, 65% Vmin Boost A : High Trq, 60 Hz, 25% Vmin Boost B : High Trq, 60 Hz, 65% Vmin Boost C : Const Trq, 60Hz base, 90Hz max D : Const Trq, 60Hz base, 120Hz max E : Const Trq, 60Hz base, 180Hz max F : Custom **Note:** • When *A1-02 = 2 [Control Method Selection = OLV]*, settings *0 to E* are not available. • Set the correct V/f pattern for the application and operation area. An incorrect V/f pattern can decrease motor torque and increase current from overexcitation.	F (Determined by A1-02)	634
E1-04 (0303)	Maximum Output Frequency	V/f CL-V/f OLV CLV AOLV Sets the maximum output frequency for the V/f pattern.	Determined by A1-02 (Determined by A1-02)	639
E1-05 (0304)	Maximum Output Voltage	V/f CL-V/f OLV CLV AOLV Sets the maximum output voltage for the V/f pattern.	200.0 (200 V Class: 0.0 - 255.0 V, 400 V Class: 0.0 - 510.0 V)	639
E1-06 (0305)	Base Frequency	V/f CL-V/f OLV CLV AOLV Sets the base frequency for the V/f pattern.	Determined by A1-02 (0.0 - E1-04)	639
E1-07 (0306)	Mid Point A Frequency	V/f CL-V/f OLV CLV AOLV Sets a middle output frequency for the V/f pattern.	Determined by A1-02 (0.0 - E1-04)	639
E1-08 (0307)	Mid Point A Voltage	V/f CL-V/f OLV CLV AOLV Sets a middle output voltage for the V/f pattern.	Determined by A1-02 (200 V Class: 0.0 - 255.0 V, 400 V Class: 0.0 - 510.0 V)	639
E1-09 (0308)	Minimum Output Frequency	V/f CL-V/f OLV CLV AOLV Sets the minimum output frequency for the V/f pattern.	Determined by A1-02 (Determined by A1-02 and E1-04)	639
E1-10 (0309)	Minimum Output Voltage	V/f CL-V/f OLV CLV AOLV Sets the minimum output voltage for the V/f pattern.	Determined by A1-02 (200 V Class: 0.0 to 255.0 V, 400 V Class: 0.0 to 510.0 V)	640
E1-11 (030A) Expert	Mid Point B Frequency	V/f CL-V/f OLV CLV AOLV Sets a middle output frequency for the V/f pattern.	0.0 Hz (0.0 - E1-04)	640
E1-12 (030B) Expert	Mid Point B Voltage	V/f CL-V/f OLV CLV AOLV Sets a middle point voltage for the V/f pattern.	0.0 V (200 V Class: 0.0 to 255.0 V, 400 V Class: 0.0 to 510.0 V)	640
E1-13 (030C) Expert	Base Voltage	V/f CL-V/f OLV CLV AOLV Sets the base voltage for the V/f pattern.	0.0 V (200 V Class: 0.0 - 255.0 V,400 V Class: 0.0 - 510.0 V)	640

No. (Hex.)	Name	Description	Default (Range)	Ref.
E1-14 (034C)	Middle Out Freq Volt Select 1	V/f CL-V/f OLV CLV AOLV Sets the mid point A voltage for reverse run used when *b1-23 = 1 [Selection REV Parameters = Enabled]*.	Determined by A1-02 and E1-03 (200 V Class: 0.0 - 255.0 V, 400 V Class: 0.0 - 510.0 V)	640
E1-15 (034D)	Minimum Out Freq Volt Select 1	V/f CL-V/f OLV CLV AOLV Sets the minimum output voltage for reverse run used when *b1-23 = 1 [Selection REV Parameters = Enabled]*.	Determined by A1-02 and E1-03 (200 V Class: 0.0 - 255.0 V, 400 V Class: 0.0 - 510.0 V)	640
E1-16 (034E)	Middle Out Freq Volt Select 2	V/f CL-V/f OLV CLV AOLV Sets the mid point A voltage used when *H1-xx = 38 [MFDI Function Selection = Counterweight Selection]*.	Determined by A1-02 and E1-03 (200 V Class: 0.0 - 255.0 V, 400 V Class: 0.0 - 510.0 V)	640
E1-17 (034F)	Minimum Out Freq Volt Select 2	V/f CL-V/f OLV CLV AOLV Sets the minimum output voltage used when *H1-xx = 38 [MFDI Function Selection = Counterweight Selection]* is ON.	Determined by A1-02 and E1-03 (200 V Class: 0.0 - 255.0 V, 400 V Class: 0.0 - 510.0 V)	641
E1-18 (0354)	Middle Out Freq Volt Select 3	V/f CL-V/f OLV CLV AOLV Sets the mid point A voltage for reverse run used when *b1-23 = 1 [Selection REV Parameters = Enabled]* and *H1-xx = 38 [MFDI Function Selection = Counterweight Selection]* is ON.	Determined by A1-02 and E1-03 (200 V Class: 0.0 - 255.0 V, 400 V Class: 0.0 - 510.0 V)	641
E1-19 (0355)	Minimum Out Freq Volt Select 3	V/f CL-V/f OLV CLV AOLV Sets the minimum output voltage for reverse run used when *b1-23 = 1 [Selection REV Parameters = Enabled]*.	Determined by A1-02 and E1-03 (200 V Class: 0.0 - 255.0 V, 400 V Class: 0.0 - 510.0 V)	641
E1-20 (0BF3)	UL Motor1 Sel	V/f CL-V/f OLV CLV AOLV Sets the motor characteristics. 0 : Constant Torque 1 : Variable Torque 2 : Auto Distinction	2 (0 - 2)	641

◆ E2: Motor Parameters

No. (Hex.)	Name	Description	Default (Range)	Ref.
E2-01 (030E)	Motor Rated Current (FLA)	V/f CL-V/f OLV CLV AOLV Sets the motor rated current in amps.	Determined by o2-04 (10% to 200% of the drive rated current)	641
E2-02 (030F)	Motor Rated Slip	V/f CL-V/f OLV CLV AOLV Sets motor rated slip.	Determined by o2-04 (0.000 - 20.000 Hz)	642
E2-03 (0310)	Motor No-Load Current	V/f CL-V/f OLV CLV AOLV Sets the no-load current for the motor in amps when operating at the rated frequency and the no-load voltage.	Determined by o2-04 (0 - E2-01)	642
E2-04 (0311)	Motor Pole Count	V/f CL-V/f OLV CLV AOLV Sets the number of motor poles. **Note:** • When *A1-02 = 0, 1, 3 [Control Method Selection = V/f, CL-V/f, CLV]*, the maximum value is 120. • When *A1-02 = 2, 4 [OLV, AOLV]*, the maximum value is 48.	4 (2 - 120)	642
E2-05 (0312)	Motor Line-to-Line Resistance	V/f CL-V/f OLV CLV AOLV Sets the line-to-line resistance for the motor stator windings.	Determined by o2-04 (0.000 - 65.000 Ω)	642
E2-06 (0313)	Motor Leakage Inductance	V/f CL-V/f OLV CLV AOLV Sets the voltage drop due to motor leakage inductance as a percentage of motor rated voltage while the motor is operating at the rated frequency and rated current.	Determined by o2-04 (0.0 - 60.0%)	643
E2-07 (0314)	Motor Saturation Coefficient 1	V/f CL-V/f OLV CLV AOLV Sets the motor iron-core saturation coefficient at 50% of the magnetic flux.	0.50 (0.00 - 0.50)	643
E2-08 (0315)	Motor Saturation Coefficient 2	V/f CL-V/f OLV CLV AOLV Sets the motor iron-core saturation coefficient at 75% of the magnetic flux.	0.75 (E2-07 - 0.75)	643
E2-09 (0316) Expert	Motor Mechanical Loss	V/f CL-V/f OLV CLV AOLV Sets the mechanical loss of the motor. It is set as a percentage of *E2-11 [Motor Rated Power]*. Usually it is not necessary to change this setting.	0.0% (0.0 - 10.0%)	643

No. (Hex.)	Name	Description	Default (Range)	Ref.
E2-10 (0317)	Motor Iron Loss	V/f CL-V/f OLV CLV AOLV Sets the motor iron loss.	Determined by o2-04 (0 - 65535 W)	643
E2-11 (0318)	Motor Rated Power	V/f CL-V/f OLV CLV AOLV Sets the motor rated power in 0.01 kW increments. (1 HP = 0.746 kW)	Determined by o2-04 (0.00 - 650.00 kW)	643

◆ E3: V/f Pattern for Motor 2

No. (Hex.)	Name	Description	Default (Range)	Ref.
E3-01 (0319)	Motor 2 Control Mode Selection	V/f CL-V/f OLV CLV AOLV Sets the control method for motor 2. **Note:** When you change this setting, the drive will set all parameters that are dependent on *E3-01* to their default settings. 0 : Open Loop V/f Control 1 : V/f Control with Encoder 2 : Open Loop Vector 3 : Closed Loop Vector	2 (0 - 3)	644
E3-04 (031A)	Motor 2 Maximum Output Frequency	V/f CL-V/f OLV CLV AOLV Set the maximum output frequency for the motor 2 V/f pattern.	Determined by E3-01 (40.0 - 590.0 Hz)	644
E3-05 (031B)	Motor 2 Maximum Output Voltage	V/f CL-V/f OLV CLV AOLV Sets the maximum output voltage for the motor 2 V/f pattern.	Determined by E3-01 (200 V Class: 0.0 - 255.0 V, 400 V Class: 0.0 - 510.0 V)	644
E3-06 (031C)	Motor 2 Base Frequency	V/f CL-V/f OLV CLV AOLV Sets the base frequency for the motor 2 V/f pattern.	Determined by E3-01 (0.0 - E3-04)	645
E3-07 (031D)	Motor 2 Mid Point A Frequency	V/f CL-V/f OLV CLV AOLV Sets a middle output frequency for the motor 2 V/f pattern.	Determined by E3-01 (0.0 - E3-04)	645
E3-08 (031E)	Motor 2 Mid Point A Voltage	V/f CL-V/f OLV CLV AOLV Sets a middle output voltage for the motor 2 V/f pattern.	Determined by E3-01 (200 V Class: 0.0 - 255.0 V, 400 V Class: 0.0 - 510.0 V)	645
E3-09 (031F)	Motor 2 Minimum Output Frequency	V/f CL-V/f OLV CLV AOLV Sets the minimum output frequency for the motor 2 V/f pattern.	Determined by E3-01 (0.0 - E3-04)	645
E3-10 (0320)	Motor 2 Minimum Output Voltage	V/f CL-V/f OLV CLV AOLV Sets the minimum output voltage for the motor 2 V/f pattern.	Determined by E3-01 (200 V Class: 0.0 - 255.0 V, 400 V Class: 0.0 - 510.0 V)	645
E3-11 (0345) Expert	Motor 2 Mid Point B Frequency	V/f CL-V/f OLV CLV AOLV Sets a middle output frequency for the motor 2 V/f pattern. Set this parameter to adjust the V/f pattern for the constant output range. Usually it is not necessary to change this parameter.	0.0 Hz (0.0 - E3-04)	645
E3-12 (0346) Expert	Motor 2 Mid Point B Voltage	V/f CL-V/f OLV CLV AOLV Sets a middle output voltage for the motor 2 V/f pattern. Set this parameter to adjust the V/f pattern for the constant output range. Usually it is not necessary to change this parameter.	0.0 V (200 V Class: 0.0 to 255.0 V, 400 V Class: 0.0 to 510.0 V)	645
E3-13 (0347) Expert	Motor 2 Base Voltage	V/f CL-V/f OLV CLV AOLV Sets the base voltage for the motor 2 V/f pattern. Set this parameter to adjust the V/f pattern for the constant output range. Usually it is not necessary to change this parameter.	0.0 V (200 V Class: 0.0 to 255.0 V, 400 V Class: 0.0 to 510.0 V)	646
E3-14 (114E)	M2 Middle Out Freq Volt Select	V/f CL-V/f OLV CLV AOLV Sets the mid point A voltage for motor 2 reverse run used when *b1-23 = 1 [Selection REV Parameters = Enabled]*.	Determined by E3-01 and E1-03 (200 V Class: 0.0 to 255.0 V, 400 V Class: 0.0 to 510.0 V)	646
E3-15 (114F)	M2 Minimum Out Freq Volt Select	V/f CL-V/f OLV CLV AOLV Sets the minimum output voltage for motor 2 reverse run used when *b1-23 = 1 [Selection REV Parameters = Enabled]*.	Determined by E3-01 and E1-03 (200 V Class: 0.0 to 255.0 V, 400 V Class: 0.0 to 510.0 V)	646
E3-20 (0BF4)	UL Motor2 Sel	V/f CL-V/f OLV CLV AOLV Sets the motor characteristics. 0 : Constant Torque 1 : Variable Torque 2 : Auto Distinction	2 (0 - 2)	646

◆ E4: Motor 2 Parameters

No. (Hex.)	Name	Description	Default (Range)	Ref.
E4-01 (0321)	Motor 2 Rated Current	V/f CL-V/f OLV CLV AOLV Sets the motor rated current for motor 2 in amps.	Determined by o2-04 (10% to 200% of the drive rated current)	646
E4-02 (0322)	Motor 2 Rated Slip	V/f CL-V/f OLV CLV AOLV Sets the motor rated slip for motor 2.	Determined by o2-04 (0.000 - 20.000 Hz)	647
E4-03 (0323)	Motor 2 Rated No-Load Current	V/f CL-V/f OLV CLV AOLV Sets the no-load current for motor 2 in amps when operating at the rated frequency and the no-load voltage.	Determined by o2-04 (Less than 0 - E4-01)	647
E4-04 (0324)	Motor 2 Motor Poles	V/f CL-V/f OLV CLV AOLV Sets the number of poles for motor 2.	4 (2 - 120)	647
E4-05 (0325)	Motor 2 Line-to-Line Resistance	V/f CL-V/f OLV CLV AOLV Sets the line-to-line resistance for the motor 2 stator windings.	Determined by o2-04 (0.000 - 65.000 Ω)	647
E4-06 (0326)	Motor 2 Leakage Inductance	V/f CL-V/f OLV CLV AOLV Sets the voltage drop from motor 2 leakage inductance as a percentage of Motor Rated Voltage when motor 2 operates at the rated frequency and rated current.	Determined by o2-04 (0.0 - 60.0%)	648
E4-07 (0343)	Motor 2 Saturation Coefficient 1	V/f CL-V/f OLV CLV AOLV Sets the motor 2 iron-core saturation coefficient at 50% of the magnetic flux.	0.50 (0.00 - 0.50)	648
E4-08 (0344)	Motor 2 Saturation Coefficient 2	V/f CL-V/f OLV CLV AOLV Sets the motor 2 iron-core saturation coefficient at 75% of the magnetic flux.	0.75 (E4-07 - 0.75)	648
E4-09 (033F) Expert	Motor 2 Mechanical Loss	V/f CL-V/f OLV CLV AOLV Sets the mechanical loss of motor 2. It is set as a percentage of *E4-11 [Motor 2 Rated Power]*. Usually it is not necessary to change this setting.	0.0% (0.0 - 10.0%)	648
E4-10 (0340)	Motor 2 Iron Loss	V/f CL-V/f OLV CLV AOLV Sets the motor iron loss for motor 2.	Determined by o2-04 (0 - 65535 W)	648
E4-11 (0327)	Motor 2 Rated Power	V/f CL-V/f OLV CLV AOLV Sets the motor rated power in 0.01 kW increments. (1 HP = 0.746 kW)	Determined by o2-04 (0.00 - 650.00 kW)	648

◆ E7: Motor 3 Parameters

No. (Hex.)	Name	Description	Default (Range)	Ref.
E7-04 (1B61)	Motor 3 Maximum Output Frequency	V/f CL-V/f OLV CLV AOLV Set the maximum output frequency for the motor 3.	Determined by E1-03 (40.0 - 590.0 Hz)	649
E7-05 (1B62)	Motor 3 Maximum Output Voltage	V/f CL-V/f OLV CLV AOLV Sets the maximum output voltage used for motor 3.	Determined by E1-03 (200 V Class: 0.0 - 255.0 V, 400 V Class: 0.0 - 510.0 V)	649
E7-06 (1B63)	Motor 3 Base Frequency	V/f CL-V/f OLV CLV AOLV Sets the base frequency used for motor 3.	Determined by E1-03 (0.0 - E7-04)	649
E7-07 (1B64)	Motor 3 Mid Point A Frequency	V/f CL-V/f OLV CLV AOLV Sets the middle output frequency used for motor 3.	Determined by E1-03 (0.0 - E7-04)	649
E7-08 (1B65)	Motor 3 Mid Point A Voltage	V/f CL-V/f OLV CLV AOLV Sets the middle output frequency voltage used for motor 3.	Determined by E1-03 (200 V Class: 0.0 - 255.0 V, 400 V Class: 0.0 - 510.0 V)	649
E7-09 (1B66)	Motor 3 Minimum Output Frequency	V/f CL-V/f OLV CLV AOLV Sets the minimum output frequency for the motor 3.	Determined by E1-03 (0.0 - E7-04)	649
E7-10 (1B67)	Motor 3 Minimum Output Voltage	V/f CL-V/f OLV CLV AOLV Sets the minimum output voltage for the motor 3.	Determined by E1-03 (200 V Class: 0.0 - 255.0 V, 400 V Class: 0.0 - 510.0 V)	649
E7-11 (1B68) Expert	Motor 3 Mid Point B Frequency	V/f CL-V/f OLV CLV AOLV Sets the mid point B frequency used for motor 3. **Note:** Usually it is not necessary to change this parameter. Set this parameter to adjust the V/f pattern for the constant output range.	0.0 Hz (0.0 - E7-04)	649

No. (Hex.)	Name	Description	Default (Range)	Ref.
E7-12 (1B69) Expert	Motor 3 Mid Point B Voltage	V/f CL-V/f OLV CLV AOLV Sets the mid point B voltage used for motor 3. **Note:** Usually it is not necessary to change this parameter. Set this parameter to adjust the V/f pattern for the constant output range.	0.0 V (200 V Class: 0.0 to 255.0 V, 400 V Class: 0.0 to 510.0 V)	650
E7-13 (1B6A) Expert	Motor 3 Base Voltage	V/f CL-V/f OLV CLV AOLV Sets the base voltage used for motor 3. **Note:** Usually it is not necessary to change this parameter. Set this parameter to adjust the V/f pattern for the constant output range.	0.0 V (200 V Class: 0.0 to 255.0 V, 400 V Class: 0.0 to 510.0 V)	650
E7-21 (1B72)	Motor 3 Rated Current	V/f CL-V/f OLV CLV AOLV Sets the motor rated current for motor 3 in amperes.	Determined by o2-04 (10% to 200% of the drive rated current)	650
E7-24 (1B75)	Motor 3 Motor Poles	V/f CL-V/f OLV CLV AOLV Sets the number of poles for motor 3.	4 (2 - 48)	650
E7-25 (1B76)	Motor 3 Line-to-Line Resistance	V/f CL-V/f OLV CLV AOLV Sets the line-to-line resistance for the motor 3 stator windings.	Determined by o2-04 (0.000 - 65.000 Ω)	650
E7-31 (1B7C)	Motor 3 Rated Power	V/f CL-V/f OLV CLV AOLV Sets the motor 3 rated power in 0.01 kW. (1 HP = 0.746 kW) (1 HP = 0.746 kW)	Determined by o2-04 (0.00 - 650.00 kW)	650

10.9 F: Options

◆ F1: Encoder Option Setup

No. (Hex.)	Name	Description	Default (Range)	Ref.
F1-01 (0380)	Encoder 1 Pulse Count (PPR)	V/f CL-V/f OLV CLV AOLV Sets the number of output pulses per revolution of the encoder.	1024 (1 - 60000 ppr)	651
F1-02 (0381)	Encoder Signal Loss Detect Sel	V/f CL-V/f OLV CLV AOLV Sets the motor operation when *PGo [Encoder (PG) Feedback Loss]* is detected. 0 : Ramp to Stop 1 : Coast to Stop 2 : Fast Stop (Use C1-09) 3 : Alarm Only 4 : No Alarm Display	1 (0 - 4)	652
F1-03 (0382)	Overspeed Detection Selection	V/f CL-V/f OLV CLV AOLV Selects the motor operation when the drive detects *oS [Overspeed]*. 0 : Ramp to Stop 1 : Coast to Stop 2 : Fast Stop (Use C1-09) 3 : Alarm Only	1 (0 - 3)	652
F1-04 (0383)	Speed Deviation Detection Select	V/f CL-V/f OLV CLV AOLV Selects the motor operation when the drive detects *dEv [Speed Deviation]*. 0 : Ramp to Stop 1 : Coast to Stop 2 : Fast Stop (Use C1-09) 3 : Alarm Only	3 (0 - 3)	652
F1-05 (0384)	Encoder 1 Rotation Selection	V/f CL-V/f OLV CLV AOLV Sets the output sequence for the A and B pulses from the encoder, assuming that the motor is operating in the forward direction. 0 : Pulse A leads in FWD Direction 1 : Pulse B leads in FWD Direction	Determined by A1-02 (0, 1)	653
F1-06 (0385)	Encoder 1 Pulse Monitor Scaling	V/f CL-V/f OLV CLV AOLV Sets the ratio between the pulse input and the pulse output of the encoder as a 3-digit number. The first digit is the numerator and the second and third digits set the denominator. The dividing ratio = (1 + x)/yz when the setting value is a 3-digit value (xyz).	001 (001 - 032, 102 - 132 (1 - 1/32))	653
F1-08 (0387)	Overspeed Detection Level	V/f CL-V/f OLV CLV AOLV Sets the detection level of *oS [Overspeed]* as a percentage when the maximum output frequency is 100%.	115% (0 - 120%)	653
F1-09 (0388)	Overspeed Detection Delay Time	V/f CL-V/f OLV CLV AOLV Sets the length of time that the speed feedback must be more than the *F1-08* level to cause *oS [Overspeed]*. **Note:** If *A1-02 = 0 [Control Method Selection = V/f]*, you must set *H6-01 = 3 [Terminal RP Pulse Train Function = Speed Feedback (V/F Control)]* to enable this parameter.	Determined by A1-02 (0.0 - 2.0 s)	653
F1-10 (0389)	Speed Deviation Detection Level	V/f CL-V/f OLV CLV AOLV Sets the detection level of *dEv [Speed Deviation]* as a percentage when the maximum output frequency is 100%.	10% (0 - 50%)	654
F1-11 (038A)	Speed Deviation Detect DelayTime	V/f CL-V/f OLV CLV AOLV Sets the length of time that the difference between the frequency reference and speed feedback must be more than the level in *F1-10* to cause *dEv [Speed Deviation]*. **Note:** If *A1-02 = 0 [Control Method Selection = V/f]*, you must set *H6-01 = 3 [Terminal RP Pulse Train Function = Speed Feedback (V/F Control)]* to enable this parameter.	0.5 s (0.0 - 10.0 s)	654
F1-12 (038B)	Encoder 1 Gear Teeth 1	V/f CL-V/f OLV CLV AOLV Sets the number of gear teeth on the motor side. This parameter and *F1-13 [Encoder 1 Gear Teeth 2]* set the gear ratio between the motor and encoder.	0 (0 - 1000)	654
F1-13 (038C)	Encoder 2 Gear Teeth 1	V/f CL-V/f OLV CLV AOLV Sets the number of gear teeth on the load side. This parameter and *F1-12 [Encoder 1 Gear Teeth 1]* set the gear ratio between the motor and encoder.	0 (0 - 1000)	654
F1-14 (038D)	Encoder Open-Circuit Detect Time	V/f CL-V/f OLV CLV AOLV Sets the detection time for *PGo [Encoder (PG) Feedback Loss]*. **Note:** Motor speed and load conditions can cause *ov [Overvoltage]* and *oC [Overcurrent]* faults.	2.0 s (0.0 - 10.0 s)	654

No. (Hex.)	Name	Description	Default (Range)	Ref.
F1-20 (03B4)	Encoder 1 PCB Disconnect Detect	V/f CL-V/f OLV CLV AOLV Sets the function that enables and disables detection of a disconnected PG-X3 encoder connection cable. Detects *PGoH [Encoder (PG) Hardware Fault]* when *F1-20 = 1*. 0 : Disable 1 : Enabled	1 (0, 1)	655
F1-21 (03BC)	Encoder 1 Signal Selection	V/f CL-V/f OLV CLV AOLV Sets the number of channels for the signal to the encoder option. 0 : A Pulse Detection 1 : AB Pulse Detection	0 (0, 1)	655
F1-30 (03AA)	Motor 2 Encoder PCB Port Select	V/f CL-V/f OLV CLV AOLV Sets the connector used when the motor 2 encoder option is installed in the drive. 0 : CN5-C 1 : CN5-B	1 (0, 1)	655
F1-31 (03B0)	Encoder 2 Pulse Count (PPR)	V/f CL-V/f OLV CLV AOLV Sets the number of output pulses per revolution of the encoder. This parameter is for motor 2.	1024 (1 - 60000 ppr)	655
F1-32 (03B1)	Encoder 2 Rotation Selection	V/f CL-V/f OLV CLV AOLV Sets the output sequence for the A and B pulses from the encoder, assuming that the motor is operating in the forward direction. This parameter is for motor 2. 0 : Pulse A leads in FWD Direction 1 : Pulse B leads in FWD Direction	0 (0, 1)	655
F1-33 (03B2)	Encoder 2 Gear Teeth 1	V/f CL-V/f OLV CLV AOLV Sets the number of gear teeth on the motor side for motor 2. This parameter and *F1-34 [Encoder 2 Gear Teeth 2]* set the gear ratio between the motor and encoder.	0 (0 - 1000)	655
F1-34 (03B3)	Encoder 2 Gear Teeth 2	V/f CL-V/f OLV CLV AOLV Sets the number of gear teeth on the load side for motor 2. This parameter and *F1-33 [Encoder 2 Gear Teeth 1]* set the gear ratio between the motor and encoder.	0 (0 - 1000)	656
F1-35 (03BE)	Encoder 2 Pulse Monitor Scaling	V/f CL-V/f OLV CLV AOLV Sets the dividing ratio for monitor signals output from the encoder option. This parameter is for motor 2.	001 (001 - 032, 102 - 132 (1 - 1/32))	656
F1-36 (03B5)	Encoder 2 PCB Disconnect Detect	V/f CL-V/f OLV CLV AOLV Sets the function that enables and disables detection of a disconnected PG-X3 encoder connection cable. *PGoH [Encoder (PG) Hardware Fault]* is detected when this parameter is enabled. This parameter is for motor 2. 0 : Disable 1 : Enabled	1 (0, 1)	656
F1-37 (03BD)	Encoder 2 Signal Selection	V/f CL-V/f OLV CLV AOLV Sets the number of channels for the signal to the encoder option. This parameter is for motor 2. 0 : A Pulse Detection 1 : AB Pulse Detection	0 (0, 1)	656

◆ F2: Analog Input Option

No. (Hex.)	Name	Description	Default (Range)	Ref.
F2-01 (038F)	Analog Input Function Selection	V/f CL-V/f OLV CLV AOLV Sets the input method for the analog reference used with AI-A3. 0 : 3 Independent Channels 1 : 3 Channels Added Together	0 (0, 1)	657
F2-02 (0368) RUN	Analog Input Option Card Gain	V/f CL-V/f OLV CLV AOLV Sets the analog reference gain as a percentage when the maximum output frequency is 100%. **Note:** Set *F2-01 = 1 [Analog Input Function Selection = 3 Channels Added Together]* to enable this function.	100.0% (-999.9 - +999.9%)	658
F2-03 (0369) RUN	Analog Input Option Card Bias	V/f CL-V/f OLV CLV AOLV Sets the analog reference bias as a percentage when the maximum output frequency is 100%. **Note:** Set *F2-01 = 1 [Analog Input Function Selection = 3 Channels Added Together]* to enable this function.	0.0% (-999.9 - +999.9%)	658

◆ F3: Digital Input Option

No. (Hex.)	Name	Description	Default (Range)	Ref.
F3-01 (0390)	Digital Input Function Selection	V/f CL-V/f OLV CLV AOLV Sets the data format of digital input signals. This parameter is enabled when *o1-03 = 0 or 1 [Frequency Display Unit Selection = 0.01 Hz or 0.01% (100% = E1-04)]*. **Note:** When *o1-03 = 2* or *3 [Revolutions Per Minute (RPM) or User Units (o1-10 & o1-11)]*, the input signal will be BCD. The *o1-03* value sets the setting units. 0 : BCD, 1% units 1 : BCD, 0.1% units 2 : BCD, 0.01% units 3 : BCD, 1 Hz units 4 : BCD, 0.1 Hz units 5 : BCD, 0.01 Hz units 6 : BCD (5-digit), 0.02 Hz 7 : Binary input 8 : Multi-Function Digital Input	0 (0 - 8)	659
F3-03 (03B9)	Digital Input Data Length Select	V/f CL-V/f OLV CLV AOLV Sets the number of bits to set the frequency reference with *DI-A3*. 0 : 8-bit 1 : 12-bit 2 : 16-bit	2 (0 - 2)	659
F3-10 (0BE3) Expert	Terminal D0 Function Selection	V/f CL-V/f OLV CLV AOLV Sets the function for terminal D0 of the DI-A3 option when *F3-01 = 8 [Digital Input Function Selection = Multi-Function Digital Input]*.	F (0 - 1FF)	660
F3-11 (0BE4) Expert	Terminal D1 Function Selection	V/f CL-V/f OLV CLV AOLV Sets the function for terminal D1 of the DI-A3 when *F3-01 = 8 [Digital Input Function Selection = Multi-Function Digital Input]*.	F (0 - 1FF)	660
F3-12 (0BE5) Expert	Terminal D2 Function Selection	V/f CL-V/f OLV CLV AOLV Sets the function for terminal D2 of the DI-A3 when *F3-01 = 8 [Digital Input Function Selection = Multi-Function Digital Input]*.	F (0 - 1FF)	661
F3-13 (0BE6) Expert	Terminal D3 Function Selection	V/f CL-V/f OLV CLV AOLV Sets the function for terminal D3 of the DI-A3 option when *F3-01 = 8 [Digital Input Function Selection = Multi-Function Digital Input]*.	F (0 - 1FF)	661
F3-14 (0BE7) Expert	Terminal D4 Function Selection	V/f CL-V/f OLV CLV AOLV Sets the function for terminal D4 of the DI-A3 when *F3-01 = 8 [Digital Input Function Selection = Multi-Function Digital Input]*.	F (0 - 1FF)	661
F3-15 (0BE8) Expert	Terminal D5 Function Selection	V/f CL-V/f OLV CLV AOLV Sets the function for terminal D5 of the DI-A3 option when *F3-01 = 8 [Digital Input Function Selection = Multi-Function Digital Input]*.	F (0 - 1FF)	661
F3-16 (0BE9) Expert	Terminal D6 Function Selection	V/f CL-V/f OLV CLV AOLV Sets the function for terminal D6 of the DI-A3 option when *F3-01 = 8 [Digital Input Function Selection = Multi-Function Digital Input]*.	F (0 - 1FF)	661
F3-17 (0BEA) Expert	Terminal D7 Function Selection	V/f CL-V/f OLV CLV AOLV Sets the function for terminal D7 of the DI-A3 option when *F3-01 = 8 [Digital Input Function Selection = Multi-Function Digital Input]*.	F (0 - 1FF)	661
F3-18 (0BEB) Expert	Terminal D8 Function Selection	V/f CL-V/f OLV CLV AOLV Sets the function for terminal D8 of the DI-A3 option when *F3-01 = 8 [Digital Input Function Selection = Multi-Function Digital Input]*.	F (0 - 1FF)	661
F3-19 (0BEC) Expert	Terminal D9 Function Selection	V/f CL-V/f OLV CLV AOLV Sets the function for terminal D9 of the DI-A3 option when *F3-01 = 8 [Digital Input Function Selection = Multi-Function Digital Input]*.	F (0 - 1FF)	661
F3-20 (0BED) Expert	Terminal DA Function Selection	V/f CL-V/f OLV CLV AOLV Sets the function for terminal DA of the DI-A3 when *F3-01 = 8 [Digital Input Function Selection = Multi-Function Digital Input]*.	F (0 - 1FF)	662
F3-21 (0BEE) Expert	Terminal DB Function Selection	V/f CL-V/f OLV CLV AOLV Sets the function for terminal DB of the DI-A3 when *F3-01 = 8 [Digital Input Function Selection = Multi-Function Digital Input]*.	F (0 - 1FF)	662
F3-22 (0BEF) Expert	Terminal DC Function Selection	V/f CL-V/f OLV CLV AOLV Sets the function for terminal DC of the DI-A3 when *F3-01 = 8 [Digital Input Function Selection = Multi-Function Digital Input]*.	F (0 - 1FF)	662
F3-23 (0BF0) Expert	Terminal DD Function Selection	V/f CL-V/f OLV CLV AOLV Sets the function for terminal DD of the DI-A3 when *F3-01 = 8 [Digital Input Function Selection = Multi-Function Digital Input]*.	F (0 - 1FF)	662

No. (Hex.)	Name	Description	Default (Range)	Ref.
F3-24 (0BF1) Expert	Terminal DE Function Selection	V/f CL-V/f OLV CLV AOLV Sets the function for terminal DE of the DI-A3 when *F3-01 = 8 [Digital Input Function Selection = Multi-Function Digital Input]*.	F (0 - 1FF)	662
F3-25 (0BF2) Expert	Terminal DF Function Selection	V/f CL-V/f OLV CLV AOLV Sets the function for terminal DF of the DI-A3 when *F3-01 = 8 [Digital Input Function Selection = Multi-Function Digital Input]*.	F (0 - 1FF)	662

◆ F4: Analog Output Option

No. (Hex.)	Name	Description	Default (Range)	Ref.
F4-01 (0391)	Terminal V1 Function Selection	V/f CL-V/f OLV CLV AOLV Sets the monitor signal output from terminal V1. Set the *x-xx* part of the *Ux-xx [Monitor]*. For example, set *F4-01 = 102* to monitor *U1-02 [Output Frequency]*.	102 (000 - 999)	663
F4-02 (0392) RUN	Terminal V1 Gain	V/f CL-V/f OLV CLV AOLV Sets the gain of the monitor signal that is sent from terminal V1. Sets the analog signal output level from the terminal V1 at 10 V or 20 mA as 100% when an output for monitoring items is 100%.	100.0% (-999.9 - +999.9%)	663
F4-03 (0393)	Terminal V2 Function Selection	V/f CL-V/f OLV CLV AOLV Sets the monitor signal output from terminal V2. Set the *x-xx* part of the *Ux-xx [Monitor]*. For example, set *F4-03 = 103* to monitor *U1-03 [Output Current]*.	103 (000 - 999)	663
F4-04 (0394) RUN	Terminal V2 Gain	V/f CL-V/f OLV CLV AOLV Sets the gain of the monitor signal that is sent from terminal V2. Sets the analog signal output level from terminal V2 at 10 V or 20 mA as 100% when an output for monitoring items is 100%.	50.0% (-999.9 - +999.9%)	664
F4-05 (0395) RUN	Terminal V1 Bias	V/f CL-V/f OLV CLV AOLV Sets the bias of the monitor signal that is sent from terminal V1. When an output for monitoring items is 0%, this parameter sets the analog signal output level from the V1 terminal as a percentage of 10 V or 20 mA.	0.0% (-999.9 - +999.9%)	664
F4-06 (0396) RUN	Terminal V2 Bias	V/f CL-V/f OLV CLV AOLV Sets the bias of the monitor signal that is sent from terminal V2. Set the level of the analog signal sent from the V2 terminal at 10 V or 20 mA as 100% when an output for monitoring items is 0%.	0.0% (-999.9 - +999.9%)	664
F4-07 (0397)	Terminal V1 Signal Level	V/f CL-V/f OLV CLV AOLV Sets the output signal level for terminal V1. 0 : 0 to 10 V 1 : -10 to 10 V	0 (0, 1)	664
F4-08 (0398)	Terminal V2 Signal Level	V/f CL-V/f OLV CLV AOLV Sets the output signal level for terminal V2. 0 : 0 to 10 V 1 : -10 to 10 V	0 (0, 1)	664

◆ F5: Digital Output Option

No. (Hex.)	Name	Description	Default (Range)	Ref.
F5-01 (0399)	Terminal P1-PC Function Select	V/f CL-V/f OLV CLV AOLV Sets the function of terminal P1-PC on the DO-A3 option. Set *F5-09 = 2 [DO-A3 Output Mode Selection = Programmable (F5-01 to F5-08)]* to enable this function.	0 (0 - 1FF)	666
F5-02 (039A)	Terminal P2-PC Function Select	V/f CL-V/f OLV CLV AOLV Sets the function of terminal P2-PC on the DO-A3 option. Set *F5-09 = 2 [DO-A3 Output Mode Selection = Programmable (F5-01 to F5-08)]* to enable this function.	1 (0 - 1FF)	666
F5-03 (039B)	Terminal P3-PC Function Select	V/f CL-V/f OLV CLV AOLV Sets the function of terminal P3-PC on the DO-A3 option. Set *F5-09 = 2 [DO-A3 Output Mode Selection = Programmable (F5-01 to F5-08)]* to enable this function.	2 (0 - 1FF)	666
F5-04 (039C)	Terminal P4-PC Function Select	V/f CL-V/f OLV CLV AOLV Sets the function of terminal P4-PC on the DO-A3 option. Set *F5-09 = 2 [DO-A3 Output Mode Selection = Programmable (F5-01 to F5-08)]* to enable this function.	4 (0 - 1FF)	666
F5-05 (039D)	Terminal P5-PC Function Select	V/f CL-V/f OLV CLV AOLV Sets the function of terminal P5-PC on the DO-A3 option. Set *F5-09 = 2 [DO-A3 Output Mode Selection = Programmable (F5-01 to F5-08)]* to enable this function.	6 (0 - 1FF)	666
F5-06 (039E)	Terminal P6-PC Function Select	V/f CL-V/f OLV CLV AOLV Sets the function of terminal P6-PC on the DO-A3 option. Set *F5-09 = 2 [DO-A3 Output Mode Selection = Programmable (F5-01 to F5-08)]* to enable this function.	37 (0 - 1FF)	666

No. (Hex.)	Name	Description	Default (Range)	Ref.
F5-07 (039F)	Terminal M1-M2 Function Select	V/f CL-V/f OLV CLV AOLV Sets the function of terminal M1-M2 on the DO-A3 option by the setting value for the multi-function digital output (0 - 1FF). Set *F5-09 = 2 [DO-A3 Output Mode Selection = Programmable (F5-01 to F5-08)]* to enable this function.	F (0 - 1FF)	667
F5-08 (03A0)	Terminal M3-M4 Function Select	V/f CL-V/f OLV CLV AOLV Sets the function of terminal M3-M4 on the DO-A3 option. Set *F5-09 = 2 [DO-A3 Output Mode Selection = Programmable (F5-01 to F5-08)]* to enable this function.	F (0 - 1FF)	667
F5-09 (03A1)	DO-A3 Output Mode Selection	V/f CL-V/f OLV CLV AOLV Sets the output mode of signals from the DO-A3 option. 0 : Predefined Individual Outputs 1 : Binary Output 2 : Programmable (F5-01 to F5-08)	0 (0 - 2)	667

◆ F6: Communication Options

No. (Hex.)	Name	Description	Default (Range)	Ref.
F6-01 (03A2)	Communication Error Selection	V/f CL-V/f OLV CLV AOLV Selects the operation of the drive when the drive detects *bUS [Option Communication Error]*. 0 : Ramp to Stop 1 : Coast to Stop 2 : Fast Stop (Use C1-09) 3 : Alarm Only 4 : Alarm (Run at *d1-04*) 5 : Alarm - Ramp Stop	1 (0 - 5)	668
F6-02 (03A3)	Comm External Fault (EF0) Detect	V/f CL-V/f OLV CLV AOLV Sets the conditions at which *EF0 [Option Card External Fault]* is detected. 0 : Always Detected 1 : Detected during RUN Only	0 (0, 1)	669
F6-03 (03A4)	Comm External Fault (EF0) Select	V/f CL-V/f OLV CLV AOLV Selects the operation of the drive when the drive detects *EF0 [Option Card External Fault]*. 0 : Ramp to Stop 1 : Coast to Stop 2 : Fast Stop (Use C1-09) 3 : Alarm Only	1 (0 - 3)	669
F6-04 (03A5)	bUS Error Detection Time	V/f CL-V/f OLV CLV AOLV Sets the delay time for the drive to detect *bUS [Option Communication Error]*. **Note:** When you install an option card in the drive, the parameter value changes to 0.0 s.	2.0 s (0.0 - 5.0 s)	669
F6-06 (03A7)	Torque Reference/Limit by Comm	V/f CL-V/f OLV CLV AOLV Sets the function that enables and disables the torque limit received from the communication option. 0 : Disable 1 : Enabled	0 (0, 1)	669
F6-07 (03A8)	Multi-Step Ref @ NetRef/ComRef	V/f CL-V/f OLV CLV AOLV Sets the function that enables and disables the multi-step speed reference when NetRef (communication option card) or ComRef (MEMOBUS/Modbus communications) are the frequency reference source. 0 : Disable Multi-Step References 1 : Enable Multi-Step References	0 (0, 1)	669
F6-08 (036A)	Comm Parameter Reset @Initialize	V/f CL-V/f OLV CLV AOLV Sets the function to initialize *F6-xx and F7-xx parameters* when the drive is initialized with *A1-03 [Initialize Parameters]*. 0 : No Reset - Parameters Retained 1 : Reset Back to Factory Default	0 (0, 1)	670
F6-10 (03B6)	CC-Link Node Address	V/f CL-V/f OLV CLV AOLV Sets the node address for CC-Link communication. Restart the drive after you change the parameter setting. **Note:** Be sure to set a node address that is different than all other node addresses. Do not set this parameter to *0*. Incorrect parameter settings will cause *AEr [Station Address Setting Error]* errors and the L.ERR LED on the option will come on.	0 (0 - 64)	670

No. (Hex.)	Name	Description	Default (Range)	Ref.
F6-11 (03B7)	CC-Link Communication Speed	V/f CL-V/f OLV CLV AOLV Sets the communication speed for CC-Link communication. Restart the drive after you change the parameter setting. 0 : 156 kbps 1 : 625 kbps 2 : 2.5 Mbps 3 : 5 Mbps 4 : 10 Mbps	0 (0 - 4)	670
F6-14 (03BB)	BUS Error Auto Reset	V/f CL-V/f OLV CLV AOLV Sets the automatic reset function for *bUS [Option Communication Errors]*. 0 : Disable 1 : Enabled	0 (0, 1)	670
F6-16 (0B8A)	Gateway Mode	V/f CL-V/f OLV CLV AOLV Sets the gateway mode operation and the number of connected slave drives. 0 : Disabled 1 : Enabled: 1 Slave Drives 2 : Enabled: 2 Slave Drives 3 : Enabled: 3 Slave Drives 4 : Enabled: 4 Slave Drives	0 (0 - 4)	671
F6-20 (036B)	MECHATROLINK Station Address	V/f CL-V/f OLV CLV AOLV Sets the station address for MECHATROLINK communication. Restart the drive after you change this parameter setting. **Note:** • The setting range changes if you use MECHATROLINK-II or MECHATROLINK-III: –MECHATROLINK-II (SI-T3): 20 - 3F –MECHATROLINK-III (SI-ET3): 03 - EF • Set a node address that is different than all other node addresses. Incorrect parameter settings will cause *AEr [Station Address Setting Error]* errors and the L. ERR LED on the option will come on. • The drive detects *AEr* errors when the station address is 20 or 3F.	0021h (MECHATROLINK-II: 0020h - 003Fh, MECHATROLINK-III: 0003h - 00EFh)	673
F6-21 (036C)	MECHATROLINK Frame Size	V/f CL-V/f OLV CLV AOLV Sets the frame size for MECHATROLINK communication. Restart the drive after you change the parameter setting. 0 : 32byte (M-2) / 64byte (M-3) 1 : 17byte (M-2) / 32byte (M-3)	0 (0, 1)	674
F6-22 (036D)	MECHATROLINK Link Speed	V/f CL-V/f OLV CLV AOLV Sets the communications speed for MECHATROLINK-II. Restart the drive after you change the parameter setting. **Note:** This parameter is only available with the MECHATROLINK-II option. 0 : 10 Mbps 1 : 4 Mbps	0 (0, 1)	674
F6-23 (036E)	MECHATROLINK Monitor Select (E)	V/f CL-V/f OLV CLV AOLV Sets the MEMOBUS register used for the monitor functions of INV_CTL (drive operation control command) and INV_I/O (drive I/O control command). Restart the drive after you change the parameter setting.	0000h (0000h - FFFFh)	674
F6-24 (036F)	MECHATROLINK Monitor Select (F)	V/f CL-V/f OLV CLV AOLV Sets the MEMOBUS register used for the monitor functions of INV_CTL (drive operation control command) and INV_I/O (drive I/O control command). Restart the drive after you change the parameter setting.	0000h (0000h - FFFFh)	674
F6-25 (03C9)	MECHATROLINK Watchdog Error Sel	V/f CL-V/f OLV CLV AOLV Selects the motor operation when the drive detects *E5 [MECHATROLINK Watchdog Timer Err]*. 0 : Ramp to Stop 1 : Coast to Stop 2 : Fast Stop (Use C1-09) 3 : Alarm Only	1 (0 - 3)	674
F6-26 (03CA)	MECHATROLINK Allowable No of Err	V/f CL-V/f OLV CLV AOLV Sets the number of times that the option must detect a *bUS* alarm to cause a *bUS [Option Communication Error]*.	2 (2 - 10 times)	675
F6-30 (03CB)	PROFIBUS-DP Node Address	V/f CL-V/f OLV CLV AOLV Sets the node address for PROFIBUS-DP communication. Restart the drive after you change the parameter setting. **Note:** Be sure to set an address that is different than all other node addresses. Do not set this parameter to 0.	0 (0 - 125)	675
F6-31 (03CC)	PROFIBUS-DP Clear Mode Selection	V/f CL-V/f OLV CLV AOLV Sets what the drive will do after it receives the Clear Mode command. 0 : Reset 1 : Hold Previous State	0 (0, 1)	675

No. (Hex.)	Name	Description	Default (Range)	Ref.
F6-32 (03CD)	PROFIBUS-DP Data Format Select	V/f CL-V/f OLV CLV AOLV Sets the data format of PROFIBUS-DP communication. Restart the drive after you change the parameter setting. 0 : PPO Type 1 : Conventional 2 : PPO (bit0) 3 : PPO (Enter) 4 : Conventional (Enter) 5 : PPO (bit0, Enter)	0 (0 - 5)	675
F6-35 (03D0)	CANopen Node ID Selection	V/f CL-V/f OLV CLV AOLV Sets the node address for CANopen communication. Restart the drive after you change the parameter setting. **Note:** Be sure to set an address that is different than all other node addresses. Do not set this parameter to *0*. Incorrect parameter settings will cause *AEr [Station Address Setting Error]* errors and the L.ERR LED on the option will come on.	0 (0 - 126)	676
F6-36 (03D1)	CANopen Communication Speed	V/f CL-V/f OLV CLV AOLV Sets the CANopen communications speed. Restart the drive after you change this parameter setting. 0 : Auto-detection 1 : 10 kbps 2 : 20 kbps 3 : 50 kbps 4 : 125 kbps 5 : 250 kbps 6 : 500 kbps 7 : 800 kbps 8 : 1 Mbps	0 (0 - 8)	676
F6-50 (03C1)	DeviceNet MAC Address	V/f CL-V/f OLV CLV AOLV Sets the MAC address for DeviceNet communication. Restart the drive after you change this parameter setting. **Note:** Be sure to set a MAC address that is different than all other node addresses. Do not set this parameter to 0. If the parameter is set incorrectly, the ERR on the option card flashes, and the drive will detect the *AEr [Station Address Setting Error]*.	0 (0 - 64)	676
F6-51 (03C2)	DeviceNet Baud Rate	V/f CL-V/f OLV CLV AOLV Sets the DeviceNet communications speed. Restart the drive after you change this parameter setting. 0 : 125 kbps 1 : 250 kbps 2 : 500 kbps 3 : Adjustable from Network 4 : Detect Automatically	0 (0 - 4)	676
F6-52 (03C3)	DeviceNet PCA Setting	V/f CL-V/f OLV CLV AOLV Sets the format of data that the DeviceNet communication master sends to the drive.	21 (0 - 255)	677
F6-53 (03C4)	DeviceNet PPA Setting	V/f CL-V/f OLV CLV AOLV Sets the format of data that the drive sends to the DeviceNet communication master.	71 (0 - 255)	677
F6-54 (03C5)	DeviceNet Idle Fault Detection	V/f CL-V/f OLV CLV AOLV Sets the function to detect *EF0 [Option Card External Fault]* when the drive does not receive data from the DeviceNet master. 0 : Enabled 1 : Disabled, No Fault Detection 2 : Vendor Specific 3 : RUN Forward 4 : Reverse run	0 (0 - 4)	677
F6-55 (03C6)	DeviceNet Baud Rate Monitor	V/f CL-V/f OLV CLV AOLV Sets the function to see the actual DeviceNet communications speed using the keypad. This parameter functions as a monitor only. 0 : 125 kbps 1 : 250 kbps 2 : 500 kbps	0 (0 - 2)	677
F6-56 (03D7)	DeviceNet Speed Scaling	V/f CL-V/f OLV CLV AOLV Sets the speed scale for DeviceNet communication.	0 (-15 - +15)	677
F6-57 (03D8)	DeviceNet Current Scaling	V/f CL-V/f OLV CLV AOLV Sets the current scale of the DeviceNet communication master.	0 (-15 - +15)	677
F6-58 (03D9)	DeviceNet Torque Scaling	V/f CL-V/f OLV CLV AOLV Sets the torque scale of the DeviceNet communication master.	0 (-15 - +15)	678

No. (Hex.)	Name	Description	Default (Range)	Ref.
F6-59 (03DA)	DeviceNet Power Scaling	V/f CL-V/f OLV CLV AOLV Sets the power scale of the DeviceNet communication master.	0 (-15 - +15)	678
F6-60 (03DB)	DeviceNet Voltage Scaling	V/f CL-V/f OLV CLV AOLV Sets the voltage scale of the DeviceNet communication master.	0 (-15 - +15)	678
F6-61 (03DC)	DeviceNet Time Scaling	V/f CL-V/f OLV CLV AOLV Sets the time scale of the DeviceNet communication master.	0 (-15 - +15)	678
F6-62 (03DD)	DeviceNet Heartbeat Interval	V/f CL-V/f OLV CLV AOLV Sets the heartbeat for DeviceNet communication. Set this parameter to 0 to disable the heartbeat function.	0 (0 - 10)	678
F6-63 (03DE)	DeviceNet Network MAC ID	V/f CL-V/f OLV CLV AOLV Sets the function to see the actual DeviceNet MAC address using the keypad. This parameter functions as a monitor only.	0 (0 - 63)	678
F6-64 to F6-67 (03DF - 03E2)	Dynamic Out Assembly 109 Param 1 to 4	V/f CL-V/f OLV CLV AOLV Sets Configurable Outputs 1 to 4 written to the MEMOBUS register.	0000H (0000H - FFFFH)	678
F6-68 to F6-71 (03E3, 03E4, 03C7, and 03C8)	Dynamic In Assembly 159 Param 1 to 4	V/f CL-V/f OLV CLV AOLV Sets Configurable Inputs 1 to 4 read from the MEMOBUS register.	0000H (0000H - FFFFH)	678
F6-72 (081B)	PowerLink Node Address	V/f CL-V/f OLV CLV AOLV Sets the node ID for PowerLink communication. **Note:** Be sure to set an address that is different than all other node addresses. Do not set this parameter to 0.	0 (0 - 255)	678

◆ F7: Communication Options

No. (Hex.)	Name	Description	Default (Range)	Ref.
F7-01 (03E5)	IP Address 1	V/f CL-V/f OLV CLV AOLV Sets the first octet of the IP Address for the device that is connecting to the network. Restart the drive after you change this parameter. **Note:** When *F7-13 = 0 [Address Mode at Startup = Static]*: • Use parameters *F7-01 to F7-04 [IP Address 1 to 4]* to set the IP Address. Be sure to set a different IP address for each drive on the network. • Also set parameters *F7-05 to F7-12 [Subnet Mask 1 to 4, Gateway Address 1 to 4]*.	192 (0 - 255)	679
F7-02 (03E6)	IP Address 2	V/f CL-V/f OLV CLV AOLV Sets the second octet of the IP Address for the device that is connecting to the network. Restart the drive after you change this parameter. **Note:** When *F7-13 = 0 [Address Mode at Startup = Static]*: • Use parameters *F7-01 to F7-04 [IP Address 1 to 4]* to set the IP Address. Be sure to set a different IP address for each drive on the network. • Also set parameters *F7-05 to F7-12 [Subnet Mask 1 to 4, Gateway Address 1 to 4]*.	168 (0 - 255)	679
F7-03 (03E7)	IP Address 3	V/f CL-V/f OLV CLV AOLV Sets the third octet of the IP Address for the device that is connecting to the network. Restart the drive after you change this parameter. **Note:** When *F7-13 = 0 [Address Mode at Startup = Static]*: • Use parameters *F7-01 to F7-04 [IP Address 1 to 4]* to set the IP Address. Be sure to set a different IP address for each drive on the network. • Also set parameters *F7-05 to F7-12 [Subnet Mask 1 to 4, Gateway Address 1 to 4]*.	1 (0 - 255)	679
F7-04 (03E8)	IP Address 4	V/f CL-V/f OLV CLV AOLV Sets the fourth octet of the IP Address for the device that is connecting to the network. Restart the drive after you change this parameter. **Note:** When *F7-13 = 0 [Address Mode at Startup = Static]*: • Use parameters *F7-01 to F7-04 [IP Address 1 to 4]* to set the IP Address. Be sure to set a different IP address for each drive on the network. • Also set parameters *F7-05 to F7-12 [Subnet Mask 1 to 4, Gateway Address 1 to 4]*.	20 (0 - 255)	679
F7-05 (03E9)	Subnet Mask 1	V/f CL-V/f OLV CLV AOLV Sets the first octet of the subnet mask of the connected network. **Note:** Set this parameter when *F7-13 = 0 [Address Mode at Startup = Static]*.	255 (0 - 255)	679

No. (Hex.)	Name	Description	Default (Range)	Ref.
F7-06 (03EA)	Subnet Mask 2	V/f CL-V/f OLV CLV AOLV Sets the second octet of the subnet mask of the connected network. **Note:** Set this parameter when *F7-13 = 0 [Address Mode at Startup = Static]*.	255 (0 - 255)	680
F7-07 (03EB)	Subnet Mask 3	V/f CL-V/f OLV CLV AOLV Sets the third octet of the subnet mask of the connected network. **Note:** Set this parameter when *F7-13 = 0 [Address Mode at Startup = Static]*.	255 (0 - 255)	680
F7-08 (03EC)	Subnet Mask 4	V/f CL-V/f OLV CLV AOLV Sets the fourth octet of the subnet mask of the connected network. **Note:** Set this parameter when *F7-13 = 0 [Address Mode at Startup = Static]*.	0 (0 - 255)	680
F7-09 (03ED)	Gateway Address 1	V/f CL-V/f OLV CLV AOLV Sets the first octet of the gateway address of the connected network. **Note:** Set this parameter when *F7-13 = 0 [Address Mode at Startup = Static]*.	192 (0 - 255)	680
F7-10 (03EE)	Gateway Address 2	V/f CL-V/f OLV CLV AOLV Sets the second octet of the gateway address of the connected network. **Note:** Set this parameter when *F7-13 = 0 [Address Mode at Startup = Static]*.	168 (0 - 255)	680
F7-11 (03EF)	Gateway Address 3	V/f CL-V/f OLV CLV AOLV Sets the third octet of the gateway address of the connected network. **Note:** Set this parameter when *F7-13 = 0 [Address Mode at Startup = Static]*.	1 (0 - 255)	680
F7-12 (03F0)	Gateway Address 4	V/f CL-V/f OLV CLV AOLV Sets the fourth octet of the gateway address of the connected network. **Note:** Set this parameter when *F7-13 = 0 [Address Mode at Startup = Static]*.	1 (0 - 255)	680
F7-13 (03F1)	Address Mode at Startup	V/f CL-V/f OLV CLV AOLV Sets the method to set option card IP addresses. 0 : Static 1 : BOOTP 2 : DHCP **Note:** • The following setting values are available when using the PROFINET communication option card (SI-EP3). –0: Static –2: DHCP • When *F7-13 = 0*, set parameters *F7-01 to F7-12 [IP Address 1 to Gateway Address 4]* to set the IP Address. Be sure to set a different IP address for each drive on the network.	2 (0 - 2)	681
F7-14 (03F2)	Duplex Mode Selection	V/f CL-V/f OLV CLV AOLV Sets the duplex mode setting method. 0 : Half/Half 1 : Auto/Auto 2 : Full/Full 3 : Half/Auto 4 : Half/Full 5 : Auto/Half 6 : Auto/Full 7 : Full/Half 8 : Full/Auto	1 (0 - 8)	681
F7-15 (03F3)	Communication Speed Selection	V/f CL-V/f OLV CLV AOLV Sets the communications speed. 10 : 10/10 Mbps 100 : 100/100 Mbps 101 : 10/100 Mbps 102 : 100/10 Mbps	10 (10, 100 - 102)	681
F7-16 (03F4)	Timeout Value	V/f CL-V/f OLV CLV AOLV Sets the detection time for a communications timeout. **Note:** Set this parameter to 0.0 to disable the connection timeout function.	0.0 s (0.0 - 30.0 s)	681
F7-17 (03F5)	EtherNet/IP Speed Scaling Factor	V/f CL-V/f OLV CLV AOLV Sets the scaling factor for the speed monitor in the EtherNet/IP Class ID 2AH Object.	0 (-15 - +15)	682
F7-18 (03F6)	EtherNet/IP Current Scale Factor	V/f CL-V/f OLV CLV AOLV Sets the scaling factor for the output current monitor in the EtherNet/IP Class ID 2AH Object.	0 (-15 - +15)	682

No. (Hex.)	Name	Description	Default (Range)	Ref.
F7-19 (03F7)	EtherNet/IP Torque Scale Factor	V/f CL-V/f OLV CLV AOLV Sets the scaling factor for the torque monitor in the EtherNet/IP Class ID 2AH Object.	0 (-15 - +15)	682
F7-20 (03F8)	EtherNet/IP Power Scaling Factor	V/f CL-V/f OLV CLV AOLV Sets the scaling factor for the power monitor in the EtherNet/IP Class ID 2AH Object.	0 (-15 - +15)	682
F7-21 (03F9)	EtherNet/IP Voltage Scale Factor	V/f CL-V/f OLV CLV AOLV Sets the scaling factor for the voltage monitor in the EtherNet/IP Class ID 2AH Object.	0 (-15 - +15)	682
F7-22 (03FA)	EtherNet/IP Time Scaling	V/f CL-V/f OLV CLV AOLV Sets the scaling factor for the time monitor in the EtherNet/IP Class ID 2AH Object.	0 (-15 - +15)	682
F7-23 (03FB)	Dynamic Out Param 1 for CommCard	V/f CL-V/f OLV CLV AOLV When you use an Ethernet/IP option, sets Output Assembly 116. The drive writes the values from Output Assembly 116 to the MEMOBUS/Modbus address register that is stored for each parameter. The drive will not write the values from Output Assembly 116 to the registers when the MEMOBUS/Modbus address is 0. When you use a PROFINET option, set this parameter to set to configurable output 1.	0	682
F7-24 (03FC)	Dynamic Out Param 2 for CommCard	V/f CL-V/f OLV CLV AOLV When you use an Ethernet/IP option, sets Output Assembly 116. The drive writes the values from Output Assembly 116 to the MEMOBUS/Modbus address register that is stored for each parameter. The drive will not write the values from Output Assembly 116 to the registers when the MEMOBUS/Modbus address is 0. When you use a PROFINET option, set this parameter to set to configurable output 2.	0	682
F7-25 (03FD)	Dynamic Out Param 3 for CommCard	V/f CL-V/f OLV CLV AOLV When you use an Ethernet/IP option, sets Output Assembly 116. The drive writes the values from Output Assembly 116 to the MEMOBUS/Modbus address register that is stored for each parameter. The drive will not write the values from Output Assembly 116 to the registers when the MEMOBUS/Modbus address is 0. When you use a PROFINET option, set this parameter to set to configurable output 3.	0	682
F7-26 (03FE)	Dynamic Out Param 4 for CommCard	V/f CL-V/f OLV CLV AOLV Sets Output Assembly 116 when you use an Ethernet/IP option. The drive writes the values from Output Assembly 116 to the MEMOBUS/Modbus address register that is stored for each parameter. The drive will not write the values from Output Assembly 116 to the registers when the MEMOBUS/Modbus address is 0. When you use a ProfiNet option, set this parameter to set to configurable output 4.	0	682
F7-27 (03FF)	Dynamic Out Param 5 for CommCard	V/f CL-V/f OLV CLV AOLV When you use an Ethernet/IP option, sets Output Assembly 116. The drive writes the values from Output Assembly 116 to the MEMOBUS/Modbus address register that is stored for each parameter. The drive will not write the values from Output Assembly 116 to the registers when the MEMOBUS/Modbus address is 0. When you use a PROFINET option, set this parameter to set to configurable output 5.	0	682
F7-28 (0370)	Dynamic Out Param 6 for CommCard	V/f CL-V/f OLV CLV AOLV When you use an Ethernet/IP option, sets Output Assembly 116. The drive writes the values from Output Assembly 116 to the MEMOBUS/Modbus address register that is stored for each parameter. The drive will not write the values from Output Assembly 116 to the registers when the MEMOBUS/Modbus address is 0.	0	682
F7-29 (0371)	Dynamic Out Param 7 for CommCard	V/f CL-V/f OLV CLV AOLV When you use an Ethernet/IP option, sets Output Assembly 116. The drive writes the values from Output Assembly 116 to the MEMOBUS/Modbus address register that is stored for each parameter. The drive will not write the values from Output Assembly 116 to the registers when the MEMOBUS/Modbus address is 0.	0	682
F7-30 (0372)	Dynamic Out Param 8 for CommCard	V/f CL-V/f OLV CLV AOLV When you use an Ethernet/IP option, sets Output Assembly 116. The drive writes the values from Output Assembly 116 to the MEMOBUS/Modbus address register that is stored for each parameter. The drive will not write the values from Output Assembly 116 to the registers when the MEMOBUS/Modbus address is 0.	0	682
F7-31 (0373)	Dynamic Out Param 9 for CommCard	V/f CL-V/f OLV CLV AOLV When you use an Ethernet/IP option, sets Output Assembly 116. The drive writes the values from Output Assembly 116 to the MEMOBUS/Modbus address register that is stored for each parameter. The drive will not write the values from Output Assembly 116 to the registers when the MEMOBUS/Modbus address is 0.	0	682
F7-32 (0374)	Dynamic Out Param 10 for CommCard	V/f CL-V/f OLV CLV AOLV When you use an Ethernet/IP option, sets Output Assembly 116. The drive writes the values from Output Assembly 116 to the MEMOBUS/Modbus address register that is stored for each parameter. The drive will not write the values from Output Assembly 116 to the registers when the MEMOBUS/Modbus address is 0.	0	682
F7-33 (0375)	Dynamic In Param 1 for CommCard	V/f CL-V/f OLV CLV AOLV Sets Input Assembly 166 when you use an Ethernet/IP option. The drive sends the values from the MEMOBUS/Modbus address registers stored for each parameter to Input Assembly 166. The drive returns the default register value for the option card when the MEMOBUS/Modbus address is 0 and the value sent to Input Assembly 166 is not defined. When you use a ProfiNet option, set this parameter to set to configurable input 1.	0	682
F7-34 (0376)	Dynamic In Param 2 for CommCard	V/f CL-V/f OLV CLV AOLV Sets Input Assembly 166 when you use an Ethernet/IP option. The drive sends the values from the MEMOBUS/Modbus address registers stored for each parameter to Input Assembly 166. The drive returns the default register value for the option card when the MEMOBUS/Modbus address is 0 and the value sent to Input Assembly 166 is not defined. When you use a ProfiNet option, set this parameter to set to configurable input 2.	0	682

No. (Hex.)	Name	Description	Default (Range)	Ref.
F7-35 (0377)	Dynamic In Param 3 for CommCard	V/f CL-V/f OLV CLV AOLV Sets Input Assembly 166 when you use an Ethernet/IP option. The drive sends the values from the MEMOBUS/Modbus address registers stored for each parameter to Input Assembly 166. The drive returns the default register value for the option card when the MEMOBUS/Modbus address is 0 and the value sent to Input Assembly 166 is not defined. When you use a ProfiNet option, set this parameter to set to configurable input 3.	0	682
F7-36 (0378)	Dynamic In Param 4 for CommCard	V/f CL-V/f OLV CLV AOLV Sets Input Assembly 166 when you use an Ethernet/IP option. The drive sends the values from the MEMOBUS/Modbus address registers stored for each parameter to Input Assembly 166. The drive returns the default register value for the option card when the MEMOBUS/Modbus address is 0 and the value sent to Input Assembly 166 is not defined. When you use a ProfiNet option, set this parameter to set to configurable input 4.	0	682
F7-37 (0379)	Dynamic In Param 5 for CommCard	V/f CL-V/f OLV CLV AOLV Sets Input Assembly 166 when you use an Ethernet/IP option. The drive sends the values from the MEMOBUS/Modbus address registers stored for each parameter to Input Assembly 166. The drive returns the default register value for the option card when the MEMOBUS/Modbus address is 0 and the value sent to Input Assembly 166 is not defined. When you use a ProfiNet option, set this parameter to set to configurable input 5.	0	682
F7-38 (037A)	Dynamic In Param 6 for CommCard	V/f CL-V/f OLV CLV AOLV Sets Input Assembly 166 when you use an Ethernet/IP option. The drive sends the values from the MEMOBUS/Modbus address registers stored for each parameter to Input Assembly 166. The drive returns the default register value for the option card when the MEMOBUS/Modbus address is 0 and the value sent to Input Assembly 166 is not defined.	0	682
F7-39 (037B)	Dynamic In Param 7 for CommCard	V/f CL-V/f OLV CLV AOLV Sets Input Assembly 166 when you use an Ethernet/IP option. The drive sends the values from the MEMOBUS/Modbus address registers stored for each parameter to Input Assembly 166. The drive returns the default register value for the option card when the MEMOBUS/Modbus address is 0 and the value sent to Input Assembly 166 is not defined.	0	682
F7-40 (037C)	Dynamic In Param 8 for CommCard	V/f CL-V/f OLV CLV AOLV Sets Input Assembly 166 when you use an Ethernet/IP option. The drive sends the values from the MEMOBUS/Modbus address registers stored for each parameter to Input Assembly 166. The drive returns the default register value for the option card when the MEMOBUS/Modbus address is 0 and the value sent to Input Assembly 166 is not defined.	0	682
F7-41 (037D)	Dynamic In Param 9 for CommCard	V/f CL-V/f OLV CLV AOLV Sets Input Assembly 166 when you use an Ethernet/IP option. The drive sends the values from the MEMOBUS/Modbus address registers stored for each parameter to Input Assembly 166. The drive returns the default register value for the option card when the MEMOBUS/Modbus address is 0 and the value sent to Input Assembly 166 is not defined.	0	682
F7-42 (037E)	Dynamic In Param 10 for CommCard	V/f CL-V/f OLV CLV AOLV Sets Input Assembly 166 when you use an Ethernet/IP option. The drive sends the values from the MEMOBUS/Modbus address registers stored for each parameter to Input Assembly 166. The drive returns the default register value for the option card when the MEMOBUS/Modbus address is 0 and the value sent to Input Assembly 166 is not defined.	0	682
F7-60 (0780)	PZD1 Write (Control Word)	V/f CL-V/f OLV CLV AOLV When you use a Profibus option, set the MEMOBUS/Modbus address for PZD1 (PPO output). PZD1 (PPO output) functions as the STW when *F7-60 = 0 to 2*.	0	683
F7-61 (0781)	PZD2 Write (Frequency Reference)	V/f CL-V/f OLV CLV AOLV When you use a Profibus option, sets the MEMOBUS/Modbus address for PZD2 (PPO output). PZD2 (PPO output) functions as the HSW when *F7-61 = 0 to 2*.	0	683
F7-62 (0782)	PZD3 Write	V/f CL-V/f OLV CLV AOLV When you use a Profibus option, sets the MEMOBUS/Modbus address for PZD3 (PPO output). A value of 0, 1, or 2 will disable the PZD3 (PPO output) write operation to the MEMOBUS/Modbus register.	0	683
F7-63 (0783)	PZD4 Write	V/f CL-V/f OLV CLV AOLV When you use a Profibus option, sets the MEMOBUS/Modbus address for PZD4 (PPO output). A value of 0, 1, or 2 will disable the PZD4 (PPO output) write operation to the MEMOBUS/Modbus register.	0	683
F7-64 (0784)	PZD5 Write	V/f CL-V/f OLV CLV AOLV When you use a Profibus option, sets the MEMOBUS/Modbus address for PZD5 (PPO output). A value of 0, 1, or 2 will disable the PZD5 (PPO output) write operation to the MEMOBUS/Modbus register.	0	683
F7-65 (0785)	PZD6 Write	V/f CL-V/f OLV CLV AOLV When you use a Profibus option, sets the MEMOBUS/Modbus address for PZD6 (PPO output). A value of 0, 1, or 2 will disable the PZD6 (PPO output) write operation to the MEMOBUS/Modbus register.	0	683
F7-66 (0786)	PZD7 Write	V/f CL-V/f OLV CLV AOLV When you use a Profibus option, sets the MEMOBUS/Modbus address for PZD7 (PPO output). A value of 0, 1, or 2 will disable the PZD7 (PPO output) write operation to the MEMOBUS/Modbus register.	0	683

No. (Hex.)	Name	Description	Default (Range)	Ref.
F7-67 (0787)	PZD8 Write	V/f CL-V/f OLV CLV AOLV When you use a Profibus option, sets the MEMOBUS/Modbus address for PZD8 (PPO output). A value of 0, 1, or 2 will disable the PZD8 (PPO output) write operation to the MEMOBUS/Modbus register.	0	683
F7-68 (0788)	PZD9 Write	V/f CL-V/f OLV CLV AOLV When you use a Profibus option, sets the MEMOBUS/Modbus address for PZD9 (PPO output). A value of 0, 1, or 2 will disable the PZD9 (PPO output) write operation to the MEMOBUS/Modbus register.	0	684
F7-69 (0789)	PZD10 Write	V/f CL-V/f OLV CLV AOLV When you use a Profibus option, sets the MEMOBUS/Modbus address for PZD10 (PPO output). A value of 0, 1, or 2 will disable the PZD10 (PPO output) write operation to the MEMOBUS/Modbus register.	0	684
F7-70 (078A)	PZD1 Read (Status Word)	V/f CL-V/f OLV CLV AOLV When you use a Profibus option, sets the MEMOBUS/Modbus address for PZD1 (PPO input). PZD1 (PPO input) functions as the ZSW when *F7-70 = 0*.	0	684
F7-71 (078B)	PZD2 Read (Output Frequency)	V/f CL-V/f OLV CLV AOLV When you use a Profibus option, sets the MEMOBUS/Modbus address for PZD2 (PPO input). PZD2 (PPO input) functions as the HIW when *F7-71 = 0*.	0	684
F7-72 (078C)	PZD3 Read	V/f CL-V/f OLV CLV AOLV When you use a Profibus option, sets the MEMOBUS/Modbus address for PZD3 (PPO input). A value of 0 will disable the PZD3 (PPO input) load operation from the MEMOBUS/Modbus register.	0	684
F7-73 (078D)	PZD4 Read	V/f CL-V/f OLV CLV AOLV When you use a Profibus option, sets the MEMOBUS/Modbus address for PZD4 (PPO input). A value of 0 will disable the PZD4 (PPO input) load operation from the MEMOBUS/Modbus register.	0	684
F7-74 (078E)	PZD5 Read	V/f CL-V/f OLV CLV AOLV When you use a Profibus option, sets the MEMOBUS/Modbus address for PZD5 (PPO input). A value of 0 will disable the PZD5 (PPO input) load operation from the MEMOBUS/Modbus register.	0	684
F7-75 (078F)	PZD6 Read	V/f CL-V/f OLV CLV AOLV When you use a Profibus option, sets the MEMOBUS/Modbus address for PZD6 (PPO input). A value of 0 will disable the PZD6 (PPO input) load operation from the MEMOBUS/Modbus register.	0	684
F7-76 (0790)	PZD7 Read	V/f CL-V/f OLV CLV AOLV When you use a Profibus option, sets the MEMOBUS/Modbus address for PZD7 (PPO input). A value of 0 will disable the PZD7 (PPO input) load operation from the MEMOBUS/Modbus register.	0	685
F7-77 (0791)	PZD8 Read	V/f CL-V/f OLV CLV AOLV When you use a Profibus option, sets the MEMOBUS/Modbus address for PZD8 (PPO input). A value of 0 will disable the PZD8 (PPO input) load operation from the MEMOBUS/Modbus register.	0	685
F7-78 (0792)	PZD9 Read	V/f CL-V/f OLV CLV AOLV When you use a Profibus option, sets the MEMOBUS/Modbus address for PZD9 (PPO input). A value of 0 will disable the PZD9 (PPO input) load operation from the MEMOBUS/Modbus register.	0	685
F7-79 (0793)	PZD10 Read	V/f CL-V/f OLV CLV AOLV When you use a Profibus option, sets the MEMOBUS/Modbus address for PZD10 (PPO input). A value of 0 will disable the PZD10 (PPO input) load operation from the MEMOBUS/Modbus register.	0	685

10.10 H: Terminal Functions

◆ H1: Digital Inputs

No. (Hex.)	Name	Description	Default (Range)	Ref.
H1-01 (0438)	Terminal S1 Function Selection	V/f CL-V/f OLV CLV AOLV Sets the function for MFDI terminal S1.	40 (0 - 1FF)	687
H1-02 (0439)	Terminal S2 Function Selection	V/f CL-V/f OLV CLV AOLV Sets the function for MFDI terminal S2.	41 (0 - 1FF)	687
H1-03 (0400)	Terminal S3 Function Selection	V/f CL-V/f OLV CLV AOLV Sets the function for MFDI terminal S3.	24 (0 - 1FF)	687
H1-04 (0401)	Terminal S4 Function Selection	V/f CL-V/f OLV CLV AOLV Sets the function for MFDI terminal S4.	14 (0 - 1FF)	687
H1-05 (0402)	Terminal S5 Function Selection	V/f CL-V/f OLV CLV AOLV Sets the function for MFDI terminal S5.	0 (0 - 1FF)	687
H1-06 (0403)	Terminal S6 Function Selection	V/f CL-V/f OLV CLV AOLV Sets the function for MFDI terminal S6.	3 (0 - 1FF)	687
H1-07 (0404)	Terminal S7 Function Selection	V/f CL-V/f OLV CLV AOLV Sets the function for MFDI terminal S7.	4 (0 - 1FF)	687
H1-08 (0405)	Terminal S8 Function Selection	V/f CL-V/f OLV CLV AOLV Sets the function for MFDI terminal S8.	9 (0 - 1FF)	687
H1-09 (0406)	Terminal S9 Function Selection	V/f CL-V/f OLV CLV AOLV Sets the function for MFDI terminal S9.	F (0 - 1FF)	688
H1-10 (0407)	Terminal S10 Function Selection	V/f CL-V/f OLV CLV AOLV Sets the function for MFDI terminal S10.	F (0 - 1FF)	688
H1-21 (0B70)	Terminal S1 Function Select 2	V/f CL-V/f OLV CLV AOLV Sets the second function for MFDI terminal S1.	F (0 - 1FF)	688
H1-22 (0B71)	Terminal S2 Function Select 2	V/f CL-V/f OLV CLV AOLV Sets the second function for MFDI terminal S2.	F (0 - 1FF)	688
H1-23 (0B72)	Terminal S3 Function Select 2	V/f CL-V/f OLV CLV AOLV Sets the second function for MFDI terminal S3.	F (0 - 1FF)	688
H1-24 (0B73)	Terminal S4 Function Select 2	V/f CL-V/f OLV CLV AOLV Sets the second function for MFDI terminal S4.	F (0 - 1FF)	688
H1-25 (0B74)	Terminal S5 Function Select 2	V/f CL-V/f OLV CLV AOLV Sets the second function for MFDI terminal S5.	F (0 - 1FF)	688
H1-26 (0B75)	Terminal S6 Function Select 2	V/f CL-V/f OLV CLV AOLV Sets the second function for MFDI terminal S6.	F (0 - 1FF)	689
H1-27 (0B76)	Terminal S7 Function Select 2	V/f CL-V/f OLV CLV AOLV Sets the second function for MFDI terminal S7.	F (0 - 1FF)	689
H1-28 (0B77)	Terminal S8 Function Select 2	V/f CL-V/f OLV CLV AOLV Sets the second function for MFDI terminal S8.	F (0 - 1FF)	689
H1-29 (0B78)	Terminal S9 Function Select 2	V/f CL-V/f OLV CLV AOLV Sets the second function for MFDI terminal S9.	F (0 - 1FF)	689
H1-30 (0B79)	Terminal S10 Function Select 2	V/f CL-V/f OLV CLV AOLV Sets the second function for MFDI terminal S10.	F (0 - 1FF)	689
H1-40 (0B54)	Mbus Reg 15C0h bit0 Input Func	V/f CL-V/f OLV CLV AOLV Sets MFDI function to set to *bit 0* of the MEMOBUS register *15C0(Hex.)*.	F (0 - 1FF)	690
H1-41 (0B55)	Mbus Reg 15C0h bit1 Input Func	V/f CL-V/f OLV CLV AOLV Sets MFDI function to set to *bit 1* of the MEMOBUS register *15C0(Hex.)*.	F (0 - 1FF)	690
H1-42 (0B56)	Mbus Reg 15C0h bit2 Input Func	V/f CL-V/f OLV CLV AOLV Selects MFDI function assigned to *bit 2* of the MEMOBUS register *15C0(Hex.)*.	F (0 - 1FF)	690

■ H1-xx: MFDI Setting Values

Setting Value	Function	Description	Ref.
0	Brake Release Check	V/f CL-V/f OLV CLV AOLV Set the wiring sequence to turn ON the brake release check when the brake release command turns ON. **Note:** Set the sequence external to the drive to use the ON and OFF states of the terminal to do these operations. ON : The brake releases. OFF : The brake tightens.	690 195 226
2	External Reference 1/2 Selection	V/f CL-V/f OLV CLV AOLV Sets the drive to use Run command source 1/2 or Reference command source 1/2 when in REMOTE Mode. ON : *b1-15 [Frequency Reference Selection 2], b1-16 [Run Command Selection 2]* OFF : *b1-01 [Frequency Reference Selection 1], b1-02 [Run Command Selection 1]*	690
3	Multi-Step Speed Reference 1	V/f CL-V/f OLV CLV AOLV Uses speed references *d1-01 to d1-16* to set a multi-step speed reference.	690
4	Multi-Step Speed Reference 2	V/f CL-V/f OLV CLV AOLV Uses speed references *d1-01 to d1-16* to set a multi-step speed reference.	690
5	Multi-Step Speed Reference 3	V/f CL-V/f OLV CLV AOLV Uses speed references *d1-01 to d1-16* to set a multi-step speed reference.	691
6	Jog Reference Selection	V/f CL-V/f OLV CLV AOLV Sets the drive to use the JOG Frequency Reference (JOG command) set in *d1-17*. The JOG Frequency command overrides *Frequency References 1 to 8 (d1-01 to d1-08)*.	691
7	Accel/Decel Time Selection 1	V/f CL-V/f OLV CLV AOLV Sets the drive to use *Acceleration/Deceleration Time 1 [C1-01, C1-02]* or *Acceleration/Deceleration Time 2 [C1-03, C1-04]*.	691
8	Baseblock Command (N.O.)	V/f CL-V/f OLV CLV AOLV Sets the command that stops drive output and coasts the motor to stop when a baseblock command (N.O.) is input. ON : Baseblock (drive output stop) OFF : Normal operation	691
9	Baseblock Command (N.C.)	V/f CL-V/f OLV CLV AOLV Sets the command that stops drive output and coasts the motor to stop when baseblock command (N.C.) is input (turned OFF). ON : Normal operation OFF : Baseblock (drive output stop)	691
A	Accel/Decel Ramp Hold	V/f CL-V/f OLV CLV AOLV Momentarily pauses motor acceleration and deceleration when the terminal is turned ON, retains the output frequency that was stored in the drive at the time of the pause, and restarts motor operation.	692
B	Overheat Alarm (oH2)	V/f CL-V/f OLV CLV AOLV Sets the drive to show an *oH2 [External Overheat (H1-XX=B)]* alarm when the input terminal is ON. The alarm does not have an effect on drive operation.	692
C	Analog Terminal Enable Selection	V/f CL-V/f OLV CLV AOLV Sets the command that enables or disables the terminals selected in *H3-14 [Analog Input Terminal Enable Sel]*. ON : Terminal selected with *H3-14* is enabled OFF : Terminal selected with *H3-14* is disabled	692
D	Ignore Speed Fdbk (V/f w/o Enc)	V/f CL-V/f OLV CLV AOLV Sets the command to disable speed feedback control and run the drive in V/f control or use speed feedback from the encoder. ON : Speed feedback control disable (V/f Control) OFF : Speed feedback control enable (Closed Loop V/f Control)	692
E	ASR Integral Reset	V/f CL-V/f OLV CLV AOLV Sets the command to reset the integral value and use PI control or P control for the speed control loop. ON : P control OFF : PI control	692
F	Not Used	V/f CL-V/f OLV CLV AOLV Use this setting for unused terminals or to use terminals in through mode.	692
10	Up Command	V/f CL-V/f OLV CLV AOLV You must also set Setting *11 [Down Command]*. Sets the command to use a push button switch to decrease the drive frequency reference ON : Increases the frequency reference. OFF : Holds the current frequency reference.	693
11	Down Command	V/f CL-V/f OLV CLV AOLV You must also set Setting *10 [Up Command]*. Sets the command to use a push button switch to decrease the drive frequency reference ON : Decreases the frequency reference. OFF : Holds the current frequency reference.	694
12	Forward Jog	V/f CL-V/f OLV CLV AOLV Sets the command to operate the motor in the forward direction at the Jog Frequency set in *d1-17 [Jog Reference]*.	694

Setting Value	Function	Description	Ref.
13	Reverse Jog	V/f CL-V/f OLV CLV AOLV Sets the command to operate the motor in the reverse direction at the Jog Frequency set in *d1-17 [Jog Reference]*.	695
14	Fault Reset	V/f CL-V/f OLV CLV AOLV Sets the command to reset the current fault when the Run command is inactive. **Note:** The drive ignores the fault reset command when the Run command is active. Remove the Run command before trying to reset a fault.	695
15	Fast Stop (N.O.)	V/f CL-V/f OLV CLV AOLV Sets the command to ramp to stop in the deceleration time set in *C1-09 [Fast Stop Time]* when the input terminal is ON while the drive is operating.	695
16	Motor 2 Selection	V/f CL-V/f OLV CLV AOLV Switches between motor 1 or motor 2. Switch the motor while the motor is stopped. ON : Selects motor 2 OFF : Selects motor 1	695 216 226
17	Fast Stop (N.C.)	V/f CL-V/f OLV CLV AOLV Sets the command to ramp to stop in the deceleration time set in *C1-09 [Fast Stop Time]* when the input terminal is ON while the drive is operating.	696
1A	Accel/Decel Time Selection 2	V/f CL-V/f OLV CLV AOLV Set this function and *H1-xx = 7 [Accel/Decel Time Selection 1]* together. Sets the drive to use *Acceleration/ Deceleration Time 3 [C1-05, C1-06]* or *Acceleration/Deceleration Time 4 [C1-07, C1-08]*.	696
1B	Programming Lockout	V/f CL-V/f OLV CLV AOLV Sets the command to prevent parameter changes when the terminal is OFF. ON : Programming Lockout OFF : Parameter Write Prohibit	696
1E	Reference Sample Hold	V/f CL-V/f OLV CLV AOLV Samples the analog frequency reference input to the terminals A1, A2, or A3, and continues operation at the sampled frequency.	697
20 to 2F	External Fault	V/f CL-V/f OLV CLV AOLV Sets a command to stop the drive when a failure or fault occurs on an external device. 20 : External Fault (NO-Always-Ramp) 21 : External Fault (NC-Always-Ramp) 22 : External Fault (NO-@Run-Ramp) 23 : External Fault (NC-@Run-Ramp) 24 : External Fault (NO-Always-Coast) 25 : External Fault (NC-Always-Coast) 26 : External Fault (NO-@Run-Coast) 27 : External Fault (NC-@Run-Coast) 28 : External Fault (NO-Always-FStop) 29 : External Fault (NC-Always-FStop) 2A : External Fault (NO-@Run-FStop) 2B : External Fault (NC-@Run-FStop) 2C : External Fault (NO-Always-Alarm) 2D : External Fault (NC-Always-Alarm) 2E : External Fault (NO-@Run-Alarm) 2F : External Fault (NC-@Run-Alarm)	697
30	Light-load Accel 1 Enabled	V/f CL-V/f OLV CLV AOLV Enables or disables the selection of Light-Load Accel 1 Enabled function. ON : Enabled OFF : Disable	698 207 226
31	Forward Travel Limit (N.O.)	V/f CL-V/f OLV CLV AOLV If you turn on a terminal while a motor rotates forward, the drive turns off the brake release command (holds the brake), the motor coasts to stop, and the output frequency becomes 0. If you turn on a terminal while a motor rotates in reverse, the motor will not stop. ON : Disables the forward operation Run command. OFF : Enables the forward operation Run command.	698 215 226
32	Forward Travel Limit (N.C.)	V/f CL-V/f OLV CLV AOLV If you turn off a terminal while a motor rotates forward, the drive turns off the brake release command (holds the brake), the motor coasts to stop, and the output frequency becomes 0. If you turn off a terminal while a motor rotates in reverse, the motor will not stop. ON : Enables the forward operation Run command. OFF : Disables the forward operation Run command.	698 215 226
33	Reverse Travel Limit (N.O.)	V/f CL-V/f OLV CLV AOLV If you turn on a terminal while a motor rotates in reverse, the drive turns off the brake release command (holds the brake), the motor coasts to stop, and the output frequency becomes 0. If you turn on a terminal while a motor rotates forward, the motor will not stop. ON : Disables the reverse operation Run command. OFF : Enables the reverse operation Run command.	698 215 226

Setting Value	Function	Description	Ref.
34	Reverse Travel Limit (N. C.)	V/f CL-V/f OLV CLV AOLV If you turn off a terminal while a motor rotates in reverse, the drive turns off the brake release command (holds the brake), the motor coasts to stop, and the output frequency becomes 0. If you turn off a terminal while a motor rotates forward, the motor will not stop. ON : Enables the reverse operation Run command. OFF : Disables the reverse operation Run command.	699 215 226
35	Impact Stop Enable	V/f CL-V/f OLV CLV AOLV When the terminal is ON and the drive receives a stop command while the output frequency is more than the impact stop creep frequency, the drive decelerates until it is at the set impact stop creep frequency. ON : Enables the Impact Stop function. OFF : Cancel the Impact Stop function and turn OFF the brake release command.	699 206 226
36	Light-load Accel 2 Enabled	V/f CL-V/f OLV CLV AOLV Enables or disables the selection of Light-Load Accel 2 Enabled function. ON : Enabled OFF : Disable	699 210 226
37	Multi-Step Speed Reference 4	V/f CL-V/f OLV CLV AOLV Uses speed references *d1-01 to d1-16* to set a multi-step speed reference. **Note:** On drives with software versions PRG: 01021 and later, this function is enabled.	699
38	Counterweight Selection	V/f CL-V/f OLV CLV AOLV Switch *C4-02 [Torque Compensation Delay Time]*, *E1-08 [Mid Point A Voltage]* and *E1-10 [Minimum Output Voltage]*. The drive decides parameters based on the combination of the condition of the terminals ON or OFF and Run command orientation (Forward/Reverse).	699 220 226
39	Motor 3 Selection	V/f CL-V/f OLV CLV AOLV Switches motor 1 or motor 2 to motor 3. Switch the motor while the motor is stopped. ON : Selects motor 3 OFF : Select motor 1 or motor 2 (Select the terminal set to *H1-xx = 16 [Motor 2 Selection]*) **Note:** Set *H1-xx = 16*, when you set *H1-xx = 39*. If you set *H1-xx = 39*, but do not set *H1-xx = 16*, the drive will detect *oPE03 [Multi-Function Input Setting Err]*.	699 216 226
3A	Micro Speed Gain1	V/f CL-V/f OLV CLV AOLV Multiplies the gain set in *S2-16 [Micro Speed Gain1]* by the final step of frequency reference when the terminal is ON.	700 216 226
3B	Micro Speed Gain2	V/f CL-V/f OLV CLV AOLV Multiplies the gain set in *S2-17 [Micro Speed Gain2]* by the final step of frequency reference when the terminal is ON.	700 216 226
40	Forward RUN (2-Wire)	V/f CL-V/f OLV CLV AOLV Input the Forward Run command for 2-wire sequence 1. Use it paired with the *Reverse Run Command (2-Wire Seq) [H1-xx = 41]*. ON : Forward Run OFF : Run Stop **Note:** • When the both Forward run command and Reverse run command terminals have been turned ON, the drive detects *EF [FWD/REV Run Command Input Error]* (minor fault), and the motor ramps to stop. • The Forward run/Reverse run command is set to terminals S1 and S2 when you initialize the drive for 2-wire sequence.	700
41	Reverse RUN (2-Wire)	V/f CL-V/f OLV CLV AOLV Input the Reverse run command for 2-wire sequence 1. Use it paired with the *Forward Run Command (2-Wire Seq) [H1-xx = 40]*. ON : Reverse Run OFF : Run Stop **Note:** • When the both Forward run command and Reverse run command terminals have been turned ON, the drive detects *EF [FWD/REV Run Command Input Error]* (minor fault), and the motor ramps to stop. • The Reverse run command is set to terminal S2 when you initialize the drive for 2-wire sequence.	700
44	Add Offset Frequency 1 (d7-01)	V/f CL-V/f OLV CLV AOLV Sets the function to add the offset frequency set in *d7-01 [Offset Frequency 1]* to the frequency reference when the terminal activates.	700
45	Add Offset Frequency 2 (d7-02)	V/f CL-V/f OLV CLV AOLV Sets the function to add the offset frequency set in *d7-02 [Offset Frequency 2]* to the frequency reference when the terminal activates.	700
46	Add Offset Frequency 3 (d7-03)	V/f CL-V/f OLV CLV AOLV Sets the function to add the offset frequency set in *d7-03 [Offset Frequency 3]* to the frequency reference when the terminal activates.	701
47	Node Setup (CANopen)	V/f CL-V/f OLV CLV AOLV Sets the function in CANopen communications to start the Node Setup function to set the drive node address from the host controller.	701
60	DC Injection Braking Command	V/f CL-V/f OLV CLV AOLV Sets the command to use DC Injection Braking to stop the motor.	701

Setting Value	Function	Description	Ref.
67	Communications Test Mode	V/f CL-V/f OLV CLV AOLV Set the function for the drive to self-test RS-485 serial communications operation.	701
72	Zero Servo	V/f CL-V/f OLV CLV AOLV Sets the function to hold a stopped motor.	701
100 - 1FF	Inverse Inputs of 0 to FF	Sets the function of the selected MFDI to operate inversely. To select the function, enter "1xx", where "xx" is the function setting value. **Note:** You cannot use inverse input for all functions. Refer to Table 11.26 for more information.	701

◆ H2: Digital Outputs

No. (Hex.)	Name	Description	Default (Range)	Ref.
H2-01 (040B)	Term M1-M2 Function Selection	V/f CL-V/f OLV CLV AOLV Sets the function for MFDO terminal M1-M2. **Note:** When you do not use the terminal or when you use the terminal in through mode, set this parameter to *F*.	21 (0 - 1FF)	704
H2-02 (040C)	Term M3-M4 Function Selection	V/f CL-V/f OLV CLV AOLV Sets the function for MFDO terminal M3-M4. **Note:** When you do not use the terminal or when you use the terminal in through mode, set this parameter to *F*.	0 (0 - 1FF)	704
H2-03 (040D)	Term M5-M6 Function Selection	V/f CL-V/f OLV CLV AOLV Sets the function for MFDO terminal M5-M6. **Note:** When you do not use the terminal or when you use the terminal in through mode, set this parameter to F.	2 (0 - 1FF)	704
H2-04 (040E)	Term P1-C1 Function Selection	V/f CL-V/f OLV CLV AOLV Sets the function for MFDO terminal P1-C1. **Note:** When you do not use the terminal or when you use the terminal in through mode, set this parameter to F.	6 (0 - 1FF)	704
H2-05 (040F)	Term P2-C2 Function Selection	V/f CL-V/f OLV CLV AOLV Sets the function for MFDO terminal P2-C2. **Note:** When you do not use the terminal or when you use the terminal in through mode, set this parameter to F.	10 (0 - 1FF)	704
H2-06 (0437)	Watt Hour Output Unit Selection	V/f CL-V/f OLV CLV AOLV Sets the unit for the output signal when *H2-01 to H2-05 = 39 [MFDO Function Selection = Watt Hour Pulse Output]*. 0 : 0.1 kWh units 1 : 1 kWh units 2 : 10 kWh units 3 : 100 kWh units 4 : 1000 kWh units	0 (0 - 4)	704
H2-07 (0B3A)	Modbus Register 1 Address Select	V/f CL-V/f OLV CLV AOLV Sets the address of the MEMOBUS/Modbus register output to the MFDO terminal.	0001 (0001 - 1FFF)	705
H2-08 (0B3B)	Modbus Register 1 Bit Select	V/f CL-V/f OLV CLV AOLV Sets the bit of the MEMOBUS/Modbus register output to the MFDO terminal.	0000 (0000 - FFFF)	705
H2-09 (0B3C)	Modbus Register 2 Address Select	V/f CL-V/f OLV CLV AOLV Sets the address of the MEMOBUS/Modbus register output to the MFDO terminal.	0001 (0001 - 1FFF)	705
H2-10 (0B3D)	Modbus Register 2 Bit Select	V/f CL-V/f OLV CLV AOLV Sets the bit of the MEMOBUS/Modbus register output to the MFDO terminal.	0000 (0000 - FFFF)	705
H2-20 (1540)	Comparator 1 Monitor Selection	V/f CL-V/f OLV CLV AOLV Sets the monitor number for comparator 1. Set the *x-xx* part of the *Ux-xx [Monitor]*. For example, set *H2-20 = 102* to monitor *U1-02 [Output Frequency]*.	102 (000 - 999)	706
H2-21 (1541)	Comparator 1 Lower Limit	V/f CL-V/f OLV CLV AOLV Sets the lower limit detection level for comparator 1 when the full scale analog output for the monitor selected in *H2-20 [Comparator 1 Monitor Selection]* is the 100% value.	0.0% (0.0 - 300.0%)	706
H2-22 (1542)	Comparator 1 Upper Limit	V/f CL-V/f OLV CLV AOLV Sets the upper limit detection level for comparator 1 when the full scale analog output for the monitor selected in *H2-20 [Comparator 1 Monitor Selection]* is the 100% value.	0.0% (0.0 - 300.0%)	706
H2-23 (1543)	Comparator 1 Hysteresis	V/f CL-V/f OLV CLV AOLV Sets the hysteresis level for comparator 1 as a percentage of the full scale analog output for the monitor selected in *H2-20 [Comparator 1 Monitor Selection]*.	0.0% (0.0 - 10.0%)	706

No. (Hex.)	Name	Description	Default (Range)	Ref.
H2-24 (1544)	Comparator 1 On-Delay Time	V/f CL-V/f OLV CLV AOLV Sets the on-delay time for comparator 1.	0.0 s (0.0 - 600.0 s)	706
H2-25 (1545)	Comparator 1 Off-Delay Time	V/f CL-V/f OLV CLV AOLV Sets the off-delay time for comparator 1.	0.0 s (0.0 - 600.0 s)	706
H2-26 (1546)	Comparator 2 Monitor Selection	V/f CL-V/f OLV CLV AOLV Sets the monitor number for comparator 2. Set the *x-xx* part of the *Ux-xx [Monitor]*. For example, set *H2-26 = 103* to monitor *U1-03 [Output Current]*.	103 (000 - 999)	707
H2-27 (1547)	Comparator 2 Lower Limit	V/f CL-V/f OLV CLV AOLV Sets the lower limit detection level for comparator 2 as a percentage of the full scale analog output for the monitor selected in *H2-26 [Comparator 2 Monitor Selection]*.	0.0% (0.0 - 300.0%)	707
H2-28 (1548)	Comparator 2 Upper Limit	V/f CL-V/f OLV CLV AOLV Sets the upper limit detection level for comparator 2 as a percentage of the full scale analog output for the monitor selected in *H2-26 [Comparator 2 Monitor Selection]*.	0.0% (0.0 - 300.0%)	707
H2-29 (1549)	Comparator 2 Hysteresis	V/f CL-V/f OLV CLV AOLV Sets the hysteresis level for comparator 2 as a percentage of the full scale analog output for the monitor selected in *H2-26 [Comparator 2 Monitor Selection]*.	0.0% (0.0 - 10.0%)	707
H2-30 (154A)	Comparator 2 On-Delay Time	V/f CL-V/f OLV CLV AOLV Sets the on-delay time for comparator 2.	0.0 s (0.0 - 600.0 s)	707
H2-31 (154B)	Comparator 2 Off-Delay Time	V/f CL-V/f OLV CLV AOLV Sets the off-delay time for comparator 2.	0.0 s (0.0 - 600.0 s)	707
H2-32 (159A)	Comparator 1 Filter Time	V/f CL-V/f OLV CLV AOLV Sets the time constant that is applied to the primary delay filter used for the analog output of the monitor selected with *H2-20 [Comparator 1 Monitor Selection]*.	0.0s (0.0 - 10.0 s)	708
H2-33 (159B)	Comparator1 Protection Selection	V/f CL-V/f OLV CLV AOLV Selects the operation of the drive when it detects *CP1 [Comparator1 Limit Fault]*. 0 : Ramp to Stop 1 : Coast to Stop 2 : Fast Stop (Use C1-09) 3 : Alarm Only 4 : Digital Output Only	4 (0 - 4)	708
H2-34 (159C)	Comparator 2 Filter Time	V/f CL-V/f OLV CLV AOLV Sets the time constant that is applied to the primary delay filter used for the analog output of the monitor selected with *H2-26 [Comparator 2 Monitor Selection]*.	0.0s (0.0 - 10.0 s)	708
H2-35 (159D)	Comparator2 Protection Selection	V/f CL-V/f OLV CLV AOLV Selects the operation of the drive when *CP2 [Comparator2 Limit Fault]* is detected. 0 : Ramp to Stop 1 : Coast to Stop 2 : Fast Stop (Use C1-09) 3 : Alarm Only 4 : Digital Output Only	4 (0 - 4)	708
H2-36 (159E)	Comparator 1 Ineffective Time	V/f CL-V/f OLV CLV AOLV Sets the length of time that *CP1 [Comparator1 Limit Fault]* is disabled.	0.0 s (0.0 - 1000.0 s)	709
H2-37 (159F)	Comparator 2 Ineffective Time	V/f CL-V/f OLV CLV AOLV Sets the length of time that *CP2 [Comparator2 Limit Fault]* is disabled.	0.0 s (0.0 - 1000.0 s)	709
H2-40 (0B58)	Mbus Reg 15E0h bit0 Output Func	V/f CL-V/f OLV CLV AOLV Sets the MFDO for bit 0 of MEMOBUS register 15E0 (Hex.).	F (0 - 1FF)	709
H2-41 (0B59)	Mbus Reg 15E0h bit1 Output Func	V/f CL-V/f OLV CLV AOLV Sets the MFDO for bit 1 of MEMOBUS register 15E0 (Hex.).	F (0 - 1FF)	709
H2-42 (0B5A)	Mbus Reg 15E0h bit2 Output Func	V/f CL-V/f OLV CLV AOLV Sets the MFDO for bit 2 of MEMOBUS register 15E0 (Hex.).	F (0 - 1FF)	709
H2-60 (1B46) Expert	Term M1-M2 Secondary Function	V/f CL-V/f OLV CLV AOLV Sets the second function for terminal M1-M2. The logical calculation results of the terminals assigned to functions by *H2-01 [Term M1-M2 Function Selection]* is output.	F (0 - FF)	709
H2-61 (1B47) Expert	Term MA,MB,MC Logical Operation	V/f CL-V/f OLV CLV AOLV Selects the logical operation for the two functions selected by *H2-01 [Term M1-M2 Function Selection]* and *H2-60 [Term M1-M2 Secondary Function]*.	0 (0 - 8)	709
H2-62 (1B48) Expert	Terminal M1-M2 Delay Time	V/f CL-V/f OLV CLV AOLV Sets the minimum on time used to output the logical calculation results from terminal M1-M2.	0.1 s (0.0 - 25.0 s)	710
H2-63 (1B49) Expert	Terminal P1 Secondary Function	V/f CL-V/f OLV CLV AOLV Sets the second function for terminal M3-M4. Outputs the logical calculation results of the terminals assigned to functions by *H2-02 [Term P1 Function Selection]*.	F (0 - FF)	710

No. (Hex.)	Name	Description	Default (Range)	Ref.
H2-64 (1B4A) Expert	Terminal P1 Logical Operation	V/f CL-V/f OLV CLV AOLV Selects the logical operation for the two functions selected by *H2-02 [Term M3-M4 Function Selection]* and *H2-63 [Term M3-M4 Secondary Function]*.	0 (0 - 8)	710
H2-65 (1B4B) Expert	Terminal M3-M4 Delay Time	V/f CL-V/f OLV CLV AOLV Sets the minimum on time used to output the logical calculation results from terminal M3-M4.	0.1 s (0.0 - 25.0 s)	710
H2-66 (1B4C) Expert	Term M5-M6 Secondary Function	V/f CL-V/f OLV CLV AOLV Sets the second function for terminal M5-M6. Outputs the logical calculation results of the terminals assigned to functions by *H2-03 [Term P1-C1 Function Selection]*.	F (0 - FF)	710
H2-67 (1B4D) Expert	Terminal M5-M6 Logical Operation	V/f CL-V/f OLV CLV AOLV Sets the logical operation for the two functions selected by *H2-03 [Terminal M5-M6 Function Select]* and *H2-66 [Term M5-M6 Secondary Function]*.	0 (0 - 8)	710
H2-68 (1B4E) Expert	Terminal P2 Minimum ON Time	V/f CL-V/f OLV CLV AOLV Sets the minimum on time used to output the logical calculation results from terminal M5-M6.	0.1 s (0.0 - 25.0 s)	710
H2-69 (1B4F) Expert	Digital Output4 Secondary Func	V/f CL-V/f OLV CLV AOLV Sets the second function for terminal P1-C1. Outputs the logical calculation results of the terminals assigned to functions by *H2-04 [Terminal P2-C2 Function Select]*.	F (0 - FF)	711
H2-70 (11F9) Expert	DigitalOutput4 Logical Operation	V/f CL-V/f OLV CLV AOLV Sets the logical operation for the functions set in *H2-04 [Terminal P1-C1 Function Select]* and *H2-69 [Digital Output4 Secondary Func]*.	0 (0 - 8)	711
H2-71 (11FA) Expert	Digital Output 4 Delay Time	V/f CL-V/f OLV CLV AOLV Sets the minimum on time used to output the logical calculation results from terminal P1-C1.	0.1 s (0.0 - 25.0 s)	711
H2-72 (11FB) Expert	Digital Output 5 Secondary Func	V/f CL-V/f OLV CLV AOLV Sets the second function for terminal P2-C2. The logical calculation results of the terminals assigned to functions by *H2-05 [Term P2-C2 Function Selection]* is output.	F (0 - FF)	711
H2-73 (11FC) Expert	DigitalOutput5 Logical Operation	V/f CL-V/f OLV CLV AOLV Sets the logical operation for the functions set in *H2-05 [Term P2-C2 Function Selection]* and *H2-72 [Digital Output 5 Secondary Func]*.	0 (0 - 8)	711
H2-74 (11FD) Expert	Digital Output 5 Delay Time	V/f CL-V/f OLV CLV AOLV Sets the minimum ON time used to output the logical calculation results from terminal P2-C2.	0.1 s (0.0 - 25.0 s)	711

■ H2-xx: MFDO Setting Values

Setting Value	Function	Description	Ref.
0	During Run	V/f CL-V/f OLV CLV AOLV The terminal activates when you input a Run command and when the drive is outputting voltage. ON : Drive is running OFF : Drive is stopping	711
1	Zero Speed	V/f CL-V/f OLV CLV AOLV The terminal activates when the output frequency is less than *E1-09 [Minimum Output Frequency]* or *b2-01 [DC Injection/Zero SpeedThreshold]*. **Note:** Parameter *A1-02 [Control Method Selection]* selects which parameter is the reference. A1-02 Setting / Description / Parameter Used as the Reference: 0 – Open Loop V/f Control – E1-09 1 – V/f Control with Encoder – E1-09 2 – Open Loop Vector – b2-01 3 – Closed Loop Vector – E1-09 4 – Advanced OpenLoop Vector Control – E1-09 ON : The output frequency is less than the value of *E1-09* or *b2-01*. OFF : The output frequency is the value of *E1-09* or more, or *b2-01* or more.	712

Setting Value	Function	Description	Ref.
2	Speed Agree 1	V/f CL-V/f OLV CLV AOLV The terminal deactivates when the output frequency is in the range of the frequency reference ± *L4-02 [Speed Agree Detection Width]*. **Note:** • The detection function operates in the two motor rotation directions. • The drive outputs the motor speed status when *A1-02 = 3 [Control Method Selection = CLV]*. The drive outputs the motor speed status when *A1-02 = 4 [Control Method Selection = AOLV]* and *n4-72 = 1 [Speed Feedback Mode = With Encoder]*. ON : The output frequency is in the range of "frequency reference ± *L4-02*". OFF : The output frequency does not align with the frequency reference although the drive is running.	712
3	User-Set Speed Agree 1	V/f CL-V/f OLV CLV AOLV The terminal activates when the output frequency is in the range of *L4-01 [Speed Agree Detection Level]* ± *L4-02 [Speed Agree Detection Width]* and in the range of the frequency reference ± *L4-02*. **Note:** • The detection function operates in the two motor rotation directions. The drive uses the *L4-01* value as the forward/reverse detection level. • The drive outputs the motor speed status when *A1-02 = 3 [Control Method Selection = CLV]*. The drive outputs the motor speed status when *A1-02 = 4 [Control Method Selection = AOLV]* and *n4-72 = 1 [Speed Feedback Mode = With Encoder]*. ON : The output frequency is in the range of "*L4-01* ± *L4-02*" and the range of frequency reference ± *L4-02*. OFF : The output frequency is not in the range of "*L4-01* ± *L4-02*" nor the range of frequency reference ± *L4-02*.	713
4	Frequency Detection 1	V/f CL-V/f OLV CLV AOLV The terminal deactivates when the output frequency > "*L4-01 [Speed Agree Detection Level]* + *L4-02 [Speed Agree Detection Width]*". After the terminal deactivates, the terminal stays deactivated until the output frequency is at the value of *L4-01*. **Note:** • The detection function operates in the two motor rotation directions. The drive uses the *L4-01* value as the forward/reverse detection level. • The drive outputs the motor speed status when *A1-02 = 3 [Control Method Selection = CLV]*. The drive outputs the motor speed status when *A1-02 = 4 [Control Method Selection = AOLV]* and *n4-72 = 1 [Speed Feedback Mode = With Encoder]*. ON : The output frequency < *L4-01*, or the output frequency ≤ "*L4-01* + *L4-02*" OFF : The output frequency > "*L4-01* + *L4-02*"	713
5	Frequency Detection 2	V/f CL-V/f OLV CLV AOLV The terminal activates when the output frequency > *L4-01 [Speed Agree Detection Level]*. After the terminal activates, the terminal stays activated until the output frequency is at the value of "*L4-01* - *L4-02*". **Note:** • The detection function operates in the two motor rotation directions. The drive uses the *L4-01* value as the forward/reverse detection level. • The drive outputs the motor speed status when *A1-02 = 3 [Control Method Selection = CLV]*. It also outputs the motor speed status when *A1-02 = 4* and *n4-72 = 1 [Speed Feedback Mode = With Encoder]*. ON : The output frequency > *L4-01* OFF : The output frequency < "*L4-01* - *L4-02*", or the output frequency ≤ *L4-01*	714
6	Drive Ready	V/f CL-V/f OLV CLV AOLV The terminal activates when the drive is ready and running.	714
7	DC Bus Undervoltage	V/f CL-V/f OLV CLV AOLV The terminal activates when the DC bus voltage or control circuit power supply is at the voltage set in *L2-05 [Undervoltage Detection Lvl (Uv1)]* or less. The terminal also activates when there is a fault with the DC bus voltage. ON : The DC bus voltage ≤ *L2-05* OFF : The DC bus voltage > *L2-05*	715
8	During Baseblock (N.O.)	V/f CL-V/f OLV CLV AOLV The terminal activates during baseblock. When the drive is in baseblock, the drive output transistor stops switching and does not make DC bus voltage. ON : During baseblock OFF : The drive is not in baseblock.	715
9	Frequency Reference from Keypad	V/f CL-V/f OLV CLV AOLV Shows the selected frequency reference source. ON : The keypad is the frequency reference source. OFF : Parameter *b1-01 or b1-15 [Frequency Reference Selection 1 or 2]* is the frequency reference source.	715
A	Run Command Source	V/f CL-V/f OLV CLV AOLV Shows the selected Run command source. ON : The keypad is the Run command source. OFF : Parameter *b1-02 or b1-16 [Run Command Selection 1 or 2]* is the Run command source.	715
B	Torque Detection 1 (N.O.)	V/f CL-V/f OLV CLV AOLV The terminal activates when the drive detects overtorque. ON : The output current/torque > *L6-02 [Torque Detection Level 1]* for longer than the time set in *L6-03 [Torque Detection Time 1]*.	715 214 226
C	Frequency Reference Loss	V/f CL-V/f OLV CLV AOLV The terminal activates when the drive detects a loss of frequency reference.	715
D	Braking Resistor Fault	V/f CL-V/f OLV CLV AOLV The terminal activates when the mounting-type braking resistor is overheating or when there is a braking transistor fault.	715

Setting Value	Function	Description	Ref.
E	Fault	V/f CL-V/f OLV CLV AOLV The terminal activates when the drive detects a fault. **Note:** The terminal will not activate for *CPF00* and *CPF01 [Control Circuit Error]* faults.	716
F	Not Used	V/f CL-V/f OLV CLV AOLV Use this setting for unused terminals or to use terminals in through mode. Also use this setting as the PLC contact output via MEMOBUS/Modbus or the communication option. This signal does not function if you do not configure signals from the PLC.	716
10	Alarm	V/f CL-V/f OLV CLV AOLV The terminal activates when the drive detects a minor fault.	716
11	Fault Reset Command Active	V/f CL-V/f OLV CLV AOLV The terminal activates when the drive receives the Reset command from the control circuit terminal, serial communications, or the communication option.	716
13	Speed Agree 2	V/f CL-V/f OLV CLV AOLV The terminal activates when the output frequency is in the range of the frequency reference ± *L4-04 [Speed Agree Detection Width(+/-)]*. **Note:** In CLV, the motor speed is the reference. ON : The output frequency is in the range of "frequency reference ± *L4-04*". OFF : The output frequency is not in the range of "frequency reference ± *L4-04*".	716
14	User-Set Speed Agree 2	V/f CL-V/f OLV CLV AOLV The terminal activates when the output frequency is in the range of *L4-03 [Speed Agree Detection Level (+/-)]* ± *L4-04 [Speed Agree Detection Width (+/-)]* and in the range of the frequency reference ± *L4-04*. ON : The output frequency is in the range of "*L4-03* ± *L4-04*" and the range of frequency reference ± *L4-04*. OFF : The output frequency is not in the range of "*L4-03* ± *L4-04*" nor the range of frequency reference ± *L4-04*.	716
15	Frequency Detection 3	V/f CL-V/f OLV CLV AOLV The terminal deactivates when the output frequency > "*L4-03 [Speed Agree Detection Level(+/-)]* + *L4-04 [Speed Agree Detection Width(+/-)]*". After the terminal deactivates, the terminal stays deactivated until the output frequency is at the value of *L4-03*. **Note:** • The detection level configured with *L4-03* is a signed value. Detections only occur one specific orientation. • In CLV, the motor speed is the reference. ON : The output frequency < *L4-03*, or the output frequency ≤ "*L4-03* + L4-04" OFF : The output frequency is higher than *L4-03* + *L4-04*.	717
16	Frequency Detection 4	V/f CL-V/f OLV CLV AOLV The terminal activates when the output frequency > *L4-03 [Speed Agree Detection Level(+/-)]*. After the terminal activates, the terminal stays activated until the output frequency = "*L4-03* - *L4-04*". **Note:** • The detection level set in *L4-03* is a signed value. The drive will only detect in one direction. • The drive outputs the motor speed status when *A1-02 = 3 [Control Method Selection = CLV]*. ON : The output frequency > *L4-03* OFF : The output frequency < "*L4-03* - *L4-04*", or the output frequency ≤ *L4-03*	717
17	Torque Detection 1 (N. C.)	V/f CL-V/f OLV CLV AOLV The terminal deactivates when the drive detects overtorque. OFF : The output current/torque > *L6-02 [Torque Detection Level 1]* for longer than the time set in *L6-03 [Torque Detection Time 1]*.	717 214 226
18	Torque Detection 2 (N. O.)	V/f CL-V/f OLV CLV AOLV The terminal activates when the drive detects overtorque. ON : The output current/torque > *L6-05 [Torque Detection Level 2]* for longer than the time set in *L6-06 [Torque Detection Time 2]*.	718 214 226
19	Torque Detection 2 (N. C.)	V/f CL-V/f OLV CLV AOLV The terminal deactivates when the drive detects overtorque. OFF : The output current/torque > *L6-05 [Torque Detection Level 2]* for longer than the time set in *L6-06 [Torque Detection Time 2]*.	718 214 226
1A	During Reverse	V/f CL-V/f OLV CLV AOLV The terminal activates when the motor operates in the reverse direction. ON : The motor is operating in the reverse direction. OFF : The motor is operating in the forward direction or the motor stopped.	718
1B	During Baseblock (N.C.)	V/f CL-V/f OLV CLV AOLV The terminal deactivates during baseblock. When the drive is in baseblock, the drive output transistor stops switching and does not make DC bus voltage. ON : The drive is not in baseblock. OFF : During baseblock	718
1C	Motor 2 Selected	V/f CL-V/f OLV CLV AOLV The terminal activates when you select motor 2. ON : Motor 2 Selected OFF : Motor 1 Selected	719 216 226

Setting Value	Function	Description	Ref.
1D	During Regeneration	V/f CL-V/f OLV CLV AOLV The terminal activates on when the motor is regenerating. ON : Motor is regenerating. OFF : Motor is operating or stopped.	719
1F	Motor Overload Alarm (oL1)	V/f CL-V/f OLV CLV AOLV The terminal activates when the electronic thermal protection value of the motor overload protective function is a minimum of 90% of the detection level.	719
20	Drive Overheat Pre-Alarm (oH)	V/f CL-V/f OLV CLV AOLV The terminal activates when the drive heatsink temperature is at the level set with *L8-02 [Overheat Alarm Level]*.	719
21	Brake Release Command	V/f CL-V/f OLV CLV AOLV Set the sequence external to the drive to release the brake when the terminal turns ON and holds the brake when the terminal turns OFF. ON : The brake releases. OFF : The brake tightens.	719 195 226
22	Overload Detection (N. O.)	V/f CL-V/f OLV CLV AOLV The terminal activates when the drive detects an overload.	719 213 226
23	Weight Det N.C.	V/f CL-V/f OLV CLV AOLV The terminal deactivates when the drive detects an overload.	719 213 226
2F	Maintenance Notification	V/f CL-V/f OLV CLV AOLV The terminal activates when drive components are at their estimated maintenance period. Tells you about the maintenance period for these items: • IGBT • Cooling Fan • Capacitor • Soft charge bypass relay	720
30	During Torque Limit	V/f CL-V/f OLV CLV AOLV The terminal activates when the torque reference is the torque limit set with *L7 parameters*, *H3-02, H3-06, or H3-10 [MFAI Function Selection]*.	720
33	Zero Servo Complete	V/f CL-V/f OLV CLV AOLV The terminal activates when positioning in the range set with *b9-02 [Zero Servo Completion Window]* completes after sending the Zero-Servo command.	720
37	During Frequency Output	V/f CL-V/f OLV CLV AOLV The terminal activates when the drive outputs frequency. ON : The drive outputs frequency. OFF : The drive does not output frequency.	720
39	Watt Hour Pulse Output	V/f CL-V/f OLV CLV AOLV Outputs the pulse that shows the watt hours.	720
3C	LOCAL Control Selected	V/f CL-V/f OLV CLV AOLV The terminal activates when the Run command source or frequency reference source is LOCAL. ON : LOCAL OFF : REMOTE	721
4C	During Fast Stop	V/f CL-V/f OLV CLV AOLV The terminal activates when the fast stop is in operation.	721
4D	oH Pre-Alarm Time Limit	V/f CL-V/f OLV CLV AOLV The terminal activates when *L8-03 = 4 [Overheat Pre-Alarm Selection = Operate at Reduced Speed (L8-19)]* and *oH [Heatsink Overheat]* does not clear after the drive decreases the frequency for 10 cycles.	721
4E	Braking Transistor Fault (rr)	V/f CL-V/f OLV CLV AOLV The terminal activates when the internal braking transistor overheats and the drive detects an *rr [Dynamic Braking Transistor Fault]* fault.	721
4F	Braking Resistor Overheat (rH)	V/f CL-V/f OLV CLV AOLV The terminal activates when the braking resistor overheats and the drive detects an *rH [Braking Resistor Overheat]* fault.	721
51	Safe Torque OFF	V/f CL-V/f OLV CLV AOLV The terminal turns on (safety stop state) when the safety circuit and safety diagnosis circuit are operating correctly and when terminals H1-HC and H2-HC are off (released). ON : Safety stop state OFF : Safety circuit fault or RUN/READY	721
52	Warning Signal	V/f CL-V/f OLV CLV AOLV The terminal activates when the number of starts is at the detection level.	722 221 226
60	Internal Cooling Fan Failure	V/f CL-V/f OLV CLV AOLV The terminal activates when the drive detects a cooling fan failure in the drive.	722

Setting Value	Function	Description	Ref.
62	Modbus Reg 1 Status Satisfied	V/f CL-V/f OLV CLV AOLV The terminal activates when the bit specified by *H2-08 [Modbus Register 1 Bit Select]* for the MEMOBUS register address set with *H2-07 [Modbus Register 1 Address Select]* activates.	722
63	Modbus Reg 2 Status Satisfied	V/f CL-V/f OLV CLV AOLV The terminal activates when the bit specified by *H2-10 [Modbus Register 2 Bit Select]* for the MEMOBUS register address set with *H2-09 [Modbus Register 2 Address Select]* activates.	722
66	Comparator1	V/f CL-V/f OLV CLV AOLV The terminal activates if the monitor value set with *H2-20 [Comparator 1 Monitor Selection]* is in range of the values of *H2-21 [Comparator 1 Lower Limit] and H2-22 [Comparator 1 Upper Limit]* for the time set in *H2-24 [Comparator 1 On-Delay Time]*.	722
67	Comparator2	V/f CL-V/f OLV CLV AOLV The terminal activates if the monitor value set with *H2-26 [Comparator 2 Monitor Selection]* is not in the range of the values of *H2-27 [Comparator 2 Lower Limit]* and *H2-28 [Comparator 2 Upper Limit]* for the time set in *H2-30 [Comparator 2 On-Delay Time]*.	722
69	External Power 24V Supply	V/f CL-V/f OLV CLV AOLV The terminal activates when there is an external 24V power supply between terminals PS-AC. ON : The external 24V power supply is supplying power. OFF : The external 24V power supply is not supplying power.	723
6A	Data Logger Error	V/f CL-V/f OLV CLV AOLV The terminal activates when the drive detects a *LoG [Com Error / Abnormal SD card]*.	723
B1	DC Injection Braking at Start	V/f CL-V/f OLV CLV AOLV The terminal activates when the motor is started and during DC Injection Braking.	723
B2	DC Injection Braking at Stop	V/f CL-V/f OLV CLV AOLV The terminal activates when the motor is stopped and during DC Injection Braking.	723
B3	Motor 3 Selection	V/f CL-V/f OLV CLV AOLV The terminal activates when you select motor 3. ON : Motor 3 Selected OFF : Motor 1 or Motor 2 Selected	723 216 226
100 - 1FF	Inverse Output of 0 to FF	V/f CL-V/f OLV CLV AOLV Causes inverse output of the function for the selected MFDO. Uses the last two digits of 1xx to select which function to inversely output.	723

◆ H3: Analog Inputs

No. (Hex.)	Name	Description	Default (Range)	Ref.
H3-01 (0410)	Terminal A1 Signal Level Select	V/f CL-V/f OLV CLV AOLV Sets the input signal level for MFAI terminal A1. 0 : 0-10V (Lower Limit at 0) 1 : -10 to +10V (Bipolar Reference)	0 (0, 1)	725
H3-02 (0434)	Terminal A1 Function Selection	V/f CL-V/f OLV CLV AOLV Sets the function for MFAI terminal A1.	0 (0 - FF)	726
H3-03 (0411) RUN	Terminal A1 Gain Setting	V/f CL-V/f OLV CLV AOLV Sets the gain of the analog signal input to MFAI terminal A1.	100.0% (-999.9 - +999.9%)	726
H3-04 (0412) RUN	Terminal A1 Bias Setting	V/f CL-V/f OLV CLV AOLV Sets the bias of the analog signal input to MFAI terminal A1.	0.0% (-999.9 - +999.9%)	726
H3-05 (0413)	Terminal A3 Signal Level Select	V/f CL-V/f OLV CLV AOLV Sets the input signal level for MFAI terminal A3. 0 : 0-10V (Lower Limit at 0) 1 : -10 to +10V (Bipolar Reference)	0 (0, 1)	726
H3-06 (0414)	Terminal A3 Function Selection	V/f CL-V/f OLV CLV AOLV Sets the function for MFAI terminal A3.	2 (0 - FF)	726
H3-07 (0415) RUN	Terminal A3 Gain Setting	V/f CL-V/f OLV CLV AOLV Sets the gain of the analog signal input to MFAI terminal A3.	100.0% (-999.9 - +999.9%)	727
H3-08 (0416) RUN	Terminal A3 Bias Setting	V/f CL-V/f OLV CLV AOLV Sets the bias of the analog signal input to MFAI terminal A3.	0.0% (-999.9 - +999.9%)	727

No. (Hex.)	Name	Description	Default (Range)	Ref.
H3-09 (0417)	Terminal A2 Signal Level Select	V/f CL-V/f OLV CLV AOLV Sets the input signal level for MFAI terminal A2. 0 : 0-10V (Lower Limit at 0) 1 : -10 to +10V (Bipolar Reference) 2 : 4 to 20 mA 3 : 0 to 20 mA	2 (0 - 3)	727
H3-10 (0418)	Terminal A2 Function Selection	V/f CL-V/f OLV CLV AOLV Sets the function for MFAI terminal A2.	0 (0 - FF)	727
H3-11 (0419) RUN	Terminal A2 Gain Setting	V/f CL-V/f OLV CLV AOLV Sets the gain of the analog signal input to MFAI terminal A2.	100.0% (-999.9 - +999.9%)	728
H3-12 (041A) RUN	Terminal A2 Bias Setting	V/f CL-V/f OLV CLV AOLV Sets the bias of the analog signal input to MFAI terminal A2.	0.0% (-999.9 - +999.9%)	728
H3-13 (041B)	Analog Input FilterTime Constant	V/f CL-V/f OLV CLV AOLV Sets the time constant for primary delay filters on MFAI terminals.	0.03 s (0.00 - 2.00 s)	728
H3-14 (041C)	Analog Input Terminal Enable Sel	V/f CL-V/f OLV CLV AOLV Sets the enabled terminal or terminals when *H1-xx = C [MFDI Function Select = Analog Terminal Enable Selection]* is ON. 1 : Terminal A1 only 2 : Terminal A2 only 3 : Terminals A1 and A2 4 : Terminal A3 only 5 : Terminals A1 and A3 6 : Terminals A2 and A3 7 : Terminals A1, A2, and A3	7 (1 - 7)	728
H3-16 (02F0)	Terminal A1 Offset	V/f CL-V/f OLV CLV AOLV Sets the offset level for analog signals input to terminal A1. Usually it is not necessary to change this setting.	0 (-500 - +500)	729
H3-17 (02F1)	Terminal A2 Offset	V/f CL-V/f OLV CLV AOLV Sets the offset level for analog signals input to terminal A2. Usually it is not necessary to change this setting.	0 (-500 - +500)	729
H3-18 (02F2)	Terminal A3 Offset	V/f CL-V/f OLV CLV AOLV Sets the offset level for analog signals input to terminal A3. Usually it is not necessary to change this setting.	0 (-500 - +500)	729
H3-40 (0B5C)	Mbus Reg 15C1h Input Function	V/f CL-V/f OLV CLV AOLV Sets the MEMOBUS AI1 function.	F (4 - 2F)	729
H3-41 (0B5F)	Mbus Reg 15C2h Input Function	V/f CL-V/f OLV CLV AOLV Sets the MEMOBUS AI2 function.	F (4 - 2F)	729
H3-42 (0B62)	Mbus Reg 15C3h Input Function	V/f CL-V/f OLV CLV AOLV Sets the MEMOBUS AI3 function.	F (4 - 2F)	729
H3-43 (117F)	Mbus Reg Inputs FilterTime Const	V/f CL-V/f OLV CLV AOLV Sets the time constant to apply a primary delay filter to the MEMOBUS analog input register values.	0.00 s (0.00 - 2.00 s)	730

■ H3-xx: Multi-Function Analog Input Terminal Settings

Setting Value	Function	Description	Ref.
0	Frequency Reference	V/f CL-V/f OLV CLV AOLV The input value from the MFAI terminal set with this function becomes the master frequency reference.	730
1	Frequency Gain	V/f CL-V/f OLV CLV AOLV The drive multiplies the analog frequency reference with the input value from the MFAI set with this function.	730
2	Auxiliary Frequency Reference 1	V/f CL-V/f OLV CLV AOLV Sets Reference 2 through multi-step speed reference to enable the command reference (Auxiliary Frequency Reference 1) from the analog input terminal set here. This value is a percentage of the maximum output frequency.	730
3	Auxiliary Frequency Reference 2	V/f CL-V/f OLV CLV AOLV Sets Reference 3 through multi-step speed reference to enable the command reference (Auxiliary Frequency Reference 2) from the analog input terminal set here. This value is a percentage of the maximum output frequency.	730
4	Output Voltage Bias	V/f CL-V/f OLV CLV AOLV Set this parameter to input a bias signal and amplify the output voltage.	730
5	Accel/Decel Time Gain	V/f CL-V/f OLV CLV AOLV Enters a signal to adjust the gain used for *C1-01 to C1-08 [Acceleration/Deceleration Times 1 to 4]* and *C1-09 [Fast Stop Time]* when the full scale analog signal (10 V or 20 mA) is 100%.	731

Setting Value	Function	Description	Ref.
6	DC Injection Braking Current	V/f CL-V/f OLV CLV AOLV Enters a signal to adjust the current level used for DC Injection Braking when the drive rated output current is 100%.	731
7	Torque Detection Level	V/f CL-V/f OLV CLV AOLV Enters a signal to adjust the overtorque detection level.	731 214 226
8	Stall Prevent Level During Run	V/f CL-V/f OLV CLV AOLV Enters a signal to adjust the stall prevention level during run if the drive rated current is 100%.	732
C	Overload Detection Level	V/f CL-V/f OLV CLV AOLV Enters the overload detection level.	732 213 226
D	Frequency Bias	V/f CL-V/f OLV CLV AOLV Enters the bias value added to the frequency reference as a percentage of the maximum output frequency.	732
E	Motor Temperature (PTC Input)	V/f CL-V/f OLV CLV AOLV Uses the motor Positive Temperature Coefficient (PTC) thermistor to prevent heat damage to the motor as a percentage of the current value when the 10 V analog signal is input.	732
F	Not Used	V/f CL-V/f OLV CLV AOLV Use this setting for unused terminals or to use terminals in through mode.	733
10	Forward Torque Limit	V/f CL-V/f OLV CLV AOLV Enters the forward torque limit if the motor rated torque is 100%.	733
11	Reverse Torque Limit	V/f CL-V/f OLV CLV AOLV Enters the load torque limit if the motor rated torque is 100%.	734
12	Regenerative Torque Limit	V/f CL-V/f OLV CLV AOLV Enters the regenerative torque limit if the motor rated torque is 100%.	734
14	Torque Compensation	V/f CL-V/f OLV CLV AOLV Enters the torque compensation value if the motor rated torque is 100%.	734
15	General Torque Limit	V/f CL-V/f OLV CLV AOLV Enters the torque limit that is the same for all quadrants for forward, reverse, and regenerative operation if the motor rated torque is 100%.	734
1F	Not Used	V/f CL-V/f OLV CLV AOLV Use this setting for unused terminals or to use terminals in through mode.	734

◆ H4: Analog Outputs

No. (Hex.)	Name	Description	Default (Range)	Ref.
H4-01 (041D)	Terminal FM Analog Output Select	V/f CL-V/f OLV CLV AOLV Sets the monitor number to send from MFAO terminal FM. Set the *x-xx* part of the *Ux-xx [Monitor]*. For example, set *H4-01 = 102* to monitor *U1-02 [Output Frequency]*.	102 (000 - 999)	736
H4-02 (041E) RUN	Terminal FM Analog Output Gain	V/f CL-V/f OLV CLV AOLV Sets the gain of the *Ux-xx* monitor signal set in *H4-01 [terminals FM Monitor Selection]*. When an output for monitoring items is 100%, this parameter sets the analog signal output level from the FM terminal at 10 V as 100%.	100.0% (-999.9 - +999.9%)	736
H4-03 (041F) RUN	Terminal FM Analog Output Bias	V/f CL-V/f OLV CLV AOLV Sets the bias of the *Ux-xx* monitor signal set in *H4-01 [Terminal FM Analog Output Select]*. When an output for monitoring items is 0%, this parameter sets the analog signal output level from the FM terminal at 10 V as 100%.	0.0% (-999.9 - +999.9%)	736
H4-04 (0420)	Terminal AM Analog Output Select	V/f CL-V/f OLV CLV AOLV Sets the monitoring number to be output from the MFAO terminal AM. Set the *x-xx* part of the *Ux-xx [Monitor]*. For example, set *H4-04 = 103* to monitor *U1-03 [Output Current]*.	103 (000 - 999)	736
H4-05 (0421) RUN	Terminal AM Analog Output Gain	V/f CL-V/f OLV CLV AOLV Sets the gain of the *Ux-xx* monitor signal set in *H4-04 [terminals AM Monitor Selection]*. When an output for monitoring items is 100%, this parameter sets the analog signal output level from the AM terminal at 10 V as 100%.	50.0% (-999.9 - +999.9%)	736
H4-06 (0422) RUN	Terminal AM Analog Output Bias	V/f CL-V/f OLV CLV AOLV Sets the bias of the *Ux-xx* monitor signal set in *H4-04 [terminals AM Monitor Selection]*. When an output for monitoring items is 0%, this parameter sets the analog signal output level from the AM terminal at 10 V as 100%.	0.0% (-999.9 - +999.9%)	737

No. (Hex.)	Name	Description	Default (Range)	Ref.
H4-07 (0423)	Terminal FM Signal Level Select	V/f CL-V/f OLV CLV AOLV Sets the MFAO terminal FM output signal level. 0 : 0-10V (Lower Limit at 0) 1 : -10 to +10V (Bipolar Reference)	0 (0, 1)	737
H4-08 (0424)	Terminal AM Signal Level Select	V/f CL-V/f OLV CLV AOLV Sets the MFAO terminal AM output signal level. 0 : 0-10V (Lower Limit at 0) 1 : -10 to +10V (Bipolar Reference)	0 (0, 1)	737
H4-20 (0B53)	Analog Power Monitor 100% Level	V/f CL-V/f OLV CLV AOLV Sets the level at 10 V when *U1-08 [Output Power]* is set for analog output.	0.00 kW (0.00 - 650.00 kW)	737

◆ H5: MEMOBUS/Modbus Communications

No. (Hex.)	Name	Description	Default (Range)	Ref.
H5-01 (0425)	Drive Node Address	V/f CL-V/f OLV CLV AOLV Sets the communication slave address for drives. **Note:** • Re-energize the drive or set *H5-20 = 1 [Communication Parameters Reload = Reload Now]* after you change the parameter setting. • Setting 0 will not let the drive respond to MEMOBUS/Modbus communications.	1FH (0 - FFH)	737
H5-02 (0426)	Communication Speed Selection	V/f CL-V/f OLV CLV AOLV Sets the communications speed for MEMOBUS/Modbus communications. **Note:** Re-energize the drive or set *H5-20 = 1 [Communication Parameters Reload = Reload Now]* after you change the parameter setting. 0 : 1200 bps 1 : 2400 bps 2 : 4800 bps 3 : 9600 bps 4 : 19.2 kbps 5 : 38.4 kbps 6 : 57.6 kbps 7 : 76.8 kbps 8 : 115.2 kbps	3 (0 - 8)	738
H5-03 (0427)	Communication Parity Selection	V/f CL-V/f OLV CLV AOLV Sets the communications parity used for MEMOBUS/Modbus communications. **Note:** Re-energize the drive or set *H5-20 = 1 [Communication Parameters Reload = Reload Now]* after you change the parameter setting. 0 : No parity 1 : Even parity 2 : Odd parity	0 (0 - 2)	738
H5-04 (0428)	Communication Error Stop Method	V/f CL-V/f OLV CLV AOLV Sets the motor Stopping Method when the drive detects *CE [MEMOBUS/Modbus Communication Err]* issues. 0 : Ramp to Stop 1 : Coast to Stop 2 : Fast Stop (Use C1-09) 3 : Alarm Only	1 (0 - 3)	738
H5-05 (0429)	Comm Fault Detection Selection	V/f CL-V/f OLV CLV AOLV Sets the function that detects *CE [Modbus Communication Error]* issues during MEMOBUS/Modbus communications. 0 : Disabled 1 : Enabled	1 (0, 1)	739
H5-06 (042A)	Drive Transmit Wait Time	V/f CL-V/f OLV CLV AOLV Sets the time to wait to send a response message after the drive receives a command message from the master. **Note:** Restart the drive after changing the parameter setting.	5 ms (0 - 65 ms)	739
H5-09 (0435)	CE Detection Time	V/f CL-V/f OLV CLV AOLV Sets the detection time for *CE [Modbus Communication Error]* issues when communication stops.	2.0 s (0.0 - 10.0 s)	739
H5-10 (0436)	Modbus Register 0025H Unit Sel	V/f CL-V/f OLV CLV AOLV Sets the unit of measure used for the MEMOBUS/Modbus communications monitor register 0025H (output voltage reference monitor). 0 : 0.1 V units 1 : 1 V units	0 (0, 1)	739

No. (Hex.)	Name	Description	Default (Range)	Ref.
H5-11 (043C)	Comm ENTER Command Mode	V/f CL-V/f OLV CLV AOLV Sets the function to make the Enter command necessary to change parameters through MEMOBUS/Modbus communications. 0 : ENTER Command Required 1 : ENTER Command Not Required	0 (0, 1)	739
H5-17 (11A1) Expert	ENTER command response @CPU BUSY	V/f CL-V/f OLV CLV AOLV Sets operation when the EEPROM write command is sent without EEPROM write available. Usually it is not necessary to change this setting. 0 : Ignore Command(No ROM/RAM Write) 1 : Write to RAM Only	0 (0, 1)	740
H5-18 (11A2)	Motor Speed Filter over Comms	V/f CL-V/f OLV CLV AOLV Sets the filter time constant used when monitoring motor speed during MEMOBUS/Modbus communications or with a communication option.	0 ms (0 - 100 ms)	740
H5-20 (0B57)	Communication Parameters Reload	V/f CL-V/f OLV CLV AOLV Sets the function to immediately enable updated MEMOBUS/Modbus communications parameters. 0 : Reload at Next Power Cycle 1 : Reload Now	0 (0, 1)	740
H5-25 (1589) RUN	Function 5A Register 1 Selection	V/f CL-V/f OLV CLV AOLV Returns the contents of the specified MEMOBUS/Modbus communications register when responding to the master device.	0044H (U1-05) (0000H - FFFFH)	740
H5-26 (158A) RUN	Function 5A Register 2 Selection	V/f CL-V/f OLV CLV AOLV Returns the contents of the specified MEMOBUS/Modbus communications register when responding to the master device.	0045H (U1-06) (0000H - FFFFH)	740
H5-27 (158B) RUN	Function 5A Register 3 Selection	V/f CL-V/f OLV CLV AOLV Returns the contents of the specified MEMOBUS/Modbus communications register when responding to the master device.	0042H (U1-03) (0000H - FFFFH)	741
H5-28 (158C) RUN	Function 5A Register 4 Selection	V/f CL-V/f OLV CLV AOLV Returns the contents of the specified MEMOBUS/Modbus communications register when responding to the master device.	0049H (U1-10) (0000H - FFFFH)	741

◆ H7: Virtual Inputs / Outputs

No. (Hex.)	Name	Description	Default (Range)	Ref.
H7-00 (116F) Expert	Virtual MFIO selection	V/f CL-V/f OLV CLV AOLV Sets the function to enable and disable the virtual I/O function. Set this parameter to 1 to operate the virtual I/O function. 0 : Disabled 1 : Enabled	0 (0, 1)	741
H7-01 (1185) Expert	Virtual Multi-Function Input 1	V/f CL-V/f OLV CLV AOLV Sets the function that enters the virtual input set in *H7-10 [Virtual Multi-Function Output 1]*.	F (0 - 1FF)	742
H7-02 (1186) Expert	Virtual Multi-Function Input 2	V/f CL-V/f OLV CLV AOLV Sets the function that enters the virtual input set in *H7-12 [Virtual Multi-Function Output 2]*.	F (0 - 1FF)	742
H7-03 (1187) Expert	Virtual Multi-Function Input 3	V/f CL-V/f OLV CLV AOLV Sets the function that enters the virtual input set in *H7-14 [Virtual Multi-Function Output 3]*.	F (0 - 1FF)	742
H7-04 (1188) Expert	Virtual Multi-Function Input 4	V/f CL-V/f OLV CLV AOLV Sets the function that enters the virtual input set in *H7-16 [Virtual Multi-Function Output 4]*.	F (0 - 1FF)	742
H7-10 (11A4) Expert	Virtual Multi-Function Output 1	V/f CL-V/f OLV CLV AOLV Sets the function for virtual digital output 1.	F (0 - 1FF)	742
H7-11 (11A5) Expert	Virtual Output 1 Delay Time	V/f CL-V/f OLV CLV AOLV Sets the minimum ON time for virtual digital output 1.	0.1 s (0.0 - 25.0 s)	742
H7-12 (11A6) Expert	Virtual Multi-Function Output 2	V/f CL-V/f OLV CLV AOLV Sets the function for virtual digital output 2.	F (0 - 1FF)	742
H7-13 (11A7) Expert	Virtual Output 2 Delay Time	V/f CL-V/f OLV CLV AOLV Sets the minimum ON time for virtual digital output 2.	0.1 s (0.0 - 25.0 s)	742

No. (Hex.)	Name	Description	Default (Range)	Ref.
H7-14 (11A8) Expert	Virtual Multi-Function Output 3	V/f CL-V/f OLV CLV AOLV Sets the function for virtual digital output 3.	F (0 - 1FF)	743
H7-15 (11A9) Expert	Virtual Output 3 Delay Time	V/f CL-V/f OLV CLV AOLV Sets the minimum ON time for virtual digital output 3.	0.1 s (0.0 - 25.0 s)	743
H7-16 (11AA) Expert	Virtual Multi-Function Output 4	V/f CL-V/f OLV CLV AOLV Sets the function for virtual digital output 4.	F (0 - 1FF)	743
H7-17 (11AB) Expert	Virtual Output 4 Delay Time	V/f CL-V/f OLV CLV AOLV Sets the minimum ON time for virtual digital output 4.	0.1 s (0.0 - 25.0 s)	743
H7-30 (1177) Expert	Virtual Analog Input Selection	V/f CL-V/f OLV CLV AOLV Sets the virtual analog input function.	F (0 - FF)	743
H7-31 (1178) RUN Expert	Virtual Analog Input Gain	V/f CL-V/f OLV CLV AOLV Sets the virtual analog input gain.	100.0% (-999.9 - 999.9%)	743
H7-32 (1179) RUN Expert	Virtual Analog Input Bias	V/f CL-V/f OLV CLV AOLV Sets the virtual analog input bias.	0.0% (-999.9 - 999.9%)	743
H7-40 (1163)	Virtual Analog Out Signal Select	V/f CL-V/f OLV CLV AOLV Sets the signal level of the virtual analog output. 0 : 0 to 100% (Absolute Value) 1 : -100 to 100% 2 : 0 to 100% (Lower Limit at 0)	0 (0 - 2)	743
H7-41 (1164)	Virtual Analog Output Function	V/f CL-V/f OLV CLV AOLV Sets the monitor to be output from the virtual analog output. Set the *x-xx* part of the *Ux-xx [Monitor]*. For example, set *H7-41 = 102* to monitor *U1-02 [Output Frequency]*.	102 (0 - 999)	744
H7-42 (1165)	Virtual Analog Output FilterTime	V/f CL-V/f OLV CLV AOLV Sets the time constant for a primary filter of the virtual analog output.	0.00 s (0.00 - 2.00 s)	744

10.11 L: Protection Functions

◆ L1: Motor Protection

No. (Hex.)	Name	Description	Default (Range)	Ref.
L1-01 (0480)	Motor Overload (oL1) Protection	V/f CL-V/f OLV CLV AOLV Sets the motor overload protection with electronic thermal protectors. 0 : Disable 1 : Variable Torque 2 : Constant Torque 10:1 Speed Range 3 : Constant Torque 100:1 SpeedRange 6 : Variable Torque (50Hz) **Note:** When you connect only one motor to a drive, set *L1-01 = 1 to 3 or 6 [Enabled]*. External thermal relays are not necessary in these conditions.	Determined by A1-02 (0 - 3, 6)	289
L1-02 (0481)	Motor Overload Protection Time	V/f CL-V/f OLV CLV AOLV Sets the operation time for the electronic thermal protector of the drive to prevent damage to the motor. Usually it is not necessary to change this setting.	1.0 min (0.1 - 5.0 min)	291
L1-03 (0482)	Motor Thermistor oH Alarm Select	V/f CL-V/f OLV CLV AOLV Sets the drive operation when the PTC input signal to the drive is at the *oH3 [Motor Overheat (PTC Input)]* detection level. 0 : Ramp to Stop 1 : Coast to Stop 2 : Fast Stop (Use C1-09) 3 : Alarm Only	3 (0 - 3)	291
L1-04 (0483)	Motor Thermistor oH Fault Select	V/f CL-V/f OLV CLV AOLV Sets the drive operation when the PTC input signal to the drive is at the *oH4 [Motor Overheat Fault (PTC Input)]* detection level. 0 : Ramp to Stop 1 : Coast to Stop 2 : Fast Stop (Use C1-09)	1 (0 - 2)	292
L1-05 (0484)	Motor Thermistor Filter Time	V/f CL-V/f OLV CLV AOLV Sets the primary delay time constant for the PTC input signal entered to the drive. This parameter prevents accidental motor overheat faults.	0.20 s (0.00 - 10.00 s)	749
L1-08 (1103)	oL1 Current Level	V/f CL-V/f OLV CLV AOLV Sets the reference current for the motor 1 thermal overload detection. **Note:** When the current level > 0.0 A, you cannot set this value < 10% of drive rated current.	0.0A (0.0 A or 10% to 150% of the drive rated current)	749
L1-09 (1104)	oL1 Current Level for Motor 2	V/f CL-V/f OLV CLV AOLV Sets the reference current for the motor 2 thermal overload detection. **Note:** When the current level > 0.0 A, you cannot set this value < 10% of drive rated current.	0.0A (0.0 A or 10 to150% of the drive rated current)	749
L1-13 (046D)	Motor Overload Memory Selection	V/f CL-V/f OLV CLV AOLV Sets the function that keeps the current electronic thermal protector value when the drive stops receiving power. 0 : Disabled 1 : Enabled	1 (0, 1)	750

◆ L2: Power Loss Ride Through

No. (Hex.)	Name	Description	Default (Range)	Ref.
L2-03 (0487)	Minimum Baseblock Time	V/f CL-V/f OLV CLV AOLV Sets the minimum time to continue the drive output block (baseblock) after a baseblock.	Determined by o2-04 (0.1 - 5.0 s)	750
L2-05 (0489)	Undervoltage Detection Lvl (Uv1)	V/f CL-V/f OLV CLV AOLV Sets the voltage at which a *Uv1 [DC Bus Undervoltage]* fault is triggered. Usually it is not necessary to change this setting. **NOTICE:** *Damage to Equipment. When you set this parameter to a value lower than the default, you must install an AC reactor on the input side of the power supply. If you do not install an AC reactor, it will cause damage to the drive circuitry.*	Determined by E1-01 (Determined by E1-01)	750

◆ L3: Stall Prevention

No. (Hex.)	Name	Description	Default (Range)	Ref.
L3-01 (048F)	Stall Prevention during Accel	V/f CL-V/f OLV CLV AOLV Sets the method of the Stall Prevention During Acceleration. 0 : Disable 1 : Enabled 2 : Intelligent (Ignore Accel Ramp) 3 : Current Limit Acceleration	1 (0 - 3)	751
L3-02 (0490)	Stall Prevent Level during Accel	V/f CL-V/f OLV CLV AOLV Sets the output current level as a percentage of the drive rated output current that the drive uses when the Stall Prevention function is enabled during acceleration. **Note:** The upper limit of this setting is determined by *L8-38 [Carrier Frequency Reduction]*.	Determined by L8-38 (0 - 150%)	752
L3-03 (0491)	Stall Prevent Limit during Accel	V/f CL-V/f OLV CLV AOLV Sets the lower limit for the stall prevention level used in the constant output range as a percentage of the drive rated output current.	50% (0 - 100%)	752
L3-04 (0492)	Stall Prevention during Decel	V/f CL-V/f OLV CLV AOLV Sets the method that the drive will use to prevent overvoltage faults when it decelerates. **Note:** To connect a dynamic braking option (braking resistor or braking resistor unit) to the drive, set this parameter to *0* or *3*. Parameter values 1, 2, 4, and 5 will enable Stall Prevention function during deceleration, and the dynamic braking option will not function. 0 : Disable 1 : General Purpose 2 : Intelligent (Ignore Accel Ramp) 3 : General Purpose w/ DB resistor 4 : Overexcitation/High Flux 1 5 : Overexcitation/High Flux 2	0 (0 - 5)	752
L3-05 (0493)	Stall Prevention during RUN	V/f CL-V/f OLV CLV AOLV Sets the function to enable and disable Stall Prevention During Run. **Note:** An output frequency lower than 6 Hz will disable Stall Prevention during Run. The *L3-05* and *L3-06 [Stall Prevent Level during Run]* settings do not have an effect. 0 : Disable 1 : Deceleration Time 1 (C1-02) 2 : Deceleration Time 2 (C1-04)	1 (0 - 2)	754
L3-06 (0494)	Stall Prevent Level during Run	V/f CL-V/f OLV CLV AOLV Sets the output current level at which the Stall Prevention function is enabled during run when the drive rated output current is 100%. **Note:** • This parameter is valid if *L3-05 = 1, 2 [Stall Prevent Select during Run = Decel time 1, Decel time 2]*. • The upper limit of this setting is determined by *L8-38 [Carrier Frequency Reduction]*.	Determined by L8-38 (30 - 150%)	754
L3-17 (0462)	DC Bus Regulation Level	V/f CL-V/f OLV CLV AOLV Sets the target value for the DC bus voltage when the Decel Stall Prevention function (Intelligent Stall Prevention) are active.	200 V Class: 375 V, 400 V Class: 750 V (200 V Class: 150 to 400 V, 400 V Class: 300 to 800 V)	755
L3-20 (0465) Expert	DC Bus Voltage Adjustment Gain	V/f CL-V/f OLV CLV AOLV Sets the proportional gain used to control the DC bus voltage.	Determined by A1-02 (0.00 - 5.00)	755
L3-21 (0466) Expert	OVSuppression Accel/ Decel P Gain	V/f CL-V/f OLV CLV AOLV Sets the proportional gain to calculate acceleration and deceleration rates.	Determined by A1-02 (0.10 - 10.00)	755
L3-23 (04FD)	Stall P Reduction at Constant HP	V/f CL-V/f OLV CLV AOLV Sets the function to automatically decrease the Stall Prevention Level during Run for Constant Horse Power (CHP) part of the speed range. 0 : Use L3-06 for Entire Speed Range 1 : Automatic Reduction @ CHP Region	0 (0, 1)	755
L3-24 (046E) Expert	Motor Accel Time @ Rated Torque	V/f CL-V/f OLV CLV AOLV Sets the motor acceleration time to reach the maximum frequency at the motor rated torque for stopped single-drive motors.	Determined by o2-04 and E2-11 (0.001 - 10.000 s)	755
L3-25 (046F) Expert	Load Inertia Ratio	V/f CL-V/f OLV CLV AOLV Sets the ratio between motor inertia and machine inertia.	1.0 (1.0 - 1000.0)	756

No. (Hex.)	Name	Description	Default (Range)	Ref.
L3-26 (0455) Expert	Additional DC Bus Capacitors	V/f CL-V/f OLV CLV AOLV Sets the capacity for external main circuit capacitors. Usually it is not necessary to change this parameter.	0 µF (0 to 65000 µF)	756
L3-27 (0456)	Stall Prevention Detection Time	V/f CL-V/f OLV CLV AOLV Sets a delay time between reaching the Stall Prevention level and starting the Stall Prevention function.	50 ms (0 - 5000 ms)	756
L3-35 (0747) Expert	Speed Agree Width for Auto Decel	V/f CL-V/f OLV CLV AOLV Sets the width for speed agreement when *L3-04 = 2 [Stall Prevention during Decel = Intelligent (Ignore Decel Ramp)]*. Usually it is not necessary to change this setting.	0.00 Hz (0.00 - 1.00 Hz)	756
L3-36 (11D0)	Current Suppression Gain@Accel	V/f CL-V/f OLV CLV AOLV Sets the gain to suppress current and motor speed hunting during operation when *L3-01 = 3 [Stall Prevention during Accel = Current Limit Method]*. Usually it is not necessary to change this setting.	Determined by A1-02 (0.0 - 100.0)	757
L3-37 (11D1) Expert	Current Limit P Gain @ Accel	V/f CL-V/f OLV CLV AOLV Suppresses current hunting during acceleration. Usually it is not necessary to change this setting.	5 ms (0 - 100 ms)	757
L3-38 (11D2) Expert	Current Limit I Time @ Accel	V/f CL-V/f OLV CLV AOLV Suppresses current hunting and overshooting that occurs when the drive stalls during acceleration. Usually it is not necessary to change this setting.	10.0 (0.0 - 100.0)	757
L3-39 (11D3)	Current Limit Filter Time @Accel	V/f CL-V/f OLV CLV AOLV Sets the time constant to adjust the acceleration rate when *L3-01 = 3 [Stall Prevention during Accel = Current Limit Method]*. Usually it is not necessary to change this setting.	100.0 ms (1.0 - 1000.0 ms)	757
L3-40 (11D4)	Current Limit S-Curve @ Acc/Dec	V/f CL-V/f OLV CLV AOLV Sets the function to enable and disable the best S-curve characteristic used for current-limited acceleration. 0 : Disable 1 : Enabled	0 (0, 1)	757

◆ L4: Speed Detection

No. (Hex.)	Name	Description	Default (Range)	Ref.
L4-01 (0499)	Speed Agree Detection Level	V/f CL-V/f OLV CLV AOLV Sets the level to detect speed agree or motor speed. Sets the level to detect speed agree or motor speed when *H2-01 to H2-05 = 2, 3, 4, 5 [MFDO Function Selection = Speed Agree 1, User-set Speed Agree 1, Frequency Detection 1, Frequency Detection 2]*.	Determined by A1-02 (Determined by A1-02)	758
L4-02 (049A)	Speed Agree Detection Width	V/f CL-V/f OLV CLV AOLV Sets the width to detect speed agree or motor speed. Sets the width to detect speed agree or motor speed when *H2-01 to H2-05 = 2, 3, 4, 5 [MFDO Function Selection = Speed Agree 1, User-set Speed Agree 1, Frequency Detection 1, Frequency Detection 2]*.	Determined by A1-02 (Determined by A1-02)	758
L4-03 (049B)	Speed Agree Detection Level(+/-)	V/f CL-V/f OLV CLV AOLV Sets the level to detect speed agree or motor speed. Sets the level to detect speed agree or motor speed when *H2-01 to H2-05 = 13, 14, 15, 16 [MFDO Function Selection = Speed Agree 2, User-set Speed Agree 2, Frequency Detection 3, Frequency Detection 4]*.	Determined by A1-02 (Determined by A1-02)	758
L4-04 (049C)	Speed Agree Detection Width(+/-)	V/f CL-V/f OLV CLV AOLV Sets the width to detect speed agree or motor speed. Sets the width to detect speed agree or motor speed when *H2-01 to H2-05 = 13, 14, 15, 16 [MFDO Function Selection = Speed Agree 2, User-set Speed Agree 2, Frequency Detection 3, Frequency Detection 4]*.	Determined by A1-02 (Determined by A1-02)	758
L4-05 (049D)	Fref Loss Detection Selection	V/f CL-V/f OLV CLV AOLV Sets the operation when the drive detects a loss of frequency reference. 0 : Stop 1 : Run at (*L4-06* x Last Reference)	0 (0, 1)	758
L4-06 (04C2)	Frequency Reference @Loss of Ref	V/f CL-V/f OLV CLV AOLV Sets the frequency reference as a percentage to continue drive operation after it detects a frequency reference loss. The value is a percentage of the frequency reference before the drive detected the loss.	80.0% (0.0 - 100.0%)	759
L4-07 (0470)	Speed Agree Detection Selection	V/f CL-V/f OLV CLV AOLV Sets the condition that activates speed detection. 0 : No Detection during Baseblock 1 : Detection Always Enabled	0 (0, 1)	759

◆ L7: Torque Limit

No. (Hex.)	Name	Description	Default (Range)	Ref.
L7-01 (04A7) RUN	Forward Torque Limit	V/f CL-V/f OLV CLV AOLV Sets the torque limit value for forward motoring as a percentage, where motor rated torque is the 100% value.	200% (0 - 300%)	760
L7-02 (04A8) RUN	Reverse Torque Limit	V/f CL-V/f OLV CLV AOLV Sets the torque limit value for reversed motoring as a percentage, where motor rated torque is the 100% value.	200% (0 - 300%)	760
L7-03 (04A9) RUN	Forward Regenerative Trq Limit	V/f CL-V/f OLV CLV AOLV Sets the torque limit value for forward regenerative conditions as a percentage of the motor rated torque.	200% (0 - 300%)	760
L7-04 (04AA) RUN	Reverse Regenerative Trq Limit	V/f CL-V/f OLV CLV AOLV Sets the torque limit value for reversed regenerative conditions as a percentage of the motor rated torque.	200% (0 - 300%)	760
L7-06 (04AC)	Torque Limit Integral Time	V/f CL-V/f OLV CLV AOLV Sets the integral time constant for the torque limit function.	200 ms (5 - 10000 ms)	761
L7-07 (04C9)	Torque Limit during Accel/Decel	V/f CL-V/f OLV CLV AOLV Sets the torque limit function during acceleration and deceleration. 0 : Proportional only 1 : Proportional & Integral control	0 (0, 1)	761
L7-16 (044D)	Torque Limit Process at Start	V/f CL-V/f OLV CLV AOLV Assigns a time filter to allow the torque limit to build at start. 0 : Disabled 1 : Enabled	1 (0, 1)	761
L7-35 (1B57) Expert	Low Freq Regen Torque Limit Lvl	V/f CL-V/f OLV CLV AOLV Sets the torque limit used during low-speed regeneration. Usually it is not necessary to change this setting.	50.0% (0.0 - 200.0%)	761
L7-36 (1B58) Expert	Regen Torque Limit Derate Freq	V/f CL-V/f OLV CLV AOLV Sets the frequency width at which *L7-35 [Low Freq Regen Torque Limit Lvl]* operates.	6.0 Hz (0.0 - 30.0 Hz)	762

◆ L8: Hardware Protection

No. (Hex.)	Name	Description	Default (Range)	Ref.
L8-01 (04AD)	3% ERF DB Resistor Protection	V/f CL-V/f OLV CLV AOLV Sets the function to enable braking resistor protection with a Yaskawa ERF series braking resistor (3% ED). 0 : Disable 1 : Enabled	0 (0, 1)	762
L8-02 (04AE)	Overheat Alarm Level	V/f CL-V/f OLV CLV AOLV Sets the *oH* detection level in temperature.	Determined by o2-04 (50 - 150 °C)	762
L8-03 (04AF)	Overheat Pre-Alarm Selection	V/f CL-V/f OLV CLV AOLV Sets operation after the drive detects an *oH* alarm. 0 : Ramp to Stop 1 : Coast to Stop 2 : Fast Stop (Use C1-09) 3 : Alarm Only 4 : Operate at Reduced Speed (L8-19)	3 (0 - 4)	762
L8-05 (04B1)	Input Phase Loss Protection Sel	V/f CL-V/f OLV CLV AOLV Sets the function to enable and disable input phase loss detection. 0 : Disable 1 : Enabled	1 (0, 1)	763
L8-07 (04B3)	Output Phase Loss Protection Sel	V/f CL-V/f OLV CLV AOLV Sets the function to enable and disable output phase loss detection. The drive starts output phase loss detection and the motor coasts to stop when the output current decreases to less than 5% of the drive rated current. **Note:** The drive can incorrectly start output phase loss detection in these conditions: Disable output phase loss protection. • The motor rated current is very small compared to the drive rating. 0 : Disable 1 : Fault when one phase is lost 2 : Fault when two phases are lost	1 (0 - 2)	764

No. (Hex.)	Name	Description	Default (Range)	Ref.
L8-08 (04B4)	Output Phase Loss Detection Lvl	V/f CL-V/f OLV CLV AOLV Sets the output phase loss detection level.	5.0% (0.0 - 20.0%)	764
L8-09 (04B5)	Output Ground Fault Detection	V/f CL-V/f OLV CLV AOLV Sets the function to enable and disable ground fault protection. 0 : Disabled 1 : Enabled	Determined by o2-04 (0, 1)	764
L8-10 (04B6)	Heatsink Fan Operation Selection	V/f CL-V/f OLV CLV AOLV Sets operation of the heatsink cooling fan. 0 : During Run, w/ L8-11 Off-Delay 1 : Always On 2 : Temperature-Dependent Fan Ctrl.	0 (0 - 2)	764
L8-11 (04B7)	Heatsink Fan Off-Delay Time	V/f CL-V/f OLV CLV AOLV Sets the length of time that the drive will wait before it stops the cooling fan after it cancels the Run command when *L8-10 = 0 [Heatsink Fan Operation Selection = During Run, w/ L8-11 Off-Delay]*.	60 s (0 - 300 s)	765
L8-12 (04B8)	Ambient Temperature Setting	V/f CL-V/f OLV CLV AOLV Sets the ambient temperature of the drive installation area.	40 °C (-10 °C - +50 °C)	765
L8-15 (04BB)	Drive oL2 @ Low Speed Protection	V/f CL-V/f OLV CLV AOLV Sets the function to decrease the drive overload level at which the drive will trigger *oL2 [Drive Overload]* during low speed operation (6 Hz or slower) to prevent damage to the main circuit transistors. **Note:** Contact Yaskawa or your nearest sales representative before disabling this function at low speeds. If you frequently operate drives with high output current in low speed ranges, it can cause heat stress and decrease the life span of drive IGBTs. 0 : Disabled (No Additional Derate) 1 : Enabled (Reduced oL2 Level)	1 (0, 1)	765
L8-18 (04BE)	Software Current Limit Selection	V/f CL-V/f OLV CLV AOLV Set the software current limit selection function to prevent damage to the main circuit transistor caused by too much current. 0 : Disabled 1 : Enabled	0 (0, 1)	765
L8-19 (04BF)	Freq Reduction @ oH Pre-Alarm	V/f CL-V/f OLV CLV AOLV Sets the ratio at which the drive derates the frequency reference during an *oH* alarm.	0.8 (0.1 - 0.9)	765
L8-32 (04E2)	Cooling Fan Failure Selection	V/f CL-V/f OLV CLV AOLV Sets operation when the drive detects *FAn [Internal Fan Fault]*. 0 : Ramp to Stop 1 : Coast to Stop 2 : Fast Stop (Use C1-09) 3 : Alarm Only 4 : Operate at Reduced Speed (L8-19)	1 (0 - 4)	766
L8-35 (04EC)	Installation Method Selection	V/f CL-V/f OLV CLV AOLV Sets the type of drive installation. 0 : IP20/Open-Chassis enclosure 1 : Side-by-Side Mounting 2 : IP21/NEMA Type 1/IP55 3 : External Heatsink	Determined by the drive (0 - 3)	766
L8-38 (04EF)	Carrier Frequency Reduction	V/f CL-V/f OLV CLV AOLV Sets the carrier frequency reduction function. The drive reduces the carrier frequency when the output current is more than a specified level. 0 : Disabled 1 : Enabled below 6 Hz 2 : Enabled for All Speeds	Determined by A1-02 and o2-04 (0 - 2)	766
L8-39 (04F0)	Carrier Freq Reduction during oL	V/f CL-V/f OLV CLV AOLV Sets the low carrier frequency when IGBT protection is enabled.	Determined by o2-04 (1.0 - 15.0 kHz)	767
L8-40 (04F1)	Carrier Freq Reduction Off-Delay	V/f CL-V/f OLV CLV AOLV Sets the length of time until the automatically reduced carrier frequency returns to the condition before the reduction.	Determined by A1-02 (0.00 - 2.00 s)	767
L8-41 (04F2)	High Current Alarm Selection	V/f CL-V/f OLV CLV AOLV Triggers an *HCA [Current Alarm]* when the output current exceeds 150% of the drive rated current. 0 : Disable 1 : Enabled	1 (0, 1)	767
L8-55 (045F)	Internal DB TransistorProtection	V/f CL-V/f OLV CLV AOLV Sets the protection function for the internal braking transistor. 0 : Disable 1 : Protection Enabled	1 (0, 1)	767

◆ L9: Drive Protection 2

No. (Hex.)	Name	Description	Default (Range)	Ref.
L9-16 (11DC) Expert	FAn1 Detect Time	V/f CL-V/f OLV CLV AOLV Sets the detection time for *FAn1 [Drive Cooling Fan Fault]*. Yaskawa recommends that you do not change this parameter value.	4.0 s (0.0 - 30.0 s)	768

10.12 n: Special Adjustment

◆ n1: Hunting Prevention

No. (Hex.)	Name	Description	Default (Range)	Ref.
n1-01 (0580)	Hunting Prevention Selection	V/f CL-V/f OLV CLV AOLV Sets the function to prevent hunting. 0 : Disable 1 : Enabled 2 : Enabled (High Carrier Frequency)	Determined by o2-04 (0 - 2)	769
n1-02 (0581) Expert	Hunting Prevention Gain Setting	V/f CL-V/f OLV CLV AOLV Sets the performance of the hunting prevention function. Usually it is not necessary to change this parameter.	1.00 (0.00 - 2.50)	769
n1-03 (0582) Expert	Hunting Prevention Time Constant	V/f CL-V/f OLV CLV AOLV Sets the primary delay time constant of the hunting prevention function. Usually it is not necessary to change this parameter.	Determined by o2-04 (0 - 500 ms)	769
n1-05 (0530) Expert	Hunting Prevent Gain in Reverse	V/f CL-V/f OLV CLV AOLV Sets the performance of the hunting prevention function. This parameter adjusts Reverse run. Usually it is not necessary to change this parameter.	0.00 (0.00 - 2.50)	769
n1-08 (1105) Expert	Current Detection Method	V/f CL-V/f OLV CLV AOLV Sets how the drive decreases the motor vibration that is caused by leakage current. Usually it is not necessary to change this parameter. 0 : 2-Phases 1 : 3-Phases	0 (0, 1)	770
n1-13 (1B59) Expert	DC Bus Stabilization Control	V/f CL-V/f OLV CLV AOLV Sets the oscillation suppression function for the DC bus voltage. 0 : Disabled 1 : Enabled	0 (0, 1)	770
n1-14 (1B5A) Expert	DC Bus Stabilization Time	V/f CL-V/f OLV CLV AOLV Adjusts the responsiveness of the oscillation suppression function for the DC bus voltage. Set *n1-13 = 1 [DC Bus Stabilization Control = Enabled]* to enable this parameter.	100.0 ms (50.0 - 500.0 ms)	770
n1-15 (0BF8) Expert	PWM Voltage Offset Calibration	V/f CL-V/f OLV CLV AOLV Sets the calibration method that the drive uses to decrease torque/current ripple. 0 : No Calibration 1 : One Time Calibrate at Next Start 2 : Calibrate Every Time at Start	Determined by A1-02 (0 - 2)	770
n1-16 (0BFB)	Hunting Prevention High Fc Gain	V/f CL-V/f OLV CLV AOLV Sets the gain for the hunting prevention function. This parameter functions best with a high carrier frequency. Usually it is not necessary to change this parameter.	Determined by o2-04 (0.00 - 2.50)	770
n1-17 (0BFC) Expert	Hunting Prevent High Fc Filter	V/f CL-V/f OLV CLV AOLV Sets the responsiveness of the hunting prevention function. Usually it is not necessary to change this parameter.	500 ms (0 - 1000 ms)	771
n1-20 (1588) Expert	Voltage Calibration Duration	V/f CL-V/f OLV CLV AOLV Sets the calibration time at start. Usually it is not necessary to change this parameter.	50 ms (10 - 500 ms)	771

◆ n2: Auto Freq Regulator (AFR)

No. (Hex.)	Name	Description	Default (Range)	Ref.
n2-01 (0584)	Automatic Freq Regulator Gain(F)	V/f CL-V/f OLV CLV AOLV Sets the gain of the AFR function for forward run as a magnification value. Usually it is not necessary to change this setting.	1.00 (0.00 - 10.00)	771
n2-02 (0585)	Automatic Freq Regulator Time 1	V/f CL-V/f OLV CLV AOLV Sets the time constant that sets the rate of change for the AFR function. Usually it is not necessary to change this setting.	50 ms (0 - 2000 ms)	771
n2-03 (0586)	Automatic Freq Regulator Time 2	V/f CL-V/f OLV CLV AOLV Sets the time constant to determine the variation in speed of the AFR function. Use this parameter during regeneration. Usually it is not necessary to change this setting.	750 ms (0 - 2000 ms)	772
n2-06 (1567)	Automatic Freq Regulator Gain(R)	V/f CL-V/f OLV CLV AOLV Sets the gain of the AFR function for reverse run as a magnification value. Usually it is not necessary to change this setting.	1.00 (0.00 - 10.00)	772

◆ n3: Overexcitation Deceleration

No. (Hex.)	Name	Description	Default (Range)	Ref.
n3-13 (0531)	OverexcitationBraking (OEB) Gain	V/f CL-V/f OLV CLV AOLV Sets the gain value that the drive multiplies by the V/f pattern output value during overexcitation deceleration to calculate the overexcitation level.	1.10 (1.00 - 1.40)	773
n3-14 (0532) Expert	OEB High Frequency Injection	V/f CL-V/f OLV CLV AOLV Sets the function that injects harmonic signals during overexcitation deceleration. 0 : Disabled 1 : Enabled	0 (0, 1)	773
n3-21 (0579)	HSB Current Suppression Level	V/f CL-V/f OLV CLV AOLV Sets the upper limit of the current that is suppressed at the time of overexcitation deceleration as a percentage of the drive rated current.	100% (0 - 150%)	773
n3-23 (057B)	Overexcitation Braking Operation	V/f CL-V/f OLV CLV AOLV Sets the direction of motor rotation where the drive will enable overexcitation. 0 : Disabled 1 : Enabled Only when Rotating FWD 2 : Enabled Only when Rotating REV	0 (0 - 2)	774

◆ n4: Adv Open Loop Vector Tune

No. (Hex.)	Name	Description	Default (Range)	Ref.
n4-60 (1B80)	Motoring Low Speed Comp Gain	V/f CL-V/f OLV CLV AOLV Sets a compensation gain to improve the control qualities for motoring loads in the low speed range.	100.0% (50.0 - 200.0%)	774
n4-61 (1B81)	Low Speed Comp Frequency Level	V/f CL-V/f OLV CLV AOLV Sets a frequency at which the settings *n4-60 [Motoring Low Speed Comp Gain]* and *n4-62 [Regen Low Speed Comp Gain]* are enabled. When the output frequency < n4-61, the drive adjusts the torque to agree with the settings for *n4-60* and *n4-62*. Usually it is not necessary to change this setting.	6.00 Hz (0.50 - 12.00 Hz)	774
n4-62 (1B82)	Regen Low Speed Comp Gain	V/f CL-V/f OLV CLV AOLV Sets a compensation gain to improve the control qualities for regenerative loads in the low speed range.	100.0 % (50.0 - 500.0%)	774
n4-63 (1B83)	Speed EstimateResponse@ High Freq	V/f CL-V/f OLV CLV AOLV In high speed ranges, where the output frequency is ≥ *n4-67 [SwitchingFreq forEstimation gain]*, this adjusts the responsiveness of the speed estimation.	60.0 (0.1 - 300.0)	775
n4-64 (1B84)	Speed Estimate Response@Low Freq	V/f CL-V/f OLV CLV AOLV In low speed ranges, where 0 ≤ the output frequency, which is < *n4-67 [SwitchingFreq forEstimation gain]*, this adjusts the responsiveness of the speed estimation.	60.0 (0.1 - 300.0)	775
n4-65 (1B85)	Flux Estimate Response@High Freq	V/f CL-V/f OLV CLV AOLV In high speed ranges, where the output frequency is ≥ *n4-67 [SwitchingFreq forEstimation gain]*, this adjusts the responsiveness of the magnetic flux estimation. Usually it is not necessary to change this setting.	1.00 (0.50 - 3.00)	775
n4-66 (1B86)	Flux Estimate Response @Low Freq	V/f CL-V/f OLV CLV AOLV Sets the responsiveness of the magnetic flux estimation in low speed ranges, where 0 ≤ the output frequency, which is < *n4-67 [Estimate Gain Switchover Freq]*. Usually it is not necessary to change this setting.	1.50 (0.50 - 3.00)	775
n4-67 (1B87)	Estimate Gain Switchover Freq	V/f CL-V/f OLV CLV AOLV Set the switching frequency for estimation gain for each of the following: *n4-63 [SpdEstimationResponseForHighFreq]*, *n4-64 [SpdEstimationResponse forLowFreq]*, *n4-65 [FluxEstimationResponseForHighFrq]*, and *n4-66 [FluxEstimationResponseForLowFreq]*. Usually it is not necessary to change this setting.	6.00 Hz (0.00 - E1-04)	775
n4-68 (1B88)	Speed Estimation Filter Time	V/f CL-V/f OLV CLV AOLV Sets the primary delay time constant for the speed estimation value. Usually it is not necessary to change this setting.	0.001 s (0.001 - 0.010 s)	776
n4-69 (1B89)	Flux Control Response	V/f CL-V/f OLV CLV AOLV Unifies control of magnetic flux to make motor vibrations more stable.	1.00 (0.00 - 60.00)	776
n4-70 (1B8A)	Speed Command Comp @ Low Freq	V/f CL-V/f OLV CLV AOLV Sets the function to make the drive more stable when it operates at low speeds. Usually it is not necessary to change this parameter.	1.00 Hz (0.00 - 6.00 Hz)	776
n4-71 (1B8B) Expert	Flux Estimation Method	V/f CL-V/f OLV CLV AOLV Sets the flux estimation method. Usually it is not necessary to change this setting. 0 : Method 1 1 : Method 2	0 (0, 1)	776

No. (Hex.)	Name	Description	Default (Range)	Ref.
n4-72 (1B8C)	Speed Feedback Mode	V/f CL-V/f OLV CLV **AOLV** Sets the requirement for an encoder option when *A1-02 = 4 [Control Method Selection = Advanced Open Loop Vector]*. 0 : Without Encoder 1 : With Encoder	0 (0, 1)	776
n4-73 (1B8D)	PGo Recovery Selection	V/f CL-V/f OLV CLV **AOLV** Sets the restart mode to Without Encoder Mode or the With Encoder Mode when an encoder is disconnected. 0 : Without Encoder 1 : With Encoder	0 (0, 1)	777
n4-74 (1B8E)	Limit of Flux Loop	V/f CL-V/f OLV CLV **AOLV** Sets the control level for flux loop control output.	250% (100 - 500%)	777

◆ n5: Feed Forward Control

No. (Hex.)	Name	Description	Default (Range)	Ref.
n5-01 (05B0)	Feed Forward Control Selection	V/f CL-V/f OLV **CLV** **AOLV** Sets the feed forward function. 0 : Disabled 1 : Enabled	0 (0, 1)	778
n5-02 (05B1)	Motor Inertia Acceleration Time	V/f CL-V/f OLV **CLV** **AOLV** Sets the length of time for the motor to accelerate from the stopped to the maximum frequency with a single motor at the rated torque. Inertia Tuning automatically sets the motor acceleration time.	Determined by o2-04 (0.001 - 10.000 s)	778
n5-03 (05B2)	Feed Forward Control Gain	V/f CL-V/f OLV **CLV** **AOLV** Sets the ratio between load inertia and motor inertia. Inertia Tuning automatically sets the Feedforward Control Gain value.	1.00 (0.00 - 100.00)	779
n5-04 (05B3) RUN Expert	Speed Response Frequency	V/f CL-V/f OLV **CLV** **AOLV** Sets the response frequency for the speed reference. Usually it is not necessary to change this parameter.	Determined by A1-02 (0.00 - 500.00 Hz)	779

◆ n6: Online Resistance Tuning

No. (Hex.)	Name	Description	Default (Range)	Ref.
n6-01 (0570)	Online Tuning Selection	V/f CL-V/f **OLV** CLV AOLV Sets the type of motor data that Online Tuning uses for OLV control. 0 : Disable 1 : Line-to-Line Resistance Tuning 2 : Voltage Correction Tuning	0 (0 - 2)	780
n6-05 (05C7) Expert	Online Tuning Gain	V/f CL-V/f **OLV** CLV AOLV Sets the compensation gain when *n6-01 = 2 [Online Tuning Selection = Voltage Correction Tuning]*. Usually it is not necessary to change this parameter.	1.0 (0.1 - 50.0)	780
n6-11 (1B56) Expert	Online Resistance Tuning	V/f CL-V/f OLV **CLV** **AOLV** Sets the responsiveness for online resistor tuning. Set this parameter to approximately *1.000* to enable the function. The function is disabled when the value is *0.000*.	0.000 (0.000 - 1.000)	780

10.13 o: Keypad-Related Settings

◆ o1: Keypad Display

No. (Hex.)	Name	Description	Default (Range)	Ref.
o1-01 (0500) RUN	User Monitor Selection	V/f CL-V/f OLV CLV AOLV Sets the *U monitor* for the Drive Mode. This parameter is only available with an LED keypad. **Note:** You cannot select *U2 Monitors [Fault Trace]* or *U3 Monitors [Fault History]*.	106 (104 - 999)	782
o1-02 (0501) RUN	Monitor Selection at Power-up	V/f CL-V/f OLV CLV AOLV Sets the monitor item that the keypad screen shows after you energize the drive. Refer to "U: Monitors" for information about the monitor items that the keypad screen can show. This parameter is only available with an LED keypad. 1 : Frequency Reference (U1-01) 2 : Direction 3 : Output Frequency (U1-02) 4 : Output Current (U1-03) 5 : User Monitor (*o1-01*)	1 (1 - 5)	782
o1-03 (0502)	Frequency Display Unit Selection	V/f CL-V/f OLV CLV AOLV Sets the display units for the frequency reference and output frequency. 0 : 0.01 Hz 1 : 0.01% (100% = E1-04) 2 : min^{-1} (r/min) units 3 : User Units (o1-10 & o1-11) 4 : 0.01m/min	Determined by A1-02 (0 - 4)	782
o1-04 (0503)	V/f Pattern Display Unit	V/f CL-V/f OLV CLV AOLV Sets the setting unit for parameters that set the V/f pattern frequency. 0 : Hz 1 : min^{-1} (r/min) units	Determined by A1-02 (0, 1)	783
o1-05 (0504) RUN	LCD Contrast Adjustment	V/f CL-V/f OLV CLV AOLV Sets the contrast of the LCD display on the keypad.	5 (0 - 10)	783
o1-10 (0520)	User Units Maximum Value	V/f CL-V/f OLV CLV AOLV Sets the value that the drive shows as the maximum output frequency.	Determined by o1-03 (1 - 60000)	784
o1-11 (0521)	User Units Decimal Position	V/f CL-V/f OLV CLV AOLV Sets the number of decimal places for frequency reference and monitor values. 0 : No Decimal Places (XXXXX) 1 : One Decimal Places (XXXX.X) 2 : Two Decimal Places (XXX.XX) 3 : Three Decimal Places (XX.XXX)	Determined by o1-03 (0 - 3)	784
o1-20 (0575)	Sheave Diameter	V/f CL-V/f OLV CLV AOLV Sets the sheave diameter.	400 mm (100 - 2000 mm)	784
o1-21 (0576)	Roping Ratio	V/f CL-V/f OLV CLV AOLV Sets the roping ratio. 1 : 1:1 2 : 1:2 3 : 1:3 4 : 1:4	2 (1 - 4)	784
o1-22 (0577)	Gear Ratio	V/f CL-V/f OLV CLV AOLV Sets the gear ratio.	14.00 (0.10 - 50.00)	784
o1-24 to o1-35: (11AD - 11B8) RUN	Custom Monitor 1 to 12	V/f CL-V/f OLV CLV AOLV Sets a maximum of 12 monitors as user monitors. This parameter is only available when using an LCD keypad.	o1-24: 101 o1-25: 102 o1-26: 103 o1-27 to o1-35: 0 (0, 101 - 999)	784
o1-36 (11B9) RUN	LCD Backlight Brightness	V/f CL-V/f OLV CLV AOLV Sets the intensity of the LCD keypad backlight.	3 (1 - 5)	785
o1-37 (11BA) RUN	LCD Backlight ON/OFF Selection	V/f CL-V/f OLV CLV AOLV Sets the automatic shut off function for the LCD backlight. 0 : OFF 1 : ON	1 (0, 1)	785

No. (Hex.)	Name	Description	Default (Range)	Ref.
o1-38 (11BB) RUN	LCD Backlight Off-Delay	V/f CL-V/f OLV CLV AOLV Sets the time until the LCD backlight automatically turns off.	60 s (10 - 300 s)	785
o1-39 (11BC) RUN	Show Initial Setup Screen	V/f CL-V/f OLV CLV AOLV Sets the function to show the LCD keypad initial setup screen each time you energize the drive. This parameter is only available with an LCD keypad. 0 : No 1 : Yes	1 (0, 1)	786
o1-40 (11BD) RUN	Home Screen Display Selection	V/f CL-V/f OLV CLV AOLV Sets the monitor display mode for the Home screen. This parameter is only available with an LCD keypad. 0 : Custom Monitor 1 : Bar Graph 2 : Analog Gauge 3 : Trend Plot	0 (0 - 3)	786
o1-41 (11C1) RUN	1st Monitor Area Selection	V/f CL-V/f OLV CLV AOLV Sets the horizontal axis value used to display the monitor set in *o1-24 [Custom Monitor 1]* as a bar graph. This parameter is only available with an LCD keypad. 0 : +/- Area (- o1-42 ~ o1-42) 1 : + Area (0 ~ o1-42)	0 (0 - 1)	786
o1-42 (11C2) RUN	1st Monitor Area Setting	V/f CL-V/f OLV CLV AOLV Sets the horizontal axis value used to display the monitor set in *o1-24 [Custom Monitor 1]* as a bar graph. This parameter is only available with an LCD keypad.	100.0% (0.0 - 100.0%)	786
o1-43 (11C3) RUN	2nd Monitor Area Selection	V/f CL-V/f OLV CLV AOLV Selects the horizontal range used to display the monitor set in *o1-25 [Custom Monitor 2]* as a bar graph. This parameter is only available with an LCD keypad. 0 : +/- Area (- o1-44 ~ o1-44) 1 : + Area (0 ~ o1-44)	0 (0 - 1)	786
o1-44 (11C4) RUN	2nd Monitor Area Setting	V/f CL-V/f OLV CLV AOLV Sets the horizontal axis value used to display the monitor set in *o1-25 [Custom Monitor 2]* as a bar graph. This parameter is only available with an LCD keypad.	100.0% (0.0 - 100.0%)	787
o1-45 (11C5) RUN	3rd Monitor Area Selection	V/f CL-V/f OLV CLV AOLV Sets the horizontal axis value used to display the monitor set in *o1-26 [Custom Monitor 3]* as a bar graph. This parameter is only available with an LCD keypad. 0 : +/- Area (- o1-46 ~ o1-46) 1 : + Area (0 ~ o1-46)	0 (0 - 1)	787
o1-46 (11C6) RUN	3rd Monitor Area Setting	V/f CL-V/f OLV CLV AOLV Sets the horizontal axis value used to display the monitor set in *o1-26 [Custom Monitor 3]* as a bar graph. This parameter is only available with an LCD keypad.	100.0% (0.0 - 100.0%)	787
o1-47 (11C7) RUN	Trend Plot 1 Scale Minimum Value	V/f CL-V/f OLV CLV AOLV Sets the minimum value for the vertical axis used to display a trend plot from the monitor selected with *o1-24*. This parameter is only available with an LCD keypad.	-100.0% (-300.0 - +99.9%)	787
o1-48 (11C8) RUN	Trend Plot 1 Scale Maximum Value	V/f CL-V/f OLV CLV AOLV Sets the maximum value for the vertical axis used to display the monitor that was set in *o1-24 [Custom Monitor 1]* as a trend plot. This parameter is only available with an LCD keypad.	100.0% (-299.9 - +300.0%)	787
o1-49 (11C9) RUN	Trend Plot 2 Scale Minimum Value	V/f CL-V/f OLV CLV AOLV Sets the minimum value for the vertical axis used to display a trend plot from the monitor selected with *o1-25*. This parameter is only available with an LCD keypad.	-100.0% (-300.0 - +99.9%)	787
o1-50 (11CA) RUN	Trend Plot 2 Scale Maximum Value	V/f CL-V/f OLV CLV AOLV Sets the maximum value for the vertical axis used to display the monitor that was set in *o1-25 [Custom Monitor 2]* as a trend plot. This parameter is only available with an LCD keypad.	100.0% (-299.9 - +300.0%)	787
o1-51 (11CB) RUN	Trend Plot Time Scale Setting	V/f CL-V/f OLV CLV AOLV Sets the time scale (horizontal axis) to display the trend plot. When you change this setting, the drive automatically adjusts the data sampling time. This parameter is only available with an LCD keypad.	300 s (1 - 3600 s)	788
o1-55 (11EE) RUN	Analog Gauge Area Selection	V/f CL-V/f OLV CLV AOLV Sets the range used when displaying the monitor set in *o1-24* as an analog gauge. This parameter is only available with an LCD keypad. 0 : +/- Area (- o1-56 ~ o1-56) 1 : + Area (0 ~ o1-56)	1 (0, 1)	788
o1-56 (11EF) RUN	Analog Gauge Area Setting	V/f CL-V/f OLV CLV AOLV Sets the value used to display the monitor set in *o1-24 [Custom Monitor 1]* as an analog meter. This parameter is only available with an LCD keypad.	100.0% (0.0 - 100.0%)	788

◆ o2: Keypad Operation

No. (Hex.)	Name	Description	Default (Setting Range)	Ref.
o2-02 (0506)	STOP Key Function Selection	V/f CL-V/f OLV CLV AOLV Sets the function to use STOP on the keypad to stop the drive when the Run command source for the drive is REMOTE (external) and not assigned to the keypad. 0 : Disabled 1 : Enabled	1 (0, 1)	788
o2-03 (0507)	User Parameter Default Value	V/f CL-V/f OLV CLV AOLV Sets the function to keep the settings of changed parameters as user parameter defaults to use during initialization. 0 : No change 1 : Set defaults 2 : Clear all	0 (0 - 2)	788
o2-04 (0508)	Drive Model (KVA) Selection	V/f CL-V/f OLV CLV AOLV Sets the Drive Model code. Set this parameter after replacing the control board.	Determined by the drive (-)	789
o2-05 (0509)	Home Mode Freq Ref Entry Mode	V/f CL-V/f OLV CLV AOLV Sets the function that makes it necessary to push ENTER to use the keypad to change the frequency reference value while in Drive Mode. 0 : ENTER Key Required 1 : Immediate / MOP-style	0 (0, 1)	789
o2-06 (050A)	Keypad Disconnect Detection	V/f CL-V/f OLV CLV AOLV Sets the function that stops the drive if you disconnect the keypad connection cable from the drive or if you damage the cable while the keypad is the Run command source. 0 : Disable 1 : Enabled	0 (0, 1)	789
o2-07 (0527)	Keypad RUN Direction @ Power-up	V/f CL-V/f OLV CLV AOLV Sets the direction of motor rotation when the drive is energized and the keypad is the Run command source. 0 : Forward 1 : Reverse	0 (0, 1)	789
o2-23 (11F8) RUN	External 24V Powerloss Detection	V/f CL-V/f OLV CLV AOLV Sets the function to give a warning if the backup external 24 V power supply turns off when the main circuit power supply is in operation. 0 : Disabled 1 : Enabled	0 (0, 1)	790
o2-24 (11FE)	LED Light Function Selection	V/f CL-V/f OLV CLV AOLV Sets the function to show the LED status rings and keypad LED lamps. 0 : Enable Status Ring & Keypad LED 1 : LED Status Ring Disable 2 : Keypad LED Light Disable	0 (0 - 2)	790
o2-26 (1563)	Alarm Display at Ext. 24V Power	V/f CL-V/f OLV CLV AOLV When you connect a backup external 24 V power supply, this parameter sets the function to trigger an alarm when the main circuit power supply voltage decreases. **Note:** The drive will not run when it is operating from one 24-V external power supply. 0 : Disabled 1 : Enabled	0 (0, 1)	790
o2-27 (1565)	bCE Detection Selection	V/f CL-V/f OLV CLV AOLV Sets drive operation if the Bluetooth device is disconnected when you operate the drive in Bluetooth Mode. 0 : Ramp to Stop 1 : Coast to Stop 2 : Fast Stop (Use *C1-09*) 3 : Alarm Only 4 : No Alarm Display	3 (0 - 4)	790

◆ o3: Copy Keypad Function

No. (Hex.)	Name	Description	Default (Range)	Ref.
o3-01 (0515)	Copy Keypad Function Selection	V/f CL-V/f OLV CLV AOLV Sets the function to use the keypad to save and copy drive parameters to a different drive. 0 : Copy Select 1 : Backup (drive → keypad) 2 : Restore (keypad → drive) 3 : Verify (check for mismatch)	0 (0 - 3)	791
o3-02 (0516)	Copy Allowed Selection	V/f CL-V/f OLV CLV AOLV Sets the copy function when *o3-01 = 1 [Copy Keypad Function Selection = Backup (drive → keypad)]*. 0 : Disabled 1 : Enabled	0 (0, 1)	791
o3-04 (0B3E)	Select Backup/Restore Location	V/f CL-V/f OLV CLV AOLV Sets the storage location for drive parameters when you back up and restore parameters. This parameter is only available when using an LCD keypad. 0 : Memory Location 1 1 : Memory Location 2 2 : Memory Location 3 3 : Memory Location 4	0 (0 - 3)	791
o3-05 (0BDA)	Select Items to Backup/ Restore	V/f CL-V/f OLV CLV AOLV Sets which parameters are backed up, restored, and referenced. This parameter is only available on an LCD keypad. 0 : Standard Parameters 1 : Standard + DWEZ Parameters	0 (0, 1)	791
o3-06 (0BDE)	Auto Parameter Backup Selection	V/f CL-V/f OLV CLV AOLV Sets the function that automatically backs up parameters. This parameter is only available when using an LCD keypad. 0 : Disabled 1 : Enabled	1 (0, 1)	791
o3-07 (0BDF)	Auto Parameter Backup Interval	V/f CL-V/f OLV CLV AOLV Sets the interval at which the automatic parameter backup function saves parameters from the drive to the keypad. **Note:** This parameter is only available when using an LCD keypad. 0 : Every 10 minutes 1 : Every 30 minutes 2 : Every 60 minutes 3 : Every 12 hours	1 (0 - 3)	792

◆ o4: Maintenance Monitors

No. (Hex.)	Name	Description	Default (Range)	Ref.
o4-01 (050B)	Elapsed Operating Time Setting	V/f CL-V/f OLV CLV AOLV Sets the initial value of the cumulative drive operation time in 10-hour units.	0 h (0 - 9999 h)	792
o4-02 (050C)	Elapsed Operating Time Selection	V/f CL-V/f OLV CLV AOLV Sets the condition that counts the cumulative operation time. 0 : U4-01 Shows Total Power-up Time 1 : U4-01 Shows Total RUN Time	0 (0, 1)	792
o4-03 (050E)	Fan Operation Time Setting	V/f CL-V/f OLV CLV AOLV Sets the value from which to start the cumulative drive cooling fan operation time in 10-hour units.	0 h (0 - 9999 h)	793
o4-05 (051D)	Capacitor Maintenance Setting	V/f CL-V/f OLV CLV AOLV Sets the *U4-05 [CapacitorMaintenance]* monitor value.	0% (0 - 150%)	793
o4-07 (0523)	Softcharge Relay Maintenance Set	V/f CL-V/f OLV CLV AOLV Sets the *U4-06 [PreChargeRelayMainte]* monitor value.	0% (0 - 150%)	793
o4-09 (0525)	IGBT Maintenance Setting	V/f CL-V/f OLV CLV AOLV Sets the *U4-07 [IGBT Maintenance]* monitor value.	0% (0 - 150%)	793
o4-11 (0510)	Fault Trace/History Init (U2/U3)	V/f CL-V/f OLV CLV AOLV Resets the records of Monitors *U2-xx [Fault Trace]* and *U3-xx [Fault History]*. 0 : Disabled 1 : Enabled	0 (0, 1)	793

No. (Hex.)	Name	Description	Default (Range)	Ref.
o4-12 (0512)	kWh Monitor Initialization	V/f CL-V/f OLV CLV AOLV Resets the monitor values for *U4-10 [kWh, Lower 4 Digits]* and *U4-11 [kWh, Upper 5 Digits]*. 0 : No Reset 1 : Reset	0 (0, 1)	794
o4-13 (0528)	RUN Command Counter @ Initialize	V/f CL-V/f OLV CLV AOLV Resets the monitor values for *U4-02 [Num of Run Commands]*, *U4-24 [Number of Runs (Low)]*, and *U4-25 [Number of Runs (High)]*. 0 : No Reset 1 : Reset	0 (0, 1)	794
o4-22 (154F) RUN	Time Format	V/f CL-V/f OLV CLV AOLV Sets the time display format. This parameter is only available when using an LCD keypad. 0 : 24 Hour Clock 1 : 12 Hour Clock 2 : 12 Hour JP Clock	0 (0 - 2)	794
o4-23 (1550) RUN	Date Format	V/f CL-V/f OLV CLV AOLV Sets the date display format. This parameter is only available when using an LCD keypad. 0 : YYYY/MM/DD 1 : DD/MM/YYYY 2 : MM/DD/YYYY	0 (0 - 2)	794
o4-24 (310F) RUN	bAT Detection Selection	V/f CL-V/f OLV CLV AOLV Selects the operation when the drive detects *bAT [Keypad Battery Low Voltage]* and *TiM [Keypad Time Not Set]*. 0 : Disable 1 : Enable (Alarm Detected) 2 : Enable (Fault Detected)	0 (0 - 2)	795

◆ o5: Log Function

No. (Hex.)	Name	Description	Default (Range)	Ref.
o5-01 (1551) RUN	Log Start/Stop Selection	V/f CL-V/f OLV CLV AOLV Sets the data log function. This parameter is only available when using an LCD keypad. 0 : OFF 1 : ON	0 (0 - 1)	797
o5-02 (1552) RUN	Log Sampling Interval	V/f CL-V/f OLV CLV AOLV Sets the data log sampling cycle. This parameter is only available on an LCD keypad.	1000 ms (100 - 60000 ms)	797
o5-03 (1553) RUN	Log Monitor Data 1	V/f CL-V/f OLV CLV AOLV Sets the data log monitor. This parameter is only available when using an LCD keypad.	101 (000, 101 - 999)	798
o5-04 (1554) RUN	Log Monitor Data 2	V/f CL-V/f OLV CLV AOLV Sets the data log monitor. This parameter is only available when using an LCD keypad.	102 (000, 101 - 999)	798
o5-05 (1555) RUN	Log Monitor Data 3	V/f CL-V/f OLV CLV AOLV Sets the data log monitor. This parameter is only available when using an LCD keypad.	103 (000, 101 - 999)	798
o5-06 (1556) RUN	Log Monitor Data 4	V/f CL-V/f OLV CLV AOLV Sets the data log monitor. This parameter is only available when using an LCD keypad.	107 (000, 101 - 999)	798
o5-07 (1557) RUN	Log Monitor Data 5	V/f CL-V/f OLV CLV AOLV Sets the data log monitor. This parameter is only available when using an LCD keypad.	108 (000, 101 - 999)	798
o5-08 (1558) RUN	Log Monitor Data 6	V/f CL-V/f OLV CLV AOLV Sets the data log monitor. This parameter is only available when using an LCD keypad.	000 (000, 101 - 999)	799
o5-09 (1559) RUN	Log Monitor Data 7	V/f CL-V/f OLV CLV AOLV Sets the data log monitor. This parameter is only available when using an LCD keypad.	000 (000, 101 - 999)	799
o5-10 (155A) RUN	Log Monitor Data 8	V/f CL-V/f OLV CLV AOLV Sets the data log monitor. This parameter is only available when using an LCD keypad.	000 (000, 101 - 999)	799

No. (Hex.)	Name	Description	Default (Range)	Ref.
o5-11 (155B) RUN	Log Monitor Data 9	V/f CL-V/f OLV CLV AOLV Sets the data log monitor. This parameter is only available when using an LCD keypad.	000 (000, 101 - 999)	799
o5-12 (155C) RUN	Log Monitor Data 10	V/f CL-V/f OLV CLV AOLV Sets the data log monitor. This parameter is only available when using an LCD keypad.	000 (000, 101 - 999)	799

10.14 S: Crane Parameters

◆ S1: Brake Sequence

No. (Hex.)	Name	Description	Default (Range)	Ref.
S1-01 (0680)	Brake Release Frequency(FWD)	V/f CL-V/f OLV CLV AOLV Sets the output frequency level at which to activate the brake release command during forward run. **Note:** You must satisfy these three conditions to output the brake release command: • Output frequency after a soft start ≥ Brake release frequency • Output current > Brake release current • Torque reference ≥ Brake release torque (*A1-02 = 2, 3, or 4 [Control Method Selection = OLV, CLV, or AOLV]*)	2.0 Hz (0.0 - 20.0 Hz)	195 226
S1-02 (0681)	Brake Release Frequency(REV)	V/f CL-V/f OLV CLV AOLV Set the output frequency level at which to activate the brake release command during reverse run. **Note:** You must satisfy these three conditions to output the brake release command: • Output frequency after a soft start ≥ Brake release frequency • Output current > Brake release current • Torque reference ≥ Brake release torque (*A1-02 = 2, 3, or 4 [Control Method Selection = OLV, CLV, or AOLV]*)	2.0 Hz (0.0 - 20.0 Hz)	195 226
S1-03 (0682)	Brake Delay Frequency	V/f CL-V/f OLV CLV AOLV Sets frequency used until the brake is released.	Determined by A1-02 (0.0 - 400.0 Hz)	195 226
S1-04 (0683)	Brake Delay Time	V/f CL-V/f OLV CLV AOLV Sets delay time before the brake is released.	Determined by A1-02 (0.00 - 10.00 s)	195 226
S1-05 (0684)	Brake Release Current (FWD)	V/f CL-V/f OLV CLV AOLV Sets the output current level at which to activate the brake release command during forward run. **Note:** You must satisfy these three conditions to output the brake release command: • Output frequency after a soft start ≥ Brake release frequency • Output current > Brake release current • Torque reference ≥ Brake release torque (*A1-02 = 2, 3, or 4 [Control Method Selection = OLV, CLV, or AOLV]*)	50% (0 - 200%)	195 226
S1-06 (0685)	Brake Release Current (REV)	V/f CL-V/f OLV CLV AOLV Set the output current level at which to activate the brake release command during reverse run. **Note:** You must satisfy these three conditions to output the brake release command: • Output frequency after a soft start ≥ Brake release frequency • Output current > Brake release current • Torque reference ≥ Brake release torque (*A1-02 = 2, 3, or 4 [Control Method Selection = OLV, CLV, or AOLV]*)	30% (0 - 200%)	195 226
S1-07 (0686)	Brake Release Torque (FWD)	V/f CL-V/f OLV CLV AOLV Sets the output torque level at which to activate the brake release command during forward run. **Note:** You must satisfy these three conditions to output the brake release command: • Output frequency after a soft start ≥ Brake release frequency • Output current > Brake release current • Torque reference ≥ Brake release torque (*A1-02 = 2, 3, or 4 [Control Method Selection = OLV, CLV, or AOLV]*)	100% (0 - 200%)	195 226
S1-08 (0687)	Brake Release Torque (REV)	V/f CL-V/f OLV CLV AOLV Sets the output torque level at which to activate the brake release command during reverse run. **Note:** You must satisfy these three conditions to output the brake release command: • Output frequency after a soft start ≥ Brake release frequency • Output current > Brake release current • Torque reference ≥ Brake release torque (*A1-02 = 2, 3, or 4 [Control Method Selection = OLV, CLV, or AOLV]*)	0% (0 - 200%)	195 226
S1-09 (0688)	Torque Compensation (FWD)	V/f CL-V/f OLV CLV AOLV Sets the torque compensation for forward operation.	Determined by A1-02 (-200 - +200%)	195 226
S1-10 (0689)	Torque Compensation (REV)	V/f CL-V/f OLV CLV AOLV Sets the amount of torque compensation for reverse run.	0% (-200 - +200%)	195 226
S1-11 (068A)	Torque Compensation Delay Time	V/f CL-V/f OLV CLV AOLV Sets the length of time for torque compensation to go from 0% to 100%.	50 ms (0 - 200 ms)	195 226

No. (Hex.)	Name	Description	Default (Range)	Ref.
S1-12 (068B)	Brake Hold Frequency (FWD)	V/f CL-V/f OLV CLV AOLV Sets the frequency used after the brake release command for forward operation is deactivated.	3.0 Hz (0.0 - 20.0 Hz)	195 226
S1-13 (068C)	Brake Hold Frequency (REV)	V/f CL-V/f OLV CLV AOLV Sets the frequency used after the brake release command for reverse run is deactivated.	3.0 Hz (0.0 - 20.0 Hz)	195 226
S1-14 (068D)	Slip Prevention Frequency	V/f CL-V/f OLV CLV AOLV Sets the operation frequency used after the brake release command is deactivated.	Determined by A1-02 (0.0 - 20.0 Hz)	195 226
S1-15 (068E)	Slip Prevention Time	V/f CL-V/f OLV CLV AOLV Sets the operation time at the setting value of *S1-14 [Slip Prevention Frequency]* after the brake release command is activated.	Determined by A1-02 (0.00 - 10.00 s)	195 226
S1-16 (068F)	Sequence Fault SE1 Detect Time	V/f CL-V/f OLV CLV AOLV Sets the delay time until the drive detects *SE1 [Brake Sequence Fault 1 (SE1)]*.	0.30 s (0.00 - 2.00 s)	195 226
S1-17 (0690)	Sequence Fault SE2 Detect Time	V/f CL-V/f OLV CLV AOLV Sets the *SE2 [Brake Sequence Fault 2 (SE2)]* detection time.	1.00 s (0.00 - 2.00 s)	195 226
S1-18 (0691)	Sequence Fault SE3 Detect Time	V/f CL-V/f OLV CLV AOLV Sets the *SE3 [Brake Sequence Fault 3 (SE3)]* detection time.	0.50 s (0.00 - 2.00 s)	195 226
S1-19 (0692)	Sequence Fault SE4 Detect Time	V/f CL-V/f OLV CLV AOLV Sets the *SE4 [Brake Sequence Fault 4 (SE4)]* detection time.	0.50 s (0.00 - 2.00 s)	195 226
S1-20 (0693)	Operation in Reverse	V/f CL-V/f OLV CLV AOLV Sets the operation mode for reverse run. 0 : Normal motoring operations 1 : Regen operation in reverse	0 (0, 1)	195 226
S1-22 (06BF)	DB Phase Fix	V/f CL-V/f OLV CLV AOLV Enables or disables the phase fix function for DC injection braking. 0 : Disable 1 : Enabled	0 (0, 1)	195 226
S1-23 (06C4)	Motor2 Brake Release Freq (FWD)	V/f CL-V/f OLV CLV AOLV Sets the motor 2 forward operation brake release frequency.	2.0 Hz (0.0 - 20.0 Hz)	216 226
S1-24 (06C5)	Motor2 Brake Release Freq(REV)	V/f CL-V/f OLV CLV AOLV Sets the motor 2 reverse operation brake release frequency.	2.0 Hz (0.0 - 20.0 Hz)	216 226
S1-25 (06C6)	Motor2 Brake Delay Frequency	V/f CL-V/f OLV CLV AOLV Sets the motor 2 brake delay frequency.	Determined by E3-01 (0.0 - 400.0 Hz)	216 226
S1-26 (06C7)	Motor2 Brake Delay Time	V/f CL-V/f OLV CLV AOLV Sets the motor 2 brake delay time.	Determined by E3-01 (0.00 - 10.00 s)	216 226
S1-27 (06C8)	M2 Brake Release Current (FWD)	V/f CL-V/f OLV CLV AOLV Sets the motor 2 forward operation brake release current.	50% (0 - 200%)	216 226
S1-28 (06C9)	M2 Brake Release Current (REV)	V/f CL-V/f OLV CLV AOLV Sets the motor 2 reverse operation brake release current.	30% (0 - 200%)	216 226
S1-29 (06CA)	M2 Brake Release Torque (FWD)	V/f CL-V/f OLV CLV AOLV Sets the motor 2 forward operation brake release torque.	100% (0 - 200%)	216 226
S1-30 (06CB)	M2 Brake Release Torque (REV)	V/f CL-V/f OLV CLV AOLV Sets the motor 2 reverse operation brake release torque.	0% (0 - 200%)	216 226
S1-31 (06CC)	Motor2 Torque Compensation (FWD)	V/f CL-V/f OLV CLV AOLV Sets the motor 2 forward operation torque compensation.	Determined by E3-01 (-200 - +200%)	216 226
S1-32 (06CD)	Motor 2 Torque Compensation (REV)	V/f CL-V/f OLV CLV AOLV Sets the motor 2 reverse operation torque compensation.	0% (-200 - +200%)	216 226
S1-33 (06CE)	M2 Torq Compensation Delay Time	V/f CL-V/f OLV CLV AOLV Sets the delay time for motor 2 torque compensation.	50 ms (0 - 200 ms)	216 226
S1-34 (06CF)	Motor2 Brake Hold Freq (FWD)	V/f CL-V/f OLV CLV AOLV Sets the motor 2 forward operation brake hold frequency.	3.0 Hz (0.0 - 20.0 Hz)	216 226
S1-35 (06D0)	Motor2 Brake Hold Freq (REV)	V/f CL-V/f OLV CLV AOLV Sets the motor 2 reverse operation brake hold frequency.	3.0 Hz (0.0 - 20.0 Hz)	216 226
S1-36 (06D1)	Motor2 Slip Prevention Frequency	V/f CL-V/f OLV CLV AOLV Sets the motor 2 slip prevention frequency.	Determined by E3-01 (0.0 - 20.0 Hz)	216 226
S1-37 (06D2)	Motor2 Slip Prevention Time	V/f CL-V/f OLV CLV AOLV Sets the motor 2 slip prevention time.	Determined by E3-01 (0.00 - 10.00 s)	216 226
S1-38 (06D3)	M2 Seq Fault SE1 Detect Time	V/f CL-V/f OLV CLV AOLV Sets the motor 2 sequence fault SE1 detection time.	0.30 s (0.00 - 2.00 s)	216 226

No. (Hex.)	Name	Description	Default (Range)	Ref.
S1-39 (06D4)	M2 Seq Fault SE2 Detect Time	V/f CL-V/f OLV CLV AOLV Sets the motor 2 sequence fault SE2 detection time.	1.00 s (0.00 - 2.00 s)	216 226
S1-40 (06D5)	M2 Seq Fault SE3 Detect Time	V/f CL-V/f OLV CLV AOLV Sets the motor 2 sequence fault SE3 detection time.	0.50 s (0.00 - 2.00 s)	216 226
S1-41 (06D6)	M2 Seq Fault SE4 Detect Time	V/f CL-V/f OLV CLV AOLV Sets the motor 2 sequence fault SE4 detection time.	0.50 s (0.00 - 2.00 s)	216 226
S1-42 (06D7)	Motor2 Operation in Reverse	V/f CL-V/f OLV CLV AOLV Sets the motor 2 reverse operation.	0 (0, 1)	216 226
S1-52 (1A80)	Motor3 Brake Release Freq (FWD)	V/f CL-V/f OLV CLV AOLV Sets the motor 3 brake release frequency.	2.0 Hz (0.0 - 20.0 Hz)	216 226
S1-53 (1A81)	Motor3 Brake Hold Freq (FWD)	V/f CL-V/f OLV CLV AOLV Sets the motor 3 brake hold frequency.	2.0 Hz (0.0 - 20.0 Hz)	216 226
S1-54 (06FD)	Brake Sequence Selection	V/f CL-V/f OLV CLV AOLV Enables and disables operation toward a brake sequence. 0 : Disable 1 : Enabled	1 (0, 1)	181
S1-55 (06FE)	Motor 2 Brake Sequence Selection	V/f CL-V/f OLV CLV AOLV Enables or disables the motor 2 brake sequence 0 : Disable 1 : Enabled	1 (0, 1)	216 226
S1-56 (06FF)	Motor 3 Brake Sequence Selection	V/f CL-V/f OLV CLV AOLV Enables or disables the motor 3 brake sequence 0 : Disable 1 : Enabled	1 (0, 1)	216 226

◆ S2: Run Command Tuning, Maintenance Monitors, Frequency Derating Gain, Rapid Deceleration

No. (Hex.)	Name	Description	Default (Range)	Ref.
S2-01 (0694)	Run Cmd Minimum On Time (FWD)	V/f CL-V/f OLV CLV AOLV Sets the time that the Forward run command is held internally.	0.00 s (0.00 - 10.00 s)	204 226
S2-02 (0695)	Run Cmd Minimum On Time (REV)	V/f CL-V/f OLV CLV AOLV Sets the time that the Reverse run command is held internally.	0.00 s (0.00 - 10.00 s)	204 226
S2-03 (0696)	Run Cmd Delay Timer (REV/FWD)	V/f CL-V/f OLV CLV AOLV Sets the time before the Forward run command is accepted after the reverse run stops.	0.00 s (0.00 - 10.00 s)	204 226
S2-08 (1A82)	Number of Driving count selec	V/f CL-V/f OLV CLV AOLV Sets the type of startup count for motors 1 to 3. 0 : Run Command count 1 : Brake Release Command count	0 (0, 1)	221 226
S2-09 (1A83)	Motor1 Number of Driving start	V/f CL-V/f OLV CLV AOLV Sets the motor 1 startup count in increments of 10,000 repetitions. Starts counting from the set value.	0 (0 - 1000)	221 226
S2-10 (1A84)	Motor2 Number of Driving start	V/f CL-V/f OLV CLV AOLV Sets the motor 2 startup count in increments of 10,000 repetitions. Starts counting from the set value.	0 (0 - 1000)	221 226
S2-11 (1A85)	Motor3 Number of Driving start	V/f CL-V/f OLV CLV AOLV Sets the motor 3 startup count in increments of 10,000 repetitions. Starts counting from the set value.	0 (0 - 1000)	221 226
S2-12 (1A86)	MentenanceTimer Output Selection	V/f CL-V/f OLV CLV AOLV Sets the method of alarm output. 0 : Disable 1 : Alarm 2 : Fault	0 (0 - 2)	221 226
S2-13 (1A87)	Motor1 Number of Driving Limit	V/f CL-V/f OLV CLV AOLV Sets the startup count 1 fault/minor fault output level in increments of 10,000 repetitions. *CnT1 [Number of Driving Over]* is detected when *S2-13 = U4-54 [Num of Driv 1 (High)]*.	0 (0 - 999)	221 226

No. (Hex.)	Name	Description	Default (Range)	Ref.
S2-14 (1A88)	Motor2 Number of Driving Limit	V/f CL-V/f OLV CLV AOLV Sets the startup count 2 fault/minor fault output level in increments of 10,000 repetitions. *CnT2 [Number of Driving Over]* is detected when *S2-14 = U4-56 [Num of Driv 2 (High)]*.	0 (0 - 999)	221 226
S2-15 (1A89)	Motor3 Number of Driving Limit	V/f CL-V/f OLV CLV AOLV Sets the startup count 3 fault/minor fault output level in increments of 10,000 repetitions. *CnT3 [Number of Driving Over]* is detected when *S2-15 = U4-58 [Num of Driv 3 (High)]*.	0 (0 - 999)	221 226
S2-16 (1A8A)	Micro Speed Gain1	V/f CL-V/f OLV CLV AOLV Sets the gain used to decrease the frequency reference. This parameter is enabled when the terminal set to *H1-xx = 3A [MFDI Function Selection = Micro Speed Gain1]* turns on.	1.00 (0.00 - 1.00)	204 226
S2-17 (1A8B)	Micro Speed Gain2	V/f CL-V/f OLV CLV AOLV Sets the gain used to decrease the frequency reference. This parameter is enabled when the terminal set with *H1-xx = 3B [MFDI Function Selection = Micro Speed Gain2]* turns on.	1.00 (0.00 - 1.00)	204 226
S2-18 (1ADD)	Rapid Deceleration Selection	V/f CL-V/f OLV CLV AOLV Enables and disables rapid deceleration. 0 : Disabled 1 : Enabled	0 (0, 1)	224
S2-19 (1ADE) RUN	Rapid Deceleration Time	V/f CL-V/f OLV CLV AOLV Sets the rapid deceleration time. **Note:** When *C1-10 = 0 [Accel/Decel Time Setting Units = 0.01 s (0.00 to 600.00 s)]*, the setting range is 0.00 s to 600.00 s.	3.0 s (0.0 - 6000.0 s)	224

◆ S3: Impact Stop

No. (Hex.)	Name	Description	Default (Range)	Ref.
S3-01 (0697)	Impact Stop Creep Frequency	V/f CL-V/f OLV CLV AOLV Sets the frequency to operate when the drive received a Stop command while *H1-xx = 35 [MFDI Function Selection = Impact Stop Enable]* is ON.	Determined by A1-02 (0.0 - 20.0 Hz)	206 226
S3-02 (0698)	Impact Stop Creep Time	V/f CL-V/f OLV CLV AOLV Sets the the length of time that the drive will operate at the frequency set with *S3-01 [Impact Stop Creep Frequency]*. If the torque does not reach the value set in *S3-03 [Impact Stop Detect Torque (FWD)]* or *S3-04 [Impact Stop Detect Torque (REV)]* for longer than *S3-02*, the motor will stop.	10.0 s (0.0 - 20.0 s)	206 226
S3-03 (0699)	Impact Stop Detect Torque (FWD)	V/f CL-V/f OLV CLV AOLV Sets the impact stop torque for forward run.	100% (0 - 200%)	206 226
S3-04 (069A)	Impact Stop Detect Torque (REV)	V/f CL-V/f OLV CLV AOLV Sets the impact stop torque for reverse run.	100% (0 - 200%)	206 226
S3-05 (069B)	Impact Stop Detection Time	V/f CL-V/f OLV CLV AOLV Sets the impact stop detection time. If the torque is more than the value set in *S3-03 [Impact Stop Detect Torque (FWD)]* or *S3-04 [Impact Stop Detect Torque (REV)]* for longer than *S3-05*, the motor will ramp to stop.	0.3 s (0.0 - 20.0 s)	206 226

◆ S4: Light-load Acceleration

No. (Hex.)	Name	Description	Default (Range)	Ref.
S4-01 (069C)	Light-load Accel Ctrl Selection	V/f CL-V/f OLV CLV AOLV Sets the operation of Light-load Acceleration control. 0 : Light-load Accel Ctrl disabled 1 : Light-load Accel Ctrl 1 enabled 2 : Light-load Accel Ctrl 2 enabled	0 (0 - 2)	207 210 226
S4-02 (069D)	Light-load 1 Max. Freq (FWD)	V/f CL-V/f OLV CLV AOLV Sets the maximum frequency used for light loads during forward run.	60.0 Hz (40.0 - 200.0 Hz)	207 226
S4-03 (069E)	Light-load 1 Max. Freq (REV)	V/f CL-V/f OLV CLV AOLV Sets the maximum frequency used for light loads during reverse run.	60.0 Hz (40.0 - 200.0 Hz)	207 226
S4-04 (069F)	Light-load 1 Detect Torque (FWD)	V/f CL-V/f OLV CLV AOLV Sets the light-load detection level for forward run.	50% (0 - 200%)	207 226
S4-05 (06A0)	Light-load 1 Detect Torque (REV)	V/f CL-V/f OLV CLV AOLV Sets the light-load detection level for reverse run.	50% (0 - 200%)	207 226

No. (Hex.)	Name	Description	Default (Range)	Ref.
S4-06 (06A1)	Light-load 1 Detect Frequency	V/f CL-V/f OLV CLV AOLV Sets the frequency that the drive checks the load. In light-load accel 1, the drive checks the load at the speed set in *S4-05 [Light-load 1 Detect Torque (REV)]* for the time set in *S4-06*.	60.0 Hz (25.0 - 60.0 Hz)	207 226
S4-07 (06A2)	Light-load 1 Detect Time	V/f CL-V/f OLV CLV AOLV Sets the time that the drive checks the load. In light-load accel 1, the drive checks the load at the speed set in *S4-05 [Light-load 1 Detect Torque (REV)]* for the time set in *S4-06 [Light-load 1 Detect Frequency]*.	1.0 s (0.0 - 10.0 s)	207 226
S4-08 (06A3)	Light-load 2 Activation Freq	V/f CL-V/f OLV CLV AOLV Sets the frequency to activate light-load accel 2.	50 Hz (0 - 200 Hz)	210 226
S4-09 (06A4)	L-L 2 Motoring Limit Start Level	V/f CL-V/f OLV CLV AOLV Sets the level that the drive starts to monitor the output power during forward run (motoring).	50% (0 - 200%)	210 226
S4-10 (06A5)	L-L 2 Motoring Hold Level	V/f CL-V/f OLV CLV AOLV Sets the power level to stop acceleration during forward run (motoring).	100% (0 - 200%)	210 226
S4-11 (06A6)	L-L 2 Regen Limit Start Level	V/f CL-V/f OLV CLV AOLV Sets the level that the drive starts to monitor the output power during reverse run (regeneration).	10% (0 - 200%)	210 226
S4-12 (06A7)	L-L 2 Regen Hold Level	V/f CL-V/f OLV CLV AOLV Sets the power level to stop acceleration during reverse run (regeneration).	100% (0 - 200%)	210 226
S4-13 (06A8)	L-L 2 Limit Timer	V/f CL-V/f OLV CLV AOLV Sets the time to continue acceleration after the limit start level has been exceeded. Acceleration stops when the output power reaches the hold level or the limit timer has elapsed.	1.0 s (0.1 - 10.0 s)	210 226
S4-14 (06A9)	L-L 2 Fault Operation Selection	V/f CL-V/f OLV CLV AOLV Sets the operation when the drive detects Light-load Accel 2 Fault (oL6). 0 : Ramp to stop 1 : Coast to stop 2 : Emergency stop 3 : Acceleration prohibited 4 : Frequency deceleration	2 (0 - 4)	210 226
S4-15 (06AA)	L-L 2 Fault Detection Level	V/f CL-V/f OLV CLV AOLV Sets the level to trigger Light-load Accel 2 Fault (oL6). 100% is the motor rated power.	150% (0 - 200%)	210 226
S4-16 (06AB)	L-L 2 Fault Detection Time	V/f CL-V/f OLV CLV AOLV Sets the time to trigger Light-load Accel 2 Fault (oL6).	0.1 s (0.0 - 10.0 s)	210 226
S4-17 (06AC)	L-L 2 Accel Time Gain	V/f CL-V/f OLV CLV AOLV Sets the acceleration time gain for light-load accel 2. The acceleration time used when light-load accel 2 is active is the resulting time after multiplying the set acceleration time by this gain.	2.0 (0.0 - 10.0)	210 226
S4-18 (06AD)	L-L 2 Select during Regeneration	V/f CL-V/f OLV CLV AOLV Sets whether to use light-load accel 2 during reverse run (regeneration). 0 : Disabled 1 : Enabled	0 (0 - 1)	210 226
S4-19 (06AE)	Light-load 1 Torque Bias (FWD)	V/f CL-V/f OLV CLV AOLV Sets the torque bias for forward run with light-load accel 1.	0.0% (-50.0 - +50.0%)	207 226
S4-20 (06AF)	Light-load 1 Torque Bias (REV)	V/f CL-V/f OLV CLV AOLV Sets the torque bias for reverse run with light-load accel 1.	0.0% (-50.0 - +50.0%)	207 226
S4-21 (06BD)	L-L 2 Deceleration Width for oL6	V/f CL-V/f OLV CLV AOLV Sets the deceleration amplitude when the drive detects Light-load Accel 2 Fault (oL6).	0.0 Hz (0.0 - 10.0 Hz)	210 226
S4-22 (06C2)	L-L 2 Freq Upper Limit Select	V/f CL-V/f OLV CLV AOLV Sets whether to clear the frequency reference upper limit hold for light-load accel 2. 0 : Disabled 1 : Enabled	0 (0, 1)	210 226
S4-24 (06D8)	Auto Spe Ctrl Sel @UL	V/f CL-V/f OLV CLV AOLV Sets whether to automatically calculate a speed limit value based on the motor torque and load torque. 0 : Disabled 1 : Enabled	1 (0, 1)	

◆ S5: Overload Detection

No. (Hex.)	Name	Description	Default (Range)	Ref.
S5-01 (06B0)	OverL Detect Operation Select 1	V/f CL-V/f OLV CLV AOLV Sets whether to enable or disable overload detection, the detection conditions, and the drive operation after detection of faults. 0 : Disabled 1 : oL5 @ Speed Agree - Alarm only 2 : oL5 @ RUN - Alarm only 3 : oL5 @ Speed Agree - Alarm only2 4 : oL5 @ RUN - Alarm only2 5 : oL5 @ Speed Agree - Fault 6 : oL5 @ RUN - Fault	0 (0 - 6)	213 226
S5-02 (06B1)	OverL Detect Operation Select 1	V/f CL-V/f OLV CLV AOLV Sets the level to trigger an overload.	150% (0 - 300%)	213 226
S5-03 (06B2)	Overload Detection Time 1	V/f CL-V/f OLV CLV AOLV Sets the overload detection time 1.	0.1 s (0.0 - 10.0 s)	213 226
S5-04 (06B3)	OverL Detect Operation Select 2	V/f CL-V/f OLV CLV AOLV Sets whether to enable or disable overload detection, the detection conditions, and the drive operation after detection of faults. 0 : Disabled 1 : oL5 @ Speed Agree - Alarm only 2 : oL5 @ RUN - Alarm only 3 : oL5 @ Speed Agree - Alarm only2 4 : oL5 @ RUN - Alarm only2 5 : oL3 @ Speed Agree - Fault 6 : oL3 @ RUN - Fault	0 (0 - 6)	213 226
S5-05 (06B4)	Overload Detection Torque 2	V/f CL-V/f OLV CLV AOLV Sets the level to trigger an overload.	150% (0 - 300%)	213 226
S5-06 (06B5)	Overload Detection Time 2	V/f CL-V/f OLV CLV AOLV Sets the overload detection time 2.	0.1 s (0.0 - 10.0 s)	213 226

◆ S6: Overtorque Detection

No. (Hex.)	Name	Description	Default (Range)	Ref.
S6-01 (06B6)	OverT Detect Operation Select 1	V/f CL-V/f OLV CLV AOLV Sets whether to enable or disable overtorque detection, the detection conditions, and the drive operation after detection of faults. 0 : Disabled 1 : oL3 @ Speed Agree - Alarm only 2 : oL3 @ RUN - Alarm only 3 : oL3 @ Speed Agree - Fault 4 : oL3 @ RUN - Fault 5 : oL3 @ Speed Agree - Alarm only2 6 : oL3 @ RUN - Alarm only2	0 (0 - 6)	214 226
S6-02 (06B7)	Overtorque Detection Level 1	V/f CL-V/f OLV CLV AOLV Sets the level to trigger an overtorque.	150% (0 - 300%)	214 226
S6-03 (06B8)	Overtorque Detection Time 1	V/f CL-V/f OLV CLV AOLV Sets the overtorque detection time 1.	0.1 s (0.0 - 10.0 s)	214 226
S6-04 (06B9)	OverT Detect Operation Select 2	V/f CL-V/f OLV CLV AOLV Sets whether to enable or disable overtorque detection, the detection conditions, and the drive operation after detection of faults. 0 : Disabled 1 : oL3 @ Speed Agree - Alarm only 2 : oL3 @ RUN - Alarm only 3 : oL3 @ Speed Agree - Fault 4 : oL3 @ RUN - Fault 5 : oL3 @ Speed Agree - Alarm only2 6 : oL3 @ RUN - Alarm only2	0 (0 - 6)	214 226
S6-05 (06BA)	Overtorque Detection Level 2	V/f CL-V/f OLV CLV AOLV Sets the level to trigger an overtorque.	150% (0 - 300%)	214 226

No. (Hex.)	Name	Description	Default (Range)	Ref.
S6-06 (06BB)	Overtorque Detection Time 2	V/f CL-V/f OLV CLV AOLV Sets the overtorque detection time 2.	0.1 s (0.0 - 10.0 s)	214 226
S6-09 (1A93)	Torque Detection Filter Time	V/f CL-V/f OLV CLV AOLV Sets the time constant for a primary filter to the torque reference or to the output current used to detect overtorque.	0 ms (0 - 1000 ms)	214 226

10.15 T: Motor Tuning

◆ T0: Tuning Mode Selection

No. (Hex.)	Name	Description	Default (Range)	Ref.
T0-00 (1197)	Tuning Mode Selection	V/f CL-V/f OLV CLV AOLV Selects the type of Auto-Tuning to be used. 0 : Motor Parameter Tuning 1 : Control Tuning	0 (0, 1)	800

◆ T1: Induction Motor Auto-Tuning

No. (Hex.)	Name	Description	Default (Range)	Ref.
T1-00 (0700)	Motor Selection	V/f CL-V/f OLV CLV AOLV Sets which motor to tune when motor switching is enabled. You must use the keypad to set this parameter. You cannot use external input terminals to set it. **Note:** You can set this parameter when you select motor switching If you disable motor switching, this parameter will not appear. 1 : Motor 1 (sets E1-xx, E2-xx) 2 : Motor 2 (sets E3-xx, E4-xx) 3 : Motor 3 (sets E7-xx)	1 (1 - 3)	800
T1-01 (0701)	Auto-Tuning Mode Selection	V/f CL-V/f OLV CLV AOLV Sets the type of Auto-Tuning. 0 : Rotational Auto-Tuning 1 : Stationary Auto-Tuning 1 2 : Stationary Line-Line Resistance	Determined by A1-02 (Determined by A1-02)	801
T1-02 (0702)	Motor Rated Power	V/f CL-V/f OLV CLV AOLV Sets the rated output power (kW) of the motor.	Determined by o2-04 (0.00 - 590.0 kW)	801
T1-03 (0703)	Motor Rated Voltage	V/f CL-V/f OLV CLV AOLV Sets the rated voltage (V) of the motor. Enter the base speed voltage for constant output motors.	Determined by o2-04 (200 V Class: 0.0 - 255.5 V, 400 V Class: 0.0 - 511.0 V)	801
T1-04 (0704)	Motor Rated Current	V/f CL-V/f OLV CLV AOLV Sets the rated current (A) of the motor.	Determined by o2-04 (10% to 200% of the drive rated current)	801
T1-05 (0705)	Motor Base Frequency	V/f CL-V/f OLV CLV AOLV Sets the base frequency (Hz) of the motor.	50.0 Hz (0.0 - 590.0 Hz)	801
T1-06 (0706)	Number of Motor Poles	V/f CL-V/f OLV CLV AOLV Sets the number of motor poles.	4 (2 - 120)	802
T1-07 (0707)	Motor Base Speed	V/f CL-V/f OLV CLV AOLV Sets the motor base speed for Auto-Tuning (min^{-1} (r/min)).	1750 min^{-1} (r/min) (0 - 35400 min^{-1} (r/min))	802
T1-08 (0708)	Encoder Pulse Count (PPR)	V/f CL-V/f OLV CLV AOLV Sets the number of PG (pulse generator, encoder) pulses.	600 ppr (0 - 60,000 ppr)	802
T1-09 (0709)	Motor No-Load Current	V/f CL-V/f OLV CLV AOLV Sets the no-load current of the motor.	- (0A - T1-04; max. of 2999.9)	802
T1-10 (070A)	Motor Rated Slip Frequency	V/f CL-V/f OLV CLV AOLV Sets motor rated slip.	- (0.000 - 20.000 Hz)	802
T1-12 (0BDB)	Test Mode Selection	V/f CL-V/f OLV CLV AOLV Sets the function to enable Test Mode after Stationary Auto-Tuning. When you can operate the motor with a light load attached after Stationary Auto-Tuning is complete, enable this parameter. **Note:** You must first set *T1-10 = 0 [Motor Rated Slip Frequency = 0 Hz]* to enable this parameter. 0 : No 1 : Yes	0 (0, 1)	802
T1-13 (0BDC)	No-Load Voltage	V/f CL-V/f OLV CLV AOLV Sets the no-load voltage of the motor. When the no-load voltage at rated speed is available, for example on the motor test report, set the voltage in this parameter. If the no-load voltage is not available, do not change this parameter. **Note:** To get the same qualities as a Yaskawa 1000-series drive or previous series drive, set this parameter = *T1-03 [Motor Rated Voltage]*.	90% of T1-03 (200 V Class: 0.0 - 255.0 V, 400 V Class: 0.0 - 510.0 V)	803

◆ T3: ASR and Inertia Tuning

No. (Hex.)	Name	Description	Default (Range)	Ref.
T3-00 (1198)	Control Loop Tuning Selection	V/f CL-V/f OLV CLV AOLV Sets the Control Loop Auto-Tuning method. 0 : Inertia Tuning 1 : ASR (Speed Regulator)	0 (0, 1)	803
T3-01 (0760)	Test Signal Frequency	V/f CL-V/f OLV CLV AOLV Usually it is not necessary to change this setting. Sets the frequency of the test signal applied to the motor during Inertia Tuning.	3.0 Hz (0.1 - 20.0 Hz)	803
T3-02 (0761)	Test Signal Amplitude	V/f CL-V/f OLV CLV AOLV Sets the amplitude of the test signal applied to the motor during Inertia Tuning. Usually it is not necessary to change this setting.	0.5 rad (0.1 - 10.0 rad)	803
T3-03 (0762)	Motor Inertia	V/f CL-V/f OLV CLV AOLV Sets the inertia of the motor. This value uses the test signal response to calculate the load inertia.	Determined by o2-04 (0.0001 - 6.0000 kgm^2)	803
T3-04 (0763)	System Response Frequency	V/f CL-V/f OLV CLV AOLV This parameter uses the load inertia value from the Inertia Tuning process to automatically calculate and set *C5-01 [ASR Proportional Gain 1]*.	10.0 Hz (0.1 - 50.0 Hz)	804

10.16 U: Monitors

◆ U1: Operation Status Monitors

No. (Hex.)	Name	Description	MFAO Signal Level
U1-01 (0040)	Frequency Reference	V/f CL-V/f OLV CLV AOLV Shows the frequency reference value. Parameter *o1-03 [Keypad Display Unit Selection]* sets the display units. Unit: 0.01 Hz	10 V = Maximum frequency (0 V to +10 V)
U1-02 (0041)	Output frequency	V/f CL-V/f OLV CLV AOLV Shows the output frequency. Parameter *o1-03 [Keypad Display Unit Selection]* sets the display units. Unit: 0.01 Hz	10 V = Maximum frequency (0 V to +10 V)
U1-03 (0042)	Output current	V/f CL-V/f OLV CLV AOLV Displays the current output current. The value of *U1-03* appears in amperes (A) on the keypad. When viewing via MEMOBUS/Modbus communications, the current is "8192 = drive rated current (A)." Current can be calculated from the monitor value present at MEMOBUS/Modbus communications using "Numerals being displayed / 8192 × drive rated current (A)." Unit: Determined by the drive model. • Models 2003 to 2033, 4002 to 4018: 0.01 A • Models 2047 to 2415, 4024 to 4605: 0.1 A	10 V = Drive rated current
U1-04 (0043)	Control Method	V/f CL-V/f OLV CLV AOLV Shows the drive control method. 0 : V/f Control 1 : V/f Control w/ PG 2 : Open Loop Vector 3 : Closed Loop Vector 4 : Advanced Open Loop Vector	No signal output available
U1-05 (0044)	Motor Speed	V/f CL-V/f OLV CLV AOLV Shows the detected motor speed. Parameter *o1-03 [Keypad Display Unit Selection]* sets the display units. Unit: 0.01 Hz	10 V = Maximum frequency (0 V to +10 V)
U1-06 (0045)	Output Voltage Ref	V/f CL-V/f OLV CLV AOLV Shows the output voltage reference. Unit: 0.1 V	200 V Class: 10 V = 200 Vrms 400 V Class: 10 V = 400 Vrms
U1-07 (0046)	DC Bus Voltage	V/f CL-V/f OLV CLV AOLV Shows the DC bus voltage. Unit: 1 V	200 V Class: 10 V = 400 V 400 V Class: 10 V = 800 V
U1-08 (0047)	Output Power	V/f CL-V/f OLV CLV AOLV Shows the internally-calculated output power. Changing the setting of *A1-02 [Control Method Selection]* changes the signal level of the analog output. • *A1-02 = 0, 1 [V/f Control]*: Drive capacity (kW) • *A1-02 = 2 to 4 [Vector Control]*: *Motor Rated Power (kW) [E2-11]* Unit: Display unit is determined by the maximum applicable motor output. The maximum applicable motor output is determined by the drive capacity setting. • Less than 11 kW (15 HP): 0.01 kW • Less than 11 kW (15 HP): 0.1 kW	10 V: Drive capacity (motor rated power) kW (-10 V to +10 V)
U1-09 (0048)	Torque Reference	V/f CL-V/f OLV CLV AOLV Shows the internal torque reference value. Unit: 0.1%	10 V = Motor rated torque (0 V to +10 V)
U1-10 (0049)	Input Terminal Status	V/f CL-V/f OLV CLV AOLV Shows the status of the MFDI terminal where 1 = ON, 0 = OFF. For example, *U1-10* shows "00000011" when terminals S1 and S2 are ON. bit0 : Terminal S1 (MFDI 1) bit1 : Terminal S2 (MFDI 2) bit2 : Terminal S3 (MFDI 3) bit3 : Terminal S4 (MFDI 4) bit4 : Terminal S5 (MFDI 5) bit5 : Terminal S6 (MFDI 6) bit6 : Terminal S7 (MFDI 7) bit7 : Terminal S8 (MFDI 8)	No signal output available

No. (Hex.)	Name	Description	MFAO Signal Level
U1-11 (004A)	Output Terminal Status	V/f CL-V/f OLV CLV AOLV Shows the status of the multi-function output terminal with 1 (ON) and 0 (OFF). For example, *U1-11 = 00000011* is shown when terminals M1 and M3 are ON. bit 0 : Terminals M1-M2 bit 1 : Terminals M3-M4 bit 2 : Terminals M5-M6 bit 3 : Terminals P1-C1 bit 4 : Terminals P2-C2 bit 5 : Not used (normal value of 0). bit 6 : Not used (normal value of 0). bit 7 : Fault relay MA/MB-MC	No signal output available
U1-12 (004B)	Drive Status	V/f CL-V/f OLV CLV AOLV Shows drive status where 1 = ON and 0 = OFF. For example, *U1-12* shows "00000101" during run with the Reverse Run command. bit0 : During Run bit1 : During zero-speed bit2 : During reverse bit3 : During fault reset signal input bit4 : During speed agreement bit5 : Drive ready bit6 : During minor fault detection bit7 : During fault detection	No signal output available
U1-13 (004E)	Terminal A1 Level	V/f CL-V/f OLV CLV AOLV Shows the signal level of terminal A1. Unit: 0.1%	10 V = 100% (0 V to +10 V)
U1-14 (004F)	Terminal A2 Level	V/f CL-V/f OLV CLV AOLV Shows the signal level of terminal A2. Unit: 0.1%	10 V = 100% (0 V to +10 V)
U1-15 (0050)	Terminal A3 Level	V/f CL-V/f OLV CLV AOLV Shows the signal level of terminal A3. Unit: 0.1%	10 V = 100% (-10 V to +10 V)
U1-16 (0053)	SFS Output Frequency	V/f CL-V/f OLV CLV AOLV Shows the output frequency after soft start. Shows the frequency with acceleration and deceleration times and S-curves. Parameter *o1-03 [Keypad Display Unit Selection]* sets the display units. Unit: 0.01 Hz	10 V = Maximum frequency (0 V to +10 V)
U1-17 (0058)	DI-A3 Input Status	V/f CL-V/f OLV CLV AOLV Shows the reference value input from DI-A3 option. Shows the input signal for DI-A3 in hexadecimal as set in *F3-01 [Digital Input Function Selection]*. 3FFFF: Set (1 bit) + Sign (1 bit) + 16 bit	No signal output available
U1-18 (0061)	oPE Fault Parameter	V/f CL-V/f OLV CLV AOLV Shows the parameter number that caused the *oPE02 [Parameter Range Setting Error]* or *oPE08 [Parameter Selection Error]*.	No signal output available
U1-19 (0066)	MEMOBUS/Modbus Error Code	V/f CL-V/f OLV CLV AOLV Shows the contents of the MEMOBUS/Modbus communication error where 1 = "error" and 0 = "no error". For example, *U1-19* shows "00000001" when there is a CRC error. bit0 : CRC Error bit1 : Data Length Error bit2 : Not used (normal value of 0). bit3 : Parity Error bit4 : Overrun Error bit5 : Framing Error bit6 : Timed Out bit7 : Not used (normal value of 0).	No signal output available
U1-21 (0077)	AI-A3 Term V1 Level	V/f CL-V/f OLV CLV AOLV Shows the analog reference of terminal V1 on analog input option card AI-A3. Unit: 0.1%	10 V = 100% (-10 V to +10 V)
U1-22 (072A)	AI-A3 Term V2 Level	V/f CL-V/f OLV CLV AOLV Shows the analog reference of terminal V2 on analog input option card AI-A3. Unit: 0.1%	10 V = 100% (-10 V to +10 V)
U1-23 (072B)	AI-A3 Term V3 Level	V/f CL-V/f OLV CLV AOLV Shows the analog reference of terminal V3 on analog input option card AI-A3. Unit: 0.1%	10 V = 100% (-10 V to +10 V)
U1-25 (004D)	SoftwareNumber Flash	V/f CL-V/f OLV CLV AOLV Shows the FLASH ID.	No signal output available

No. (Hex.)	Name	Description	MFAO Signal Level
U1-26 (005B)	SoftwareNumber ROM	V/f CL-V/f OLV CLV AOLV Shows the ROM ID.	No signal output available
U1-40 (009D)	Input Term Status 1	V/f CL-V/f OLV CLV AOLV Shows the status of the multi-function input terminal with 1 (ON) and 0 (OFF). For example, *U1-40 = 00000011* is shown when terminals S1 and S2 are ON. bit 0 : Terminal S1 (MFDI 1) bit 1 : Terminal S2 (MFDI 2) bit 2 : Terminal S3 (MFDI 3) bit 3 : Terminal S4 (MFDI 4) bit 4 : Terminal S5 (MFDI 5) bit 5 : Terminal S6 (MFDI 6) bit 6 : Terminal S7 (MFDI 7) bit 7 : Terminal S8 (MFDI 8)	No signal output available
U1-41 (009E)	Input Term Status 2	V/f CL-V/f OLV CLV AOLV Shows the status of the multi-function input terminal with 1 (ON) and 0 (OFF). For example, *U1-41 = 00000011* is shown when terminals S9 and S10 are ON. bit 0 : Terminal S9 (MFDI 9) bit 1 : Terminal S10 (MFDI 10) bit 2 : Not used (normal value of 0). bit 3 : Not used (normal value of 0). bit 4 : Not used (normal value of 0). bit 5 : Not used (normal value of 0). bit 6 : Not used (normal value of 0). bit 7 : Not used (normal value of 0).	No signal output available
U1-50 (1199) Expert	Virtual Analog Input	V/f CL-V/f OLV CLV AOLV Shows the virtual analog input value.	Determined by H7-40
U1-91 (154E) Expert	Output Voltage	V/f CL-V/f OLV CLV AOLV Shows the drive internal output voltage reference. Unit: 0.1 V	200 V Class: 10 V = 200 Vrms 400 V Class: 10 V = 400 Vrms

◆ U2: Fault Trace

No. (Hex.)	Name	Description	MFAO Signal Level
U2-01 (0080)	Current Fault	V/f CL-V/f OLV CLV AOLV Shows the fault that the drive has when viewing the monitor.	No signal output available
U2-02 (0081)	Previous Fault	V/f CL-V/f OLV CLV AOLV Shows the fault that occurred most recently.	No signal output available
U2-03 (0082)	Freq Reference@Fault	V/f CL-V/f OLV CLV AOLV Shows the frequency reference at the fault that occurred most recently. Use *U1-01 [Frequency Reference]* to monitor the frequency reference value. Unit: 0.01 Hz	No signal output available
U2-04 (0083)	Output Freq @ Fault	V/f CL-V/f OLV CLV AOLV Shows the output frequency at the fault that occurred most recently. Use *U1-02 [Output Frequency]* to monitor the actual output frequency. Unit: 0.01 Hz	No signal output available
U2-05 (0084)	Output Current@Fault	V/f CL-V/f OLV CLV AOLV Displays the output current at the latest fault. The current output current can be monitored by *U1-03 [Output Current]*. The value of *U1-03* appears in amperes (A) on the keypad. When viewing via MEMOBUS/Modbus communications, the current is "8192 = drive rated current (A)." Current can be calculated from the monitor value present at MEMOBUS/Modbus communications using "Numerals being displayed / 8192 × drive rated current (A)." Unit: Determined by the drive model. • Models 2003 to 2033, 4002 to 4018: 0.01 A • Models 2047 to 2415, 4024 to 4605: 0.1 A	No signal output available
U2-06 (0085)	Motor Speed @ Fault	V/f CL-V/f OLV CLV AOLV Shows the motor speed at the fault that occurred most recently. Use *U1-05 [Motor Speed]* to monitor the motor speed. Unit: 0.01 Hz	No signal output available
U2-07 (0086)	Output Voltage@Fault	V/f CL-V/f OLV CLV AOLV Shows the output voltage reference at the fault that occurred most recently. Use *U1-06 [Output Voltage Ref]* to monitor the output voltage reference. Unit: 0.1 V	No signal output available

No. (Hex.)	Name	Description	MFAO Signal Level
U2-08 (0087)	DC Bus Voltage@Fault	V/f CL-V/f OLV CLV AOLV Shows the DC bus voltage at the fault that occurred most recently. Use *U1-07 [DC Bus Voltage]* to monitor the DC bus voltage. Unit: 1 V	No signal output available
U2-09 (0088)	Output Power @ Fault	V/f CL-V/f OLV CLV AOLV Shows the output power at the fault that occurred most recently. Use *U1-08 [Output Power]* to monitor the output power. Unit: 0.1 kW	No signal output available
U2-10 (0089)	Torque Ref @ Fault	V/f CL-V/f OLV CLV AOLV Shows the torque reference at the fault that occurred most recently as a percentage of the motor rated torque. Use *U1-09 [Torque Reference]* to monitor the torque reference. Unit: 0.1%	No signal output available
U2-11 (008A)	Input Terminal Status @ Fault	V/f CL-V/f OLV CLV AOLV Shows the status of the MFDI terminals at the most recent fault where 1 = (ON) and 0 = (OFF). For example, *U2-11* shows “00000011” when terminals S1 and S2 are ON. Use *U1-10 [Input Terminal Status]* to monitor the MFDI terminal status. bit0 : Terminal S1 bit1 : Terminal S2 bit2 : Terminal S3 bit3 : Terminal S4 bit4 : Terminal S5 bit5 : Terminal S6 bit6 : Terminal S7 bit7 : Terminal S8	No signal output available
U2-12 (008B)	Output Terminal Status @ Fault	V/f CL-V/f OLV CLV AOLV Displays the status of the multi-function digital output terminal at the latest fault using 1 (ON) and 0 (OFF). The current status of the MFDO terminals can be monitored by *U1-11 [Output Terminal Status]*. For example, *U2-12 = 00000011* is displayed when terminals M1 and M3 are ON. bit 0 : Terminals M1-M2 bit 1 : Terminals M3-M4 bit 2 : Terminals M5-M6 bit 3 : Terminals P1-C1 bit 4 : Terminals P2-C2 bit 5 : Not used (normal value of 0). bit 6 : Not used (normal value of 0). bit 7 : Fault relay MA/MB-MC	No signal output available
U2-13 (008C)	Operation Status @ Fault	V/f CL-V/f OLV CLV AOLV Shows the status of the MFDO terminals at the most recent fault where 1 = (ON) and 0 = (OFF). For example, *U2-13* shows “00000001” during run. Use *U1-12 [Drive Status]* to monitor the MFDO terminal status. bit0 : During Run bit1 : During zero-speed bit2 : During reverse bit3 : During fault reset signal input bit4 : During speed agreement bit5 : Drive ready bit6 : During minor fault detection bit7 : During fault detection	No signal output available
U2-14 (008D)	Elapsed Time @ Fault	V/f CL-V/f OLV CLV AOLV Shows the cumulative operation time of the drive at the fault that occurred most recently. Use *U4-01 [Cumulative Ope Time]* to monitor the cumulative operation time. Unit: 1 h	No signal output available
U2-15 (07E0)	SFS Output @ Fault	V/f CL-V/f OLV CLV AOLV Shows the output frequency after soft start at the fault that occurred most recently. Use *U1-16 [SFS Output Frequency]* to monitor the output frequency after soft start. Unit: 0.01 Hz	No signal output available
U2-16 (07E1)	q-Axis Current@Fault	V/f CL-V/f OLV CLV AOLV Shows the q-Axis current of the motor at the fault that occurred most recently. Use *U6-01 [Iq Secondary Current]* to monitor the q-Axis current of the motor. Unit: 0.1 %	No signal output available
U2-17 (07E2)	d-Axis Current@Fault	V/f CL-V/f OLV CLV AOLV Shows the d-Axis current of the motor at the fault that occurred most recently. Use *U6-02 [Id ExcitationCurrent]* to monitor the d-Axis current of the motor. Unit: 0.1 %	No signal output available

No. (Hex.)	Name	Description	MFAO Signal Level
U2-20 (008E)	Heatsink Temp @Fault	V/f CL-V/f OLV CLV AOLV Shows the heatsink temperature at the fault that occurred most recently. Use *U4-08 [Heatsink Temperature]* to monitor the temperature of the heatsink. Unit: 1 °C	No signal output available
U2-21 (07E6)	Peak Hold Current	V/f CL-V/f OLV CLV AOLV Displays the current held at peak when the latest fault occurred. Use *U4-13 [Peak Hold Current]* to monitor the current peak hold current. Unit: 0.1 A	No signal output available
U2-22 (07E7)	Peak Hold Out Freq	V/f CL-V/f OLV CLV AOLV Displays the frequency held at peak when the latest fault occurred. Use *U4-14 [PeakHold Output Freq]* to monitor the current peak hold frequency. Unit: 0.01 Hz	No signal output available
U2-29 (009F)	InTerm Status2@Fault	V/f CL-V/f OLV CLV AOLV Displays the status of the multi-function digital input terminals at the latest fault using 1 (ON) and 0 (OFF). The status of the current MFDI terminals can be monitored by *U1-41 [Input Term Status 2]*. For example, *U2-29 = 00000011* is shown when terminals S9 and S10 are ON. bit 0 : Terminal S9 (MFDI 1) bit 1 : Terminal S10 (MFDI 2) bit 2 : Not used (normal value of 0). bit 3 : Not used (normal value of 0). bit 4 : Not used (normal value of 0). bit 5 : Not used (normal value of 0). bit 6 : Not used (normal value of 0). bit 7 : Not used (normal value of 0).	No signal output available

◆ U3: Fault History

No. (Hex.)	Name	Description	MFAO Signal Level
U3-01 (0090)	1st MostRecent Fault	V/f CL-V/f OLV CLV AOLV Shows the fault history of the most recent fault. **Note:** The drive saves this fault history to two types of registers at the same time for the MEMOBUS/Modbus communications.	No signal output available
U3-02 (0091)	2nd MostRecent Fault	V/f CL-V/f OLV CLV AOLV Shows the fault history of the second most recent fault. **Note:** The drive saves this fault history to two types of registers at the same time for the MEMOBUS/Modbus communications.	No signal output available
U3-03 (0092)	3rd MostRecent Fault	V/f CL-V/f OLV CLV AOLV Shows the fault history of the third most recent fault. **Note:** The drive saves this fault history to two types of registers at the same time for the MEMOBUS/Modbus communications.	No signal output available
U3-04 (0093)	4th MostRecent Fault	V/f CL-V/f OLV CLV AOLV Shows the fault history of the fourth most recent fault. **Note:** The drive saves this fault history to two types of registers at the same time for the MEMOBUS/Modbus communications.	No signal output available
U3-05 (0804)	5th MostRecent Fault	V/f CL-V/f OLV CLV AOLV Shows the fault history of the fifth most recent fault.	No signal output available
U3-06 (0805)	6th MostRecent Fault	V/f CL-V/f OLV CLV AOLV Shows the fault history of the sixth most recent fault.	No signal output available
U3-07 (0806)	7th MostRecent Fault	V/f CL-V/f OLV CLV AOLV Shows the fault history of the seventh most recent fault.	No signal output available
U3-08 (0807)	8th MostRecent Fault	V/f CL-V/f OLV CLV AOLV Shows the fault history of the eighth most recent fault.	No signal output available
U3-09 (0808)	9th MostRecent Fault	V/f CL-V/f OLV CLV AOLV Shows the fault history of the ninth most recent fault.	No signal output available
U3-10 (0809)	10th MostRecentFault	V/f CL-V/f OLV CLV AOLV Shows the fault history of the tenth most recent fault.	No signal output available

No. (Hex.)	Name	Description	MFAO Signal Level
U3-11 (0094)	ElapsedTime@1stFault	V/f CL-V/f OLV CLV AOLV Shows the cumulative operation time when the most recent fault occurred. **Note:** The drive saves this cumulative operation time to two types of registers at the same time for the MEMOBUS/Modbus communications. Unit: 1 h	No signal output available
U3-12 (0095)	ElapsedTime@2ndFault	V/f CL-V/f OLV CLV AOLV Shows the cumulative operation time when the second most recent fault occurred. **Note:** The drive saves this cumulative operation time to two types of registers at the same time for the MEMOBUS/Modbus communications. Unit: 1 h	No signal output available
U3-13 (0096)	ElapsedTime@3rdFault	V/f CL-V/f OLV CLV AOLV Shows the cumulative operation time when the third most recent fault occurred. **Note:** The drive saves this cumulative operation time to two types of registers at the same time for the MEMOBUS/Modbus communications. Unit: 1 h	No signal output available
U3-14 (0097)	ElapsedTime@4thFault	V/f CL-V/f OLV CLV AOLV Shows the cumulative operation time when the fourth most recent fault occurred. **Note:** The drive saves this cumulative operation time to two types of registers at the same time for the MEMOBUS/Modbus communications. Unit: 1 h	No signal output available
U3-15 (080E)	ElapsedTime@5thFault	V/f CL-V/f OLV CLV AOLV Shows the cumulative operation time when the fifth most recent fault occurred. Unit: 1 h	No signal output available
U3-16 (080F)	ElapsedTime@6thFault	V/f CL-V/f OLV CLV AOLV Shows the cumulative operation time when the sixth most recent fault occurred. Unit: 1 h	No signal output available
U3-17 (0810)	ElapsedTime@7thFault	V/f CL-V/f OLV CLV AOLV Shows the cumulative operation time when the seventh most recent fault occurred. Unit: 1 h	No signal output available
U3-18 (0811)	ElapsedTime@8thFault	V/f CL-V/f OLV CLV AOLV Shows the cumulative operation time when the eighth most recent fault occurred. Unit: 1 h	No signal output available
U3-19 (0812)	ElapsedTime@9thFault	V/f CL-V/f OLV CLV AOLV Shows the cumulative operation time when the ninth most recent fault occurred. Unit: 1 h	No signal output available
U3-20 (0813)	ElapsedTime@10 Fault	V/f CL-V/f OLV CLV AOLV Shows the cumulative operation time when the tenth most recent fault occurred. Unit: 1 h	No signal output available

◆ U4: Maintenance Monitors

No. (Hex.)	Name	Description	MFAO Signal Level
U4-01 (004C)	Cumulative Ope Time	V/f CL-V/f OLV CLV AOLV Shows the cumulative operation time of the drive. Use parameter *o4-01 [Elapsed Operating Time Setting]* to reset this monitor. Use parameter *o4-02 [Elapsed Operating Time Selection]* to select the cumulative operation times from: • The time from when the drive is energized until it is de-energized. • The time at which the Run command is turned ON. The maximum value that the monitor will show is *99999*. After this value is more than *99999*, the drive automatically resets it and starts to count from *0* again. Unit: 1 h **Note:** The MEMOBUS/Modbus communication data is shown in 10 h units. Use register 0099H for data in 1 h units.	10 V: 99999 h
U4-02 (0075)	Num of Run Commands	V/f CL-V/f OLV CLV AOLV Shows how many times that the drive has received a Run command. Use parameter *o4-13 [RUN Command Counter @ Initialize]* to reset this monitor. The maximum value that the monitor will show is *65535*. After this value is more than *65535*, the drive automatically resets it and starts to count from *0* again. Unit: 1	10 V: 65535 times

No. (Hex.)	Name	Description	MFAO Signal Level
U4-03 (0067)	Cooling Fan Ope Time	V/f CL-V/f OLV CLV AOLV Shows the cumulative operation time of the cooling fans. Use parameter *o4-03 [Fan Operation Time Setting]* to reset this monitor. The maximum value that the monitor will show is *99999*. After this value is more than *99999*, the drive automatically resets it and starts to count from *0* again. Unit: 1 h **Note:** The MEMOBUS/Modbus communication data is shown in 10 h units. Use register 009BH for data in 1 h units.	10 V: 99999 h
U4-04 (007E)	Cool Fan Maintenance	V/f CL-V/f OLV CLV AOLV Shows the cumulative operation time of the cooling fans as a percentage of the replacement life of the cooling fans. Use parameter *o4-03 [Fan Operation Time Setting]* to reset this monitor. Unit: 1% **Note:** Replace the cooling fans when this monitor is 90%.	10 V: 100%
U4-05 (007C)	CapacitorMaintenance	V/f CL-V/f OLV CLV AOLV Shows the operation time of the electrolytic capacitors for the main circuit and control circuit as a percentage of the replacement life of the electrolytic capacitors. Use parameter *o4-05 [Capacitor Maintenance Setting]* to reset this monitor. Unit: 1% **Note:** Replace the electrolytic capacitor when this monitor is 90%.	10 V: 100%
U4-06 (07D6)	PreChargeRelayMainte	V/f CL-V/f OLV CLV AOLV Shows the operation time of the soft charge bypass relay as a percentage of the replacement life of the soft charge bypass relay. Use parameter *o4-07 [Softcharge Relay Maintenance Set]* to reset this monitor. Unit: 1% **Note:** Replace the drive when this monitor is 90%.	10 V: 100%
U4-07 (07D7)	IGBT Maintenance	V/f CL-V/f OLV CLV AOLV Shows the operation time of the IGBTs as a percentage of the replacement life of the IGBTs. Set parameter *o4-09 [IGBT Maintenance Setting]* to reset this monitor. Unit: 1% **Note:** Replace the drive when this monitor is 90%.	10 V: 100%
U4-08 (0068)	Heatsink Temperature	V/f CL-V/f OLV CLV AOLV Shows the heatsink temperature of the drive. Unit: 1 °C	10 V: 100 °C
U4-09 (005E)	LED Check	V/f CL-V/f OLV CLV AOLV Turns on the LED Status Ring and all of the keypad LEDs to make sure that the LEDs operate correctly. **Note:** A damaged LED Status Ring board will prevent an accurate estimate of the internal status of the drive. Do not use only the LED Status Ring to estimate the status of the drive and motors. 1. Set *o2-24 = 0 [LED Light Function Selection = Enable Status Ring & Keypad LED]*. 2. Push (↵) when *U4-09* is the top monitor shown on the keypad. All LEDs on the keypad and LED Status Ring will turn on. **Note:** When Safety input 2 CH is open (STo), READY will flash.	No signal output available
U4-10 (005C)	kWh, Lower 4 Digits	V/f CL-V/f OLV CLV AOLV Shows the lower 4 digits of the watt hour value for the drive. Unit: 1 kWh **Note:** The watt hour is displayed in 9 digits. Monitor *U4-11 [kWh, Upper 5 Digits]* shows the upper 5 digits and *U4-10* shows the lower 4 digits. Example for 12345678.9 kWh: *U4-10*: *678.9 kWh* *U4-11*: *12345 MWh*	No signal output available
U4-11 (005D)	kWh, Upper 5 Digits	V/f CL-V/f OLV CLV AOLV Shows the upper 5 digits of the watt hour value for the drive. Unit: 1 MWh **Note:** Monitor *U4-11* shows the upper 5 digits and *U4-10 [kWh, Lower 4 Digits]* shows the lower 4 digits. Example for 12345678.9 kWh: *U4-10*: 678.9 kWh *U4-11*: 12345 MWh	No signal output available

No. (Hex.)	Name	Description	MFAO Signal Level
U4-13 (07CF)	Peak Hold Current	V/f CL-V/f OLV CLV AOLV Displays the hold value of the peak value (rms) for the drive output current. The drive output frequency at the time the output current is held can be monitored by *U4-14 [PeakHold Output Freq]*. The peak hold current will be cleared at the next startup and restart of the power supply. The drive keeps the value that was under hold during baseblock (during stop). The value of *U4-13* appears in amperes (A) on the keypad. When viewing via MEMOBUS/Modbus communications, the current is "8192 = drive rated current (A)." Current can be calculated from the monitor value present at MEMOBUS/Modbus communications using "Numerals being displayed / 8192 × drive rated current (A)." Unit: Determined by the drive model. • Models 2003 to 2033, 4002 to 4018: 0.01 A • Models 2047 to 2415, 4024 to 4605: 0.1 A	No signal output available
U4-14 (07D0)	PeakHold Output Freq	V/f CL-V/f OLV CLV AOLV Displays the output frequency at which the peak value (rms) of the drive output current is held. The peak hold current can be monitored by *U4-13 [Peak Hold Current]*. The peak hold output frequency will be cleared at the next startup and restart of the power supply. The drive keeps the value that was under hold during baseblock (during stop). Unit: 0.01 Hz **Note:** Units are determined by *o1-03 [Frequency Display Unit Selection]*.	No signal output available
U4-15 (007F)	Torque Ref@UL1	V/f CL-V/f OLV CLV AOLV Check this when adjusting light-load accel 1 torque reference monitor *S4-04 [Light-load 1 Detect Torque (FWD)]*. Unit: 0.1%	- 0.1%
U4-16 (07D8)	Motor oL1 Level	V/f CL-V/f OLV CLV AOLV Shows the integrated value of *oL1 [Motor Overload]* as a percentage of *oL1* detection level. Unit: 0.1%	10 V: 100%
U4-18 (07DA)	Reference Source	V/f CL-V/f OLV CLV AOLV Displays the frequency reference source that is currently selected. The frequency reference source is presented as XY-nn in the following manner. X: *External Reference 1/2 Selection [H1-xx = 2]* selection status • 1: *b1-01 [Frequency Reference Selection 1]* • 2: *b1-15 [Frequency Reference Selection 2]* Y-nn: Frequency reference source • 0-01: Keypad (*d1-01 [Reference 1]*) • 1-00: Analog input (unassigned) • 1-01: MFAI terminal A1 • 1-02: MFAI terminal A2 • 1-03: MFAI terminal A3 • 2-02 to 2-08, 2-17: Multi-step speed reference (*d1-02 to d1-08 [Reference 2 to 8, Jog Reference]*) • 3-01: MEMOBUS/Modbus communications • 4-01: Communication option card • 9-01: Up/Down command	No signal output available
U4-19 (07DB)	Modbus FreqRef (dec)	V/f CL-V/f OLV CLV AOLV Shows the frequency reference sent to the drive from the MEMOBUS/Modbus communications as a decimal. Unit: 0.01%	10 V: Maximum frequency (0 V to +10 V)
U4-20 (07DC)	Option Freq Ref(dec)	V/f CL-V/f OLV CLV AOLV Shows the frequency reference sent to the drive from the communication option as a decimal. Unit: 0.01 %	10 V: Maximum frequency (0 V to +10 V)

No. (Hex.)	Name	Description	MFAO Signal Level
U4-21 (07DD)	Run Command Source	V/f CL-V/f OLV CLV AOLV Displays the Run command source that is currently selected. The Run command source is presented as XY-nn in the following manner. X: *External Reference 1/2 Selection [H1-xx = 2]* selection status • 1: *b1-02 [Run Command Selection 1]* • 2: *b1-16 [Run Command Selection 2]* Y: Run command source • 0: Keypad • 1: Control circuit terminal • 3: MEMOBUS/Modbus communications • 4: Communication option card nn: Run command limit status data • 00: No limit status. • 01: The Run command was left ON when the drive stopped in the Programming Mode. • 02: The Run command was left ON when switching from LOCAL Mode to REMOTE Mode. • 03: The Run command is in standby after the drive was energized until the soft charge bypass contactor turns ON. **Note:** When the soft charge bypass contactor does not turn ON after 10 s have passed, *Uv1 [DC Bus Undervoltage]* or *Uv [Undervoltage]* is detected. • 04: Restart after run stop is prohibited. • 05: Fast stop has been executed using the MFDI terminal. Or, the motor has ramped to stop by pressing the STOP key on the keypad. • 06: *b1-17 = 0 [Run Command at Power Up = Disregard Existing RUN Command]* is set. • 07: During baseblock while coast to stop with timer. • 08: Frequency reference is below *E1-09 [Minimum Output Frequency]* during baseblock. • 09: Waiting for the Enter command from PLC.	No signal output available
U4-22 (07DE)	Modbus CmdData (hex)	V/f CL-V/f OLV CLV AOLV Displays the operation signal (register No. 0001H) from MEMOBUS/Modbus communications to the drive as a four-digit hexadecimal number (zero suppress). The operation signal is displayed in the following way. bit 0 : Forward run/Stop bit 1 : Reverse run/Stop bit 2 : External Fault bit 3 : Fault Reset bit 4 : Multi-function input 1 bit 5 : Multi-function input 2 bit 6 : Multi-function input 3 bit 7 : Multi-function input 4 bit 8 : Multi-function input 5 bit 9 : Multi-function input 6 bit A : Multi-function input 7 bit B : Multi-function input 8 bit C : Multi-function input 9 bit D : Multi-function input 10 bit E : Not used (normal value of 0). bit F : Not used (normal value of 0).	No signal output available
U4-23 (07DF)	Option CmdData (hex)	V/f CL-V/f OLV CLV AOLV Displays the operation signal (register No. 0001H) from communication option to the drive as a four-digit hexadecimal number. The operation signal is displayed in the following way. bit 0 : Forward run/Stop bit 1 : Reverse run/Stop bit 2 : External Fault bit 3 : Fault Reset bit 4 : Multi-function input 1 bit 5 : Multi-function input 2 bit 6 : Multi-function input 3 bit 7 : Multi-function input 4 bit 8 : Multi-function input 5 bit 9 : Multi-function input 6 bit A : Multi-function input 7 bit B : Multi-function input 8 bit C : Multi-function input 9 bit D : Multi-function input 10 bit E : Not used (normal value of 0). bit F : Not used (normal value of 0).	No signal output available

No. (Hex.)	Name	Description	MFAO Signal Level
U4-24 (1581)	Number of Runs (Low)	V/f CL-V/f OLV CLV AOLV Displays the lower 4 digits of the drive run count. **Note:** The drive run count appears as an 8-digit number. The upper 4 digits of *U4-25 [Number of Runs(High)]* and the lower 4 digits of *U4-24* appear.	No signal output available
U4-25 (1582)	Number of Runs(High)	V/f CL-V/f OLV CLV AOLV Displays the upper 4 digits of the drive run count. **Note:** The drive run count appears as an 8-digit number. The upper 4 digits of *U4-25* and the lower 4 digits of *U4-24 [Number of Runs (Low)]* appear.	No signal output available
U4-52 (1592)	Torque Ref from Comm	V/f CL-V/f OLV CLV AOLV Displays the torque limit given to the drive via a serial communication option card or via MEMOBUS/Modbus communications as a decimal number. Unit: 0.1%	No signal output available
U4-53 (1593)	Num of Driv 1 (Low)	V/f CL-V/f OLV CLV AOLV Displays the lower 4 digits of the cumulative motor 1 startup count. **Note:** The startup count 1 appears as an 8-digit number. The upper 4 digits of *U4-54 [Num of Driv 1 (High)]* and the lower 4 digits of *U4-53* appear. The maximum count value is 10,000,000.	No signal output available
U4-54 (1594)	Num of Driv 1 (High)	V/f CL-V/f OLV CLV AOLV Displays the upper 4 digits of the cumulative motor 1 startup count. **Note:** The startup count 1 appears as an 8-digit number. The upper 4 digits of *U4-54* and the lower 4 digits of *U4-53 [Num of Driv 1 (Low)]* appear. The maximum count value is 10,000,000.	No signal output available
U4-55 (1595)	Num of Driv 2 (Low)	V/f CL-V/f OLV CLV AOLV Displays the lower 4 digits of the cumulative motor 2 startup count. **Note:** The startup count 2 appears as an 8-digit number. The upper 4 digits of *U4-56 [Num of Driv 2 (High)]* and the lower 4 digits of *U4-55* appear. The maximum count value is 10,000,000.	No signal output available
U4-56 (1596)	Num of Driv 2 (High)	V/f CL-V/f OLV CLV AOLV Displays the upper 4 digits of the cumulative motor 2 startup count. **Note:** The startup count 2 appears as an 8-digit number. The upper 4 digits of *U4-56* and the lower 4 digits of *U4-55 [Num of Driv 2 (Low)]* appear. The maximum count value is 10,000,000.	No signal output available
U4-57 (1597)	Num of Driv 3 (Low)	V/f CL-V/f OLV CLV AOLV Displays the lower 4 digits of the cumulative motor 3 startup count. **Note:** The startup count 3 appears as an 8-digit number. The upper 4 digits of *U4-58 [Num of Driv 3 (High)]* and the lower 4 digits of *U4-57* appear. The maximum count value is 10,000,000.	No signal output available
U4-58 (1598)	Num of Driv 3 (High)	V/f CL-V/f OLV CLV AOLV Displays the upper 4 digits of the cumulative motor 3 startup count. **Note:** The startup count 3 appears as an 8-digit number. The upper 4 digits of *U4-58* and the lower 4 digits of *U4-57 [Num of Driv 3 (Low)]* appear. The maximum count value is 10,000,000.	No signal output available

◆ U6: Operation Status Monitors

No. (Hex.)	Name	Description	MFAO Signal Level
U6-01 (0051)	Iq Secondary Current	V/f CL-V/f OLV CLV AOLV Shows the value calculated for the motor secondary current (q-Axis) as a percentage of the motor rated secondary current. Unit: 0.1%	10 V: Motor secondary rated current (0 V to +10 V)
U6-02 (0052)	Id ExcitationCurrent	V/f CL-V/f OLV CLV AOLV Shows the value calculated for the motor excitation current (d-Axis) as a percentage of the motor rated secondary current. Unit: 0.1%	10 V: Motor secondary rated current (0 V to +10 V)
U6-03 (0054)	ASR Input	V/f CL-V/f OLV CLV AOLV Shows the ASR input value as a percentage of the maximum frequency. Unit: 0.01%	10 V: Maximum frequency (0 V to +10 V)
U6-04 (0055)	ASR Output	V/f CL-V/f OLV CLV AOLV Shows the ASR output value as a percentage of the motor rated secondary current. Unit: 0.01%	10 V: Motor secondary rated current (0 V to +10 V)
U6-05 (0059)	OutputVoltageRef: Vq	V/f CL-V/f OLV CLV AOLV Shows the drive internal voltage reference for motor secondary current control (q-Axis). Unit: 0.1 V	200 V Class: 10 V = 200 Vrms 400 V Class: 10 V = 400 Vrms (0 V to +10 V)

No. (Hex.)	Name	Description	MFAO Signal Level
U6-06 (005A)	OutputVoltageRef: Vd	V/f CL-V/f **OLV** **CLV** **AOLV** Shows the drive internal voltage reference for motor excitation current control (d-Axis). Unit: 0.1 V	200 V Class: 10 V = 200 Vrms 400 V Class: 10 V = 400 Vrms (0 V to +10 V)
U6-07 (005F) Expert	q-Axis ACR Output	V/f CL-V/f **OLV** **CLV** **AOLV** Shows the output value for current control related to motor secondary current (q axis). Unit: 0.1 %	200 V Class: 10 V = 200 Vrms 400 V Class: 10 V = 400 Vrms (0 V to +10 V)
U6-08 (0060) Expert	d-Axis ACR Output	V/f CL-V/f **OLV** **CLV** **AOLV** Shows the output value for current control related to motor excitation current (d axis). Unit: 0.1 %	200 V Class: 10 V = 200 Vrms 400 V Class: 10 V = 400 Vrms (0 V to +10 V)
U6-18 (07CD)	Enc 1 Pulse Counter	**V/f** **CL-V/f** **OLV** **CLV** **AOLV** Shows the number of pulses for speed detection (PG1). Unit: 1 pulse	10 V: 65536
U6-19 (07E5)	Enc 2 Pulse Counter	**V/f** **CL-V/f** **OLV** **CLV** **AOLV** Shows the number of pulses for speed detection (PG2). Unit: 1 pulse	10 V: 65536
U6-20 (07D4)	UP/DOWN 2 Bias Value	**V/f** **CL-V/f** **OLV** **CLV** **AOLV** Shows the bias value used to adjust the frequency reference. Unit: 0.1%	10 V: Maximum Frequency
U6-21 (07D5)	Offset Frequency	**V/f** **CL-V/f** **OLV** **CLV** **AOLV** Shows the total value of *d7-01 to d7-03 [Offset Frequency 1 to 3]* selected with *Add Offset Frequency 1 to 3 [H1-xx = 44 to 46]*. Unit: 0.1%	10 V: Maximum Frequency
U6-22 (0062)	ZeroServo Pulse Move	V/f CL-V/f OLV **CLV** AOLV Shows the distance that the rotor moved from its last position when Zero Servo is available. The value shown in this monitor = 4 X [No. of PG pulses]. Unit: 1 pulse	10 V = Number of pulses per revolution (-10 V to +10 V)
U6-25 (006B) Expert	ASR Output Level	V/f CL-V/f OLV **CLV** **AOLV** Displays the primary delay filter input value of the ASR (speed control loop). Unit: 0.01%	10 V: Motor secondary rated current (-10 V to +10 V)
U6-26 (006C) Expert	Feed Fwd Cont Output	V/f CL-V/f OLV **CLV** **AOLV** Displays the Feed Forward control output. Unit: 0.01%	10 V: Motor secondary rated current (-10 V to +10 V)
U6-27 (006D) Expert	FeedFwd Estimate Spd	V/f CL-V/f OLV **CLV** **AOLV** Shows the feed forward estimated speed. Unit: 0.01%	10 V = Maximum frequency (-10 V to +10 V)
U6-31 (007B)	TorqueDetect Monitor	**V/f** **CL-V/f** **OLV** **CLV** **AOLV** Monitors the torque reference or the output current after applying the filter set to *S6-09 [Torque Detection Filter Time]*. Unit: 0.1%	10 V:100%
U6-36 (0720) Expert	Comm Errors-Host	**V/f** **CL-V/f** **OLV** **CLV** **AOLV** Shows the number of inter-CPU communication errors. When you de-energize the drive, this value resets to 0.	No signal output available
U6-37 (0721) Expert	Comm Errors-Sensor	**V/f** **CL-V/f** **OLV** **CLV** **AOLV** Shows the number of inter-CPU communication errors. When you de-energize the drive, this value resets to 0.	No signal output available
U6-48 (072E) Expert	ASIC Comm Errors	**V/f** **CL-V/f** **OLV** **CLV** **AOLV** Shows the number of inter-ASIC communication errors detected by the ASIC. When you de-energize the drive, this value resets to 0.	No signal output available
U6-80 to U6-83 (07B0 - 07B3)	Option IP Address 1 to 4	**V/f** **CL-V/f** **OLV** **CLV** **AOLV** Shows the currently available local IP Address. • *U6-80*: 1st octet • *U6-81*: 2nd octet • *U6-82*: 3rd octet • *U6-83*: 4th octet	No signal output available
U6-84 to U6-87 (07B4 - 07B7)	Online Subnets 1 to 4	**V/f** **CL-V/f** **OLV** **CLV** **AOLV** Shows the currently available subnet mask. • *U6-84*: 1st octet • *U6-85*: 2nd octet • *U6-86*: 3rd octet • *U6-87*: 4th octet	No signal output available

No. (Hex.)	Name	Description	MFAO Signal Level
U6-88 to U6-91 (07B8, 07B9, 07F0, 07F1)	Online Gateways 1 to 4	V/f CL-V/f OLV CLV AOLV Shows the currently available gateway address. • *U6-88*: 1st octet • *U6-89*: 2nd octet • *U6-90*: 3rd octet • *U6-91*: 4th octet	No signal output available
U6-92 (07F2)	Online Speed	V/f CL-V/f OLV CLV AOLV Shows the currently available communications speed. 10: 10 Mbps 100: 100 Mbps	No signal output available
U6-93 (07F3)	Online Duplex	V/f CL-V/f OLV CLV AOLV Shows the currently available Duplex setting.	No signal output available
U6-98 (07F8)	First Fault	V/f CL-V/f OLV CLV AOLV Shows the contents of the most recent communication options fault (DeviceNet, Modbus TCP/IP, EtherNet/IP).	No signal output available
U6-99 (07F9)	Current Fault	V/f CL-V/f OLV CLV AOLV Shows the contents of current fault from communication options (DeviceNet, Modbus TCP/IP, EtherNet/IP).	No signal output available

10.17 Parameters that Change from the Default Settings with A1-02 [Control Method Selection]

The values for the parameters in these tables depend on the values for parameter *A1-02*. When you change *A1-02*, the default settings will change.

◆ A1-02 = 0 to 4 [Induction Motor Control Methods]

No.	Name	Range	Unit	Control Method (A1-02 Setting)				
				V/f (0)	CL-V/f (1)	OLV (2)	CLV (3)	AOLV (4)
b2-01	DC Injection/ Zero SpeedThreshold	0.0 - 10.0	0.1 Hz	0.5	0.5	0.5	0.5	0.5
b2-04	DC Inject Braking Time at Stop	0.00 - 10.00	0.01 s	0.00	0.00	0.00	0.50	0.00
C1-11	Accel/Decel Time Switchover Freq	0.0 - 400.0	0.1 Hz	0.0	0.0	0.0	0.0	0.0
C2-01	S-Curve Time @ Start of Accel	0.00 - 10.00	0.01 s	0.20	0.20	0.20	0.20	0.20
C3-01	Slip Compensation Gain	0.0 - 2.5	0.1	0.0	-	1.0	1.0	0.1
C3-02	Slip Compensation Delay Time	0 - 10000	1 ms	2000	-	200	-	-
C4-01	Torque Compensation Gain	0.00 - 2.50	0.01	1.00	1.00	1.00	-	-
C4-02	Torque Compensation Delay Time	0 - 10000	1 ms	200	200	20	-	-
C4-13	Torque Comp Delay Time Select 1	0 - 60000	1 ms	200	200	20	-	20
C4-15	Torque Comp Delay Time Select 2	0 - 60000	1 ms	200	200	20	-	20
C4-16	Torque Comp Delay Time Select 3	0 - 60000	1 ms	200	200	20	-	20
C5-01	ASR Proportional Gain 1	0.00 - 300.00	0.01	-	0.20	-	20.00	10.00
C5-02	ASR Integral Time 1	0.000 - 60.000	0.001 s	-	0.200	-	0.500	0.500
C5-03	ASR Proportional Gain 2	0.00 - 300.00	0.01	-	0.02	-	20.00	10.00
C5-04	ASR Integral Time 2	0.000 - 10.000	0.001 s	-	0.050	-	0.500	0.500
C5-06	ASR Delay Time	0.000 - 0.500	0.001 s	-	-	-	0.004	0.004
C5-07	ASR Gain Switchover Frequency	0.0 - 400.0	0.1 Hz	0.0	0.0	0.0	0.0	0.0
C6-02	Carrier Frequency Selection	1 - F	1	1	1	1	1	1
d3-01	Jump Frequency 1	0.0 - 400.0	0.1 Hz	0.0	0.0	0.0	0.0	0.0
d3-02	Jump Frequency 2	0.0 - 400.0	0.1 Hz	0.0	0.0	0.0	0.0	0.0
d3-03	Jump Frequency 3	0.0 - 400.0	0.1 Hz	0.0	0.0	0.0	0.0	0.0
d3-04	Jump Frequency Width	0.0 - 20.0	0.1 Hz	1.0	1.0	1.0	1.0	1.0

No.	Name	Range	Unit	Control Method (A1-02 Setting)				
				V/f (0)	CL-V/f (1)	OLV (2)	CLV (3)	AOLV (4)
E1-04	Maximum Output Frequency	40.0 - 400.0	0.1 Hz	50.0 *1	50.0 *1	50.0	50.0	50.0
E1-05	Maximum Output Voltage	0.0 - 255.0 *2	0.1 V	200.0 *1	200.0 *1	200.0	200.0	200.0
E1-06	Base Frequency	0.0 - 400.0	0.1 Hz	50.0 *1	50.0 *1	50.0	50.0	50.0
E1-07	Mid Point A Frequency	0.0 - 400.0	0.1 Hz	2.5 *1	2.5 *1	3.0	-	0.0
E1-08	Mid Point A Voltage	0.0 - 255.0 *2	0.1 V	15.0 *1	15.0 *1	14.4	-	0.0
E1-09	Minimum Output Frequency	0.0 - 400.0	0.1 Hz	1.3 *1	1.3 *1	0.5	-	0.0
E1-10	Minimum Output Voltage	0.0 - 255.0 *2	0.1 V	9.0 *1	9.0 *1	3.0	-	0.0
E1-14	Middle Out Freq Volt Select 1	0.0 - 255.0 *2	0.1 V	15.0 *1	15.0 *1	14.4	-	0.0
E1-15	Minimum Out Freq Volt Select 1	0.0 - 255.0	0.1 V	9.0 *1	9.0 *1	3.0	-	0.0
E1-16	Middle Out Freq Volt Select 2	0.0 - 255.0	0.1 V	15.0 *1	15.0 *1	14.4	-	0.0
E1-17	Minimum Out Freq Volt Select 2	0.0 - 255.0 *2	0.1 V	9.0 *1	9.0 *1	3.0	-	0.0
E1-18	Middle Out Freq Volt Select 3	0.0 - 255.0	0.1 V	15.0 *1	15.0 *1	14.4	-	0.0
E1-19	Minimum Out Freq Volt Select 3	0.0 - 255.0	0.1 V	9.0 *1	9.0 *1	3.0	-	0.0
F1-01	Encoder 1 Pulse Count (PPR)	0 - 60000	1 ppr	600	600	600	600	600
F1-05	Encoder 1 Rotation Selection	0 - 1	1	0	0	0	0	0
F1-09	Overspeed Detection Delay Time	0.0 - 2.0	0.1 s	-	1.0	-	0.0	0.1
H4-20	Analog Power Monitor 100% Level	0.00 - 650.00	0.01	Default value of E2-11	Default value of E2-11	Determined by E2-11	Determined by E2-11	Determined by E2-11
L1-01	Motor Overload (oL1) Protection	0 - 4	1	1	1	1	1	1
L3-05	Stall Prevention during RUN	0 - 3	1	1	1	-	-	-
L3-20	DC Bus Voltage Adjustment Gain	0.00 - 5.00	0.01	1.00	1.00	0.30	0.30	0.30
L3-21	OVSuppression Accel/Decel P Gain	0.10 - 10.00	0.01	1.00	1.00	1.00	1.00	1.00
L3-36	Current Suppression Gain@Accel	0.0 - 100.0	0.1	10.0	10.0	20.0	-	-
L4-01	Speed Agree Detection Level	0.0 - 400.0	0.1	0.0 Hz	0.0 Hz	0.0 Hz	0.0 Hz	0.0 Hz
L4-02	Speed Agree Detection Width	0.0 - 20.0	0.1	2.0 Hz	2.0 Hz	2.0 Hz	2.0 Hz	2.0 Hz
L4-03	Speed Agree Detection Level (+/-)	-400.0 - +400.0	0.1	0.0 Hz	0.0 Hz	0.0 Hz	0.0 Hz	0.0 Hz
L4-04	Speed Agree Detection Width (+/-)	0.0 - 20.0	0.1	2.0 Hz	2.0 Hz	2.0 Hz	2.0 Hz	2.0 Hz
L8-38	Carrier Frequency Reduction	0 - 2	1	2	2	2	2	0
L8-40	Carrier Freq Reduction Off-Delay	0.00 - 2.00	0.01 s	0.50	0.50	0.50	0.50	0.50

No.	Name	Range	Unit	Control Method (A1-02 Setting)				
				V/f (0)	CL-V/f (1)	OLV (2)	CLV (3)	AOLV (4)
n1-15	PWM Voltage Offset Calibration	0 - 2	1	1	1	1	1	2
o1-03	Frequency Display Unit Selection	0 - 3	1	0	0	0	0	0
o1-04	V/f Pattern Display Unit	0 - 1	1	-	-	-	0	0
S1-03	Brake Delay Frequency	0.0 - 400.0	0.1 Hz	3.0	3.0	3.0	0.0	3.0
S1-04	Brake Delay Time	0.00 - 10.00	0.01 s	0.30	0.30	0.30	0.00	0.30
S1-09	Torque Compensation (FWD)	-200 - +200	1%	-	-	50	0	50
S1-14	Slip Prevention Frequency	0.0 - 20.0	0.1 Hz	3.0	3.0	3.0	0.0	3.0
S1-15	Slip Prevention Time	0.00 - 10.00	0.01 s	0.30	0.30	0.30	0.00	0.30
S3-01	Impact Stop Creep Frequency	0.0 - 20.0	0.1 Hz	6.0	6.0	3.0	3.0	3.0

*1 The default setting changes when the drive model and *E1-03 [V/f Pattern Selection]* change.
*2 This is the value for 200 V class drives. Double the value for 400 V class drives.

10.18 Parameters that Change from the Default Settings with E3-01 [Motor 2 Control Mode Selection]

The values for the parameters in these tables depend on the values for parameter *E3-01*. When you change *E3-01*, the default settings will change.

No.	Name	Range	Unit	Motor 2 Control Method (setting value of E3-01)			
				V/f (0)	CL-V/f (1)	OLV (2)	CLV (3)
C3-21	Motor 2 Slip Compensation Gain	0.0 - 2.50	0.1	0.0	-	1.0	1.0
C3-22	Motor 2 Slip Comp Delay Time	0 - 10000	1 ms	2000	-	200	-
C4-08	M2 Torque Comp Delay Time	0 - 60000	1 ms	200	200	20	-
C4-14	M2 Torque Comp Delay Time Sel 1	0 - 60000	1 ms	200	200	20	-
C5-21	Motor 2 ASR Proportional Gain 1 (P)	0.00 - 300.00	0.01	-	0.20	-	20.00
C5-22	Motor 2 ASR Integral Time 1 (I)	0.000 - 10.000	0.001 s	-	0.200	-	0.500
C5-23	Motor 2 ASR Proportional Gain 2 (P)	0.00 - 300.00	0.01	-	0.02	-	20.00
C5-24	Motor 2 ASR Integral Time 2 (I)	0.000 - 10.000	0.001 s	-	0.050	-	0.500
C5-26	Motor 2 ASR Delay Time	0.000 - 0.500	0.001 s	-	-	-	0.004
E3-04	Motor 2 Maximum Output Frequency	40.0 - 590.0	0.1 Hz	50.0	50.0	50.0	50.0
E3-05	Motor 2 Maximum Output Voltage	0.0 - 255.0 *1	0.1 V	200.0	200.0	200.0	200.0
E3-06	Motor 2 Base Frequency	0.0 - 590.0	0.1 Hz	50.0	50.0	50.0	50.0
E3-07	Motor 2 Mid Point A Frequency	0.0 - 590.0	0.1 Hz	2.5	2.5	3.0	-
E3-08	Motor 2 Mid Point A Voltage	0.0 - 255.0 *1	0.1 V	15.0	15.0	14.4	-
E3-09	Motor 2 Minimum Output Frequency	0.0 - 590.0	0.1 Hz	1.3	1.3	0.5	0.0
E3-10	Motor 2 Minimum Output Voltage	0.0 - 255.0 *1	0.1 V	9.0	9.0	3.0	-
E3-11	Motor 2 Mid Point B Frequency	0.0 - 590.0	Determined by o1-04	0.0	0.0	0.0	0.0
E3-12	Motor 2 Mid Point B Voltage	0.0 - 255.0 *1	0.1 V	0.0	0.0	0.0	0.0
E3-13	Motor 2 Base Voltage	0.0 - 255.0 *1	0.1 V	0.0	0.0	0.0	0.0
E3-14	M2 Middle Out Freq Volt Select	0.0 - 255.0 *1	0.1 V	15.0	15.0	14.4	-
E3-15	M2 Minimum Out Freq Volt Select	0.0 - 255.0 *1	0.1 V	9.0	9.0	3.0	-
S1-25	Motor2 Brake Delay Frequency	0.0 - 400.0	0.1 Hz	3.0	3.0	3.0	0.0
S1-26	Motor2 Brake Delay Time	0.00 - 10.00	0.01 s	0.30	0.30	0.30	0.00
S1-31	Motor2 Torque Compensation (FWD)	-200 - +200	1%	-	-	50	0
S1-36	Motor2 Slip Prevention Frequency	0.0 - 20.0	0.1 Hz	3.0	3.0	3.0	0.0
S1-37	Motor2 Slip Prevention Time	0.00 - 10.00	0.01 s	0.30	0.30	0.30	0.00

*1 This is the value for 200 V class drives. Double the value for 400 V class drives.

10.19 Parameters Changed by E1-03 [V/f Pattern Selection]

The default settings of the parameters listed in the following table vary depending on the setting of *A1-02 [Control Method Selection]* and *E1-03 [V/f Pattern Selection]*.

Table 10.1 Parameters Changed by E1-03 (2003 to 2018 and 4002 to 4009)

No.	Unit	Setting Value																Control Method (A1-02 Setting)	
E1-03		0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F	OLV (2)	CLV (3)
E1-04	Hz	50.0	60.0	60.0	72.0	50.0	50.0	60.0	60.0	50.0	50.0	60.0	60.0	90.0	120.0	180.0	50.0 *1	50.0	50.0
E1-05 *2	V	200.0	200.0	200.0	200.0	200.0	200.0	200.0	200.0	200.0	200.0	200.0	200.0	200.0	200.0	200.0	200.0 *1	200.0	200.0
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	50.0 *1	50.0	50.0
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	2.5 *1	3.0	-
E1-08 *2	V	15.0	15.0	15.0	15.0	35.0	50.0	35.0	50.0	19.0	24.0	19.0	24.0	15.0	15.0	15.0	15.0 *1	14.4	-
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	1.3 *1	0.5	0.0
E1-10 *2	V	9.0	9.0	9.0	9.0	8.0	9.0	8.0	9.0	11.0	13.0	11.0	15.0	9.0	9.0	9.0	9.0 *1	3.0	-
E1-11	Hz	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0 *1	0.0	0.0
E1-12 *2	V	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0 *1	0.0	0.0
E1-13 *2	V	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0 *1	0.0	0.0
E1-14 *2	V	15.0	15.0	15.0	15.0	35.0	50.0	35.0	50.0	19.0	24.0	19.0	24.0	15.0	15.0	15.0	15.0 *1	14.4	-
E1-15 *2	V	9.0	9.0	9.0	9.0	8.0	9.0	8.0	9.0	11.0	13.0	11.0	15.0	9.0	9.0	9.0	9.0 *1	3.0	-
E1-16 *2	V	15.0	15.0	15.0	15.0	35.0	50.0	35.0	50.0	19.0	24.0	19.0	24.0	15.0	15.0	15.0	15.0 *1	14.4	-
E1-17 *2	V	9.0	9.0	9.0	9.0	8.0	9.0	8.0	9.0	11.0	13.0	11.0	15.0	9.0	9.0	9.0	9.0 *1	3.0	-
E1-18 *2	V	15.0	15.0	15.0	15.0	35.0	50.0	35.0	50.0	19.0	24.0	19.0	24.0	15.0	15.0	15.0	15.0 *1	14.4	-
E1-19 *2	V	9.0	9.0	9.0	9.0	8.0	9.0	8.0	9.0	11.0	13.0	11.0	15.0	9.0	9.0	9.0	9.0 *1	3.0	-

*1 Default settings for *E1-04 to E1-10, E3-04 to E3-10 [V/f Pattern for Motor 2]*, and *E7-04 to E7-10 [V/f Pattern for Motor 3]*. These settings are the same as those for the V/f pattern when *E1-03 = 0 [Const Trq, 50Hz base, 50Hz max]*.

*2 This is the value for 200 V class drives. Double the value for 400 V class drives.

Table 10.2 Parameters Changed by E1-03 (2025 to 2180 and 4015 to 4091)

No.	Unit	Setting Value																Control Method (A1-02 Setting)	
E1-03		0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F	OLV (2)	CLV (3)
E1-04	Hz	50.0	60.0	60.0	72.0	50.0	50.0	60.0	60.0	50.0	50.0	60.0	60.0	90.0	120.0	180.0	50.0 *1	50.0	50.0
E1-05 *2	V	200.0	200.0	200.0	200.0	200.0	200.0	200.0	200.0	200.0	200.0	200.0	200.0	200.0	200.0	200.0	200.0 *1	200.0	200.0
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	50.0 *1	50.0	50.0
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	2.5 *1	3.0	-
E1-08 *2	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 *1	13.2	-
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	1.3 *1	0.5	0.0
E1-10 *2	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 *1	2.4	-
E1-11	Hz	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0 *1	0.0	0.0
E1-12 *2	V	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0 *1	0.0	0.0

No.	Unit	Setting Value															Control Method (A1-02 Setting)	
E1-03		0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F	OLV (2)	CLV (3)
E1-13 *2	V	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0 *1	0.0	0.0
E1-14 *2	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 *1	13.2	-
E1-15 *2	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 *1	2.4	-
E1-16 *2	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 *1	13.2	-
E1-17 *2	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 *1	2.4	-
E1-18 *2	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 *1	13.2	-
E1-19 *2	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 *1	2.4	-

*1 Default settings for *E1-04 to E1-10, E3-04 to E3-10 [V/f Pattern for Motor 2]*, and *E7-04 to E7-10 [V/f Pattern for Motor 3]*. These settings are the same as those for the V/f pattern when *E1-03 = 0 [Const Trq, 50Hz base, 50Hz max]*.
*2 This is the value for 200 V class drives. Double the value for 400 V class drives.

Table 10.3 Parameters Changed by E1-03 (2215 to 2415 and 4112 to 4605)

No.	Unit	Setting Value															Control Method (A1-02 Setting)	
E1-03		0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F	OLV (2)	CLV (3)
E1-04	Hz	50.0	60.0	60.0	72.0	50.0	50.0	60.0	60.0	50.0	50.0	60.0	60.0	90.0	120.0	180.0	50.0 *1	50.0	50.0
E1-05 *2	V	200.0	200.0	200.0	200.0	200.0	200.0	200.0	200.0	200.0	200.0	200.0	200.0	200.0	200.0	200.0	200.0 *1	200.0	200.0
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	50.0 *1	50.0	50.0
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	2.5 *1	3.0	-
E1-08 *2	V	12.0	12.0	12.0	12.0	35.0	50.0	35.0	50.0	15.0	20.0	15.0	20.0	12.0	12.0	12.0	12.0 *1	13.2	-
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	1.3 *1	0.5	0.0
E1-10 *2	V	6.0	6.0	6.0	6.0	5.0	6.0	5.0	6.0	7.0	9.0	7.0	11.0	6.0	6.0	6.0	6.0 *1	2.4	-
E1-11	Hz	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0 *1	0.0	0.0
E1-12 *2	V	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0 *1	0.0	0.0
E1-13 *2	V	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0 *1	0.0	0.0
E1-14 *2	V	12.0	12.0	12.0	12.0	35.0	50.0	35.0	50.0	15.0	20.0	15.0	20.0	12.0	12.0	12.0	12.0 *1	13.2	-
E1-15 *2	V	6.0	6.0	6.0	6.0	5.0	6.0	5.0	6.0	7.0	9.0	7.0	11.0	6.0	6.0	6.0	6.0 *1	2.4	-
E1-16 *2	V	12.0	12.0	12.0	12.0	35.0	50.0	35.0	50.0	15.0	20.0	15.0	20.0	12.0	12.0	12.0	12.0 *1	13.2	-
E1-17 *2	V	6.0	6.0	6.0	6.0	5.0	6.0	5.0	6.0	7.0	9.0	7.0	11.0	6.0	6.0	6.0	6.0 *1	2.4	-
E1-18 *2	V	12.0	12.0	12.0	12.0	35.0	50.0	35.0	50.0	15.0	20.0	15.0	20.0	12.0	12.0	12.0	12.0 *1	13.2	-
E1-19 *2	V	6.0	6.0	6.0	6.0	5.0	6.0	5.0	6.0	7.0	9.0	7.0	11.0	6.0	6.0	6.0	6.0 *1	2.4	-

*1 Default settings for *E1-04 to E1-10, E3-04 to E3-10 [V/f Pattern for Motor 2]*, and *E7-04 to E7-10 [V/f Pattern for Motor 3]*. These settings are the same as those for the V/f pattern when *E1-03 = 0 [Const Trq, 50Hz base, 50Hz max]*.
*2 This is the value for 200 V class drives. Double the value for 400 V class drives.

10.20 Parameters Changed by o2-04 [Drive Model (KVA) Selection]

The values for the parameters in these tables depend on the values for the parameter *o2-04*. The values of the default settings change as the setting of *o2-04* changes.

◆ 200 V Class

No.	Name	Unit	Default		
-	Drive Model	-	2003	2005	2008
o2-04	Drive Model (KVA) Selection	Hex.	62	63	65
Motor 1: E2-11 Motor 2: E4-11 Motor 3: E7-31	Motor Rated Power	kW	0.4	0.75	1.5
Motor 1: C5-17 Motor 2: C5-37	Motor Inertia	kgm^2	0.0015	0.0028	0.0068
C6-02	Carrier Frequency Selection	-	1	1	1
E1-01	Input AC Supply Voltage	V	230	230	230
Motor 1: E2-01 Motor 2: E4-01 Motor 3: E7-21	Motor Rated Current (FLA)	A	1.9	3.3	6.2
Motor 1: E2-02 Motor 2: E4-02	Motor Rated Slip	Hz	2.9	2.5	2.6
Motor 1: E2-03 Motor 2: E4-03	Motor No-Load Current	A	1.2	1.8	2.8
Motor 1: E2-05 Motor 2: E4-05 Motor 3: E7-25	Motor Line-to-Line Resistance	Ω	9.842	5.156	1.997
Motor 1: E2-06 Motor 2: E4-06	Motor Leakage Inductance	%	18.2	13.8	18.5
Motor 1: E2-10 Motor 2: E4-10	Motor Iron Loss	W	14	26	53
L2-03	Minimum Baseblock Time	s	0.2	0.3	0.4
L2-05	Undervoltage Detection Lvl (Uv1)	-	190	190	190
L3-24	Motor Accel Time @ Rated Torque	s	0.178	0.142	0.166
L8-02	Overheat Alarm Level	°C	115	115	115
L8-09	Output Ground Fault Detection	-	1	1	1
L8-38	Carrier Frequency Reduction	-	2	2	2
L8-39	Carrier Freq Reduction during oL	-	2	2	2
n1-01	Hunting Prevention Selection	-	1	1	1
n1-03	Hunting Prevention Time Constant	ms	10	10	10
n1-16	Hunting Prevention High Fc Gain	-	0.50	0.50	0.50
n2-01	Automatic Freq Regulator Gain(F)	-	1.00	1.00	1.00
n5-02	Motor Inertia Acceleration Time	s	0.178	0.142	0.166

No.	Name	Unit	Default			
-	Drive Model	-	2011	2014	2018	2025
o2-04	Drive Model (KVA) Selection	Hex.	66	67	68	6A
Motor 1: E2-11 Motor 2: E4-11 Motor 3: E7-31	Motor Rated Power	kW	2.2	3.0	3.7	5.5
Motor 1: C5-17 Motor 2: C5-37	Motor Inertia	kgm^2	0.0088	0.0158	0.0158	0.026
C6-02	Carrier Frequency Selection	-	1	1	1	1
E1-01	Input AC Supply Voltage	V	230	230	230	230
Motor 1: E2-01 Motor 2: E4-01 Motor 3: E7-21	Motor Rated Current (FLA)	A	8.5	11.4	14	19.6
Motor 1: E2-02 Motor 2: E4-02	Motor Rated Slip	Hz	2.9	2.7	2.73	1.5
Motor 1: E2-03 Motor 2: E4-03	Motor No-Load Current	A	3	3.7	4.5	5.1
Motor 1: E2-05 Motor 2: E4-05 Motor 3: E7-25	Motor Line-to-Line Resistance	Ω	1.601	1.034	0.771	0.399
Motor 1: E2-06 Motor 2: E4-06	Motor Leakage Inductance	%	18.4	19	19.6	18.2
Motor 1: E2-10 Motor 2: E4-10	Motor Iron Loss	W	77	91	112	172
L2-03	Minimum Baseblock Time	s	0.5	0.5	0.6	0.7
L2-05	Undervoltage Detection Lvl (Uv1)	-	190	190	190	190
L3-24	Motor Accel Time @ Rated Torque	s	0.145	0.145	0.154	0.168
L8-02	Overheat Alarm Level	°C	124	110	110	110
L8-09	Output Ground Fault Detection	-	1	1	1	1
L8-38	Carrier Frequency Reduction	-	2	2	2	2
L8-39	Carrier Freq Reduction during oL	-	2	2	2	2
n1-01	Hunting Prevention Selection	-	1	1	1	1
n1-03	Hunting Prevention Time Constant	ms	10	10	10	10
n1-16	Hunting Prevention High Fc Gain	-	0.50	0.50	0.50	0.50
n2-01	Automatic Freq Regulator Gain(F)	-	1.00	1.00	1.00	1.50
n5-02	Motor Inertia Acceleration Time	s	0.145	0.145	0.154	0.168

No.	Name	Unit	Default			
-	Drive Model	-	2033	2047	2060	2075
o2-04	Drive Model (KVA) Selection	Hex.	6B	6D	6E	6F
Motor 1: E2-11 Motor 2: E4-11 Motor 3: E7-31	Motor Rated Power	kW	7.5	11	15	18.5
Motor 1: C5-17 Motor 2: C5-37	Motor Inertia	kgm^2	0.037	0.053	0.076	0.138
C6-02	Carrier Frequency Selection	-	1	1	1	1
E1-01	Input AC Supply Voltage	V	230	230	230	230

No.	Name	Unit	Default			
-	Drive Model	-	2033	2047	2060	2075
o2-04	Drive Model (KVA) Selection	Hex.	6B	6D	6E	6F
Motor 1: E2-11 Motor 2: E4-11 Motor 3: E7-31	Motor Rated Power	kW	7.5	11	15	18.5
Motor 1: E2-01 Motor 2: E4-01 Motor 3: E7-21	Motor Rated Current (FLA)	A	26.6	39.7	53	65.8
Motor 1: E2-02 Motor 2: E4-02	Motor Rated Slip	Hz	1.3	1.7	1.6	1.67
Motor 1: E2-03 Motor 2: E4-03	Motor No-Load Current	A	8	11.2	15.2	15.7
Motor 1: E2-05 Motor 2: E4-05 Motor 3: E7-25	Motor Line-to-Line Resistance	Ω	0.288	0.23	0.138	0.101
Motor 1: E2-06 Motor 2: E4-06	Motor Leakage Inductance	%	15.5	19.5	17.2	20.1
Motor 1: E2-10 Motor 2: E4-10	Motor Iron Loss	W	262	245	272	505
L2-03	Minimum Baseblock Time	s	0.8	0.9	1	1
L2-05	Undervoltage Detection Lvl (Uv1)	-	190	190	190	190
L3-24	Motor Accel Time @ Rated Torque	s	0.175	0.265	0.244	0.317
L8-02	Overheat Alarm Level	°C	110	115	120	133
L8-09	Output Ground Fault Detection	-	1	1	1	1
L8-38	Carrier Frequency Reduction	-	2	2	2	2
L8-39	Carrier Freq Reduction during oL	-	2	2	2	2
n1-01	Hunting Prevention Selection	-	1	2	2	2
n1-03	Hunting Prevention Time Constant	ms	10	10	10	10
n1-16	Hunting Prevention High Fc Gain	-	0.50	0.50	0.50	0.50
n2-01	Automatic Freq Regulator Gain(F)	-	1.50	1.00	1.50	1.00
n5-02	Motor Inertia Acceleration Time	s	0.175	0.265	0.244	0.317

No.	Name	Unit	Default			
-	Drive Model	-	2088	2115	2145	2180
o2-04	Drive Model (KVA) Selection	Hex.	70	72	73	74
Motor 1: E2-11 Motor 2: E4-11 Motor 3: E7-31	Motor Rated Power	kW	22	30	37	45
Motor 1: C5-17 Motor 2: C5-37	Motor Inertia	kgm^2	0.165	0.220	0.273	0.333
C6-02	Carrier Frequency Selection	-	1	1	1	1
E1-01	Input AC Supply Voltage	V	230	230	230	230
Motor 1: E2-01 Motor 2: E4-01 Motor 3: E7-21	Motor Rated Current (FLA)	A	77.2	105	131	160
Motor 1: E2-02 Motor 2: E4-02	Motor Rated Slip	Hz	1.7	1.8	1.33	1.6

No.	Name	Unit	Default			
-	Drive Model	-	2088	2115	2145	2180
o2-04	Drive Model (KVA) Selection	Hex.	70	72	73	74
Motor 1: E2-11 Motor 2: E4-11 Motor 3: E7-31	Motor Rated Power	kW	22	30	37	45
Motor 1: E2-03 Motor 2: E4-03	Motor No-Load Current	A	18.5	21.9	38.2	44
Motor 1: E2-05 Motor 2: E4-05 Motor 3: E7-25	Motor Line-to-Line Resistance	Ω	0.079	0.064	0.039	0.03
Motor 1: E2-06 Motor 2: E4-06	Motor Leakage Inductance	%	19.5	20.8	18.8	20.2
Motor 1: E2-10 Motor 2: E4-10	Motor Iron Loss	W	538	699	823	852
L2-03	Minimum Baseblock Time	s	1	1.1	1.1	1.2
L2-05	Undervoltage Detection Lvl (Uv1)	-	190	190	190	190
L3-24	Motor Accel Time @ Rated Torque	s	0.355	0.323	0.32	0.387
L8-02	Overheat Alarm Level	°C	105	115	105	105
L8-09	Output Ground Fault Detection	-	1	1	1	1
L8-38	Carrier Frequency Reduction	-	2	2	2	2
L8-39	Carrier Freq Reduction during oL	-	2	2	2	2
n1-01	Hunting Prevention Selection	-	2	2	2	2
n1-03	Hunting Prevention Time Constant	ms	10	10	10	10
n1-16	Hunting Prevention High Fc Gain	-	0.50	0.50	0.50	0.50
n2-01	Automatic Freq Regulator Gain(F)	-	1.00	1.00	1.00	1.00
n5-02	Motor Inertia Acceleration Time	s	0.355	0.323	0.32	0.387

No.	Name	Unit	Default			
-	Drive Model	-	2215	2283	2346	2415
o2-04	Drive Model (KVA) Selection	Hex.	75	76	77	78
Motor 1: E2-11 Motor 2: E4-11 Motor 3: E7-31	Motor Rated Power	kW	55	75	90	110
Motor 1: C5-17 Motor 2: C5-37	Motor Inertia	kgm^2	0.49	0.90	1.10	1.90
C6-02	Carrier Frequency Selection	-	1	1	1	1
E1-01	Input AC Supply Voltage	V	230	230	230	230
Motor 1: E2-01 Motor 2: E4-01 Motor 3: E7-21	Motor Rated Current (FLA)	A	190	260	260	260
Motor 1: E2-02 Motor 2: E4-02	Motor Rated Slip	Hz	1.43	1.39	1.39	1.39
Motor 1: E2-03 Motor 2: E4-03	Motor No-Load Current	A	45.6	72	72	72
Motor 1: E2-05 Motor 2: E4-05 Motor 3: E7-25	Motor Line-to-Line Resistance	Ω	0.022	0.023	0.023	0.023

No.	Name	Unit	Default			
-	Drive Model	-	2215	2283	2346	2415
o2-04	Drive Model (KVA) Selection	Hex.	75	76	77	78
Motor 1: E2-11 Motor 2: E4-11 Motor 3: E7-31	Motor Rated Power	kW	55	75	90	110
Motor 1: E2-06 Motor 2: E4-06	Motor Leakage Inductance	%	20.5	20	20	20
Motor 1: E2-10 Motor 2: E4-10	Motor Iron Loss	W	960	1200	1200	1200
L2-03	Minimum Baseblock Time	s	1.3	1.5	1.5	1.7
L2-05	Undervoltage Detection Lvl (Uv1)	-	190	190	190	190
L3-24	Motor Accel Time @ Rated Torque	s	0.317	0.533	0.592	0.646
L8-02	Overheat Alarm Level	°C	105	105	120	120
L8-09	Output Ground Fault Detection	-	1	1	1	1
L8-38	Carrier Frequency Reduction	-	2	2	2	2
L8-39	Carrier Freq Reduction during oL	-	2	2	2	2
n1-01	Hunting Prevention Selection	-	2	2	2	2
n1-03	Hunting Prevention Time Constant	ms	10	10	100	100
n1-16	Hunting Prevention High Fc Gain	-	0.50	0.50	1.00	1.00
n2-01	Automatic Freq Regulator Gain(F)	-	1.00	1.00	1.00	1.00
n5-02	Motor Inertia Acceleration Time	s	0.317	0.533	0.592	0.646

◆ 400 V Class

No.	Name	Unit	Default			
-	Drive Model	-	4002	4003	4005	4006
o2-04	Drive Model (KVA) Selection	Hex.	92	93	94	95
Motor 1: E2-11 Motor 2: E4-11 Motor 3: E7-31	Motor Rated Power	kW	0.4	1.1	1.5	2.2
Motor 1: C5-17 Motor 2: C5-37	Motor Inertia	kgm^2	0.0015	0.0028	0.0068	0.0088
C6-02	Carrier Frequency Selection	-	1	1	1	1
E1-01	Input AC Supply Voltage	V	400	400	400	400
Motor 1: E2-01 Motor 2: E4-01 Motor 3: E7-21	Motor Rated Current (FLA)	A	1	1.6	3.1	4.2
Motor 1: E2-02 Motor 2: E4-02	Motor Rated Slip	Hz	2.9	2.6	2.5	3
Motor 1: E2-03 Motor 2: E4-03	Motor No-Load Current	A	0.6	0.8	1.4	1.5
Motor 1: E2-05 Motor 2: E4-05 Motor 3: E7-25	Motor Line-to-Line Resistance	Ω	38.198	22.459	10.1	6.495
Motor 1: E2-06 Motor 2: E4-06	Motor Leakage Inductance	%	18.2	14.3	18.3	18.7

No.	Name	Unit	Default			
-	Drive Model	-	4002	4003	4005	4006
o2-04	Drive Model (KVA) Selection	Hex.	92	93	94	95
Motor 1: E2-11 Motor 2: E4-11 Motor 3: E7-31	Motor Rated Power	kW	0.4	1.1	1.5	2.2
Motor 1: E2-10 Motor 2: E4-10	Motor Iron Loss	W	14	26	53	77
L2-03	Minimum Baseblock Time	s	0.2	0.3	0.4	0.5
L2-05	Undervoltage Detection Lvl (Uv1)	-	380	380	380	380
L3-24	Motor Accel Time @ Rated Torque	s	0.178	0.142	0.166	0.145
L8-02	Overheat Alarm Level	°C	100	105	112	110
L8-09	Output Ground Fault Detection	-	1	1	1	1
L8-38	Carrier Frequency Reduction	-	2	2	2	2
L8-39	Carrier Freq Reduction during oL	-	2	2	2	2
n1-01	Hunting Prevention Selection	-	1	1	1	1
n1-03	Hunting Prevention Time Constant	ms	10	10	10	10
n1-16	Hunting Prevention High Fc Gain	-	0.50	0.50	0.50	0.50
n2-01	Automatic Freq Regulator Gain(F)	-	1.00	1.00	1.00	1.00
n5-02	Motor Inertia Acceleration Time	s	0.178	0.142	0.166	0.145

No.	Name	Unit	Default			
-	Drive Model	-	4007	4009	4015	4018
o2-04	Drive Model (KVA) Selection	Hex.	96	97	99	9A
Motor 1: E2-11 Motor 2: E4-11 Motor 3: E7-31	Motor Rated Power	kW	3.0	4.0	5.5	7.5
Motor 1: C5-17 Motor 2: C5-37	Motor Inertia	kgm^2	0.0158	0.0158	0.026	0.037
C6-02	Carrier Frequency Selection	-	1	1	1	1
E1-01	Input AC Supply Voltage	V	400	400	400	400
Motor 1: E2-01 Motor 2: E4-01 Motor 3: E7-21	Motor Rated Current (FLA)	A	5.7	7	9.8	13.3
Motor 1: E2-02 Motor 2: E4-02	Motor Rated Slip	Hz	2.7	2.7	1.5	1.3
Motor 1: E2-03 Motor 2: E4-03	Motor No-Load Current	A	1.9	2.3	2.6	4
Motor 1: E2-05 Motor 2: E4-05 Motor 3: E7-25	Motor Line-to-Line Resistance	Ω	4.360	3.333	1.595	1.152
Motor 1: E2-06 Motor 2: E4-06	Motor Leakage Inductance	%	19	19.3	18.2	15.5
Motor 1: E2-10 Motor 2: E4-10	Motor Iron Loss	W	105	130	193	263
L2-03	Minimum Baseblock Time	s	0.5	0.6	0.7	0.8
L2-05	Undervoltage Detection Lvl (Uv1)	-	380	380	380	380

No.	Name	Unit	Default			
-	Drive Model	-	4007	4009	4015	4018
o2-04	Drive Model (KVA) Selection	Hex.	96	97	99	9A
Motor 1: E2-11 Motor 2: E4-11 Motor 3: E7-31	Motor Rated Power	kW	3.0	4.0	5.5	7.5
L3-24	Motor Accel Time @ Rated Torque	s	0.145	0.154	0.168	0.175
L8-02	Overheat Alarm Level	°C	100	100	105	105
L8-09	Output Ground Fault Detection	-	1	1	1	1
L8-38	Carrier Frequency Reduction	-	2	2	2	2
L8-39	Carrier Freq Reduction during oL	-	2	2	2	2
n1-01	Hunting Prevention Selection	-	1	1	1	1
n1-03	Hunting Prevention Time Constant	ms	10	10	10	10
n1-16	Hunting Prevention High Fc Gain	-	0.50	0.50	0.50	0.50
n2-01	Automatic Freq Regulator Gain(F)	-	1.00	1.00	1.50	1.50
n5-02	Motor Inertia Acceleration Time	s	0.145	0.154	0.168	0.175

No.	Name	Unit	Default			
-	Drive Model	-	4024	4031	4039	4045
o2-04	Drive Model (KVA) Selection	Hex.	9C	9D	9E	9F
Motor 1: E2-11 Motor 2: E4-11 Motor 3: E7-31	Motor Rated Power	kW	11	15	18.5	22
Motor 1: C5-17 Motor 2: C5-37	Motor Inertia	kgm^2	0.053	0.076	0.138	0.165
C6-02	Carrier Frequency Selection	-	1	1	1	1
E1-01	Input AC Supply Voltage	V	400	400	400	400
Motor 1: E2-01 Motor 2: E4-01 Motor 3: E7-21	Motor Rated Current (FLA)	A	19.9	26.5	32.9	38.6
Motor 1: E2-02 Motor 2: E4-02	Motor Rated Slip	Hz	1.7	1.6	1.67	1.7
Motor 1: E2-03 Motor 2: E4-03	Motor No-Load Current	A	5.6	7.6	7.8	9.2
Motor 1: E2-05 Motor 2: E4-05 Motor 3: E7-25	Motor Line-to-Line Resistance	Ω	0.922	0.55	0.403	0.316
Motor 1: E2-06 Motor 2: E4-06	Motor Leakage Inductance	%	19.6	17.2	20.1	23.5
Motor 1: E2-10 Motor 2: E4-10	Motor Iron Loss	W	385	440	508	586
L2-03	Minimum Baseblock Time	s	0.9	1	1	1
L2-05	Undervoltage Detection Lvl (Uv1)	-	380	380	380	380
L3-24	Motor Accel Time @ Rated Torque	s	0.265	0.244	0.317	0.355
L8-02	Overheat Alarm Level	°C	115	120	120	130
L8-09	Output Ground Fault Detection	-	1	1	1	1

No.	Name	Unit	Default			
-	Drive Model	-	4024	4031	4039	4045
o2-04	Drive Model (KVA) Selection	Hex.	9C	9D	9E	9F
Motor 1: E2-11 Motor 2: E4-11 Motor 3: E7-31	Motor Rated Power	kW	11	15	18.5	22
L8-38	Carrier Frequency Reduction	-	2	2	2	2
L8-39	Carrier Freq Reduction during oL	-	2	2	2	2
n1-01	Hunting Prevention Selection	-	2	2	2	2
n1-03	Hunting Prevention Time Constant	ms	10	10	10	10
n1-16	Hunting Prevention High Fc Gain	-	0.50	0.50	0.50	0.50
n2-01	Automatic Freq Regulator Gain(F)	-	1.50	1.00	1.00	1.00
n5-02	Motor Inertia Acceleration Time	s	0.265	0.244	0.317	0.355

No.	Name	Unit	Default			
-	Drive Model	-	4060	4075	4091	4112
o2-04	Drive Model (KVA) Selection	Hex.	A1	A2	A3	A4
Motor 1: E2-11 Motor 2: E4-11 Motor 3: E7-31	Motor Rated Power	kW	30	37	45	55
Motor 1: C5-17 Motor 2: C5-37	Motor Inertia	kgm²	0.220	0.273	0.333	0.49
C6-02	Carrier Frequency Selection	-	1	1	1	1
E1-01	Input AC Supply Voltage	V	400	400	400	400
Motor 1: E2-01 Motor 2: E4-01 Motor 3: E7-21	Motor Rated Current (FLA)	A	52.3	65.6	79.7	95
Motor 1: E2-02 Motor 2: E4-02	Motor Rated Slip	Hz	1.8	1.33	1.6	1.46
Motor 1: E2-03 Motor 2: E4-03	Motor No-Load Current	A	10.9	19.1	22	24
Motor 1: E2-05 Motor 2: E4-05 Motor 3: E7-25	Motor Line-to-Line Resistance	Ω	0.269	0.155	0.122	0.088
Motor 1: E2-06 Motor 2: E4-06	Motor Leakage Inductance	%	20.7	18.8	19.9	20
Motor 1: E2-10 Motor 2: E4-10	Motor Iron Loss	W	750	925	1125	1260
L2-03	Minimum Baseblock Time	s	1.1	1.1	1.2	1.2
L2-05	Undervoltage Detection Lvl (Uv1)	-	380	380	380	380
L3-24	Motor Accel Time @ Rated Torque	s	0.323	0.32	0.387	0.317
L8-02	Overheat Alarm Level	°C	120	115	126	120
L8-09	Output Ground Fault Detection	-	1	1	1	1
L8-38	Carrier Frequency Reduction	-	2	2	2	2
L8-39	Carrier Freq Reduction during oL	-	2	2	2	2
n1-01	Hunting Prevention Selection	-	2	2	2	2

No.	Name	Unit	Default			
-	Drive Model	-	4060	4075	4091	4112
o2-04	Drive Model (KVA) Selection	Hex.	A1	A2	A3	A4
Motor 1: E2-11 Motor 2: E4-11 Motor 3: E7-31	Motor Rated Power	kW	30	37	45	55
n1-03	Hunting Prevention Time Constant	ms	10	10	10	30
n1-16	Hunting Prevention High Fc Gain	-	0.50	0.50	0.50	0.50
n2-01	Automatic Freq Regulator Gain(F)	-	1.00	1.00	1.00	1.00
n5-02	Motor Inertia Acceleration Time	s	0.323	0.32	0.387	0.317

No.	Name	Unit	Default			
-	Drive Model	-	4150	4180	4216	4260
o2-04	Drive Model (KVA) Selection	Hex.	A5	A6	A7	A8
Motor 1: E2-11 Motor 2: E4-11 Motor 3: E7-31	Motor Rated Power	kW	75	90	110	132
Motor 1: C5-17 Motor 2: C5-37	Motor Inertia	kgm²	0.90	1.10	1.90	2.10
C6-02	Carrier Frequency Selection	-	1	1	1	1
E1-01	Input AC Supply Voltage	V	400	400	400	400
Motor 1: E2-01 Motor 2: E4-01 Motor 3: E7-21	Motor Rated Current (FLA)	A	130	156	190	223
Motor 1: E2-02 Motor 2: E4-02	Motor Rated Slip	Hz	1.39	1.4	1.4	1.38
Motor 1: E2-03 Motor 2: E4-03	Motor No-Load Current	A	36	40	49	58
Motor 1: E2-05 Motor 2: E4-05 Motor 3: E7-25	Motor Line-to-Line Resistance	Ω	0.092	0.056	0.046	0.035
Motor 1: E2-06 Motor 2: E4-06	Motor Leakage Inductance	%	20	20	20	20
Motor 1: E2-10 Motor 2: E4-10	Motor Iron Loss	W	1600	1760	2150	2350
L2-03	Minimum Baseblock Time	s	1.3	1.5	1.7	1.7
L2-05	Undervoltage Detection Lvl (Uv1)	-	380	380	380	380
L3-24	Motor Accel Time @ Rated Torque	s	0.533	0.592	0.646	0.673
L8-02	Overheat Alarm Level	°C	110	105	120	120
L8-09	Output Ground Fault Detection	-	1	1	1	1
L8-38	Carrier Frequency Reduction	-	2	2	2	2
L8-39	Carrier Freq Reduction during oL	-	2	2	2	2
n1-01	Hunting Prevention Selection	-	2	2	2	2
n1-03	Hunting Prevention Time Constant	ms	30	30	30	30
n1-16	Hunting Prevention High Fc Gain	-	0.50	0.50	0.50	0.50

No.	Name	Unit	Default			
-	Drive Model	-	4150	4180	4216	4260
o2-04	Drive Model (KVA) Selection	Hex.	A5	A6	A7	A8
Motor 1: E2-11 Motor 2: E4-11 Motor 3: E7-31	Motor Rated Power	kW	75	90	110	132
n2-01	Automatic Freq Regulator Gain(F)	-	1.00	1.00	1.00	1.00
n5-02	Motor Inertia Acceleration Time	s	0.533	0.592	0.646	0.673

No.	Name	Unit	Default			
-	Drive Model	-	4304	4371	4414	4453
o2-04	Drive Model (KVA) Selection	Hex.	A9	AA	AC	AD
Motor 1: E2-11 Motor 2: E4-11 Motor 3: E7-31	Motor Rated Power	kW	160	200	220	250
Motor 1: C5-17 Motor 2: C5-37	Motor Inertia	kgm^2	3.30	3.60	4.10	6.50
C6-02	Carrier Frequency Selection	-	1	1	1	1
E1-01	Input AC Supply Voltage	V	400	400	400	400
Motor 1: E2-01 Motor 2: E4-01 Motor 3: E7-21	Motor Rated Current (FLA)	A	270	310	370	500
Motor 1: E2-02 Motor 2: E4-02	Motor Rated Slip	Hz	1.35	1.3	1.3	1.25
Motor 1: E2-03 Motor 2: E4-03	Motor No-Load Current	A	70	81	96	130
Motor 1: E2-05 Motor 2: E4-05 Motor 3: E7-25	Motor Line-to-Line Resistance	Ω	0.029	0.025	0.02	0.014
Motor 1: E2-06 Motor 2: E4-06	Motor Leakage Inductance	%	20	20	20	20
Motor 1: E2-10 Motor 2: E4-10	Motor Iron Loss	W	2850	3200	3700	4700
L2-03	Minimum Baseblock Time	s	1.8	1.9	2	2.1
L2-05	Undervoltage Detection Lvl (Uv1)	-	380	380	380	380
L3-24	Motor Accel Time @ Rated Torque	s	0.777	0.864	0.91	1.392
L8-02	Overheat Alarm Level	°C	130	140	140	140
L8-09	Output Ground Fault Detection	-	1	1	1	1
L8-38	Carrier Frequency Reduction	-	2	2	2	2
L8-39	Carrier Freq Reduction during oL	-	2	2	2	2
n1-01	Hunting Prevention Selection	-	2	2	2	2
n1-03	Hunting Prevention Time Constant	ms	30	100	100	100
n1-16	Hunting Prevention High Fc Gain	-	0.50	0.50	0.50	0.50
n2-01	Automatic Freq Regulator Gain(F)	-	1.00	1.00	1.00	1.00
n5-02	Motor Inertia Acceleration Time	s	0.777	0.864	0.91	1.392

11

Parameter Details

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11.1 Section Safety

⚠DANGER

Do not ignore the safety messages in this manual.

If you ignore the safety messages in this manual, it will cause serious injury or death. The manufacturer is not responsible for injuries or damage to equipment.

11.2 A: Initialization Parameters

A parameters [Initialization Parameters] set the operating environment and operating conditions for the drive.

◆ A1: Initialization

A1 parameters set the operating environment and operating conditions for the drive. For example, these parameters set the keypad language, the control method, and the parameter access level for the drive.

■ A1-00: Language Selection

No. (Hex.)	Name	Description	Default (Range)
A1-00 (0100) RUN	Language Selection	V/f CL-V/f OLV CLV AOLV Sets the language for the LCD keypad.	0 (0, 1, 7)

Note:
When you initialize the drive with parameter *A1-03 [Initialize Parameters]*, the drive will not reset this parameter.

0 : English

1 : Japanese

7 : Chinese

■ A1-01: Access Level Selection

No. (Hex.)	Name	Description	Default (Range)
A1-01 (0101) RUN	Access Level Selection	V/f CL-V/f OLV CLV AOLV Sets user access to parameters. The access level controls the parameters shown on the keypad and which parameters you can set.	2 (0 - 3)

0 : Operation Only

Access to *A1-00, A1-01, A1-04 [Password]*, and the *U Monitors*.

1 : User Parameters

Access to *A1-00, A1-01, A1-04*, and *A2-01 to A2-32 [User Parameters 1 to 32]* only.

2 : Advanced Level

Access to all parameters, but not Expert Mode parameters.

3 : Expert Level

Access to all parameters including Expert Mode parameters.

This table lists the access permissions to keypad screen in accordance with the setting value of *A1-01*.

Mode	Keypad Screen	*A1-01 [Access Level Selection]* Setting			
		0	1	2	3
Drive Mode	Monitors	Yes	Yes	Yes	Yes
Programming Mode	Parameters	Yes	Yes	Yes	Yes
	User Custom Parameters	No	Yes	Yes	Yes
	Parameter Backup/Restore	No	No	Yes	Yes
	Modified Parameters/Fault Log	No	No	Yes	Yes
	Auto-Tuning	No	No	Yes	Yes
	Initial Setup Screen	No	No	Yes	Yes
	Diagnostic Tools	No	No	Yes	Yes

Note these points about the Parameter Access.

- When you use *A1-04* and *A1-05 [Password Setting]* to set a password, you cannot change the values set in *A1-01 to A1-03, A1-06*, and *A2-01 to A2-32*.
- When *H1-xx = 1B [MFDI Function Selection = Programming Lockout]*, even if *A1-01 = 1, 2, 3*, you cannot change parameter settings unless the terminal set to *1B* is turned ON.

- When you use MEMOBUS/Modbus communications, you must send the Enter command from the controller to the drive and complete the serial communication write process before you can use the keypad to change parameter settings.

■ A1-02: Control Method Selection

No. (Hex.)	Name	Description	Default (Range)
A1-02 (0102)	Control Method Selection	V/f CL-V/f OLV CLV AOLV Sets the control method for the drive application and the motor.	2 (0 - 4)

Note:

Parameters that are determined by *A1-02* are changed back to their default settings whenever the control method is changed.

Sets the control method for the drive application and the motor.

0 : V/f Control

Use this control method for general variable speed control applications that do not require a high level of responsiveness and high-precision speed control and connect multiple motors to a single drive. Also use this control method when there is not enough data to set the motor parameters or when it is not possible to perform Auto-Tuning. The speed control range is 1:40.

1 : V/f Control w/ PG

Use this control method for general applications that do not require a high level of responsiveness but require high-precision speed control. Also use this control method when it is not possible to perform Auto-Tuning because there is not enough data to set the motor parameters. The speed control range is 1:40.

2 : Open Loop Vector Control

Use this control method for general variable speed control applications that require high-precision speed control. This control method achieves high torque response as well as high torque even when operating at low speeds, even without a feedback signal from the motor. The speed control range is 1:120.

3 : Closed Loop Vector

Use this control method for general variable speed control applications that require high torque response, high-precision speed control up to zero speed, and high-precision torque control. This method requires a speed feedback signal from the motor. The speed control range is 1:1500.

4 : Advanced Open Loop Vector

This is a control method for induction motors. Use this control method for applications that require high-precision speed control.

This control method achieves high speed and torque response as well as high torque even when operating at low speeds. The speed control range is 1:200.

■ A1-03: Initialize Parameters

No. (Hex.)	Name	Description	Default (Range)
A1-03 (0103)	Initialize Parameters	V/f CL-V/f OLV CLV AOLV Sets parameters to default values.	0 (0 - 2220)

Note:

- *A1-03 = 0* is automatically set after initializing the drive.
- User Parameter Settings let the user save parameter values needed for the application, and have the drive use those parameter settings as the default value when initializing the drive.
- When using the 2 motor switchover function, turn off the terminal to which *H1-xx = 16 [Terminal Sx Function Selection = Motor 2 Selection]* has been assigned, and then change the *A1-03* setting. An incorrect procedure will trigger *oPE08 [Parameter Selection Error]*.

0 : No Initialization

1110 : User Initialization

Resets parameters to the values selected by the user as User Settings. Set *o2-03 = 1 [User Parameter Default Value = Set defaults]* to save the user settings.

Users can save the parameter settings adjusted for the test run as user-set default values to the drive. Set *A1-03 = 1110* to reset to the saved parameter settings.

Follow the following steps to save User Parameter setting values, and to perform a User Initialization.

1. Set parameters appropriately for the application.

2. Set *o2-03 = 1 [User Parameter Default Value = Set defaults]* after setting parameters.
   This saves parameter settings for a User Initialization.
   The setting value for *o2-03* automatically goes back to *0*.
3. Any changes made after settings are saved as User Parameter Settings will be reset to the previously set value when setting *A1-03 = 1110*.
   The drive initializes parameter values by setting them back to the User Parameter Setting values.

2220 : 2-Wire Initialization

Resets MFDI terminal S1 to Forward Run and terminal S2 to Reverse Run, and resets all parameters to default settings.

The drive will not initialize these parameters when *A1-03 = 2220*.

No.	Name
A1-00	Language Selection
A1-02	Control Method Selection
E1-03	V/f Pattern Selection
F6-08	Comm Parameter Reset @Initialize
F6-xx/F7-xx	Communication Option Parameters Communication option card parameters are initialized when setting *F6-08 = 1 [Comm Parameter Reset @Initialize = Reset Back to Factory Default]*.
L8-35	Installation Method Selection
o2-04	Drive Model (KVA) Selection

Note:
- Setting *A1-06 [Application Preset]* automatically optimizes parameter settings for the application that was selected, although the drive does not initialize *A1-02* when the user sets *A1-03 = 2220*.
- Setting *A1-03 = 2220* initializes *A1-05 [Password Setting]* to *0000*. Be sure to set the password again for applications that require a password.

■ A1-04: Password

No. (Hex.)	Name	Description	Default (Range)
A1-04 (0104)	Password	V/f CL-V/f OLV CLV AOLV Enter the correct password set in *A1-05 [Password Setting]* to unlock parameters. You can view parameter settings. Monitors are locked Enter the password in *A1-04 [Password]* to unlock and change the settings.	0000 (0000 - 9999)

If the password entered in *A1-04* does not agree with the password setting in *A1-05*, you cannot change these parameters:

- *A1-01 [Access Level Selection]*
- *A1-02 [Control Method Selection]*
- *A1-03 [Initialize Parameters]*
- *A1-06 [Application Preset]*
- *A2-01 to A2-32 [User Parameter 1 to 32]*

To lock parameter settings after making changes without changing the password, enter the incorrect password in *A1-04* and push ↵.

Enter the Password to Unlock Parameters

Use this procedure to unlock parameter settings.

Set the password in *A1-05 [Password Setting]*, and show the Parameter Setting Mode screen on the keypad.

This procedure verifies the password, and makes sure that the parameter settings are unlocked.

1. Push ∧ or ∨ to select “A: Initialization Parameters”, then push ↵.
2. Push ∧ or ∨ to select *[A1-04]*, then push ↵.
   You can now change parameter settings.
3. Push > or < to move the digit and enter the password.
4. Push ↵ to confirm the password.
   The drive unlocks the parameters and automatically shows the Parameters Screen.

5. Push ▲ or ▼ to show *[A1-02]*, then push ↵.
   The keypad shows the setting value for *[A1-02]*.
6. Push ▲ or ▼ to make sure that you can change the setting value.

Push F1 (Back) until the keypad shows the Parameter Setup Mode screen.

■ A1-05: Password Setting

No. (Hex.)	Name	Description	Default (Range)
A1-05 (0105)	Password Setting	V/f CL-V/f OLV CLV AOLV Set the password to lock parameters and prevent changes to parameter settings. The following parameters can be changed when the user enters the correct password in *A1-04 [Password]* that matches the password set in *A1-05*.	0000 (0000 - 9999)

This parameter can lock these parameter settings:

- *A1-01 [Access Level Selection]*
- *A1-02 [Control Method Selection]*
- *A1-03 [Initialize Parameters]*
- *A1-06 [Application Preset]*
- *A2-01 to A2-32 [User Parameter 1 to 32]*

Note:

- Usually, the keypad will not show *A1-05*. To show and set *A1-05*, show *A1-04 [Password]* and then push STOP and ▼ on the keypad at the same time.
- Once *A1-05* is set, *A1-05* is not shown again unless the correct password is entered in *A1-04*. Make sure that you remember the *A1-05* setting value. Contact Yaskawa or your nearest sales representative in case of forgetting the *A1-05* setting value.
- When *A1-03 = 2220 [2-Wire Initialization]*, the drive is initialized to *A1-05 = 0000*. Be sure to set the password again for applications that require a password.
- Change the setting value in *A1-05* to change the password. The new setting value becomes the new password.
- To lock the parameter again with the same password after unlocking the parameter with the password and changing the parameter, enter a value other than the password such as *0000* in *A1-04*.
- If *A1-04* ≠ *A1-05*, MEMOBUS Communication cannot read or write *A1-05*.

■ A1-06: Application Preset

WARNING! *Sudden Movement Hazard. Check the I/O signals and the external sequences for the drive before you set the Application Preset function. When you set the Application Preset function (A1-06 ≠ 0), it changes the I/O terminal functions for the drive and it can cause equipment to operate unusually. This can cause serious injury or death.*

No. (Hex.)	Name	Description	Default (Range)
A1-06 (0127)	Application Preset	V/f CL-V/f OLV CLV AOLV Sets the drive to operate in selected application conditions.	0 (0 - 3)

The drive software contains the application presets shown below. Set *A1-06* to align with the application to let the drive automatically set the best parameter settings for the selected application. The drive saves parameters frequently used for the application in parameters *A2-01 to A2-16 [User Parameters 1 to 16]* for easy configuration and reference in [User Custom Parameters] in the main menu.

- Crane (Hoist)
- Crane (Traveling)
- Closed Loop Crane (Hoist)

Note:

- Before you set *A1-06*, make sure that you set *A1-03 = 2220 [Initialize Parameters = 2-Wire Initialization]* to initialize parameters.
- Make sure that you do Auto-Tuning after you set *A1-06* for a hoist application.
- It is not possible to change the *A1-06* value. To set an application preset, set *A1-03 = 2220* to initialize parameters, then set this parameter. If initializing all parameters will cause a problem, do not change the settings.
  If you set *A2-33 = 1 [User Parameter Auto Selection = Enabled: Auto Save Recent Parms]* to set parameters to *A2-17 to A2-32 [User Parameters 17 to 32]* automatically, the drive will reset these parameters when you change the *A1-06* setting.

0 : General-purpose

The drive saves these parameters as user parameters.

Table 11.1 Parameters Saved as User Parameters with the General Preset

User Parameter No.	Parameter No. Saved	Name
A2-01	A1-02	Control Method Selection
A2-02	b1-01	Frequency Reference Selection 1
A2-03	b1-02	Run Command Selection 1
A2-04	b1-03	Stopping Method Selection
A2-05	C1-01	Acceleration Time 1
A2-06	C1-02	Deceleration Time 1
A2-07	C6-02	Carrier Frequency Selection
A2-08	d1-01	Reference 1
A2-09	d1-02	Reference 2
A2-10	d1-03	Reference 3
A2-11	d1-04	Reference 4
A2-12	d1-17	Jog Reference
A2-13	E1-01	Input AC Supply Voltage
A2-14	E1-03	V/f Pattern Selection
A2-15	E1-04	Maximum Output Frequency
A2-16	E1-05	Maximum Output Voltage
A2-17	E1-06	Base Frequency
A2-18	E1-09	Minimum Output Frequency
A2-19	E1-13	Base Voltage
A2-20	E2-01	Motor Rated Current (FLA)
A2-21	E2-04	Motor Pole Count
A2-22	E2-11	Motor Rated Power
A2-23	H4-02	Terminal FM Analog Output Gain
A2-24	L1-01	Motor Overload (oL1) Protection
A2-25	L3-04	Stall Prevention during Decel

1 : Crane (Hoist)

The drive automatically sets these parameters for a hoist application.

Note:

Make sure that you do Auto-Tuning after you set *A1-06* for a hoist application. Refer to *Notes when Opening and Closing the Brake Without the Crane Sequence on page 577* for hoist (elevator) instructions.

Table 11.2 Best Parameter Settings for Hoist Applications

No.	Name	Optimal Value
A1-02	Control Method Selection	2: Open Loop Vector
b1-01	Frequency Reference Selection 1	0: Keypad
C1-01	Acceleration Time 1	3.0 s
C1-02	Deceleration Time 1	3.0 s
C1-09	Fast Stop Time	2.0 s
d1-01	Reference 1	5.00 Hz
d1-02	Reference 2	25.00 Hz
d1-03	Reference 3	50.00 Hz
E1-03	V/f Pattern Selection	F: Custom
H2-01	Term M1-M2 Function Selection	21: Brake Release Command
H2-02	Term M3-M4 Function Selection	1: Zero Speed
H3-06	Terminal A3 Function Selection	F: Not Used (Through Mode)
L2-03	Minimum Baseblock Time	0.1 s

No.	Name	Optimal Value
L3-04	Stall Prevention during Decel	0: Disabled
L4-01	Speed Agree Detection Level	0.0 Hz
L4-02	Speed Agree Detection Width	0.0 Hz
L8-05	Input Phase Loss Protection Sel	1: Enabled
L8-07	Output Phase Loss Protection Sel	1: Fault when One Phase is Lost
L8-38	Carrier Frequency Reduction	1: Enabled below 6 Hz
L8-41	High Current Alarm Selection	1: Enabled
S1-01	Brake Release Frequency (FWD)	3.0 Hz
S1-02	Brake Release Frequency (REV)	2.0 Hz
S1-03	Brake Delay Frequency	3.0 Hz
S1-04	Brake Delay Time	0.30 s
S1-09	Torque Compensation (FWD)	50%
S1-12	Brake Hold Frequency (FWD)	3.0 Hz
S1-13	Brake Hold Frequency (REV)	3.0 Hz
S1-14	Slip Prevention Frequency	3.0 Hz
S1-15	Slip Prevention Time	0.30 s
S1-16	Sequence Fault SE1 Detect Time	0.30 s
S1-17	Sequence Fault SE2 Detect Time	1.00 s
S1-18	Sequence Fault SE3 Detect Time	0.50 s
S1-19	Sequence Fault SE4 Detect Time	0.50 s
S1-54	Brake Sequence Selection	1: Enabled

The drive saves these parameters as user parameters.

Table 11.3 Parameters Saved as User Parameters with the Hoist Preset

User Parameter No.	Parameter No. Saved	Name
A2-01	A1-02	Control Method Selection
A2-02	b1-01	Frequency Reference Selection 1
A2-03	C1-01	Acceleration Time 1
A2-04	C1-02	Deceleration Time 1
A2-05	d1-01	Reference 1
A2-06	d1-02	Reference 2
A2-07	d1-03	Reference 3
A2-08	E1-08	Mid Point A Voltage
A2-09	H2-01	Term M1-M2 Function Selection
A2-10	L1-01	Motor Overload (oL1) Protection
A2-11	L4-01	Speed Agree Detection Level

2 : Crane (Traveling)

The drive automatically sets these parameters for a traveling application.

Table 11.4 Optimal Settings for Traveling Applications

No.	Name	Optimal Value
A1-02	Control Method Selection	0: V/f Control
b1-01	Frequency Reference Selection 1	0: Keypad
C1-01	Acceleration Time 1	3.0 s
C1-02	Deceleration Time 1	3.0 s
C1-09	Fast Stop Time	2.0 s
d1-01	Reference 1	5.00 Hz

No.	Name	Optimal Value
d1-02	Reference 2	25.00 Hz
d1-03	Reference 3	50.00 Hz
H1-05	Terminal S5 Function Selection	3: Multi-Step Speed Reference 1
H1-06	Terminal S6 Function Selection	4: Multi-Step Speed Reference 2
H2-01	Term M1-M2 Function Selection	0: During Run
H2-02	Term M3-M4 Function Selection	37: During Frequency Output
H3-06	Terminal A3 Function Selection	F: Not Used (Through Mode)
L3-04	Stall Prevention during Decel	0: Disabled
L8-05	Input Phase Loss Protection Sel	1: Enabled
L8-07	Output Phase Loss Protection Sel	1: Fault when One Phase is Lost
L8-38	Carrier Frequency Reduction	1: Enabled below 6 Hz
L8-41	High Current Alarm Selection	1: Enabled
S1-01	Brake Release Frequency (FWD)	0.0 Hz
S1-02	Brake Release Frequency (REV)	0.0 Hz
S1-03	Brake Delay Frequency	0.0 Hz
S1-04	Brake Delay Time	0.00 s
S1-12	Brake Hold Frequency (FWD)	0.0 Hz
S1-13	Brake Hold Frequency (REV)	0.0 Hz
S1-14	Slip Prevention Frequency	0.0 Hz
S1-15	Slip Prevention Time	0.00 s
S1-16	Sequence Fault SE1 Detect Time	0.00 s
S1-17	Sequence Fault SE2 Detect Time	0.00 s
S1-18	Sequence Fault SE3 Detect Time	0.00 s
S1-19	Sequence Fault SE4 Detect Time	0.00 s
S1-54	Brake Sequence Selection	0: Disabled

The drive saves these parameters as user parameters.

Table 11.5 Parameters Saved as User Parameters with the Traveling Preset

User Parameter No.	Parameter No. Saved	Name
A2-01	b1-01	Frequency Reference Selection 1
A2-02	C1-01	Acceleration Time 1
A2-03	C1-02	Deceleration Time 1
A2-04	d1-01	Reference 1
A2-05	d1-02	Reference 2
A2-06	d1-03	Reference 3
A2-07	E2-01	Motor Rated Current (FLA)
A2-08	H1-05	Terminal S5 Function Selection
A2-09	H1-06	Terminal S6 Function Selection
A2-10	H2-01	Term M1-M2 Function Selection
A2-11	L1-01	Motor Overload (oL1) Protection

3 : Closed Loop Crane (Hoist)

The drive automatically sets these parameters for a closed loop crane (hoist) application.

Table 11.6 Optimal Settings for Closed Loop Crane (Hoist) Applications

No.	Name	Optimal Value
A1-02	Control Method Selection	3: Closed Loop Vector (CLV)
b1-01	Frequency Reference Selection 1	0: Keypad

No.	Name	Optimal Value
C1-01	Acceleration Time 1	3.0 s
C1-02	Deceleration Time 1	3.0 s
C1-09	Fast Stop Time	2.0 s
d1-01	Reference 1	5.00 Hz
d1-02	Reference 2	25.00 Hz
d1-03	Reference 3	50.00 Hz
E1-03	V/f Pattern Selection	F: Custom
F1-05	Encoder 1 Rotation Selection	1: A pulse leads with Forward run command
H2-01	Term M1-M2 Function Selection	21: Brake Release Command
H2-02	Term M3-M4 Function Selection	1: Zero Speed
H3-06	Terminal A3 Function Selection	F: Not Used (Through Mode)
L2-03	Minimum Baseblock Time	0.1 s
L3-04	Stall Prevention during Decel	0: Disabled
L8-05	Input Phase Loss Protection Sel	1: Enabled
L8-07	Output Phase Loss Protection Sel	1: Fault when One Phase is Lost
L8-38	Carrier Frequency Reduction	1: Enabled below 6 Hz
L8-41	High Current Alarm Selection	1: Enabled
S1-01	Brake Release Frequency (FWD)	0.0 Hz
S1-02	Brake Release Frequency (REV)	2.0 Hz
S1-03	Brake Delay Frequency	0.0 Hz
S1-04	Brake Delay Time	0.00 s
S1-09	Torque Compensation (FWD)	0%
S1-12	Brake Hold Frequency (FWD)	3.0 Hz
S1-13	Brake Hold Frequency (REV)	3.0 Hz
S1-14	Slip Prevention Frequency	0.0 Hz
S1-15	Slip Prevention Time	0.00 s
S1-16	Sequence Fault SE1 Detect Time	0.30 s
S1-17	Sequence Fault SE2 Detect Time	1.00 s
S1-18	Sequence Fault SE3 Detect Time	0.50 s
S1-19	Sequence Fault SE4 Detect Time	0.50 s
S1-54	Brake Sequence Selection	1: Enabled

Table 11.7 Parameters Saved as User Parameters with the Closed Loop Crane (Hoist) Preset

User Parameter No.	Parameter No. Saved	Name
A2-01	b1-01	Frequency Reference Selection 1
A2-02	b2-01	DC Injection/Zero SpeedThreshold
A2-03	C1-01	Acceleration Time 1
A2-04	C1-02	Deceleration Time 1
A2-05	d1-01	Reference 1
A2-06	d1-02	Reference 2
A2-07	d1-03	Reference 3
A2-08	F1-01	Encoder 1 Pulse Count (PPR)
A2-09	F1-05	Encoder 1 Rotation Selection
A2-10	L1-01	Motor Overload (oL1) Protection

■ Notes when Opening and Closing the Brake Without the Crane Sequence

When you open or close the brake without the crane sequence, read the safety descriptions and precautions carefully, and use the drive safely and correctly.

Conditions to Open and Close the Brake

Set *L4-07 = 0 [Speed Agree Detection Selection = No Detection during Baseblock]* to open and close the holding brake.

When *L4-07 = 1 [Detection Always Enabled]*, the output frequency increases when you input the Run command although the external baseblock command is input. Because of this, speed detection operates and will open the brake signal.

- Set Related Parameters
  The table below shows examples of parameter settings to use the MFDO terminal (M1-M2) as the holding brake open and close signal.

Table 11.8 Holding Brake Open and Close Signal Setting Example

Brake Open and Close Signal		Brake Open and Close Level Adjust		Applicable Control Method (A1-02 Setting)			
Signal Name	Parameter Settings	Signal Name	Parameter Settings	V/f (0)	OLV (2)	CLV (3)	AOLV (4)
Frequency (FOUT) Detection 2	L4-07 = 0	Speed Agree Detection Level	L4-01 = 1.0 Hz to 3.0 Hz *1	x	x	-	x
	H2-01 = 5	Speed Agree Detection Width	L4-02 = 0.0 Hz to 0.5 Hz *2				
During Frequency Output	H2-01 = 37	DC Injection/Zero SpeedThreshold	b2-01 = 0.1 Hz to 0.5 Hz	-	-	x	-

*1 When *A1-02 = 2 [Open Loop Vector]*, it is the usual setting range. When *A1-02 = 0 [V/f Control]*, set *L4-01* to the rated slip frequency of the motor + approximately 0.5 Hz. If you set the value too low, motor torque will not be sufficient and it will cause motor rollback. Be sure to set the setting value to agree with these two conditions at the same time. However, if the setting value is too high, shock will likely occur during start up.

- L4-01 > E1-09 [Minimum Output Frequency]
- L4-01 > L4-02 [Speed Agree Detection Width]

*2 The detection width of Frequency Detection 2 can be adjusted with *L4-02*. If rollback occurs when the motor is stopped, change the frequency to approximately 0.1 Hz.

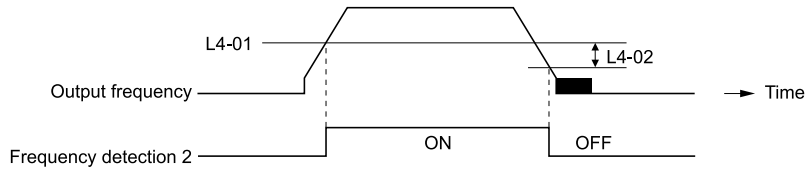


Figure 11.1 Frequency Detection 2

Sequence Circuit Configuration

Set the circuit for the open/close sequence of the holding brake as follows.

- Set the sequence which opens the holding brake by turning terminal M1-M2 on when the sequence side operation conditions are met.
- Set the sequence so that the holding brake will be firmly closed when a fault signal is detected in the event of an emergency.
- If a raise or lower command is entered, set the sequence so that the holding brake will be open.

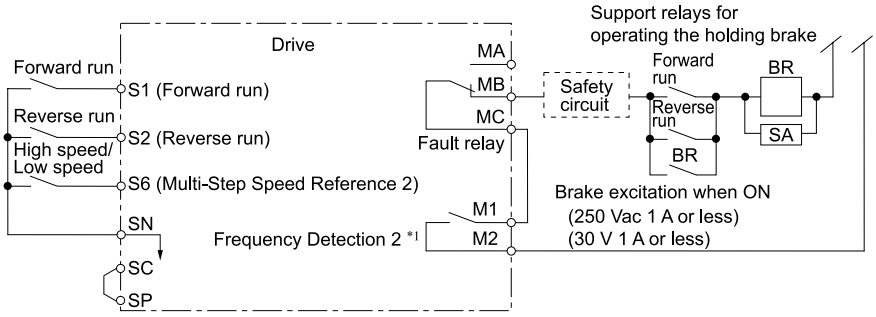


Figure 11.2 Sequence Circuit Configuration Diagram

*1 *L4-07 = 0 [Speed Agree Detection Selection = No Detection during Baseblock]* or During Frequency Output

Time Chart

This time chart shows the open/close sequence of the holding brake.

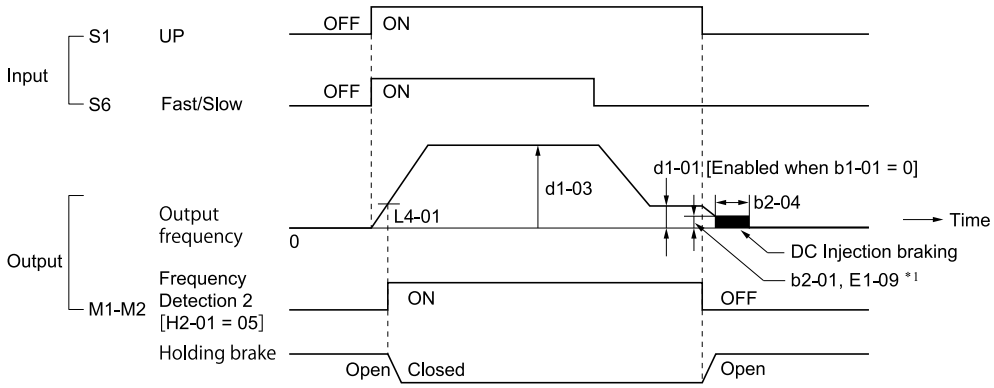


Figure 11.3 Holding Brake Open and Close Sequence Time Chart (V/f, CL-V/f, OLV)

*1 Start braking from higher set frequency between *b2-01 [DC Injection/Zero SpeedThreshold]* or *E1-09 [Minimum Output Frequency]*.

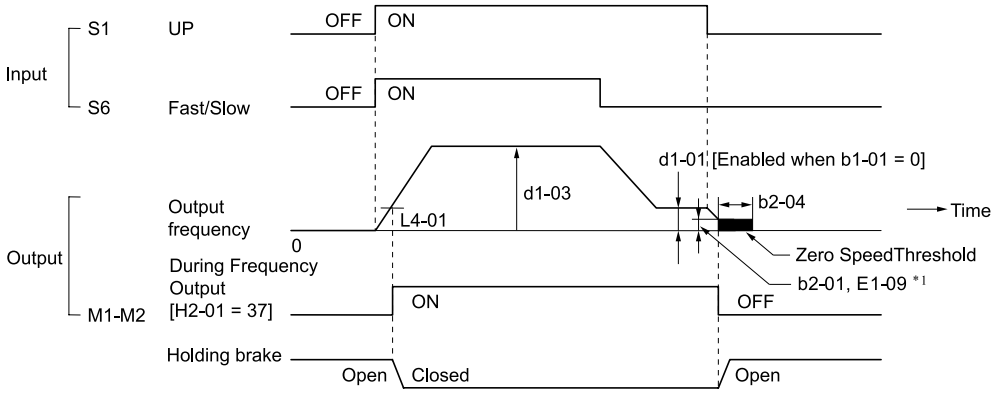


Figure 11.4 Holding Brake Open and Close Sequence Time Chart (CLV)

*1 Start braking from higher set frequency between *b2-01 [DC Injection/Zero SpeedThreshold]* or *E1-09 [Minimum Output Frequency]*.

Notes on When Using Other Functions

Function	Notes
Decel Stall Prevention Function	When you connect a braking resistor to discharge the regenerative power to the drive, keep *L3-04 = 0 [Stall Prevention during Decel = Disabled]*. **Note:** If *L3-04 = 1 [General Purpose]*, it is possible that the drive will not stop in the set deceleration time. Do not change the default settings of these related parameters: • *L3-01 = 1 [Stall Prevention during Accel = Enabled]* • *L3-05 = 1 [Stall Prevention during RUN = Deceleration Time 1 (C1-02)]*
Auto-Tuning for Induction Motors	• When *A1-02 = 2, 3, or 4 [Control Method Selection = Open Loop Vector, Closed Loop Vector, or Advanced Open Loop Vector]*, Auto-Tune the motor before you operate the drive. • Disconnect the drive from the motor to do Rotational Auto-Tuning. • Auto-Tuning runs automatically for approximately 1 minute. Do not do Auto-Tuning with the motor engaged in the elevator system. **Note:** • If you cannot disconnect the motor from the machine, do Stationary Auto-Tuning. When you do Stationary Auto-Tuning, the drive energizes the motor and the motor stays stopped. During this time, the drive automatically measures the necessary motor data. If the motor test report or the motor nameplate is not available, use Stationary Auto-Tuning. • Do Stationary Auto-Tuning for Line-to-Line Resistance for better torque characteristics at low speeds in the V/f Control mode • To Auto-Tune a specialized motor, for example a wound motor, prepare a motor test report before Auto-Tuning and make sure that the motor parameter *E2-xx* is not too different than the value in the test report.
Braking Resistor Overheat Protection	When you use a braking resistor other than the optional Yaskawa braking resistor unit (LKEB-series), use the thermal overload relay to detect braking resistor overheat. Load a sequence program that cuts the drive input power supply when the braking resistor overheats. **Note:** When you load the sequence circuit, refer to “Standard Connection Diagrams”.
Torque Limit Function	The *L7-01 to L7-04 [Torque Limit]* value is based on the motor rated torque. When torque will likely be insufficient during startup, replace the drive with a large capacity drive and adjust the torque limit between 200% and 300%. The *L7-01 to L7-04* default setting is 200%.

Function	Notes
I/O phase loss protection, overtorque detection function	To prevent falls due to phase loss, set the following relevant parameters. • *L8-05 = 1 [Input Phase Loss Protection Sel = Enabled]* • *L8-07 = 1 [Output Phase Loss Protection Sel = Fault when one phase is lost]* • *S6-01 and S6-04 = 1 to 6 [OverT Detect Operation Select = Enabled]* • *S6-02 and S6-05 [Overtorque Detection Level 1/2]* • *S6-03 and S6-06 [Overtorque Detection Time 1/2]* **Note:** Execute safety measures such as fall detection on the machine side.
External baseblock command	• If the external baseblock signal set in *H1-01 to H1-10 = 8 or 9 [Terminal S1 to S10 Function Selection = Baseblock Command]* is entered during run, the motor immediately coasts to stop. Do not enter an unnecessary external baseblock command while the motor is operating. • When using an external baseblock command for the fast stop and operation startup interlocks, load the sequence which firmly locks the holding brake while the external baseblock command is entered. • When the external baseblock command is immediately removed after it is entered, the drive will not output the voltage within the time set in *L2-03 [Minimum Baseblock Time]*. Do not use an external baseblock command for applications involving frequent Run/Stop execution.
Accel & Decel Time	If the acceleration and deceleration times for the drive side are set short without factoring the mechanical operation delay time of the holding brake, the holding brake could operate late, or could experience overcurrent at startup, brake grinding and rollback when stopping. In this case, consider using a brake sequence. Parameters used to adjust holding brake timing are available.
Electromagnetic contactor on the drive output side	Usually you must not install the electromagnetic contactor between the drive and motor. When you must install an electromagnetic contactor to use one drive to switchover more than one motor, follow these precautions: • Load a sequence that opens and closes the electromagnetic contactor when both of the following conditions are satisfied at once. Unless there is an emergency. – The holding brake is fully closed – The drive terminals for *H2-xx = 8 or 1B [MFDO Function Selection = During Baseblock]* are ON • If the electromagnetic contactor is opened and closed during motor control or during DC Injection Braking (or zero speed control), fault detections may occur due to the effects of the surge voltage and the motor direct input current. • When you install the electromagnetic contactor between the drive and the motor, set *L8-07 = 1 or 2 [Output Phase Loss Protection Sel = Fault when one phase is lost or Fault when two phases are lost]*.

S-Curve Characteristics, Accel & Decel Time

Adjustment Parameter	Name
C1-01, C1-03, C1-05, C1-07	Acceleration Time 1 to 4
C1-02, C1-04, C1-06, C1-08	Deceleration Time 1 to 4
C2-01	S-Curve Time @ Start of Accel
C2-02	S-Curve Time @ End of Accel
C2-03	S-Curve Time @ Start of Decel
C2-04	S-Curve Time @ End of Decel

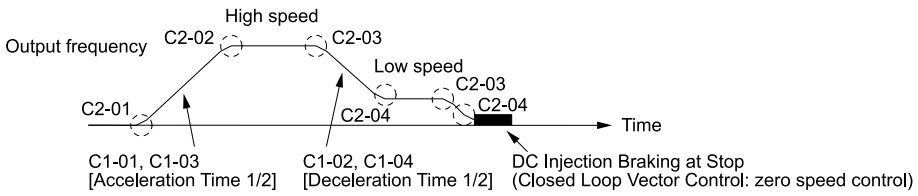


Figure 11.5 S-curve Characteristics, Accel & Decel Time

Note:
- When decreased operation times are necessary for the application, for example with cranes and hoists, do not use S-curve characteristic times.
- The default setting for *C2-04 [S-Curve Time @ End of Decel]* will be 0.00 seconds. The default setting for other S-curve characteristics will be 0.20 seconds. Set the acceleration/deceleration times and S-curve characteristic time correctly for acceleration/deceleration start up and end. The recommended setting of the S-curve characteristics time is 0.2 to 1.0 seconds.
- When you use the *C1-11 [Accel/Decel Time Switchover Freq]*, you can switch the acceleration/deceleration rate automatically during acceleration/deceleration. The default setting is disabled.
  When the Output Frequency ≥ *C1-11*, operate at the acceleration and deceleration times set in *C1-01* and *C1-02*
  When the Output Frequency < *C1-11*, operate at the acceleration and deceleration times set in *C1-07* and *C1-08*
- During low speed operation, if the Output Frequency < *E1-09 [Minimum Output Frequency]* in the S-Curve Time @ Start of Decel, the drive will cancel the S-curve characteristics and will do DC Inject Braking at Stop (zero speed control).

DC Injection Braking at Stop, Zero Speed Control Function

Note:

If you must disconnect the drive from the motor when you stop the elevator, make sure that you fully close the holding brake and disconnect the drive during baseblock (i.e., while the baseblock signal is ON). This is not applicable in emergencies. If you disconnect the drive from the motor when the drive is controlling the motor or during DC Injection Braking (Zero speed level), a voltage surge can trigger a fault. When you use an electromagnetic contactor between the drive and motor, set *L8-07 = 1 or 2 [Output Phase Loss Protection Sel = Fault when one phase is lost, Fault when two phases are lost]*.

Adjustment Parameter	Name
b2-01	DC Injection/Zero SpeedThreshold
b2-02	DC Injection Braking Current
b2-04	DC Inject Braking Time at Stop
H2-xx = 5	Frequency Detection 2

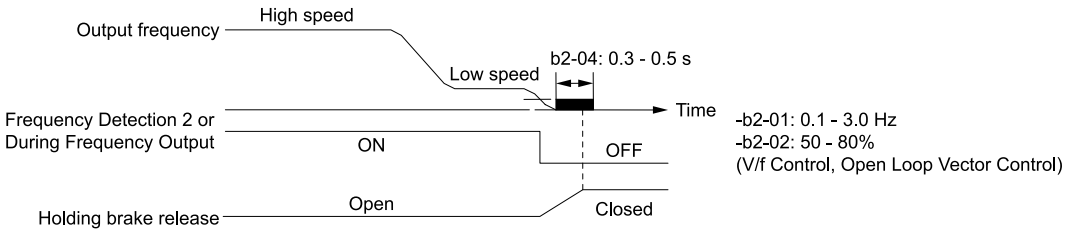


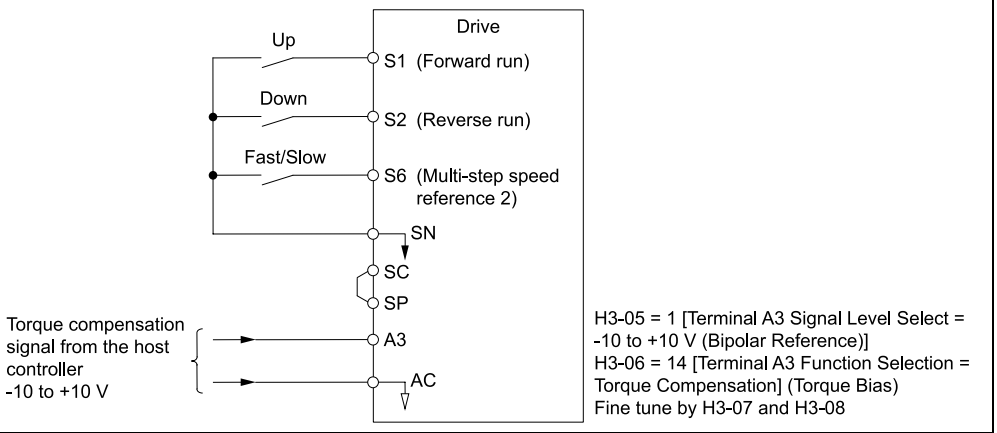
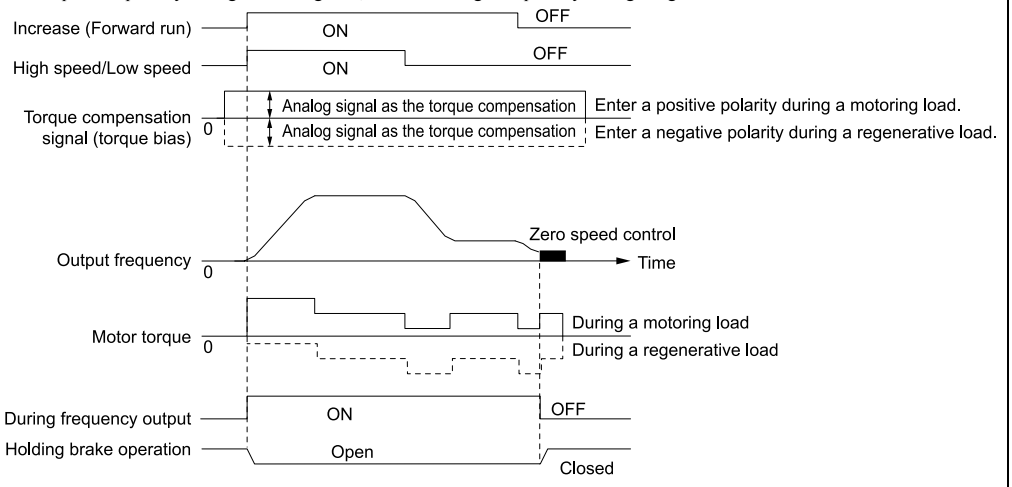
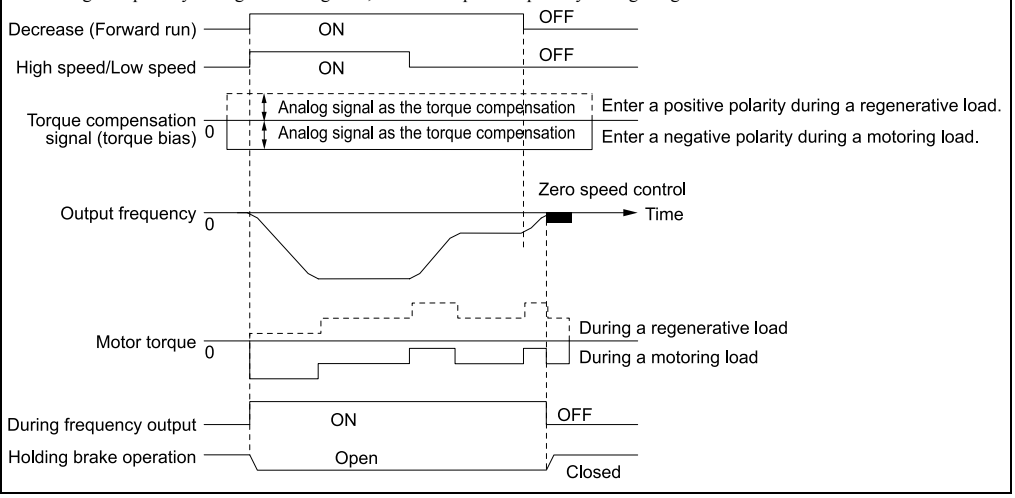
Figure 11.6 DC Injection Braking at Stop, Zero Speed Control Function

Note:

If the mechanical operation of the holding brake is slow, use DC Injection Braking (zero speed control when set to Closed Loop Vector) until the brake is fully closed to prevent rollback.

Torque Compensation (Torque Bias)

This function allows the shock from opening and closing the holding brake to be decreased by entering the torque compensation (torque bias) signal that matches a predefined load from the MFAI terminal while in CLV control. Detection of the load and motoring/regeneration on the machine side must be done beforehand. If there is a polarity error, shock may increase in some circumstances.

Item	Description
Sequence Circuit Configuration	
Time chart: Increase	Enter the analog signal as the torque compensation (torque bias) signal in accordance with load amount prior to running the drive up till drive operation completes. The default setting is 10 V/100% torque. Enter a positive polarity during a motoring load, and enter a negative polarity during a regenerative load. 
Time chart: Decrease	In the same manner as an increase, enter the analog signal as the torque compensation (torque bias) signal in accordance with load amount before running the drive up to when it finishes running. The default setting is 10 V/100% torque. Enter a negative polarity during a motoring load, and enter a positive polarity during a regenerative load. 

Note:

- Holds via an external source so that the torque compensation signal does not change during run. If the torque compensation signal is changed during run, the motor may produce oscillation.
- When motor reverse is set to the increase command and motor forward is set to the decrease command, the polarity of the torque compensation signal will reverse.

Analog Input FilterTime Constant

When *b1-01 = 1 [Frequency Reference Selection 1 = Analog Input]*, it adds noise to the analog frequency reference during run.

- Minimize the effects of noise.
- Change *H3-13 [Analog Input FilterTime Constant]* to a range of 0.01 s to 0.10 s.

Startup Current Check

When you do a test run, set *L8-41 =1 [High Current Alarm Selection = Enabled]* and use *U4-13 [Peak Hold Current]* and a clamp ammeter with the machine under load and not under load to check the motor current during start up.

If the motor torque is not sufficient during start up or if the timing between the motor and the holding brake is unsatisfactory and causes the motor to lock, a large quantity of current will flow. In these conditions, adjust the parameters again and decrease the load to decrease the current to less than 150%. If the current flow is more than 150% of the drive rated current, the heat stress on the IGBTs will decrease the service life of drive parts.

To decrease the effects of heat stress, decrease the carrier frequency of the drive to 2.0 kHz to 2.5 kHz for applications where low audible noise is not necessary.

■ A1-11: Firmware Update Lock

No. (Hex.)	Name	Description	Default (Range)
A1-11 (111D) Expert	Firmware Update Lock	V/f CL-V/f OLV CLV AOLV Protects the drive firmware. When you enable the protection, you cannot update the drive firmware.	0 (0, 1)

0 : Disabled

Lock is disabled.

1 : Enabled

Lock is enabled.

■ A1-12: Bluetooth ID

No. (Hex.)	Name	Description	Default (Range)
A1-12 (1564)	Bluetooth ID	V/f CL-V/f OLV CLV AOLV Sets the password necessary to use Bluetooth to control the drive with a smartphone or tablet.	1915 (0000 - 9999)

■ A1-13: All Function Parameter Display

No. (Hex.)	Name	Description	Default (Range)
A1-13 (156F)	All Function Parameter Display	V/f CL-V/f OLV CLV AOLV Shows and hides applicable parameters.	1 (0, 1)

0 : Disabled

1 : Enabled

◆ A2: User Parameters

You can register frequently used parameters and recently changed parameters here to access them quickly. You can show the registered parameters in [User Custom Parameters] in the main menu.

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

No. (Hex.)	Name	Description	Default (Range)
A2-01 to A2-32 (0106 - 0125)	User Parameters 1 to 32	V/f CL-V/f OLV CLV AOLV The user can select up to 32 parameters for the drive and assign them to parameters *A2-01 to A2-32*. The [User Parameters] section of the keypad main menu shows the set parameters. You can immediately access these saved parameters.	Determined by A1-06 (A1-00 to S-xx)

Note:

- Settings for *A2-01 to A2-32* vary depending on the value selected for *A1-06 [Application Preset]*.
- You must set *A1-01 = 1 [Access Level Selection = User Parameters]* to access parameters *A2-01 to A2-32*.

The drive saves these parameters to *A2-01 to A2-32*.

- The drive saves a maximum of 32 parameters.

  Note:
  Set *A1-01 = 2 [Advanced Level]* or *A1-01 = 3 [Expert Level]* to register the necessary parameters.

- The drive automatically saves changed parameters to *A2-17 to A2-32*.

  Note:
  Set *A2-33 = 1 [User Parameter Auto Selection = Enabled: Auto Save Recent Parms]*.

■ A2-33: User Parameter Auto Selection

No. (Hex.)	Name	Description	Default (Range)
A2-33 (0126)	User Parameter Auto Selection	V/f CL-V/f OLV CLV AOLV Sets the automatic save feature for changes to parameters *A2-17 to A2-32 [User Parameters 17 to 32]*.	1 (0, 1)

0 : Disabled: Manual Entry Required

Set User Parameters manually.

1 : Enabled: Auto Save Recent Parms

The drive automatically registers any parameters that are changed to *A2-17 to A2-32*. The drive automatically saves the most recently changed parameter to *A2-17*, and saves a maximum of 16 parameters. Once 16 parameters have been registered, the drive will start to remove old parameters from the User Parameter list.

Registered parameters can be shown in [User Custom Parameters] under the main menu.

Note:

In General-Purpose Setup Mode, the drive registers parameters starting from *A2-27* since parameters up to *A2-26* are already registered by default.

11.3 b: Application

b parameters set these functions.

- Frequency reference source/Run command source
- Stopping method settings
- DC Injection Braking
- Droop Control
- Zero Servo Control

◆ b1: Operation Mode Selection

b1 parameters set the operation mode for the drive.

■ b1-01: Frequency Reference Selection 1

No. (Hex.)	Name	Description	Default (Range)
b1-01 (0180)	Frequency Reference Selection 1	V/f CL-V/f OLV CLV AOLV Sets the input method for the frequency reference.	0 (0 - 3)

Note:
- The RUN light on the keypad will flash if the Run command is entered when the frequency reference is 0 Hz or below the value set in *E1-09 [Minimum Output Frequency]*. Examine the setting for the frequency reference input and enter a value more than or equal to the *E1-09* value.

0 : Keypad

Use the keypad to enter the frequency reference.

The frequency reference can be changed by using ∧ and ∨ on the keypad.

1 : Digital Input

Use the MFAI terminals A1, A2, and A3 to input an analog frequency reference with a voltage or current input signal.

- Voltage Input
  Refer to this table to use a voltage signal input to one of the MFAI terminals.

Table 11.9 Frequency Reference Voltage Input

Terminal	Terminal Signal Level	Parameter Settings				Note
		Signal Level Selection	Function Selection	Gain	Bias	
A1	0 - 10 V	H3-01 = 0	H3-02 = 0 [Frequency Reference]	H3-03	H3-04	-
	-10 - 10 V	H3-01 = 1				
A2	0 - 10 V	H3-09 = 0	H3-10 = 0 [Frequency Reference]	H3-11	H3-12	Set DIP switch S1 to "V" for voltage input.
	-10 - 10 V	H3-09 = 1				
A3	0 - 10 V	H3-05 = 0	H3-06 = 0 [Frequency Reference]	H3-07	H3-08	Set DIP switch S4 to "AI" for analog input.
	-10 - 10 V	H3-05 = 1				

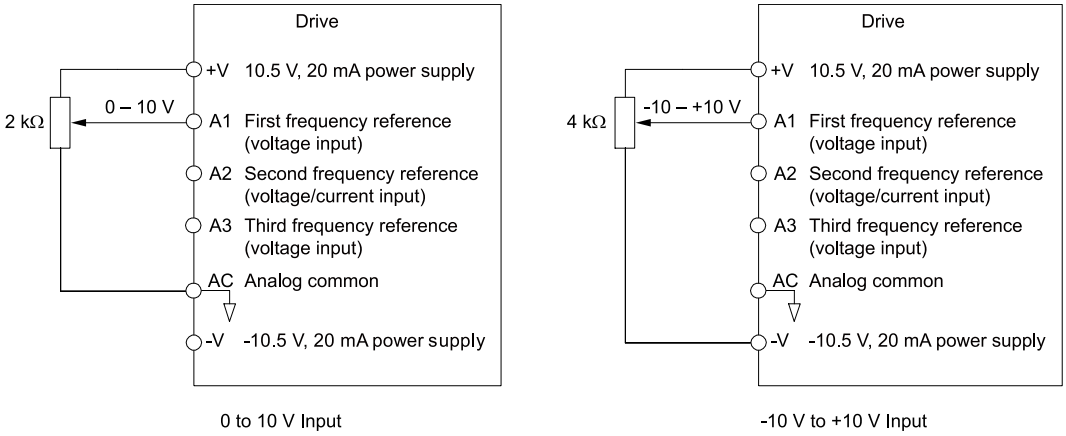


Figure 11.7 Example of Setting the Frequency Reference with a Voltage Signal to Terminal A1

Note:
Use this diagram also when wiring terminals A2 and A3.

- Current Input
  Refer to this table to use a current signal input to one of the MFAI terminals.

Terminal	Signal Level	Parameter Settings				Note
		Signal Level Selection	Function Selection	Gain	Bias	
A2	4 mA to 20 mA	H3-09 = 2	H3-10 = 0 [Frequency Reference]	H3-11	H3-12	Set DIP switch S1 to "I" for current input.
	0 - 20 mA	H3-09 = 3				

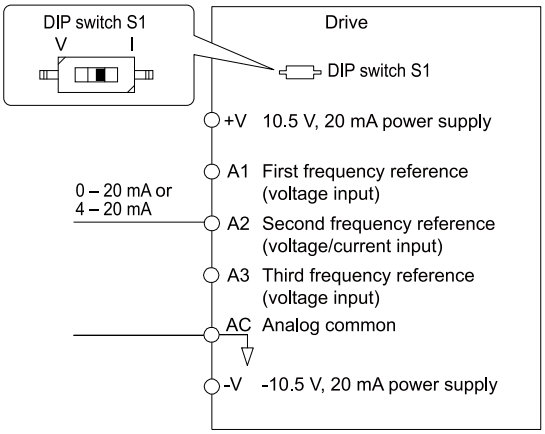


Figure 11.8 Example of Setting the Frequency Reference with a Current Signal to Terminal A2

Switching between master/auxiliary frequency references

The user can switch frequency reference input between terminals A1, A2, and A3 using the multi-step speed reference function.

2 : Memobus/Modbus Communications

Enter the frequency reference by using MEMOBUS/Modbus communications.

3 : Option PCB

Use a communications option card or input option card connected to the drive to enter the frequency reference.

Refer to the instruction manual included with the option card for installing and setting the option card.

Note:
If *b1-01 = 3* but no connected option card, then *oPE05 [Run Cmd/Freq Ref Source Sel Err]* will flash on the keypad.

■ b1-02: Run Command Selection 1

No. (Hex.)	Name	Description	Default (Range)
b1-02 (0181)	Run Command Selection 1	V/f CL-V/f OLV CLV AOLV Sets the input method for the Run command.	1 (0 - 3)

0 : Keypad

Use the keypad to enter the Run command.

You can use the JOG operation or the FWD/REV commands from the keypad.

Note:
LO/RE will illuminate when the keypad is the Run command source.

1 : Digital Input

Use the control circuit terminals to enter the Run command. Select the input method for the Run command with a parameter. Set *H1-xx = 40 or 41 [Forward RUN/Reverse RUN (2-Wire)]*.

- 2-Wire Sequence
  This sequence has two input types: FWD/Stop and REV/Stop. Setting *A1-03 = 2220 [Initialize Parameters = 2-Wire Initialization]* and initializing the drive sets terminals S1 and S2 for a 2-wire sequence.

2 : Memobus/Modbus Communications

Use MEMOBUS/Modbus communications to enter the Run command.

3 : Option PCB

Use a communications option card or input option card connected to the drive to enter the Run command.

Refer to the instruction manual included with the option card to install and set the option card.

Note:

If *b1-02 = 3* but no connected option card, then *oPE05 [Run Cmd/Freq Ref Source Sel Err]* will flash on the keypad.

■ b1-03: Stopping Method Selection

No. (Hex.)	Name	Description	Default (Range)
b1-03 (0182)	Stopping Method Selection	V/f CL-V/f OLV CLV AOLV Sets the method to stop the motor after removing a Run command or entering a Stop command.	0 (0 - 3)

Note:

The setting range is 0, 1, and 3 when *A1-02 = 3, 4 [Control Method Selection = Closed Loop Vector, Advanced Open Loop Vector]*.

Select the appropriate stopping method for the application from the following four options.

0 : Ramp to Stop

The drive decelerates the motor to stop when the Stop command is entered (or when the Run command is switched OFF).

The drive ramps the motor to stop according to the deceleration time. The default setting for the deceleration time is *C1-02 [Deceleration Time 1]*. The actual deceleration time will vary depending on load conditions, such as mechanical loss and inertia.

If the output frequency falls below or is equal to the value set in *b2-01 [DC Injection/Zero SpeedThreshold]* during deceleration, then the drive will perform DC Injection Braking, or Zero Speed Control, depending on the control mode.

- Ramp to stop with V/f control, Advanced Open Loop Vector Control, Closed Loop V/f Control, Open Loop Vector Control Mode
  Parameter *b2-01* sets the frequency to begin DC Injection Braking at stop. If the output frequency falls below or is equal to the value set in *b2-01* during deceleration, then the drive will perform DC Injection Braking for the time set in *b2-04 [DC Inject Braking Time at Stop]*.

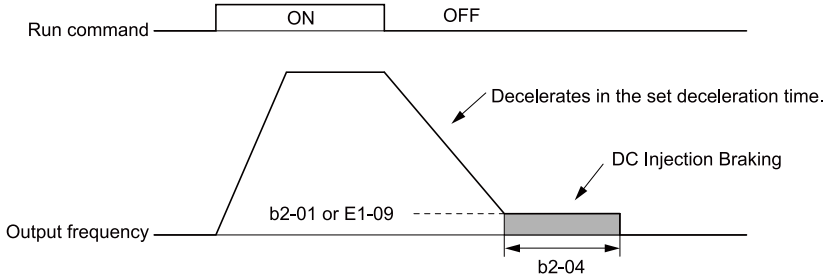


Figure 11.9 Ramping to Stop in V/f, CL-V/f, or OLV

Note:

The drive will begin DC Injection Braking from the frequency set in *E1-09 [Minimum Output Frequency]* if *b2-01 ≤ E1-09*.

- Ramping to Stop in Closed Loop Vector Control
  Parameter *b2-01* sets the frequency to begin Zero Speed Control at stop. If the output frequency falls below or is equal to the value set in *b2-01* during deceleration, then the drive will perform Zero Speed Control for the time set in *b2-04*.

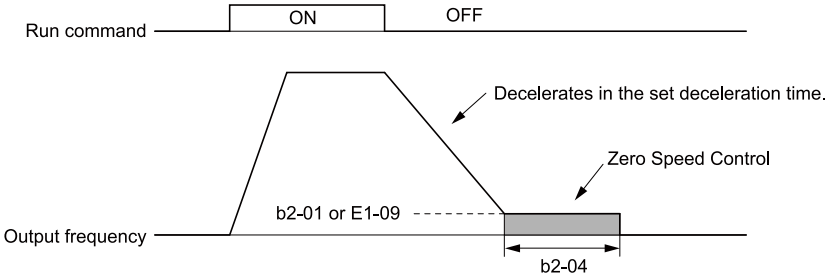


Figure 11.10 Ramping to Stop in Closed Loop Vector Control

Note:
The drive will begin Zero Speed Control from the frequency set in *E1-09 [Minimum Output Frequency]* if *b2-01 ≤ E1-09*.

1 : Coast to Stop

The drive shuts OFF its output when the Stop command is entered (or when the Run command is switched OFF). The motor coasts to stop.

Load conditions such as mechanical loss and inertia determine the deceleration rate as the motor coasts to stop.

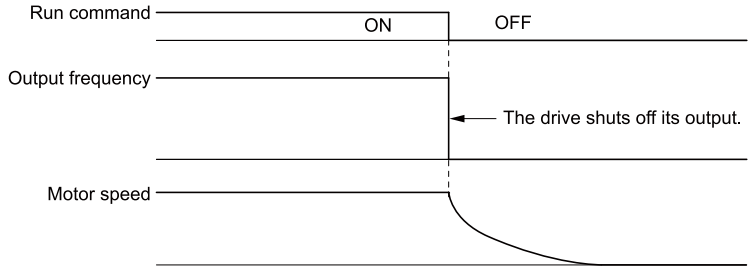


Figure 11.11 Coast to Stop

Note:
The drive disregards the Run command for the time set in *L2-03 [Momentary Power Loss Min BB Time]* when the Stop command is entered (or when the Run command is switched OFF). Do not enter the Run command until the motor comes to a complete stop. Use DC Injection to restart the motor before it stops.

2 : DC Injection Braking to Stop

The drive shuts off its output for the time set in *L2-03* when the Stop command is entered (or when the Run command is switched OFF). Once the minimum baseblock time has passed, the drive then injects the amount of DC current into the motor that is set in *b2-02 [DC Injection Braking Current]*, stopping the motor with DC current.

DC Injection Braking stops the motor more quickly than coasting to stop.

Note:
DC Injection Braking to Stop is not available if *A1-02 = 3, 4*.

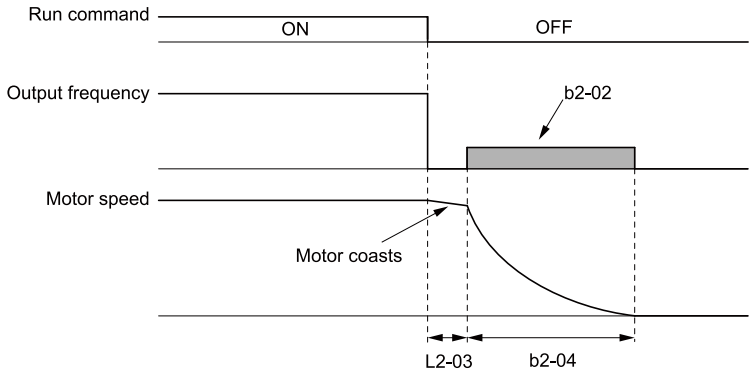


Figure 11.12 DC Injection Braking to Stop

The value set in *b2-04* and the output frequency when the Stop command is entered determine the DC Injection Braking time. The drive calculates the DC Injection Braking time as follows.

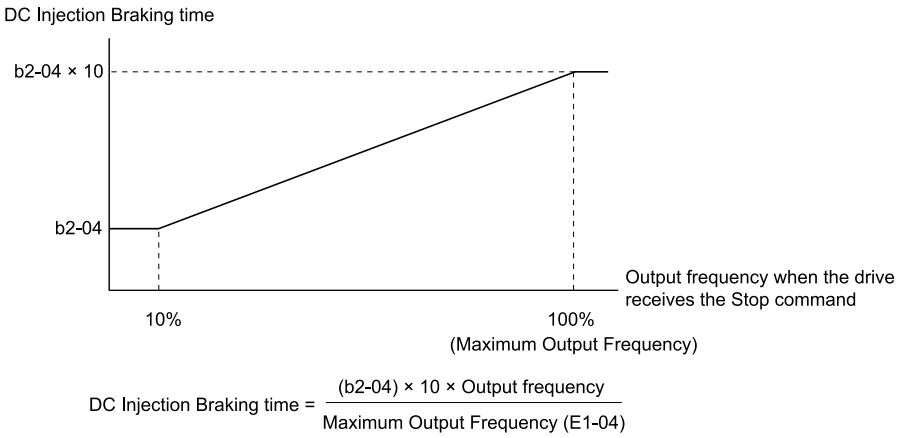


Figure 11.13 DC Injection Braking Time and Output Frequency

Note:
Set *L2-03* to a high enough value so that *oC [Overcurrent]* is not triggered when using DC Injection Braking to stop the motor.

3 : Coast to Stop with Timer

The drive shuts off its output when the Stop command is entered (or when the Run command is switched OFF). The motor coasts to stop. The drive ignores the Run command until the "Run wait time" t has passed.

To start the drive again, re-enter the Run command once the "Run wait time" *t* has passed.

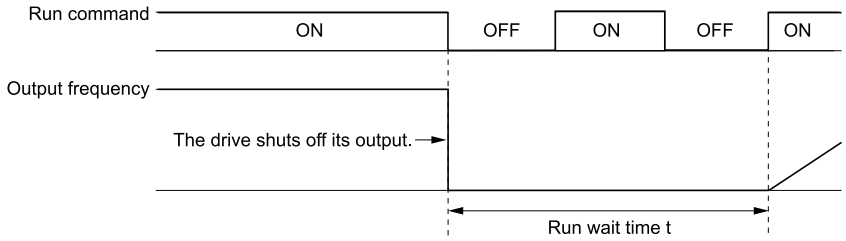


Figure 11.14 Coast to Stop with Timer

The active deceleration time and the output frequency when the Stop command is entered determine the length of "Run wait time" *t*.

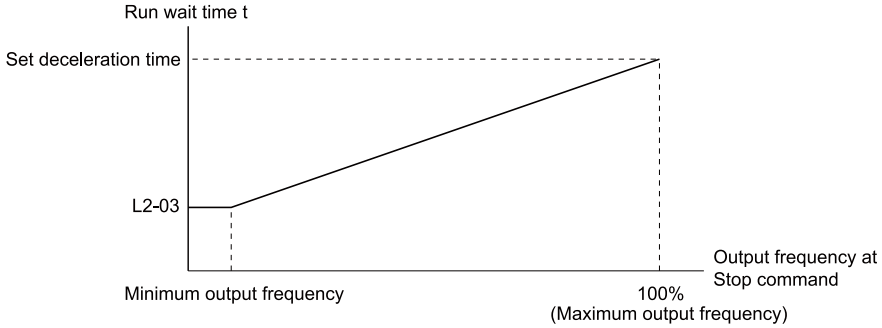


Figure 11.15 Run Wait Time and Output Frequency

■ b1-04: Reverse Operation Selection

No. (Hex.)	Name	Description	Default (Range)
b1-04 (0183)	Reverse Operation Selection	V/f CL-V/f OLV CLV AOLV Sets the reverse operation function.	0 (0, 1)

The drive does not accept the Reverse operation command when reverse operation is prohibited.

0 : Reverse Enabled

The drive accepts the Reverse operation command.

1 : Reverse Disabled

The drive disregards the Reverse operation command.

■ b1-05: Operation Below Minimum Freq

No. (Hex.)	Name	Description	Default (Range)
b1-05 (0184)	Operation Below Minimum Freq	V/f CL-V/f OLV CLV AOLV Sets the operation to perform when the frequency reference falls below the value set in *E1-09 [Minimum Output Frequency]*.	0 (0 - 3)

0 : Operate at Frequency Reference

When the frequency reference is less than the value set in *E1-09*, the drive will continue to operate the motor as specified by the frequency reference.

If the motor speed is less than or equal to the value set in *b2-01 [DC Injection/Zero SpeedThreshold]* when you enter the Stop command (or deactivate the Run command), the drive will do Zero Speed Control for the time set in *b2-04 [DC Inject Braking Time at Stop]* and then turn OFF its output.

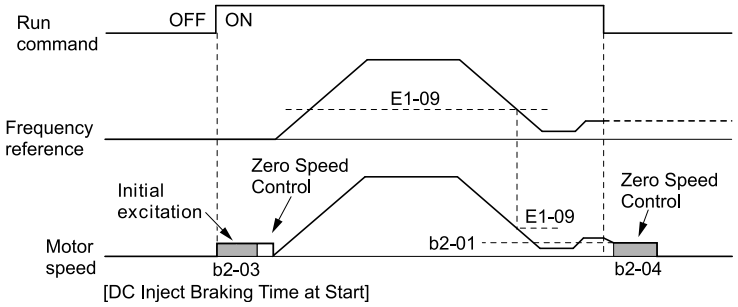


Figure 11.16 Operate at the Frequency Reference

1 : Coast to Stop

If the frequency reference is less than the value set in *E1-09*, the drive stops motor voltage output and the motor coasts to stop. If the motor speed is less than or equal to the value set in *b2-01*, the drive will do Zero Speed Control for the time set in *b2-04*.

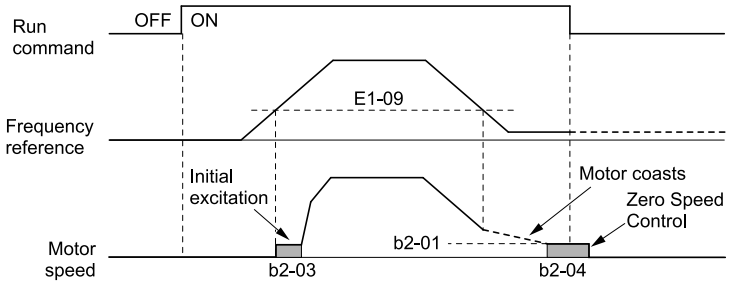


Figure 11.17 Coast to Stop

2 : Operate at Minimum Frequency

If the frequency reference is less than the value set in *E1-09* and the Run command is still enabled, the drive operates the motor at the minimum frequency reference set in *E1-09*.

When you enter the Stop command (or deactivate the Run command), the drive decelerates the motor. If the motor speed is less than or equal to the value set in *b2-01*, the drive will do Zero Speed Control for the time set in *b2-04*.

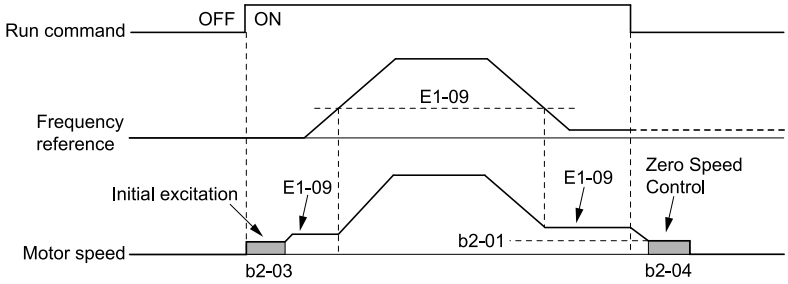


Figure 11.18 Operate at Minimum Frequency

3 : Operate at Zero Speed

If the frequency reference is less than the value set in *E1-09*, the drive will do Zero Speed Control.

When you enter the Stop command (or deactivate the Run command), the drive will do Zero Speed Control again for the time set in *b2-04*.

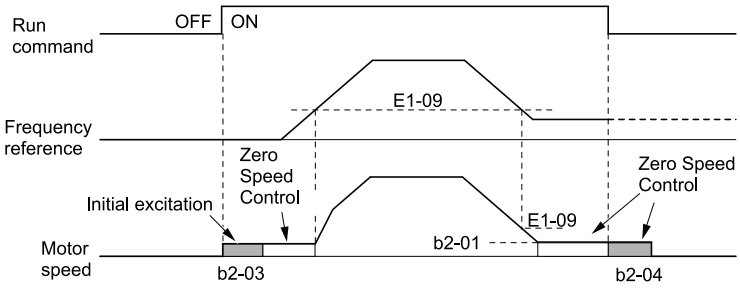


Figure 11.19 Operate at Zero Speed

■ b1-06: Digital Input Reading

No. (Hex.)	Name	Description	Default (Range)
b1-06 (0185)	Digital Input Reading	V/f CL-V/f OLV CLV AOLV Sets the number of times that the drive reads the sequence input command to prevent malfunction because of electrical interference.	1 (0, 1)

0 : Single Scan

The drive reads the terminal status one time. The drive immediately reads all changes to the terminal status.

This setting lets the drive quickly respond to changes in the sequence, but noise can cause malfunction.

1 : Double Scan

The drive reads all changes to the terminal status two times to make sure that the reading is the same.

The drive responds slower than when it reads the sequence one time, but this setting prevents malfunction because of electrical interference.

■ b1-14: Phase Order Selection

No. (Hex.)	Name	Description	Default (Range)
b1-14 (01C3)	Phase Order Selection	V/f CL-V/f OLV CLV AOLV Sets the phase order for output terminals U/T1, V/T2, and W/T3. This parameter can align the Forward Run command from the drive and the forward direction of the motor without changing wiring.	0 (0, 1)

0 : Standard

1 : Switch Phase Order

■ b1-15: Frequency Reference Selection 2

No. (Hex.)	Name	Description	Default (Range)
b1-15 (01C4)	Frequency Reference Selection 2	V/f CL-V/f OLV CLV AOLV Sets the input method for frequency reference 2.	0 (0 - 3)

This parameter is enabled when the terminal set for *H1-xx = 2 [MFDI Function Selection = External Reference 1/2 Selection]* is switched ON.

Note:
- When the drive receives a Run command when the frequency reference is 0 Hz less than the *E1-09 [Minimum Output Frequency]* value, the RUN LED on the keypad will flash. Examine the setting for the frequency reference input and enter a value more than or equal to the *E1-09* value.

0 : Keypad

Use the keypad to enter the frequency reference.

Use ⌃ and ⌄ on the keypad to change the frequency reference.

1 : Analog Input

Use MFAI terminals A1, A2, and A3 to input an analog frequency reference with a voltage or current input signal.

- Voltage Input
  Refer to this table to use a voltage signal input to one of the MFAI terminals.

Table 11.10 Frequency Reference Voltage Input

Terminal	Terminal Signal Level	Parameter Settings				Note
		Signal Level Selection	Function Selection	Gain	Bias	
A1	0 - 10 V	H3-01 = 0	H3-02 = 0 [Frequency Reference]	H3-03	H3-04	-
	-10 - +10 V	H3-01 = 1				
A2	0 - 10 V	H3-09 = 0	H3-10 = 0 [Frequency Reference]	H3-11	H3-12	Set DIP switch S1 to "V" for voltage input.
	-10 - +10 V	H3-09 = 1				
A3	0 - 10 V	H3-05 = 0	H3-06 = 0 [Frequency Reference]	H3-07	H3-08	Set DIP switch S4 to "AI" for analog input.
	-10 - +10 V	H3-05 = 1				

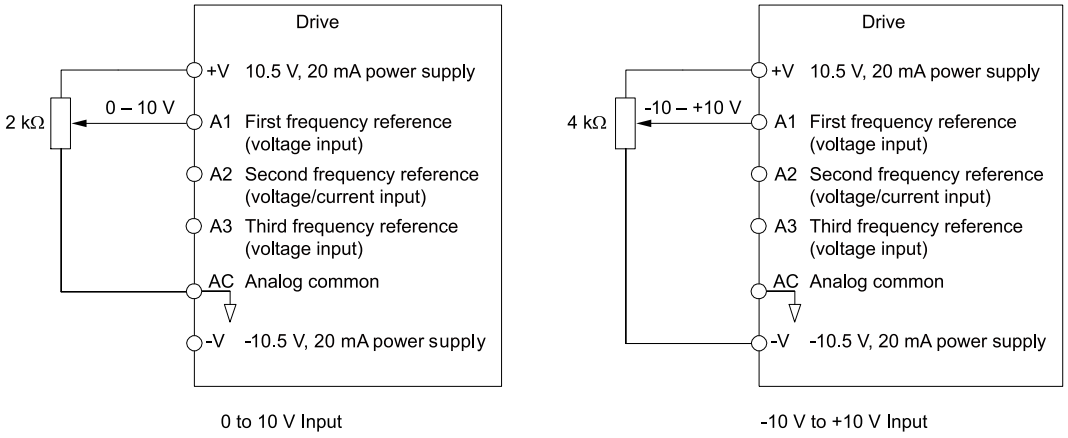


Figure 11.20 Example of Setting the Frequency Reference with a Voltage Signal to Terminal A1

Note:
You can also use this diagram to wire terminals A2 and A3.

- Current Input
  Refer to this table to use a current signal input to one of the MFAI terminals.

Terminal	Signal Level	Parameter Settings				Note
		Signal Level Selection	Function Selection	Gain	Bias	
A2	4 mA to 20 mA	H3-09 = 2	H3-10 = 0 [Frequency Reference]	H3-11	H3-12	Set DIP switch S1 to "I" for current input.
	0 - 20 mA	H3-09 = 3				

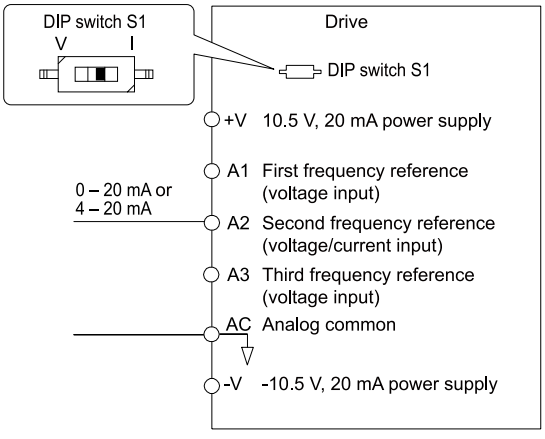


Figure 11.21 Example of Setting the Frequency Reference with a Current Signal to Terminal A2

Changing between Master and Auxiliary Frequency References

You can switch frequency reference input between terminals A1, A2, and A3 with the multi-step speed reference function.

2 : Memobus/Modbus Communications

Use MEMOBUS/Modbus communications to enter the frequency reference.

3 : Option PCB

Use a communications option card or input option card connected to the drive to enter the frequency reference.

Refer to the instruction manual included with the option card for installing and setting the option card.

Note:

If *b1-01 = 3* but no connected option card, then *oPE05 [Run Cmd/Freq Ref Source Sel Err]* will flash on the keypad.

■ b1-16: Run Command Selection 2

No. (Hex.)	Name	Description	Default (Range)
b1-16 (01C5)	Run Command Selection 2	V/f CL-V/f OLV CLV AOLV Sets the input method for Run Command 2 when the user switches the control circuit terminals ON/OFF to change the Run command source.	0 (0 - 3)

This parameter is enabled when the terminal set for *H1-xx = 2 [MFDI Function Selection = External Reference 1/2 Selection]* is switched ON.

0 : Keypad

Use the keypad to enter the Run command.

You can use the JOG operation or the FWD/REV commands from the keypad.

Note:

will illuminate when the keypad is the Run command source.

1 : Digital Input

Use the control circuit terminals to enter the Run command.

- 2-Wire Sequence
  This sequence has two input types: FWD/Stop and REV/Stop. Set *A1-03 = 2220 [Initialize Parameters = 2-Wire Initialization]* to initialize the drive and set terminals S1 and S2 for a 2-wire sequence.

2 : Memobus/Modbus Communications

Use Run command MEMOBUS/Modbus communications, which comes standard with the drive, to enter the Run command.

3 : Option PCB

Use a communications option card or input option card connected to the drive to enter the Run command.

Refer to the instruction manual included with the option card to install and set the option card.

Note:

If *b1-02 = 3* but no connected option card, then *oPE05 [Run Cmd/Freq Ref Source Sel Err]* will flash on the keypad.

■ b1-17: Run Command at Power Up

No. (Hex.)	Name	Description	Default (Range)
b1-17 (01C6)	Run Command at Power Up	V/f CL-V/f OLV CLV AOLV Sets drive response when the CPU changes from de-energized to energized and there is an active Run command. Set this parameter in applications where energizing or de-energizing the drive enables the Run command.	0 (0, 1)

0 : Disregard Existing RUN Command

The drive does not start operating the application when the power is switched ON, even when there is an existing Run command.

Enter the Run command again to operate the application.

Note:

For safety, the drive is set so that it will not start operating the application when the power is switched ON, even if the Run command is already enabled. When you energize the drive,

on the keypad will flash quickly if the Run command is already enabled from an external source.

1 : Accept Existing RUN Command

When there is an existing Run command, the drive starts to operate the application when the power is switched ON.

■ b1-21 CLV Start Selection

No. (Hex.)	Name	Description	Default (Range)
b1-21 (0748) Expert	CLV Start Selection	V/f CL-V/f OLV CLV AOLV Sets the conditions for the drive to accept the Run command when the motor speed is at least the setting value of *b2-01* or less than the setting value of *E1-09*. Usually it is not necessary to change this setting.	0 (0, 1)

0 : Reject RUN if b2-01<U1-05<E1-09

The Run command input is not accepted when the motor speed is at least the setting value of *b2-01* or less than the setting value of *E1-09*.

1 : Accept RUN Command at Any Speed

The Run command input is accepted when the motor speed is at least the setting value of *b2-01* or less than the setting value of *E1-09*.

■ b1-23: Selection REV Parameters

No. (Hex.)	Name	Description	Default (Range)
b1-23 (0B1D)	Selection REV Parameters	V/f CL-V/f OLV CLV AOLV Sets the operation of reverse parameters.	0 (0, 1)

0 : Disabled

The drive operates with forward operation parameters.

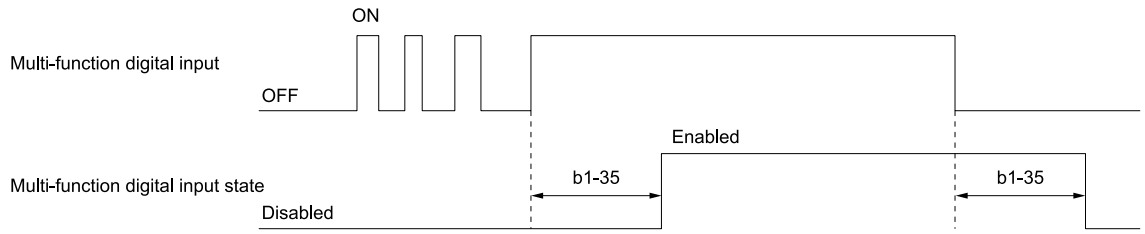
1 : Enabled

The drive operates with reverse operation parameters during reverse operation.

■ b1-35: Digital Input Deadband Time

No. (Hex.)	Name	Description	Default (Range)
b1-35 (1117) Expert	Digital Input Deadband Time	V/f CL-V/f OLV CLV AOLV Sets the deadband time for MFDIs.	0.0 ms (0.0 to 100.0 ms)

When the on/off time for MFDIs is longer than the time set in *b1-35*, the drive activates the MFDI. Set this parameter to prevent malfunctions caused by relay chattering for applications in which relays send input to MFDI terminals.



◆ b2: DC Injection Braking

b2 parameters set DC Injection Braking.

DC Injection Braking: A braking method that injects DC current into the motor windings. This function should not be used too frequently, because it generates a fair amount of heat in the motor.

■ b2-01: DC Injection/Zero SpeedThreshold

No. (Hex.)	Name	Description	Default (Range)
b2-01 (0189)	DC Injection/Zero SpeedThreshold	V/f CL-V/f OLV CLV AOLV Sets the frequency to start DC Circuit Braking and Zero Servo.	0.5 (0.0 - 10.0 Hz)

Note:

This parameter is available when *b1-03 = 0 [Stopping Method Selection = Ramp to Stop]*.

When the control method selected in *A1-02 [Control Method Selection]* changes, the *b2-01* function changes.

- *A1-02 = 0, 1, or 2 [V/f, CL-V/f, OLV]*, or *A1-02 = 4 [AOLV]* and *n4-72 = 0 [PG Mode = Without PG]*
  In these control methods, *b2-01* sets the starting frequency for DC Injection Braking at Stop. When the output frequency is less than or equal to the value set in *b2-01*, the drive will inject the quantity of DC current set in *b2-02 [DC Injection Braking Current]* into the motor for the time set in *b2-04 [DC Inject Braking Time at Stop]*.

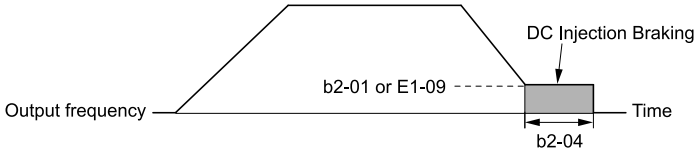


Figure 11.22 DC Injection Braking at Stop

Note:
When *b2-01* is less than or equal to the value set in *E1-09 [Minimum Output Frequency]*, the drive will start DC Injection Braking from the frequency set in *E1-09*.

- *A1-02 = 3 [CLV]*, or *A1-02 = 4 [AOLV]* and *n4-72 = 1 [With PG]*
  In these control methods, *b2-01* sets the starting frequency for Zero Speed Control at Stop. When the output frequency is less than or equal to the value set in *b2-01*, the drive will do Zero Speed Control for the time set in *b2-04*.

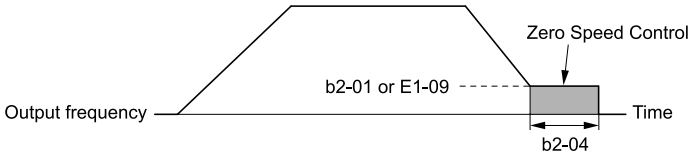


Figure 11.23 Zero Speed Control at Stop

Note:
When *b2-01* is less than or equal to the value set in *E1-09*, the drive will start Zero Speed Control from the frequency set in *E1-09*.

■ b2-02: DC Injection Braking Current

No. (Hex.)	Name	Description	Default (Range)
b2-02 (018A)	DC Injection Braking Current	V/f CL-V/f OLV CLV AOLV Sets the DC Injection Braking current as a percentage of the drive rated current.	50% (0 - 100%)

When the DC Injection Braking current is more than 50%, the drive decreases the carrier frequency to 1 kHz. The motor rated current determines how much DC Injection Braking current that the drive can use.

The DC Injection Braking current level has an effect on the strength of the magnetic field that locks the motor shaft. As the current level increases, the motor windings will supply more heat. Do not set this parameter higher than the level that is necessary to hold the motor shaft.

Note:
When *A1-02 = 4 [Control Method Selection = AOLV]* and *n4-72 = 1 [Speed Feedback Mode = With Encoder]*, the drive ignores the *b2-02* setting and does initial excitation.

■ b2-03: DC Inject Braking Time at Start

No. (Hex.)	Name	Description	Default (Range)
b2-03 (018B)	DC Inject Braking Time at Start	V/f CL-V/f OLV CLV AOLV Sets the DC Injection Braking Time at stop. Sets the zero speed control at start in CLV.	0.00 s (0.00 - 10.00 s)

This function is used to stop a coasting motor and restart it, or to increase motor flux to create high starting torque (a process called initial excitation). A setting of 0.00 disables this function.

Note:
To restart a coasting motor, use DC Injection Braking to stop and then restart the motor. DC Injection Braking may trigger *ov [Overvoltage]* or *oC [Overcurrent]*.

■ b2-04: DC Inject Braking Time at Stop

No. (Hex.)	Name	Description	Default (Range)
b2-04 (018C)	DC Inject Braking Time at Stop	V/f CL-V/f OLV CLV AOLV Sets the DC Injection Braking Time at stop. Sets the zero speed control at stop in CLV.	Determined by A1-02 (0.00 - 10.00 s)

This function is used to completely stop a motor with a large inertia during deceleration, and prevent the inertia from causing the motor to continue rotating.

A setting of 0.00 disables this function.

When a longer time is necessary to stop the motor, increase the value.

■ b2-08: Magnetic Flux Compensation Value

No. (Hex.)	Name	Description	Default (Range)
b2-08 (0190)	Magnetic Flux Compensation Value	V/f CL-V/f **OLV** CLV AOLV Sets how much current the drive injects when DC Injection Braking at Start starts (Initial Excitation) as a percentage of *E2-03 [Motor No-Load Current]*.	0% (0 - 1000%)

This parameter is effective when you start a high-capacity motor (a motor with a large secondary circuit time constant). This function can quickly increase motor flux to make high starting torque (a process called initial excitation).

The current level for DC Injection Braking at start changes linearly from the setting of *b2-08* to the setting of *b2-03* as shown in Figure 11.24.

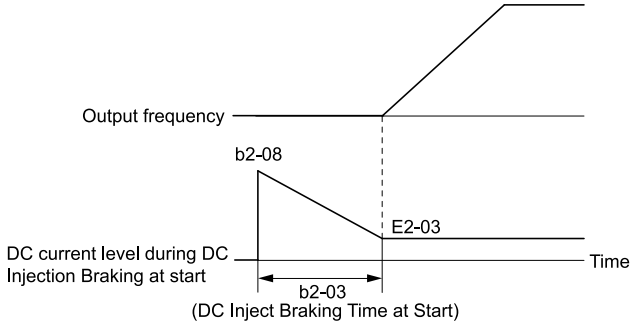


Figure 11.24 DC Current Level during DC Injection Braking at Start

Note:
- If *b2-08 < 100%*, flux will develop very slowly.
- When *b2-08 = 0%*, the DC current level will be the DC Injection current set in *b2-02 [DC Injection Braking Current]*.
- If *b2-08* is set too high, DC Injection Braking at start can cause a large noise. Adjust *b2-08* to decrease the volume to the permitted level.

◆ b4: Timer Function

The drive uses timers to delay activating and deactivating MFDO terminals.

Timers prevent chattering noise from sensors and switches.

Set delay times in parameters *b4-03 to b4-12* to enable this function.

■ Timer Function Operation

- Setting ON/OFF-Delay Time for MFDO
  The following diagram shows an example of how the timer function works using H2-01 terminals. Set this function with *b4-03 [Terminal M1-M2 ON-Delay Time]* and *b4-04 [Terminal M1-M2 OFF-Delay Time]*.

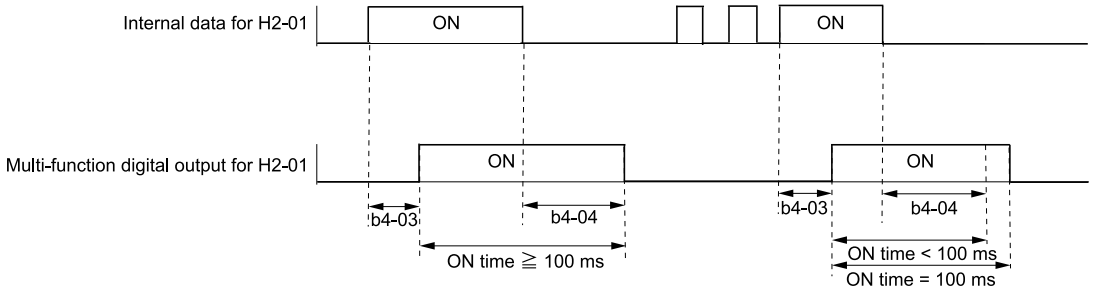


Figure 11.25 Example of How the Timer Function Works with H2-01 Terminals

Note:
When the terminal is triggered, it continues for a minimum of 100 ms regardless of the setting of on/off-delay time of MFDO terminal.

■ b4-03: Terminal M1-M2 ON-Delay Time

No. (Hex.)	Name	Description	Default (Range)
b4-03 (0B30) Expert	Terminal M1-M2 ON-Delay Time	V/f CL-V/f OLV CLV AOLV Sets the delay time to activate the contact after the function set in *H2-01* activates.	0 ms (0 - 65000 ms)

■ b4-04: Terminal M1-M2 OFF-Delay Time

No. (Hex.)	Name	Description	Default (Range)
b4-04 (0B31) Expert	Terminal M1-M2 OFF-Delay Time	V/f CL-V/f OLV CLV AOLV Sets the delay time to deactivate the contact after the function set in *H2-01* deactivates.	0 ms (0 - 65000 ms)

■ b4-05: Terminal M3-M4 ON-Delay Time

No. (Hex.)	Name	Description	Default (Range)
b4-05 (0B32) Expert	Terminal M3-M4 ON-Delay Time	V/f CL-V/f OLV CLV AOLV Sets the delay time to activate the contact after the function set in *H2-02* activates.	0 ms (0 - 65000 ms)

■ b4-06: Terminal M3-M4 OFF-Delay Time

No. (Hex.)	Name	Description	Default (Range)
b4-06 (0B33) Expert	Terminal M3-M4 OFF-Delay Time	V/f CL-V/f OLV CLV AOLV Sets the delay time to deactivate the contact after the function set in *H2-02* deactivates.	0 ms (0 - 65000 ms)

■ b4-07: Terminal M5-M6 ON-Delay Time

No. (Hex.)	Name	Description	Default (Range)
b4-07 (0B34) Expert	Terminal P2 ON-Delay Time	V/f CL-V/f OLV CLV AOLV Sets the delay time to activate the contact after the function set in *H2-03* activates.	0 ms (0 - 65000 ms)

■ b4-08: Terminal M5-M6 OFF-Delay Time

No. (Hex.)	Name	Description	Default (Range)
b4-08 (0B35) Expert	Terminal P2 OFF-Delay Time	V/f CL-V/f OLV CLV AOLV Sets the delay time to deactivate the contact after the function set in *H2-03* deactivates.	0 ms (0 - 65000 ms)

■ b4-09: Terminal P1-C1 ON-Delay Time

No. (Hex.)	Name	Description	Default (Range)
b4-09 (0B36) Expert	Terminal P2-C2 ON-Delay Time	V/f CL-V/f OLV CLV AOLV Sets the delay time to activate the contact after the function set in *H2-04* activates.	0 ms (0 - 65000 ms)

■ b4-10: Terminal P1-C1 OFF-Delay Time

No. (Hex.)	Name	Description	Default (Range)
b4-10 (0B37) Expert	Terminal P2-C2 OFF-Delay Time	V/f CL-V/f OLV CLV AOLV Sets the delay time to deactivate the contact after the function set in *H2-04* deactivates.	0 ms (0 - 65000 ms)

■ b4-11: Terminal P2-C2 ON-Delay Time

No. (Hex.)	Name	Description	Default (Range)
b4-11 (0B38) Expert	Terminal P2-C2 ON-Delay Time	V/f CL-V/f OLV CLV AOLV Sets the delay time to activate the contact after the function set in *H2-05* activates.	0 ms (0 - 65000 ms)

■ b4-12: Terminal P2-C2 OFF-Delay Time

No. (Hex.)	Name	Description	Default (Range)
b4-12 (0B39) Expert	Terminal P2-C2 OFF-Delay Time	V/f CL-V/f OLV CLV AOLV Sets the delay time to deactivate the contact after the function set in *H2-05* deactivates.	0 ms (0 - 65000 ms)

◆ b7: Droop Control

Droop control automatically balances the load level between two motors that operate the same load.

Droop control decreases motor speed as the load changes. You must enable the Droop control function for each motor it is operating.

To decrease motor speed, the Droop control function decreases the speed reference when an increase in the load increases the torque reference. To increase motor speed, the Droop control function increases the speed reference when a decrease in the load decreases the torque reference. The Droop control function adjusts motor speed as the torque reference changes to balance the load between the motors.

Note:

When you use Droop control, set *n5-01 = 0 [Feed Forward Control Selection = Disabled]*.

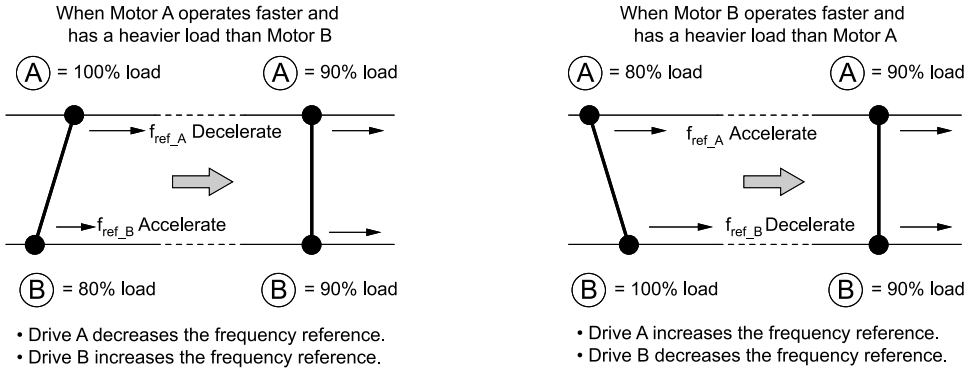


Figure 11.26 Droop Control Application (Crane Movement Viewed from Top)

■ b7-01: Droop Control Gain

No. (Hex.)	Name	Description	Default (Range)
b7-01 (01CA) RUN	Droop Control Gain	V/f CL-V/f OLV CLV AOLV Sets the amount of deceleration when the torque reference is at 100% as a percentage of *E1-04 [Maximum Output Frequency]*.	0.0% (0.0 - 100.0%)

To disable Droop control, set this parameter to 0.0%.

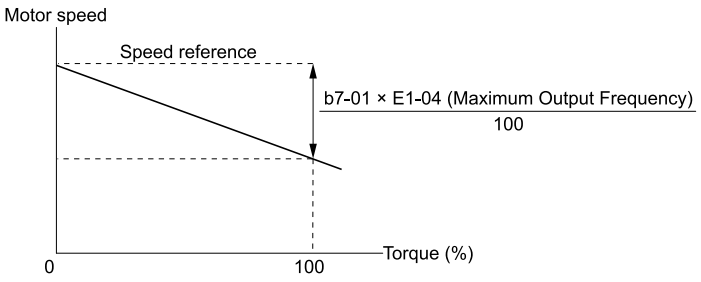


Figure 11.27 Droop Control Gain

■ b7-02: Droop Control Delay Time

No. (Hex.)	Name	Description	Default (Range)
b7-02 (01CB) RUN	Droop Control Delay Time	V/f CL-V/f OLV CLV AOLV Sets the responsiveness of Droop control. Decrease this setting when drive response is slow. Increase this setting when hunting or oscillation occur.	0.05 s (0.03 - 2.00 s)

■ b7-03: Droop Control Limit Selection

No. (Hex.)	Name	Description	Default (Range)
b7-03 (017E)	Droop Control Limit Selection	V/f CL-V/f OLV CLV AOLV Sets the Droop control limit function.	1 (0, 1)

0 : Disabled

1 : Enabled

◆ b9: Zero Servo

Zero Servo is a position control function that stops and holds the motor shaft. The drive secures the stopped motor so that the motor does not move when an external force is applied.

The drive saves the home position when the Zero Servo function is enabled. The drive can correct the motor position to bring the motor back to the home position, even if the load rotates the motor.

Set *H1-xx = 72 [MFDI Function Selection = Zero Servo]* to enable Zero Servo. The drive begins Zero Servo once the multi-function digital input terminal set for *Zero Servo [H1-xx = 72]* switches ON and the motor speed drops below the value set in *b2-01 [DC Injection/Zero SpeedThreshold]*. The drive stops and holds the motor in the Zero Servo start position. The drive will continue to hold the motor in position as long as Zero Servo is enabled, even if the frequency reference rises above the setting in *b2-01*. The drive accelerates back to the frequency reference when the multi-function digital input terminal assigned to trigger the Zero Servo function is released and the Run command is still present.

Note:

Zero Servo is available when *A1-02 = 3 [Control Method Selection = Closed Loop Vector]*.

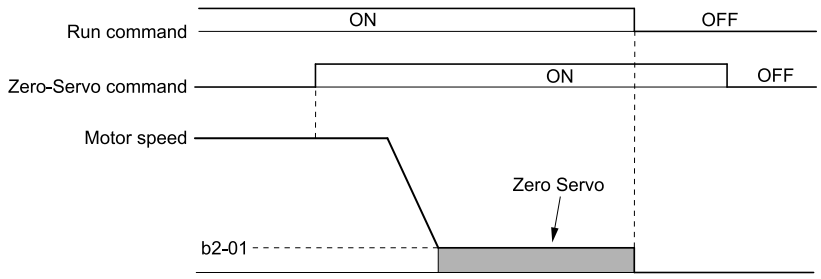


Figure 11.28 Zero Servo Time Chart

Monitor *U6-22 [ZeroServo Pulse Move]* shows the deviation between the actual position of the motor shaft and Zero Servo start position when Zero Servo is enabled. Divide the number of pulses shown in *U6-22* by 4 to find deviation.

The drive will turn ON an MFDO terminal set for *Zero Servo Complete [H2-xx = 33]* once the position of the motor shaft is within the range "Zero Servo start position ± *b9-02 [Zero Servo Completion Window]*".

Note:
- Keep the Run command active when you use the Zero Servo function. The drive will not hold the motor shaft in position if the Run command is switched OFF.
- The terminal set for Zero Servo Complete will switch OFF once the Zero-Servo command is switched OFF.
- Do not have the Zero Servo function hold 100% load for prolonged periods of time. Doing so may damage the drive. If the application needs to hold 100% load for long periods using Zero Servo, then either operate within 50% of the drive rated output current, or select a larger capacity drive.

■ b9-01: Zero Servo Gain

No. (Hex.)	Name	Description	Default (Range)
b9-01 (01DA)	Zero Servo Gain	V/f CL-V/f OLV **CLV** AOLV Sets the responsiveness for the Zero Servo function.	5 (0 - 100)

If the drive is not responsive, or if there is too much deviation from the Zero Servo start point when you increase the load, increase this setting. If oscillation or hunting occurs, decrease this setting.

Note:
- Set *C5-xx [Automatic Speed Regulator (ASR)]* parameters correctly before you adjust the Zero Servo gain.
- When you operate with the Zero Servo command enabled, oscillation and hunting must not occur.

■ b9-02: Zero Servo Completion Window

No. (Hex.)	Name	Description	Default (Range)
b9-02 (01DB)	Zero Servo Completion Window	V/f CL-V/f OLV **CLV** AOLV Sets the range to trigger an output terminal set for "Zero Servo Complete" during Zero Servo operation. Be sure to set the deviation from the Zero Servo start position.	10 (0 - 16383)

When the position of the motor shaft is in the range of "Zero Servo start position ± *b9-02*", the drive will activate a MFDO set for *Zero Servo Complete [H2-xx = 33]*.

11.4 C: Tuning

C parameters adjust drive operation, including:

- Acceleration Time
- Deceleration Time
- Slip Compensation
- Torque Compensation
- Carrier Frequency

◆ C1: Accel & Decel Time

You can set four different acceleration and deceleration time pairs in the drive. When you activate and deactivate H1-xx = 7, 16, 1A [MFDI Function Selection = Accel/Decel Time Selection 1, Motor 2 Selection, Accel/Decel Time Selection 2], you can switch acceleration and deceleration times during run.

Acceleration time parameters always set the time to accelerate from 0 Hz to *E1-04 [Maximum Output Frequency]*. Deceleration time parameters always set the time to decelerate from *E1-04* to 0 Hz.

C1-01 [Acceleration Time 1] and *C1-02 [Deceleration Time 1]* are the default active accel/decel settings.

Parameters	Setting Range
C1-01 [Acceleration Time 1]	0.0 s to 6000.0 s
C1-02 [Deceleration Time 1]	
C1-03 [Acceleration Time 2]	
C1-04 [Deceleration Time 2]	
C1-05 [Acceleration Time 3]	
C1-06 [Deceleration Time 3]	
C1-07 [Acceleration Time 4]	
C1-08 [Deceleration Time 4]	
C1-22 [Acceleration Time 1]	
C1-23 [Deceleration Time 1]	
C1-24 [Acceleration Time 2]	
C1-25 [Deceleration Time 2]	

Note:

When *C1-10 = 0 [Accel/Decel Time Setting Units = 0.01 s (0.00 to 600.00 s)]*, the setting range for acceleration and deceleration times is *0.00 s to 600.00 s*.

■ Use MFDIs to Switch Acceleration Times

Select the different acceleration and deceleration times as shown in the following table.

H1-xx = 7 [Accel/Decel Time Selection 1]	H1-xx = 1A [Accel/Decel Time Selection 2]	Active Parameter	
		Acceleration Time	Deceleration Time
OFF	OFF	C1-01 [Acceleration Time 1]	C1-02 [Deceleration Time 1]
ON	OFF	C1-03 [Acceleration Time 2]	C1-04 [Deceleration Time 2]
OFF	ON	C1-05 [Acceleration Time 3]	C1-06 [Deceleration Time 3]
ON	ON	C1-07 [Acceleration Time 4]	C1-08 [Deceleration Time 4]

The following figure shows an operation example to change acceleration and deceleration times. It is necessary to set *b1-03 = 0 [Stopping Method Selection = Ramp to Stop]* for this example.

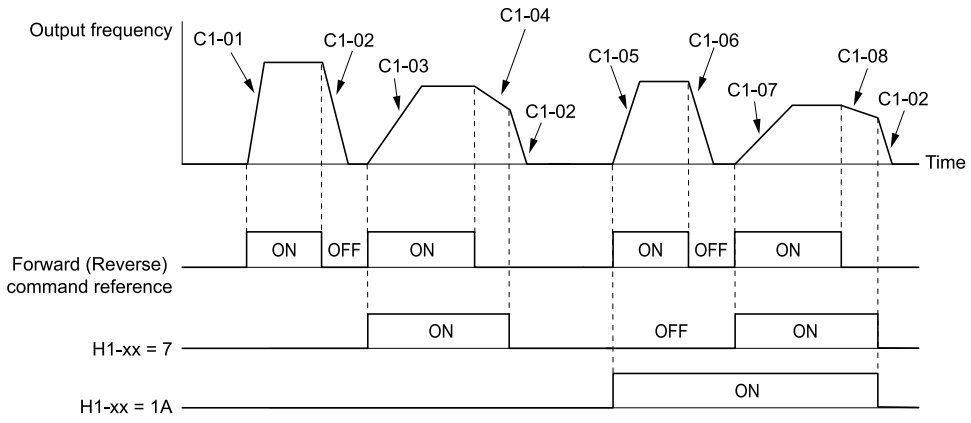


Figure 11.29 Timing Diagram of Acceleration and Deceleration Times

■ Use Motor Selection to Switch Acceleration and Deceleration Times

When you set *H1-xx = 16 [MFDI Function Selection = Motor 2 Selection]* you can activate and deactivate the input terminal to switch between motor 1 and motor 2.

The following table shows the possible acceleration and deceleration time combinations when you use the Motor 2 Selection function.

Table 11.11 Motor Selection and Acceleration and Deceleration Times

H1-xx = 7 [Accel/Decel Time Selection 1]	H1-xx = 16 [Motor 2 Selection]			
	Motor 2 Selection: OFF		Motor 2 Selection: ON	
	Acceleration Time	Deceleration Time	Acceleration Time	Deceleration Time
OFF	C1-01	C1-02	C1-05	C1-06
ON	C1-03	C1-04	C1-07	C1-08

■ Use Output Frequency Level to Switch Acceleration and Deceleration Times

The drive can use output frequency to automatically switch between different acceleration and deceleration times. The acceleration and deceleration times for the drive are switched automatically when output frequency reaches the setting value set to *C1-11 [Accel/Decel Time Switchover Freq]*. Set *C1-11 = 0.0 Hz* to disable this function.

Note:

- Acceleration and deceleration times set to MFDIs have priority over the automatic switching by the frequency level set to *C1-11*. For example, if the MFDI terminal set for *Accel/Decel Time Selection 1 [H1-xx = 7]* is ON, the drive will use only Accel/Decel Time 2 (or Accel/Decel Time 4 for motor 2). If you use a frequency level set in *C1-11*, the drive will not automatically switch acceleration and deceleration times.
- If Motor 2 Selection *[H1-xx = 16]* is activated, the drive will set the acceleration/deceleration time to *C1-05* and *C1-06* for motor 2 when the output frequency is more than the frequency level set in *C1-11*.

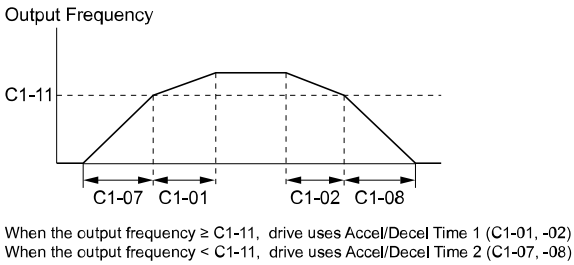


Figure 11.30 Accel/Decel Time Switchover Frequency

■ C1-01: Acceleration Time 1

No. (Hex.)	Name	Description	Default (Range)
C1-01 (0200) RUN	Acceleration Time 1	V/f CL-V/f OLV CLV AOLV Sets the length of time to accelerate from zero to maximum output frequency.	3.0 s (0.0 - 6000.0 s)

Note:

When *C1-10 = 0 [Accel/Decel Time Setting Units = 0.01 s (0.00 to 600.00 s)]*, the setting range is 0.00 s to 600.00 s.

■ C1-02: Deceleration Time 1

No. (Hex.)	Name	Description	Default (Range)
C1-02 (0201) RUN	Deceleration Time 1	V/f CL-V/f OLV CLV AOLV Sets the length of time to decelerate from maximum output frequency to zero.	3.0 s (0.0 - 6000.0 s)

Note:
When *C1-10 = 0 [Accel/Decel Time Setting Units = 0.01 s (0.00 to 600.00 s)]*, the setting range is 0.00 s to 600.00 s.

■ C1-03: Acceleration Time 2

No. (Hex.)	Name	Description	Default (Range)
C1-03 (0202) RUN	Acceleration Time 2	V/f CL-V/f OLV CLV AOLV Sets the length of time to accelerate from zero to maximum output frequency.	10.0 s (0.0 - 6000.0 s)

Note:
When *C1-10 = 0 [Accel/Decel Time Setting Units = 0.01 s (0.00 to 600.00 s)]*, the setting range is 0.00 to 600.00 s.

■ C1-04: Deceleration Time 2

No. (Hex.)	Name	Description	Default (Range)
C1-04 (0203) RUN	Deceleration Time 2	V/f CL-V/f OLV CLV AOLV Sets the length of time to decelerate from maximum output frequency to zero.	10.0 s (0.0 - 6000.0 s)

Note:
When *C1-10 = 0 [Accel/Decel Time Setting Units = 0.01 s (0.00 to 600.00 s)]*, the setting range is 0.00 to 600.00 s.

■ C1-05: Acceleration Time 3

No. (Hex.)	Name	Description	Default (Range)
C1-05 (0204) RUN	Acceleration Time 3	V/f CL-V/f OLV CLV AOLV Sets the length of time to accelerate from zero to maximum output frequency.	10.0 s (0.0 - 6000.0 s)

Note:
When *C1-10 = 0 [Accel/Decel Time Setting Units = 0.01 s (0.00 to 600.00 s)]*, the setting range is 0.00 to 600.00 s.

■ C1-06: Deceleration Time 3

No. (Hex.)	Name	Description	Default (Range)
C1-06 (0205) RUN	Deceleration Time 3	V/f CL-V/f OLV CLV AOLV Sets the length of time to decelerate from maximum output frequency to zero.	10.0 s (0.0 - 6000.0 s)

Note:
When *C1-10 = 0 [Accel/Decel Time Setting Units = 0.01 s (0.00 to 600.00 s)]*, the setting range is 0.00 to 600.00 s.

■ C1-07: Acceleration Time 4

No. (Hex.)	Name	Description	Default (Range)
C1-07 (0206) RUN	Acceleration Time 4	V/f CL-V/f OLV CLV AOLV Sets the length of time to accelerate from zero to maximum output frequency.	10.0 s (0.0 - 6000.0 s)

Note:
When *C1-10 = 0 [Accel/Decel Time Setting Units = 0.01 s (0.00 to 600.00 s)]*, the setting range is 0.00 to 600.00 s.

■ C1-08: Deceleration Time 4

No. (Hex.)	Name	Description	Default (Range)
C1-08 (0207) RUN	Deceleration Time 4	V/f CL-V/f OLV CLV AOLV Sets the length of time to decelerate from maximum output frequency to zero.	10.0 s (0.0 - 6000.0 s)

Note:
When *C1-10 = 0 [Accel/Decel Time Setting Units = 0.01 s (0.00 to 600.00 s)]*, the setting range is 0.00 to 600.00 s.

■ C1-09: Fast Stop Time

No. (Hex.)	Name	Description	Default (Range)
C1-09 (0208) RUN	Fast Stop Time	V/f CL-V/f OLV CLV AOLV Sets the length of time that the drive will decelerate to zero for a Fast Stop.	2.0 s (0.0 - 6000.0 s)

Note:
• If *C1-10 = 0 [Accel/Decel Time Setting Units = 0.01 s (0.00 to 600.00 s)]*, the setting range becomes 0.00 s to 600.00 s.

The Fast Stop function will be triggered in the following circumstances.

- The Fast Stop operation will be triggered by the input of the Fast Stop command via MFDI terminal.
- The Fast Stop operation is will be triggered when by the input of the Fast Stop command is input via MFDI terminal.

Set *H1-xx = 15, 17 [MFDI Function Selection = Fast Stop (N.O.), Fast Stop (N.C.)]*.

When the Fast Stop command is input, the Fast Stop operation will be triggered at the deceleration time set to *C1-09*. The drive cannot be restarted after initiating a Fast Stop operation until deceleration is complete. Complete deceleration and cycle the Run command to clear the Fast Stop input.

The terminal set for *H2-xx = 4C [MFDO Function Selection = During Fast Stop]* will be ON during Fast Stop.

Note:
Decelerating too quickly can cause an *ov [Overvoltage]* fault. When *ov* is detected, the drive output will shut off and the motor will coast to stop. Set a Fast Stop time in *C1-09* that prevents motor coasting and makes sure that the motor stops quickly and safely.

■ C1-10: Accel/Decel Time Setting Units

No. (Hex.)	Name	Description	Default (Range)
C1-10 (0209)	Accel/Decel Time Setting Units	V/f CL-V/f OLV CLV AOLV Sets the setting units for *C1-01 to C1-08 [Accel/Decel Times 1 to 4]* and *C1-09 [Fast Stop Time]*.	1 (0, 1)

0 : 0.01 s (0.00 to 600.00 s)

Sets acceleration and deceleration times in 0.01 s units. The setting range is 0.00 s to 600.00 s.

If *C1-01 to C1-08 [Accel/Decel Times 1 to 4]* or *C1-09 [Fast Stop Time]* are set to 1000.0 s or longer, you cannot set *C1-10 = 0*. When one of those parameters is set to a value between 600.1 s and 1000.0 s, you can set *C1-10 = 0*, but the time will change to 600.00 s.

1 : 0.1 s (0.0 to 6000.0 s)

The acceleration and deceleration times are set in 0.1 s units. The setting range is 0.0 s to 6000.0 s.

■ C1-11: Accel/Decel Time Switchover Freq

No. (Hex.)	Name	Description	Default (Range)
C1-11 (020A)	Accel/Decel Time Switchover Freq	V/f CL-V/f OLV CLV AOLV Sets the frequency at which the drive will automatically change acceleration and deceleration times.	Determined by A1-02 (0.0 - 590.0 Hz)

The acceleration and deceleration times for the drive are switched automatically when output frequency reaches the setting value set to *C1-11*. Setting *C1-11 = 0.0 Hz (0.0%)* disables this function.

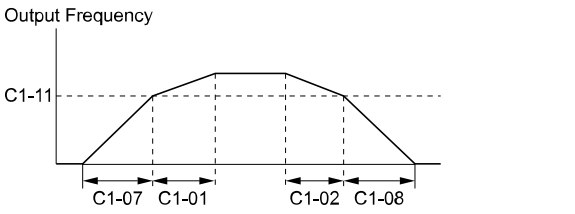


Figure 11.31 Accel/Decel Time Switchover Freq

The following table lists the possible combinations of acceleration and deceleration time switchover frequencies and the acceleration times when using the Motor 2 Selection function.

Table 11.12 Motor and Acceleration and Deceleration Time Combination

Motor	Accel & Decel Time	C1-11	
		Less than the Setting Value	At Least the Setting Value
Motor 1	Acceleration Time	C1-07 [Acceleration Time 4]	C1-01 [Acceleration Time 1]
	Deceleration Time	C1-08 [Deceleration Time 4]	C1-02 [Deceleration Time 1]
Motor 2	Acceleration Time	C1-07 [Acceleration Time 4]	C1-05 [Acceleration Time 3]
	Deceleration Time	C1-08 [Deceleration Time 4]	C1-06 [Deceleration Time 3]
Motor 3	Acceleration Time	C1-24 [Acceleration Time 2]	C1-22 [Acceleration Time 1]
	Deceleration Time	C1-25 [Deceleration Time 2]	C1-23 [Deceleration Time 1]

■ C1-22: Acceleration Time 1

No. (Hex.)	Name	Description	Default (Range)
C1-22 (155F) RUN	Acceleration Time 1	V/f CL-V/f OLV CLV AOLV Sets the first length of time 3 to accelerate for motor from zero to the maximum output frequency.	10.0 s (0.0 - 6000.0 s)

■ C1-23: Deceleration Time 1

No. (Hex.)	Name	Description	Default (Range)
C1-23 (1560) RUN	Deceleration Time 1	V/f CL-V/f OLV CLV AOLV Sets the first length of time to decelerate for motor 3 from maximum output frequency to zero.	10.0 s (0.0 - 6000.0 s)

■ C1-24: Acceleration Time 2

No. (Hex.)	Name	Description	Default (Range)
C1-24 (1561) RUN	Acceleration Time 2	V/f CL-V/f OLV CLV AOLV Sets the second length of time to accelerate for motor 3 from zero to the maximum output frequency.	10.0 s (0.0 - 6000.0 s)

■ C1-25: Deceleration Time 2

No. (Hex.)	Name	Description	Default (Range)
C1-25 (1562) RUN	Deceleration Time 2	V/f CL-V/f OLV CLV AOLV Sets the second length of time to decelerate for motor 3 from maximum output frequency to zero.	10.0 s (0.0 - 6000.0 s)

◆ C2: S-Curve Characteristics

Use S-curve characteristics to smooth acceleration and deceleration and to minimize abrupt shock to the load. Set S-curve characteristic time during acceleration/deceleration at start and acceleration/deceleration at stop. The following figure explains how S-curves are applied.

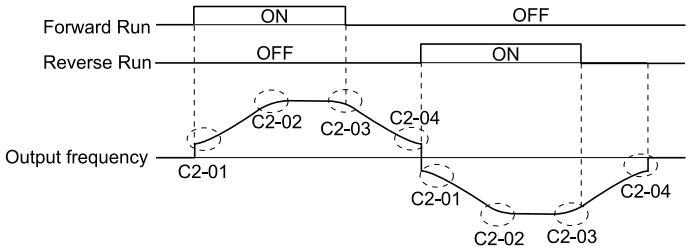


Figure 11.32 S-Curve Timing Diagram - Forward/Reverse Operation

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

$$\text{Acceleration time} = \text{Selected acceleration time} + \frac{\text{C2-01} + \text{C2-02}}{2}$$

$$\text{Deceleration time} = \text{Selected deceleration time} + \frac{\text{C2-03} + \text{C2-04}}{2}$$

■ C2-01: S-Curve Time @ Start of Accel

No. (Hex.)	Name	Description	Default (Range)
C2-01 (020B)	S-Curve Time @ Start of Accel	V/f CL-V/f OLV CLV AOLV Sets the S-curve acceleration time at start.	Determined by A1-02 (0.00 - 10.00 s)

■ C2-02: S-Curve Time @ End of Accel

No. (Hex.)	Name	Description	Default (Range)
C2-02 (020C)	S-Curve Time @ End of Accel	V/f CL-V/f OLV CLV AOLV Sets the S-curve acceleration time at completion.	0.20 s (0.00 - 10.00 s)

■ C2-03: S-Curve Time @ Start of Decel

No. (Hex.)	Name	Description	Default (Range)
C2-03 (020D)	S-Curve Time @ Start of Decel	V/f CL-V/f OLV CLV AOLV Sets the S-curve deceleration time at start.	0.20 s (0.00 - 10.00 s)

■ C2-04: S-Curve Time @ End of Decel

No. (Hex.)	Name	Description	Default (Range)
C2-04 (020E)	S-Curve Time @ End of Decel	V/f CL-V/f OLV CLV AOLV Sets the S-curve deceleration time at completion.	0.00 s (0.00 - 10.00 s)

◆ C3: Slip Compensation

The Slip Compensation function improves the speed accuracy of an induction motor. As loads on induction motors increase, motor slip increases and motor speed decreases. By adjusting the output frequency in accordance with the motor load, it compensates the slip and makes the motor speed equal to the frequency reference.

■ C3-01: Slip Compensation Gain

No. (Hex.)	Name	Description	Default (Range)
C3-01 (020F) RUN	Slip Compensation Gain	V/f CL-V/f OLV CLV AOLV Sets the gain for the slip compensation function. Usually it is not necessary to change this setting.	Determined by A1-02 (0.0 - 2.5)

Note:
- Correctly set these parameters before you change the slip compensation gain: When *A1-02 = 2 [Control Method Selection = Open Loop Vector]*, you can use Auto-Tuning to set *E2-02 [Motor Rated Slip]*.
  – *E2-01 [Motor Rated Current (FLA)]*
  – *E2-02 [Motor Rated Slip]*
  – *E2-03 [Motor No-Load Current]*
- When *A1-02 = 3 [Closed Loop Vector]*, the slip compensation gain becomes the motor temperature compensation gain. When the motor temperature increases, the motor internal constant changes and increases the slip. If *C3-01* is set, the slip will be adjusted in accordance with rises in temperature. Adjust this parameter in these conditions: When the setting value increases, the compensation also increases.
  – There are torque limits.
  – Output torque changes when the temperature changes.
- When *A1-02 = 4 [Advanced Open Loop Vector]*, you cannot change the setting while the drive is running.

Adjust this parameter in these conditions:

- If the motor speed is slower than the frequency reference, increase the setting value in 0.1-unit increments
- If the motor speed is faster than the frequency reference, decrease the setting value in 0.1-unit increments.

■ C3-02: Slip Compensation Delay Time

No. (Hex.)	Name	Description	Default (Range)
C3-02 (0210) RUN	Slip Compensation Delay Time	V/f CL-V/f OLV CLV AOLV Sets the slip compensation delay time when speed is unstable or when the slip compensation response is too slow. Usually it is not necessary to change this setting.	Determined by A1-02 (0 - 10000 ms)

Use these settings to adjust this parameter as necessary:

- When the speed is not stable, increase the setting.
- When the slip compensation response is too slow, decrease the setting.

■ C3-03: Slip Compensation Limit

No. (Hex.)	Name	Description	Default (Range)
C3-03 (0211)	Slip Compensation Limit	V/f CL-V/f OLV CLV AOLV Sets the upper limit for the slip compensation function as a percentage of the motor rated slip.	200% (0 - 250%)

If you increase the value of *C3-01 [Slip Compensation Gain]* and the motor speed is slow, use this parameter. The drive uses this parameter when the slip is at the upper limit of slip compensation. Make sure that you measure the motor speed when you increase this parameter value. Set this parameter to make the frequency reference and the slip compensation limit less than the permitted range of the machine.

The slip compensation limit is constant in the constant torque range (frequency reference ≤ *E1-06 [Base Frequency]*). In the constant output range where the frequency reference > *E1-06*, the slip compensation limit increases with the *C3-03* value and the output frequency as shown in Figure 11.33.

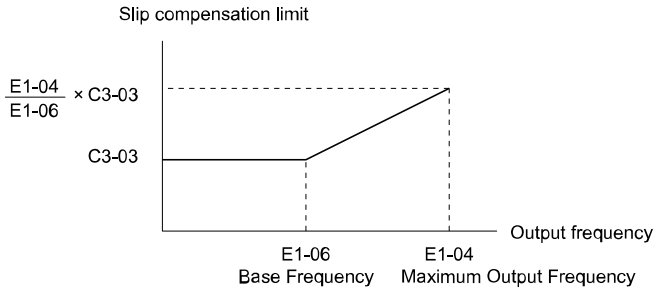


Figure 11.33 Slip Compensation Limit

■ C3-04: Slip Compensation at Regen

No. (Hex.)	Name	Description	Default (Range)
C3-04 (0212)	Slip Compensation at Regen	V/f CL-V/f OLV CLV AOLV Sets the slip compensation function during regenerative operation.	0 (0 - 2)

If you apply a regenerative load when slip compensation function during regeneration is active, the quantity of regeneration can increase immediately. In this condition, it is necessary to use a dynamic braking option (braking resistor or braking resistor unit).

0 : Disabled

The drive does not provide slip compensation during regeneration.

The load and operation status (regenerative operation) can cause the motor speed to be higher or lower than the frequency reference.

1 : Enabled Above 6Hz

Slip compensation function is enabled during regeneration. Slip compensation is disabled at output frequencies of 6 Hz or less.

2 : Enabled Above C3-15

The drive uses *E2-02 [Motor Rated Slip]* to automatically calculate the frequency range where it will disable slip compensation function during regenerative operation.

Slip compensation is enabled at frequencies as low as 2 Hz.

■ C3-05: Output Voltage Limit Selection

No. (Hex.)	Name	Description	Default (Range)
C3-05 (0213)	Output Voltage Limit Selection	V/f CL-V/f OLV CLV AOLV Sets the automatic reduction of motor magnetic flux when the output voltage is saturated.	0 (0, 1)

The drive will decrease flux and increase current to compensate torque when voltage is saturated. Make sure that the drive has sufficient output current capacity before you enable this parameter. When this parameter = *1 [Enabled]*, the output current will increase by 10% at a maximum (at rated load) before it is enabled.

Enable this parameter to increase speed precision when you move heavy loads at high speeds in these conditions:

- Power supply voltage is low
- Motor rated voltage is high

Do not enable this parameter in these conditions:

- Operating a motor in the middle speed range or low speed range
- Power supply voltage is a minimum of 10% more than the motor rated voltage

When you enable this parameter, if the power supply voltage is much less than the motor rated voltage, torque control will not be accurate.

0 : Disabled

1 : Enabled

■ C3-16: Vout Modulation Limit Start Lvl

No. (Hex.)	Name	Description	Default (Range)
C3-16 (0261) Expert	Vout Modulation Limit Start Lvl	V/f CL-V/f OLV CLV AOLV Sets the modulation factor that starts the output voltage limit operation when *C3-05 = 1 [Output Voltage Limit Selection = Enabled]*.	90.0% (70.0 - 90.0%)

■ C3-17: Vout Modulation Limit Max Level

No. (Hex.)	Name	Description	Default (Range)
C3-17 (0262) Expert	Vout Modulation Limit Max Level	V/f CL-V/f OLV CLV AOLV Sets the modulation factor used with *C3-18 [Output Voltage Limit Level]* for the output voltage limit operation when *C3-05 = 1 [Output Voltage Limit Selection = Enabled]*.	100.0% (85.0 - 100.0%)

■ C3-18: Output Voltage Limit Level

No. (Hex.)	Name	Description	Default (Range)
C3-18 (0263) Expert	Output Voltage Limit Level	V/f CL-V/f OLV CLV AOLV Sets the maximum drop width of the voltage reference when *C3-05 = 1 [Output Voltage Limit Selection = Enabled]*.	90.0% (50.0 - 100.0%)

■ C3-21: Motor 2 Slip Compensation Gain

No. (Hex.)	Name	Description	Default (Range)
C3-21 (033E) RUN	Motor 2 Slip Compensation Gain	V/f CL-V/f OLV CLV AOLV Sets the gain for the motor 2 slip compensation function. Usually it is not necessary to change this setting.	Determined by E3-01 (0.0 - 2.5)

Note:

Correctly set these parameters before you change the slip compensation gain:
- *E4-01 [Motor 2 Rated Current]*
- *E4-02 [Motor 2 Rated Slip]*
- *E4-03 [Motor 2 Rated No-Load Current]*

Adjust this parameter as follows if necessary:

- If the motor speed is slower than the frequency reference, increase *C3-01* in 0.1-unit increments.
- If the motor speed is faster than the frequency reference, decrease *C3-01* in 0.1-unit increments.

■ C3-22: Motor 2 Slip Comp Delay Time

No. (Hex.)	Name	Description	Default (Range)
C3-22 (0241) RUN	Motor 2 Slip Comp Delay Time	V/f CL-V/f OLV CLV AOLV Sets the slip compensation delay time for motor 2 when speed is unstable or when the slip compensation response is too slow. Usually it is not necessary to change this setting.	Determined by E3-01 (0 - 10000 ms)

Use these settings to adjust this parameter as necessary:

- When the speed is not stable, increase the setting.
- When the slip compensation response is too slow, decrease the setting.

■ C3-23: Motor 2 Slip Compensation Limit

No. (Hex.)	Name	Description	Default (Range)
C3-23 (0242)	Motor 2 Slip Compensation Limit	V/f CL-V/f OLV CLV AOLV Sets the upper limit for the slip compensation function as a percentage of the motor 2 rated slip.	200% (0 - 250%)

If you increase the value of *C3-21 [Motor 2 Slip Compensation Gain]* and the motor speed is slow, use this parameter. The drive uses this parameter when the slip is at the upper limit of slip compensation. Make sure that you measure the motor speed when you increase this parameter value. Set this parameter to make the frequency reference and the slip compensation limit less than the permitted range of the machine.

The slip compensation limit is constant in the constant torque range (frequency reference ≤ *E3-06 [Motor 2 Base Frequency]*). In the constant power range where the frequency reference > *E3-06*, the slip compensation limit increases with the *C3-23* value and the output frequency as shown in Figure 11.34.

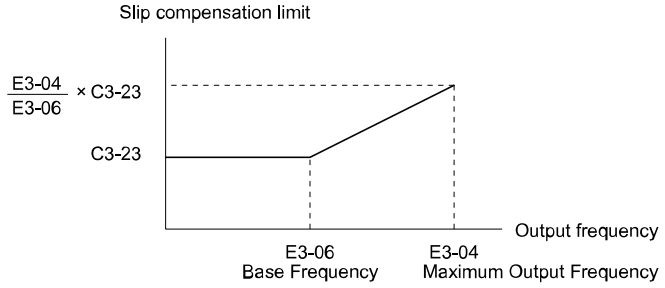


Figure 11.34 Motor 2 Slip Compensation Limit

■ C3-24: Motor 2 Slip Comp during Regen

No. (Hex.)	Name	Description	Default (Range)
C3-24 (0243)	Motor 2 Slip Comp during Regen	V/f CL-V/f OLV CLV AOLV Sets the slip compensation during regenerative operation function for motor 2.	0 (0 - 2)

If you enable the slip compensation function during regeneration, the quantity of regeneration can increase immediately. In this condition, it is necessary to use a dynamic braking option (braking resistor or braking resistor unit).

0 : Disabled

The drive will not do Slip compensation during regeneration.

The load and operation status (regenerative operation) can cause the motor speed to be higher or lower than the frequency reference.

1 : Enabled Above 6Hz

The slip compensation function is enabled during regeneration. Slip compensation is disabled at output frequencies of 6 Hz or less.

2 : Enabled Above C3-15

The drive uses *E2-02 [Motor Rated Slip]* to automatically calculate the frequency range where it will disable slip compensation function during regeneration.

Slip compensation is enabled at frequencies as low as 2 Hz.

■ C3-28: Adaptive Slip Control Mode

No. (Hex.)	Name	Description	Default (Range)
C3-28 (1B5B) Expert	Adaptive Slip Control Mode	V/f CL-V/f OLV **CLV** AOLV Sets the slip compensation function mode.	0 (0, 1)

0 : Normal

1 : Advanced

Note:

Set *C3-28 = 0* for better torque precision. If the torque precision does is not better, set *C3-28 = 1* and increase the value of *n4-65 [Flux Estimate Response@High Freq]* or *n4-66 [Flux Estimate Response @Low Freq]* in 0.1-unit increments. Then, you must do Rotational Auto-Tuning.

◆ C4: Torque Compensation

Torque compensation is a function that increases voltage to increase output torque as compensation for insufficient torque production at start-up or low-speed operation.

Voltage drops due to motor winding resistance cause torque generating voltage to decrease, which causes insufficient torque. If the main circuit cable connecting the drive and motor is long, this can also cause insufficient torque due to voltage drops.

Note:

Set the motor parameters and V/f pattern properly before setting *C4 parameters*.

■ C4-01: Torque Compensation Gain

No. (Hex.)	Name	Description	Default (Range)
C4-01 (0215) RUN	Torque Compensation Gain	**V/f** **CL-V/f** **OLV** CLV AOLV Sets the gain for the torque compensation function. Use this parameter value for motor 1 when operating multiple motors.	Determined by A1-02 (0.00 - 2.50)

In V/f Control or CL-V/f Control, adjust the value set to *C4-01* in 0.05 unit increments for these conditions:

- When torque is not sufficient during low-speed operation of 10 Hz or less, increase the setting value
- When there is vibration in the motor or when the motor hunts when operating the drive with a light load, decrease the setting value
- When you use a long motor cable, increase the setting value.

Note:

- Adjust *C4-01* to make sure that the output current is not more than the drive rated current during low-speed operation.
- Usually, do not change this parameter in OLV Control. Torque accuracy is decreased.

■ C4-02: Torque Compensation Delay Time

No. (Hex.)	Name	Description	Default (Range)
C4-02 (0216) RUN	Torque Compensation Delay Time	V/f CL-V/f OLV CLV AOLV Sets the torque compensation delay time. Usually it is not necessary to change this setting.	Determined by A1-02 (0 - 60000 ms)

Set this parameter in these conditions:

- If there is vibration in the motor, increase the setting.
- If the motor speed or motor torque response is too slow, decrease the setting.

■ C4-06: Motor 2 Torque Comp Delay Time

No. (Hex.)	Name	Description	Default (Range)
C4-06 (021A)	Motor 2 Torque Comp Delay Time	V/f CL-V/f OLV CLV AOLV Sets the value if *ov [Overvoltage]* occurs with sudden changes in the load, at the end of acceleration, or at the start of deceleration.	150 ms (0 - 10000 ms)

Sets the time constant when *ov* occurs during regenerative operation.

Gradually increase the setting in 10 ms increments and check the performance to improve motor torque speed response when *ov* occurs.

Note:
- Ensure that *C4-06 ≥ C4-02 [Torque Compensation Delay Time]*.
- Increase the setting value of *n2-03 [Automatic Freq Regulator Time 2]* proportional to *C4-06*.

■ C4-07: Motor 2 Torque Compensation Gain

No. (Hex.)	Name	Description	Default (Range)
C4-07 (0341) RUN	Motor 2 Torque Compensation Gain	V/f CL-V/f OLV CLV AOLV Sets the gain for motor 2 torque compensation function when using the Motor Switch function.	1.00 (0.00 - 2.50)

In V/f Control or CL-V/f Control, adjust the value in 0.05 unit increments for these conditions:

- When torque is not sufficient during low-speed operation of 10 Hz or less, increase the setting value
- When there is vibration in the motor or when the motor hunts when operating the drive with a light load, decrease the setting value
- When you use a long motor cable, increase the setting.

Note:
- Adjust *C4-07* and make sure that the output current is not more than the drive rated current during low-speed operation.
- When *A1-02 = 2 [Open Loop Vector]*, usually it is not necessary to change this setting. If you change this parameter in that control method, it can decrease the torque precision.

■ C4-08: M2 Torque Comp Delay Time

No. (Hex.)	Name	Description	Default (Range)
C4-08 (1110) RUN	M2 Torque Comp Delay Time	V/f CL-V/f OLV CLV AOLV Sets the primary delay time for motor 2 torque compensation.	Determined by E3-01 (0 - 60000 ms)

■ C4-13: Torque Comp Delay Time Select 1

No. (Hex.)	Name	Description	Default (Range)
C4-13 (1115) RUN	Torque Comp Delay Time Select 1	V/f CL-V/f OLV CLV AOLV Sets the primary delay time constant for torque compensation when the drive receives a Reverse run command and *b1-23 = 1 [Selection REV Parameters = Enabled]*.	Determined by A1-02 (0 - 60000 ms)

■ C4-14: M2 Torque Comp Delay Time Sel 1

No. (Hex.)	Name	Description	Default (Range)
C4-14 (1116) RUN	M2 Torque Comp Delay Time Sel 1	V/f CL-V/f OLV CLV AOLV Sets the primary delay time constant for torque compensation for motor 2 when the drive receives a Reverse run command and *b1-23 = 1 [Selection REV Parameters = Enabled]*.	Determined by E3-01 (0 - 60000 ms)

■ C4-15: Torque Comp Delay Time Select 2

No. (Hex.)	Name	Description	Default (Range)
C4-15 (111B) RUN	Torque Comp Delay Time Select 2	V/f CL-V/f OLV CLV AOLV Sets the primary delay time constant for torque compensation that the drive uses when *b1-23 = 0 [Selection REV Parameters = Disabled]* or *b1-23 = 1 [Enabled]*, and the MFDI "Counterweight Selection" setting is ON for the Forward run command.	Determined by A1-02 (0 - 60000 ms)

■ C4-16: Torque Comp Delay Time Select 3

No. (Hex.)	Name	Description	Default (Range)
C4-16 (111C) RUN	Torque Comp Delay Time Select 3	V/f CL-V/f OLV CLV AOLV Sets the primary delay time constant for torque compensation that the drive uses when the reverse command activates, *b1-23 = 1 [Selection REV Parameters = Enabled]*, and the MFDI "Counterweight Selection" setting activates.	Determined by A1-02 (0 - 60000 ms)

■ C4-19: Torque Ripple Suppress Min Freq

No. (Hex.)	Name	Description	Default (Range)
C4-19 (0B8D) Expert	Torque Ripple Suppress Min Freq	V/f CL-V/f OLV CLV AOLV If there is slow oscillation at low speeds, adjust this setting. Usually it is not necessary to change this setting.	0.1 Hz (0.0 - 10.0 Hz)

Note:

Set *C4-20 [Voltage Compensation Adjust 1] ≠ 0* to enable this parameter.

■ C4-20: Voltage Compensation Adjust 1

No. (Hex.)	Name	Description	Default (Range)
C4-20 (0BCB) Expert	Voltage Compensation Adjust 1	V/f CL-V/f OLV CLV AOLV Sets voltage precision compensation. Usually it is not necessary to change this setting.	120 Hz (0 - 200 Hz)

Note:

Set *C4-20 = 0* when noise occurs during low-speed operation.

■ C4-21: Voltage Compensation Adjust 2

No. (Hex.)	Name	Description	Default (Range)
C4-21 (0BCC) Expert	Voltage Compensation Adjust 2	V/f CL-V/f OLV CLV AOLV Sets voltage precision compensation. Usually it is not necessary to change this parameter.	Determined by o2-04 (0 - 10)

Note:

Set *C4-21 = 0* when noise occurs during high-speed operation.

■ C4-23: Current Control Gain

No. (Hex.)	Name	Description	Default (Range)
C4-23 (1583) Expert	Current Control Gain	V/f CL-V/f OLV CLV AOLV Sets the Current control gain. Usually it is not necessary to change this parameter.	1.00 (0.50 - 2.50)

◆ C5: Auto Speed Regulator (ASR)

The ASR adjusts the output frequency or torque reference to minimize the difference between frequency reference and actual motor speed. The exact parameter that is adjusted depends on the control mode.

Control Method	Targets of Adjustment
CL-V/f control	Output frequency
• CLV control • AOLV control	Torque reference

Figure 11.35 is a speed control block diagram of each control mode.

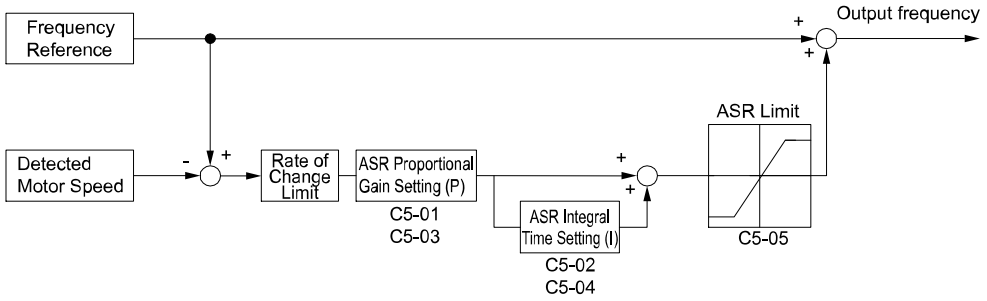


Figure 11.35 Speed Control Block Diagram for CL-V/f Control

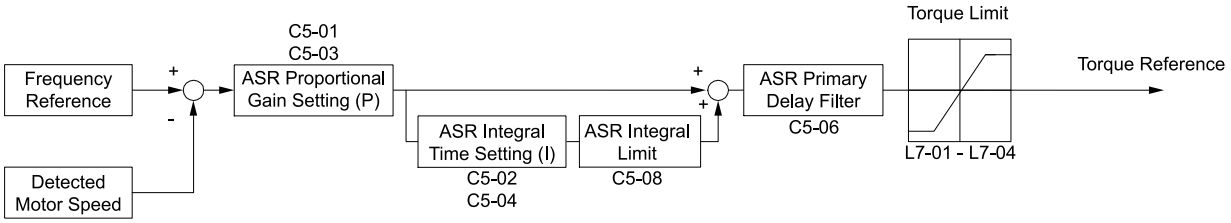


Figure 11.36 Speed Control Block Diagram for CLV Control and AOLV Control

Note:
The detected speed value is the speed estimation value when *A1-02 = 4 [Control Method Selection = Advanced Open Loop Vector]*.

■ Before Adjusting ASR Parameters

- Perform Auto-Tuning and set up all motor data correctly prior to adjusting ASR parameters.
- Always make adjustments with the load connected to the motor.
- Use analog output signals to monitor *U1-16 [SFS Output Frequency]* and *U1-05 [Motor Speed]* when adjusting the ASR.

■ ASR Adjustment Procedure for CL-V/f Control

Perform the following steps for adjusting ASR parameters:

1. Run the motor at minimum speed and increase *C5-03 [ASR Proportional Gain 2]* as much as possible without oscillation.

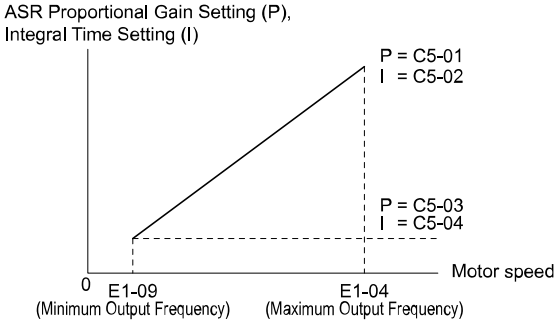


Figure 11.37 ASR Gain and Integral Time Adjustment

2. Run the motor at minimum speed and decrease *C5-04 [ASR Integral Time 2]* as much as possible without oscillation.

3. Check the output current monitor to make sure that the output current is less than 50% of the drive rated current. If the setting value is higher than 50%, decrease *C5-03* and usuallyincrease *C5-04*.
4. Run the motor at maximum speed and increase *C5-01 [ASR Proportional Gain 1]* as much as possible without oscillations.
5. Run the motor at maximum speed and decrease *C5-02 [ASR Integral Time 1]* as much as possible without oscillations.
6. If higher speed precision and faster response during acceleration or deceleration are required, set *C5-12 = 1 [Integral Operation @ Accel/Decel = Enabled]* to enable integral control during acceleration / deceleration.

Note:
- If overshooting occurs when acceleration ends, decrease the value set in *C5-01* and increase the value set in *C5-02*.
- if undershoot occurs at stop, decrease the value set in *C5-03* and increase the value set in *C5-04*.
- If adjusting the gain does not resolve issues of overshooting and undershooting, decrease the value set to *C5-05 [ASR Limit]* to decrease the upper limit of the frequency reference compensation.

■ ASR Adjustment Procedure for CLV Control and AOLV Control

Perform the following steps for adjusting ASR parameters:

1. Run the motor at zero speed or low speed and increase *C5-01 [ASR Proportional Gain 1]* until just before vibration begins to occur.
2. Run the motor at zero speed or low speed and decrease *C5-02 [ASR Integral Time 1]* until just before vibration begins to occur.
3. Check for any oscillation when running the motor at maximum speed.
4. Increase *C5-02* and decrease C5-01 if oscillation occurs.
   The adjustment procedure is complete if there is no oscillation.
5. Set the low-speed gain. Run the motor at zero speed or low speed and increase *C5-03 [ASR Proportional Gain 2]* until just before vibration begins to occur.

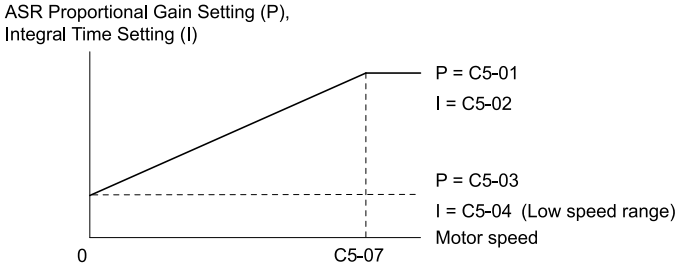


Figure 11.38 Low-speed/High-speed Gain Settings

6. Set the low-speed integral time. Run the motor at zero speed or low speed and decrease *C5-04 [ASR Integral Time 2]* until just before vibration begins to occur.
7. Set *C5-07 [ASR Gain Switchover Frequency]*.
8. Check for any oscillation when running the motor at speeds above the setting in *C5-07*.

Note:
- If overshooting occurs when acceleration ends, decrease the value set in *C5-01* and increase the value set in *C5-02*.
- if undershoot occurs at stop, decrease the value set in *C5-03* and increase the value set in *C5-04*.

■ Proportional Gain via Multi-function Digital Input Switch

Note:

This function cannot be set when *A1-02 = 1 [Control Method Selection = Closed Loop V/f Control]*.

The proportional gains set with *C5-01* and *C5-03* can be switched by using the input terminals set for ASR Gain Switch *[H1-xx = 77]*. The proportional gain set for *C5-01* is selected when the input terminal is turned OFF. The proportional gain set for *C5-03* is selected when the terminal is turned ON. The proportional gain changes linearly over the time set in *C5-02 [ASR Integral Time 1]*. The signals from this MFDI terminal have priority over *C5-07 [ASR Gain Switchover Frequency]*.

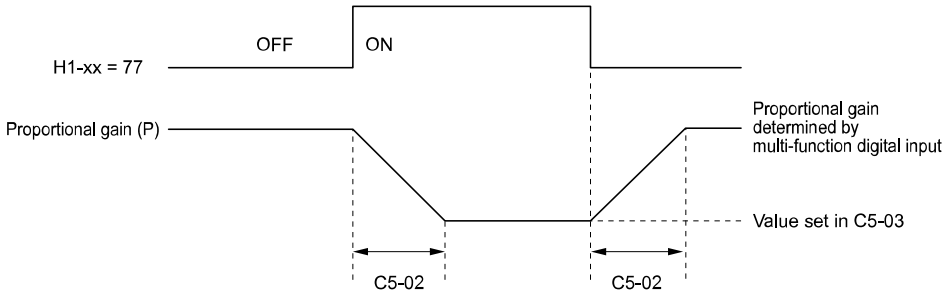


Figure 11.39 Proportional Gain via Multi-function Digital Input Switch

■ Speed Waveform Monitoring Method

To make fine adjustments of ASR parameters, observe speed waveforms while making adjustments. The following table lists example settings of parameters used to observe speed waveforms.

Table 11.13 Example Settings of Multi-function Analog Output Terminals Used to Monitor Speed Waveforms

No.	Name	Setting Value	Description
H4-01	Terminal FM Analog Output Select	116	This setting enables use of the terminal FM to monitor *U1-16 [Output Freq afterSFS]*.
H4-02	Terminal FM Analog Output Gain	100.0%	
H4-03	Terminal FM Analog Output Bias	0.0%	
H4-04	Terminal AM Analog Output Select	105	This setting enables use of the terminal AM to monitor *U1-05 [Motor Speed]*.
H4-05	Terminal AM Analog Output Gain	50.0%	
H4-06	Terminal AM Analog Output Bias	0.0%	
H4-07	Terminal FM Signal Level Select	1	This setting enables monitoring within a range of -10 to +10 V.
H4-08	Terminal AM Signal Level Select	1	

These settings result in the following multi-function analog output configuration. The multi-function analog output common is the terminal AC.

- Terminal FM: Outputs the output frequency after SFS within a range of -10 to +10 V (-100 to +10).
- Terminal AM: Outputs the motor speed within a range of -10 to +10 V (-200 to +200).

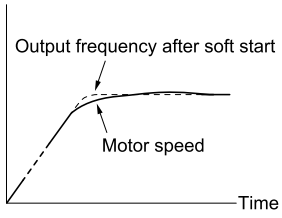
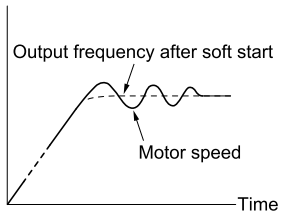
Yaskawa recommends monitoring both the output frequency after SFS and the motor speed to observe any delay in response and differences in reference values.

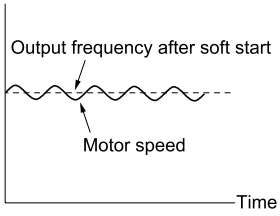
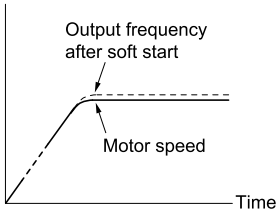
■ Adjusting the ASR Parameters

Use the following table when making adjustments to ASR. The table lists parameters for motor 1. Though the parameters listed below are for motor 1, the same changes can be made to the corresponding motor 2 parameters when running a second motor.

Note:

When adjusting the proportional gain and integral time, adjust the proportional gain first.

Problem		Solution
Speed response is slow.		• Increase *C5-01/C5-03 [ASR Proportional Gain]*. • Decrease *C5-02/C5-04 [ASR Integral Time]*.
Overshoot or undershoot occurs at the end of acceleration or deceleration.		• Decrease *C5-01/C5-03*. • Increase *C5-02/C5-04*.

Problem		Solution
Vibration and oscillation occur at constant speed.		• Decrease *C5-01/C5-03*. • Increase *C5-02/C5-04*. • Increase *C5-06 [ASR Delay Time]*.
Speed accuracy is poor when running motors with significant rated slip in CL-V/f Control mode.		• Check the pulse number set to *F1-01 [Encoder 1 Pulse Count (PPR)]* and the gear ratio to *F1-12 [Encoder 1 Gear Teeth 1]* and *F1-13 [Encoder 1 Gear Teeth 2]*. • Make sure the pulse signal from the encoder is set up properly. • Check *U6-04 [ASR Output]* and determine if the ASR is working at its output limit set to *C5-05 [ASR Limit]*. If the ASR is at the output limit, increase C5-05.
If *C5-12 = 1* or *C5-32 = 1 [Enabled]* in Closed Loop V/f Control and over/undershoot occurs when changing speed.	-	• Decrease *C5-01/C5-03*. • Increase *C5-02/C5-04*. • Decrease the value set to *C5-05*.
Oscillation at low speed and response is too slow at high speed. Alternatively, the opposite problem occurs.	-	• CL-V/f Control Mode: Use *C5-03* and *C5-04* at maximum speed and *C5-01* and *C5-02* at minimum speed to set up different ASR settings. • CLV Control Mode: Use *C5-01 to C5-04* to define optimal ASR settings for high and low speed. Use *C5-07 [ASR Gain Switchover Frequency]* to switch the ASR proportional gain and ASR integral time in accordance with the output frequency.

■ C5-01: ASR Proportional Gain 1

No. (Hex.)	Name	Description	Default (Range)
C5-01 (021B) RUN	ASR Proportional Gain 1	V/f CL-V/f OLV CLV AOLV Sets the gain to adjust ASR response.	Determined by A1-02 (0.00 - 300.00)

The speed response increases with the weight of the load. Usually, the gain increases with larger loads. Excessive gain causes vibration.

Note:
- Motor 1 ASR is usually set using *C5-01* and *C5-02 [ASR Integral Time 1]*. Parameter *C5-03* can be used in place of *C5-01* and parameter *C5-04* can be used in place *C5-02* when the speed is the same or less than that set with *C5-07 [ASR Gain Switchover Frequency]*.
- *C5-01* is automatically adjusted when the ASR Tuning process is executed.

■ C5-02: ASR Integral Time 1

No. (Hex.)	Name	Description	Default (Range)
C5-02 (021C) RUN	ASR Integral Time 1	V/f CL-V/f OLV CLV AOLV Sets the ASR integral time.	Determined by A1-02 (0.000 - 60.000 s)

When you increase the integral time, the responsiveness will decrease. An integral time that is too short can cause oscillation.

■ C5-03: ASR Proportional Gain 2

No. (Hex.)	Name	Description	Default (Range)
C5-03 (021D) RUN	ASR Proportional Gain 2	V/f CL-V/f OLV CLV AOLV Sets the gain to adjust ASR response.	Determined by A1-02 (0.00 - 300.00)

A higher gain provides a higher speed response. Usually, the gain increases with larger loads. Too much gain will cause vibration.

■ C5-04: ASR Integral Time 2

No. (Hex.)	Name	Description	Default (Range)
C5-04 (021E) RUN	ASR Integral Time 2	V/f CL-V/f OLV CLV AOLV Sets the ASR integral time.	Determined by A1-02 (0.000 - 60.000 s)

When you increase the integral time, the responsiveness will decrease. An integral time that is too short can cause oscillation.

■ C5-05: ASR Limit

No. (Hex.)	Name	Description	Default (Range)
C5-05 (021F)	ASR Limit	V/f CL-V/f OLV CLV AOLV Set the ASR output limit as a percentage of *E1-04 [Maximum Output Frequency]*.	5.0% (0.0 - 20.0%)

If the motor rated slip is high, it is necessary to increase the setting for correct motor speed control. Use *U6-04 [ASR Output]* to make sure that ASR is operating at the limit set in this parameter. When ASR is operating at the limit, correctly set the PG signal and these parameters before you make changes to *C5-05*.

- *F1-01 [Encoder 1 Pulse Count (PPR)]*
- *F1-12 [Encoder 1 Gear Teeth 1]*
- *F1-13 [Encoder 1 Gear Teeth 2]*

■ C5-06: ASR Delay Time

No. (Hex.)	Name	Description	Default (Range)
C5-06 (0220)	ASR Delay Time	V/f CL-V/f OLV CLV AOLV Sets the filter time constant of the torque reference output from the speed loop. Usually it is not necessary to change this setting.	Determined by A1-02 (0.000 - 0.500 s)

If you have a load with low rigidity or if oscillation is a problem, decrease *C5-01* in 2-unit decrements or decrease *C5-06* in 0.001-unit decrements.

■ C5-07: ASR Gain Switchover Frequency

No. (Hex.)	Name	Description	Default (Range)
C5-07 (0221)	ASR Gain Switchover Frequency	V/f CL-V/f OLV CLV AOLV Sets the frequency where the drive should switch between *C5-01 [ASR Proportional Gain 1] and C5-03 [ASR Proportional Gain 2]* as well as between integral time 1 and 2 (C5-02, C5-04). Sets the frequency where the drive should switch between *C5-02 [ASR Integral Time 1] and C5-04 [ASR Integral Time 2]*.	Determined by A1-02 (Determined by A1-02)

Switching the proportional gain and integral time in the low or high speed range can help stabilize operation. A good switching point is 80% of the frequency where oscillation occurs or at 80% of the maximum output frequency.

■ C5-08: ASR Integral Limit

No. (Hex.)	Name	Description	Default (Range)
C5-08 (0222)	ASR Integral Limit	V/f CL-V/f OLV CLV AOLV Set the upper limit of the ASR integral amount as a percentage of the rated load.	400% (0 - 400%)

■ C5-12: Integral Operation @ Accel/Decel

No. (Hex.)	Name	Description	Default (Range)
C5-12 (0386)	Integral Operation @ Accel/Decel	V/f CL-V/f OLV CLV AOLV Sets ASR integral operation during acceleration and deceleration.	0 (0, 1)

When it is necessary for the motor speed to be as near the frequency reference as possible during acceleration or deceleration, set this parameter to *1*.

Note:

If you enable integral control, overshoot or undershoot can occur when acceleration or deceleration complete. If there are problems with overshooting and undershooting, set this parameter to *0*.

0 : Disabled

Integral operation is always enabled during constant speed. The drive will not enable integral operation during acceleration or deceleration.

1 : Enabled

Integral operation is always enabled.

■ C5-17: Motor Inertia

No. (Hex.)	Name	Description	Default (Range)
C5-17 (0276) Expert	Motor Inertia	V/f CL-V/f OLV **CLV** **AOLV** Sets the motor inertia.	Determined by o2-04 (0.0001 - 6.0000 kgm^2)

When *A1-02 = 3 [Control Method Selection = Closed Loop Vector Control]*, *C5-17* is automatically set to the value of *[Motor Inertia]* when any of the following Auto-Tuning processes are executed.

- *Inertia Tuning*
- *ASR Tuning*

■ C5-18: Load Inertia Ratio

No. (Hex.)	Name	Description	Default (Range)
C5-18 (0277) Expert	Load Inertia Ratio	V/f CL-V/f OLV **CLV** **AOLV** Sets the load inertia ratio for the motor inertia.	1.0 (0.0 - 6000.0)

When *A1-02 = 3 [Control Method Selection = Closed Loop Vector]*, *C5-18* is automatically set to the load inertia ratio when any of these Auto-Tuning processes are executed.

- *Inertia Tuning*
- *ASR Tuning*

■ C5-21: Motor 2 ASR Proportional Gain 1

No. (Hex.)	Name	Description	Default (Range)
C5-21 (0356) RUN	Motor 2 ASR Proportional Gain 1	V/f **CL-V/f** OLV **CLV** AOLV Sets the gain to adjust ASR response.	Determined by E3-01 (0.00 - 300.00)

The speed response increases with the weight of the load. Usually, the gain increases with larger loads. Excessive gain causes vibration.

Note:

- Motor 2 ASR is usually set using *C5-21 and C5-22 [Motor 2 ASR Integral Time 1]*. Parameter *C5-23* can also be used in place of *C5-21* when the speed is less than or equal to the frequency set in *C5-27 [Motor 2 ASR Gain Switchover Freq]*.
- *C5-21* is automatically adjusted when the ASR Tuning process is executed.

■ C5-22: Motor 2 ASR Integral Time 1

No. (Hex.)	Name	Description	Default (Range)
C5-22 (0357) RUN	Motor 2 ASR Integral Time 1	V/f **CL-V/f** OLV **CLV** AOLV Sets the ASR integral time.	Determined by E3-01 (0.000 - 60.000 s)

An integral time that is too long decreases the responsiveness of the speed control and weakens repulsion against external force. An integral time that is too short can cause oscillation.

Note:

CLV control is usually set using *C5-21 [Motor 2 ASR Proportional Gain 1]* and *C5-22 [Motor 2 ASR Integral Time 1]*. Parameter *C5-22* can also be used instead of *C5-24 [Motor 2 ASR Integral Time 2]* when the speed is less than or equal to the frequency set to *C5-27 [Motor 2 ASR Gain Switchover Freq]*.

■ C5-23: Motor 2 ASR Proportional Gain 2

No. (Hex.)	Name	Description	Default (Range)
C5-23 (0358) RUN	Motor 2 ASR Proportional Gain 2	V/f CL-V/f OLV CLV AOLV Sets the gain to adjust ASR response.	Determined by E3-01 (0.00 - 300.00)

The speed response increases with the weight of the load. Usually, the gain increases with larger loads. Note that excessive gain causes oscillation.

■ C5-24: Motor 2 ASR Integral Time 2

No. (Hex.)	Name	Description	Default (Range)
C5-24 (0359) RUN	Motor 2 ASR Integral Time 2	V/f CL-V/f OLV CLV AOLV Sets the ASR integral time.	Determined by E3-01 (0.000 - 60.000 s)

An integral time that is too long decreases the responsiveness of the speed control and weakens repulsion against external force. An integral time that is too short can cause oscillation.

Note:

CLV control is usually set using *C5-21 [Motor 2 ASR Proportional Gain 1]* and *C5-22 [Motor 2 ASR Integral Time 1]*. Parameter*C5-24* can also be used instead of *C5-22* when the speed is less than or equal to the frequency set in *C5-27 [Motor 2 ASR Gain Switchover Freq]*.

■ C5-25: Motor 2 ASR Limit

No. (Hex.)	Name	Description	Default (Range)
C5-25 (035A)	Motor 2 ASR Limit	V/f CL-V/f OLV CLV AOLV Set the motor 2 ASR output limit as a percentage of *E1-04 [Maximum Output Frequency]*.	5.0% (0.0 - 20.0%)

If the motor rated slip is high, it is necessary to increase the setting for correct motor speed control. Use *U6-04 [ASR Output]* to make sure that ASR is operating at the limit set in this parameter. When ASR is operating at the limit, correctly set the PG signal and these parameters before you make changes to *C5-25*.

- *F1-31 [Encoder 2 Pulse Count (PPR)]*
- *F1-33 [Encoder 2 Gear Teeth 1]*
- *F1-34 [Encoder 2 Gear Teeth 2]*

■ C5-26: Motor 2 ASR Delay Time

No. (Hex.)	Name	Description	Default (Range)
C5-26 (035B)	Motor 2 ASR Delay Time	V/f CL-V/f OLV CLV AOLV Sets the filter time constant of the torque reference output from the ASR. Usually it is not necessary to change this parameter.	Determined by E3-01 (0.000 - 0.500 s)

Increase this setting gradually in increments of 0.01 for loads with low rigidity or when oscillation is a problem.

■ C5-27: Motor 2 ASR Gain Switchover Freq

No. (Hex.)	Name	Description	Default (Range)
C5-27 (035C)	Motor 2 ASR Gain Switchover Freq	V/f CL-V/f OLV CLV AOLV Sets the frequency where the drive should switch between *C5-21 [Motor 2 ASR Proportional Gain 1] and C5-23 [Motor 2 ASR Proportional Gain 2]*. Sets the frequency where the drive should switch between *C5-22 [Motor 2 ASR Integral Time 1] and C5-24 [Motor 2 ASR Integral Time 2]*.	0.0 Hz (0.0 - 400.0 Hz)

Switching the proportional gain and integral time in the low or high speed range can help stabilize operation. A good switching point is 80% of the frequency where oscillation occurs or the maximum output frequency.

■ C5-28: Motor 2 ASR Integral Limit

No. (Hex.)	Name	Description	Default (Range)
C5-28 (035D)	Motor 2 ASR Integral Limit	V/f CL-V/f OLV CLV AOLV Set the upper limit of the motor 2 ASR integral amount as a percentage of the rated load.	400% (0 - 400%)

■ C5-29: Speed Control Response

No. (Hex.)	Name	Description	Default (Range)
C5-29 (0B18) Expert	Speed Control Response	V/f CL-V/f OLV CLV AOLV Sets the level of speed control responsiveness. Usually it is not necessary to change this setting.	0 (0, 1)

If a high level of speed control responsiveness is necessary, set *C5-29 = 1*,then adjust the speed control (ASR) parameter.

0 : Standard

1 : High Performance 1

■ C5-32: Motor 2 Integral Oper at Acc/Dec

No. (Hex.)	Name	Description	Default (Range)
C5-32 (0361)	Motor 2 Integral Oper at Acc/Dec	V/f CL-V/f OLV CLV AOLV Sets ASR integral operation during acceleration and deceleration for motor 2.	0 (0, 1)

When it is necessary for the motor speed to be as near the frequency reference as possible during acceleration or deceleration, set this parameter to *1*.

Note:

If you enable integral control, overshoot or undershoot can occur when acceleration or deceleration complete. If there are problems with overshooting and undershooting, set this parameter to *0*.

0 : Disabled

Integral operation is not enabled during acceleration or deceleration. Integral operation is always enabled during constant speed.

1 : Enabled

Integral operation is always enabled.

■ C5-37: Motor 2 Inertia

No. (Hex.)	Name	Description	Default (Range)
C5-37 (0278) Expert	Motor 2 Inertia	V/f CL-V/f OLV CLV AOLV Sets the motor inertia.	Determined by o2-04 (0.0001 - 6.0000 kgm^2)

Automatically sets *C5-37* with the value of [Motor Inertia] when executing any of the following Auto-Tuning processes.

- Inertia Tuning
- ASR Tuning

■ C5-38: Motor 2 Load Inertia Ratio

No. (Hex.)	Name	Description	Default (Range)
C5-38 (0279) Expert	Motor 2 Load Inertia Ratio	V/f CL-V/f OLV CLV AOLV Sets the load inertia ratio for the motor 2 inertia.	1.0 (0.0 - 6000.0)

The drive automatically sets *C5-38* to the value of [Load Inertia Ratio] when you do Inertia Tuning or ASR Tuning.

■ C5-50: Notch Filter Frequency

No. (Hex.)	Name	Description	Default (Range)
C5-50 (0B14) Expert	Notch Filter Frequency	V/f CL-V/f OLV CLV AOLV Sets the machine resonance frequency.	0 Hz (0, or 2 to 100 Hz)

Machine resonance can cause high-frequency noise and vibration during operation. A notch filter can help prevent the noise and vibration. Notch filters set the resonant frequency of the machine to remove specific vibrational frequency components caused by machine resonance.

Note:
- Correctly set the value for the notch filter frequency. If the frequency value is too low for the speed loop response frequency, the speed control function will not function correctly. Set the frequency to be a minimum of 4 times the speed loop response frequency.
- Set *C5-50 = 0 [0 Hz]* to disable the notch filter.

■ C5-51: Notch Filter Bandwidth

No. (Hex.)	Name	Description	Default (Range)
C5-51 (0B15) Expert	Notch Filter Bandwidth	V/f CL-V/f OLV CLV AOLV Sets the notch width of the notch filter.	1.0 (0.5 - 5.0)

Note:
Set *C5-50 = 0 [Notch Filter Frequency = 0 Hz]* to disable the notch filter.

◆ C6: Duty & Carrier Frequency

C6 parameters are used to set the selection of drive duty rating, selection of carrier frequency, and upper and lower limits of carrier frequencies.

■ C6-02: Carrier Frequency Selection

No. (Hex.)	Name	Description	Default (Range)
C6-02 (0224)	Carrier Frequency Selection	V/f CL-V/f OLV CLV AOLV Sets the switching frequency (carrier frequency) for the transistors in the drive.	Determined by A1-02 and o2-04 (1 - 6, F)

Changes to the switching frequency will decrease audible noise and decrease leakage current.

Note:
Increasing the carrier frequency to more than the default setting will automatically decrease the drive current rating.

1 : 2.0 kHz
2 : 5.0 kHz
3 : 8.0 kHz
4 : 10.0 kHz
5 : 12.5 kHz
6 : 15.0 kHz
F : User Defined (C6-03 to C6-05)
Use *C6-03 to C6-05* to set detailed setting values.

Table 11.14 Guidelines for Carrier Frequency Parameter Setup

Symptom	Remedy
Speed and torque are not stable at low speed.	Decrease the carrier frequency.
Audible noise from the drive has an effect on peripheral devices.	Decrease the carrier frequency.
Too much leakage current from the drive.	Decrease the carrier frequency.
Wiring between the drive and motor is too long.	Decrease the carrier frequency. **Note:** Refer to Table 11.15 for the wiring distance and decrease the carrier frequency.
Audible motor noise is too loud.	Increase the carrier frequency.

Table 11.15 Wiring Distance

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

■ C6-03: Carrier Frequency Upper Limit

No. (Hex.)	Name	Description	Default (Range)
C6-03 (0225)	Carrier Frequency Upper Limit	V/f CL-V/f OLV CLV AOLV Sets the upper limit of the carrier frequency. Set *C6-02 = F [Carrier Frequency Selection = User Defined (C6-03 to C6-05)]* to set this parameter.	Determined by C6-02 (1.0 - 15.0 kHz)

Setting a Fixed User-Defined Carrier Frequency

When you cannot use *C6-02* to set a carrier frequency between set selectable values, you can set the value in *C6-03*. The carrier frequency will be fixed to the value set to *C6-03*.

When *A1-02 = 0, 1 [Control Method Selection = V/f, CL-V/f]*, set *C6-03 = C6-04 [Carrier Frequency Lower Limit]* to fix the carrier frequency.

Setting a Variable Carrier Frequency to Agree with the Output Frequency

When *A1-02 = 0, 1*, set *C6-03*, *C6-04*, and *C6-05 [Carrier Freq Proportional Gain]* as shown in Figure 11.40 to make the carrier frequency change linearly with the output frequency.

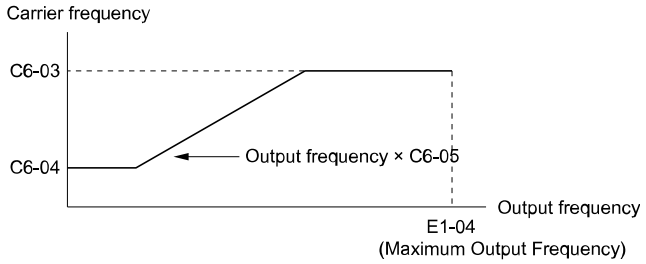


Figure 11.40 Setting a Variable Carrier Frequency to Agree with the Output Frequency

Note:
- When *C6-05* ≤ *7*, the drive disables *C6-04*. The carrier frequency is fixed to the value set to *C6-03*.
- The drive detects *oPE11 [Carrier Frequency Setting Error]* when these conditions are correct at the same time:
  - *C6-05* ≥ *6*
  - *C6-04* ≥ *C6-03*

■ C6-04: Carrier Frequency Lower Limit

No. (Hex.)	Name	Description	Default (Range)
C6-04 (0226)	Carrier Frequency Lower Limit	V/f CL-V/f OLV CLV AOLV Sets the lower limit of the carrier frequency. Set *C6-02 = F [Carrier Frequency Selection = User Defined (C6-03 to C6-05)]* to set this parameter.	Determined by C6-02 (1.0 - 15.0 kHz)

Set *C6-03 [Carrier Frequency Upper Limit]*, *C6-04*, and *C6-05 [Carrier Freq Proportional Gain]* to make the carrier frequency change linearly with the output frequency.

Note:

The drive detects *oPE11 [Carrier Frequency Setting Error]* when these conditions are correct at the same time:
- *C6-04* ≥ *C6-03*
- *C6-05* ≥ *6*

■ C6-05: Carrier Freq Proportional Gain

No. (Hex.)	Name	Description	Default (Range)
C6-05 (0227)	Carrier Freq Proportional Gain	V/f CL-V/f OLV CLV AOLV Sets the proportional gain for the carrier frequency. Set *C6-02 = F [Carrier Frequency Selection = User Defined (C6-03 to C6-05)]* to set this parameter.	Determined by C6-02 (0 - 99)

Set *C6-03 [Carrier Frequency Upper Limit]*, *C6-04 [Carrier Frequency Lower Limit]*, and *C6-05* to make the carrier frequency change linearly with the output frequency.

11.5 d: References

*d parameters [References]*set the frequency reference input method, dead band range, and field forcing functions.

WARNING! *Sudden Movement Hazard. Use fast stop circuits to safely and quickly stop the drive. After you wire the fast stop circuits, you must check their operation. Test the operation of the fast stop function before you use the drive. If you do not test the fast stop circuit before you operate the drive, it can cause serious injury or death.*

WARNING! *Sudden Movement Hazard. When you use the drive in a lifting application, you must also install external safety circuitry. The drive does not have protection against accidental load drops in lifting applications. Install electrical and/or mechanical safety circuit mechanisms that are isolated from the drive circuitry. If you do not use external safety circuitry, the drive could drop the load and cause serious injury or death.*

◆ d1: Frequency Reference

This block diagram shows the frequency reference input method, command source selection method, and priority descriptions.

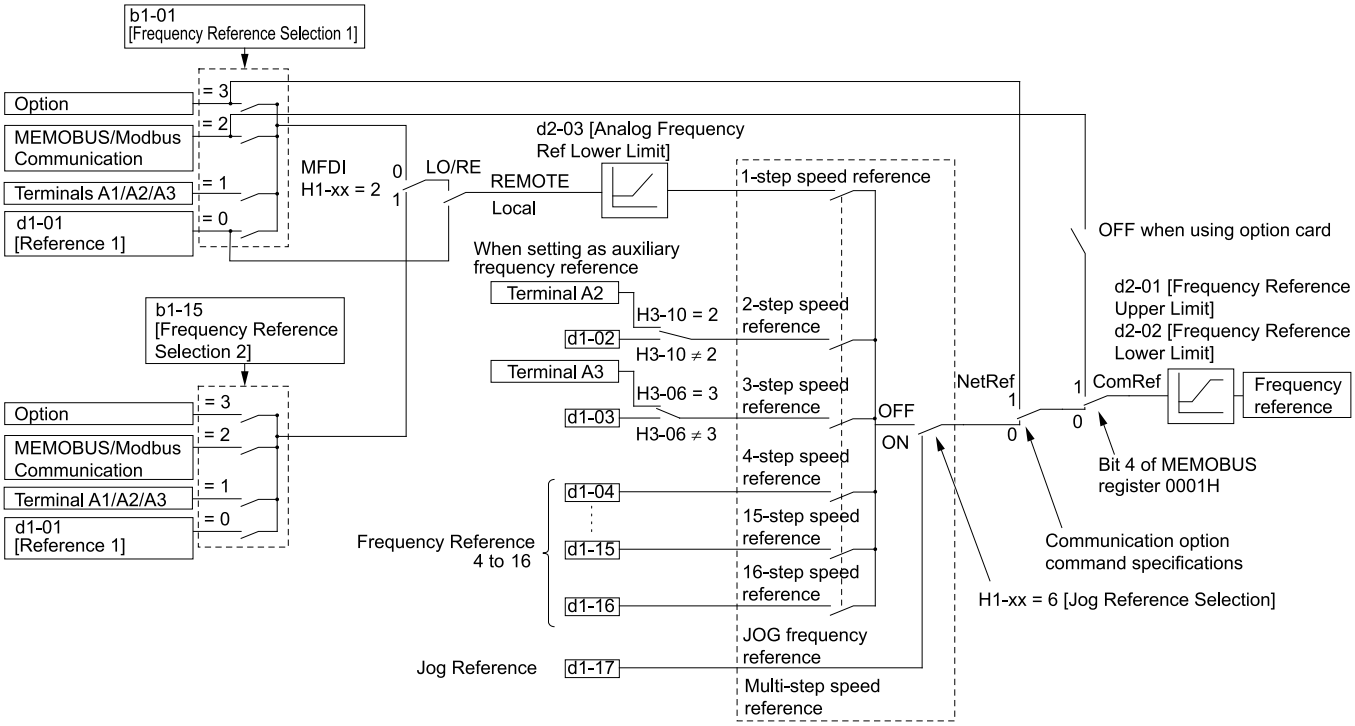


Figure 11.41 Frequency Reference Setting Hierarchy

■ Multi-Step Speed Operation

The drive has a multi-step speed operation function that can set many frequency references in advance. Set frequency references in parameter *d1-xx*. You can select the set frequency references with MFDI signals from an external source. Activate and deactivate the digital input to select the frequency reference to change the motor speed in steps. You can use the 16-step frequency reference and one Jog Frequency Reference (Jog command) to switch the speed to the maximum 17-step speeds.

Note:

- The Jog Frequency Reference (JOG command) overrides all other frequency references.
- You can use the MFDI to switch the frequency reference when the motor is running. The drive will apply the enabled acceleration and deceleration times.
- The default settings for Multi-Step Speed Reference 1 (master frequency reference) and Multi-Step Speed Reference 2 (auxiliary frequency reference) are the analog frequency reference.
  Also, voltage command input terminal A1 and current input terminal A2 for Multi-Step Speed Reference 1 (master frequency reference) are added internally by default. The drive uses Multi-Step Speed Reference 1 when the signal is connected to an analog input terminal.

■ Setting Procedures for Multi-step Speed Operation

Use an Analog Input as Reference 1 and 2

This section gives information about the procedures to set these examples:

- Multi-Step Speed 6 (6 types of frequency references)

• When you set the voltage input of analog inputs from terminals A1 and A3 to -10 V to +10 V

Procedure	Setting Parameter	Task Contents
1	Reference 1	1. Set *b1-01 = 1 [Frequency Reference Selection 1 = Analog Input]*. 2. Set *H3-02 = 0 [Terminal A1 Function Selection = Frequency Reference]*. 3. Set *H3-01 = 1 [Terminal A1 Signal Level Select = -10 to +10V (Bipolar Reference)]*.
2	Reference 2	1. Set *H3-06 = 2 [Terminal A3 Function Selection = Auxiliary Frequency Reference 1]*. 2. Set *H3-05 = 1 [Terminal A3 Signal Level Select = -10 to +10V (Bipolar Reference)]*.
3	Reference 3	Set the value of *d1-03 [Reference 3]*.
4	Reference 4	Set the value of *d1-04 [Reference 4]*.
5	Reference 5	Set the value of *d1-05 [Reference 5]*.
6	Jog Reference	Set *d1-17 [Jog Reference]* to the jog speed.
7	External digital input (3 inputs)	Set the *Multi-Step Speed Reference 1 to 3 [H1-xx = 3, 4, 5]* to one of the MFDI terminals S1 to S10.
8	JOG command	Set the *Jog Reference Selection [H1-xx = 6]* to one of the MFDI terminals S1 to S10.

Use the Maximum 17-Step Speed with All Digital Inputs

This section is the procedure to set the 17-step speeds (17 types of frequency references) without an analog input.

Procedure	Setting Parameter	Task Contents
1	Reference 1	1. Set *b1-01 = 0 [Frequency Reference Selection 1 = Keypad]*. 2. Set the value of *d1-01 [Reference 1]*.
2	Reference 2	1. Set *H3-06 = F [Terminal A3 Function Selection = Not Used]*, and disables the analog reference. 2. Set the value of *d1-02 [Reference 2]*.
3	Reference 3	1. Set *H3-10 = F [Terminal A2 Function Selection = Not Used]*, and disables the analog reference. 2. Set the value of *d1-03 [Reference 3]*.
4	Reference 4	Set the value of *d1-04 [Reference 4]*.
5	Reference 5 to 16	Set the values of *d1-05 to d1-16 [Reference 5 to 16]* using the same procedure.
6	Jog Reference	Set *d1-17 [Jog Reference]* to the jog speed.
7	External digital input (4 inputs)	Set *Multi-Step Speed Reference 1 to 4 [H1-xx = 3, 4, 5, 37]* to one of the MFDI terminals S1 to S10.
8	JOG command	Set the *Jog Reference Selection [H1-xx = 6]* to one of the MFDI terminals S1 to S10.

Multi-step Speed Operation Combinations

Refer to the table and the figure for information about multi-step speed reference combinations. The selected frequency reference changes when the combination of digital input signals from an external source changes.

Table 11.16 Multi-step Speed Reference and MFDI Terminal Combinations

Related Parameters	Multi-Step Speed Reference 1 *H1-xx = 3*	Multi-Step Speed Reference 2 *H1-xx = 4*	Multi-Step Speed Reference 3 *H1-xx = 5*	Multi-Step Speed Reference 4 *H1-xx = 37*	Jog Reference *H1-xx = 6*
Reference 1 (set in *b1-01*)	OFF	OFF	OFF	OFF	OFF
Reference 2 (*d1-02* or terminals A1, A2, A3)	ON	OFF	OFF	OFF	OFF
Reference 3 (*d1-03* or terminals A1, A2, A3)	OFF	ON	OFF	OFF	OFF
Reference 4 (*d1-04*)	ON	ON	OFF	OFF	OFF
Reference 5 (*d1-05*)	OFF	OFF	ON	OFF	OFF
Reference 6 (*d1-06*)	ON	OFF	ON	OFF	OFF
Reference 7 (*d1-07*)	OFF	ON	ON	OFF	OFF
Reference 8 (*d1-08*)	ON	ON	ON	OFF	OFF
Reference 9 (*d1-09*)	OFF	OFF	OFF	ON	OFF
Reference 10 (*d1-10*)	ON	OFF	OFF	ON	OFF
Reference 11 (*d1-11*)	OFF	ON	OFF	ON	OFF
Reference 12 (*d1-12*)	ON	ON	OFF	ON	OFF
Reference 13 (*d1-13*)	OFF	OFF	ON	ON	OFF
Reference 14 (*d1-14*)	ON	OFF	ON	ON	OFF

Related Parameters	Multi-Step Speed Reference 1 *H1-xx = 3*	Multi-Step Speed Reference 2 *H1-xx = 4*	Multi-Step Speed Reference 3 *H1-xx = 5*	Multi-Step Speed Reference 4 *H1-xx = 37*	Jog Reference *H1-xx = 6*
Reference 15 (*d1-15*)	OFF	ON	ON	ON	OFF
Reference 16 (*d1-16*)	ON	ON	ON	ON	OFF
Jog Reference (*d1-17*) *1	-	-	-	-	ON

*1 The Jog Frequency Reference (JOG command) overrides all other frequency references.

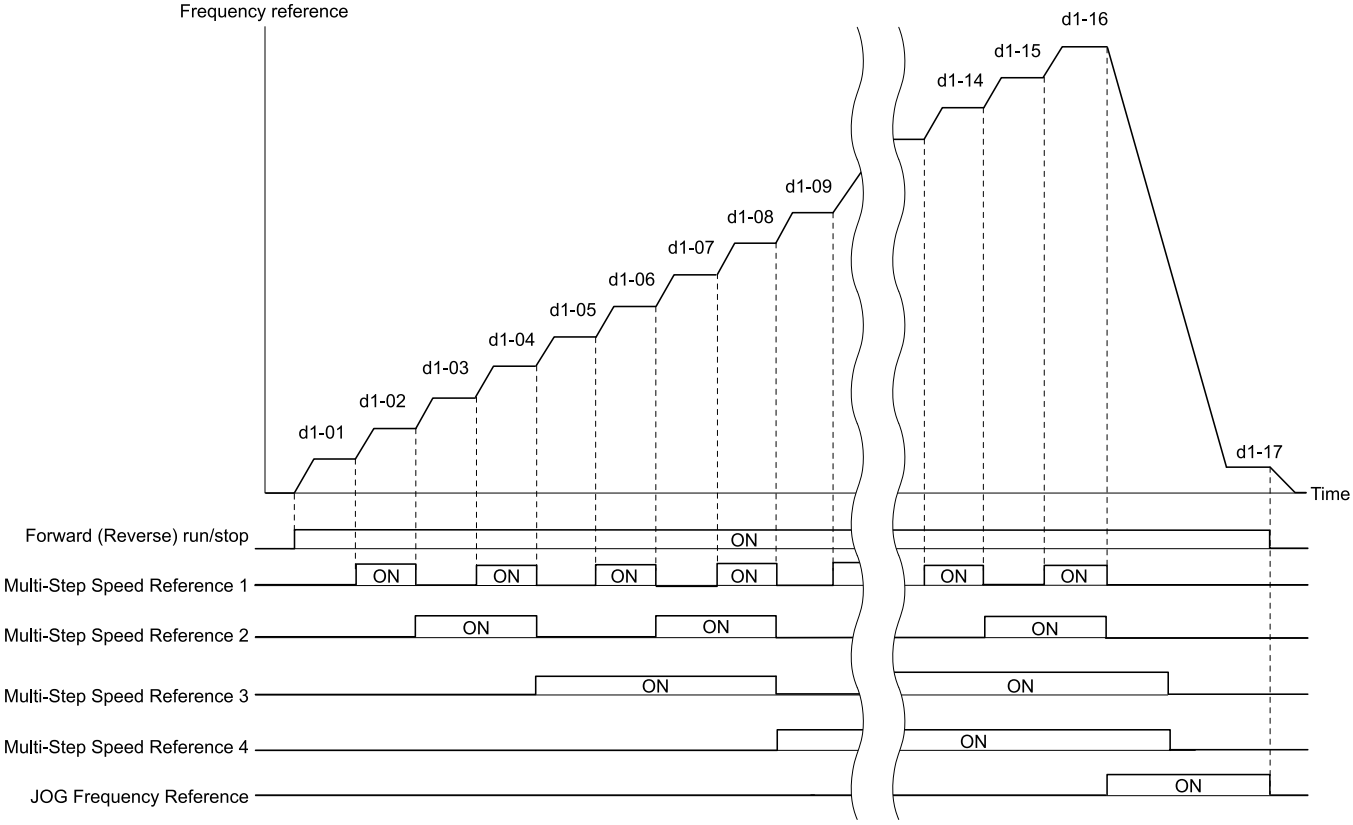


Figure 11.42 Time Chart for Multi-step Speed Reference/JOG Reference

■ d1-01: Reference 1

No. (Hex.)	Name	Description	Default (Range)
d1-01 (0280) RUN	Reference 1	V/f CL-V/f OLV CLV AOLV Sets the frequency reference in the units from *o1-03 [Frequency Display Unit Selection*.	0.00 Hz (0.00 - 590.00 Hz)

Note:
- The upper limit value changes when the *E1-04 [Maximum Output Frequency]* and *d2-01 [Frequency Reference Upper Limit]* values change. Calculate the upper limit value with this formula:
  Upper limit value = (*E1-04*) × (*d2-01*) / 100
- To set *d1-01* to 1-step speed parameter in a multi-step speed operation, set *b1-01 = 0 [Frequency Reference Selection 1 = Keypad]*.

■ d1-02: Reference 2

No. (Hex.)	Name	Description	Default (Range)
d1-02 (0281) RUN	Reference 2	V/f CL-V/f OLV CLV AOLV Sets the frequency reference in the units from *o1-03 [Frequency Display Unit Selection*.	0.00 Hz (0.00 - 590.00 Hz)

Note:
- The upper limit value changes when the *E1-04 [Maximum Output Frequency]* and *d2-01 [Frequency Reference Upper Limit]* values change.
- To set *d1-02* to Multi-Step Speed 2, set *H3-02, H3-06, and H3-10 ≠ 2 [MFAI Function Selection ≠ Auxiliary Frequency Reference 1]*. When the status is the default setting, set *H3-06 = F [Terminal A3 Function Selection = Not Used]*.

■ d1-03: Reference 3

No. (Hex.)	Name	Description	Default (Range)
d1-03 (0282) RUN	Reference 3	V/f CL-V/f OLV CLV AOLV Sets the frequency reference in the units from *o1-03 [Frequency Display Unit Selection*.	0.00 Hz (0.00 - 590.00 Hz)

Note:
- The upper limit value changes when the *E1-04 [Maximum Output Frequency]* and *d2-01 [Frequency Reference Upper Limit]* values change.
- To set *d1-03* to Multi-Step Speed 3, set *H3-02, H3-06, and H3-10 ≠ 3 [MFAI Function Selection ≠ Auxiliary Frequency Reference 2]*.

■ d1-04: Reference 4

No. (Hex.)	Name	Description	Default (Range)
d1-04 (0283) RUN	Reference 4	V/f CL-V/f OLV CLV AOLV Sets the frequency reference in the units from *o1-03 [Frequency Display Unit Selection*.	0.00 Hz (0.00 - 590.00 Hz)

Note:
- The upper limit value changes when the *E1-04 [Maximum Output Frequency]* and *d2-01 [Frequency Reference Upper Limit]* values change.
- Parameter *d1-04* sets the frequency reference of Multi-Step Speed 4.

■ d1-05: Reference 5

No. (Hex.)	Name	Description	Default (Range)
d1-05 (0284) RUN	Reference 5	V/f CL-V/f OLV CLV AOLV Sets the frequency reference in the units from *o1-03 [Frequency Display Unit Selection*.	0.00 Hz (0.00 - 590.00 Hz)

Note:
- The upper limit value changes when the *E1-04 [Maximum Output Frequency]* and *d2-01 [Frequency Reference Upper Limit]* values change.
- Parameter *d1-05* sets the frequency reference of Multi-Step Speed 5.

■ d1-06: Reference 6

No. (Hex.)	Name	Description	Default (Range)
d1-06 (0285) RUN	Reference 6	V/f CL-V/f OLV CLV AOLV Sets the frequency reference in the units from *o1-03 [Frequency Display Unit Selection*.	0.00 Hz (0.00 - 590.00 Hz)

Note:
- The upper limit value changes when the *E1-04 [Maximum Output Frequency]* and *d2-01 [Frequency Reference Upper Limit]* values change.
- Parameter *d1-06* sets the frequency reference of Multi-Step Speed 6.

■ d1-07: Reference 7

No. (Hex.)	Name	Description	Default (Range)
d1-07 (0286) RUN	Reference 7	V/f CL-V/f OLV CLV AOLV Sets the frequency reference in the units from *o1-03 [Frequency Display Unit Selection*.	0.00 Hz (0.00 - 590.00 Hz)

Note:
- The upper limit value changes when the *E1-04 [Maximum Output Frequency]* and *d2-01 [Frequency Reference Upper Limit]* values change.
- Parameter *d1-07* sets the frequency reference of Multi-Step Speed 7.

■ d1-08: Reference 8

No. (Hex.)	Name	Description	Default (Range)
d1-08 (0287) RUN	Reference 8	V/f CL-V/f OLV CLV AOLV Sets the frequency reference in the units from *o1-03 [Frequency Display Unit Selection*.	0.00 Hz (0.00 - 590.00 Hz)

Note:
- The upper limit value changes when the *E1-04 [Maximum Output Frequency]* and *d2-01 [Frequency Reference Upper Limit]* values change.
- Parameter *d1-08* sets the frequency reference of Multi-Step Speed 8.

■ d1-09: Reference 9

No. (Hex.)	Name	Description	Default (Range)
d1-09 (0288) RUN	Reference 9	V/f CL-V/f OLV CLV AOLV Sets the frequency reference in the units from *o1-03 [Frequency Display Unit Selection*.	0.00 Hz (0.00 - 590.00 Hz)

Note:
- On drives with software versions PRG: 01021 and later, this function is enabled.
  The "PRG" column on the nameplate on the right side of the drive identifies the software version. You can also use *U1-25 [SoftwareNumber FLASH]* to identify the software version.
- The upper limit value changes when the *E1-04 [Maximum Output Frequency]* and *d2-01 [Frequency Reference Upper Limit]* values change.
- This parameter sets the frequency reference of Multi-Step Speed 9.

■ d1-10: Reference 10

No. (Hex.)	Name	Description	Default (Range)
d1-10 (028B) RUN	Reference 10	V/f CL-V/f OLV CLV AOLV Sets the frequency reference in the units from *o1-03 [Frequency Display Unit Selection*.	0.00 Hz (0.00 - 590.00 Hz)

Note:
- On drives with software versions PRG: 01021 and later, this function is enabled.
  The "PRG" column on the nameplate on the right side of the drive identifies the software version. You can also use *U1-25 [SoftwareNumber FLASH]* to identify the software version.
- The upper limit value changes when the *E1-04 [Maximum Output Frequency]* and *d2-01 [Frequency Reference Upper Limit]* values change.
- This parameter sets the frequency reference of Multi-Step Speed 10.

■ d1-11: Reference 11

No. (Hex.)	Name	Description	Default (Range)
d1-11 (028C) RUN	Reference 11	V/f CL-V/f OLV CLV AOLV Sets the frequency reference in the units from *o1-03 [Frequency Display Unit Selection*.	0.00 Hz (0.00 - 590.00 Hz)

Note:
- On drives with software versions PRG: 01021 and later, this function is enabled.
  The "PRG" column on the nameplate on the right side of the drive identifies the software version. You can also use *U1-25 [SoftwareNumber FLASH]* to identify the software version.
- The upper limit value changes when the *E1-04 [Maximum Output Frequency]* and *d2-01 [Frequency Reference Upper Limit]* values change.
- This parameter sets the frequency reference of Multi-Step Speed 11.

■ d1-12: Reference 12

No. (Hex.)	Name	Description	Default (Range)
d1-12 (028D) RUN	Reference 12	V/f CL-V/f OLV CLV AOLV Sets the frequency reference in the units from *o1-03 [Frequency Display Unit Selection*.	0.00 Hz (0.00 - 590.00 Hz)

Note:
- On drives with software versions PRG: 01021 and later, this function is enabled.
  The "PRG" column on the nameplate on the right side of the drive identifies the software version. You can also use *U1-25 [SoftwareNumber FLASH]* to identify the software version.
- The upper limit value changes when the *E1-04 [Maximum Output Frequency]* and *d2-01 [Frequency Reference Upper Limit]* values change.
- This parameter sets the frequency reference of Multi-Step Speed 12.

■ d1-13: Reference 13

No. (Hex.)	Name	Description	Default (Range)
d1-13 (028E) RUN	Reference 13	V/f CL-V/f OLV CLV AOLV Sets the frequency reference in the units from *o1-03 [Frequency Display Unit Selection*.	0.00 Hz (0.00 - 590.00 Hz)

Note:
- On drives with software versions PRG: 01021 and later, this function is enabled.
  The "PRG" column on the nameplate on the right side of the drive identifies the software version. You can also use *U1-25 [SoftwareNumber FLASH]* to identify the software version.
- The upper limit value changes when the *E1-04 [Maximum Output Frequency]* and *d2-01 [Frequency Reference Upper Limit]* values change.
- This parameter sets the frequency reference of Multi-Step Speed 13.

■ d1-14: Reference 14

No. (Hex.)	Name	Description	Default (Range)
d1-14 (028F) RUN	Reference 14	V/f CL-V/f OLV CLV AOLV Sets the frequency reference in the units from *o1-03 [Frequency Display Unit Selection*.	0.00 Hz (0.00 - 590.00 Hz)

Note:
- On drives with software versions PRG: 01021 and later, this function is enabled.
  The "PRG" column on the nameplate on the right side of the drive identifies the software version. You can also use *U1-25 [SoftwareNumber FLASH]* to identify the software version.
- The upper limit value changes when the *E1-04 [Maximum Output Frequency]* and *d2-01 [Frequency Reference Upper Limit]* values change.
- This parameter sets the frequency reference of Multi-Step Speed 14.

■ d1-15: Reference 15

No. (Hex.)	Name	Description	Default (Range)
d1-15 (0290) RUN	Reference 15	V/f CL-V/f OLV CLV AOLV Sets the frequency reference in the units from *o1-03 [Frequency Display Unit Selection*.	0.00 Hz (0.00 - 590.00 Hz)

Note:
- On drives with software versions PRG: 01021 and later, this function is enabled.
  The "PRG" column on the nameplate on the right side of the drive identifies the software version. You can also use *U1-25 [SoftwareNumber FLASH]* to identify the software version.
- The upper limit value changes when the *E1-04 [Maximum Output Frequency]* and *d2-01 [Frequency Reference Upper Limit]* values change.
- This parameter sets the frequency reference of Multi-Step Speed 15.

■ d1-16: Reference 16

No. (Hex.)	Name	Description	Default (Range)
d1-16 (0291) RUN	Reference 16	V/f CL-V/f OLV CLV AOLV Sets the frequency reference in the units from *o1-03 [Frequency Display Unit Selection*.	0.00 Hz (0.00 - 590.00 Hz)

Note:
- On drives with software versions PRG: 01021 and later, this function is enabled. The "PRG" column on the nameplate on the right side of the drive identifies the software version. You can also use *U1-25 [SoftwareNumber FLASH]* to identify the software version.
- The upper limit value changes when the *E1-04 [Maximum Output Frequency]* and *d2-01 [Frequency Reference Upper Limit]* values change.
- This parameter sets the frequency reference of Multi-Step Speed 16.

■ d1-17: Jog Reference

No. (Hex.)	Name	Description	Default (Range)
d1-17 (0292) RUN	Jog Reference	V/f CL-V/f OLV CLV AOLV Sets the frequency reference in the units from *o1-03 [Frequency Display Unit Selection]*. Set *H1-xx = 6 [MFDI Function Select = Jog Reference Selection]* to use the Jog frequency reference.	6.00 Hz (0.00 - 590.00 Hz)

Note:
The upper limit value changes according to the value set in *E1-04 [Maximum Output Frequency]* and *d2-01 [Frequency Reference Upper Limit]*.

◆ d2: Reference Limits

d2 parameters set the upper and lower frequency limits to control the motor speed. Apply these parameters to for example, run the motor at low-speed due to mechanical strength concerns, or if the motor should not be run at low speed because of lubrication issues with the gears and bearings.

The upper frequency limit is set in *d2-01 [Frequency Reference Upper Limit]* and the lower limit is set in *d2-02 [Frequency Reference Lower Limit]*.

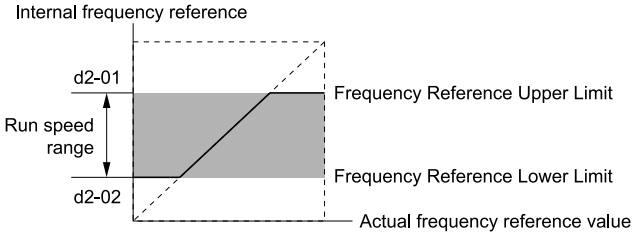


Figure 11.43 Upper and Lower Frequency Limits

■ d2-01: Frequency Reference Upper Limit

No. (Hex.)	Name	Description	Default (Range)
d2-01 (0289)	Frequency Reference Upper Limit	V/f CL-V/f OLV CLV AOLV Sets maximum limit for all frequency references. The maximum output frequency is 100%.	100.0% (0.0 - 110.0%)

When the frequency reference is more than the value set in *d2-01* the drive will continue to operate at the value set in *d2-01*.

■ d2-02: Frequency Reference Lower Limit

No. (Hex.)	Name	Description	Default (Range)
d2-02 (028A)	Frequency Reference Lower Limit	V/f CL-V/f OLV CLV AOLV Sets minimum limit for all frequency references. The maximum output frequency is 100%.	0.0% (0.0 - 110.0%)

When the frequency reference is less than the value set in *d2-02*, the drive will continue to operate at the value set in *d2-02*. The motor will accelerate to the *d2-02* value after the drive receives a Run command and a lower frequency reference than *d2-02* has been entered.

■ d2-03: Analog Frequency Ref Lower Limit

No. (Hex.)	Name	Description	Default (Range)
d2-03 (0293)	Analog Frequency Ref Lower Limit	V/f CL-V/f OLV CLV AOLV Sets the lower limit for the master frequency reference (the first frequency of the multi-step speed reference) as a percentage. The maximum output frequency is 100%.	0.0% (0.0 - 110.0%)

This parameter does not change the lower limit of Jog reference, frequency reference for multi-step speed operation, or the auxiliary frequency reference.

The drive operates at the value set in *d2-03* when the frequency reference decreases to less than the value set in *d2-03*.

Note:

When lower limits are set to parameters *d2-02 [Frequency Reference Lower Limit]* and *d2-03*, the drive uses the larger value as the lower limit.

◆ d3: Jump Frequency

The Jump frequency is a function that sets the dead band to a specified frequency band. If a machine that operated at constant speed is operated with variable speed, it can make resonance. To operate the machine without resonance from the natural frequency of the machinery mechanical system, use a frequency band jump.

You can program the drive to have three different Jump frequencies. Sets *d3-01[Jump Frequency 1]* to *d3-03 [Jump Frequency 3]* to the center value for the frequency to avoid and sets *d3-04 [Jump Frequency Width]* to be 1/2 of the total band to avoid.

When you input a frequency reference that is the same as or near the Jump frequency width, the frequency reference changes automatically.

The drive accelerates or decelerates the motor smoothly until the frequency reference is not in the range of the Jump frequency band. The drive will use the active accel/decel time to go through the specified dead band range. If the frequency reference is not in the range of the Jump frequency band, switch to constant speed operation.

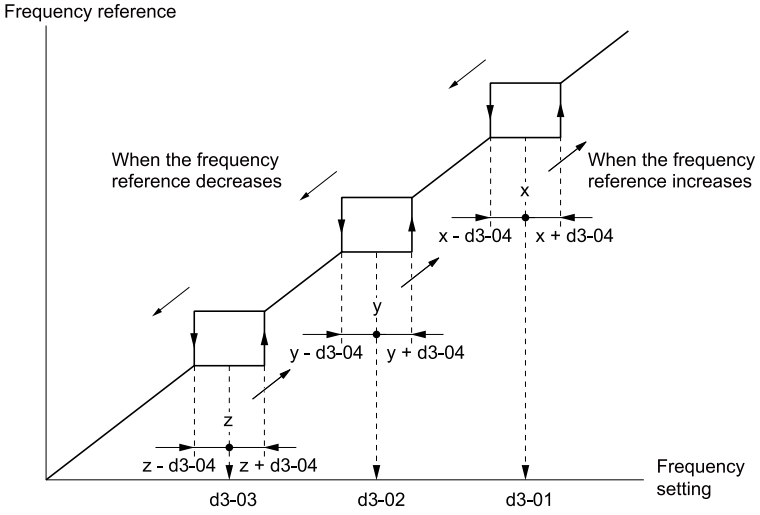


Figure 11.44 Jump Frequency

Note:

- When you set Jump Frequencies 1 to 3, make sure that the parameters do not overlap. The drive will not indicate this condition.
- When the drive is in the range of the Jump frequency, the frequency reference changes automatically. When the drive jumps frequencies, the output frequency changes smoothly as specified by the values set in *C1-01 [Acceleration Time 1]* and *C1-02 [Deceleration Time 1]*.

■ d3-01: Jump Frequency 1

No. (Hex.)	Name	Description	Default (Range)
d3-01 (0294)	Jump Frequency 1	V/f CL-V/f OLV CLV AOLV Sets the median value of the frequency band that the drive will avoid.	0.0 Hz (Determined by A1-02)

Note:

Set this parameter to 0.0 Hz to disable the Jump frequency.

■ d3-02: Jump Frequency 2

No. (Hex.)	Name	Description	Default (Range)
d3-02 (0295)	Jump Frequency 2	V/f CL-V/f OLV CLV AOLV Sets the median value of the frequency band that the drive will avoid.	0.0 Hz (Determined by A1-02)

Note:
Set this parameter to 0.0 Hz to disable the Jump frequency.

■ d3-03: Jump Frequency 3

No. (Hex.)	Name	Description	Default (Range)
d3-03 (0296)	Jump Frequency 3	V/f CL-V/f OLV CLV AOLV Sets the median value of the frequency band that the drive will avoid.	0.0 Hz (Determined by A1-02)

Note:
Set this parameter to 0.0 Hz to disable the Jump frequency.

■ d3-04: Jump Frequency Width

No. (Hex.)	Name	Description	Default (Range)
d3-04 (0297)	Jump Frequency Width	V/f CL-V/f OLV CLV AOLV Sets the width of the frequency band that the drive will avoid.	1.0 Hz (Determined by A1-02)

◆ d4: Frequency Ref Up/Down & Hold

The *d4 parameters* set the Frequency Reference Hold function and Up/Down 2 commands.

WARNING! *Sudden Movement Hazard. When you use the drive in a lifting application, you must also install external safety circuitry. The drive does not have protection against accidental load drops in lifting applications. Install electrical and/or mechanical safety circuit mechanisms that are isolated from the drive circuitry. If you do not use external safety circuitry, the drive could drop the load and cause serious injury or death.*

WARNING! *Sudden Movement Hazard. When you use a mechanical holding brake with the drive in a lifting application, you must close the brake if an input terminal triggers the Baseblock command to stop drive output. If you enter the baseblock command, the motor will suddenly coast and the load will slip, which can cause serious injury or death.*

- Frequency Reference Hold Function Command: This acceleration/deceleration ramp hold command uses an MFDI to momentarily stop the acceleration/deceleration of the motor, and continues to operate the motor at the output frequency at which the command reference was input. Turn OFF the acceleration/deceleration ramp hold command to continue acceleration/deceleration.
  With a crane for example, use the function and a 2-stage push button to stop acceleration and operate at low speed with one of the output frequencies.
- Up/Down command: The Up/Down command is a function to activate and deactivate an MFDI to increase and decrease the frequency reference. The Up/Down command overrides frequency references from the analog input terminal and keypad.

■ d4-01: Freq Reference Hold Selection

No. (Hex.)	Name	Description	Default (Range)
d4-01 (0298)	Freq Reference Hold Selection	V/f CL-V/f OLV CLV AOLV Sets the drive to save the frequency reference when the Stop command is entered or the drive is de-energized.	0 (0, 1)

This parameter is available when *H1-xx [MFDI Function Selection]* has been set to one of the following.

- *H1-xx = A [Accel/Decel Ramp Hold]*
- *H1-xx = 10/11 [Up/Down Command]*

The Frequency Reference Hold function depends on which function it is combined with.

0 : Disabled

- Acceleration/Deceleration Ramp Hold
  When you enter a Stop command or de-energize the drive, the hold value is reset to 0 Hz. The drive will use the active frequency reference when it restarts.
- Up/Down Command
  When you enter a Stop command or de-energize the drive, the frequency reference value is reset to 0 Hz. The drive will start from 0 Hz when it restarts.

1 : Enabled

- Acceleration/Deceleration Ramp Hold
  When you clear the Run command or de-energize the drive, it will save the last hold value. The drive will use the saved value as the frequency reference when it restarts.

Note:
When you energize the drive, continuously enable the MFDI terminal set for *Accel/Decel Ramp Hold [H1-xx = A]*. If the digital input is not ON, the drive will clear the hold value and set it to 0 Hz.

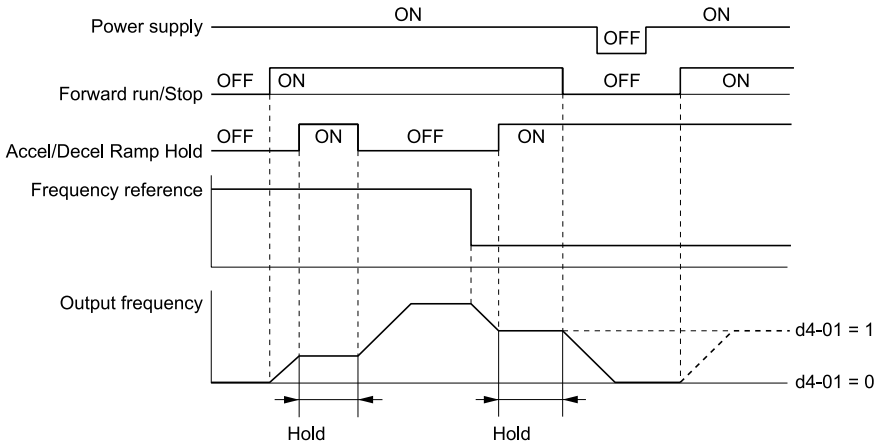


Figure 11.45 Frequency Reference Hold with Accel/Decel Hold Function

- Up/Down Command
  When you clear the Run command or de-energize the drive, it will save the frequency reference value. The drive will use the saved value as the frequency reference when it restarts.

Remove the Saved Frequency Reference Value

The procedure to remove the saved frequency reference value is different for different functions. Use these methods to remove the value:

- Release the input programmed for *Accel/Decel Ramp Hold [H1-xx = A]*.
- Set an Up or Down command while no Run command is active.

■ d4-10: Up/Down Freq Lower Limit Select

No. (Hex.)	Name	Description	Default (Range)
d4-10 (02B6)	Up/Down Freq Lower Limit Select	V/f CL-V/f OLV CLV AOLV Sets the lower frequency limit for the Up/Down function.	0 (0, 1)

0 : Greater of d2-02 or Analog

The higher value between *d2-02 [Frequency Reference Lower Limit]* and an analog input programmed for *Frequency Reference [H3-02, H3-06, H3-10 = 0]* sets the lower frequency reference limit.

Note:
When you use *External Reference 1/2 Selection [H1-xx = 2]* to switch between the Up/Down function and an analog input as the reference source, the analog value becomes the lower reference limit when the Up/Down command is active. Set *d4-10 = 1* to isolate the Up/Down function and the analog input value.

1 : d2-02

You can only use *d2-02* to set the lower limit of the frequency reference.

◆ d6: Field Forcing

d6 parameters set the field forcing functions.

The Field Forcing function adjusts the delaying influence of the motor time constant when the drive changes the excitation current reference and it also increases motor responsiveness. The function improves the development of the actual motor excitation current with a high motor excitation current reference only to energize the drive. Consequently, if the Field Forcing function is enabled, motor responsiveness will be better.

Note:
You cannot use Field Forcing during DC Injection Braking.

■ d6-03: Field Forcing Selection

No. (Hex.)	Name	Description	Default (Range)
d6-03 (02A2)	Field Forcing Selection	V/f CL-V/f OLV CLV AOLV Sets the field forcing function.	0 (0, 1)

0 : Disabled
1 : Enabled

■ d6-06: Field Forcing Limit

No. (Hex.)	Name	Description	Default (Range)
d6-06 (02A5)	Field Forcing Limit	V/f CL-V/f OLV CLV AOLV Sets the limit value for field forcing to increase the motor excitation current reference as a percentage of *E2-03 [Motor No-Load Current]*. Usually it is not necessary to change this setting.	400% (100 - 400%)

Note:
You cannot use Field Forcing during DC Injection Braking.

◆ d7: Offset Frequency

The drive will use 3 digital signal inputs to add or subtract the set frequency (offset frequency) to/from the frequency reference and correct the speed. The drive uses the terminal set in *H1-xx = 44 to 46 [MFDI Function Selection = Add Offset Frequency 1 (d7-01) to Add Offset Frequency 3 (d7-03)]* to set the offset frequency. When you close more than one input at the same time, the drive adds the selected offset values together.

Figure 11.46 shows the Offset frequency function:

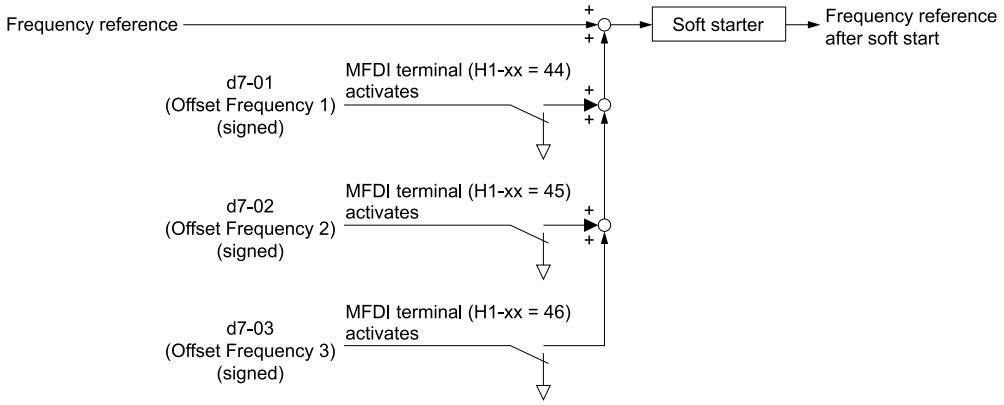


Figure 11.46 Offset Frequency Operation

■ d7-01: Offset Frequency 1

No. (Hex.)	Name	Description	Default (Range)
d7-01 (02B2) RUN	Offset Frequency 1	V/f CL-V/f OLV CLV AOLV Sets the value to add to or subtract from the frequency reference when *H1-xx = 44 [MFDI Function Select = Add Offset Frequency 1 (d7-01)]* as a percentage of the maximum output frequency.	0.0% (-100.0 - +100.0%)

■ d7-02: Offset Frequency 2

No. (Hex.)	Name	Description	Default (Range)
d7-02 (02B3) RUN	Offset Frequency 2	V/f CL-V/f OLV CLV AOLV Sets the value to add to or subtract from the frequency reference when *H1-xx = 45 [MFDI Function Select = Add Offset Frequency 2 (d7-01)]* as a percentage of the maximum output frequency.	0.0% (-100.0 - +100.0%)

■ d7-03: Offset Frequency 3

No. (Hex.)	Name	Description	Default (Range)
d7-03 (02B4) RUN	Offset Frequency 3	V/f CL-V/f OLV CLV AOLV Sets the value to add to or subtract from the frequency reference when *H1-xx = 46 [MFDI Function Select = Add Offset Frequency 3 (d7-01)]* as a percentage of the maximum output frequency.	0.0% (-100.0 - +100.0%)

11.6 E: Motor Parameters

E parameters cover drive input voltage, V/f pattern, and motor parameters.

◆ E1: V/f Pattern for Motor 1

E1 parameters set the drive input voltage and motor V/f characteristics. To switch drive operation from one motor to another motor, set the V/f characteristics for motor 1.

■ V/f Pattern Settings

The drive uses a V/f pattern to adjust the output voltage relative to the frequency reference.

This product has been preconfigured with 15 voltage/frequency (V/f) patterns. Use *E1-03 [V/f Pattern Selection]* to select the V/f pattern that is appropriate for the application.

Additionally, one custom V/f pattern is available. Set *E1-03 = F [Custom]* and then manually set parameters *E1-04 to E1-10*.

Table 11.17 Predefined V/f Patterns

Setting Value	Specification	Characteristic	Application
0	Const Trq, 50Hz base, 50Hz max	Constant torque	For general purpose applications. This pattern is used when the load torque is constant without any rotation speed such as that used for linear conveyor systems.
1	Const Trq, 60Hz base, 60Hz max		
2	Const Trq, 50Hz base, 60Hz max		
3	Const Trq, 60Hz base, 72Hz max		
4	VT, 50Hz, 65% Vmid reduction	Derated torque characteristics	This pattern is used for torque loads proportional to 2 or 3 times the rotation speed, such as is the case with fans and pumps.
5	VT, 50Hz, 50% Vmid reduction		
6	VT, 60 Hz, 65% Vmid reduction		
7	VT, 60 Hz, 50% Vmid reduction		
8	High Trq, 50Hz, 25% Vmin boost	High starting torque	This pattern is used when strong torque is required during startup.
9	High Trq, 50Hz, 65% Vmin boost		
A	High Trq, 60Hz, 25% Vmin boost		
B	High Trq, 60Hz, 65% Vmin boost		
C	High Freq, 60Hz base, 90Hz max	Constant output	This pattern is used to rotate motors at greater than 60 Hz. Output voltage is constant when operating at greater than 60 Hz.
D	High Freq, 60Hz base, 120Hz max		
E	High Freq, 60Hz base, 180Hz max		
F	Custom	Constant torque	Enables a custom V/f pattern by changing *E1-04 to E1-13 [V/f Pattern for Motor 1]*. The default settings for *E1-04 to E1-13* are the same as *Setting Value 1 [Const Trq, 60Hz base, 60Hz max]*.

Note:

When you manually set V/f patterns, note these items:

- To set linear V/f characteristics at frequencies lower than *E1-06 [Base Frequency]*, set *E1-07 = E1-09 [Mid Point A Frequency = Minimum Output Frequency]*. In this application, the drive ignores *E1-08 [Mid Point A Voltage]*.
- Set the five frequencies as specified by these rules: Incorrect settings will cause *oPE10 [V/f Data Setting Error]*.
  E1-09 ≤ E1-07 < E1-06 ≤ E1-11 ≤ E1-04 [Minimum Output Frequency ≤ Mid Point A Frequency < Base Frequency ≤ Mid Point B Frequency ≤ Maximum Output Frequency]
- Setting *E1-11 = 0 [Mid Point B Frequency = 0 Hz]* disables *E1-12 [Mid Point B Voltage]*. Ensure that the four frequencies are set according to the following rules;
  E1-09 ≤ E1-07 < E1-06 ≤ E1-04
- When you use *A1-03 [Initialize Parameters]* to initialize the drive, it will not reset *E1-03*.

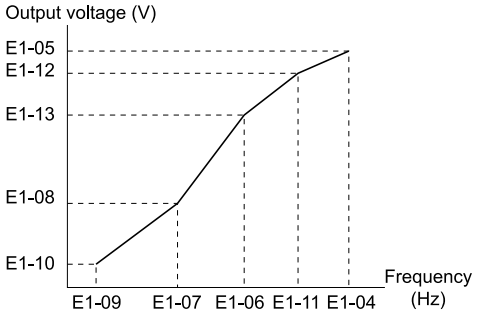


Figure 11.47 V/f Pattern

■ E1-01: Input AC Supply Voltage

No. (Hex.)	Name	Description	Default (Range)
E1-01 (0300)	Input AC Supply Voltage	V/f CL-V/f OLV CLV AOLV Sets the drive input voltage.	200 V Class: 230 V, 400 V Class: 400 V (200 V Class: 155 to 255 V, 400 V Class: 310 to 510 V)

NOTICE: *Set parameter E1-01 [Input AC Supply Voltage] to align with the drive input voltage (not motor voltage). If this parameter is incorrect, the protective functions of the drive will not operate correctly and it can cause damage to the drive.*

Values Related to the Drive Input Voltage

The value set in *E1-01* is the base value that the drive uses for the motor protective functions shown in this table. With a 400 V class drive, the detection level changes for some motor protective functions.

Voltage	E1-01 Setting	Approximate Values			
		ov Detection Level	BTR Operation Level (rr Detection Level) *1	L2-05 [Undervoltage Detection Lvl (Uv1)]	L3-17 [DC Bus Regulation Level]
200 V Class	All settings	410 V	394 V	190 V	375 V
400 V Class	Setting value ≥ 400 V	820 V	788 V	380 V	750 V
	Setting value < 400 V	820 V	788 V	350 V	750 V

*1 This is the protection function enabled in drives with built-in braking transistors. These values show the level that will trigger the built-in braking transistor. Refer to “YASKAWA AC Drive Series Option Braking Unit and Braking Resistor Unit Installation Manual (TOBPC72060001)” for more information.

■ E1-03: V/f Pattern Selection

No. (Hex.)	Name	Description	Default (Range)
E1-03 (0302)	V/f Pattern Selection	V/f CL-V/f OLV CLV AOLV Sets the V/f pattern for the drive and motor from 15 predefined patterns (settings: 0 to E) or creates a custom V/f pattern (setting: F).	F (Determined by A1-02)

Note:

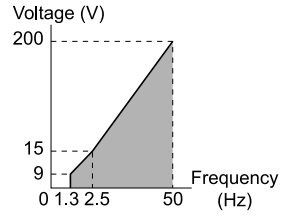
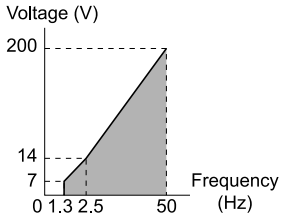
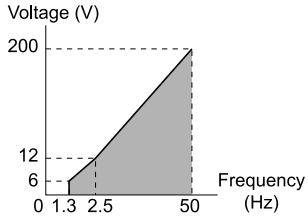
- You cannot select *0 to E* when *A1-02 = 2 [Control Method Selection = Open Loop Vector]*.
- Select the appropriate V/f pattern in accordance with the application and usage environment. Setting an improper V/f pattern may result in low motor torque or increased current because of overexcitation.
- The setting value for *E1-03* is not initialized by the Initialize Parameters *[A1-03]*.

0 : Const Trq, 50Hz base, 50Hz max

For general purpose applications. This pattern is used when the load torque is constant without any rotation speed such as that used for linear conveyor systems.

Note:

The voltage values in the figure represent those when using 200 V class drives. Double the values for 400 V class drives.

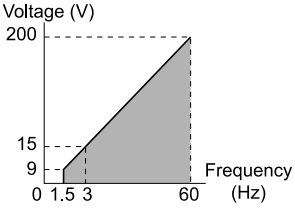
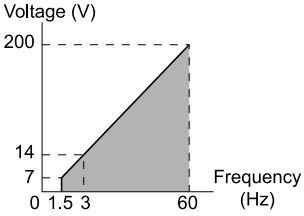
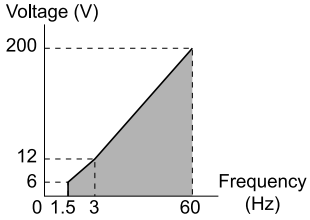
2003 - 2018, 4002 - 4009	2025 - 2180, 4015 - 4091	2215 - 2415, 4112 - 4605
		

1 : Const Trq, 60Hz base, 60Hz max

For general purpose applications. This pattern is used when the load torque is constant without any rotation speed such as that used for linear conveyor systems.

Note:

The voltage values in the figure represent those when using 200 V class drives. Double the values for 400 V class drives.

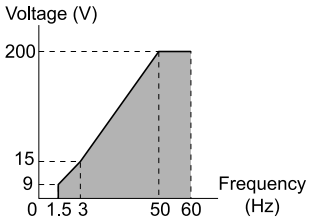
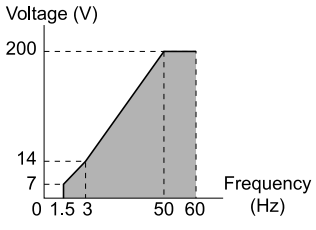
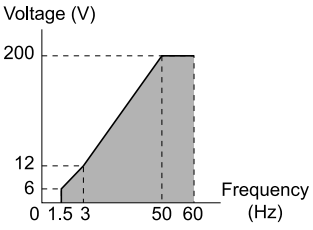
2003 - 2018, 4002 - 4009	2025 - 2180, 4015 - 4091	2215 - 2415, 4112 - 4605
		

2 : Const Trq, 50Hz base, 60Hz max

For general purpose applications. This pattern is used when the load torque is constant without any rotation speed such as that used for linear conveyor systems.

Note:

The voltage values in the figure represent those when using 200 V class drives. Double the values for 400 V class drives.

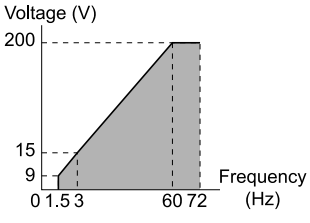
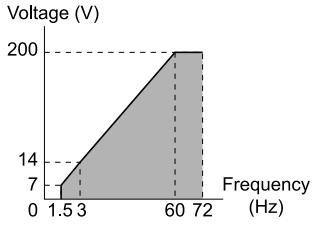
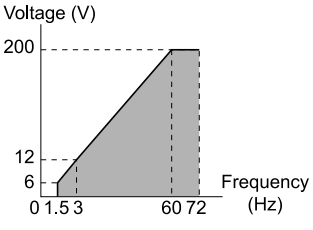
2003 - 2018, 4002 - 4009	2025 - 2180, 4015 - 4091	2215 - 2415, 4112 - 4605
		

3 : Const Trq, 60 Hz base, 72 Hz max

For general purpose applications. This pattern is used when the load torque is constant without any rotation speed such as that used for linear conveyor systems.

Note:

The voltage values in the figure represent those when using 200 V class drives. Double the values for 400 V class drives.

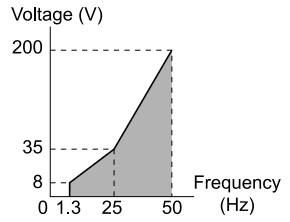
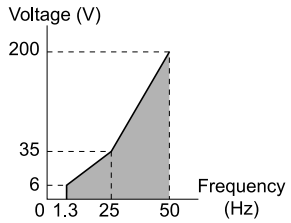
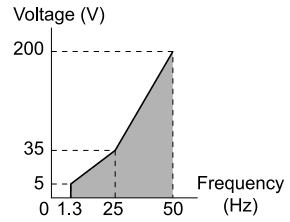
2003 - 2018, 4002 - 4009	2025 - 2180, 4015 - 4091	2215 - 2415, 4112 - 4605
		

4 : VT, 50Hz, 65% Vmid reduction

This derated torque characteristics pattern is used for torque loads proportional to three times the rotation speed, such as is the case with fans and pumps.

Note:

The voltage values in the figure represent those when using 200 V class drives. Double the values for 400 V class drives.

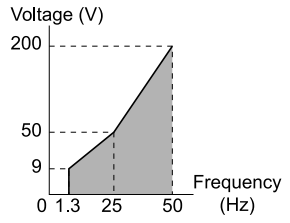
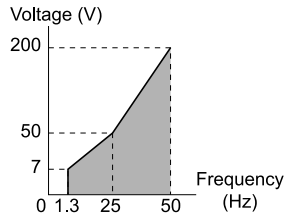
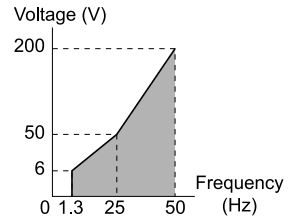
2003 - 2018, 4002 - 4009	2025 - 2180, 4015 - 4091	2215 - 2415, 4112 - 4605
		

5 : VT, 50Hz, 50% Vmid reduction

This derated torque characteristics pattern is used for torque loads proportional to two times the rotation speed, such as is the case with fans and pumps.

Note:

The voltage values in the figure represent those when using 200 V class drives. Double the values for 400 V class drives.

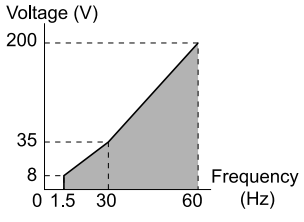
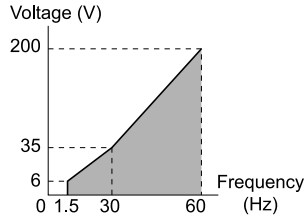
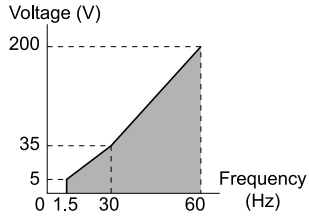
2003 - 2018, 4002 - 4009	2025 - 2180, 4015 - 4091	2215 - 2415, 4112 - 4605
		

6 : VT, 60Hz, 65% Vmid reduction

This derated torque characteristics pattern is used for torque loads proportional to three times the rotation speed, such as is the case with fans and pumps.

Note:

The voltage values in the figure represent those when using 200 V class drives. Double the values for 400 V class drives.

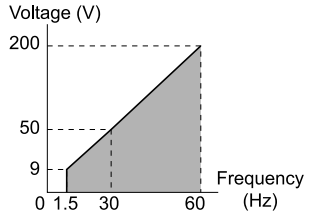
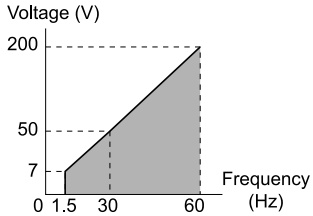
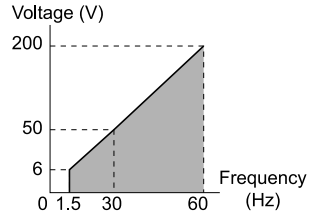
2003 - 2018, 4002 - 4009	2025 - 2180, 4015 - 4091	2215 - 2415, 4112 - 4605
		

7 : VT, 60Hz, 50% Vmid reduction

This derated torque characteristics pattern is used for torque loads proportional to two times the rotation speed, such as is the case with fans and pumps.

Note:

The voltage values in the figure represent those when using 200 V class drives. Double the values for 400 V class drives.

2003 - 2018, 4002 - 4009	2025 - 2180, 4015 - 4091	2215 - 2415, 4112 - 4605
		

8 : High Trq, 50Hz, 25% Vmin boost

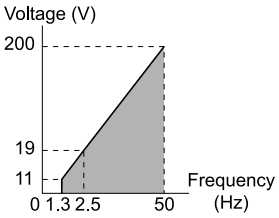
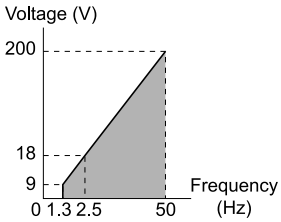
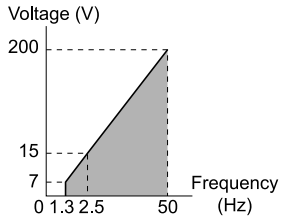
This pattern is used when moderate torque is required during startup.

Select this pattern only in the following circumstances.

- Wiring distance between the drive and motor is at least 150 m.
- An AC reactor is connected to the drive output.

Note:

The voltage values in the figure represent those when using 200 V class drives. Double the values for 400 V class drives.

2003 - 2018, 4002 - 4009	2025 - 2180, 4015 - 4091	2215 - 2415, 4112 - 4605
		

9 : High Trq, 50Hz, 65% Vmin boost

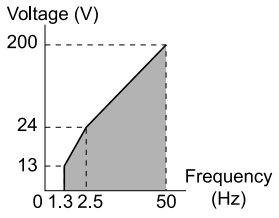
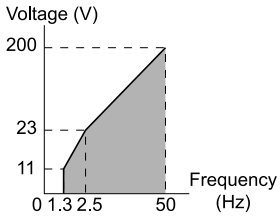
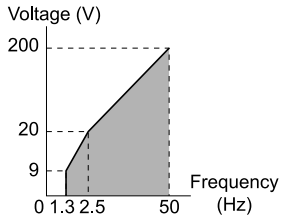
This pattern is used when strong torque is required during startup.

Select this pattern only in the following circumstances.

- Wiring distance between the drive and motor is at least 150 m.
- An AC reactor is connected to the drive output.

Note:

The voltage values in the figure represent those when using 200 V class drives. Double the values for 400 V class drives.

2003 - 2018, 4002 - 4009	2025 - 2180, 4015 - 4091	2215 - 2415, 4112 - 4605
		

A : High Trq, 60Hz, 25% Vmin boost

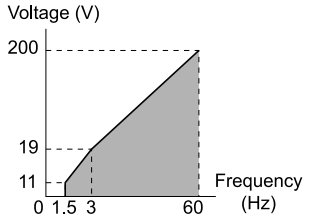
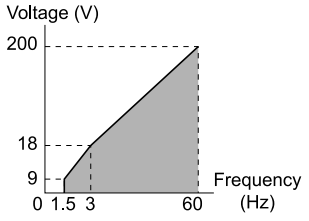
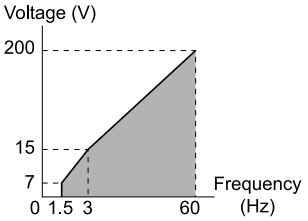
This pattern is used when moderate torque is required during startup.

Select this pattern only in the following circumstances.

- Wiring distance between the drive and motor is at least 150 m.
- An AC reactor is connected to the drive output.

Note:

The voltage values in the figure represent those when using 200 V class drives. Double the values for 400 V class drives.

2003 - 2018, 4002 - 4009	2025 - 2180, 4015 - 4091	2215 - 2415, 4112 - 4605
		

B : High Trq, 60Hz, 65% Vmin boost

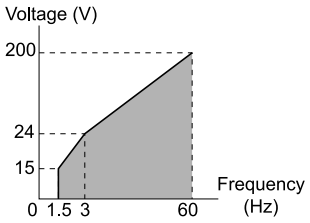
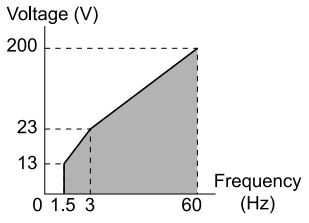
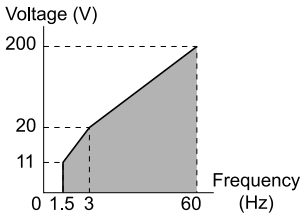
This pattern is used when strong torque is required during startup.

Select this pattern only in the following circumstances.

- Wiring distance between the drive and motor is at least 150 m.
- An AC reactor is connected to the drive output.

Note:

The voltage values in the figure represent those when using 200 V class drives. Double the values for 400 V class drives.

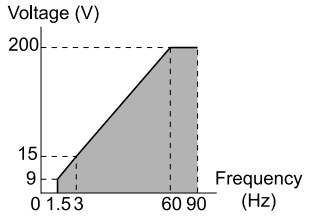
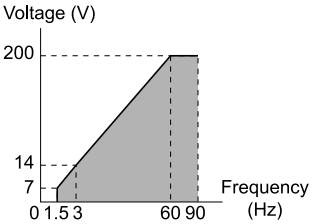
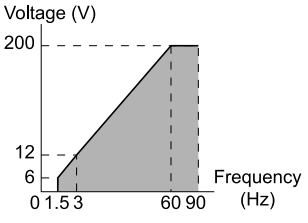
2003 - 2018, 4002 - 4009	2025 - 2180, 4015 - 4091	2215 - 2415, 4112 - 4605
		

C : Const Trq, 60 Hz base, 90 Hz max

This pattern is used to rotate motors at greater than 60 Hz. Output voltage is constant when operating at greater than 60 Hz.

Note:

The voltage values in the figure represent those when using 200 V class drives. Double the values for 400 V class drives.

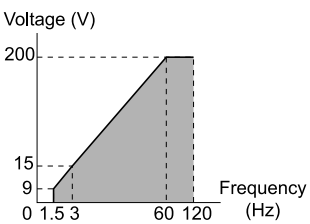
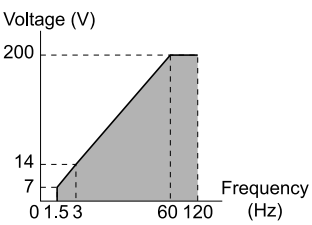
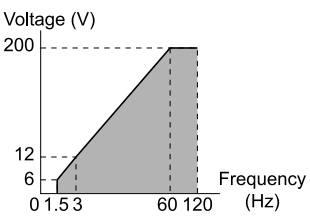
2003 - 2018, 4002 - 4009	2025 - 2180, 4015 - 4091	2215 - 2415, 4112 - 4605
		

D : Const Trq, 60 Hz base, 120 Hz max

This pattern is used to rotate motors at greater than 60 Hz. Output voltage is constant when operating at greater than 60 Hz.

Note:

The voltage values in the figure represent those when using 200 V class drives. Double the values for 400 V class drives.

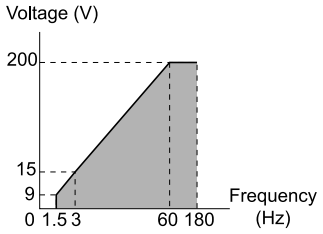
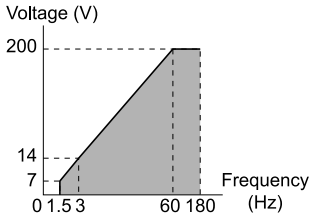
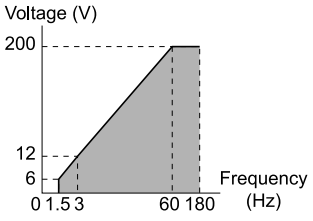
2003 - 2018, 4002 - 4009	2025 - 2180, 4015 - 4091	2215 - 2415, 4112 - 4605
		

E : Const Trq, 60 Hz base, 180 Hz max

This pattern is used to rotate motors at greater than 60 Hz. Output voltage is constant when operating at greater than 60 Hz.

Note:

The voltage values in the figure represent those when using 200 V class drives. Double the values for 400 V class drives.

2003 - 2018, 4002 - 4009	2025 - 2180, 4015 - 4091	2215 - 2415, 4112 - 4605
		

F : Custom

Enables a custom V/f pattern by changing *E1-04 to E1-13 [V/f Pattern for Motor 1]*.

The default settings are equivalent to setting value *1 [Const Trq, 60Hz base, 60Hz max]*.

■ E1-04: Maximum Output Frequency

No. (Hex.)	Name	Description	Default (Range)
E1-04 (0303)	Maximum Output Frequency	V/f CL-V/f OLV CLV AOLV Sets the maximum output frequency for the V/f pattern.	Determined by A1-02 (Determined by A1-02)

■ E1-05: Maximum Output Voltage

No. (Hex.)	Name	Description	Default (Range)
E1-05 (0304)	Maximum Output Voltage	V/f CL-V/f OLV CLV AOLV Sets the maximum output voltage for the V/f pattern.	200.0 (200 V Class: 0.0 - 255.0 V, 400 V Class: 0.0 - 510.0 V)

■ E1-06: Base Frequency

No. (Hex.)	Name	Description	Default (Range)
E1-06 (0305)	Base Frequency	V/f CL-V/f OLV CLV AOLV Sets the base frequency for the V/f pattern.	Determined by A1-02 (0.0 - E1-04)

■ E1-07: Mid Point A Frequency

No. (Hex.)	Name	Description	Default (Range)
E1-07 (0306)	Mid Point A Frequency	V/f CL-V/f OLV CLV AOLV Sets a middle output frequency for the V/f pattern.	Determined by A1-02 (0.0 - E1-04)

■ E1-08: Mid Point A Voltage

No. (Hex.)	Name	Description	Default (Range)
E1-08 (0307)	Mid Point A Voltage	V/f CL-V/f OLV CLV AOLV Sets a middle output voltage for the V/f pattern.	Determined by A1-02 (200 V Class: 0.0 - 255.0 V, 400 V Class: 0.0 - 510.0 V)

Note:

Default setting is determined by *A1-02 [Control Method Selection]* and *o2-04 [Drive Model (KVA) Selection]*.

■ E1-09: Minimum Output Frequency

No. (Hex.)	Name	Description	Default (Range)
E1-09 (0308)	Minimum Output Frequency	V/f CL-V/f OLV CLV AOLV Sets the minimum output frequency for the V/f pattern.	Determined by A1-02 (Determined by A1-02 and E1-04)

■ E1-10: Minimum Output Voltage

No. (Hex.)	Name	Description	Default (Range)
E1-10 (0309)	Minimum Output Voltage	V/f CL-V/f OLV CLV AOLV Sets the minimum output voltage for the V/f pattern.	Determined by A1-02 (200 V Class: 0.0 to 255.0 V, 400 V Class: 0.0 to 510.0 V)

■ E1-11: Mid Point B Frequency

No. (Hex.)	Name	Description	Default (Range)
E1-11 (030A) Expert	Mid Point B Frequency	V/f CL-V/f OLV CLV AOLV Sets a middle output frequency for the V/f pattern.	0.0 Hz (0.0 - E1-04)

Note:

Set this parameter to *0.0* to disable the function.

■ E1-12: Mid Point B Voltage

No. (Hex.)	Name	Description	Default (Range)
E1-12 (030B) Expert	Mid Point B Voltage	V/f CL-V/f OLV CLV AOLV Sets a middle point voltage for the V/f pattern.	0.0 V (200 V Class: 0.0 to 255.0 V, 400 V Class: 0.0 to 510.0 V)

Note:

Set this parameter to *0.0* to disable the function.

■ E1-13: Base Voltage

No. (Hex.)	Name	Description	Default (Range)
E1-13 (030C) Expert	Base Voltage	V/f CL-V/f OLV CLV AOLV Sets the base voltage for the V/f pattern.	0.0 V (200 V Class: 0.0 - 255.0 V,400 V Class: 0.0 - 510.0 V)

Note:

- After Auto-Tuning, the value of *E1-13 = E1-05 [Maximum Output Voltage]*.
- When *E1-13 = 0.0*, use the value of *E1-05* to control the voltage.

■ E1-14: Middle Out Freq Volt Select 1

No. (Hex.)	Name	Description	Default (Range)
E1-14 (034C)	Middle Out Freq Volt Select 1	V/f CL-V/f OLV CLV AOLV Sets the mid point A voltage for reverse run used when *b1-23 = 1 [Selection REV Parameters = Enabled]*.	Determined by A1-02 and E1-03 (200 V Class: 0.0 - 255.0 V, 400 V Class: 0.0 - 510.0 V)

■ E1-15: Minimum Out Freq Volt Select 1

No. (Hex.)	Name	Description	Default (Range)
E1-15 (034D)	Minimum Out Freq Volt Select 1	V/f CL-V/f OLV CLV AOLV Sets the minimum output voltage for reverse run used when *b1-23 = 1 [Selection REV Parameters = Enabled]*.	Determined by A1-02 and E1-03 (200 V Class: 0.0 - 255.0 V, 400 V Class: 0.0 - 510.0 V)

■ E1-16: Middle Out Freq Volt Select 2

No. (Hex.)	Name	Description	Default (Range)
E1-16 (034E)	Middle Out Freq Volt Select 2	V/f CL-V/f OLV CLV AOLV Sets the mid point A voltage used when *H1-xx = 38 [MFDI Function Selection = Counterweight Selection]*.	Determined by A1-02 and E1-03 (200 V Class: 0.0 - 255.0 V, 400 V Class: 0.0 - 510.0 V)

■ E1-17: Minimum Out Freq Volt Select 2

No. (Hex.)	Name	Description	Default (Range)
E1-17 (034F)	Minimum Out Freq Volt Select 2	V/f CL-V/f OLV CLV AOLV Sets the minimum output voltage used when *H1-xx = 38 [MFDI Function Selection = Counterweight Selection]* is ON.	Determined by A1-02 and E1-03 (200 V Class: 0.0 - 255.0 V, 400 V Class: 0.0 - 510.0 V)

■ E1-18: Middle Out Freq Volt Select 3

No. (Hex.)	Name	Description	Default (Range)
E1-18 (0354)	Middle Out Freq Volt Select 3	V/f CL-V/f OLV CLV AOLV Sets the mid point A voltage for reverse run used when *b1-23 = 1 [Selection REV Parameters = Enabled]* and *H1-xx = 38 [MFDI Function Selection = Counterweight Selection]* is ON.	Determined by A1-02 and E1-03 (200 V Class: 0.0 - 255.0 V, 400 V Class: 0.0 - 510.0 V)

■ E1-19: Minimum Out Freq Volt Select 3

No. (Hex.)	Name	Description	Default (Range)
E1-19 (0355)	Minimum Out Freq Volt Select 3	V/f CL-V/f OLV CLV AOLV Sets the minimum output voltage for reverse run used when *b1-23 = 1 [Selection REV Parameters = Enabled]*.	Determined by A1-02 and E1-03 (200 V Class: 0.0 - 255.0 V, 400 V Class: 0.0 - 510.0 V)

■ E1-20: UL Motor1 Sel

No. (Hex.)	Name	Description	Default (Range)
E1-20 (0BF3)	UL Motor1 Sel	V/f CL-V/f OLV CLV AOLV Sets the motor characteristics.	2 (0 - 2)

0 : Constant Torque
1 : Variable Torque
2 : Auto Distinction

◆ E2: Motor Parameters

E2 parameters [Motor Parameters] are used to set induction motor data. To switch drive operation from one motor to another motor, set the first motor (motor 1).

Performing Auto-Tuning automatically sets the *E2 parameters* to the optimal values. If Auto-Tuning cannot be performed, set the *E2 parameters* manually.

■ E2-01: Motor Rated Current (FLA)

No. (Hex.)	Name	Description	Default (Range)
E2-01 (030E)	Motor Rated Current (FLA)	V/f CL-V/f OLV CLV AOLV Sets the motor rated current in amps.	Determined by o2-04 (10% to 200% of the drive rated current)

Note:
- If parameter *E2-01 < E2-03 [Motor No-Load Current]* is set, *oPE02 [Parameter Range Setting Error]* will be detected.
- The units for the default setting and setting range vary depending on the model of the drive.
  – 2003 to 2033, 4002 to 4018: 0.01 A units
  – 2047 to 2415, 4024 to 4605: 0.1 A units

The value set for *E2-01* becomes the reference value for motor protection and the torque limit. Enter the motor rated current as shown on the motor nameplate. The value of *E2-01* is automatically set to the value input for "Motor Rated Current" by the Auto-Tuning process.

■ E2-02: Motor Rated Slip

No. (Hex.)	Name	Description	Default (Range)
E2-02 (030F)	Motor Rated Slip	V/f CL-V/f OLV CLV AOLV Sets motor rated slip.	Determined by o2-04 (0.000 - 20.000 Hz)

The setting value of *E2-02* is the slip compensation reference value. The drive sets this parameter during the Auto-Tuning process (Rotational Auto-Tuning and Stationary Auto-Tuning). If Auto-Tuning cannot be performed, calculate the motor rated slip using the information written on the motor nameplate and the formula below:

E2-02 = f - (n × p) / 120

- f: Motor rated frequency (Hz)
- n: Rated motor speed (min^{-1} (r/min))
- p: Number of motor poles

■ E2-03: Motor No-Load Current

No. (Hex.)	Name	Description	Default (Range)
E2-03 (0310)	Motor No-Load Current	V/f CL-V/f OLV CLV AOLV Sets the no-load current for the motor in amps when operating at the rated frequency and the no-load voltage.	Determined by o2-04 (0 - E2-01)

Note:

The units for the default setting and setting range vary depending on the model of the drive.
- 2003 to 2033, 4002 to 4018: 0.01 A units
- 2047 to 2415, 4024 to 4605: 0.1 A units

The drive sets this parameter during the Auto-Tuning process (Rotational Auto-Tuning and Stationary Auto-Tuning). The motor no-load current listed in the motor test report can also be entered to E2-03 manually. Contact the motor manufacturer to receive a copy of the motor test report.

Note:

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

■ E2-04: Motor Pole Count

No. (Hex.)	Name	Description	Default (Range)
E2-04 (0311)	Motor Pole Count	V/f CL-V/f OLV CLV AOLV Sets the number of motor poles.	4 (2 - 120)

Note:
- When *A1-02 = 0, 1, 3 [Control Method Selection = V/f, CL-V/f, CLV]*, the maximum value is 120.
- When *A1-02 = 2, 4 [OLV, AOLV]*, the maximum value is 48.

Auto-Tuning automatically sets this parameter to the value of [Number of Motor Poles].

■ E2-05: Motor Line-to-Line Resistance

No. (Hex.)	Name	Description	Default (Range)
E2-05 (0312)	Motor Line-to-Line Resistance	V/f CL-V/f OLV CLV AOLV Sets the line-to-line resistance for the motor stator windings.	Determined by o2-04 (0.000 - 65.000 Ω)

Note:

This value is the motor line-to-line resistance. Be careful not to set this parameter with the single phase resistance.

If Auto-Tuning completes successfully, this value is automatically calculated. If Auto-Tuning cannot be executed, obtain a test report from the motor manufacturer. Use the information found on the motor nameplate with any of the following formulas to calculate the motor line-to-line resistance.

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

■ E2-06: Motor Leakage Inductance

No. (Hex.)	Name	Description	Default (Range)
E2-06 (0313)	Motor Leakage Inductance	V/f CL-V/f OLV CLV AOLV Sets the voltage drop due to motor leakage inductance as a percentage of motor rated voltage while the motor is operating at the rated frequency and rated current.	Determined by o2-04 (0.0 - 60.0%)

This value is automatically set during Auto-Tuning (Rotational Auto-Tuning, Stationary Auto-Tuning).

Note:

The amount of voltage drop cannot usually be found on the motor nameplate. If you do not know the value of the motor leakage inductance, contact the motor manufacturer to receive a copy of the motor test report.

■ E2-07: Motor Saturation Coefficient 1

No. (Hex.)	Name	Description	Default (Range)
E2-07 (0314)	Motor Saturation Coefficient 1	V/f CL-V/f OLV CLV AOLV Sets the motor iron-core saturation coefficient at 50% of the magnetic flux.	0.50 (0.00 - 0.50)

The drive uses this coefficient when it operates with constant output. The drive uses this coefficient when it operates the motor in the constant output range.

■ E2-08: Motor Saturation Coefficient 2

No. (Hex.)	Name	Description	Default (Range)
E2-08 (0315)	Motor Saturation Coefficient 2	V/f CL-V/f OLV CLV AOLV Sets the motor iron-core saturation coefficient at 75% of the magnetic flux.	0.75 (E2-07 - 0.75)

The drive uses this coefficient when it operates with constant output. The drive uses this coefficient when it operates the motor in the constant output range.

■ E2-09: Motor Mechanical Loss

No. (Hex.)	Name	Description	Default (Range)
E2-09 (0316) Expert	Motor Mechanical Loss	V/f CL-V/f OLV CLV AOLV Sets the mechanical loss of the motor. It is set as a percentage of *E2-11 [Motor Rated Power]*. Usually it is not necessary to change this setting.	0.0% (0.0 - 10.0%)

Adjust this parameter in these conditions. The drive adds the configured mechanical loss to the torque reference value as a torque compensation value:

- There is a large quantity of torque loss from motor bearing friction.
- There is a large quantity of torque loss in fans and pumps.

■ E2-10: Motor Iron Loss

No. (Hex.)	Name	Description	Default (Range)
E2-10 (0317)	Motor Iron Loss	V/f CL-V/f OLV CLV AOLV Sets the motor iron loss.	Determined by o2-04 (0 - 65535 W)

■ E2-11: Motor Rated Power (kW)

No. (Hex.)	Name	Description	Default (Range)
E2-11 (0318)	Motor Rated Power	V/f CL-V/f OLV CLV AOLV Sets the motor rated power in 0.01 kW increments. (1 HP = 0.746 kW)	Determined by o2-04 (0.00 - 650.00 kW)

The drive automatically sets *E2-11* to the value input for [Motor Rated Power] during Auto-Tuning.

Note:

The motor rated power unit changes when the maximum applicable motor output changes.
- The maximum applicable motor output ≤ 300 kW: 0.01 kW units
- The maximum applicable motor output > 300 kW: 0.1 kW units

◆ E3: V/f Pattern for Motor 2

E3 parameters [V/f Pattern for Motor 2] set the control mode and V/f pattern used for motor 2.

Note:

V/f preset patterns equivalent to those set with *E1-03 [V/f Pattern Selection]* are not available for *E3 parameters*. Use *E3-04 [Motor 2 Maximum Output Frequency]* to *E3-10 [Motor 2 Minimum Output Voltage]* to manually set the V/f pattern.

■ Notes on Manually Setting V/f Patterns

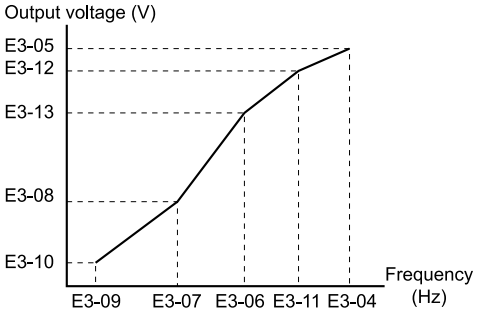


Figure 11.48 Motor 2 V/f Pattern Diagram

- To configure a linear V/f pattern at frequencies lower than *E3-06 [Motor 2 Base Frequency]*, set *E3-07 = E3-09 [Motor 2 Mid Point A Frequency = Motor 2 Minimum Output Frequency]*. In this application, the drive ignores *E1-08 [Mid Point A Voltage]*.
- Set the five frequencies as specified by these rules:
  E3-09 ≤ E3-07 < E3-06 ≤ E3-11 ≤ E3-04 [Motor 2 Minimum Output Frequency ≤ Motor 2 Mid Point A Frequency < Motor 2 Base Frequency ≤ Motor 2 Mid Point B Frequency ≤ Motor 2 Maximum Output Frequency]
  Incorrect settings will trigger *oPE10 [V/f Data Setting Error]*.
- If *E3-11 = 0.0 Hz*, the drive will ignore the V/f pattern settings.
- When you use *A1-03 [Initialize Parameters]* to initialize the drive, the drive will reset the manually set values for *E3-04 to E3-13 [Motor 2 Base Voltage]* to default values.

■ E3-01: Motor 2 Control Mode Selection

No. (Hex.)	Name	Description	Default (Range)
E3-01 (0319)	Motor 2 Control Mode Selection	V/f CL-V/f OLV CLV AOLV Sets the control method for motor 2.	2 (0 - 3)

Note:

- Changing the motor 2 control mode selection changes the settings value of parameters dependent on *E3-01* to the default settings.
- Parameter *L1-01 [Motor Overload (oL1) Protection]* sets the protection operation of *oL1 [Motor Overload]* the same as Motor 1.
- When you use parameter *A1-03 [Initialize Parameters]* to initialize the drive, this parameter is not reset.

0 : V/f Control

1 : Closed Loop V/f control

2 : Open Loop Vector control

3 : Closed Loop Vector control

■ E3-04: Motor 2 Maximum Output Frequency

No. (Hex.)	Name	Description	Default (Range)
E3-04 (031A)	Motor 2 Maximum Output Frequency	V/f CL-V/f OLV CLV AOLV Set the maximum output frequency for the motor 2 V/f pattern.	Determined by E3-01 (40.0 - 590.0 Hz)

■ E3-05: Motor 2 Maximum Output Voltage

No. (Hex.)	Name	Description	Default (Range)
E3-05 (031B)	Motor 2 Maximum Output Voltage	V/f CL-V/f OLV CLV AOLV Sets the maximum output voltage for the motor 2 V/f pattern.	Determined by E3-01 (200 V Class: 0.0 - 255.0 V, 400 V Class: 0.0 - 510.0 V)

■ E3-06: Motor 2 Base Frequency

No. (Hex.)	Name	Description	Default (Range)
E3-06 (031C)	Motor 2 Base Frequency	V/f CL-V/f OLV CLV AOLV Sets the base frequency for the motor 2 V/f pattern.	Determined by E3-01 (0.0 - E3-04)

■ E3-07: Motor 2 Mid Point A Frequency

No. (Hex.)	Name	Description	Default (Range)
E3-07 (031D)	Motor 2 Mid Point A Frequency	V/f CL-V/f OLV CLV AOLV Sets a middle output frequency for the motor 2 V/f pattern.	Determined by E3-01 (0.0 - E3-04)

■ E3-08: Motor 2 Mid Point A Voltage

No. (Hex.)	Name	Description	Default (Range)
E3-08 (031E)	Motor 2 Mid Point A Voltage	V/f CL-V/f OLV CLV AOLV Sets a middle output voltage for the motor 2 V/f pattern.	Determined by E3-01 (200 V Class: 0.0 - 255.0 V, 400 V Class: 0.0 - 510.0 V)

■ E3-09: Motor 2 Minimum Output Frequency

No. (Hex.)	Name	Description	Default (Range)
E3-09 (031F)	Motor 2 Minimum Output Frequency	V/f CL-V/f OLV CLV AOLV Sets the minimum output frequency for the motor 2 V/f pattern.	Determined by E3-01 (0.0 - E3-04)

■ E3-10: Motor 2 Minimum Output Voltage

No. (Hex.)	Name	Description	Default (Range)
E3-10 (0320)	Motor 2 Minimum Output Voltage	V/f CL-V/f OLV CLV AOLV Sets the minimum output voltage for the motor 2 V/f pattern.	Determined by E3-01 (200 V Class: 0.0 - 255.0 V, 400 V Class: 0.0 - 510.0 V)

■ E3-11: Motor 2 Mid Point B Frequency

No. (Hex.)	Name	Description	Default (Range)
E3-11 (0345) Expert	Motor 2 Mid Point B Frequency	V/f CL-V/f OLV CLV AOLV Sets a middle output frequency for the motor 2 V/f pattern. Set this parameter to adjust the V/f pattern for the constant output range. Usually it is not necessary to change this parameter.	0.0 Hz (0.0 - E3-04)

Note:
- Set this parameter to *0.0* to disable the function.
- When you initialize the drive, this parameter is reset to the default value.

■ E3-12: Motor 2 Mid Point B Voltage

No. (Hex.)	Name	Description	Default (Range)
E3-12 (0346) Expert	Motor 2 Mid Point B Voltage	V/f CL-V/f OLV CLV AOLV Sets a middle output voltage for the motor 2 V/f pattern. Set this parameter to adjust the V/f pattern for the constant output range. Usually it is not necessary to change this parameter.	0.0 V (200 V Class: 0.0 to 255.0 V, 400 V Class: 0.0 to 510.0 V)

Note:
- Set this parameter to *0.0* to disable the function.
- When you initialize the drive, this parameter is reset to the default value.
- The setting value changes automatically when you do Auto-Tuning (rotational and stationary 1 or 2).

■ E3-13: Motor 2 Base Voltage

No. (Hex.)	Name	Description	Default (Range)
E3-13 (0347) Expert	Motor 2 Base Voltage	V/f CL-V/f OLV CLV AOLV Sets the base voltage for the motor 2 V/f pattern. Set this parameter to adjust the V/f pattern for the constant output range. Usually it is not necessary to change this parameter.	0.0 V (200 V Class: 0.0 to 255.0 V, 400 V Class: 0.0 to 510.0 V)

Note:
- When you initialize the drive, this parameter is reset to the default value.
- The setting value changes automatically when you do Auto-Tuning (rotational and stationary 1 or 2).

■ E3-14: M2 Middle Out Freq Volt Select

No. (Hex.)	Name	Description	Default (Range)
E3-14 (114E)	M2 Middle Out Freq Volt Select	V/f CL-V/f OLV CLV AOLV Sets the mid point A voltage for motor 2 reverse run used when *b1-23 = 1 [Selection REV Parameters = Enabled]*.	Determined by E3-01 and E1-03 (200 V Class: 0.0 to 255.0 V, 400 V Class: 0.0 to 510.0 V)

■ E3-15: M2 Minimum Out Freq Volt Select

No. (Hex.)	Name	Description	Default (Range)
E3-15 (114F)	M2 Minimum Out Freq Volt Select	V/f CL-V/f OLV CLV AOLV Sets the minimum output voltage for motor 2 reverse run used when *b1-23 = 1 [Selection REV Parameters = Enabled]*.	Determined by E3-01 and E1-03 (200 V Class: 0.0 to 255.0 V, 400 V Class: 0.0 to 510.0 V)

■ E3-20: UL Motor2 Sel

No. (Hex.)	Name	Description	Default (Range)
E3-20 (0BF4)	UL Motor2 Sel	V/f CL-V/f OLV CLV AOLV Sets the motor characteristics.	2 (0 - 2)

0 : Constant Torque
1 : Variable Torque
2 : Auto Distinction

◆ E4: Motor 2 Parameters

E4 parameters [Motor 2 Parameters] set induction motor data. To switch drive operation from one motor to a different motor, configure motor 2.

Auto-Tuning automatically sets the *E4 parameters* to the best values for the application. If you cannot do Auto-Tuning, set the *E4 parameters* manually.

Note:
E3-xx and *E4-xx* are available when *H1-xx = 16 [MFDI Function Select = Motor 2 Selection]*.

■ E4-01: Motor 2 Rated Current

No. (Hex.)	Name	Description	Default (Range)
E4-01 (0321)	Motor 2 Rated Current	V/f CL-V/f OLV CLV AOLV Sets the motor rated current for motor 2 in amps.	Determined by o2-04 (10% to 200% of the drive rated current)

Note:
- If *E4-01 ≤ E4-03 [Motor 2 Rated No-Load Current]* is set, *oPE02 [Parameter Range Setting Error]* will be detected.
- The default settings and setting ranges appear in the following units:
  – 2003 to 2033, 4002 to 4018: 0.01 A units
  – 2047 to 2415, 4024 to 4605: 0.1 A units

The value set for *E4-01* becomes the reference value for motor protection and the torque limit. Enter the motor rated current as shown on the motor nameplate. The value of *E4-01* is automatically set to the value input for [Motor Rated Current] by the Auto-Tuning process.

■ E4-02: Motor 2 Rated Slip

No. (Hex.)	Name	Description	Default (Range)
E4-02 (0322)	Motor 2 Rated Slip	V/f CL-V/f OLV CLV AOLV Sets the motor rated slip for motor 2.	Determined by o2-04 (0.000 - 20.000 Hz)

The setting value of *E4-02* is the slip compensation reference value. The drive sets this parameter during the Auto-Tuning process (Rotational Auto-Tuning and Stationary Auto-Tuning). If Auto-Tuning cannot be performed, calculate the motor rated slip using the information written on the motor nameplate and the formula below:

E4-02 = f - (n × p) / 120

- f: Motor rated frequency (Hz)
- n: Rated motor speed (min^{-1} (r/min))
- p: Number of motor poles

■ E4-03: Motor 2 Rated No-Load Current

No. (Hex.)	Name	Description	Default (Range)
E4-03 (0323)	Motor 2 Rated No-Load Current	V/f CL-V/f OLV CLV AOLV Sets the no-load current for motor 2 in amps when operating at the rated frequency and the no-load voltage.	Determined by o2-04 (Less than 0 - E4-01)

Note:

The default settings and setting ranges appear in the following units:
- 2003 to 2033, 4002 to 4018: 0.01 A units
- 2047 to 2415, 4024 to 4605: 0.1 A units

The drive sets this parameter during the Auto-Tuning process (Rotational Auto-Tuning and Stationary Auto-Tuning). The motor no-load current listed in the motor test report can also be entered to E2-03 manually. Contact the motor manufacturer to receive a copy of the motor test report.

Note:

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

■ E4-04: Motor 2 Motor Poles

No. (Hex.)	Name	Description	Default (Range)
E4-04 (0324)	Motor 2 Motor Poles	V/f CL-V/f OLV CLV AOLV Sets the number of poles for motor 2.	4 (2 - 120)

Auto-Tuning automatically sets *E4-04* to the value input for [Number of Motor Poles].

■ E4-05: Motor 2 Line-to-Line Resistance

No. (Hex.)	Name	Description	Default (Range)
E4-05 (0325)	Motor 2 Line-to-Line Resistance	V/f CL-V/f OLV CLV AOLV Sets the line-to-line resistance for the motor 2 stator windings.	Determined by o2-04 (0.000 - 65.000 Ω)

Note:

This value represents the line-to-line resistance for motor 2. Be careful not to set this parameter with the single phase resistance.

If Auto-Tuning completes successfully, this value is automatically calculated. If Auto-Tuning cannot be executed, obtain a test report from the motor manufacturer. Use the information found on the motor nameplate with any of the following formulas to calculate the motor line-to-line resistance.

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

■ E4-06: Motor 2 Leakage Inductance

No. (Hex.)	Name	Description	Default (Range)
E4-06 (0326)	Motor 2 Leakage Inductance	V/f CL-V/f OLV CLV AOLV Sets the voltage drop from motor 2 leakage inductance as a percentage of Motor Rated Voltage when motor 2 operates at the rated frequency and rated current.	Determined by o2-04 (0.0 - 60.0%)

This value is automatically set during Auto-Tuning (Rotational Auto-Tuning, Stationary Auto-Tuning).

Note:

The amount of voltage drop cannot usually be found on the motor nameplate. If the value of the motor 2 leakage inductance is unknown, obtain a test report from the motor manufacturer.

■ E4-07: Motor 2 Saturation Coefficient 1

No. (Hex.)	Name	Description	Default (Range)
E4-07 (0343)	Motor 2 Saturation Coefficient 1	V/f CL-V/f OLV CLV AOLV Sets the motor 2 iron-core saturation coefficient at 50% of the magnetic flux.	0.50 (0.00 - 0.50)

The drive sets this parameter during Rotational Auto-Tuning. The drive uses this value when it operates the motor in the constant output range.

■ E4-08: Motor 2 Saturation Coefficient 2

No. (Hex.)	Name	Description	Default (Range)
E4-08 (0344)	Motor 2 Saturation Coefficient 2	V/f CL-V/f OLV CLV AOLV Sets the motor 2 iron-core saturation coefficient at 75% of the magnetic flux.	0.75 (E4-07 - 0.75)

The drive sets this parameter during Rotational Auto-Tuning. The drive uses this value when it operates the motor in the constant output range.

■ E4-09: Motor 2 Mechanical Loss

No. (Hex.)	Name	Description	Default (Range)
E4-09 (033F) Expert	Motor 2 Mechanical Loss	V/f CL-V/f OLV CLV AOLV Sets the mechanical loss of motor 2. It is set as a percentage of *E4-11 [Motor 2 Rated Power]*. Usually it is not necessary to change this setting.	0.0% (0.0 - 10.0%)

Adjust this parameter in these conditions. The drive adds the configured mechanical loss to the torque reference value as a torque compensation value:

- There is a large quantity of torque loss from motor bearing friction.
- There is a large quantity of torque loss in fans and pumps.

■ E4-10: Motor 2 Iron Loss

No. (Hex.)	Name	Description	Default (Range)
E4-10 (0340)	Motor 2 Iron Loss	V/f CL-V/f OLV CLV AOLV Sets the motor iron loss for motor 2.	Determined by o2-04 (0 - 65535 W)

■ E4-11: Motor 2 Rated Power

No. (Hex.)	Name	Description	Default (Range)
E4-11 (0327)	Motor 2 Rated Power	V/f CL-V/f OLV CLV AOLV Sets the motor rated power in 0.01 kW increments. (1 HP = 0.746 kW)	Determined by o2-04 (0.00 - 650.00 kW)

The drive automatically sets *E4-11* to the value input for [Motor Rated Power] during Auto-Tuning.

Note:

The value appears in units of 300 kW when the maximum applicable motor output is less than 0.01 kW and appears in units of 300 kW when over 0.1 kW.

◆ E7: Motor 3 Parameters

E7 parameters [Motor 3 Parameters] are used to set induction motor data.
Motor 3 is only available with V/f Control.

■ E7-04: Motor 3 Maximum Output Frequency

No. (Hex.)	Name	Description	Default (Range)
E7-04 (1B61)	Motor 3 Maximum Output Frequency	V/f CL-V/f OLV CLV AOLV Set the maximum output frequency for the motor 3.	Determined by E1-03 (40.0 - 590.0 Hz)

■ E7-05: Motor 3 Maximum Output Voltage

No. (Hex.)	Name	Description	Default (Range)
E7-05 (1B62)	Motor 3 Maximum Output Voltage	V/f CL-V/f OLV CLV AOLV Sets the maximum output voltage used for motor 3.	Determined by E1-03 (200 V Class: 0.0 - 255.0 V, 400 V Class: 0.0 - 510.0 V)

■ E7-06: Motor 3 Base Frequency

No. (Hex.)	Name	Description	Default (Range)
E7-06 (1B63)	Motor 3 Base Frequency	V/f CL-V/f OLV CLV AOLV Sets the base frequency used for motor 3.	Determined by E1-03 (0.0 - E7-04)

■ E7-07: Motor 3 Mid Point A Frequency

No. (Hex.)	Name	Description	Default (Range)
E7-07 (1B64)	Motor 3 Mid Point A Frequency	V/f CL-V/f OLV CLV AOLV Sets the middle output frequency used for motor 3.	Determined by E1-03 (0.0 - E7-04)

■ E7-08: Motor 3 Mid Point A Voltage

No. (Hex.)	Name	Description	Default (Range)
E7-08 (1B65)	Motor 3 Mid Point A Voltage	V/f CL-V/f OLV CLV AOLV Sets the middle output frequency voltage used for motor 3.	Determined by E1-03 (200 V Class: 0.0 - 255.0 V, 400 V Class: 0.0 - 510.0 V)

■ E7-09: Motor 3 Minimum Output Frequency

No. (Hex.)	Name	Description	Default (Range)
E7-09 (1B66)	Motor 3 Minimum Output Frequency	V/f CL-V/f OLV CLV AOLV Sets the minimum output frequency for the motor 3.	Determined by E1-03 (0.0 - E7-04)

■ E7-10: Motor 3 Minimum Output Voltage

No. (Hex.)	Name	Description	Default (Range)
E7-10 (1B67)	Motor 3 Minimum Output Voltage	V/f CL-V/f OLV CLV AOLV Sets the minimum output voltage for the motor 3.	Determined by E1-03 (200 V Class: 0.0 - 255.0 V, 400 V Class: 0.0 - 510.0 V)

■ E7-11: Motor 3 Mid Point B Frequency

No. (Hex.)	Name	Description	Default (Range)
E7-11 (1B68) Expert	Motor 3 Mid Point B Frequency	V/f CL-V/f OLV CLV AOLV Sets the mid point B frequency used for motor 3.	0.0 Hz (0.0 - E7-04)

■ E7-12: Motor 3 Mid Point B Voltage

No. (Hex.)	Name	Description	Default (Range)
E7-12 (1B69) Expert	Motor 3 Mid Point B Voltage	V/f CL-V/f OLV CLV AOLV Sets the mid point B voltage used for motor 3.	0.0 V (200 V Class: 0.0 to 255.0 V, 400 V Class: 0.0 to 510.0 V)

■ E7-13: Motor 3 Base Voltage

No. (Hex.)	Name	Description	Default (Range)
E7-13 (1B6A) Expert	Motor 3 Base Voltage	V/f CL-V/f OLV CLV AOLV Sets the base voltage used for motor 3.	0.0 V (200 V Class: 0.0 to 255.0 V, 400 V Class: 0.0 to 510.0 V)

■ E7-21: Motor 3 Rated Current

No. (Hex.)	Name	Description	Default (Range)
E7-21 (1B72)	Motor 3 Rated Current	V/f CL-V/f OLV CLV AOLV Sets the motor rated current for motor 3 in amperes.	Determined by o2-04 (10% to 200% of the drive rated current)

■ E7-24: Motor 3 Motor Poles

No. (Hex.)	Name	Description	Default (Range)
E7-24 (1B75)	Motor 3 Motor Poles	V/f CL-V/f OLV CLV AOLV Sets the number of poles for motor 3.	4 (2 - 48)

■ E7-25: Motor 3 Line-to-Line Resistance

No. (Hex.)	Name	Description	Default (Range)
E7-25 (1B76)	Motor 3 Line-to-Line Resistance	V/f CL-V/f OLV CLV AOLV Sets the line-to-line resistance for the motor 3 stator windings.	Determined by o2-04 (0.000 - 65.000 Ω)

■ E7-31: Motor 3 Rated Power

No. (Hex.)	Name	Description	Default (Range)
E7-31 (1B7C)	Motor 3 Rated Power	V/f CL-V/f OLV CLV AOLV Sets the motor 3 rated power in 0.01 kW. (1 HP = 0.746 kW) (1 HP = 0.746 kW)	Determined by o2-04 (0.00 - 650.00 kW)

11.7 F: Options

F parameters are used to set option cards, which function as interfaces for encoders, analog I/O, digital I/O, and fieldbus communication.

◆ F1: Encoder Option Setup

F1 parameters are used to set the operation of and protective function for the encoder option card. The following table lists the setting parameters available for each option card.

Refer to the instruction manual packaged with the encoder option card for more information on installing, wiring, and setting the encoder option cards.

WARNING! *Sudden Movement Hazard. Do test runs and examine the drive to make sure that the command references are correct. If you set the command reference incorrectly, it can cause damage to the drive or serious injury or death.*

WARNING! *Sudden Movement Hazard. Make sure that the host controller circuitry has correct safety design that will let you keep control of the motor if the drive loses speed feedback. If you do not have control of the motor, it can cause serious injury or death.*

Table 11.18 Encoder Option Card Setting Parameters

Setting Parameter	Encoder Option Card		
	PG-B3	PG-X3	PG-RT3
F1-01	x	x	-
F1-02	x	x	x
F1-03	x	x	x
F1-04	x	x	x
F1-05	x	x	x
F1-06	x	x	-
F1-08	x	x	x
F1-09	x	x	x
F1-10	x	x	x
F1-11	x	x	x
F1-12 *1	x	x	-
F1-13 *1	x	x	-
F1-14	x	x	x
F1-20	-	x	-
F1-21	x	x	-
F1-30	x	x	-
F1-31 *2	x	x	-
F1-32 *2	x	x	-
F1-33 *1 *2	x	x	-
F1-34 *1 *2	x	x	-
F1-35 *2	x	x	-
F1-36	-	x	-
F1-37 *2	x	x	-
Number of cards that can be installed in a drive	2	2	1

*1 Parameters set when using the Closed Loop V/f Control method.
*2 Parameters to set an option card connected to CN5-B.

■ F1-01: Encoder 1 Pulse Count (PPR)

No. (Hex.)	Name	Description	Default (Range)
F1-01 (0380)	Encoder 1 Pulse Count (PPR)	V/f CL-V/f OLV CLV AOLV Sets the number of output pulses per revolution of the encoder.	1024 (1 - 60000 ppr)

■ F1-02: PG Open Circuit Detection Select

No. (Hex.)	Name	Description	Default (Range)
F1-02 (0381)	Encoder Signal Loss Detect Sel	V/f CL-V/f OLV CLV AOLV Sets the motor operation when *PGo [Encoder (PG) Feedback Loss]* is detected.	1 (0 - 4)

The drive detects *PGo* when output pulses from the encoder has not been detected for an amount of time longer than or equal to the value set in *F1-14 [Encoder Open-Circuit Detect Time]*.

Note:
- Faults such as *ov [Overvoltage]* and *oC [Overcurrent]* may occur depending on the motor speed and load conditions.
- When using Advanced Open Loop Vector Control, this is enabled when *n4-72 = 1 [PG Mode = With PG]*.

0 : Ramp to Stop

The drive ramps the motor to stop according to the deceleration time. Fault relay output terminal MA-MC will turn ON, and MB-MC will turn OFF.

1 : Coast to Stop

The drive output shuts off and the motor coasts to stop. Fault relay output terminal MA-MC will turn ON, and MB-MC will turn OFF.

2 : Fast Stop (Use C1-09)

The drive stops the motor using the deceleration time set in *C1-09 [Fast Stop Time]*. Fault relay output terminal MA-MC will turn ON, and MB-MC will turn OFF.

3 : Alarm Only

The keypad shows *PGo*, and the drive continues operation. Due to potential damage to motor and machinery, refrain from using this setting except under special circumstances. The output terminal set for *Alarm [H2-01 to H2-05 = 10]* switches ON.

4 : No Alarm Display

Operation continues without showing *PGo* on the keypad. Due to potential damage to motor and machinery, refrain from using this setting except under special circumstances.

■ F1-03: Overspeed Detection Selection

No. (Hex.)	Name	Description	Default (Range)
F1-03 (0382)	Overspeed Detection Selection	V/f CL-V/f OLV CLV AOLV Selects the motor operation when the drive detects *oS [Overspeed]*.	1 (0 - 3)

The drive detects the *oS* state when the motor speed exceeds the value set for *F1-08 [Overspeed Detection Level]* for an amount of time longer than the time set for *F1-09 [Overspeed Detection Delay Time]*.

0 : Ramp to Stop

The drive ramps the motor to stop according to the deceleration time. Fault relay output terminal MA-MC will turn ON, and MB-MC will turn OFF.

1 : Coast to Stop

The drive output shuts off and the motor coasts to stop. Fault relay output terminal MA-MC will turn ON, and MB-MC will turn OFF.

2 : Fast Stop (Use C1-09)

The drive stops the motor using the deceleration time set in *C1-09 [Fast Stop Time]*. Fault relay output terminal MA-MC will turn ON, and MB-MC will turn OFF.

3 : Alarm Only

The keypad shows *oS*, and the drive continues operation. Due to potential damage to motor and machinery, refrain from using this setting except under special circumstances. The output terminal set for *Alarm [H2-01 to H2-05 = 10]* switches ON.

■ F1-04: Speed Deviation Detection Select

No. (Hex.)	Name	Description	Default (Range)
F1-04 (0383)	Speed Deviation Detection Select	V/f CL-V/f OLV CLV AOLV Selects the motor operation when the drive detects *dEv [Speed Deviation]*.	3 (0 - 3)

The drive detects *dEv* when the difference (speed deviation) between the frequency reference and the actual motor speed exceeds the value set in *F1-10 [Speed Deviation Detection Level]* for an amount of time longer than the time set in *F1-11 [Speed Deviation Detect DelayTime]*.

0 : Ramp to Stop

The drive ramps the motor to stop according to the deceleration time. Fault relay output terminal MA-MC will turn ON, and MB-MC will turn OFF.

1 : Coast to Stop

The drive output shuts off and the motor coasts to stop. Fault relay output terminal MA-MC will turn ON, and MB-MC will turn OFF.

2 : Fast Stop (Use C1-09)

The drive stops the motor using the deceleration time set in *C1-09 [Fast Stop Time]*. Fault relay output terminal MA-MC will turn ON, and MB-MC will turn OFF.

3 : Alarm Only

The keypad shows *dEv*, and the drive continues operation. Due to potential damage to motor and machinery, refrain from using this setting except under special circumstances. The output terminal set for *Alarm [H2-01 to H2-05 = 10]* switches ON.

■ F1-05: Encoder 1 Rotation Selection

No. (Hex.)	Name	Description	Default (Range)
F1-05 (0384)	Encoder 1 Rotation Selection	V/f CL-V/f OLV CLV AOLV Sets the output sequence for the A and B pulses from the encoder, assuming that the motor is operating in the forward direction.	Determined by A1-02 (0, 1)

Refer to the installation manual included with the option card for more information on how to confirm and set the encoder pulse output sequence.

0 : Pulse A leads in FWD Direction

1 : Pulse B leads in FWD Direction

■ F1-06: Encoder 1 Pulse Monitor Scaling

No. (Hex.)	Name	Description	Default (Range)
F1-06 (0385)	Encoder 1 Pulse Monitor Scaling	V/f CL-V/f OLV CLV AOLV Sets the ratio between the pulse input and the pulse output of the encoder as a 3-digit number. The first digit is the numerator and the second and third digits set the denominator.	001 (001 - 032, 102 - 132 (1 - 1/32))

When the setting value is a 3-digit value (xyz), the dividing ratio is (1 + x)/yz

For example, when *F1-06 = 032*, the dividing ratio is 1/32.

Note:

When you use a single-pulse encoder, the dividing ratio for the monitor signal is 1:1

■ F1-08: Overspeed Detection Level

No. (Hex.)	Name	Description	Default (Range)
F1-08 (0387)	Overspeed Detection Level	V/f CL-V/f OLV CLV AOLV Sets the detection level of *oS [Overspeed]* as a percentage when the maximum output frequency is 100%.	115% (0 - 120%)

When the motor speed is more than the value set in *F1-08* for longer than the time set in *F1-09 [Overspeed Detection Delay Time]*, the drive will detect *oS*.

■ F1-09: Overspeed Detection Delay Time

No. (Hex.)	Name	Description	Default (Range)
F1-09 (0388)	Overspeed Detection Delay Time	V/f CL-V/f OLV CLV AOLV Sets the length of time that the speed feedback must be more than the *F1-08* level to cause *oS [Overspeed]*.	Determined by A1-02 (0.0 - 2.0 s)

When the motor speed is more than the value set in *F1-08 [Overspeed Detection Level]* for longer than the time set in *F1-09*, the drive will detect *oS*.

■ F1-10: Speed Deviation Detection Level

No. (Hex.)	Name	Description	Default (Range)
F1-10 (0389)	Speed Deviation Detection Level	V/f CL-V/f OLV CLV AOLV Sets the detection level of *dEv [Speed Deviation]* as a percentage when the maximum output frequency is 100%.	10% (0 - 50%)

When the speed deviation between the frequency reference and the actual motor speed is more than the value set in *F1-10* for longer than the time set in *F1-11 [Speed Deviation Detect DelayTime]*, the drive will detect *dEv*.

■ F1-11: Speed Deviation Detect DelayTime

No. (Hex.)	Name	Description	Default (Range)
F1-11 (038A)	Speed Deviation Detect DelayTime	V/f CL-V/f OLV CLV AOLV Sets the length of time that the difference between the frequency reference and speed feedback must be more than the level in *F1-10* to cause *dEv [Speed Deviation]*.	0.5 s (0.0 - 10.0 s)

When the speed deviation between the frequency reference and the actual motor speed is more than the value set in *F1-10 [Speed Deviation Detection Level]* for longer than the time set in *F1-11*, the drive will detect *dEv*.

■ F1-12: Encoder 1 Gear Teeth 1

No. (Hex.)	Name	Description	Default (Range)
F1-12 (038B)	Encoder 1 Gear Teeth 1	V/f CL-V/f OLV CLV AOLV Sets the number of gear teeth on the motor side. This parameter and *F1-13 [Encoder 1 Gear Teeth 2]* set the gear ratio between the motor and encoder.	0 (0 - 1000)

After you set the number of gear teeth, the drive uses this formula to calculate the motor speed:

$$\text{Motor speed (min}^{-1}\text{ or r/min)} = \frac{\text{Number of pulses from the encoder} \times 60}{\text{F1-01}} \times \frac{\text{F1-13}}{\text{F1-12}}$$

Note:
When *F1-12 = 0* or *F1-13 = 0*, the gear ratio is 1.

■ F1-13: Encoder 1 Gear Teeth 2

No. (Hex.)	Name	Description	Default (Range)
F1-13 (038C)	Encoder 2 Gear Teeth 1	V/f CL-V/f OLV CLV AOLV Sets the number of gear teeth on the load side. This parameter and *F1-12 [Encoder 1 Gear Teeth 1]* set the gear ratio between the motor and encoder.	0 (0 - 1000)

After you set the number of gear teeth, the drive uses this formula to calculate the motor speed:

$$\text{Motor speed (min}^{-1}\text{ or r/min)} = \frac{\text{Number of pulses from the encoder} \times 60}{\text{F1-01}} \times \frac{\text{F1-13}}{\text{F1-12}}$$

Note:
When *F1-12 = 0* or *F1-13 = 0*, the gear ratio is 1.

■ F1-14: Encoder Open-Circuit Detect Time

No. (Hex.)	Name	Description	Default (Range)
F1-14 (038D)	Encoder Open-Circuit Detect Time	V/f CL-V/f OLV CLV AOLV Sets the detection time for *PGo [Encoder (PG) Feedback Loss]*.	2.0 s (0.0 - 10.0 s)

PGo is detected when the drive does not detect output pulses from the encoder for an amount of time longer than or equal to the value set in *F1-14*.

Note:
Faults such as *ov [Overvoltage]* and *oC [Overcurrent]* may occur depending on the motor speed and load conditions.

■ F1-20: Encoder 1 PCB Disconnect Detect

No. (Hex.)	Name	Description	Default (Range)
F1-20 (03B4)	Encoder 1 PCB Disconnect Detect	V/f CL-V/f OLV CLV AOLV Sets the function that enables and disables detection of a disconnected PG-X3 encoder connection cable. Detects *PGoH [Encoder (PG) Hardware Fault]* when *F1-20 = 1*.	1 (0, 1)

0 : Disabled

1 : Enabled

■ F1-21: Encoder 1 Signal Selection

No. (Hex.)	Name	Description	Default (Range)
F1-21 (03BC)	Encoder 1 Signal Selection	V/f CL-V/f OLV CLV AOLV Sets the number of channels for the signal to the encoder option.	0 (0, 1)

0 : A Pulse Detection

1 : AB Pulse Detection

■ F1-30: Motor 2 Encoder PCB Port Select

No. (Hex.)	Name	Description	Default (Range)
F1-30 (03AA)	Motor 2 Encoder PCB Port Select	V/f CL-V/f OLV CLV AOLV Sets the connector used when the motor 2 encoder option is installed in the drive.	1 (0, 1)

0 : CN5-C

Set when the speed feedback from the encoder for motor 1 and motor 2 is received by one option card while such signals are switched externally.

1 : CN5-B

Set when the speed feedback from the encoder for motor 1 and motor 2 is received by two PG option cards independently.

■ F1-31: Encoder 2 Pulse Count (PPR)

No. (Hex.)	Name	Description	Default (Range)
F1-31 (03B0)	Encoder 2 Pulse Count (PPR)	V/f CL-V/f OLV CLV AOLV Sets the number of output pulses per revolution of the encoder. This parameter is for motor 2.	1024 (1 - 60000 ppr)

■ F1-32: PG 2 Rotation Selection

No. (Hex.)	Name	Description	Default (Range)
F1-32 (03B1)	Encoder 2 Rotation Selection	V/f CL-V/f OLV CLV AOLV Sets the output sequence for the A and B pulses from the encoder, assuming that the motor is operating in the forward direction. This parameter is for motor 2.	0 (0, 1)

Refer to the installation manual included with the option card for more information on how to confirm and set the encoder pulse output sequence.

0 : Pulse A leads in FWD Direction

1 : Pulse B leads in FWD Direction

■ F1-33: Encoder 2 Gear Teeth 1

No. (Hex.)	Name	Description	Default (Range)
F1-33 (03B2)	Encoder 2 Gear Teeth 1	V/f CL-V/f OLV CLV AOLV Sets the number of gear teeth on the motor side for motor 2. This parameter and *F1-34 [Encoder 2 Gear Teeth 2]* set the gear ratio between the motor and encoder.	0 (0 - 1000)

After you set the number of gear teeth, the drive uses this formula to calculate the motor speed:

$$\text{Motor speed } (\text{min}^{-1} \text{ or r/min}) = \frac{\text{Number of pulses from the encoder} \times 60}{\text{F1-31}} \times \frac{\text{F1-33}}{\text{F1-34}}$$

Note:
When *F1-33 = 0* or *F1-34 = 0*, the gear ratio is 1.

■ F1-34: Encoder 2 Gear Teeth 2

No. (Hex.)	Name	Description	Default (Range)
F1-34 (03B3)	Encoder 2 Gear Teeth 2	V/f CL-V/f OLV CLV AOLV Sets the number of gear teeth on the load side for motor 2. This parameter and *F1-33 [Encoder 2 Gear Teeth 1]* set the gear ratio between the motor and encoder.	0 (0 - 1000)

After you set the number of gear teeth, the drive uses this formula to calculate the motor speed:

$$\text{Motor speed (min}^{-1}\text{ or r/min)} = \frac{\text{Number of pulses from the encoder} \times 60}{\text{F1-31}} \times \frac{\text{F1-33 (load-side PG gear teeth)}}{\text{F1-34 (motor-side PG gear teeth)}}$$

Note:
When *F1-33 = 0* or *F1-34 = 0*, the gear ratio is 1.

■ F1-35: Encoder 2 Pulse Monitor Scaling

No. (Hex.)	Name	Description	Default (Range)
F1-35 (03BE)	Encoder 2 Pulse Monitor Scaling	V/f CL-V/f OLV CLV AOLV Sets the dividing ratio for monitor signals output from the encoder option. This parameter is for motor 2.	001 (001 - 032, 102 - 132 (1 - 1/32))

The dividing ratio = (1 + x)/yz when the setting value is a 3-digit value (xyz).
For example, the dividing ratio is 1/32 when *F1-35 = 032*.

Note:
The dividing ratio for the monitor signal is 1:1 when using a single-pulse encoder.

■ F1-36: Encoder 2 PCB Disconnect Detect

No. (Hex.)	Name	Description	Default (Range)
F1-36 (03B5)	Encoder 2 PCB Disconnect Detect	V/f CL-V/f OLV CLV AOLV Sets the function that enables and disables detection of a disconnected PG-X3 encoder connection cable. *PGoH [Encoder (PG) Hardware Fault]* is detected when this parameter is enabled. This parameter is for motor 2.	1 (0, 1)

0 : Disabled
1 : Enabled

■ F1-37: Encoder 2 Signal Selection

No. (Hex.)	Name	Description	Default (Range)
F1-37 (03BD)	Encoder 2 Signal Selection	V/f CL-V/f OLV CLV AOLV Sets the number of channels for the signal to the encoder option. This parameter is for motor 2.	0 (0, 1)

0 : A Pulse Detection
1 : AB Pulse Detection

◆ F2: Analog Input Option

F2 parameters set the operation of the drive when you use analog input option card AI-A3. The AI-A3 card has 3 input terminals that accept voltages of -10 V to +10 V (20 kΩ) or currents of 4 mA to 20 mA (250 Ω). Install the AI-A3 card to enable setting very accurate analog references with high resolution.

Refer to the AI-A3 option manual for more information about how to install, wire, and set the AI-A3 card.

WARNING! *Sudden Movement Hazard. Do test runs and examine the drive to make sure that the command references are correct. If you set the command reference incorrectly, it can cause damage to the drive or serious injury or death.*

■ F2-01: Analog Input Function Selection

No. (Hex.)	Name	Description	Default (Range)
F2-01 (038F)	Analog Input Function Selection	V/f CL-V/f OLV CLV AOLV Sets the input method for the analog reference used with AI-A3.	0 (0, 1)

Note:

When the AI-A3 card is not mounted in the drive, analog input terminals A1 to A3 on the drive are always enabled. The setting of this parameter does not have an effect.

0 : 3 Independent Channels

Set *F2-01 = 0* to increase the precision of A/D conversion when you use the functions for terminals A1 to A3 on the drive as they are. You can input the MFAI signal from terminals V1 through V3 for AI-A3. The functions for terminals A1, A2, and A3 on the drive are sent to terminals V1, V2, and V3 for AI-A3. Use gain and bias adjustment when you input current to set signals to have negative numbers.

Note:

- Set *b1-01 = 1 [Frequency Reference Selection 1 = Analog Input]* to set inputs individually.
- If *F2-01 = 0* and *b1-01 = 3 [Option PCB]*, the drive will detect *oPE05 [Run Cmd/Freq Ref Source Sel Err]*.

Figure 11.49 shows the individual input of analog inputs. *H3-xx parameters* set the function to input the analog reference received from the AI-A3 card and to adjust the gain and bias of these signals.

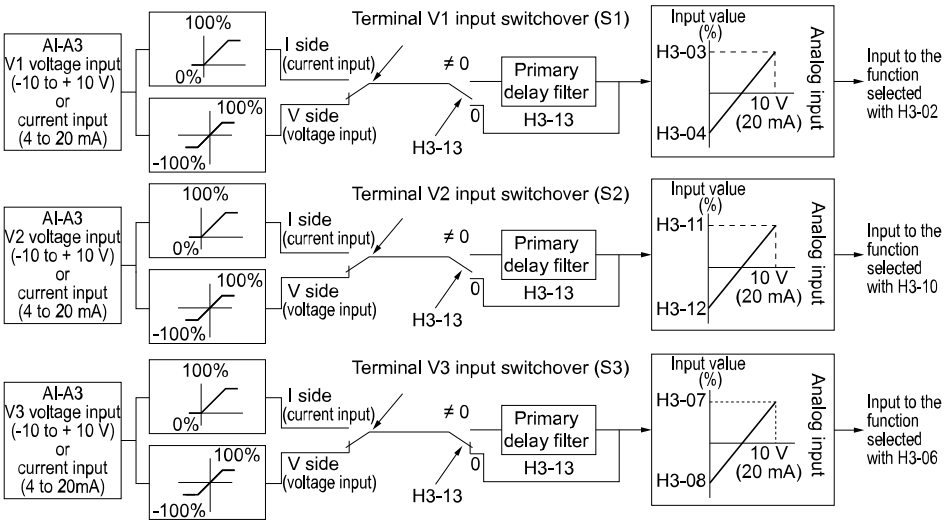


Figure 11.49 Analog Input Reference Individual Input Block Diagram

1 : 3 Channels Added Together

Set *b1-01 = 3 [Option PCB]* to set addition input.

You can input the frequency reference directly. The sum value when you add the input from terminals V1 to V3 becomes the frequency reference.

Set *F2-01 = 1* to use the AI-A3 card as addition input.

Figure 11.50 shows addition input. Use *F2-02 [Analog Input Option Card Gain]* and *F2-03 [Analog Input Option Card Bias]* to adjust the analog reference gain and bias for addition input.

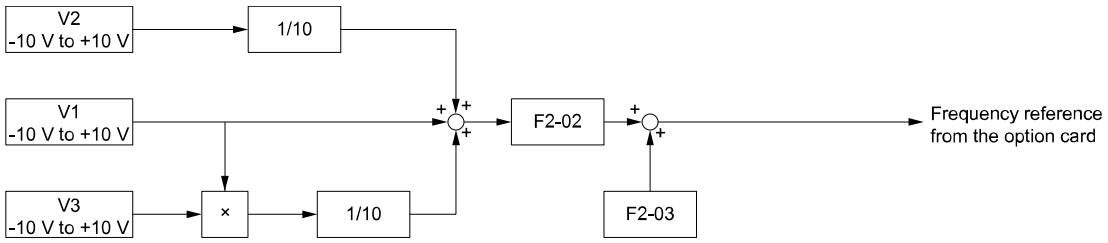


Figure 11.50 Analog Input Reference Addition Input Block Diagram

Use F2-02 and F2-03 to Adjust the Input Status

When the bias set in *F2-03* is 0%, the gain in *F2-02* and the addition input value set the ratio (%) of the maximum output frequency output as the frequency reference.

Note:

A voltage input of 10 V or a current input of 20 mA is the 100% value for each channel.

The bias set in *F2-03* sets the ratio (%) of the maximum output frequency output as the frequency reference when the addition input value is 0%.

Note:

A voltage input of 0 V or a current input of 4 mA is the 0% value for each channel.

- Example 1:
  When the gain set in *F2-02* is 50%, the bias set in *F2-03* is 0%, and the addition input value is 100%, the frequency reference is 50% of the maximum output frequency. When the addition input value is 200%, the frequency reference is 100% of the maximum output frequency.
- Example 2:
  When the gain set in *F2-02* is 200%, the bias set in *F2-03* is 0%, and the addition input value is 50%, the frequency reference is equivalent to the maximum output frequency. The frequency reference will not be more than the maximum output frequency, although the addition input value is 50% or higher.
- Example 3:
  When the gain set in *F2-02* is 100%, the bias set in *F2-03* is 30%, and the addition input value is 0%, the frequency reference is 30% of the maximum output frequency. When the addition input value is 70%, the frequency reference will be equivalent to the maximum output frequency. The frequency reference will not be more than the maximum output frequency, although the addition input value is 70% or higher.

■ F2-02: Analog Input Option Card Gain

No. (Hex.)	Name	Description	Default (Range)
F2-02 (0368) RUN	Analog Input Option Card Gain	V/f CL-V/f OLV CLV AOLV Sets the analog reference gain as a percentage when the maximum output frequency is 100%.	100.0% (-999.9 - +999.9%)

Note:

Set *F2-01 = 1 [Analog Input Function Selection = 3 Channels Added Together]* to enable this function.

■ F2-03: Analog Input Option Card Bias

No. (Hex.)	Name	Description	Default (Range)
F2-03 (0369) RUN	Analog Input Option Card Bias	V/f CL-V/f OLV CLV AOLV Sets the analog reference bias as a percentage when the maximum output frequency is 100%.	0.0% (-999.9 - +999.9%)

Note:

Set *F2-01 = 1 [Analog Input Function Selection = 3 Channels Added Together]* to enable this function.

◆ F3: Digital Input Option

F3 parameters set the type of input signal to use with digital input option card DI-A3.

Use these digital inputs to set the frequency reference when you install the DI-A3 card in a drive. Set *b1-01 = 3 [Frequency Reference Selection 1 = Option PCB]* to use this card as the frequency reference input. The input signal is isolated input of 24 Vdc and 8 mA.

- Binary, 16-bit/BCD, 4-digit input
- Binary, 12-bit/BCD, 3-digit input
- Binary, 8-bit/BCD, 2-digit input

You can also use the DI-A3 option as an MFDI, if the setting of *F3-01* is correct.

On drives with software versions PRG: 01021 and later that do not have a DI-A3 option installed, when you set *F3-01 = 8 [Digital Input Function Selection = Multi-Function Digital Input]*, it enables these functions:

- *H1-40 [Mbus Reg 15C0h bit0 Input Func] to H1-42 [Mbus Reg 15C0h bit2 Input Func]*
- *H7-01 to H7-04 [Virtual Multi-Function Input 1 to 4]*

WARNING! *Sudden Movement Hazard. Do test runs and examine the drive to make sure that the command references are correct. If you set the command reference incorrectly, it can cause damage to the drive or serious injury or death.*

■ MFDI for DI-A3

When you set to *F3-01 = 8 [Digital Input Function Selection = Multi-Function Digital Input]*, you can use the digital input option DI-A3 as the multi-function input. To use this as the multi-function input, set such that *b1-01 ≠ 3 [Frequency Reference Selection 1 ≠ Option PCB]*.

Select the function for the DI-A3 terminals with *F3-10 to F3-25 [Terminal D0 to DF Function Selection]*.

Note:
- Refer to *H1-xx* "MFDI Function Selections" for more information about multi-function digital input setting values.
- You cannot set *20 to 2F [External Fault]* to *F3-10* to *F3-25*.
- Set *F3-10 to F3-25 = F [Not Used]* when not using the DI-A3 multi-function input. The through mode function is not supported.
- Terminal Dx of the DI-A3 is read twice in accordance with the setting of *b1-06 [Digital Input Reading]*.
- If you set *F3-01 = 8* when DI-A3 is the frequency reference source (*b1-01 or b1-15 = 3 [Frequency Reference Selection 1/2 = Option PCB]*), the drive will detect *oPE05 [Run Cmd/Freq Ref Source Sel Err]*.
- The following functions can be used together with the DI-A3 multi-function input.
  – *H1-40 to H1-42 [Mbus Reg 15C0h bit0 to bit2 Input Func]*
  – *H7-01 to H7-04 [Virtual Multi-Function Inputs 1 to 4]*

■ F3-01: Digital Input Function Selection

No. (Hex.)	Name	Description	Default (Range)
F3-01 (0390)	Digital Input Function Selection	V/f CL-V/f OLV CLV AOLV Sets the data format of digital input signals. This parameter is enabled when *o1-03 = 0 or 1 [Frequency Display Unit Selection = 0.01 Hz or 0.01% (100% = E1-04)]*.	0 (0 - 8)

Note:

When *o1-03 = 2 [min^{-1} (r/min) unit]* or *3 [User Units]*, the input signal type is BCD. The *o1-03* value sets the setting units.

0 : BCD, 1% units
1 : BCD, 0.1% units
2 : BCD, 0.01% units
3 : BCD, 1 Hz units
4 : BCD, 0.1 Hz units
5 : BCD, 0.01 Hz units
6 : BCD (5-digit), 0.01 Hz
7 : Binary input

The setting unit and setting range are different for different values of *F3-03 [Digital Input Data Length Select]*.

- *F3-03 = 0 [8-bit]*: 100%/255 (-255 to +255)
- *F3-03 = 1 [12-bit]*: 100%/4095 (-4095 to +4095)
- *F3-03 = 2 [16-bit]*: 100%/30000 (-33000 to +33000)

8 : Multi-Function Digital Input

The DI-A3 option is also used as a multi-function digital input terminal.

When the DI-A3 option is not installed in the drive and *F3-01 = 8*, these functions are enabled:

- *H1-40 [Mbus Reg 15C0h bit0 Input Func] to H1-42 [Mbus Reg 15C0h bit2 Input Func]*
- *H7-01 to H7-04 [Virtual Multi-Function Input 1 to 4]*

■ F3-03: Digital Input Data Length Select

No. (Hex.)	Name	Description	Default (Range)
F3-03 (03B9)	Digital Input Data Length Select	V/f CL-V/f OLV CLV AOLV Sets the number of bits to set the frequency reference with *DI-A3*.	2 (0 - 2)

0 : 8-bit
1 : 12-bit
2 : 16-bit

Table 11.19 DI-A3 Terminal Function Selection

Terminal Block	Terminal Name	BCD, Signed [F3-01 = 0 to 5]						BCD, Unsigned [F3-01 = 6] *1		Binary, Signed [F3-01 = 7]		
		8-bit [F3-03 = 0]		12-bit [F3-03 = 1]		16-bit [F3-03 = 2]				8-bit [F3-03 = 0]	12-bit [F3-03 = 1]	16-bit [F3-03 = 2]
TB2	D0	1 digit (0 - 9)	1	1 digit (0 - 9)	1	1 digit (0 - 9)	1	1 digit (0, 2, 4, 6, 8)	2	bit 0	bit 0	bit 0
	D1		2		2		2		4	bit 1	bit 1	bit 1
	D2		4		4		4		8	bit 2	bit 2	bit 2
	D3		8		8		8	2 digits (0 - 9)	1	bit 3	bit 3	bit 3
	D4	2 digits (0 - 15) *2	1	2 digits (0 - 9)	1	2 digits (0 - 9)	1		2	bit 4	bit 4	bit 4
	D5		2		2		2		4	bit 5	bit 5	bit 5
	D6		4		4		4		8	bit 6	bit 6	bit 6
	D7		8		8		8	3 digits (0 - 9)	1	bit 7	bit 7	bit 7
TB3	D8	-	-	3 digits (0 - 15) *2	1	3 digits (0 - 9)	-		2	-	bit 8	bit 8
	D9		-		2		-		4	-	bit 9	bit 9
	DA		-		4		-		8	-	bit 10	bit 10
	DB		-		8		-	4 digits (0 - 9)	1	-	bit 11	bit 11
	DC	-	-	-	-	4 digits (0 - 15) *2	-		2	-	-	bit 12
	DD		-		-		-		4	-	-	bit 13
	DE		-		-		-		8	-	-	bit 14
	DF		-		-		-	5 digits (0 - 3)	1	-	-	bit 15
TB1	SI	SIGN (encoded) signal 0: Forward run, 1: Reverse run							2	SIGN (encoded) signal 0: Forward run, 1: Reverse run		
	SE	SET (loaded) signal 1: Loads the value set for D0 to DF and SI.										
	SP	Internal power supply: 24 V ± 5%										
	SC	Input signal common										
	SN	Internal power supply common: 0 V										
	SD	Cable sheath connection terminal (ungrounded)										
	FE	Cable sheath connection terminal (grounded)										

*1 Setting *F3-03 = 2 [Digital Input Data Length Select = 16-bit]* enables *F3-01 = 6 [Digital Input Function Selection = BCD (5-digit), 0.01 Hz]* and a frequency between 0.00 Hz to 399.8 Hz can be set by the BCD. Note that terminal SI is also used as for data bits. Negative commands cannot be input as encoding information (positive/negative) cannot be added to the data.

The minimum bit value for the first BCD digit is 2. For this reason, 0.02 Hz is the smallest setting unit available for this frequency setting. An *oPE05 [Run Cmd/Freq Ref Source Sel Err]* occurs when *F3-03 ≠ 2* while *F3-01 = 6*.

*2 The most significant digit can be set to a value between 0 to 15 when using “BCD, Signed”. Other digits can be set to a value between 0 to 9.

■ F3-10: Terminal D0 Function Selection

No. (Hex.)	Name	Description	Default (Range)
F3-10 (0BE3) Expert	Terminal D0 Function Selection	V/f CL-V/f OLV CLV AOLV Sets the function for terminal D0 of the DI-A3 option when *F3-01 = 8 [Digital Input Function Selection = Multi-Function Digital Input]*.	F (0 - 1FF)

■ F3-11: Terminal D1 Function Selection

No. (Hex.)	Name	Description	Default (Range)
F3-11 (0BE4) Expert	Terminal D1 Function Selection	V/f CL-V/f OLV CLV AOLV Sets the function for terminal D1 of the DI-A3 when *F3-01 = 8 [Digital Input Function Selection = Multi-Function Digital Input]*.	F (0 - 1FF)

■ F3-12: Terminal D2 Function Selection

No. (Hex.)	Name	Description	Default (Range)
F3-12 (0BE5) Expert	Terminal D2 Function Selection	V/f CL-V/f OLV CLV AOLV Sets the function for terminal D2 of the DI-A3 when *F3-01 = 8 [Digital Input Function Selection = Multi-Function Digital Input]*.	F (0 - 1FF)

■ F3-13: Terminal D3 Function Selection

No. (Hex.)	Name	Description	Default (Range)
F3-13 (0BE6) Expert	Terminal D3 Function Selection	V/f CL-V/f OLV CLV AOLV Sets the function for terminal D3 of the DI-A3 option when *F3-01 = 8 [Digital Input Function Selection = Multi-Function Digital Input]*.	F (0 - 1FF)

■ F3-14: Terminal D4 Function Selection

No. (Hex.)	Name	Description	Default (Range)
F3-14 (0BE7) Expert	Terminal D4 Function Selection	V/f CL-V/f OLV CLV AOLV Sets the function for terminal D4 of the DI-A3 when *F3-01 = 8 [Digital Input Function Selection = Multi-Function Digital Input]*.	F (0 - 1FF)

■ F3-15: Terminal D5 Function Selection

No. (Hex.)	Name	Description	Default (Range)
F3-15 (0BE8) Expert	Terminal D5 Function Selection	V/f CL-V/f OLV CLV AOLV Sets the function for terminal D5 of the DI-A3 option when *F3-01 = 8 [Digital Input Function Selection = Multi-Function Digital Input]*.	F (0 - 1FF)

■ F3-16: Terminal D6 Function Selection

No. (Hex.)	Name	Description	Default (Range)
F3-16 (0BE9) Expert	Terminal D6 Function Selection	V/f CL-V/f OLV CLV AOLV Sets the function for terminal D6 of the DI-A3 option when *F3-01 = 8 [Digital Input Function Selection = Multi-Function Digital Input]*.	F (0 - 1FF)

■ F3-17: Terminal D7 Function Selection

No. (Hex.)	Name	Description	Default (Range)
F3-17 (0BEA) Expert	Terminal D7 Function Selection	V/f CL-V/f OLV CLV AOLV Sets the function for terminal D7 of the DI-A3 option when *F3-01 = 8 [Digital Input Function Selection = Multi-Function Digital Input]*.	F (0 - 1FF)

■ F3-18: Terminal D8 Function Selection

No. (Hex.)	Name	Description	Default (Range)
F3-18 (0BEB) Expert	Terminal D8 Function Selection	V/f CL-V/f OLV CLV AOLV Sets the function for terminal D8 of the DI-A3 option when *F3-01 = 8 [Digital Input Function Selection = Multi-Function Digital Input]*.	F (0 - 1FF)

■ F3-19: Terminal D9 Function Selection

No. (Hex.)	Name	Description	Default (Range)
F3-19 (0BEC) Expert	Terminal D9 Function Selection	V/f CL-V/f OLV CLV AOLV Sets the function for terminal D9 of the DI-A3 option when *F3-01 = 8 [Digital Input Function Selection = Multi-Function Digital Input]*.	F (0 - 1FF)

■ F3-20: Terminal DA Function Selection

No. (Hex.)	Name	Description	Default (Range)
F3-20 (0BED) Expert	Terminal DA Function Selection	V/f CL-V/f OLV CLV AOLV Sets the function for terminal DA of the DI-A3 when *F3-01 = 8 [Digital Input Function Selection = Multi-Function Digital Input]*.	F (0 - 1FF)

■ F3-21: Terminal DB Function Selection

No. (Hex.)	Name	Description	Default (Range)
F3-21 (0BEE) Expert	Terminal DB Function Selection	V/f CL-V/f OLV CLV AOLV Sets the function for terminal DB of the DI-A3 when *F3-01 = 8 [Digital Input Function Selection = Multi-Function Digital Input]*.	F (0 - 1FF)

■ F3-22: Terminal DC Function Selection

No. (Hex.)	Name	Description	Default (Range)
F3-22 (0BEF) Expert	Terminal DC Function Selection	V/f CL-V/f OLV CLV AOLV Sets the function for terminal DC of the DI-A3 when *F3-01 = 8 [Digital Input Function Selection = Multi-Function Digital Input]*.	F (0 - 1FF)

■ F3-23: Terminal DD Function Selection

No. (Hex.)	Name	Description	Default (Range)
F3-23 (0BF0) Expert	Terminal DD Function Selection	V/f CL-V/f OLV CLV AOLV Sets the function for terminal DD of the DI-A3 when *F3-01 = 8 [Digital Input Function Selection = Multi-Function Digital Input]*.	F (0 - 1FF)

■ F3-24: Terminal DE Function Selection

No. (Hex.)	Name	Description	Default (Range)
F3-24 (0BF1) Expert	Terminal DE Function Selection	V/f CL-V/f OLV CLV AOLV Sets the function for terminal DE of the DI-A3 when *F3-01 = 8 [Digital Input Function Selection = Multi-Function Digital Input]*.	F (0 - 1FF)

■ F3-25: Terminal DF Function Selection

No. (Hex.)	Name	Description	Default (Range)
F3-25 (0BF2) Expert	Terminal DF Function Selection	V/f CL-V/f OLV CLV AOLV Sets the function for terminal DF of the DI-A3 when *F3-01 = 8 [Digital Input Function Selection = Multi-Function Digital Input]*.	F (0 - 1FF)

◆ F4: Analog Monitor Option

F4 parameters set drive operation when you use analog monitor option card AO-A3. The AO-A3 card has 2 output terminals (terminals V1 and V2) for signals with an Output resolution of 11 bits (1/2048) + encoding and that have an output voltage range of -10 V to +10 V. Install the AO-A3 card to a drive to output analog signals that monitor the output status of the drive (output frequency and output current).

Refer to the AO-A3 card manual for more information about how to install, wire, and set the AO-A3 card.

Use the *U monitor* number to set the monitor data to be output from terminals V1 and V2 on the AO-A3 card. Enter the last three digits of *Ux-xx* as the setting value.

- Use Gain and Bias to Adjust the Output Signal Level of Terminal V1

You must stop the drive to adjust the output signal. Use this procedure to calibrate the drive:

1. View the *F4-02 [Terminal V1 Gain]* value on the keypad.
   Terminal V1 will output a voltage = 100% of the monitor set in *F4-01 [Terminal V1 Function Selection]*.
2. View the monitor connected to terminal V1 and adjust *F4-02*.
3. View the *F4-05 [Terminal V1 Bias]* value on the keypad.

Terminal V1 will output an analog signal = 100% of the parameter set in *F4-01*.

4. View the monitor connected to terminal V1 and adjust *F4-05*.

• Use Gain and Bias to Adjust the Output Signal Level of Terminal V2

You must stop the drive to adjust the output signal. Use this procedure to calibrate the drive:

1. View the *F4-04 [Terminal V2 Gain]* value on the keypad.
   Terminal V2 will output a voltage = 100% of the monitor set in *F4-03 [Terminal V2 Function Selection]*.
2. View the monitor connected to terminal V2 and adjust *F4-04*.
3. View the *F4-06 [Terminal V2 Bias]* value on the keypad.
   The analog signal equal to 0% of the parameter being set in *F4-03* will be output from terminal V2.
4. View the monitor connected to terminal V2 and adjust *F4-06*.

■ F4-01: Terminal V1 Function Selection

No. (Hex.)	Name	Description	Default (Range)
F4-01 (0391)	Terminal V1 Function Selection	V/f CL-V/f OLV CLV AOLV Sets the monitor signal output from terminal V1.	102 (000 - 999)

Set the *x-xx* part of the *Ux-xx [Monitors]* to set monitor data to output from the option card. For example, set *F4-01 = 102* to monitor *U1-02 [Output Frequency]*.

Note:
- You cannot use all of the monitors in all of the control methods.
- When you use the terminal in through mode, set this parameter to *000* or *031*. You can use MEMOBUS/Modbus communications or the communication option to set the terminal V1 output level from the PLC.

■ F4-02: Terminal V1 Gain

No. (Hex.)	Name	Description	Default (Range)
F4-02 (0392) RUN	Terminal V1 Gain	V/f CL-V/f OLV CLV AOLV Sets the gain of the monitor signal that is sent from terminal V1. Sets the analog signal output level from the terminal V1 at 10 V or 20 mA as 100% when an output for monitoring items is 100%.	100.0% (-999.9 - +999.9%)

The maximum output voltage output from terminal V1 is ±10 V. Use *F4-07 [Terminal V1 Signal Level]* to set the signal level.

Example settings:

When you use these settings, and the monitored output voltage is at 100% (drive rated current), the output voltage of terminal V1 is 5 V (50% of 10 V). The output current is 200% of the drive rated current when terminal V1 outputs a maximum voltage of 10 V.

- F4-01 [Terminal V1 Function Selection] = 102 (U1-02: Output Frequency)
- F4-02 = 50.0%
- F4-05 [Terminal V1 Bias] = 0.0%
- F4-07 = 0 (0 V to 10 V)

■ F4-03: Terminal V2 Function Selection

No. (Hex.)	Name	Description	Default (Range)
F4-03 (0393)	Terminal V2 Function Selection	V/f CL-V/f OLV CLV AOLV Sets the monitor signal output from terminal V2.	103 (000 - 999)

Set the x-xx part of the *Ux-xx [Monitors]* to set monitor data to output from the option card. For example, set *F4-03 = 103* to monitor *U1-03 [Output Current]*.

Note:
- You cannot use all of the monitors in all of the control methods.
- When you use the terminal in through mode, set this parameter to *000* or *031*. You can use this setting to adjust the V2 terminal output from PLC through MEMOBUS/Modbus communications or a communications option.

■ F4-04: Terminal V2 Gain

No. (Hex.)	Name	Description	Default (Range)
F4-04 (0394) RUN	Terminal V2 Gain	V/f CL-V/f OLV CLV AOLV Sets the gain of the monitor signal that is sent from terminal V2. Sets the analog signal output level from terminal V2 at 10 V or 20 mA as 100% when an output for monitoring items is 100%.	50.0% (-999.9 - +999.9%)

The maximum output voltage output from terminal V2 is ±10 V. Use *F4-08 [Terminal V2 Signal Level]* to set the signal level.

Example settings:

When you use these settings, and the monitored output voltage is at 100% (drive rated current), the output voltage of terminal V2 is 5 V (50% of 10 V). The output current is 200% of the drive rated current when terminal V2 outputs a maximum voltage of 10 V.

- F4-03 [Terminal V2 Function Selection] = 103 (U1-03: Output Current)
- F4-04 = 50.0%
- F4-06 [Terminal V2 Bias] = 0.0%
- F4-08 = 0 (0 V to 10 V)

■ F4-05: Terminal V1 Bias

No. (Hex.)	Name	Description	Default (Range)
F4-05 (0395) RUN	Terminal V1 Bias	V/f CL-V/f OLV CLV AOLV Sets the bias of the monitor signal that is sent from terminal V1. When an output for monitoring items is 0%, this parameter sets the analog signal output level from the V1 terminal as a percentage of 10 V or 20 mA.	0.0% (-999.9 - +999.9%)

The maximum output voltage output from terminal V1 is ±10 V. Use *F4-07 [Terminal V1 Signal Level]* to set the signal level.

■ F4-06: Terminal V2 Bias

No. (Hex.)	Name	Description	Default (Range)
F4-06 (0396) RUN	Terminal V2 Bias	V/f CL-V/f OLV CLV AOLV Sets the bias of the monitor signal that is sent from terminal V2. Set the level of the analog signal sent from the V2 terminal at 10 V or 20 mA as 100% when an output for monitoring items is 0%.	0.0% (-999.9 - +999.9%)

The maximum output voltage output from terminal V2 is ±10 V. Use *F4-08 [Terminal V2 Signal Level]* to set the signal level.

■ F4-07: Terminal V1 Signal Level

No. (Hex.)	Name	Description	Default (Range)
F4-07 (0397)	Terminal V1 Signal Level	V/f CL-V/f OLV CLV AOLV Sets the output signal level for terminal V1.	0 (0, 1)

0 : 0 to 10 V
1 : -10 to 10 V

■ F4-08: Terminal V2 Signal Level

No. (Hex.)	Name	Description	Default (Range)
F4-08 (0398)	Terminal V2 Signal Level	V/f CL-V/f OLV CLV AOLV Sets the output signal level for terminal V2.	0 (0, 1)

0 : 0 to 10 V
1 : -10 to 10 V

◆ F5: Digital Output Option

F5 parameters set the output mode and function of output signals when you use digital output option card DO-A3.

When you install a DO-A3 to the drive, you can output isolated digital signals to monitor the drive operation status.

- 6 points of photocoupler output (48 V, 50 mA or less)
- 2 points of relay contact output (250 Vac, 30 Vdc: 1 A or less)

Refer to the DO-A3 option manual for more information about how to install, wire, and set the DO-A3 card.

■ Output Mode Selection via Parameters

Signal output from the DO-A3 card can be set as follows with *F5-09 [DO-A3 Output Mode Selection]*.

Table 11.20 Details of F5-09 and the DO-A3 Terminal Output

DO-A3 Terminal Block	DO-A3 Terminal Name	F5-09 = 0 [Predefined Individual Outputs] (Default Setting)	F5-09 = 1 [Binary Output]	F5-09 = 2 [Programmable (F5-01 to F5-08)]
TB1	M1-M2	Zero speed detection in progress	During Run	Depending on the setting of F5-07 [Terminal M1-M2 Function Select]
	M3-M4	During speed agreement	Minor fault (excluding bb [Baseblock])	Depending on the setting of F5-08 [Terminal M3-M4 Function Select]
TB2	P1-PC	oC [Overcurrent], GF [Ground Fault]	Coded output **Note:** Refer to Table 11.21 for details.	Depending on the setting of F5-01 [Terminal P1-PC Function Select]
	P2-PC	ov [Overvoltage]		Depending on the setting of F5-02 [Terminal P2-PC Function Select]
	P3-PC	oL2 [Drive Overloaded] or oH2 [External Overheat (H1-XX=B)]		Depending on the setting of F5-03 [Terminal P3-PC Function Select]
	P4-PC	Not used		Depending on the setting of F5-04 [Terminal P4-PC Function Select]
	P5-PC	oS [Overspeed]	Zero speed detection in progress	Depending on the setting of F5-05 [Terminal P5-PC Function Select]
	P6-PC	oH, oH1 [Heatsink Overheat] or oL1 [Motor Overload]	During speed agreement	Depending on the setting of F5-06 [Terminal P6-PC Function Select]

Table 11.21 Binary Output [F5-09 = 1]

Coded Output (Binary)	Description	DO-A3 Terminal Block TB2			
		Terminals P1-PC	Terminals P2-PC	Terminals P3-PC	Terminals P4-PC
0	No fault	0	0	0	0
1	oC [Overcurrent], GF [Ground Fault]	1	0	0	0
2	ov [Overvoltage]	0	1	0	0
3	oL2 [Drive Overload]	1	1	0	0
4	oH, oH1 [Heatsink Overheat]	0	0	1	0
5	oS [Overspeed]	1	0	1	0
6	Not used	0	1	1	0
7	rr [Dynamic Braking Transistor Fault], rH [Braking Resistor Overheat]	1	1	1	0
8	External Fault [EF1 to EF10]	0	0	0	1
9	CPFxx, oFAxx, oFbxx, oFCxx [Drive Hardware Fault] *1	1	0	0	1
A	oL1 [Motor Overload]	0	1	0	1
B	Not used	1	1	0	1
C	Uv1, Uv2 [Undervoltage], Uv3 [Soft Charge Answerback Fault]	0	0	1	1
D	dEv [Speed Deviation]	1	0	1	1
E	PGo [Encoder (PG) Feedback Loss]	0	1	1	1
F	Not used	1	1	1	1

*1 The digits represented by xx vary depending on the type of fault that occurs.

■ Digital Output Card Selection

Refer to "H2: Multi-function Digital Output" for more information about the functions that output from the terminals when *F5-09 = 2 [DO-A3 Output Mode Selection = Programmable (F5-01 to F5-08)]*. Use *F5-01 to F5-08* to set the output items.

No.	Name	Setting Range	Default
F5-01	Terminal P1-PC Function Select	0 - 192	0: During Run
F5-02	Terminal P2-PC Function Select	0 - 192	1: Zero Speed
F5-03	Terminal P3-PC Function Select	0 - 192	2: Speed Agree 1
F5-04	Terminal P4-PC Function Select	0 - 192	4: Frequency Detection 1
F5-05	Terminal P5-PC Function Select	0 - 192	6: Drive Ready
F5-06	Terminal P6-PC Function Select	0 - 192	37: During Frequency Output
F5-07	Terminal M1-M2 Function Select	0 - 192	F: Not Used
F5-08	Terminal M3-M4 Function Select	0 - 192	F: Not Used

■ F5-01: Terminal P1-PC Function Select

No. (Hex.)	Name	Description	Default (Range)
F5-01 (0399)	Terminal P1-PC Function Select	V/f CL-V/f OLV CLV AOLV Sets the function of terminal P1-PC on the DO-A3 option. Set *F5-09 = 2 [DO-A3 Output Mode Selection = Programmable (F5-01 to F5-08)]* to enable this function.	0 (0 - 1FF)

■ F5-02: Terminal P2-PC Function Select

No. (Hex.)	Name	Description	Default (Range)
F5-02 (039A)	Terminal P2-PC Function Select	V/f CL-V/f OLV CLV AOLV Sets the function of terminal P2-PC on the DO-A3 option. Set *F5-09 = 2 [DO-A3 Output Mode Selection = Programmable (F5-01 to F5-08)]* to enable this function.	1 (0 - 1FF)

■ F5-03: Terminal P3-PC Function Select

No. (Hex.)	Name	Description	Default (Range)
F5-03 (039B)	Terminal P3-PC Function Select	V/f CL-V/f OLV CLV AOLV Sets the function of terminal P3-PC on the DO-A3 option. Set *F5-09 = 2 [DO-A3 Output Mode Selection = Programmable (F5-01 to F5-08)]* to enable this function.	2 (0 - 1FF)

■ F5-04: Terminal P4-PC Function Select

No. (Hex.)	Name	Description	Default (Range)
F5-04 (039C)	Terminal P4-PC Function Select	V/f CL-V/f OLV CLV AOLV Sets the function of terminal P4-PC on the DO-A3 option. Set *F5-09 = 2 [DO-A3 Output Mode Selection = Programmable (F5-01 to F5-08)]* to enable this function.	4 (0 - 1FF)

■ F5-05: Terminal P5-PC Function Select

No. (Hex.)	Name	Description	Default (Range)
F5-05 (039D)	Terminal P5-PC Function Select	V/f CL-V/f OLV CLV AOLV Sets the function of terminal P5-PC on the DO-A3 option. Set *F5-09 = 2 [DO-A3 Output Mode Selection = Programmable (F5-01 to F5-08)]* to enable this function.	6 (0 - 1FF)

■ F5-06: Terminal P6-PC Function Select

No. (Hex.)	Name	Description	Default (Range)
F5-06 (039E)	Terminal P6-PC Function Select	V/f CL-V/f OLV CLV AOLV Sets the function of terminal P6-PC on the DO-A3 option. Set *F5-09 = 2 [DO-A3 Output Mode Selection = Programmable (F5-01 to F5-08)]* to enable this function.	37 (0 - 1FF)

■ F5-07: Terminal M1-M2 Function Select

No. (Hex.)	Name	Description	Default (Range)
F5-07 (039F)	Terminal M1-M2 Function Select	V/f CL-V/f OLV CLV AOLV Sets the function of terminal M1-M2 on the DO-A3 option by the setting value for the multi-function digital output (0 - 1FF). Set *F5-09 = 2 [DO-A3 Output Mode Selection = Programmable (F5-01 to F5-08)]* to enable this function.	F (0 - 1FF)

■ F5-08: Terminal M3-M4 Function Select

No. (Hex.)	Name	Description	Default (Range)
F5-08 (03A0)	Terminal M3-M4 Function Select	V/f CL-V/f OLV CLV AOLV Sets the function of terminal M3-M4 on the DO-A3 option. Set *F5-09 = 2 [DO-A3 Output Mode Selection = Programmable (F5-01 to F5-08)]* to enable this function.	F (0 - 1FF)

■ F5-09: DO-A3 Output Mode Selection

No. (Hex.)	Name	Description	Default (Range)
F5-09 (03A1)	DO-A3 Output Mode Selection	V/f CL-V/f OLV CLV AOLV Sets the output mode of signals from the DO-A3 option.	0 (0 - 2)

Refer to *Output Mode Selection via Parameters on page 665* for more information.

0 : Predefined Individual Outputs

1 : Binary Output

2 : Programmable (*F5-01 to F5-08*)

◆ F6, F7: Communication Options

F6 and F7 parameters are used to set the basic communication settings and method of fault detection for the communication option card. The communication option card parameters include common option card parameters and communication protocol-specific parameters.

The following table lists the parameters that need to be set for each communication option card.

Refer to the technical manual for each communication option card for more information on installing, wiring, and configuring the details needed before starting communication.

WARNING! *Sudden Movement Hazard. Do test runs and examine the drive to make sure that the command references are correct. If you set the command reference incorrectly, it can cause damage to the drive or serious injury or death.*

Table 11.22 Correspondence Between Communication Protocols and Parameters (SI-C3, SI-T3, SI-ET3, SI-P3, and SI-S3)

Parameter	CC-Link SI-C3	MECHATROLINK-II SI-T3	MECHATROLINK-III SI-ET3	PROFIBUS-DP SI-P3	CANopen SI-S3
F6-01 - F6-03	x	x	x	x	x
F6-04	x	-	-	-	-
F6-06 - F6-08	x	x	x	x	x
F6-10, F6-11	x	-	-	-	-
F6-14	x	x	x	x	x
F6-16	x	x	x	x	x
F6-20, F6-21	-	x	x	-	-
F6-22	-	x	-	-	-
F6-23 - F6-26	-	x	x	-	-
F6-30 - F6-32	-	-	-	x	-
F6-35, F6-36	-	-	-	-	x
F6-50 - F6-71	-	-	-	-	-
F7-01 - F7-15	-	-	-	-	-
F7-16	-	-	-	-	-

Parameter	CC-Link SI-C3	MECHATROLINK-II SI-T3	MECHATROLINK-III SI-ET3	PROFIBUS-DP SI-P3	CANopen SI-S3
F7-17 - F7-42	-	-	-	-	-
F7-60 - F7-79	-	-	-	x	-

Table 11.23 Correspondence Between Communication Protocols and Parameters (SI-N3, SI-EM3, SI-EP3, and SI-EN3)

Parameter	DeviceNet SI-N3	Modbus TCP/IP SI-EM3	PROFINET SI-EP3	EtherNet/IP SI-EN3
F6-01 - F6-03	x	x	x	x
F6-04	-	-	-	-
F6-06 - F6-08	x	x	x	x
F6-10, F6-11	-	-	-	-
F6-14	x	x	x	x
F6-16	x	x	x	x
F6-20, F6-21	-	-	-	-
F6-22	-	-	-	-
F6-23 - F6-26	-	-	-	-
F6-30 - F6-32	-	-	-	-
F6-35, F6-36	-	-	-	-
F6-50 - F6-71	x	-	-	-
F7-01 - F7-15	-	x	x	x
F7-16	-	x	-	-
F7-17 - F7-42	-	-	x	x
F7-60 - F7-79	-	-	-	-

■ F6-01: Communication Error Selection

No. (Hex.)	Name	Description	Default (Range)
F6-01 (03A2)	Communication Error Selection	V/f CL-V/f OLV CLV AOLV Selects the operation of the drive when the drive detects *bUS [Option Communication Error]*.	1 (0 - 5)

0 : Ramp to Stop

The drive ramps the motor to stop according to the deceleration time. Fault relay output terminal MA-MC will turn ON, and MB-MC will turn OFF.

1 : Coast to Stop

The drive output shuts off and the motor coasts to stop. Fault relay output terminal MA-MC will turn ON, and MB-MC will turn OFF.

2 : Fast Stop (Use C1-09)

The drive stops the motor using the deceleration time set in *C1-09 [Fast Stop Time]*. Fault relay output terminal MA-MC will turn ON, and MB-MC will turn OFF.

3 : Alarm Only

The keypad shows *bUS*, and the drive continues operation with the current frequency reference.

Note:

Prepare safety protection equipment and systems such as fast stop switches separately.

The output terminal set for *Alarm [H2-01 to H2-05 = 10]* switches ON.

4 : Alarm (Run at *d1-04*)

The keypad shows *bUS*, and the drive continues operation at the speed set in *d1-04 [Reference 4]*.

Note:

Prepare safety protection equipment and systems such as fast stop switches separately.

5 : Alarm - Ramp Stop

The motor is stopped during the deceleration time set in *C1-02 [Deceleration Time 1]* when *bUS* is detected. When the *bUS* fault clears, the motor starts accelerating to return to the previous frequency reference.

■ F6-02: Comm External Fault (EF0) Detect

No. (Hex.)	Name	Description	Default (Range)
F6-02 (03A3)	Comm External Fault (EF0) Detect	V/f CL-V/f OLV CLV AOLV Sets the conditions at which *EF0 [Option Card External Fault]* is detected.	0 (0, 1)

0 : Always Detected

1 : Detected during RUN Only

■ F6-03: Comm External Fault (EF0) Select

No. (Hex.)	Name	Description	Default (Range)
F6-03 (03A4)	Comm External Fault (EF0) Select	V/f CL-V/f OLV CLV AOLV Selects the operation of the drive when the drive detects *EF0 [Option Card External Fault]*.	1 (0 - 3)

0 : Ramp to Stop

The drive ramps the motor to stop according to the deceleration time. Fault relay output terminal MA-MC will turn ON, and MB-MC will turn OFF.

1 : Coast to Stop

The drive output shuts off and the motor coasts to stop. Fault relay output terminal MA-MC will turn ON, and MB-MC will turn OFF.

2 : Fast Stop (Use C1-09)

The drive stops the motor using the deceleration time set in *C1-09 [Fast Stop Time]*. Fault relay output terminal MA-MC will turn ON, and MB-MC will turn OFF.

3 : Alarm Only

The keypad shows *EF0*, and the drive continues operation.

Note:

Prepare safety protection equipment and systems such as fast stop switches separately.

The output terminal set for *Alarm [H2-01 to H2-05 = 10]* switches ON.

■ F6-04: bUS Error Detection Time

No. (Hex.)	Name	Description	Default (Range)
F6-04 (03A5)	bUS Error Detection Time	V/f CL-V/f OLV CLV AOLV Sets the delay time for the drive to detect *bUS [Option Communication Error]*.	2.0 s (0.0 - 5.0 s)

Note:

When you install an option card in the drive, the parameter value changes to 0.0 s.

■ F6-06: Torque Reference/Limit by Comm

No. (Hex.)	Name	Description	Default (Range)
F6-06 (03A7)	Torque Reference/Limit by Comm	V/f CL-V/f OLV CLV AOLV Sets the function that enables and disables the torque limit received from the communication option.	0 (0, 1)

0 : Disabled

1 : Enabled

■ F6-07: Multi-Step Ref @ NetRef/ComRef

No. (Hex.)	Name	Description	Default (Range)
F6-07 (03A8)	Multi-Step Ref @ NetRef/ ComRef	V/f CL-V/f OLV CLV AOLV Sets the function that enables and disables the multi-step speed reference when NetRef (communication option card) or ComRef (MEMOBUS/Modbus communications) are the frequency reference source.	0 (0, 1)

0 : Disable Multi-Step References

The multi-step speed reference (2-step speed to 8-step speed references) and the Jog Frequency Reference (JOG command) are disabled when NetRef or ComRef is selected as the frequency reference source.

1 : Enable Multi-Step References

The multi-step speed reference (2-step speed through 8-step speed references) and the Jog Frequency Reference (JOG command) are enabled, and the frequency reference can be changed when NetRef or ComRef is selected as the frequency reference source.

■ F6-08: Comm Parameter Reset @Initialize

No. (Hex.)	Name	Description	Default (Range)
F6-08 (036A)	Comm Parameter Reset @Initialize	V/f CL-V/f OLV CLV AOLV Sets the function to initialize *F6-xx and F7-xx parameters* when the drive is initialized with *A1-03 [Initialize Parameters]*.	0 (0, 1)

0 : No Reset - Parameters Retained

1 : Reset Back to Factory Default

Note:

When you use *A1-03* to initialize the drive, this setting will not change.

■ F6-10: CC-Link Node Address

No. (Hex.)	Name	Description	Default (Range)
F6-10 (03B6)	CC-Link Node Address	V/f CL-V/f OLV CLV AOLV Sets the node address for CC-Link communication. Restart the drive after you change the parameter setting.	0 (0 - 64)

Note:

Be sure to set a node address that is different than all other node addresses. Do not set this parameter to *0*. Incorrect parameter settings will cause *AEr [Station Address Setting Error]* errors and the L.ERR LED on the option will come on.

When the only drive is connected, you can connect a maximum of 42 nodes. Follow these rules to connect devices that are not drives:

- $\{(1 \times a) + (2 \times b) + (3 \times c) + (4 \times d)\} \leq 64$
  (a: number of units that occupies 1 node, b: number of units that occupies 2 nodes, c: number of units that occupies 3 nodes, d: number of units that occupies 4 nodes)
- $\{(16 \times A) + (54 \times B) + (88 \times C)\} \leq 2304$
  (A: number of remote I/O nodes (64 max.), B: number of remote device nodes (42 max.), C: number of local nodes (26 max.))

■ F6-11: CC-Link Communication Speed

No. (Hex.)	Name	Description	Default (Range)
F6-11 (03B7)	CC-Link Communication Speed	V/f CL-V/f OLV CLV AOLV Sets the communication speed for CC-Link communication. Restart the drive after you change the parameter setting.	0 (0 - 4)

0 : 156 kbps

1 : 625 kbps

2 : 2.5 Mbps

3 : 5 Mbps

4 : 10 Mbps

■ F6-14: BUS Error Auto Reset

No. (Hex.)	Name	Description	Default (Range)
F6-14 (03BB)	BUS Error Auto Reset	V/f CL-V/f OLV CLV AOLV Sets the automatic reset function for *bUS [Option Communication Errors]*.	0 (0, 1)

0 : Disable

1 : Enabled

■ F6-16: Gateway Mode

No. (Hex.)	Name	Description	Default (Range)
F6-16 (0B8A)	Gateway Mode	V/f CL-V/f OLV CLV AOLV Sets the gateway mode operation and the number of connected slave drives.	0 (0 - 4)

0 : Disabled

1 : Enabled: 1 Slave Drive

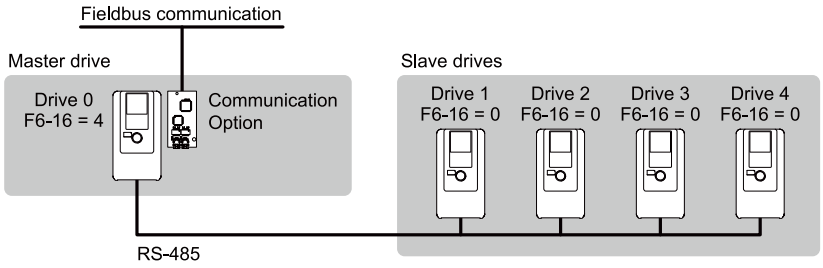
2 : Enabled: 2 Slave Drives

3 : Enabled: 3 Slave Drives

4 : Enabled: 4 Slave Drives

The gateway mode performs communications processing to relay data from a drive equipped with the communication option to multiple drives not equipped with the communication option via the internal RS-485 communication function. This enables up to a maximum of 5 drives to be connected via fieldbus communication using only one communication option. The following commands and responses are exchanged between the controller (Host device), master drive (Drive 0), and the slave drives (Drive 1 to Drive 4).

- Commands: Run command and frequency reference
- Output frequency and drive status (running, faults)
- Reading and writing parameters
- Reading monitors



Note:
- Do not mount the communication option in slave drives when using the gateway mode.
- Doing so may disrupt synchronization of drive commands and responses.
- Response speed using the communication option is slower than when using point-to-point communications.
- Make sure H5-03 [Communication Parity Selection] is set to the same value on both the master drive and slave drives.

The following example illustrates the parameter settings when connecting four slave drives.

	F6-16 [Gateway Mode]	H5-01 [Drive Node Address]	H5-02 [Communication Speed Selection]	H5-03 [Communication Parity Selection]	H5-06 [Drive Transmit Wait Time]	H5-09 [CE Detection Time]	b1-01 [Frequency Reference Selection 1]	b1-02 [Run Command Selection 1]
Drive0 (Master Drive)	1 to 4 *1	1F (Default value)	*2	*2	5 ms *3	At least 2.0 seconds *4	3 [Option PCB]	3 [Option PCB]
Drive1 (Slave Drive 1)	0	01	*2	*2	5 ms *3	At least 0.9 seconds *4	2 [Memobus/ Modbus Communications] *5	2 [Memobus/ Modbus Communications] *5
Drive2 (Slave Drive 2)	0	02	*2	*2	5 ms *3	At least 0.9 seconds *4	2 [Memobus/ Modbus Communications] *5	2 [Memobus/ Modbus Communications] *5
Drive3 (Slave Drive 3)	0	03	*2	*2	5 ms *3	At least 0.9 seconds *4	2 [Memobus/ Modbus Communications] *5	2 [Memobus/ Modbus Communications] *5
Drive4 (Slave Drive 4)	0	04	*2	*2	5 ms *3	At least 0.9 seconds *4	2 [Memobus/ Modbus Communications] *5	2 [Memobus/ Modbus Communications] *5

*1 Set the number of connected slave drives.
*2 Make sure the communications speed and communications parity are set to the same value on both the master drive and slave drives.
*3 Do not change the value of *H5-06* from the default value to correctly detect the response timeout.
*4 Set *H5-09* to a value of at least 0.9 seconds. When *H5-09* < *0.9*, *CE* will be detected before the response timeout is detected.
*5 Set the Run command and frequency reference source on slave drives to MEMOBUS/Modbus communications.

Note:
- The master drive stops transmitting to the slave drives when timeouts or message errors occur consecutively for 10 times. Input the fault reset command to restart communication.
- If the access command is changed before the MEMOBUS/Modbus access completion flag turns on, the previous command may not be executed.

Special Register Specifications

Table 11.24 Command Data

Register No.	Description		
1	Command source update (15C5H)		This flag enables command updates.
	bit 0	Drive 1 Update Command Enabled	To input both the Run command and frequency reference simultaneously, change the bit value from 0 to 1 after all commands have been written.
	bit 1	Drive 2 Update Command Enabled	
	bit 2	Drive 3 Update Command Enabled	
	bit 3	Drive 4 Update Command Enabled	
	bit 4	Update Register Access Command Enabled	
	bit 5 - F	Reserved	
2	Run Command (Drive 1) (15C6H)		
	bit 0	Forward run/Stop 1: Forward run, 0: Stop	
	bit 1	Reverse run/Stop 1: Reverse run, 0: Stop	
	bit 2	External Fault	
	bit 3	Fault Reset	
	bit 4	ComRef	
	bit 5	ComCtrl	
	bit 6 - F	Reserved	
3	Frequency Reference (Drive 1) (15C7H)		The unit of measure varies depending on the setting of o1-03.
4	Run Command (Drive 2) (15C8H)		
5	Frequency Reference (Drive 2) (15C9H)		
6	Run Command (Drive 3) (15CAH)		
7	Frequency Reference (Drive 3) (15CBH)		
8	Run Command (Drive 4) (15CCH)		
9	Frequency Reference (Drive 4) (15CDH)		
10	Slave Address for Reg. Access + Read/Write (15CEH)		
	bit 0 bit 1 bit 2 bit 3	Slave address 0: Broadcast Messages (MEMOBUS) 1: Drive 1 2: Drive 2 3: Drive 3 4: Drive 4 5: Broadcast Messages (Run command and frequency reference)	When bit 0 to 3 = 0, access is only enabled for broadcast messages. When bit 0 to 3 = 5, access is enabled only for Run command and frequency reference broadcast messages. Drive 0 is excluded.
	bit 4	0: Read, 1: Write	
	bit 5 - F	Reserved	
11	Register number (15CFH)		
12	Data (write register) (15D0H)		

Table 11.25 Monitor Data

Register No.	Description		
1	Drive Status (Drive 1) (15E7H)		
	bit 0	During Run	
	bit 1	During Reverse Run	
	bit 2	Drive Ready	
	bit 3	Fault	
	bit 4	Frequency Command Setting Fault	1: Upper/Lower Limit Fault
	bit 5	No response from slave	1: Response has timed out.
	bit 6	Communication Error	1: A fault has been detected from a slave.
	bit 7	No response from slave for 10 consecutive attempts.	1: Timeout has occurred for 10 consecutive times.
	bit 8	Communication fault has occurred for 10 consecutive times.	1: Fault has occurred from a slave for 10 consecutive times.
	bit 9	Receive broadcast command while drive is running	1: Drive operates in accordance with the broadcast message command.
	bit A	Communication error with master drive	1: Communication with the master will not be performed due to a communication error.
	bit B - D	Reserved	
	bit E	ComRef status	
	bit F	ComCtrl status	
2	Output frequency or frequency reference (Drive Status Bit 4: ON) (Drive 4) (15E8H) Drive Status Bit 4 = 0 [Output Frequency] Drive Status Bit 4 = 1 [Frequency Reference]		The unit of measure varies depending on the setting of o1-03.
3	Drive Status (Drive 2) (15E9H)		
4	Output frequency or frequency reference (Drive Status Bit 4: ON) (Drive 2) (15EAH)		
5	Drive Status (Drive 3) (15EBH)		
6	Output frequency or frequency reference (Drive Status Bit 4: ON) (Drive 3) (15ECH)		
7	Drive Status (Drive 4) (15EDH)		
8	Output frequency or frequency reference (Drive Status Bit 4: ON) (Drive 4) (15EEH)		
9	Slave Address for Reg. Access + During MEMOBUS process & ErrCode (15EFH)		
	bit 0 bit 1 bit 2 bit 3 bit 4 bit 5 bit 6 bit 7	00H: MEMOBUS/Modbus Communication Complete 02H: Register number not registered 21H: Upper/Lower Limit Fault 22H: Write Mode Error 23H: Write performed during occurrence of *Uv* 24H: Write performed while writing parameter settings FFH: During MEMOBUS/Modbus Communication	
	bit 8 bit 9 bit A	Slave address 0: MEMOBUS command ignored 1: Drive 1 2: Drive 2 4: Drive 3 5: Drive 4	
11	Register number (15F0H)		
12	Data (write register) (15F1H)		

■ F6-20: MECHATROLINK Station Address

No. (Hex.)	Name	Description	Default (Range)
F6-20 (036B)	MECHATROLINK Station Address	V/f CL-V/f OLV CLV AOLV Sets the station address for MECHATROLINK communication. Restart the drive after you change this parameter setting.	0021h (MECHATROLINK-II: 0020h - 003Fh, MECHATROLINK-III: 0003h - 00EFh)

Note:
- The setting range varies depending on the type of MECHATROLINK communication.
  – MECHATROLINK-II (SI-T3): 20 through 3F
  – MECHATROLINK-III (SI-ET3): 03 through EF
- Set an address that does overlap with other nodes. If the parameter is set incorrectly, the drive will detect the *AEr [Station Address Setting Error]* error, and the ERR light on the option card flashes.
- An *AEr* is triggered when the station address is set to either 20 or 3F.

■ F6-21: MECHATROLINK Frame Size

No. (Hex.)	Name	Description	Default (Range)
F6-21 (036C)	MECHATROLINK Frame Size	V/f CL-V/f OLV CLV AOLV Sets the frame size for MECHATROLINK communication. Restart the drive after you change the parameter setting.	0 (0, 1)

0 : 32byte (M-2) / 64byte (M-3)

1 : 17byte (M-2) / 32byte (M-3)

■ F6-22: MECHATROLINK Link Speed

No. (Hex.)	Name	Description	Default (Range)
F6-22 (036D)	MECHATROLINK Link Speed	V/f CL-V/f OLV CLV AOLV Sets the communications speed for MECHATROLINK-II. Restart the drive after you change the parameter setting.	0 (0, 1)

Note:
This parameter is only available with the MECHATROLINK-II option.

0 : 10 Mbps

1 : 4 Mbps

■ F6-23: MECHATROLINK Monitor Select (E)

No. (Hex.)	Name	Description	Default (Range)
F6-23 (036E)	MECHATROLINK Monitor Select (E)	V/f CL-V/f OLV CLV AOLV Sets the MEMOBUS register used for the monitor functions of INV_CTL (drive operation control command) and INV_I/O (drive I/O control command). Restart the drive after you change the parameter setting.	0000h (0000h - FFFFh)

To enable the MEMOBUS register set in *F6-23*, set SEL_MON2/1 to 0EH or set SEL_MON 3/4 and SEL_MON 5/6 to 0EH. Bytes of the response data enable the MEMOBUS register content that was set in *F6-23*.

■ F6-24: MECHATROLINK Monitor Select (F)

No. (Hex.)	Name	Description	Default (Range)
F6-24 (036F)	MECHATROLINK Monitor Select (F)	V/f CL-V/f OLV CLV AOLV Sets the MEMOBUS register used for the monitor functions of INV_CTL (drive operation control command) and INV_I/O (drive I/O control command). Restart the drive after you change the parameter setting.	0000h (0000h - FFFFh)

To enable the MEMOBUS register set in *F6-24*, set SEL_MON2/1 to 0FH or set SEL_MON3/4 and SEL_MON 5/6 to 0FH. Bytes of the response data enable the MEMOBUS register content that was set *F6-24*.

■ F6-25: MECHATROLINK Watchdog Error Sel

No. (Hex.)	Name	Description	Default (Range)
F6-25 (03C9)	MECHATROLINK Watchdog Error Sel	V/f CL-V/f OLV CLV AOLV Selects the motor operation when the drive detects *E5 [MECHATROLINK Watchdog Timer Err]*.	1 (0 - 3)

0 : Ramp to Stop

The drive ramps the motor to stop according to the deceleration time. Fault relay output terminal MA-MC will turn ON, and MB-MC will turn OFF.

1 : Coast to Stop

The drive output shuts off and the motor coasts to stop. Fault relay output terminal MA-MC will turn ON, and MB-MC will turn OFF.

2 : Fast Stop (Use C1-09)

The drive stops the motor using the deceleration time set in *C1-09 [Fast Stop Time]*. Fault relay output terminal MA-MC will turn ON, and MB-MC will turn OFF.

3 : Alarm Only

The keypad shows *E5*, and the drive continues operation.

Note:

Prepare safety protection equipment and systems such as fast stop switches separately.

The output terminal set for *Alarm [H2-01 to H2-05 = 10]* switches ON.

■ F6-26: MECHATROLINK Allowable No of Err

No. (Hex.)	Name	Description	Default (Range)
F6-26 (03CA)	MECHATROLINK Allowable No of Err	V/f CL-V/f OLV CLV AOLV Sets the number of times that the option must detect a *bUS* alarm to cause a *bUS [Option Communication Error]*.	2 (2 - 10 times)

■ F6-30: PROFIBUS-DP Node Address

No. (Hex.)	Name	Description	Default (Range)
F6-30 (03CB)	PROFIBUS-DP Node Address	V/f CL-V/f OLV CLV AOLV Sets the node address for PROFIBUS-DP communication. Restart the drive after you change the parameter setting.	0 (0 - 125)

Note:

- Be sure to set a node address that is different than all other node addresses.
- Node addresses 0, 1, and 2 are usually reserved for control, maintenance, and device self-diagnosis.

■ F6-31: PROFIBUS-DP Clear Mode Selection

No. (Hex.)	Name	Description	Default (Range)
F6-31 (03CC)	PROFIBUS-DP Clear Mode Selection	V/f CL-V/f OLV CLV AOLV Sets what the drive will do after it receives the Clear Mode command.	0 (0, 1)

0 : Reset

Resets drive settings, for example frequency reference and I/O settings.

1 : Hold Previous State

The drive keeps the same status as before it received the command.

■ F6-32: PROFIBUS-DP Data Format Select

No. (Hex.)	Name	Description	Default (Range)
F6-32 (03CD)	PROFIBUS-DP Data Format Select	V/f CL-V/f OLV CLV AOLV Sets the data format of PROFIBUS-DP communication. Restart the drive after you change the parameter setting.	0 (0 - 5)

Note:

The *H5-11 [Comm ENTER Command Mode]* setting makes the RAM enter command necessary or not necessary to write parameters over network communication. When *F6-32 = 0, 1, or 2*, the *H5-11* setting does not have an effect. The RAM enter command is always necessary to write parameters.

0 : PPO Type

1 : Conventional

2 : PPO (bit0)

This function operates when bit 0 and bit 4 in the register STW have values of 1 (operate). Refer to the PROFIBUS-DP communication manual for more information.

3 : PPO (Enter)

4 : Conventional (Enter)

5 : PPO (bit0, Enter)

This function operates when bit 0 and bit 4 in the register STW have values of 1 (operate). Refer to the PROFIBUS-DP communication manual for more information.

■ F6-35: CANopen Node ID Selection

No. (Hex.)	Name	Description	Default (Range)
F6-35 (03D0)	CANopen Node ID Selection	V/f CL-V/f OLV CLV AOLV Sets the node address for CANopen communication. Restart the drive after you change the parameter setting.	0 (0 - 126)

Note:

Be sure to set an address that is different than all other node addresses. Do not set this parameter to *0*. Incorrect parameter settings will cause *AEr [Station Address Setting Error]* errors and the L.ERR LED on the option will come on.

■ F6-36: CANopen Communication Speed

No. (Hex.)	Name	Description	Default (Range)
F6-36 (03D1)	CANopen Communication Speed	V/f CL-V/f OLV CLV AOLV Sets the CANopen communications speed. Restart the drive after you change this parameter setting.	0 (0 - 8)

0 : Auto-detection

The drive detects the network communication speed and automatically adjusts the communications speed.

1 : 10 kbps

2 : 20 kbps

3 : 50 kbps

4 : 125 kbps

5 : 250 kbps

6 : 500 kbps

7 : 800 kbps

8 : 1 Mbps

■ F6-50: DeviceNet MAC Address

No. (Hex.)	Name	Description	Default (Range)
F6-50 (03C1)	DeviceNet MAC Address	V/f CL-V/f OLV CLV AOLV Sets the MAC address for DeviceNet communication. Restart the drive after you change this parameter setting.	0 (0 - 64)

Note:

Set a MAC address that does not overlap with other nodes. Do not set this parameter to a value of 0. If the parameter is set incorrectly, the ERR on the option card flashes, and the drive will detect the *AEr [Station Address Setting Error]*.

■ F6-51: DeviceNet Baud Rate

No. (Hex.)	Name	Description	Default (Range)
F6-51 (03C2)	DeviceNet Baud Rate	V/f CL-V/f OLV CLV AOLV Sets the DeviceNet communications speed. Restart the drive after you change this parameter setting.	0 (0 - 4)

0 : 125 kbps

1 : 250 kbps

2 : 500 kbps

3 : Adjustable from Network

The controller sets the communications speed.

4 : Detect Automatically

The drive detects the network communication speed and automatically adjusts the communications speed accordingly.

■ F6-52: DeviceNet PCA Setting

No. (Hex.)	Name	Description	Default (Range)
F6-52 (03C3)	DeviceNet PCA Setting	V/f CL-V/f OLV CLV AOLV Sets the format of data that the DeviceNet communication master sends to the drive.	21 (0 - 255)

Note:
If *F6-52 [DeviceNet PCA Setting]* and *F6-53 [DeviceNet PPA Setting]* are not correct, the value is reset to default.

■ F6-53: DeviceNet PPA Setting

No. (Hex.)	Name	Description	Default (Range)
F6-53 (03C4)	DeviceNet PPA Setting	V/f CL-V/f OLV CLV AOLV Sets the format of data that the drive sends to the DeviceNet communication master.	71 (0 - 255)

Note:
If *F6-52 [DeviceNet PCA Setting]* and *F6-53 [DeviceNet PPA Setting]* are not correct, the value is reset to default.

■ F6-54: DeviceNet Idle Fault Detection

No. (Hex.)	Name	Description	Default (Range)
F6-54 (03C5)	DeviceNet Idle Fault Detection	V/f CL-V/f OLV CLV AOLV Sets the function to detect *EF0 [Option Card External Fault]* when the drive does not receive data from the DeviceNet master.	0 (0 - 4)

0 : Enabled

1 : Disabled, No Fault Detection

Does not detect *EF0* issues.

2 : Vendor Specific

3 : RUN Forward

4 : RUN Reverse

■ F6-55: DeviceNet Baud Rate Monitor

No. (Hex.)	Name	Description	Default (Range)
F6-55 (03C6)	DeviceNet Baud Rate Monitor	V/f CL-V/f OLV CLV AOLV Sets the function to see the actual DeviceNet communications speed using the keypad. This parameter functions as a monitor only.	0 (0 - 2)

0 : 125 kbps

1 : 250 kbps

2 : 500 kbps

■ F6-56: DeviceNet Speed Scaling

No. (Hex.)	Name	Description	Default (Range)
F6-56 (03D7)	DeviceNet Speed Scaling	V/f CL-V/f OLV CLV AOLV Sets the speed scale for DeviceNet communication.	0 (-15 - +15)

■ F6-57: DeviceNet Current Scaling

No. (Hex.)	Name	Description	Default (Range)
F6-57 (03D8)	DeviceNet Current Scaling	V/f CL-V/f OLV CLV AOLV Sets the current scale of the DeviceNet communication master.	0 (-15 - +15)

■ F6-58: DeviceNet Torque Scaling

No. (Hex.)	Name	Description	Default (Range)
F6-58 (03D9)	DeviceNet Torque Scaling	V/f CL-V/f OLV CLV AOLV Sets the torque scale of the DeviceNet communication master.	0 (-15 - +15)

■ F6-59: DeviceNet Power Scaling

No. (Hex.)	Name	Description	Default (Range)
F6-59 (03DA)	DeviceNet Power Scaling	V/f CL-V/f OLV CLV AOLV Sets the power scale of the DeviceNet communication master.	0 (-15 - +15)

■ F6-60: DeviceNet Voltage Scaling

No. (Hex.)	Name	Description	Default (Range)
F6-60 (03DB)	DeviceNet Voltage Scaling	V/f CL-V/f OLV CLV AOLV Sets the voltage scale of the DeviceNet communication master.	0 (-15 - +15)

■ F6-61: DeviceNet Time Scaling

No. (Hex.)	Name	Description	Default (Range)
F6-61 (03DC)	DeviceNet Time Scaling	V/f CL-V/f OLV CLV AOLV Sets the time scale of the DeviceNet communication master.	0 (-15 - +15)

■ F6-62: DeviceNet Heartbeat Interval

No. (Hex.)	Name	Description	Default (Range)
F6-62 (03DD)	DeviceNet Heartbeat Interval	V/f CL-V/f OLV CLV AOLV Sets the heartbeat for DeviceNet communication. Set this parameter to 0 to disable the heartbeat function.	0 (0 - 10)

■ F6-63: DeviceNet Network MAC ID

No. (Hex.)	Name	Description	Default (Range)
F6-63 (03DE)	DeviceNet Network MAC ID	V/f CL-V/f OLV CLV AOLV Sets the function to see the actual DeviceNet MAC address using the keypad. This parameter functions as a monitor only.	0 (0 - 63)

■ F6-64 to F6-67: Dynamic Out Assembly 109 Param1 to 4

No. (Hex.)	Name	Description	Default (Range)
F6-64 to F6-67 (03DF - 03E2)	Dynamic Out Assembly 109 Param 1 to 4	V/f CL-V/f OLV CLV AOLV Sets Configurable Outputs 1 to 4 written to the MEMOBUS register.	0000H (0000H - FFFFH)

■ F6-68 to F6-71: Dynamic In Assembly 159 Param 1 to 4

No. (Hex.)	Name	Description	Default (Range)
F6-68 to F6-71 (03E3, 03E4, 03C7, and 03C8)	Dynamic In Assembly 159 Param 1 to 4	V/f CL-V/f OLV CLV AOLV Sets Configurable Inputs 1 to 4 read from the MEMOBUS register.	0000H (0000H - FFFFH)

■ F6-72: PowerLink Node Address

No. (Hex.)	Name	Description	Default (Range)
F6-72 (081B)	PowerLink Node Address	V/f CL-V/f OLV CLV AOLV Sets the node ID for PowerLink communication.	0 (0 - 255)

■ F7-01: IP Address 1

No. (Hex.)	Name	Description	Default (Range)
F7-01 (03E5)	IP Address 1	V/f CL-V/f OLV CLV AOLV Sets the first octet of the IP Address for the device that is connecting to the network. Restart the drive after you change this parameter.	192 (0 - 255)

Note:

When *F7-13 = 0 [Address Mode at Startup = Static]*:

- Use parameters *F7-01 to F7-04 [IP Address 1 to 4]* to set the IP Address. Be sure to set a different IP address for each drive on the network.
- Also set parameters *F7-05 to F7-12 [Subnet Mask 1 to 4, Gateway Address 1 to 4]*.

■ F7-02: IP Address 2

No. (Hex.)	Name	Description	Default (Range)
F7-02 (03E6)	IP Address 2	V/f CL-V/f OLV CLV AOLV Sets the second octet of the IP Address for the device that is connecting to the network. Restart the drive after you change this parameter.	168 (0 - 255)

Note:

When *F7-13 = 0 [Address Mode at Startup = Static]*:

- Use parameters *F7-01 to F7-04 [IP Address 1 to 4]* to set the IP Address. Be sure to set a different IP address for each drive on the network.
- Also set parameters *F7-05 to F7-12 [Subnet Mask 1 to 4, Gateway Address 1 to 4]*.

■ F7-03: IP Address 3

No. (Hex.)	Name	Description	Default (Range)
F7-03 (03E7)	IP Address 3	V/f CL-V/f OLV CLV AOLV Sets the third octet of the IP Address for the device that is connecting to the network. Restart the drive after you change this parameter.	1 (0 - 255)

Note:

When *F7-13 = 0 [Address Mode at Startup = Static]*:

- Use parameters *F7-01 to F7-04 [IP Address 1 to 4]* to set the IP Address. Be sure to set a different IP address for each drive on the network.
- Also set parameters *F7-05 to F7-12 [Subnet Mask 1 to 4, Gateway Address 1 to 4]*.

■ F7-04: IP Address 4

No. (Hex.)	Name	Description	Default (Range)
F7-04 (03E8)	IP Address 4	V/f CL-V/f OLV CLV AOLV Sets the fourth octet of the IP Address for the device that is connecting to the network. Restart the drive after you change this parameter.	20 (0 - 255)

Note:

When *F7-13 = 0 [Address Mode at Startup = Static]*:

- Use parameters *F7-01 to F7-04 [IP Address 1 to 4]* to set the IP Address. Be sure to set a different IP address for each drive on the network.
- Also set parameters *F7-05 to F7-12 [Subnet Mask 1 to 4, Gateway Address 1 to 4]*.

■ F7-05: Subnet Mask 1

No. (Hex.)	Name	Description	Default (Range)
F7-05 (03E9)	Subnet Mask 1	V/f CL-V/f OLV CLV AOLV Sets the first octet of the subnet mask of the connected network.	255 (0 - 255)

Note:

Set this parameter when *F7-13 = 0 [Address Mode at Startup = Static]*.

■ F7-06: Subnet Mask 2

No. (Hex.)	Name	Description	Default (Range)
F7-06 (03EA)	Subnet Mask 2	V/f CL-V/f OLV CLV AOLV Sets the second octet of the subnet mask of the connected network.	255 (0 - 255)

Note:
Set this parameter when *F7-13 = 0 [Address Mode at Startup = Static]*.

■ F7-07: Subnet Mask 3

No. (Hex.)	Name	Description	Default (Range)
F7-07 (03EB)	Subnet Mask 3	V/f CL-V/f OLV CLV AOLV Sets the third octet of the subnet mask of the connected network.	255 (0 - 255)

Note:
Set this parameter when *F7-13 = 0 [Address Mode at Startup = Static]*.

■ F7-08: Subnet Mask 4

No. (Hex.)	Name	Description	Default (Range)
F7-08 (03EC)	Subnet Mask 4	V/f CL-V/f OLV CLV AOLV Sets the fourth octet of the subnet mask of the connected network.	0 (0 - 255)

Note:
Set this parameter when *F7-13 = 0 [Address Mode at Startup = Static]*.

■ F7-09: Gateway Address 1

No. (Hex.)	Name	Description	Default (Range)
F7-09 (03ED)	Gateway Address 1	V/f CL-V/f OLV CLV AOLV Sets the first octet of the gateway address of the connected network.	192 (0 - 255)

Note:
Set this parameter when *F7-13 = 0 [Address Mode at Startup = Static]*.

■ F7-10: Gateway Address 2

No. (Hex.)	Name	Description	Default (Range)
F7-10 (03EE)	Gateway Address 2	V/f CL-V/f OLV CLV AOLV Sets the second octet of the gateway address of the connected network.	168 (0 - 255)

Note:
Set this parameter when *F7-13 = 0 [Address Mode at Startup = Static]*.

■ F7-11: Gateway Address 3

No. (Hex.)	Name	Description	Default (Range)
F7-11 (03EF)	Gateway Address 3	V/f CL-V/f OLV CLV AOLV Sets the third octet of the gateway address of the connected network.	1 (0 - 255)

Note:
Set this parameter when *F7-13 = 0 [Address Mode at Startup = Static]*.

■ F7-12: Gateway Address 4

No. (Hex.)	Name	Description	Default (Range)
F7-12 (03F0)	Gateway Address 4	V/f CL-V/f OLV CLV AOLV Sets the fourth octet of the gateway address of the connected network.	1 (0 - 255)

Note:
Set this parameter when *F7-13 = 0 [Address Mode at Startup = Static]*.

■ F7-13: Address Mode at Startup

No. (Hex.)	Name	Description	Default (Range)
F7-13 (03F1)	Address Mode at Startup	V/f CL-V/f OLV CLV AOLV Sets the method to set option card IP addresses.	2 (0 - 2)

0 : Static

1 : BOOTP

2 : DHCP

Note:

- The following setting values are available when using the PROFINET communication option card (SI-EP3).
  - –0: Static
  - –2: DCP
- When *F7-13 = 0*, set parameters *F7-01 to F7-12 [IP Address 1 to Gateway Address 4]* to set the IP Address. Be sure to set a different IP address for each drive on the network.

■ F7-14: Duplex Mode Selection

No. (Hex.)	Name	Description	Default (Range)
F7-14 (03F2)	Duplex Mode Selection	V/f CL-V/f OLV CLV AOLV Sets the duplex mode setting method.	1 (0 - 8)

0 : Half/Half

1 : Auto/Auto

2 : Full/Full

3 : Half/Auto

Port 1 is set to “Half” and port 2 is set to “Auto”.

4 : Half/Full

Port 1 is set to “Half” and port 2 is set to “Full”.

5 : Auto/Half

Port 1 is set to “Auto” and port 2 is set to “Half”.

6 : Auto/Full

Port 1 is set to “Auto” and port 2 is set to “Full”.

7 : Full/Half

Port 1 is set to “Full” and port 2 is set to “Half”.

8 : Full/Auto

Port 1 is set to “Full” and port 2 is set to “Auto”.

■ F7-15: Communication Speed Selection

No. (Hex.)	Name	Description	Default (Range)
F7-15 (03F3)	Communication Speed Selection	V/f CL-V/f OLV CLV AOLV Sets the communications speed.	10 (10, 100 - 102)

10 : 10/10 Mbps

100 : 100/100 Mbps

101 : 10/100 Mbps

102 : 100/10 Mbps

Note:

Set this parameter when *F7-14 = 0* or *2 [Duplex Mode Selection = Half/Half or Full/Full]*.

■ F7-16: Timeout Value

No. (Hex.)	Name	Description	Default (Range)
F7-16 (03F4)	Timeout Value	V/f CL-V/f OLV CLV AOLV Sets the detection time for a communications timeout.	0.0 s (0.0 - 30.0 s)

Note:
Set this parameter to 0.0 to disable the connection timeout function.

■ F7-17: EtherNet/IP Speed Scaling Factor

No. (Hex.)	Name	Description	Default (Range)
F7-17 (03F5)	EtherNet/IP Speed Scaling Factor	V/f CL-V/f OLV CLV AOLV Sets the scaling factor for the speed monitor in the EtherNet/IP Class ID 2AH Object.	0 (-15 - +15)

■ F7-18: EtherNet/IP Current Scale Factor

No. (Hex.)	Name	Description	Default (Range)
F7-18 (03F6)	EtherNet/IP Current Scale Factor	V/f CL-V/f OLV CLV AOLV Sets the scaling factor for the output current monitor in the EtherNet/IP Class ID 2AH Object.	0 (-15 - +15)

■ F7-19: EtherNet/IP Torque Scale Factor

No. (Hex.)	Name	Description	Default (Range)
F7-19 (03F7)	EtherNet/IP Torque Scale Factor	V/f CL-V/f OLV CLV AOLV Sets the scaling factor for the torque monitor in the EtherNet/IP Class ID 2AH Object.	0 (-15 - +15)

■ F7-20: EtherNet/IP Power Scaling Factor

No. (Hex.)	Name	Description	Default (Range)
F7-20 (03F8)	EtherNet/IP Power Scaling Factor	V/f CL-V/f OLV CLV AOLV Sets the scaling factor for the power monitor in the EtherNet/IP Class ID 2AH Object.	0 (-15 - +15)

■ F7-21: EtherNet/IP Voltage Scale Factor

No. (Hex.)	Name	Description	Default (Range)
F7-21 (03F9)	EtherNet/IP Voltage Scale Factor	V/f CL-V/f OLV CLV AOLV Sets the scaling factor for the voltage monitor in the EtherNet/IP Class ID 2AH Object.	0 (-15 - +15)

■ F7-22: EtherNet/IP Time Scaling

No. (Hex.)	Name	Description	Default (Range)
F7-22 (03FA)	EtherNet/IP Time Scaling	V/f CL-V/f OLV CLV AOLV Sets the scaling factor for the time monitor in the EtherNet/IP Class ID 2AH Object.	0 (-15 - +15)

■ F7-23 to F7-32: Dynamic Out Param 1 to 10 for CommCard

No. (Hex.)	Name	Description	Default (Range)
F7-23 to F7-27 (03FB - 03FF) F7-28 to F7-32 (0370 - 0374)	Dynamic Out Param 1 to 10 for CommCard	V/f CL-V/f OLV CLV AOLV When you use an Ethernet/IP option, sets Output Assembly 116. The drive writes the values from Output Assembly 116 to the MEMOBUS/Modbus address register that is stored for each parameter. The drive will not write the values from Output Assembly 116 to the registers when the MEMOBUS/Modbus address is 0. When you use a ProfiNet option, set *F7-23* to *F7-27* to configurable Output 1-5.	0

■ F7-33 to F7-42: Dynamic In Param 1 to 10 for CommCard

No. (Hex.)	Name	Description	Default (Range)
F7-33 to F7-42 (0375 - 037E)	Dynamic In Param 1 to 10 for CommCard	V/f CL-V/f OLV CLV AOLV When you use an Ethernet/IP option, sets Input Assembly 166. The drive sends the values from the MEMOBUS/Modbus address registers stored for each parameter to Input Assembly 166. The drive returns the default register value for the option card when the MEMOBUS/Modbus address is 0 and the value sent to Input Assembly 166 is not defined. When you use a ProfiNet option, set *F7-33* to *F7-37* to configurable inputs 1-5.	0

■ F7-60: PZD1 Write (Control Word)

No. (Hex.)	Name	Description	Default (Range)
F7-60 (0780)	PZD1 Write (Control Word)	V/f CL-V/f OLV CLV AOLV When you use a Profibus option, set the MEMOBUS/Modbus address for PZD1 (PPO output). PZD1 (PPO output) functions as the STW when *F7-60 = 0 to 2*.	0

■ F7-61: PZD2 Write (Frequency Reference)

No. (Hex.)	Name	Description	Default (Range)
F7-61 (0781)	PZD2 Write (Frequency Reference)	V/f CL-V/f OLV CLV AOLV When you use a Profibus option, sets the MEMOBUS/Modbus address for PZD2 (PPO output). PZD2 (PPO output) functions as the HSW when *F7-61 = 0 to 2*.	0

■ F7-62: PZD3 Write

No. (Hex.)	Name	Description	Default (Range)
F7-62 (0782)	PZD3 Write	V/f CL-V/f OLV CLV AOLV When you use a Profibus option, sets the MEMOBUS/Modbus address for PZD3 (PPO output). A value of 0, 1, or 2 will disable the PZD3 (PPO output) write operation to the MEMOBUS/Modbus register.	0

■ F7-63: PZD4 Write

No. (Hex.)	Name	Description	Default (Range)
F7-63 (0783)	PZD4 Write	V/f CL-V/f OLV CLV AOLV When you use a Profibus option, sets the MEMOBUS/Modbus address for PZD4 (PPO output). A value of 0, 1, or 2 will disable the PZD4 (PPO output) write operation to the MEMOBUS/Modbus register.	0

■ F7-64: PZD5 Write

No. (Hex.)	Name	Description	Default (Range)
F7-64 (0784)	PZD5 Write	V/f CL-V/f OLV CLV AOLV When you use a Profibus option, sets the MEMOBUS/Modbus address for PZD5 (PPO output). A value of 0, 1, or 2 will disable the PZD5 (PPO output) write operation to the MEMOBUS/Modbus register.	0

■ F7-65: PZD6 Write

No. (Hex.)	Name	Description	Default (Range)
F7-65 (0785)	PZD6 Write	V/f CL-V/f OLV CLV AOLV When you use a Profibus option, sets the MEMOBUS/Modbus address for PZD6 (PPO output). A value of 0, 1, or 2 will disable the PZD6 (PPO output) write operation to the MEMOBUS/Modbus register.	0

■ F7-66: PZD7 Write

No. (Hex.)	Name	Description	Default (Range)
F7-66 (0786)	PZD7 Write	V/f CL-V/f OLV CLV AOLV When you use a Profibus option, sets the MEMOBUS/Modbus address for PZD7 (PPO output). A value of 0, 1, or 2 will disable the PZD7 (PPO output) write operation to the MEMOBUS/Modbus register.	0

■ F7-67: PZD8 Write

No. (Hex.)	Name	Description	Default (Range)
F7-67 (0787)	PZD8 Write	V/f CL-V/f OLV CLV AOLV When you use a Profibus option, sets the MEMOBUS/Modbus address for PZD8 (PPO output). A value of 0, 1, or 2 will disable the PZD8 (PPO output) write operation to the MEMOBUS/Modbus register.	0

■ F7-68: PZD9 Write

No. (Hex.)	Name	Description	Default (Range)
F7-68 (0788)	PZD9 Write	V/f CL-V/f OLV CLV AOLV When you use a Profibus option, sets the MEMOBUS/Modbus address for PZD9 (PPO output). A value of 0, 1, or 2 will disable the PZD9 (PPO output) write operation to the MEMOBUS/Modbus register.	0

■ F7-69: PZD10 Write

No. (Hex.)	Name	Description	Default (Range)
F7-69 (0789)	PZD10 Write	V/f CL-V/f OLV CLV AOLV When you use a Profibus option, sets the MEMOBUS/Modbus address for PZD10 (PPO output). A value of 0, 1, or 2 will disable the PZD10 (PPO output) write operation to the MEMOBUS/Modbus register.	0

■ F7-70: PZD1 Read (Status Word)

No. (Hex.)	Name	Description	Default (Range)
F7-70 (078A)	PZD1 Read (Status Word)	V/f CL-V/f OLV CLV AOLV When you use a Profibus option, sets the MEMOBUS/Modbus address for PZD1 (PPO input). PZD1 (PPO input) functions as the ZSW when *F7-70 = 0*.	0

■ F7-71: PZD2 Read (Output Frequency)

No. (Hex.)	Name	Description	Default (Range)
F7-71 (078B)	PZD2 Read (Output Frequency)	V/f CL-V/f OLV CLV AOLV When you use a Profibus option, sets the MEMOBUS/Modbus address for PZD2 (PPO input). PZD2 (PPO input) functions as the HIW when *F7-71 = 0*.	0

■ F7-72: PZD3 Read

No. (Hex.)	Name	Description	Default (Range)
F7-72 (078C)	PZD3 Read	V/f CL-V/f OLV CLV AOLV When you use a Profibus option, sets the MEMOBUS/Modbus address for PZD3 (PPO input). A value of 0 will disable the PZD3 (PPO input) load operation from the MEMOBUS/Modbus register.	0

■ F7-73: PZD4 Read

No. (Hex.)	Name	Description	Default (Range)
F7-73 (078D)	PZD4 Read	V/f CL-V/f OLV CLV AOLV When you use a Profibus option, sets the MEMOBUS/Modbus address for PZD4 (PPO input). A value of 0 will disable the PZD4 (PPO input) load operation from the MEMOBUS/Modbus register.	0

■ F7-74: PZD5 Read

No. (Hex.)	Name	Description	Default (Range)
F7-74 (078E)	PZD5 Read	V/f CL-V/f OLV CLV AOLV When you use a Profibus option, sets the MEMOBUS/Modbus address for PZD5 (PPO input). A value of 0 will disable the PZD5 (PPO input) load operation from the MEMOBUS/Modbus register.	0

■ F7-75: PZD6 Read

No. (Hex.)	Name	Description	Default (Range)
F7-75 (078F)	PZD6 Read	V/f CL-V/f OLV CLV AOLV When you use a Profibus option, sets the MEMOBUS/Modbus address for PZD6 (PPO input). A value of 0 will disable the PZD6 (PPO input) load operation from the MEMOBUS/Modbus register.	0

■ F7-76: PZD7 Read

No. (Hex.)	Name	Description	Default (Range)
F7-76 (0790)	PZD7 Read	V/f CL-V/f OLV CLV AOLV When you use a Profibus option, sets the MEMOBUS/Modbus address for PZD7 (PPO input). A value of 0 will disable the PZD7 (PPO input) load operation from the MEMOBUS/Modbus register.	0

■ F7-77: PZD8 Read

No. (Hex.)	Name	Description	Default (Range)
F7-77 (0791)	PZD8 Read	V/f CL-V/f OLV CLV AOLV When you use a Profibus option, sets the MEMOBUS/Modbus address for PZD8 (PPO input). A value of 0 will disable the PZD8 (PPO input) load operation from the MEMOBUS/Modbus register.	0

■ F7-78: PZD9 Read

No. (Hex.)	Name	Description	Default (Range)
F7-78 (0792)	PZD9 Read	V/f CL-V/f OLV CLV AOLV When you use a Profibus option, sets the MEMOBUS/Modbus address for PZD9 (PPO input). A value of 0 will disable the PZD9 (PPO input) load operation from the MEMOBUS/Modbus register.	0

■ F7-79: PZD10 Read

No. (Hex.)	Name	Description	Default (Range)
F7-79 (0793)	PZD10 Read	V/f CL-V/f OLV CLV AOLV When you use a Profibus option, sets the MEMOBUS/Modbus address for PZD10 (PPO input). A value of 0 will disable the PZD10 (PPO input) load operation from the MEMOBUS/Modbus register.	0

11.8 H: Terminal Functions

H parameters are used to assign functions to external input and output terminals.

◆ H1: Digital Inputs

H1 Parameters set the MFDI terminal functions.

■ H1-01 to H1-10 Terminal S1 to S10 Function Selection

The drive has 10 MFDI terminals. Refer to the table for drive default settings and functions.

No.	Name	Default	Function
H1-01	Terminal S1 Function Selection	40	Forward RUN (2-Wire)
H1-02	Terminal S2 Function Selection	41	Reverse RUN (2-Wire)
H1-03	Terminal S3 Function Selection	24	External Fault (NO-Always-Coast)
H1-04	Terminal S4 Function Selection	14	Fault Reset
H1-05	Terminal S5 Function Selection	0	Brake Release Check
H1-06	Terminal S6 Function Selection	3	Multi-Step Speed Reference 1
H1-07	Terminal S7 Function Selection	4	Multi-Step Speed Reference 2
H1-08	Terminal S8 Function Selection	9	Baseblock Command (N.C.)
H1-09	Terminal S9 Function Selection	F	Not Used
H1-10	Terminal S10 Function Selection	F	Not Used

Refer to the following table and use *H1-xx [MFDI Function Select]* to set the function.

Table 11.26 MFDI Setting Values

Setting Value	Function
0	Brake Release Check
2	External Reference 1/2 Selection
3	Multi-Step Speed Reference 1
4	Multi-Step Speed Reference 2
5	Multi-Step Speed Reference 3
6	Jog Reference Selection
7	Accel/Decel Time Selection 1
8 *1	Baseblock Command (N.O.)
9 *1	Baseblock Command (N.C.)
A	Accel/Decel Ramp Hold
B	Overheat Alarm (oH2)
C	Analog Terminal Enable Selection
D	Ignore Speed Fdbk (V/f w/o Enc)
E	ASR Integral Reset
F	Not Used
10	Up Command
11	Down Command
12 *1	Forward Jog
13 *1	Reverse Jog
14	Fault Reset
15 *1	Fast Stop (N.O.)
16	Motor 2 Selection
17 *1	Fast Stop (N.C.)
1A	Accel/Decel Time Selection 2

Setting Value	Function
1B	Programming Lockout
1E	Reference Sample Hold
20 to 2F *1	External Fault
30	Light-load Accel 1 Enabled
31 *1	Forward Travel Limit (N.O.)
32 *1	Forward Travel Limit (N.C.)
33 *1	Reverse Travel Limit (N.O.)
34 *1	Reverse Travel Limit (N.C.)
35	Impact Stop Enable
36	Light-load Accel 2 Enabled
37	Multi-Step Speed Reference 4
38	Counterweight Selection
39	Motor 3 Selection
3A	Micro Speed Gain1
3B	Micro Speed Gain2
40 *1	Forward RUN (2-Wire)
41 *1	Reverse RUN (2-Wire)
44	Add Offset Frequency 1 (d7-01)
45	Add Offset Frequency 2 (d7-02)
46	Add Offset Frequency 3 (d7-03)
47	Node Setup (CANopen)
60	DC Injection Braking Command
67	Communications Test Mode

Setting Value	Function
72	Zero Servo

Setting Value	Function
100 - 1FF	Inverse Inputs of 0 to FF Sets the function of the selected MFDI to operate inversely. To select the function, enter "1xx", where "xx" is the function setting value.

*1 Inverse input is not available.

■ H1-01: Terminal S1 Function Selection

No. (Hex.)	Name	Description	Default (Range)
H1-01 (0438)	Terminal S1 Function Selection	V/f CL-V/f OLV CLV AOLV Sets the function for MFDI terminal S1.	40 (0 - 1FF)

■ H1-02: Terminal S2 Function Selection

No. (Hex.)	Name	Description	Default (Range)
H1-02 (0439)	Terminal S2 Function Selection	V/f CL-V/f OLV CLV AOLV Sets the function for MFDI terminal S2.	41 (0 - 1FF)

■ H1-03: Terminal S3 Function Selection

No. (Hex.)	Name	Description	Default (Range)
H1-03 (0400)	Terminal S3 Function Selection	V/f CL-V/f OLV CLV AOLV Sets the function for MFDI terminal S3.	24 (0 - 1FF)

■ H1-04: Terminal S4 Function Selection

No. (Hex.)	Name	Description	Default (Range)
H1-04 (0401)	Terminal S4 Function Selection	V/f CL-V/f OLV CLV AOLV Sets the function for MFDI terminal S4.	14 (0 - 1FF)

■ H1-05: Terminal S5 Function Selection

No. (Hex.)	Name	Description	Default (Range)
H1-05 (0402)	Terminal S5 Function Selection	V/f CL-V/f OLV CLV AOLV Sets the function for MFDI terminal S5.	0 (0 - 1FF)

■ H1-06: Terminal S6 Function Selection

No. (Hex.)	Name	Description	Default (Range)
H1-06 (0403)	Terminal S6 Function Selection	V/f CL-V/f OLV CLV AOLV Sets the function for MFDI terminal S6.	3 (0 - 1FF)

■ H1-07: Terminal S7 Function Selection

No. (Hex.)	Name	Description	Default (Range)
H1-07 (0404)	Terminal S7 Function Selection	V/f CL-V/f OLV CLV AOLV Sets the function for MFDI terminal S7.	4 (0 - 1FF)

■ H1-08: Terminal S8 Function Selection

No. (Hex.)	Name	Description	Default (Range)
H1-08 (0405)	Terminal S8 Function Selection	V/f CL-V/f OLV CLV AOLV Sets the function for MFDI terminal S8.	9 (0 - 1FF)

■ H1-09: Terminal S9 Function Selection

No. (Hex.)	Name	Description	Default (Range)
H1-09 (0406)	Terminal S9 Function Selection	V/f CL-V/f OLV CLV AOLV Sets the function for MFDI terminal S9.	F (0 - 1FF)

■ H1-10: Terminal S10 Function Selection

No. (Hex.)	Name	Description	Default (Range)
H1-10 (0407)	Terminal S10 Function Selection	V/f CL-V/f OLV CLV AOLV Sets the function for MFDI terminal S10.	F (0 - 1FF)

■ H1-21: Terminal S1 Function Select 2

No. (Hex.)	Name	Description	Default (Range)
H1-21 (0B70)	Terminal S1 Function Select 2	V/f CL-V/f OLV CLV AOLV Sets the second function for MFDI terminal S1.	F (0 - 1FF)

Operates the function assigned to *H1-01 [Terminal S1 Function Selection]* and the function assigned to *H1-21* simultaneously if the MFDI terminal S1 is turned ON.

When you set *F*, the function will be disabled.

■ H1-22: Terminal S2 Function Select 2

No. (Hex.)	Name	Description	Default (Range)
H1-22 (0B71)	Terminal S2 Function Select 2	V/f CL-V/f OLV CLV AOLV Sets the second function for MFDI terminal S2.	F (0 - 1FF)

Operates the function assigned to *H1-02 [Terminal S2 Function Selection]* and the function assigned to *H1-22* simultaneously if the MFDI terminal S2 is turned ON.

When you set *F*, the function will be disabled.

■ H1-23: Terminal S3 Function Select 2

No. (Hex.)	Name	Description	Default (Range)
H1-23 (0B72)	Terminal S3 Function Select 2	V/f CL-V/f OLV CLV AOLV Sets the second function for MFDI terminal S3.	F (0 - 1FF)

Operates the function assigned to *H1-03 [Terminal S3 Function Selection]* and the function assigned to *H1-23* simultaneously if the MFDI terminal S3 is turned ON.

When you set *F*, the function will be disabled.

■ H1-24: Terminal S4 Function Select 2

No. (Hex.)	Name	Description	Default (Range)
H1-24 (0B73)	Terminal S4 Function Select 2	V/f CL-V/f OLV CLV AOLV Sets the second function for MFDI terminal S4.	F (0 - 1FF)

Operates the function assigned to *H1-04 [Terminal S4 Function Selection]* and the function assigned to *H1-24* simultaneously if the MFDI terminal S4 is turned ON.

When you set *F*, the function will be disabled.

■ H1-25: Terminal S5 Function Select 2

No. (Hex.)	Name	Description	Default (Range)
H1-25 (0B74)	Terminal S5 Function Select 2	V/f CL-V/f OLV CLV AOLV Sets the second function for MFDI terminal S5.	F (0 - 1FF)

Operates the function assigned to *H1-05 [Terminal S5 Function Selection]* and the function assigned to *H1-25* simultaneously if the MFDI terminal S5 is turned ON.

When you set *F*, the function will be disabled.

■ H1-26: Terminal S6 Function Select 2

No. (Hex.)	Name	Description	Default (Range)
H1-26 (0B75)	Terminal S6 Function Select 2	V/f CL-V/f OLV CLV AOLV Sets the second function for MFDI terminal S6.	F (0 - 1FF)

Operates the function assigned to *H1-06 [Terminal S6 Function Selection]* and the function assigned to *H1-26* simultaneously if the MFDI terminal S6 is turned ON.

When you set *F*, the function will be disabled.

■ H1-27: Terminal S7 Function Select 2

No. (Hex.)	Name	Description	Default (Range)
H1-27 (0B76)	Terminal S7 Function Select 2	V/f CL-V/f OLV CLV AOLV Sets the second function for MFDI terminal S7.	F (0 - 1FF)

Operates the function assigned to *H1-07 [Terminal S7 Function Selection]* and the function assigned to *H1-27* simultaneously if the MFDI terminal S7 is turned ON.

When you set *F*, the function will be disabled.

■ H1-28: Terminal S8 Function Select 2

No. (Hex.)	Name	Description	Default (Range)
H1-28 (0B77)	Terminal S8 Function Select 2	V/f CL-V/f OLV CLV AOLV Sets the second function for MFDI terminal S8.	F (0 - 1FF)

Operates the function set to *H1-08 [Terminal S8 Function Selection]* and the function set to *H1-28* simultaneously if MFDI terminal S8 is turned ON.

When you set *F*, the function will be disabled.

■ H1-29: Terminal S9 Function Select 2

No. (Hex.)	Name	Description	Default (Range)
H1-29 (0B78)	Terminal S9 Function Select 2	V/f CL-V/f OLV CLV AOLV Sets the second function for MFDI terminal S9.	F (0 - 1FF)

Operates the function assigned to *H1-09 [Terminal S9 Function Selection]* and the function assigned to *H1-29* simultaneously if the MFDI terminal S9 is turned ON.

When you set *F*, the function will be disabled.

■ H1-30: Terminal S10 Function Select 2

No. (Hex.)	Name	Description	Default (Range)
H1-30 (0B79)	Terminal S10 Function Select 2	V/f CL-V/f OLV CLV AOLV Sets the second function for MFDI terminal S10.	F (0 - 1FF)

Operates the function assigned to *H1-10 [Terminal S10 Function Selection]* and the function assigned to *H1-30* simultaneously if the MFDI terminal S10 is turned ON.

When you set *F*, the function will be disabled.

■ MEMOBUS/Modbus Multi-Function Digital Input 1 to 3 Functions Selection

The function for the MFDI can be assigned to MEMOBUS register *bit 0 to 2* of *[15C0 (Hex.)]*. Select the function with *H1-40 to H1-42 [Mbus Reg 15C0h bit0 to bit 2 Input Func]*.

Note:
- Refer to H1-xx “MFDI Function Selections” for the setting values of the MFDI.
- You cannot set *20 to 2F [External Fault]* to *H1-40* to *H1-42*.
- When *H1-40* to *H1-42* are not used, set *H1-40 to H1-42 = F [Not Used]*.
- Multi-function input for digital input option D1-A3 cannot be used simultaneously with function selection for MEMOBUS/Modbus MFDI 1 to 3.

■ H1-40: Mbus Reg 15C0h bit0 Input Func

No. (Hex.)	Name	Description	Default (Range)
H1-40 (0B54)	Mbus Reg 15C0h bit0 Input Func	V/f CL-V/f OLV CLV AOLV Sets MFDI function to set to *bit 0* of the MEMOBUS register *15C0(Hex.)*.	F (0 - 1FF)

■ H1-41: Mbus Reg 15C0h bit1 Input Func

No. (Hex.)	Name	Description	Default (Range)
H1-41 (0B55)	Mbus Reg 15C0h bit1 Input Func	V/f CL-V/f OLV CLV AOLV Sets MFDI function to set to *bit 1* of the MEMOBUS register *15C0(Hex.)*.	F (0 - 1FF)

■ H1-42: Mbus Reg 15C0h bit2 Input Func

No. (Hex.)	Name	Description	Default (Range)
H1-42 (0B56)	Mbus Reg 15C0h bit2 Input Func	V/f CL-V/f OLV CLV AOLV Selects MFDI function assigned to *bit 2* of the MEMOBUS register *15C0(Hex.)*.	F (0 - 1FF)

◆ MFDI Function Selections

Sets a function set to *H1-01 to H1-10*.

■ 0: Brake Release Check

Setting Value	Function	Description
0	Brake Release Check	V/f CL-V/f OLV CLV AOLV Set the wiring sequence to turn ON the brake release check when the brake release command turns ON.

■ 2: External Reference 1/2 Selection

Setting Value	Function	Description
2	External Reference 1/2 Selection	V/f CL-V/f OLV CLV AOLV Sets the drive to use Run command source 1/2 or Reference command source 1/2 when in REMOTE Mode.

Note:
When the drive is receiving a Run command, you cannot switch between reference sources.

ON : *b1-15 [Frequency Reference Selection 2], b1-16 [Run Command Selection 2]*
OFF : *b1-01 [Frequency Reference Selection 1], b1-02 [Run Command Selection 1]*

■ 3: Multi-Step Speed Reference 1

Setting Value	Function	Description
3	Multi-Step Speed Reference 1	V/f CL-V/f OLV CLV AOLV Uses speed references *d1-01 to d1-16* to set a multi-step speed reference.

Note:
Refer to *Setting Procedures for Multi-step Speed Operation on page 622* for more information.

■ 4: Multi-Step Speed Reference 2

Setting Value	Function	Description
4	Multi-Step Speed Reference 2	V/f CL-V/f OLV CLV AOLV Uses speed references *d1-01 to d1-16* to set a multi-step speed reference.

Note:
Refer to *Setting Procedures for Multi-step Speed Operation on page 622* for more information.

■ 5: Multi-Step Speed Reference 3

Setting Value	Function	Description
5	Multi-Step Speed Reference 3	V/f CL-V/f OLV CLV AOLV Uses speed references *d1-01 to d1-16* to set a multi-step speed reference.

Note:
Refer to *Setting Procedures for Multi-step Speed Operation on page 622* for more information.

■ 6: Jog Reference Selection

Setting Value	Function	Description
6	Jog Reference Selection	V/f CL-V/f OLV CLV AOLV Sets the drive to use the JOG Frequency Reference (JOG command) set in *d1-17*. The JOG Frequency command overrides *Frequency References 1 to 8 (d1-01 to d1-08)*.

■ 7: Accel/Decel Time Selection 1

Setting Value	Function	Description
7	Accel/Decel Time Selection 1	V/f CL-V/f OLV CLV AOLV Sets the drive to use *Acceleration/Deceleration Time 1 [C1-01, C1-02]* or *Acceleration/Deceleration Time 2 [C1-03, C1-04]*.

Note:
Refer to *C1: Accel & Decel Time on page 600* for more information.

■ 8: Baseblock Command (N.O.)

Setting Value	Function	Description
8	Baseblock Command (N. O.)	V/f CL-V/f OLV CLV AOLV Sets the command that stops drive output and coasts the motor to stop when a baseblock command (N.O.) is input.

The keypad flashes *bb [Baseblock]*. Acceleration always starts from the zero speed when the Run command is input. The drive keeps the baseblock state when the Run command is not input.

WARNING! *Sudden Movement Hazard. When you use a mechanical holding brake with the drive in a lifting application, you must close the brake if an input terminal triggers the Baseblock command to stop drive output. If you enter the baseblock command, the motor will suddenly coast and the load will slip, which can cause serious injury or death.*

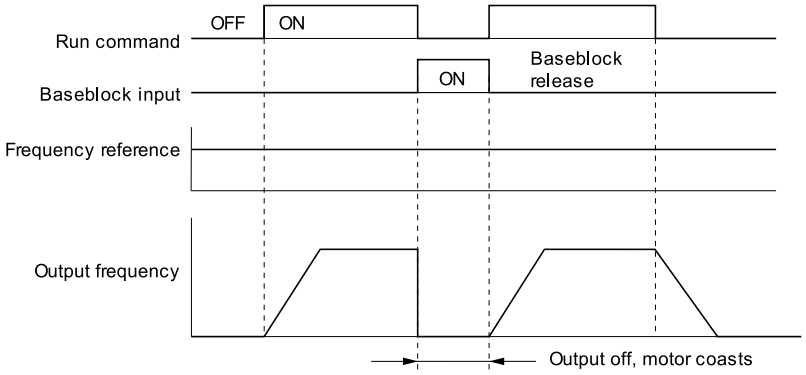


Figure 11.51 Baseblock Command Time Chart

ON : Baseblock (drive output stop)

OFF : Normal operation

■ 9: Baseblock Command (N.C.)

Setting Value	Function	Description
9	Baseblock Command (N. C.)	V/f CL-V/f OLV CLV AOLV Sets the command that stops drive output and coasts the motor to stop when baseblock command (N.C.) is input (turned OFF).

The keypad flashes *bb [Baseblock]*.

WARNING! *Sudden Movement Hazard. When you use a mechanical holding brake with the drive in a lifting application, you must close the brake if an input terminal triggers the Baseblock command to stop drive output. If you enter the baseblock command, the motor will suddenly coast and the load will slip, which can cause serious injury or death.*

ON : Normal operation
OFF : Baseblock (drive output stop)

■ A: Accel/Decel Ramp Hold

Setting Value	Function	Description
A	Accel/Decel Ramp Hold	V/f CL-V/f OLV CLV AOLV Momentarily pauses motor acceleration and deceleration when the terminal is turned ON, retains the output frequency that was stored in the drive at the time of the pause, and restarts motor operation.

If the terminal is turned OFF, the drive restarts acceleration and deceleration.

When *d4-01 = 1 [Freq Reference Hold Selection = Enabled]*, if the acceleration/deceleration ramp hold terminal is ON, the drive will store the output frequency in memory. While the acceleration/deceleration ramp hold command is ON, the drive will restart the motor at this output frequency even if the drive experiences a run stop.

Note:
Refer to "d4-01: Freq Reference Hold Selection" for details.

■ B: Overheat Alarm (oH2)

Setting Value	Function	Description
B	Overheat Alarm (oH2)	V/f CL-V/f OLV CLV AOLV Sets the drive to show an *oH2 [External Overheat (H1-XX=B)]* alarm when the input terminal is ON. The alarm does not have an effect on drive operation.

■ C: Analog Terminal Enable Selection

Setting Value	Function	Description
C	Analog Terminal Enable Selection	V/f CL-V/f OLV CLV AOLV Sets the command that enables or disables the terminals selected in *H3-14 [Analog Input Terminal Enable Sel]*.

ON : Terminal selected with *H3-14* is enabled
OFF : Terminal selected with *H3-14* is disabled

■ D: Ignore Speed Fdbk (V/f w/o Enc)

Setting Value	Function	Description
D	Ignore Speed Fdbk (V/f w/o Enc)	V/f CL-V/f OLV CLV AOLV Sets the command to disable speed feedback control and run the drive in V/f control or use speed feedback from the encoder.

ON : Speed feedback control disable (V/f Control)
OFF : Speed feedback control enable (Closed Loop V/f Control)

■ E: ASR Integral Reset

Setting Value	Function	Description
E	ASR Integral Reset	V/f CL-V/f OLV CLV AOLV Sets the command to reset the integral value and use PI control or P control for the speed control loop.

ON : P control
OFF : PI control

■ F: Not Used

Setting Value	Function	Description
F	Not Used	V/f CL-V/f OLV CLV AOLV Use this setting for unused terminals or to use terminals in through mode.

Through Mode uses the signal input to the terminal as a digital input for the upper sequence through a communication option or MEMOBUS/Modbus communications. This input signal does not have an effect on drive operation.

■ 10: Up Command

Setting Value	Function	Description
10	Up Command	V/f CL-V/f OLV CLV AOLV You must also set Setting *11 [Down Command]*. Sets the command to use a push button switch to decrease the drive frequency reference

ON : Increases the frequency reference.

OFF : Holds the current frequency reference.

Note:

- If only one of either the Up command or Down command has been set, *oPE03 [Multi-Function Input Setting Err]* will be detected.
- If two or more of the following functions have been allocated at the same time, *oPE03* occurs.
  - –Up/Down command
  - –Accel/Decel Ramp Hold
  - –Reference Sample Hold
  - –Offset Frequency 1, 2, 3 addition
- The Up/Down command can be used when the keypad is in REMOTE mode or *b1-01 ≠ 0 [Frequency Reference Selection 1 ≠ Keypad]*.
- The Up/Down command does not function when switching to parameter *b1-15 [Frequency Reference Selection 2]* using *External Reference 1/2 Selection [H1-xx = 2]*.

If the Up command is input, the frequency reference increases, and if Down command is input, the frequency reference decreases.

Up and Down command has priority over all other frequency references. When the Up/Down command is enabled, the following frequency references will be disregarded.

- Frequency reference from Keypad *[b1-01 = 0]*
- Frequency reference from Analog Input *[b1-01 = 1]*

The table below shows the Up and Down commands with their corresponding operation.

Table 11.27 Up Command and Down Command

Command Status		Drive Operation
Up Command (10)	Down Command (11)	
OFF	OFF	Holds the current frequency reference.
ON	OFF	Increases the frequency reference.
OFF	ON	Decreases the frequency reference.
ON	ON	Holds the current frequency reference.

Combine Frequency Reference Hold Functions and Up/Down Commands

- When the Run command is cleared, or when the drive is restarted when *d4-01 = 0 [Freq Reference Retention Function = Disabled]*, the Up/Down command will reset to 0.
- When parameter *d4-01 = 1 [Enabled]*, the drive saves the frequency reference set during the Up/Down command. If the Run command is cycled or the drive is restarted, the drive stores the frequency reference value and restarts the motor at this frequency value. After the Run command is cleared, turn ON the terminal set for the Up command or Down command to reset the stored reference value to 0.

Note:

Refer to “d4-01: Freq Reference Hold Selection” for details.

Combining Upper/Lower Limits of the Frequency Reference and the Up/Down Commands

Set the upper limit value of the frequency reference to *d2-01 [Frequency Reference Upper Limit]*.

The lower limit value of the frequency reference can be set with analog input or in*d2-02 [Frequency Reference Lower Limit]*. The configurable values differ depending on the setting for *d4-10 [Up/Down Freq Lower Limit Select]*. When the Run command is executed, the lower limits of the frequency reference are as follows.

- When the lower limit of the frequency reference is set only for *d2-02*, the drive accelerates the motor up to the lower limit value of the frequency reference at the same time the Run command is input.
- When the lower limit of the frequency reference is set only for analog input, the drive accelerates the motor up to the lower limit value of the frequency reference when the Run command, and Up command or Down command for the drive is enabled. When only the Run command is enabled, the motor does not start.
- When the following conditions are present, the drive accelerates the motor up to *d2-02* setting value if the Run command is input. When the motor has accelerated to the setting value of *d2-02*, if the Up/Down command is enabled, the motor accelerates to the lower limit value of the analog input.

– The lower limit value of the frequency reference is set for both the analog input and *d2-02*

– The lower limit value of the analog input is higher than the setting value of*d2-02*

Note:

Refer to "d4-10: Up/Down Freq Lower Limit Select" for details.

The following time chart shows an example of how Up/Down command operates. In this example, the lower limit value of the frequency reference is set in *d2-02*. The time chart when *Freq Reference Retention Select [d4-01]* is enabled and disabled is shown below.

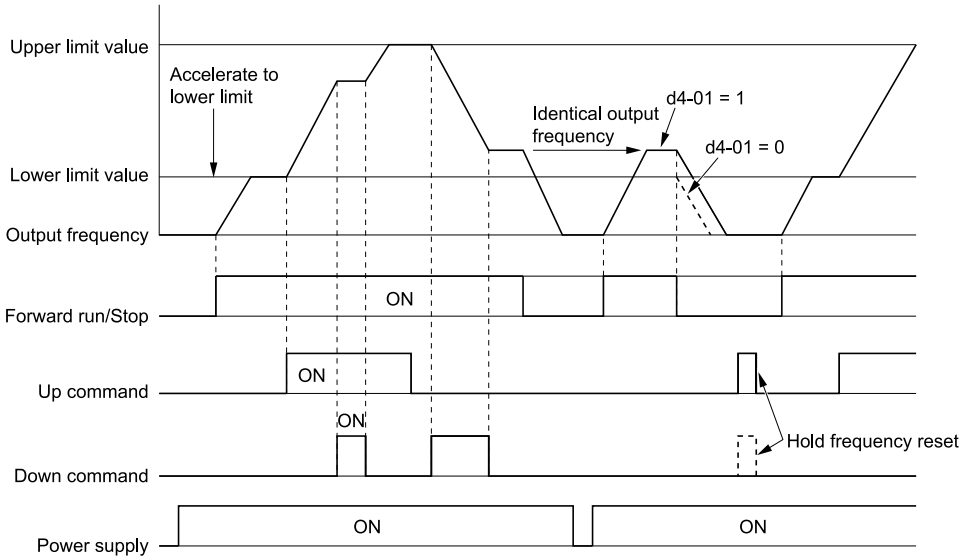


Figure 11.52 Up/Down Command Time Chart

■ 11: Down Command

Setting Value	Function	Description
11	Down Command	V/f CL-V/f OLV CLV AOLV You must also set Setting *10 [Up Command]*. Sets the command to use a push button switch to decrease the drive frequency reference

ON : Decreases the frequency reference.

OFF : Holds the current frequency reference.

Note:

- If only one of either the Up command or Down command has been set, *oPE03 [Multi-Function Input Setting Err]* will be detected.
- If two or more of the following functions have been allocated at the same time, *oPE03* occurs.
  - –Up/Down command
  - –Accel/Decel Ramp Hold
  - –Reference Sample Hold
  - –Offset Frequency 1, 2, 3 addition
- The Up/Down command can be used when the keypad is in REMOTE mode or *b1-01 ≠ 0 [Frequency Reference Selection 1 ≠ Keypad]*.
- The Up/Down command does not function when switching to parameter *b1-15 [Frequency Reference Selection 2]* using *External Reference 1/2 Selection [H1-xx = 2]*.

If the Up command is input, the frequency reference increases, and if Down command is input, the frequency reference decreases.

Up and Down command has priority over all other frequency references. When the Up/Down command is enabled, the following frequency references will be disregarded.

- Frequency reference from Keypad *[b1-01 = 0]*
- Frequency reference from Analog Input *[b1-01 = 1]*

■ 12: Forward Jog

Setting Value	Function	Description
12	Forward Jog	V/f CL-V/f OLV CLV AOLV Sets the command to operate the motor in the forward direction at the Jog Frequency set in *d1-17 [Jog Reference]*.

Note:
- It is not necessary to input the Run command.
- The Forward JOG command has priority over all other frequency references.
- When the Forward JOG and Reverse JOG commands are activated at the same time for 500 ms or longer, the drive will ramp to stop.

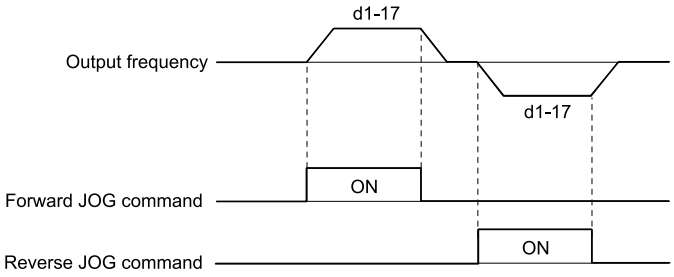


Figure 11.53 JOG Operation Pattern

■ 13: Reverse Jog

Setting Value	Function	Description
13	Reverse Jog	V/f CL-V/f OLV CLV AOLV Sets the command to operate the motor in the reverse direction at the Jog Frequency set in *d1-17 [Jog Reference]*.

Note:
- It is not necessary to input the Run command.
- The Reverse JOG command has priority over all other frequency references.
- When the Forward JOG and Reverse JOG commands are activated at the same time for 500 ms or longer, the drive will ramp to stop.

■ 14: Fault Reset

Setting Value	Function	Description
14	Fault Reset	V/f CL-V/f OLV CLV AOLV Sets the command to reset the current fault when the Run command is inactive.

If the drive detects a fault, the drive will activate the fault relay output, turn off the output, and the motor will coast to stop.

If the drive detects a fault for which you can set the stopping method, apply the appropriate Stopping Method. Then push (RESET) on the keypad to turn the Run command OFF, or activate the fault reset terminal to reset the fault.

Note:
The drive ignores the fault reset command when the Run command is active. Remove the Run command before trying to reset a fault.

■ 15: Fast Stop (N.O.)

Setting Value	Function	Description
15	Fast Stop (N.O.)	V/f CL-V/f OLV CLV AOLV Sets the command to ramp to stop in the deceleration time set in *C1-09 [Fast Stop Time]* when the input terminal is ON while the drive is operating.

If you cancel the fast stop input, the drive will not restart the motor until you meet these conditions:

- Fully stop the motor
- Cancel the Run command
- Cancel the fast stop command

Note:
- To use the N.C. switch to input the fast stop command, set 17 (Fast Stop (N.C.)).
- Refer to *C1-09: Fast Stop Time on page 603* for more information.
- Set *C1-09 [Fast Stop Time]* to a correct deceleration time. If the deceleration time is too short, it can cause an overvoltage fault and failure to stop the motor from coasting.

■ 16: Motor 2 Selection

Setting Value	Function	Description
16	Motor 2 Selection	V/f CL-V/f OLV CLV AOLV Switches between motor 1 or motor 2. Switch the motor while the motor is stopped.

The user can switch between 2 induction motors using an external input, and operate them. The drive saves the control methods, V/f patterns, motor parameters, and crane sequences for 2 motors and optimizes control of both motors.

ON : Selects motor 2

OFF : Selects motor 1

Note:

Refer to *Motor Switch Function on page 216* for details.

■ 17: Fast Stop (N.C.)

Setting Value	Function	Description
17	Fast Stop (N.C.)	V/f CL-V/f OLV CLV AOLV Sets the command to ramp to stop in the deceleration time set in *C1-09 [Fast Stop Time]* when the input terminal is ON while the drive is operating.

If you cancel the fast stop input, the drive will not restart the motor until you meet these conditions:

- Fully stop the motor
- Cancel the Run command
- Cancel the fast stop command

Note:

- To use the N.O. switch to input the fast stop command, set 15 (Fast Stop (N.O.)).
- Refer to *C1-09: Fast Stop Time on page 603* for more information.
- Set *C1-09 [Fast Stop Time]* to a correct deceleration time. If the deceleration time is too short, it can cause an overvoltage fault and failure to stop the motor from coasting.

Figure 11.54 shows an example of how fast stop operates.

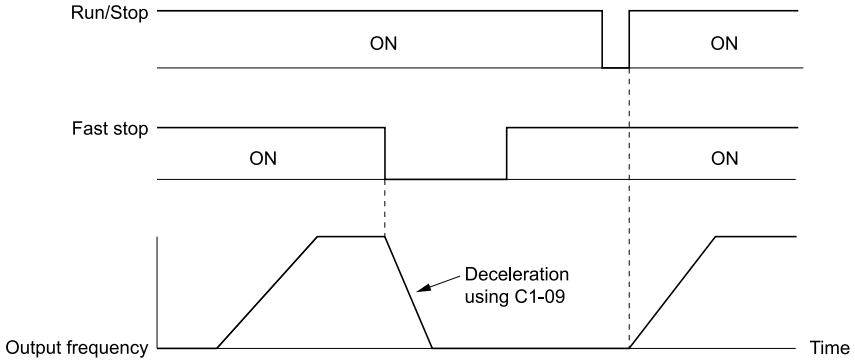


Figure 11.54 Fast Stop Time Chart

■ 1A: Accel/Decel Time Selection 2

Setting Value	Function	Description
1A	Accel/Decel Time Selection 2	V/f CL-V/f OLV CLV AOLV Set this function and *H1-xx = 7 [Accel/Decel Time Selection 1]* together. Sets the drive to use *Acceleration/Deceleration Time 3 [C1-05, C1-06]* or *Acceleration/Deceleration Time 4 [C1-07, C1-08]*.

Note:

Refer to *C1: Accel & Decel Time on page 600* for more information.

■ 1B: Programming Lockout

Setting Value	Function	Description
1B	Programming Lockout	V/f CL-V/f OLV CLV AOLV Sets the command to prevent parameter changes when the terminal is OFF.

You can continue to view parameter setting values when the terminal is *OFF [Parameter Write Prohibit]*.

ON : Programming Lockout

OFF : Parameter Write Prohibit

■ 1E: Reference Sample Hold

Setting Value	Function	Description
1E	Reference Sample Hold	V/f CL-V/f OLV CLV AOLV Samples the analog frequency reference input to the terminals A1, A2, or A3, and continues operation at the sampled frequency.

This function takes a sample of the analog frequency reference at the point in time 100 ms has passed since the terminal was turned ON, and holds the sample. If the sample/hold command is re-input, the function takes another sample of the analog frequency reference and holds it. If the power is shut off, the analog frequency that was saved via sampling will be erased and the frequency reference will be reset to 0.

The following illustration shows an example of how the function operates.

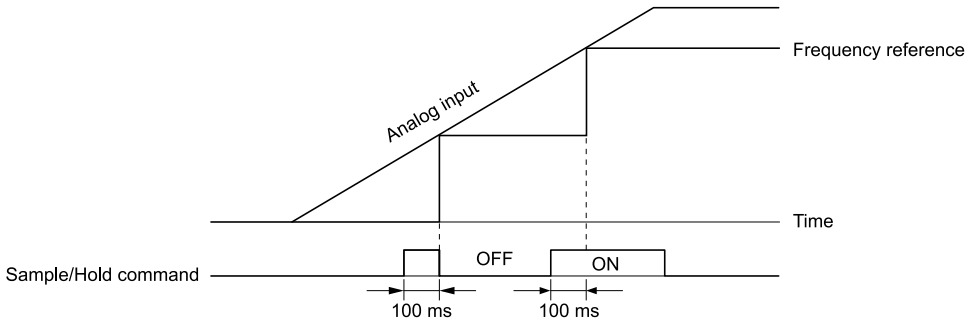


Figure 11.55 Reference Sample Hold

The Reference sample hold function cannot be set at the same time as the following functions. Setting them at the same time will trigger *oPE03 [Multi-Function Input Setting Err]*.

- *H1-xx = A [Accel/Decel Ramp Hold]*
- *H1-xx = 10 or 11 [Up Command or Down Command]*
- *H1-xx = 44 to 46 [Offset frequency]*

■ 20 to 2F: External Fault

Setting Value	Function	Description
20 to 2F	External Fault	V/f CL-V/f OLV CLV AOLV Sets a command to stop the drive when a failure or fault occurs on an external device.

If an external fault is input to the drive, the keypad will show *EFx [External Fault (Terminal Sx)]*, where x is the number of the terminal (terminal Sx) to which the external fault signal is assigned. For example, when an external fault signal is input to terminal S3, the keypad will show EF3.

Use these conditions to select the value to set in *H1-xx*:

- Signal input method from peripheral devices
- External fault detection method
- Motor stopping method (operation after external fault detection)

Table 11.28 shows the relation between the conditions and the value set to *H1-xx*.

Table 11.28 Stopping Methods for External Fault

Setting	Signal Input Method from Peripheral Devices *1		External Fault Detection Method *2		Stopping Method			
	N.O.	N.C.	Always Detected	Detected during RUN Only	Ramp to Stop (Fault)	Coast to Stop (Fault)	Fast Stop (Fault)	Continuous Operation (Alarm Only)
20	x	-	x	-	x	-	-	-
21	-	x	x	-	x	-	-	-
22	x	-	-	x	x	-	-	-
23	-	x	-	x	x	-	-	-
24	x	-	x	-	-	x	-	-
25	-	x	x	-	-	x	-	-
26	x	-	-	x	-	x	-	-
27	-	x	-	x	-	x	-	-
28	x	-	x	-	-	-	x	-

Setting	Signal Input Method from Peripheral Devices *1		External Fault Detection Method *2		Stopping Method			
	N.O.	N.C.	Always Detected	Detected during RUN Only	Ramp to Stop (Fault)	Coast to Stop (Fault)	Fast Stop (Fault)	Continuous Operation (Alarm Only)
29	-	x	x	-	-	-	x	-
2A	x	-	-	x	-	-	x	-
2B	-	x	-	x	-	-	x	-
2C	x	-	x	-	-	-	-	x
2D	-	x	x	-	-	-	-	x
2E	x	-	-	x	-	-	-	x
2F	-	x	-	x	-	-	-	x

*1 Set the terminal to N.O. (detects external fault when switched ON) or N.C. (detects external fault when switched OFF).
*2 Set the drive to always detect each fault or to detect only during run.

■ 30: Light-load Accel 1 Enabled

Setting Value	Function	Description
30	Light-load Accel 1 Enabled	V/f CL-V/f OLV CLV AOLV Enables or disables the selection of Light-Load Accel 1 Enabled function.

ON : Enabled
OFF : Disabled

Note:
Refer to *Light-load Acceleration 1 Function on page 207* for details.

■ 31: Forward Travel Limit (N.O.)

Setting Value	Function	Description
31	Forward Travel Limit (N.O.)	V/f CL-V/f OLV CLV AOLV If you turn on a terminal while a motor rotates forward, the drive turns off the brake release command (holds the brake), the motor coasts to stop, and the output frequency becomes 0. If you turn on a terminal while a motor rotates in reverse, the motor will not stop.

ON : Disables the forward operation Run command.
OFF : Enables the forward operation Run command.

Note:
Refer to *Travel Limit Function on page 215* for details.

■ 32: Forward Travel Limit (N.C.)

Setting Value	Function	Description
32	Forward Travel Limit (N.C.)	V/f CL-V/f OLV CLV AOLV If you turn off a terminal while a motor rotates forward, the drive turns off the brake release command (holds the brake), the motor coasts to stop, and the output frequency becomes 0. If you turn off a terminal while a motor rotates in reverse, the motor will not stop.

ON : Enables the forward operation Run command.
OFF : Disables the forward operation Run command.

Note:
Refer to *Travel Limit Function on page 215* for details.

■ 33: Reverse Travel Limit (N.O.)

Setting Value	Function	Description
33	Reverse Travel Limit (N.O.)	V/f CL-V/f OLV CLV AOLV If you turn on a terminal while a motor rotates in reverse, the drive turns off the brake release command (holds the brake), the motor coasts to stop, and the output frequency becomes 0. If you turn on a terminal while a motor rotates forward, the motor will not stop.

ON : Disables the reverse operation Run command.
OFF : Enables the reverse operation Run command.

Note:
Refer to *Travel Limit Function on page 215* for details.

■ 34: Reverse Travel Limit (N.C.)

Setting Value	Function	Description
34	Reverse Travel Limit (N.C.)	V/f CL-V/f OLV CLV AOLV If you turn off a terminal while a motor rotates in reverse, the drive turns off the brake release command (holds the brake), the motor coasts to stop, and the output frequency becomes 0. If you turn off a terminal while a motor rotates forward, the motor will not stop.

ON : Enables the reverse operation Run command.
OFF : Disables the reverse operation Run command.

Note:
Refer to *Travel Limit Function on page 215* for details.

■ 35: Impact Stop Enable

Setting Value	Function	Description
35	Impact Stop Enable	V/f CL-V/f OLV CLV AOLV When the terminal is ON and the drive receives a stop command while the output frequency is more than the impact stop creep frequency, the drive decelerates until it is at the set impact stop creep frequency.

ON : Enables the Impact Stop function.
OFF : Cancel the Impact Stop function and turn OFF the brake release command.

Note:
Refer to *Impact Stop Function on page 206* for details.

■ 36: Light-load Accel 2 Enabled

Setting Value	Function	Description
36	Light-load Accel 2 Enabled	V/f CL-V/f OLV CLV AOLV Enables or disables the selection of Light-Load Accel 2 Enabled function.

ON : Enabled
OFF : Disabled

Note:
Refer to *Light-load Acceleration 2 Function on page 210* for details.

■ 37: Multi-Step Speed Reference 4

Setting Value	Function	Description
37	Multi-Step Speed Reference 4	V/f CL-V/f OLV CLV AOLV Uses speed references *d1-01 to d1-16* to set a multi-step speed reference.

Note:
- On drives with software versions PRG: 01021 and later, this function is enabled.
  The "PRG" column on the nameplate on the right side of the drive identifies the software version. You can also use *U1-25 [SoftwareNumber FLASH]* to identify the software version.
- Refer to *Setting Procedures for Multi-step Speed Operation on page 622* for more information.

■ 38: Counterweight Selection

Setting Value	Function	Description
38	Counterweight Selection	V/f CL-V/f OLV CLV AOLV Switch *C4-02 [Torque Compensation Delay Time]*, *E1-08 [Mid Point A Voltage]* and *E1-10 [Minimum Output Voltage]*. The drive decides parameters based on the combination of the condition of the terminals ON or OFF and Run command orientation (Forward/Reverse).

Note:
Refer to *Parameter Switching Function for Reverse Operation on page 220* for details.

■ 39: Motor 3 Selection

Setting Value	Function	Description
39	Motor 3 Selection	V/f CL-V/f OLV CLV AOLV Switches motor 1 or motor 2 to motor 3. Switch the motor while the motor is stopped.

ON : Selects motor 3

OFF : Select motor 1 or motor 2 (Select the terminal assigned *H1-xx = 16 [Motor 2 Selection]*)

Note:
- Set *H1-xx = 16*, when setting *H1-xx = 39*. If *H1-xx = 39* is set while *H1-xx = 16* is not set, *oPE03 [Multi-Function Input Setting Err]* is detected.
- Refer to *Motor Switch Function on page 216* for details.

■ 3A: Micro Speed Gain1

Setting Value	Function	Description
3A	Micro Speed Gain1	V/f CL-V/f OLV CLV AOLV Multiplies the gain set in *S2-16 [Micro Speed Gain1]* by the final step of frequency reference when the terminal is ON.

■ 3B: Micro Speed Gain2

Setting Value	Function	Description
3B	Micro Speed Gain2	V/f CL-V/f OLV CLV AOLV Multiplies the gain set in *S2-17 [Micro Speed Gain2]* by the final step of frequency reference when the terminal is ON.

■ 40: Forward RUN (2-Wire)

Setting Value	Function	Description
40	Forward RUN (2-Wire)	V/f CL-V/f OLV CLV AOLV Input the Forward Run command for 2-wire sequence 1. Use it paired with the *Reverse Run Command (2-Wire Seq) [H1-xx = 41]*.

ON : Forward Run

OFF : Run Stop

Note:
- When the both Forward run command and Reverse run command terminals have been turned ON, the drive detects *EF [FWD/REV Run Command Input Error]* (minor fault), and the motor ramps to stop.
- The Forward run/Reverse run command is set to terminals S1 and S2 when the drive is initialized using a 2-wire sequence.

■ 41: Reverse RUN (2-Wire)

Setting Value	Function	Description
41	Reverse RUN (2-Wire)	V/f CL-V/f OLV CLV AOLV Input the Reverse run command for 2-wire sequence 1. Use it paired with the *Forward Run Command (2-Wire Seq) [H1-xx = 40]*.

ON : Reverse Run

OFF : Run Stop

Note:
- When the both Forward run command and Reverse run command terminals have been turned ON, the drive detects *EF [FWD/REV Run Command Input Error]* (minor fault), and the motor ramps to stop.
- The Reverse run command is set to terminal S2 when the drive is initialized using a 2-wire sequence.

■ 44: Add Offset Frequency 1 (d7-01)

Setting Value	Function	Description
44	Add Offset Frequency 1 (d7-01)	V/f CL-V/f OLV CLV AOLV Sets the function to add the offset frequency set in *d7-01 [Offset Frequency 1]* to the frequency reference when the terminal activates.

Note:

Refer to *d7: Offset Frequency on page 632* for more information.

■ 45: Add Offset Frequency 2 (d7-02)

Setting Value	Function	Description
45	Add Offset Frequency 2 (d7-02)	V/f CL-V/f OLV CLV AOLV Sets the function to add the offset frequency set in *d7-02 [Offset Frequency 2]* to the frequency reference when the terminal activates.

Note:

Refer to *d7: Offset Frequency on page 632* for more information.

■ 46: Add Offset Frequency 3 (d7-03)

Setting Value	Function	Description
46	Add Offset Frequency 3 (d7-03)	V/f CL-V/f OLV CLV AOLV Sets the function to add the offset frequency set in *d7-03 [Offset Frequency 3]* to the frequency reference when the terminal activates.

Note:

Refer to *d7: Offset Frequency on page 632* for more information.

■ 47: Node Setup (CANopen)

Setting Value	Function	Description
47	Node Setup (CANopen)	V/f CL-V/f OLV CLV AOLV Sets the function in CANopen communications to start the Node Setup function to set the drive node address from the host controller.

■ 60: DC Injection Braking Command

Setting Value	Function	Description
60	DC Injection Braking Command	V/f CL-V/f OLV CLV AOLV Sets the command to use DC Injection Braking to stop the motor.

■ 67: Communications Test Mode

Setting Value	Function	Description
67	Communications Test Mode	V/f CL-V/f OLV CLV AOLV Set the function for the drive to self-test RS-485 serial communications operation.

The Self-Diagnostics function connects the transmission terminal of the control terminal block to the reception terminal. The function transmits the data that the drive sent to make sure that the drive can communicate correctly.

Note:

Refer to MEMOBUS/Modbus communications “Self-Diagnostics” for the self-diagnostics procedure.

■ 72: Zero Servo

Setting Value	Function	Description
72	Zero Servo	V/f CL-V/f OLV CLV AOLV Sets the function to hold a stopped motor.

This function will hold a stopped motor if an external force is applied or an analog reference is offset.

Note:

- Refer to “b9: Zero Servo” for more information.
- When you use the Zero Servo function, keep the Run command ON. Zero servo stops the motor and if you turn OFF the Run command, it will not have power.

■ 100 to 1FF: Inverse Input of 0 to FF

Setting Value	Function	Description
100 - 1FF	Inverse Inputs of 0 to FF	Sets the function of the selected MFDI to operate inversely. To select the function, enter “1xx”, where “xx” is the function setting value.

To inverse the input of *E [ASR Integral Reset]*, for example, set *H1-xx = 10E [MFDI Function Select = ASR Integral Reset (N.C.)]*.

Note:

Some functions can be for inverse input, and some cannot. Refer to Table 11.26 for details.

◆ H2: Digital Outputs

H2 parameters sets the MFDO terminal functions.

■ H2-01 to H2-05 Function selection for terminals M1-M2, M3-M4, M5-M6, P1-C1, and P2-C2

This product is equipped with five MFDO terminals. The following table lists the functions according to the default settings.

No.	Name	Default	Function
H2-01	Multi-Function Digital Output 1 (contact)	21	Brake Release Command
H2-02	Multi-Function Digital Output 2 (contact)	0	During Run
H2-03	Multi-Function Digital Output 3 (contact)	2	Speed Agree 1
H2-04	Multi-Function Digital Output 4 (open-collector)	6	Drive Ready
H2-05	Multi-Function Digital Output 5 (open-collector)	10	Alarm

Refer to the following table when setting *H2-xx [MFDO Function Selection]*.

Table 11.29 MFDO Setting Value

Setting Value	Function
0	During Run
1	Zero Speed
2	Speed Agree 1
3	User-Set Speed Agree 1
4	Frequency Detection 1
5	Frequency Detection 2
6	Drive Ready
7	DC Bus Undervoltage
8	During Baseblock (N.O.)
9	Frequency Reference from Keypad
A	Run Command from Keypad
B	Torque Detection 1 (N.O.)
C	Frequency Reference Loss
D	Braking Resistor Fault
E	Fault
F *1	Not Used
10	Alarm
11	Fault Reset Command Active
13	Speed Agree 2
14	User-Set Speed Agree 2
15	Frequency Detection 3
16	Frequency Detection 4
17	Torque Detection 1 (N.C.)
18	Torque Detection 2 (N.O.)
19	Torque Detection 2 (N.C.)
1A	During Reverse
1B	During Baseblock (N.C.)
1C	Motor 2 Selection
1D	During Regeneration
1F	Motor Overload Alarm (oL1)
20	Drive Overheat Pre-Alarm (oH)
21	Brake Release Command
22	Overload Detection (N.O.)
23	Weight Det N.C.
2F	Maintenance Notification
30	During Torque Limit
33	Zero Servo Complete
37	During Frequency Output
39	Watt Hour Pulse Output
3C	LOCAL Control Selected
4C	During Fast Stop
4D	oH Pre-Alarm Reduction Limit
4E *2	Braking Transistor Fault (rr)
4F *2	Braking Resistor Overheat (rH)
51	Safe Torque OFF
52	Warning Signal
60	Internal Cooling Fan Failure
62	Modbus Reg 1 Status Satisfied
63	Modbus Reg 2 Status Satisfied
66	Comparator1
67	Comparator2
69	External Power 24V Supply
6A	Data Logger Error
6C	Motor Start Speed Warning Signal
B1	DC Injection Braking at Start
B2	DC Injection Braking at Stop
B3	Motor 3 Selection
100 to 1FF	Inverse output of 0 to FF Generates inverse output of the function for the selected MFDO. Sets the function for which to generate inverse output by specifying the last 2 digits of 1xx (00 to FF).

*1 Inverse output is not available.
*2 This parameter cannot be set on models 2145 to 2415 and 4075 to 4605.

■ Extended MFDO1 to MFDO3 Function Selection

You can set MFDO functions to *bit 0 to bit 2 [MEMOBUS MFDO1 to 3]* of MEMOBUS register 15E0 (Hex.). Use *H2-40 to H2-42 [Mbus Reg 15E0h bit0 to bit2 Output Func]* to select the function.

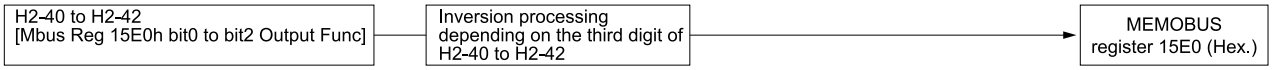


Figure 11.56 Functional Block Diagram of MEMOBUS Multi-function Output

Table 11.30 MEMOBUS MFDO Registers

Register number (Hex.)	Name	
15E0	bit0	MEMOBUS MFDO 1
	bit1	MEMOBUS MFDO 2
	bit2	MEMOBUS MFDO 3

Note:
- Refer to *MFDO Setting Values on page 711* for more information about MFDO setting values.
- When you do not set functions to *H2-40 to H2-42*, set them to *F*.

■ Output of Logical Operation Results of MFDO

This enables the logical operation results of two MFDOs to be output to one MFDO terminal.

Sets the function of the output signal for which logical operations are performed with *H2-60, H2-63, H2-66, H2-69, and H2-72 [Digital Output 1 Secondary Func to Digital Output 5 Secondary Func]*.

Sets the logical operation with *H2-61, H2-64, H2-67, H2-70, and H2-73 [Digital Output 1 Logical Operation to Digital Output 5 Logical Operation]*.

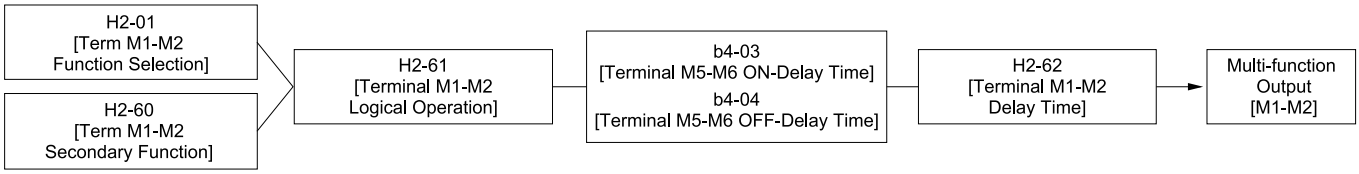
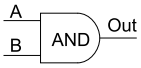
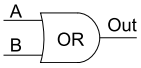
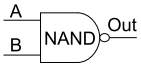
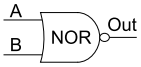
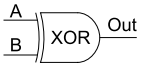
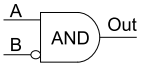
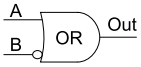


Figure 11.57 Functional Block Diagram of Logical Operation Output for MFDO 1

Table 11.31 MFDO Logical Operation Table

Logical Operation Selection H2-61, H2-64, H2-67, H2-70	Logical Operation Expression	Logical Operation Notation
0	A=B=1	
1	A=1 or B=1	
2	A=0 or B=0	
3	A=B=0	
4	A=B	A=B
5	A != B	
6	AND(A, $\bar{B}$)	
7	OR(A, $\bar{B}$)	
8	-	On

Note:
- You cannot set *H2-01 to H2-05 = 1xx [Inverse Output of xx]* when using the function to output logical operation results.
- *H2-60, H2-63, H2-66, H2-69, and H2-72* cannot be set to *20 to 2F [External Fault]*.
- Set *H2-60, H2-63, H2-66, H2-69, and H2-72 = F* when not using the terminal. However, the Through Mode function is not supported.

◆ H2 MFDO Parameters

■ H2-01: Term M1-M2 Function Selection

No. (Hex.)	Name	Description	Default (Range)
H2-01 (040B)	Term M1-M2 Function Selection	V/f CL-V/f OLV CLV AOLV Sets the function for MFDO terminal M1-M2.	21 (0 - 1FF)

Note:
Set this parameter to *F* when not using the terminal or to use the terminal in through mode.

■ H2-02: Term M3-M4 Function Selection

No. (Hex.)	Name	Description	Default (Range)
H2-02 (040C)	Term M3-M4 Function Selection	V/f CL-V/f OLV CLV AOLV Sets the function for MFDO terminal M3-M4.	0 (0 - 1FF)

Note:
Set this parameter to *F* when not using the terminal or to use the terminal in through mode.

■ H2-03: Term M5-M6 Function Selection

No. (Hex.)	Name	Description	Default (Range)
H2-03 (040D)	Term M5-M6 Function Selection	V/f CL-V/f OLV CLV AOLV Sets the function for MFDO terminal M5-M6.	2 (0 - 1FF)

Note:
Set this parameter to F when not using the terminal or to use the terminal in through mode.

■ H2-04: Term P1-C1 Function Selection

No. (Hex.)	Name	Description	Default (Range)
H2-04 (040E)	Term P1-C1 Function Selection	V/f CL-V/f OLV CLV AOLV Sets the function for MFDO terminal P1-C1.	6 (0 - 1FF)

Note:
Set this parameter to F when not using the terminal or to use the terminal in through mode.

■ H2-05: Term P2-C2 Function Selection

No. (Hex.)	Name	Description	Default (Range)
H2-05 (040F)	Term P2-C2 Function Selection	V/f CL-V/f OLV CLV AOLV Sets the function for MFDO terminal P2-C2.	10 (0 - 1FF)

Note:
Set this parameter to F when not using the terminal or to use the terminal in through mode.

■ H2-06: Watt Hour Output Unit Selection

No. (Hex.)	Name	Description	Default (Range)
H2-06 (0437)	Watt Hour Output Unit Selection	V/f CL-V/f OLV CLV AOLV Sets the unit for the output signal when *H2-01 to H2-05 = 39 [MFDO Function Selection = Watt Hour Pulse Output]*.	0 (0 - 4)

This output is input to the Watt hour meter or PLC via a 200 ms pulse signal. Each pulse is output by the kWh unit selected by *H2-06*.

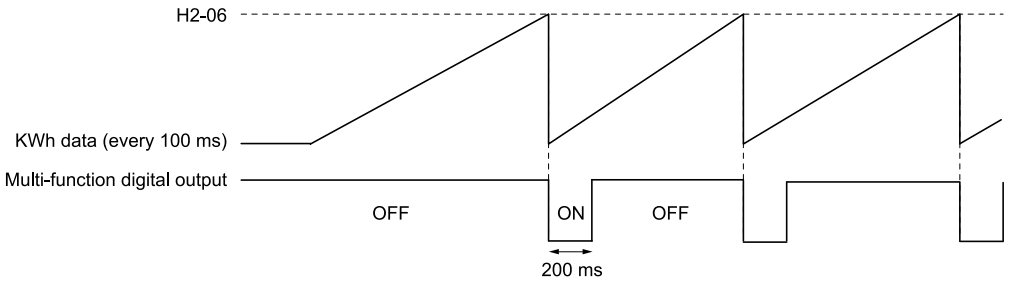


Figure 11.58 Example MFDO when Set for Watt Hours

Note:
- Watt hours are not counted when the power value is a negative value (regenerative state).
- Stores the Watt hours while the control power supply to the drive is operating. The Watt hour count is reset when the control power is cut because of a momentary power loss or other reason.

0 : 0.1 kWh units
1 : 1 kWh units
2 : 10 kWh units
3 : 100 kWh units
4 : 1000 kWh units

■ H2-07: Modbus Register 1 Address Select

No. (Hex.)	Name	Description	Default (Range)
H2-07 (0B3A)	Modbus Register 1 Address Select	V/f CL-V/f OLV CLV AOLV Sets the address of the MEMOBUS/Modbus register output to the MFDO terminal.	0001 (0001 - 1FFF)

Sets *H2-07* with the address of the register that is output to *Modbus Reg 1 Status Satisfied [H2-01 to H2-05 = 62]* and sets *H2-08* with the bit value.

■ H2-08: Modbus Register 1 Bit Select

No. (Hex.)	Name	Description	Default (Range)
H2-08 (0B3B)	Modbus Register 1 Bit Select	V/f CL-V/f OLV CLV AOLV Sets the bit of the MEMOBUS/Modbus register output to the MFDO terminal.	0000 (0000 - FFFF)

Sets *H2-07* with the address of the register that is output to *Modbus Reg 1 Status Satisfied [H2-01 to H2-05 = 62]* and sets *H2-08* with the bit value.

■ H2-09: Modbus Register 2 Address Select

No. (Hex.)	Name	Description	Default (Range)
H2-09 (0B3C)	Modbus Register 2 Address Select	V/f CL-V/f OLV CLV AOLV Sets the address of the MEMOBUS/Modbus register output to the MFDO terminal.	0001 (0001 - 1FFF)

Sets *H2-09* with the address of the register that is output to *Modbus Reg 2 Status Satisfied [H2-01 to H2-05 = 63]* and sets *H2-10* with the bit value.

■ H2-10: Modbus Register 2 Bit Select

No. (Hex.)	Name	Description	Default (Range)
H2-10 (0B3D)	Modbus Register 2 Bit Select	V/f CL-V/f OLV CLV AOLV Sets the bit of the MEMOBUS/Modbus register output to the MFDO terminal.	0000 (0000 - FFFF)

Sets *H2-09* with the address of the register that is output to *Modbus Reg 2 Status Satisfied [H2-01 to H2-05 = 63]* and sets *H2-10* with the bit value.

■ H2-20: Comparator 1 Monitor Selection

No. (Hex.)	Name	Description	Default (Range)
H2-20 (1540)	Comparator 1 Monitor Selection	V/f CL-V/f OLV CLV AOLV Sets the monitor number for comparator 1. Set the *x-xx* part of the *Ux-xx [Monitor]*. For example, set *H2-20 = 102* to monitor *U1-02 [Output Frequency]*.	102 (000 - 999)

Note:
- For information on the comparator function, refer to *66: Comparator1 on page 722* and *67: Comparator2 on page 722*.
- The configurable monitor changes when the control method changes.

■ H2-21: Comparator 1 Lower Limit

No. (Hex.)	Name	Description	Default (Range)
H2-21 (1541)	Comparator 1 Lower Limit	V/f CL-V/f OLV CLV AOLV Sets the lower limit detection level for comparator 1 when the full scale analog output for the monitor selected in *H2-20 [Comparator 1 Monitor Selection]* is the 100% value.	0.0% (0.0 - 300.0%)

Note:
For information on the comparator function, refer to *66: Comparator1 on page 722* and *67: Comparator2 on page 722*.

■ H2-22: Comparator 1 Upper Limit

No. (Hex.)	Name	Description	Default (Range)
H2-22 (1542)	Comparator 1 Upper Limit	V/f CL-V/f OLV CLV AOLV Sets the upper limit detection level for comparator 1 when the full scale analog output for the monitor selected in *H2-20 [Comparator 1 Monitor Selection]* is the 100% value.	0.0% (0.0 - 300.0%)

Note:
For information on the comparator function, refer to *66: Comparator1 on page 722* and *67: Comparator2 on page 722*.

■ H2-23: Comparator 1 Hysteresis

No. (Hex.)	Name	Description	Default (Range)
H2-23 (1543)	Comparator 1 Hysteresis	V/f CL-V/f OLV CLV AOLV Sets the hysteresis level for comparator 1 as a percentage of the full scale analog output for the monitor selected in *H2-20 [Comparator 1 Monitor Selection]*.	0.0% (0.0 - 10.0%)

Note:
For information on the comparator function, refer to *66: Comparator1 on page 722* and *67: Comparator2 on page 722*.

■ H2-24: Comparator 1 On-Delay Time

No. (Hex.)	Name	Description	Default (Range)
H2-24 (1544)	Comparator 1 On-Delay Time	V/f CL-V/f OLV CLV AOLV Sets the on-delay time for comparator 1.	0.0 s (0.0 - 600.0 s)

Note:
For information on the comparator function, refer to *66: Comparator1 on page 722* and *67: Comparator2 on page 722*.

■ H2-25: Comparator 1 Off-Delay Time

No. (Hex.)	Name	Description	Default (Range)
H2-25 (1545)	Comparator 1 Off-Delay Time	V/f CL-V/f OLV CLV AOLV Sets the off-delay time for comparator 1.	0.0 s (0.0 - 600.0 s)

Note:
For information on the comparator function, refer to *66: Comparator1 on page 722* and *67: Comparator2 on page 722*.

■ H2-26: Comparator 2 Monitor Selection

No. (Hex.)	Name	Description	Default (Range)
H2-26 (1546)	Comparator 2 Monitor Selection	V/f CL-V/f OLV CLV AOLV Sets the monitor number for comparator 2. Set the *x-xx* part of the *Ux-xx [Monitor]*. For example, set *H2-26 = 103* to monitor *U1-03 [Output Current]*.	103 (000 - 999)

Note:
- The configurable monitor changes when the control method changes.
- When you use the terminal in through mode, set this parameter to *000* or *031*. You can set the terminal output level from the PLC through MEMOBUS/Modbus communications or the communication option.
- For information on the comparator function, refer to *66: Comparator1 on page 722* and *67: Comparator2 on page 722*.

■ H2-27: Comparator 2 Lower Limit

No. (Hex.)	Name	Description	Default (Range)
H2-27 (1547)	Comparator 2 Lower Limit	V/f CL-V/f OLV CLV AOLV Sets the lower limit detection level for comparator 2 as a percentage of the full scale analog output for the monitor selected in *H2-26 [Comparator 2 Monitor Selection]*.	0.0% (0.0 - 300.0%)

Note:
For information on the comparator function, refer to *66: Comparator1 on page 722* and *67: Comparator2 on page 722*.

■ H2-28: Comparator 2 Upper Limit

No. (Hex.)	Name	Description	Default (Range)
H2-28 (1548)	Comparator 2 Upper Limit	V/f CL-V/f OLV CLV AOLV Sets the upper limit detection level for comparator 2 as a percentage of the full scale analog output for the monitor selected in *H2-26 [Comparator 2 Monitor Selection]*.	0.0% (0.0 - 300.0%)

Note:
For information on the comparator function, refer to *66: Comparator1 on page 722* and *67: Comparator2 on page 722*.

■ H2-29: Comparator 2 Hysteresis

No. (Hex.)	Name	Description	Default (Range)
H2-29 (1549)	Comparator 2 Hysteresis	V/f CL-V/f OLV CLV AOLV Sets the hysteresis level for comparator 2 as a percentage of the full scale analog output for the monitor selected in *H2-26 [Comparator 2 Monitor Selection]*.	0.0% (0.0 - 10.0%)

Note:
For information on the comparator function, refer to *66: Comparator1 on page 722* and *67: Comparator2 on page 722*.

■ H2-30: Comparator 2 On-Delay Time

No. (Hex.)	Name	Description	Default (Range)
H2-30 (154A)	Comparator 2 On-Delay Time	V/f CL-V/f OLV CLV AOLV Sets the on-delay time for comparator 2.	0.0 s (0.0 - 600.0 s)

Note:
Refer to *H2-xx = 66 and 67 [Multi-Function Digital Out Function Select = Comparator1 and Comparator 2]* for more information on the comparator function.

■ H2-31: Comparator 2 Off-Delay Time

No. (Hex.)	Name	Description	Default (Range)
H2-31 (154B)	Comparator 2 Off-Delay Time	V/f CL-V/f OLV CLV AOLV Sets the off-delay time for comparator 2.	0.0 s (0.0 - 600.0 s)

Note:
Refer to *H2-xx = 66 and 67 [Multi-Function Digital Out Function Select = Comparator1 and Comparator 2]* for more information on the comparator function.

■ H2-32: Comparator 1 Filter Time

No. (Hex.)	Name	Description	Default (Range)
H2-32 (159A)	Comparator 1 Filter Time	V/f CL-V/f OLV CLV AOLV Sets the time constant that is applied to the primary delay filter used for the analog output of the monitor selected with *H2-20 [Comparator 1 Monitor Selection]*.	0.0s (0.0 - 10.0 s)

Note:

For information on the comparator function, refer to *66: Comparator1 on page 722* and *67: Comparator2 on page 722*.

■ H2-33: Comparator1 Protection Selection

No. (Hex.)	Name	Description	Default (Range)
H2-33 (159B)	Comparator1 Protection Selection	V/f CL-V/f OLV CLV AOLV Selects the operation of the drive when it detects *CP1 [Comparator1 Limit Fault]*.	4 (0 - 4)

0 : Ramp to Stop

The drive ramps the motor to stop according to the deceleration time. Fault relay output terminal MA-MC will turn ON, and MB-MC will turn OFF.

1 : Coast to Stop

The drive output shuts off and the motor coasts to stop. Fault relay output terminal MA-MC will turn ON, and MB-MC will turn OFF.

2 : Fast Stop (Use C1-09)

The drive stops the motor using the deceleration time set in *C1-09 [Fast Stop Time]*. Fault relay output terminal MA-MC will turn ON, and MB-MC will turn OFF.

3 : Alarm Only

The keypad shows *CP1*, and the drive continues operation. The output terminal set for *Alarm [H2-01 to H2-05 = 10]* switches ON.

4 : Operate at Reduced Speed (L8-19)

■ H2-34: Comparator 2 Filter Time

No. (Hex.)	Name	Description	Default (Range)
H2-34 (159C)	Comparator 2 Filter Time	V/f CL-V/f OLV CLV AOLV Sets the time constant that is applied to the primary delay filter used for the analog output of the monitor selected with *H2-26 [Comparator 2 Monitor Selection]*.	0.0s (0.0 - 10.0 s)

■ H2-35: Comparator2 Protection Selection

No. (Hex.)	Name	Description	Default (Range)
H2-35 (159D)	Comparator2 Protection Selection	V/f CL-V/f OLV CLV AOLV Selects the operation of the drive when *CP2 [Comparator2 Limit Fault]* is detected.	4 (0 - 4)

0 : Ramp to Stop

The drive ramps the motor to stop according to the deceleration time. Fault relay output terminal MA-MC will turn ON, and MB-MC will turn OFF.

1 : Coast to Stop

The drive output shuts off and the motor coasts to stop. Fault relay output terminal MA-MC will turn ON, and MB-MC will turn OFF.

2 : Fast Stop (Use C1-09)

The drive stops the motor using the deceleration time set in *C1-09 [Fast Stop Time]*. Fault relay output terminal MA-MC will turn ON, and MB-MC will turn OFF.

3 : Alarm Only

The keypad shows *CP2*, and the drive continues operation. The output terminal set for *Alarm [H2-01 to H2-05 = 10]* switches ON.

4 : Operate at Reduced Speed (L8-19)

■ H2-36: Comparator 1 Ineffective Time

No. (Hex.)	Name	Description	Default (Range)
H2-36 (159E)	Comparator 1 Ineffective Time	V/f CL-V/f OLV CLV AOLV Sets the length of time that *CP1 [Comparator1 Limit Fault]* is disabled.	0.0 s (0.0 - 1000.0 s)

Note:
- After you enter a Run command and wait for the time set in this parameter, the drive will monitor operation and make sure that it is in the Comparator 1 range until you enter the Stop command.
- When *CP1* detection is disabled, the drive will activate the output terminal set for *Comparator 1 [H2-xx = 66]*.

■ H2-37: Comparator 2 Ineffective Time

No. (Hex.)	Name	Description	Default (Range)
H2-37 (159F)	Comparator 2 Ineffective Time	V/f CL-V/f OLV CLV AOLV Sets the length of time that *CP2 [Comparator2 Limit Fault]* is disabled.	0.0 s (0.0 - 1000.0 s)

Note:
- After you enter a Run command and wait for the time set in this parameter, the drive will monitor operation and make sure that it is in the Comparator 2 range until you enter the Stop command.
- When *CP2* detection is disabled, the drive will activate the output terminal set for *Comparator 2 [H2-xx = 67]*.

■ H2-40: Mbus Reg 15E0h bit0 Output Func

No. (Hex.)	Name	Description	Default (Range)
H2-40 (0B58)	Mbus Reg 15E0h bit0 Output Func	V/f CL-V/f OLV CLV AOLV Sets the MFDO for bit 0 of MEMOBUS register 15E0 (Hex.).	F (0 - 1FF)

■ H2-41: Mbus Reg 15E0h bit1 Output Func

No. (Hex.)	Name	Description	Default (Range)
H2-41 (0B59)	Mbus Reg 15E0h bit1 Output Func	V/f CL-V/f OLV CLV AOLV Sets the MFDO for bit 1 of MEMOBUS register 15E0 (Hex.).	F (0 - 1FF)

■ H2-42: Mbus Reg 15E0h bit2 Output Func

No. (Hex.)	Name	Description	Default (Range)
H2-42 (0B5A)	Mbus Reg 15E0h bit2 Output Func	V/f CL-V/f OLV CLV AOLV Sets the MFDO for bit 2 of MEMOBUS register 15E0 (Hex.).	F (0 - 1FF)

■ H2-60: Term M1-M2 Secondary Function

No. (Hex.)	Name	Description	Default (Range)
H2-60 (1B46) Expert	Term M1-M2 Secondary Function	V/f CL-V/f OLV CLV AOLV Sets the second function for terminal M1-M2. The logical calculation results of the terminals assigned to functions by *H2-01 [Term M1-M2 Function Selection]* is output.	F (0 - FF)

■ H2-61: Terminal M1-M2 Logical Operation

No. (Hex.)	Name	Description	Default (Range)
H2-61 (1B47) Expert	Term MA,MB,MC Logical Operation	V/f CL-V/f OLV CLV AOLV Selects the logical operation for the two functions selected by *H2-01 [Term M1-M2 Function Selection]* and *H2-60 [Term M1-M2 Secondary Function]*.	0 (0 - 8)

Note:

Refer to *Output of Logical Operation Results of MFDO on page 703* for more information about the relationship between parameter settings and logical operations.

■ H2-62: Terminal M1-M2 Delay Time

No. (Hex.)	Name	Description	Default (Range)
H2-62 (1B48) Expert	Terminal M1-M2 Delay Time	V/f CL-V/f OLV CLV AOLV Sets the minimum on time used to output the logical calculation results from terminal M1-M2.	0.1 s (0.0 - 25.0 s)

■ H2-63: Term M3-M4 Secondary Function

No. (Hex.)	Name	Description	Default (Range)
H2-63 (1B49) Expert	Terminal P1 Secondary Function	V/f CL-V/f OLV CLV AOLV Sets the second function for terminal M3-M4. Outputs the logical calculation results of the terminals assigned to functions by *H2-02 [Term P1 Function Selection]*.	F (0 - FF)

■ H2-64: Terminal M3-M4 Logical Operation

No. (Hex.)	Name	Description	Default (Range)
H2-64 (1B4A) Expert	Terminal P1 Logical Operation	V/f CL-V/f OLV CLV AOLV Selects the logical operation for the two functions selected by *H2-02 [Term M3-M4 Function Selection]* and *H2-63 [Term M3-M4 Secondary Function]*.	0 (0 - 8)

Note:

Refer to *Output of Logical Operation Results of MFDO on page 703* for more information about the relationship between parameter settings and logical operations.

■ H2-65: Terminal M3-M4 Delay Time

No. (Hex.)	Name	Description	Default (Range)
H2-65 (1B4B) Expert	Terminal M3-M4 Delay Time	V/f CL-V/f OLV CLV AOLV Sets the minimum on time used to output the logical calculation results from terminal M3-M4.	0.1 s (0.0 - 25.0 s)

■ H2-66: Term M5-M6 Secondary Function

No. (Hex.)	Name	Description	Default (Range)
H2-66 (1B4C) Expert	Term M5-M6 Secondary Function	V/f CL-V/f OLV CLV AOLV Sets the second function for terminal M5-M6. Outputs the logical calculation results of the terminals assigned to functions by *H2-03 [Term P1-C1 Function Selection]*.	F (0 - FF)

■ H2-67: Terminal M5-M6 Logical Operation

No. (Hex.)	Name	Description	Default (Range)
H2-67 (1B4D) Expert	Terminal M5-M6 Logical Operation	V/f CL-V/f OLV CLV AOLV Sets the logical operation for the two functions selected by *H2-03 [Terminal M5-M6 Function Select]* and *H2-66 [Term M5-M6 Secondary Function]*.	0 (0 - 8)

Note:

Refer to *Output of Logical Operation Results of MFDO on page 703* for more information about the relationship between parameter settings and logical operations.

■ H2-68: Terminal M5-M6 Delay Time

No. (Hex.)	Name	Description	Default (Range)
H2-68 (1B4E) Expert	Terminal P2 Minimum ON Time	V/f CL-V/f OLV CLV AOLV Sets the minimum on time used to output the logical calculation results from terminal M5-M6.	0.1 s (0.0 - 25.0 s)

■ H2-69: Digital Output4 Secondary Func

No. (Hex.)	Name	Description	Default (Range)
H2-69 (1B4F) Expert	Digital Output4 Secondary Func	V/f CL-V/f OLV CLV AOLV Sets the second function for terminal P1-C1. Outputs the logical calculation results of the terminals assigned to functions by *H2-04 [Terminal P2-C2 Function Select]*.	F (0 - FF)

■ H2-70: DigitalOutput4 Logical Operation

No. (Hex.)	Name	Description	Default (Range)
H2-70 (11F9) Expert	DigitalOutput4 Logical Operation	V/f CL-V/f OLV CLV AOLV Sets the logical operation for the functions set in *H2-04 [Terminal P1-C1 Function Select]* and *H2-69 [Digital Output4 Secondary Func]*.	0 (0 - 8)

Note:

Refer to *Output of Logical Operation Results of MFDO on page 703* for more information about the relationship between parameter settings and logical operations.

■ H2-71: Digital Output 4 Delay Time

No. (Hex.)	Name	Description	Default (Range)
H2-71 (11FA) Expert	Digital Output 4 Delay Time	V/f CL-V/f OLV CLV AOLV Sets the minimum on time used to output the logical calculation results from terminal P1-C1.	0.1 s (0.0 - 25.0 s)

■ H2-72: Digital Output 5 Secondary Func

No. (Hex.)	Name	Description	Default (Range)
H2-72 (11FB) Expert	Digital Output 5 Secondary Func	V/f CL-V/f OLV CLV AOLV Sets the second function for terminal P2-C2. The logical calculation results of the terminals assigned to functions by *H2-05 [Term P2-C2 Function Selection]* is output.	F (0 - FF)

■ H2-73: DigitalOutput5 Logical Operation

No. (Hex.)	Name	Description	Default (Range)
H2-73 (11FC) Expert	DigitalOutput5 Logical Operation	V/f CL-V/f OLV CLV AOLV Sets the logical operation for the functions set in *H2-05 [Term P2-C2 Function Selection]* and *H2-72 [Digital Output 5 Secondary Func]*.	0 (0 - 8)

■ H2-74: Digital Output 5 Delay Time

No. (Hex.)	Name	Description	Default (Range)
H2-74 (11FD) Expert	Digital Output 5 Delay Time	V/f CL-V/f OLV CLV AOLV Sets the minimum ON time used to output the logical calculation results from terminal P2-C2.	0.1 s (0.0 - 25.0 s)

◆ MFDO Setting Values

Selects the function configured to MFDO.

■ 0: During Run

Setting Value	Function	Description
0	During Run	V/f CL-V/f OLV CLV AOLV The terminal activates when you input a Run command and when the drive is outputting voltage.

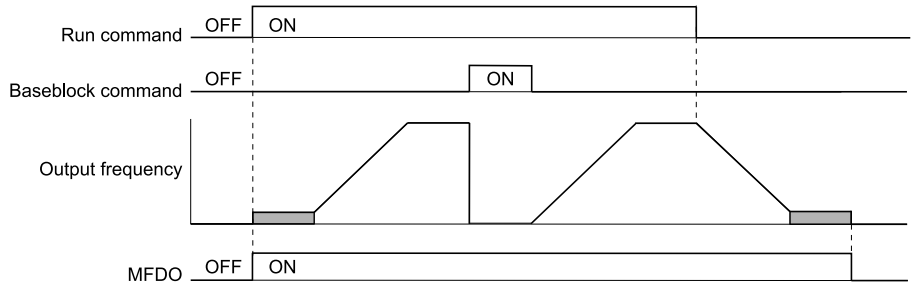


Figure 11.59 Drive Running Time Chart

ON : Drive is during run

The Run command is input or the drive is in deceleration or DC injection.

OFF : Drive is stopped

■ 1: Zero Speed

Setting Value	Function	Description
1	Zero Speed	V/f CL-V/f OLV CLV AOLV The terminal activates when the output frequency is less than *E1-09 [Minimum Output Frequency]* or *b2-01 [DC Injection/Zero SpeedThreshold]*.

Note:

The parameter used as the reference is determined by the setting of *A1-02 [Control Method Selection]*.

A1-02 Settings	Description	Parameter Used as the Reference
0	V/f Control	E1-09
1	Closed Loop V/f Control	E1-09
2	Open Loop Vector Control	b2-01
3	Closed Loop Vector Control	E1-09
4	Advanced Open Loop Vector Control	E1-09

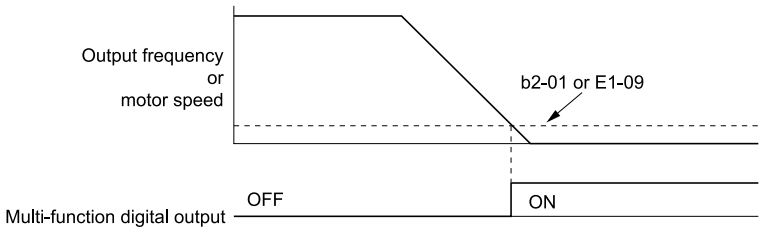


Figure 11.60 Zero Speed Time Chart

ON : The output frequency is less than the value of *E1-09* or *b2-01*.

OFF : The output frequency is the value of *E1-09* or more, or *b2-01* or more.

■ 2: Speed Agree 1

Setting Value	Function	Description
2	Speed Agree 1	V/f CL-V/f OLV CLV AOLV The terminal deactivates when the output frequency is in the range of the frequency reference ± *L4-02 [Speed Agree Detection Width]*.

Note:

- The detection function operates in the two motor rotation directions.
- The drive outputs the motor speed status when *A1-02 = 3 [Control Method Selection = CLV]*. The drive outputs the motor speed status when *A1-02 = 4 [Control Method Selection = AOLV]* and *n4-72 = 1 [Speed Feedback Mode = With Encoder]*.

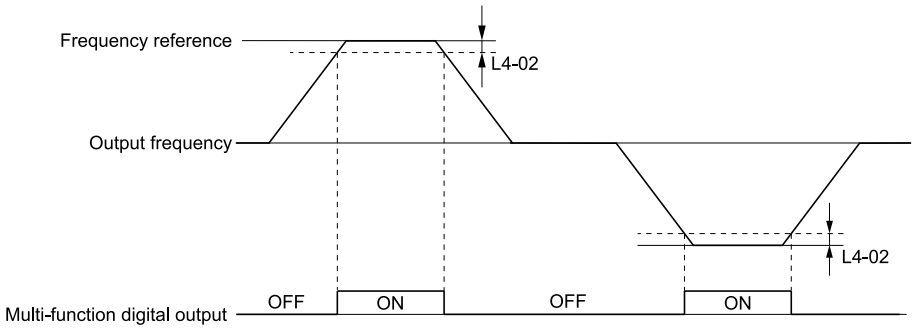


Figure 11.61 Speed Agree 1 Time Chart

ON : The output frequency is in the range of "frequency reference ± *L4-02*".

OFF : The output frequency does not align with the frequency reference although the drive is running.

■ 3: User-Set Speed Agree 1

Setting Value	Function	Description
3	User-Set Speed Agree 1	V/f CL-V/f OLV CLV AOLV The terminal activates when the output frequency is in the range of *L4-01 [Speed Agree Detection Level]* ± *L4-02 [Speed Agree Detection Width]* and in the range of the frequency reference ± *L4-02*.

Note:
- The detection function operates in the two motor rotation directions. The drive uses the *L4-01* value as the forward/reverse detection level.
- The drive outputs the motor speed status when *A1-02 = 3 [Control Method Selection = CLV]*. The drive outputs the motor speed status when *A1-02 = 4 [Control Method Selection = AOLV]* and *n4-72 = 1 [Speed Feedback Mode = With Encoder]*.

ON : The output frequency is in the range of "*L4-01* ± *L4-02*" and the range of frequency reference ± *L4-02*.

OFF : The output frequency is not in the range of "*L4-01* ± *L4-02*" nor the range of frequency reference ± *L4-02*.

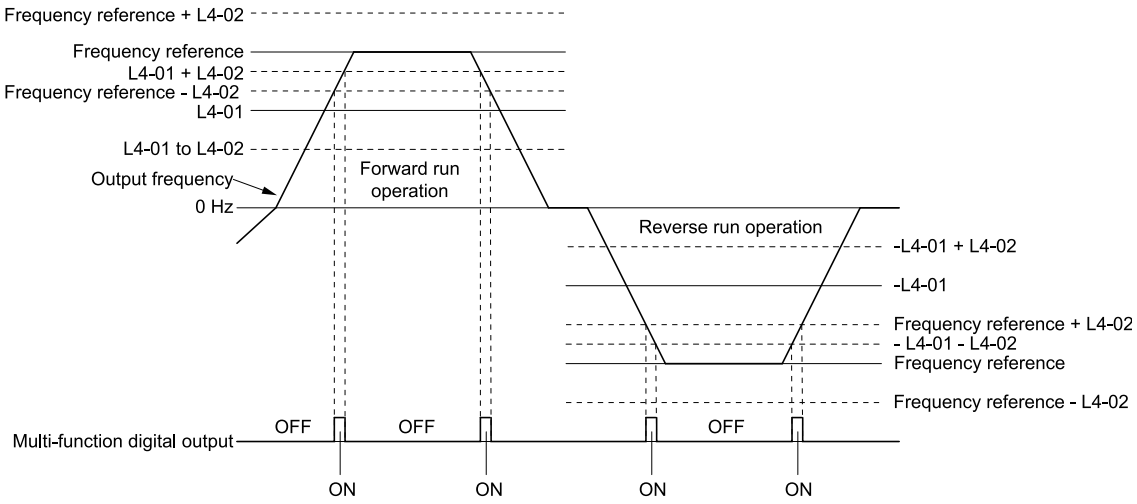


Figure 11.62 User-Defined Speed Agree 1 Time Chart

■ 4: Frequency Detection 1

Setting Value	Function	Description
4	Frequency Detection 1	V/f CL-V/f OLV CLV AOLV The terminal deactivates when the output frequency > "*L4-01 [Speed Agree Detection Level]* + *L4-02 [Speed Agree Detection Width]*". After the terminal deactivates, the terminal stays deactivated until the output frequency is at the value of *L4-01*.

Note:
- The detection function operates in the two motor rotation directions. The drive uses the *L4-01* value as the forward/reverse detection level.
- The drive outputs the motor speed status when *A1-02 = 3 [Control Method Selection = CLV]*. The drive outputs the motor speed status when *A1-02 = 4 [Control Method Selection = AOLV]* and *n4-72 = 1 [Speed Feedback Mode = With Encoder]*.

ON : The output frequency is less than the value of *L4-01* or is not more than the value of *L4-01* + *L4-02*.

OFF : The output frequency > *L4-01* + *L4-02*.

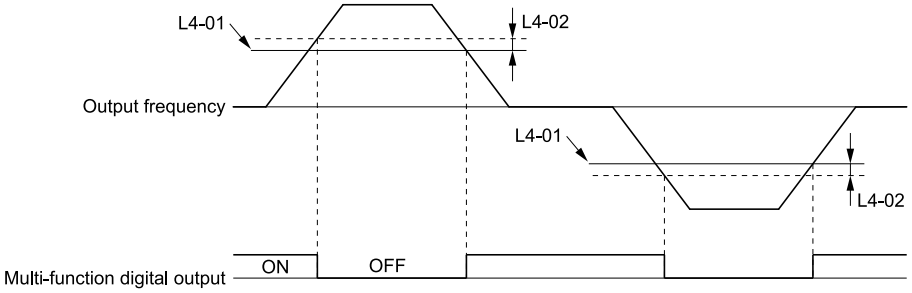


Figure 11.63 Frequency Detection 1 Time Chart

Note:

Figure 11.63 shows the result of the configuration when *L4-07 = 1 [Speed Agree Detection Selection = Detection Always Enabled]*. The default setting of *L4-07* is *0 [No detection during baseblock]*. When the speed agreement detection selection is "No Detection during Baseblock", the terminal is deactivated when the drive output stops.

■ 5: Frequency Detection 2

Setting Value	Function	Description
5	Frequency Detection 2	V/f CL-V/f OLV CLV AOLV The terminal activates when the output frequency > *L4-01 [Speed Agree Detection Level]*. After the terminal activates, the terminal stays activated until the output frequency is at the value of "*L4-01 - L4-02*".

Note:

- The detection function operates in the two motor rotation directions. The drive uses the *L4-01* value as the forward/reverse detection level.
- The drive outputs the motor speed status when *A1-02 = 3 [Control Method Selection = CLV]*. It also outputs the motor speed status when *A1-02 = 4* and *n4-72 = 1 [Speed Feedback Mode = With Encoder]*.

ON : The output frequency is more than *L4-01*.

OFF : The output frequency is less than "*L4-01 - L4-02*," or it is not more than *L4-01*.

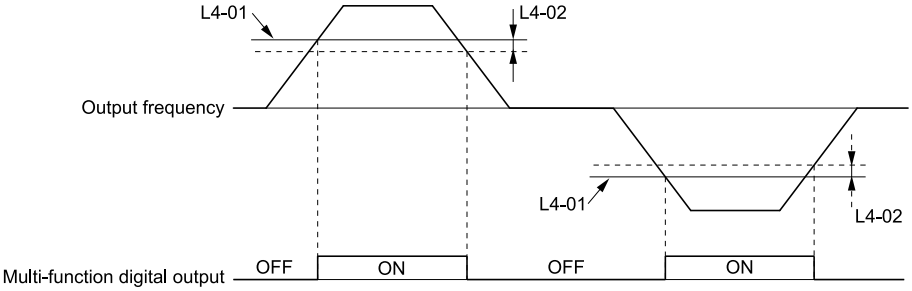


Figure 11.64 Frequency Detection 2 Time Chart

■ 6: Drive Ready

Setting Value	Function	Description
6	Drive Ready	V/f CL-V/f OLV CLV AOLV The terminal activates when the drive is ready and running.

The terminal deactivates in these conditions:

- When the power supply is OFF
- During a fault
- When there is problem with the control power supply
- When there is a parameter setting error and the drive cannot operate although there is a Run command
- When you enter a Run command and it immediately triggers an overvoltage or undervoltage fault because the drive has an overvoltage or undervoltage fault during stop
- When the drive is in Programming Mode and will not accept a Run command
- When the Safe Disable function is active

■ 7: DC Bus Undervoltage

Setting Value	Function	Description
7	DC Bus Undervoltage	V/f CL-V/f OLV CLV AOLV The terminal activates when the DC bus voltage or control circuit power supply is at the voltage set in *L2-05 [Undervoltage Detection Lvl (Uv1)]* or less. The terminal also activates when there is a fault with the DC bus voltage.

ON : The DC bus voltage ≤ *L2-05*
OFF : The DC bus voltage > *L2-05*

■ 8: During Baseblock (N.O.)

Setting Value	Function	Description
8	During Baseblock (N.O.)	V/f CL-V/f OLV CLV AOLV The terminal activates during baseblock. When the drive is in baseblock, the drive output transistor stops switching and does not make DC bus voltage.

ON : During baseblock
OFF : The drive is not in baseblock.

■ 9: Frequency Reference from Keypad

Setting Value	Function	Description
9	Frequency Reference from Keypad	V/f CL-V/f OLV CLV AOLV Shows the selected frequency reference source.

ON : The keypad is the frequency reference source.
OFF : *b1-01 or b1-15 [Frequency Reference Selection 1 or 2]* is the frequency reference source.

■ A: Run Command from Keypad

Setting Value	Function	Description
A	Run Command Source	V/f CL-V/f OLV CLV AOLV Shows the selected Run command source.

ON : The keypad is the Run command source.
OFF : *b1-02* or *b1-16* [Run Command Selection 1 or 2] is the Run command source.

■ B: Torque Detection 1 (N.O.)

Setting Value	Function	Description
B	Torque Detection 1 (N.O.)	V/f CL-V/f OLV CLV AOLV The terminal activates when the drive detects overtorque.

ON : The output current/torque exceeds the torque value set with *S6-02 [Overtorque Detection Level 1]* and remained in this state longer than the time set with *S6-03 [Overtorque Detection Time 1]*.

Note:
Refer to *Overtorque Detection on page 214* for details.

■ C: Frequency Reference Loss

Setting Value	Function	Description
C	Frequency Reference Loss	V/f CL-V/f OLV CLV AOLV The terminal activates when the drive detects a loss of frequency reference.

Note:
Refer to “L4-05: Fref Loss Detection Selection” for more information.

■ D: Braking Resistor Fault

Setting Value	Function	Description
D	Braking Resistor Fault	V/f CL-V/f OLV CLV AOLV The terminal activates when the mounting-type braking resistor is overheating or when there is a braking transistor fault.

■ E: Fault

Setting Value	Function	Description
E	Fault	V/f CL-V/f OLV CLV AOLV The terminal activates when the drive detects a fault.

Note:
The terminal will not activate for *CPF00* and *CPF01 [Control Circuit Error]* faults.

■ F: Not Used

Setting Value	Function	Description
F	Not Used	V/f CL-V/f OLV CLV AOLV Use this setting for unused terminals or to use terminals in through mode. Also use this setting as the PLC contact output via MEMOBUS/Modbus or the communication option. This signal does not function if you do not configure signals from the PLC.

■ 10: Alarm

Setting Value	Function	Description
10	Alarm	V/f CL-V/f OLV CLV AOLV The terminal activates when the drive detects a minor fault.

■ 11: Fault Reset Command Active

Setting Value	Function	Description
11	Fault Reset Command Active	V/f CL-V/f OLV CLV AOLV The terminal activates when the drive receives the Reset command from the control circuit terminal, serial communications, or the communication option.

■ 13: Speed Agree 2

Setting Value	Function	Description
13	Speed Agree 2	V/f CL-V/f OLV CLV AOLV The terminal activates when the output frequency is in the range of the frequency reference ± *L4-04 [Speed Agree Detection Width(+/-)]*.

Note:
When using Closed Loop Vector Control, the motor speed is used as the reference.

ON : The output frequency is within the range of "frequency reference ± *L4-04*".

OFF : The output frequency is not within the range of "frequency reference ± *L4-04*".

■ 14: User-Set Speed Agree 2

Setting Value	Function	Description
14	User-Set Speed Agree 2	V/f CL-V/f OLV CLV AOLV The terminal activates when the output frequency is in the range of *L4-03 [Speed Agree Detection Level (+/-)]* ± *L4-04 [Speed Agree Detection Width (+/-)]* and in the range of the frequency reference ± *L4-04*.

Note:
- The detection level set with *L4-03* is a signed value. Detections only occur one specific orientation.
- When using CLV control, the motor speed is used as the reference.

ON : The output frequency is within the range of "*L4-03* ± *L4-04*" and the range of the frequency reference ± *L4-04*.

OFF : The output frequency is not within the range of "*L4-03* ± *L4-04*" or the range of frequency reference ± *L4-04*.

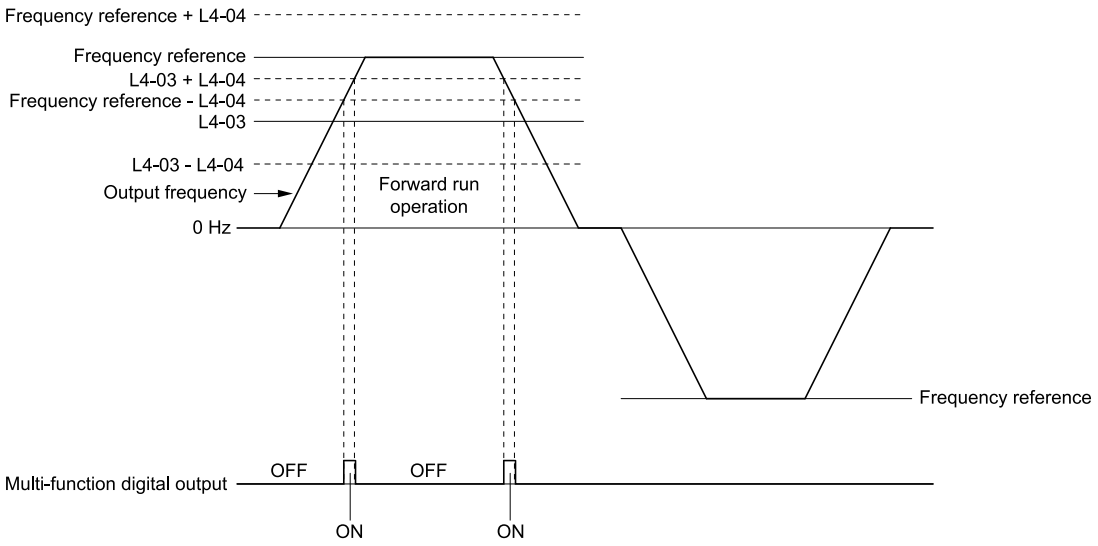


Figure 11.65 Example of User-set Speed Agree 2 (L4-03 Is Positive)

■ 15: Frequency Detection 3

Setting Value	Function	Description
15	Frequency Detection 3	V/f CL-V/f OLV CLV AOLV The terminal deactivates when the output frequency > "*L4-03 [Speed Agree Detection Level(+/-)] + L4-04 [Speed Agree Detection Width(+/-)]*". After the terminal deactivates, the terminal stays deactivated until the output frequency is at the value of *L4-03*.

Note:
- The detection level set with *L4-03* is a signed value. Detections only occur one specific orientation.
- When using CLV control, the motor speed is used as the reference.

ON : The output frequency is less than the value of *L4-03* or does not exceed the value of *L4-03* + *L4-04*.

OFF : The output frequency exceeds the value of *L4-03* + *L4-04*.

■ 16: Frequency Detection 4

Setting Value	Function	Description
16	Frequency Detection 4	V/f CL-V/f OLV CLV AOLV The terminal activates when the output frequency > *L4-03 [Speed Agree Detection Level(+/-)]*. After the terminal activates, the terminal stays activated until the output frequency = "*L4-03 - L4-04*".

Note:
- The detection level set in *L4-03* is a signed value. The drive will only detect in one direction.
- The drive outputs the motor speed status when *A1-02 = 3 [Control Method Selection = CLV]*.

ON : The output frequency > *L4-03*.

OFF : The output frequency < "*L4-03 - L4-04*," or it is not more than *L4-03*.

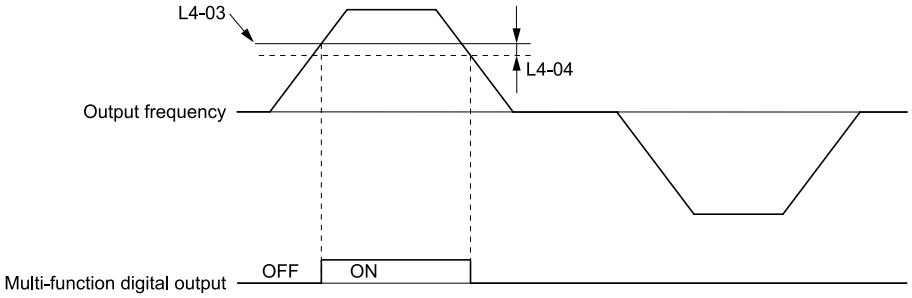


Figure 11.66 Example of Frequency Detection 4 (value of L4-03 Is Positive)

■ 17: Torque Detection 1 (N.C.)

Setting Value	Function	Description
17	Torque Detection 1 (N.C.)	V/f CL-V/f OLV CLV AOLV The terminal deactivates when the drive detects overtorque.

OFF : The output current/torque exceeds the torque value set with *S6-02 [Overtorque Detection Level 1]* and remained in this state longer than the time set with *S6-03 [Overtorque Detection Time 1]*.

Note:

Refer to *Overtorque Detection on page 214* for details.

■ 18: Torque Detection 2 (N.O.)

Setting Value	Function	Description
18	Torque Detection 2 (N.O.)	V/f CL-V/f OLV CLV AOLV The terminal activates when the drive detects overtorque.

ON : The output current/torque exceeds the torque value set with *S6-05 [Overtorque Detection Level 2]* and remained in this state longer than the time set with *S6-06 [Overtorque Detection Time 2]*.

Note:

Refer to *Overtorque Detection on page 214* for details.

■ 19: Torque Detection 2 (N.C.)

Setting Value	Function	Description
19	Torque Detection 2 (N.C.)	V/f CL-V/f OLV CLV AOLV The terminal deactivates when the drive detects overtorque.

OFF : The output current/torque exceeds the torque value set with *S6-05 [Overtorque Detection Level 2]* and remained in this state longer than the time set with *S6-06 [Overtorque Detection Time 2]*.

Note:

Refer to *Overtorque Detection on page 214* for details.

■ 1A: During Reverse

Setting Value	Function	Description
1A	During Reverse	V/f CL-V/f OLV CLV AOLV The terminal activates when the motor operates in the reverse direction.

ON : The motor is operating in the reverse direction.

OFF : The motor is operating in the forward direction or the motor stopped.

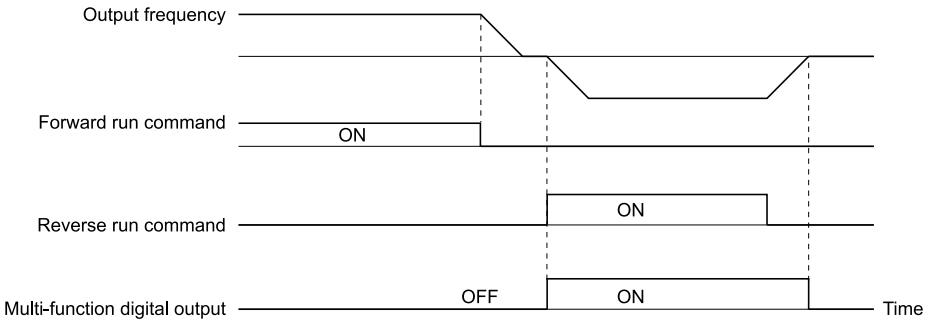


Figure 11.67 Reverse Operation Output Time Chart

■ 1B: During Baseblock (N.C.)

Setting Value	Function	Description
1B	During Baseblock (N.C.)	V/f CL-V/f OLV CLV AOLV The terminal deactivates during baseblock. When the drive is in baseblock, the drive output transistor stops switching and does not make DC bus voltage.

ON : The drive is not in baseblock.

OFF : During baseblock

■ 1C: Motor 2 Selected

Setting Value	Function	Description
1C	Motor 2 Selected	V/f CL-V/f OLV CLV AOLV The terminal activates when you select motor 2.

ON : Motor 2 Selection
OFF : Motor 1 Selected

■ 1D: During Regeneration

Setting Value	Function	Description
1D	During Regeneration	V/f CL-V/f OLV CLV AOLV The terminal activates on when the motor is regenerating.

ON : Motor is regenerating.
OFF : Motor is operating or stopped.

■ 1F: Motor Overload Alarm (oL1)

Setting Value	Function	Description
1F	Motor Overload Alarm (oL1)	V/f CL-V/f OLV CLV AOLV The terminal activates when the electronic thermal protection value of the motor overload protective function is a minimum of 90% of the detection level.

Note:
Refer to “L1-01: Motor Overload (oL1) Protection” for more information.

■ 20: Drive Overheat Pre-Alarm (oH)

Setting Value	Function	Description
20	Drive Overheat Pre-Alarm (oH)	V/f CL-V/f OLV CLV AOLV The terminal activates when the drive heatsink temperature is at the level set with *L8-02 [Overheat Alarm Level]*.

Note:
Refer to “L8-02: Overheat Alarm Level” for more information.

■ 21: Brake Release Command

Setting Value	Function	Description
21	Brake Release Command	V/f CL-V/f OLV CLV AOLV Set the sequence external to the drive to release the brake when the terminal turns ON and holds the brake when the terminal turns OFF.

ON : The brake is released.
OFF : The brake is tightened.

Note:
Refer to *Brake Sequence on page 195* for details.

■ 22: Overload Detection (N.O.)

Setting Value	Function	Description
22	Overload Detection (N.O.)	V/f CL-V/f OLV CLV AOLV The terminal activates when the drive detects an overload.

Note:
Refer to *Overload Detection on page 213* for details.

■ 23: Weight Det N.C.

Setting Value	Function	Description
23	Weight Det N.C.	V/f CL-V/f OLV CLV AOLV The terminal deactivates when the drive detects an overload.

Note:
Refer to *Overload Detection on page 213* for details.

■ 2F: Maintenance Notification

Setting Value	Function	Description
2F	Maintenance Notification	V/f CL-V/f OLV CLV AOLV The terminal activates when drive components are at their estimated maintenance period.

Tells the user about the maintenance period for these items:

- IGBT
- Cooling fan
- Capacitor
- Soft charge bypass relay

Note:

Refer to "Alarm Outputs for Maintenance Monitors" for more information.

■ 30: During Torque Limit

Setting Value	Function	Description
30	During Torque Limit	V/f CL-V/f OLV CLV AOLV The terminal activates when the torque reference is the torque limit set with *L7 parameters*, *H3-02, H3-06, or H3-10 [MFAI Function Selection]*.

Note:

Refer to "L7: Torque Limit" for more information.

■ 33: Zero Servo Complete

Setting Value	Function	Description
33	Zero Servo Complete	V/f CL-V/f OLV CLV AOLV The terminal activates when positioning in the range set with *b9-02 [Zero Servo Completion Window]* completes after sending the Zero-Servo command.

Note:

Refer to "b9: Zero Servo" for more information.

■ 37: During Frequency Output

Setting Value	Function	Description
37	During Frequency Output	V/f CL-V/f OLV CLV AOLV The terminal activates when the drive outputs frequency.

ON : The drive outputs frequency.

OFF : The drive does not output frequency.

Note:

The terminal turns off in any of these conditions:

- During Stop
- During baseblock
- During DC Injection Braking (initial excitation)

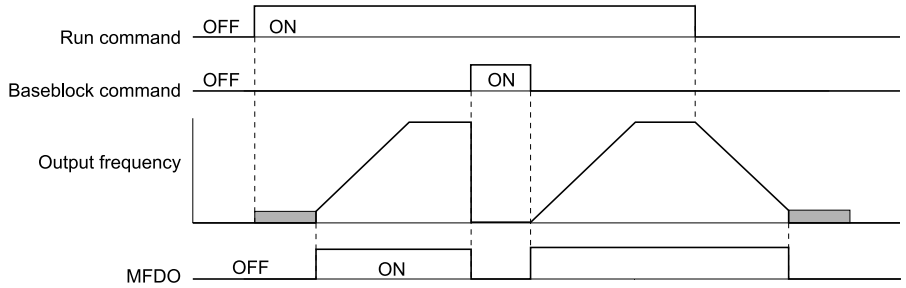


Figure 11.68 Active Frequency Output Time Chart

■ 39: Watt Hour Pulse Output

Setting Value	Function	Description
39	Watt Hour Pulse Output	V/f CL-V/f OLV CLV AOLV Outputs the pulse that shows the watt hours.

Note:
Refer to "H2-06: Watt Hour Output Unit Selection" for more information.

■ 3C: LOCAL Control Selected

Setting Value	Function	Description
3C	LOCAL Control Selected	V/f CL-V/f OLV CLV AOLV The terminal activates when the Run command source or frequency reference source is LOCAL.

ON : LOCAL
The keypad is the Run command source or the frequency reference source.

OFF : REMOTE
The Run command source or frequency reference source is an external source set with *b1-01 [Frequency Reference Selection 1]*, *b1-15 [Frequency Reference Selection 2]*, *b1-02 [Run Command Selection 1]*, or *b1-16 [Run Command Selection 2]*.

■ 4C: During Fast Stop

Setting Value	Function	Description
4C	During Fast Stop	V/f CL-V/f OLV CLV AOLV The terminal activates when the fast stop is in operation.

■ 4D: oH Pre-Alarm Time Limit

Setting Value	Function	Description
4D	oH Pre-Alarm Time Limit	V/f CL-V/f OLV CLV AOLV The terminal activates when *L8-03 = 4 [Overheat Pre-Alarm Selection = Operate at Reduced Speed (L8-19)]* and *oH [Heatsink Overheat]* does not clear after the drive decreases the frequency for 10 cycles.

Note:
Refer to "L8-03: Overheat Pre-Alarm Ope Selection" for more information about drive derating operation.

■ 4E: Braking Transistor Fault (rr)

Setting Value	Function	Description
4E	Braking Transistor Fault (rr)	V/f CL-V/f OLV CLV AOLV The terminal activates when the internal braking transistor overheats and the drive detects an *rr [Dynamic Braking Transistor Fault]* fault.

■ 4F: Braking Resistor Overheat (rH)

Setting Value	Function	Description
4F	Braking Resistor Overheat (rH)	V/f CL-V/f OLV CLV AOLV The terminal activates when the braking resistor overheats and the drive detects an *rH [Braking Resistor Overheat]* fault.

The braking resistor overheats when the deceleration time is short and there is too much motor regeneration energy.

■ 51: Safe Torque OFF

Setting Value	Function	Description
51	Safe Torque OFF	V/f CL-V/f OLV CLV AOLV The terminal turns on (safety stop state) when the safety circuit and safety diagnosis circuit are operating correctly and when terminals H1-HC and H2-HC are off (released).

Note:
EDM = External Device Monitor

ON : Safety stop state
Both terminal H1-HC and H2-HC have been turned off, or released (safety stop state).

OFF : Safety circuit fault or RUN/READY
Either terminal H1-HC or H2-HC has been turned OFF, or released (safety circuit fault), or both of these terminals are ON, or have short circuited (RUN/READY).

■ 52: Warning Signal

Setting Value	Function	Description
52	Warning Signal	V/f CL-V/f OLV CLV AOLV The terminal activates when the number of starts is at the detection level.

■ 60: Internal Cooling Fan Failure

Setting Value	Function	Description
60	Internal Cooling Fan Failure	V/f CL-V/f OLV CLV AOLV The terminal activates when the drive detects a cooling fan failure in the drive.

■ 62: Modbus Reg 1 Status Satisfied

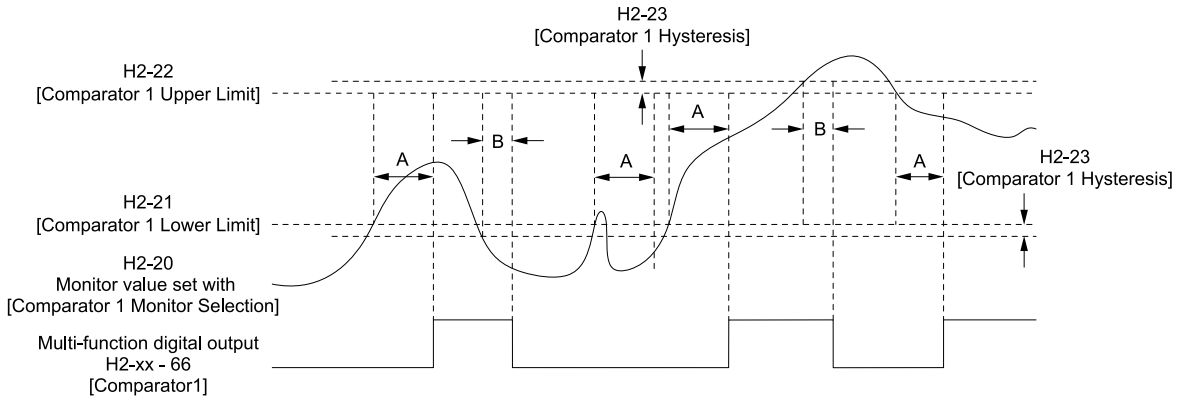
Setting Value	Function	Description
62	Modbus Reg 1 Status Satisfied	V/f CL-V/f OLV CLV AOLV The terminal activates when the bit specified by *H2-08 [Modbus Register 1 Bit Select]* for the MEMOBUS register address set with *H2-07 [Modbus Register 1 Address Select]* activates.

■ 63: Modbus Reg 2 Status Satisfied

Setting Value	Function	Description
63	Modbus Reg 2 Status Satisfied	V/f CL-V/f OLV CLV AOLV The terminal activates when the bit specified by *H2-10 [Modbus Register 2 Bit Select]* for the MEMOBUS register address set with *H2-09 [Modbus Register 2 Address Select]* activates.

■ 66: Comparator1

Setting Value	Function	Description
66	Comparator1	V/f CL-V/f OLV CLV AOLV The terminal activates if the monitor value set with *H2-20 [Comparator 1 Monitor Selection]* is in range of the values of *H2-21 [Comparator 1 Lower Limit] and H2-22 [Comparator 1 Upper Limit]* for the time set in *H2-24 [Comparator 1 On-Delay Time]*.



A - H2-24 [Comparator 1 On-Delay Time]

B - H2-25 [Comparator 1 Off-Delay Time]

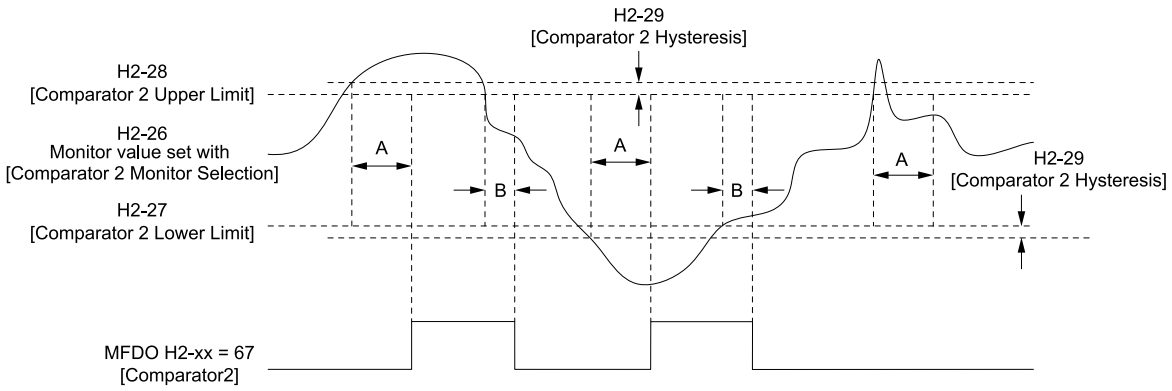
Figure 11.69 Comparator 1 Output Time Chart

Note:

The drive compares the monitors set with *H2-20* as absolute values.

■ 67: Comparator2

Setting Value	Function	Description
67	Comparator2	V/f CL-V/f OLV CLV AOLV The terminal activates if the monitor value set with *H2-26 [Comparator 2 Monitor Selection]* is not in the range of the values of *H2-27 [Comparator 2 Lower Limit]* and *H2-28 [Comparator 2 Upper Limit]* for the time set in *H2-30 [Comparator 2 On-Delay Time]*.



A - H2-30 [Comparator 2 On-Delay Time]

B - H2-31 [Comparator 2 Off-Delay Time]

Figure 11.70 Comparator 2 Output Time Chart

Note:

The drive compares the monitors set with *H2-26* as absolute values.

■ 69: External Power 24V Supply

Setting Value	Function	Description
69	External Power 24V Supply	V/f CL-V/f OLV CLV AOLV The terminal activates when there is an external 24V power supply between terminals PS-AC.

ON : The external 24V power supply is supplying power.

OFF : The external 24V power supply is not supplying power.

■ 6A: Data Logger Error

Setting Value	Function	Description
6A	Data Logger Error	V/f CL-V/f OLV CLV AOLV The terminal activates when the drive detects a *LoG [Com Error / Abnormal SD card]*.

■ B1: DC Injection Braking at Start

Setting Value	Function	Description
B1	DC Injection Braking at Start	V/f CL-V/f OLV CLV AOLV The terminal activates when the motor is started and during DC Injection Braking.

■ B2: DC Injection Braking at Stop

Setting Value	Function	Description
B2	DC Injection Braking at Stop	V/f CL-V/f OLV CLV AOLV The terminal activates when the motor is stopped and during DC Injection Braking.

■ B3: Motor 3 Selection

Setting Value	Function	Description
B3	Motor 3 Selection	V/f CL-V/f OLV CLV AOLV The terminal activates when you select motor 3.

ON : Motor 3 Selection

OFF : Motor 1 or Motor 2 Selection

■ 100 to 1FF: Inverse output of 0 to FF

Setting Value	Function	Description
100 - 1FF	Inverse Output of 0 to FF	V/f CL-V/f OLV CLV AOLV Causes inverse output of the function for the selected MFDO. Uses the last two digits of 1xx to select which function to inversely output.

For example, set *H2-xx = 10E* to generate inverse output of *E [Fault]*.

◆ H3: Analog Inputs

WARNING! *Sudden Movement Hazard. Do test runs and examine the drive to make sure that the command references are correct. If you set the command reference incorrectly, it can cause damage to the drive or serious injury or death.*

Drives have three analog input terminals, named terminals A1, A2, and A3. *H3 parameters* select the functions set to these analog input terminals and adjust signal levels.

The table shows the functions that you can set to analog input terminals. Use *H3-02, H3-06, and H3-10 [MFAI Function Select]* to set functions.

Table 11.32 Multi-Function Analog Input Terminal Settings

Setting Value	Function
0	Frequency Reference
1	Frequency Gain
2	Auxiliary Frequency Reference 1
3	Auxiliary Frequency Reference 2
4	Output Voltage Bias
5	Accel/Decel Time Gain
6	DC Injection Braking Current
7	Torque Detection Level
8	Stall Prevent Level during Run
C	Overload Detection Level
D	Frequency Bias
E	Motor Temperature (PTC Input)
F	Not Used
10	Forward Torque Limit
11	Reverse Torque Limit
12	Regenerative Torque Limit
14	Torque Compensation
15	General Torque Limit
1F	Not Used

Note:

All analog input scaling uses gain and bias for adjustment. Set the gain and bias values correctly.

■ Example Analog Input Settings

- The function set for terminal A1 is set with *Frequency Reference [H3-02 = 0]*, the gain is *200% [H3-03 = 200.0]*, and the bias is *0% [H3-04 = 0.0]*.
  When you input a 10 V signal, the frequency reference will be 200%.
  When you input a 5 V signal, the frequency reference will be 100%. As the drive output at this time is restricted by *E1-04 [Maximum Output Frequency]*, the frequency reference will be at 100% when a signal of 5 V or more is input.

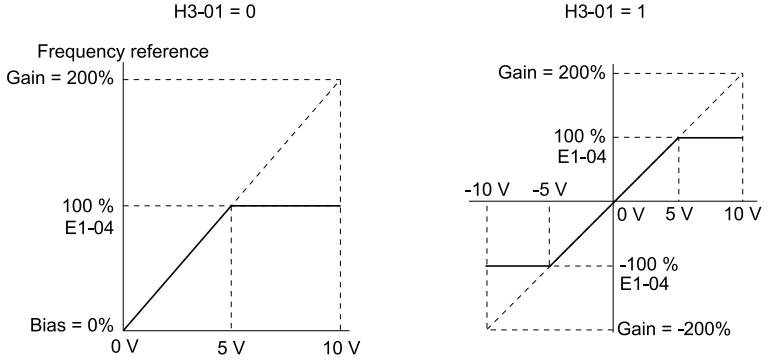


Figure 11.71 Freq Reference When the Analog Input Gain Setting Is Adjusted

- The function set for terminal A1 is set with *Frequency Reference [H3-02 = 0]*, the gain is *100% [H3-03 = 100.0]*, and the bias is *-25% [H3-04 = -25.0]*.
  When you input a 0 V signal, the frequency reference will be -25%.
  When *H3-01 = 0 [Terminal A1 Signal Level Select = 0 to 10V (Lower Limit at 0)]*, when you input a 0 V to 2 V signal, the frequency reference will be 0%. When you input a 2 V to 10 V signal, the frequency reference will be 0% to 100%.
  When *H3-01 = 1 [-10 to +10V (Bipolar Reference)]*, it enables signals of positive and negative polarities. When you input a 0 V to 2 V signal, and the motor rotates in reverse.

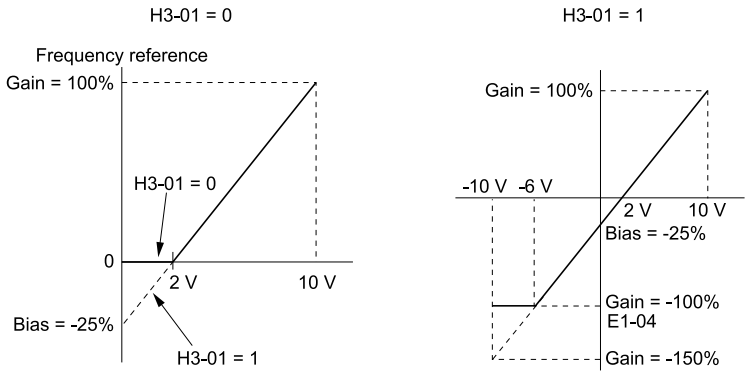


Figure 11.72 Frequency Reference When You Set the Bias to a Negative Number

■ MEMOBUS/Modbus Multi-Function AI1 to 3 Function Selection

Allows the MFAI function to be assigned to MEMOBUS register *15C1 to 15C3 (Hex.) [Mbus Reg 15C1h to 15C3h Input Function]*. Select the function with *H3-40 to H3-42 [Mbus Reg 15C1h to 15C3h Input Function]* and set the input filter with *H3-43 [Mbus Reg Inputs FilterTime Const]*.

Table 11.33 MEMOBUS Multi-Function AI Command Register

Register No. (Hex.)	Name	Range *1	Parameter
15C1	Mbus Reg 15C1h Input Function	-32767 to 32767	H3-40
15C2	Mbus Reg 15C2h Input Function	-32767 to 32767	H3-41
15C3	Mbus Reg 15C3h Input Function	-32767 to 32767	H3-42

*1 Set as 100% = 4096.

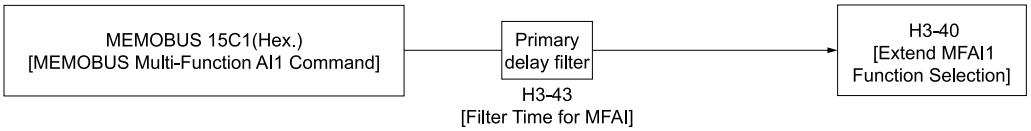


Figure 11.73 Functional Block Diagram for MEMOBUS Multi-Function AI Command 1

Note:
- Refer to H3-xx "MFAI Function Selections" for the analog input setting values.
- Set *H3-40 to H3-42 = F* when not using the terminal. The through mode function is not supported.
- The following MFAI terminals cannot be selected with *H3-40 to H3-42*.

H3-xx Setting Value	Function
0	Frequency Reference
1	Frequency Gain
2	Auxiliary Frequency Reference 1
3	Auxiliary Frequency Reference 2

◆ H3: MFAI Parameters

■ H3-01: Terminal A1 Signal Level Select

No. (Hex.)	Name	Description	Default (Range)
H3-01 (0410)	Terminal A1 Signal Level Select	V/f CL-V/f OLV CLV AOLV Sets the input signal level for MFAI terminal A1.	0 (0, 1)

0 : 0 to 10 V (Lower Limit at 0)

Inputs the voltage signal of 0 V to 10 V. The signal is reset to 0% when it becomes a negative number due to gain and bias adjustment.

1 : -10 to +10V (Bipolar Reference)

Inputs the voltage signal of -10 V to 10 V. This setting enables positive and negative polarity signals. When this setting is used as the frequency reference, the motor runs reverse when the Forward run command is input, or runs forward when the reverse run signal is input, while the signal is a negative number due to the gain and bias adjustment.

■ H3-02: Terminal A1 Function Selection

No. (Hex.)	Name	Description	Default (Range)
H3-02 (0434)	Terminal A1 Function Selection	V/f CL-V/f OLV CLV AOLV Sets the function for MFAI terminal A1.	0 (0 - FF)

■ H3-03: Terminal A1 Gain Setting

No. (Hex.)	Name	Description	Default (Range)
H3-03 (0411) RUN	Terminal A1 Gain Setting	V/f CL-V/f OLV CLV AOLV Sets the gain of the analog signal input to MFAI terminal A1.	100.0% (-999.9 - +999.9%)

This parameter sets the command reference amount for the function set for terminal A1 as a percentage when 10 V is input.

Use *H3-03 and H3-04 [Terminal A1 Bias Setting]* to adjust the characteristics of the analog input signal to terminal A1.

■ H3-04: Terminal A1 Bias Setting

No. (Hex.)	Name	Description	Default (Range)
H3-04 (0412) RUN	Terminal A1 Bias Setting	V/f CL-V/f OLV CLV AOLV Sets the bias of the analog signal input to MFAI terminal A1.	0.0% (-999.9 - +999.9%)

This parameter sets the bias for the function set for terminal A1 as a percentage when 0 V is input.

Use *H3-03 [Terminal A1 Gain Setting] and H3-04* to adjust the characteristics of the analog input signal to terminal A1.

■ H3-05: Terminal A3 Signal Level Select

No. (Hex.)	Name	Description	Default (Range)
H3-05 (0413)	Terminal A3 Signal Level Select	V/f CL-V/f OLV CLV AOLV Sets the input signal level for MFAI terminal A3.	0 (0, 1)

0 : 0 to 10 V (Lower Limit at 0)

Inputs the voltage signal of 0 V to 10 V. The signal is reset to 0% when it becomes a negative number due to gain and bias adjustment.

1 : -10 to +10V (Bipolar Reference)

Inputs the voltage signal of -10 V to 10 V. This setting enables positive and negative polarity signals. When this setting is used as the frequency reference, the motor runs reverse when the Forward run command is input, or runs forward when the reverse run signal is input, while the signal is a negative number due to the gain and bias adjustment.

■ H3-06: Terminal A3 Function Selection

No. (Hex.)	Name	Description	Default (Range)
H3-06 (0414)	Terminal A3 Function Selection	V/f CL-V/f OLV CLV AOLV Sets the function for MFAI terminal A3.	2 (0 - FF)

Note:

When using terminal A3 as the PTC input terminal, set *H3-06 = E [Motor Temperature (PTC Input)]*, and set DIP switch S4 to the PTC side.

■ H3-07: Terminal A3 Gain Setting

No. (Hex.)	Name	Description	Default (Range)
H3-07 (0415) RUN	Terminal A3 Gain Setting	V/f CL-V/f OLV CLV AOLV Sets the gain of the analog signal input to MFAI terminal A3.	100.0% (-999.9 - +999.9%)

This parameter sets the command reference amount for the function set for terminal A3 as a percentage when 10 V is input.

Use *H3-07 and H3-08 [Terminal A3 Bias Setting]* to adjust the characteristics of the analog input signal to terminal A3.

■ H3-08: Terminal A3 Bias Setting

No. (Hex.)	Name	Description	Default (Range)
H3-08 (0416) RUN	Terminal A3 Bias Setting	V/f CL-V/f OLV CLV AOLV Sets the bias of the analog signal input to MFAI terminal A3.	0.0% (-999.9 - +999.9%)

This parameter sets the bias for the function set for terminal A3 as a percentage when 0 V is input.

Use *H3-07 [Terminal A3 Gain Setting] and H3-08* to adjust the characteristics of the analog input signal to terminal A3.

■ H3-09: Terminal A2 Signal Level Select

No. (Hex.)	Name	Description	Default (Range)
H3-09 (0417)	Terminal A2 Signal Level Select	V/f CL-V/f OLV CLV AOLV Sets the input signal level for MFAI terminal A2.	2 (0 - 3)

0 : 0 to 10 V (Lower Limit at 0)

Inputs the voltage signal of 0 V to 10 V. The signal is reset to 0% when it becomes a negative number due to gain and bias adjustment.

1 : -10 to +10V (Bipolar Reference)

Inputs the voltage signal of -10 V to 10 V. This setting enables positive and negative polarity signals. When this setting is used as the frequency reference, the motor runs reverse when the Forward run command is input, or runs forward when the reverse run signal is input, while the signal is a negative number due to the gain and bias adjustment.

2 : 4 to 20 mA

Inputs the current signal of 4 mA to 20 mA. The signal is reset to 0% when it becomes a negative number due to gain and bias adjustment.

3 : 0 to 20 mA

Inputs the current signal of 0 mA to 20 mA. The signal is reset to 0% when it becomes a negative number due to gain and bias adjustment.

Note:

When *H3-09 = 0, 1*, set DIP switch S1 to the V side (voltage). When *H3-09 = 2, 3*, set DIP switch S1 to the I side (current). The default setting is the I side (current).

■ H3-10: Terminal A2 Function Selection

No. (Hex.)	Name	Description	Default (Range)
H3-10 (0418)	Terminal A2 Function Selection	V/f CL-V/f OLV CLV AOLV Sets the function for MFAI terminal A2.	0 (0 - FF)

■ H3-11: Terminal A2 Gain Setting

No. (Hex.)	Name	Description	Default (Range)
H3-11 (0419) RUN	Terminal A2 Gain Setting	V/f CL-V/f OLV CLV AOLV Sets the gain of the analog signal input to MFAI terminal A2.	100.0% (-999.9 - +999.9%)

When 10 V (or 20 mA) is input, this parameter sets the reference quantity for the function set for terminal A2 as a percentage.

Use this parameter and *H3-12 [Terminal A2 Bias Setting]* to adjust the characteristics of the analog input signal to terminal A2.

■ H3-12: Terminal A2 Bias Setting

No. (Hex.)	Name	Description	Default (Range)
H3-12 (041A) RUN	Terminal A2 Bias Setting	V/f CL-V/f OLV CLV AOLV Sets the bias of the analog signal input to MFAI terminal A2.	0.0% (-999.9 - +999.9%)

When 0 V (4 mA or 0 mA) is input, this parameter sets the bias for the function set for terminal A2 as a percentage.

Use this parameter and *H3-11 [Terminal A2 Gain Setting]* to adjust the characteristics of the analog input signal to terminal A2.

■ H3-13: Analog Input FilterTime Constant

No. (Hex.)	Name	Description	Default (Range)
H3-13 (041B)	Analog Input FilterTime Constant	V/f CL-V/f OLV CLV AOLV Sets the time constant for primary delay filters on MFAI terminals.	0.03 s (0.00 - 2.00 s)

Apply the primary delay filter to the analog input to enable an analog input signal without the use of high-frequency noise components. An analog input filter prevents irregular drive control. Drive operation becomes more stable as the programmed time becomes longer, but it also becomes less responsive to quickly changing analog signals.

■ H3-14: Analog Input Terminal Enable Sel

No. (Hex.)	Name	Description	Default (Range)
H3-14 (041C)	Analog Input Terminal Enable Sel	V/f CL-V/f OLV CLV AOLV Sets the enabled terminal or terminals when *H1-xx = C [MFDI Function Select = Analog Terminal Enable Selection]* is ON.	7 (1 - 7)

Input signals do not have an effect on terminals not set as targets.

1 : Terminal A1

2 : Terminal A2

3 : Terminals A1 and A2

4 : Terminal A3

5 : Terminals A1 and A3

6 : Terminals A2 and A3

7 : Terminals A1, A2, and A3

Note:

- The ON/OFF operation of terminal Sx set in *Analog Terminal Input Selection [H1-xx = C]* has an effect on only the analog input terminal selected with *H3-14*.
- When *H1-xx* ≠ *C*, the functions set to terminals A1 to A3 are always enabled.

■ H3-16: Terminal A1 Offset

No. (Hex.)	Name	Description	Default (Range)
H3-16 (02F0)	Terminal A1 Offset	V/f CL-V/f OLV CLV AOLV Sets the offset level for analog signals input to terminal A1. Usually it is not necessary to change this setting.	0 (-500 - +500)

Adds the offset value for the analog input value. For voltage input, sets the offset when a signal of 0 V is input.

■ H3-17: Terminal A2 Offset

No. (Hex.)	Name	Description	Default (Range)
H3-17 (02F1)	Terminal A2 Offset	V/f CL-V/f OLV CLV AOLV Sets the offset level for analog signals input to terminal A2. Usually it is not necessary to change this setting.	0 (-500 - +500)

Adds the offset value for the analog input value. For voltage input, this parameter will set the offset when a signal of 0 V is input. For current input, this parameter will set the offset when a signal of *4 mA [H3-09 = 2]* or *0 mA [H3-09 = 3]* is input.

■ H3-18: Terminal A3 Offset

No. (Hex.)	Name	Description	Default (Range)
H3-18 (02F2)	Terminal A3 Offset	V/f CL-V/f OLV CLV AOLV Sets the offset level for analog signals input to terminal A3. Usually it is not necessary to change this setting.	0 (-500 - +500)

Adds the offset value for the analog input value. For voltage input, sets the offset when a signal of 0 V is input.

■ H3-40: Mbus Reg 15C1h Input Function

No. (Hex.)	Name	Description	Default (Range)
H3-40 (0B5C)	Mbus Reg 15C1h Input Function	V/f CL-V/f OLV CLV AOLV Sets the MEMOBUS AI1 function.	F (4 - 2F)

You can use the MFAI function from MEMOBUS/Modbus communications. Use this parameter to set the function. Sets the function for MEMOBUS/Modbus register 15C1h.

Refer to *Multi-Function Analog Input Terminal Settings on page 730* for the setting values.

■ H3-41: Mbus Reg 15C2h Input Function

No. (Hex.)	Name	Description	Default (Range)
H3-41 (0B5F)	Mbus Reg 15C2h Input Function	V/f CL-V/f OLV CLV AOLV Sets the MEMOBUS AI2 function.	F (4 - 2F)

You can use the MFAI function from MEMOBUS/Modbus communications. Use this parameter to set the function. Sets the function for MEMOBUS/Modbus register 15C2h.

Refer to *Multi-Function Analog Input Terminal Settings on page 730* for the setting values.

■ H3-42: Mbus Reg 15C3h Input Function

No. (Hex.)	Name	Description	Default (Range)
H3-42 (0B62)	Mbus Reg 15C3h Input Function	V/f CL-V/f OLV CLV AOLV Sets the MEMOBUS AI3 function.	F (4 - 2F)

You can use the MFAI function from MEMOBUS/Modbus communications. Use this parameter to set the function. Sets the input for the function in MEMOBUS/Modbus register 15C3.

Refer to *Multi-Function Analog Input Terminal Settings on page 730* for the setting values.

■ H3-43: Mbus Reg Inputs FilterTime Const

No. (Hex.)	Name	Description	Default (Range)
H3-43 (117F)	Mbus Reg Inputs FilterTime Const	V/f CL-V/f OLV CLV AOLV Sets the time constant to apply a primary delay filter to the MEMOBUS analog input register values.	0.00 s (0.00 - 2.00 s)

◆ Multi-Function Analog Input Terminal Settings

This section gives information about the functions set with *H3-02, H3-06, and H3-10*.

■ 0: Frequency Reference

Setting Value	Function	Description
0	Frequency Reference	V/f CL-V/f OLV CLV AOLV The input value from the MFAI terminal set with this function becomes the master frequency reference.

- You can copy the configuration to more than one of the analog input terminals A1 through A3. When you set more than one analog input terminal with the master frequency reference, the sum value becomes the frequency bias.
- If you use this function to set the analog input value as the master frequency reference, set *b1-01 = 1 [Frequency Reference Selection 1 = Analog Input]*. This setting value is the default value for terminals A1 and A2.
- The frequency reference is the sum of the input values for terminals A1 and A2 when they are used at the same time. For example, when a 20% bias is input to terminal A2 while a frequency reference of 50% is input from terminal A1, the calculated frequency reference will be 70% of the maximum output frequency.

■ 1: Frequency Gain

Setting Value	Function	Description
1	Frequency Gain	V/f CL-V/f OLV CLV AOLV The drive multiplies the analog frequency reference with the input value from the MFAI set with this function.

Example: When you set frequency gain for terminal A2

- *H3-10 = 1 [Terminal A2 Function Selection = Frequency Gain]*
- A 50% frequency gain is input to terminal A2
- A frequency reference of 80% is input from terminal A1

The calculated frequency reference is 40% of the maximum output frequency.

■ 2: Auxiliary Frequency Reference 1

Setting Value	Function	Description
2	Auxiliary Frequency Reference 1	V/f CL-V/f OLV CLV AOLV Sets Reference 2 through multi-step speed reference to enable the command reference (Auxiliary Frequency Reference 1) from the analog input terminal set here. This value is a percentage of the maximum output frequency.

■ 3: Auxiliary Frequency Reference 2

Setting Value	Function	Description
3	Auxiliary Frequency Reference 2	V/f CL-V/f OLV CLV AOLV Sets Reference 3 through multi-step speed reference to enable the command reference (Auxiliary Frequency Reference 2) from the analog input terminal set here. This value is a percentage of the maximum output frequency.

■ 4: Output Voltage Bias

Setting Value	Function	Description
4	Output Voltage Bias	V/f CL-V/f OLV CLV AOLV Set this parameter to input a bias signal and amplify the output voltage.

The gain (%) for the MFAI terminals A1, A2, and A3 is 100% of the voltage class standard, which is 200 V for 200 V class drives and 400 V for 400 V class drives. The bias (%) for MFAI terminals A1, A2, and A3 is 100% of the voltage configured for *E1-05 [Maximum Output Voltage]*.

Note:

The gain for each terminal A1, A2, and A3 is configured independently with *H3-03 [Terminal A1 Gain Setting], H3-11 [Terminal A2 Gain Setting], and H3-07 [Terminal A3 Gain Setting]*. The bias for each terminal A1, A2, and A3 is configured independently with *H3-04 [Terminal A1 Bias Setting], H3-12 [Terminal A2 Bias Setting], and H3-08 [Terminal A3 Bias Setting]*.

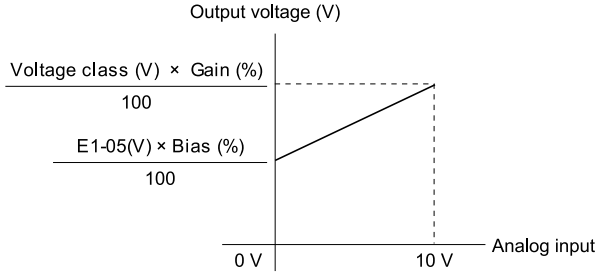


Figure 11.74 Output Voltage Bias through Analog Input

■ 5: Accel/Decel Time Gain

Setting Value	Function	Description
5	Accel/Decel Time Gain	V/f CL-V/f OLV CLV AOLV Enters a signal to adjust the gain used for *C1-01 to C1-08 [Acceleration/Deceleration Times 1 to 4]* and *C1-09 [Fast Stop Time]* when the full scale analog signal (10 V or 20 mA) is 100%.

When you enable *C1-01 [Acceleration Time 1]*, the acceleration time is:

Acceleration Time 1 = Setting value of *C1-01* × acceleration and deceleration time gain / 100

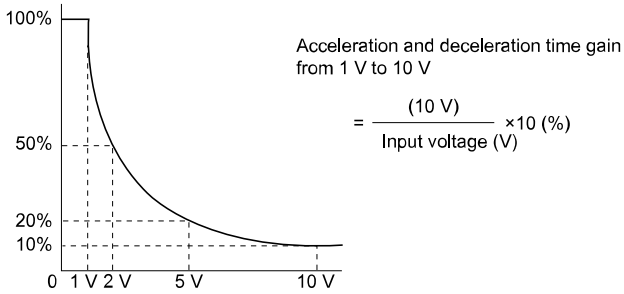


Figure 11.75 Acceleration/Deceleration Time Gain through Analog Input

■ 6: DC Injection Braking Current

Setting Value	Function	Description
6	DC Injection Braking Current	V/f CL-V/f OLV CLV AOLV Enters a signal to adjust the current level used for DC Injection Braking when the drive rated output current is 100%.

Note:

When you set this function, it will disable the setting value of *b2-02 [DC Injection Braking Current]*.

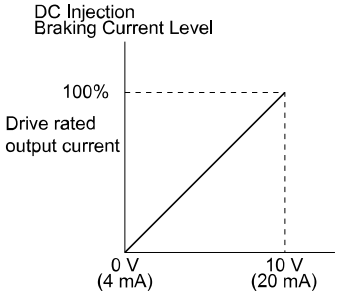


Figure 11.76 DC Injection Braking Current through Analog Input

■ 7: Torque Detection Level

Setting Value	Function	Description
7	Torque Detection Level	V/f CL-V/f OLV CLV AOLV Enters a signal to adjust the overtorque detection level.

The drive rated current is 100% when *A1-02 = 0 or 1 [Control Method Selection = V/f Control or V/f Control w/ PG]*. The motor rated current is 100% when *A1-02 = 2, 3, or 4 [Open Loop Vector, Closed Loop Vector, or Advanced Open Loop Vector]*.

Note:

Use this function in conjunction with *S6-01 [OverT Detect Operation Select 1]*. This parameter functions in place of *S6-02 [Overtorque Detection Level 1]*.

■ 8: Stall Prevent Level During Run

Setting Value	Function	Description
8	Stall Prevent Level During Run	V/f CL-V/f OLV CLV AOLV Enters a signal to adjust the stall prevention level during run if the drive rated current is 100%.

Note:

The Stall Prevent Level During Run is based on the smaller of these two values:
- Analog input value of MFAI terminal
- *L3-06 [Stall Prevent Level during Run]*

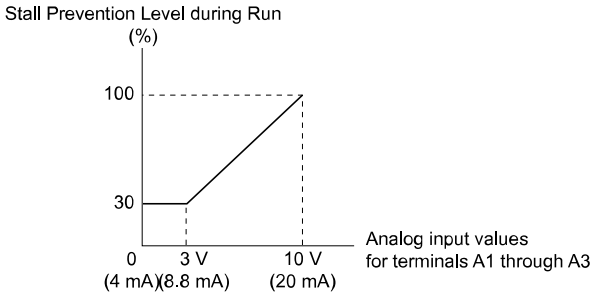


Figure 11.77 Stall Prevention Level during Run with Analog Input

■ C: Overload Detection Level

Setting Value	Function	Description
C	Overload Detection Level	V/f CL-V/f OLV CLV AOLV Enters the overload detection level.

Note:

Refer to *Overload Detection on page 213* for details.

■ D: Frequency Bias

Setting Value	Function	Description
D	Frequency Bias	V/f CL-V/f OLV CLV AOLV Enters the bias value added to the frequency reference as a percentage of the maximum output frequency.

The drive adds the input value from the MFAI terminal set with this function to the frequency reference as the bias value.

Note:

When you select *d1-01 to d1-16 or d1-17 [Reference 1 to 16 or JOG Frequency Reference]* as the frequency reference, it will disable this function.

■ E: Motor Temperature (PTC Input)

Setting Value	Function	Description
E	Motor Temperature (PTC Input)	V/f CL-V/f OLV CLV AOLV Uses the motor Positive Temperature Coefficient (PTC) thermistor to prevent heat damage to the motor as a percentage of the current value when the 10 V analog signal is input.

- The Positive Temperature Coefficient (PLC) thermistor can be used as an auxiliary or alternative detection function for issues of drive *oL1 [Motor Overload]* to help protect motors from heat. If the PTC input signal exceeds the overload alarm level, *oH3 [Motor Overheat (PTC Input)]* flashes on the keypad.
- The motor is stopped in accordance with the method selected by *L1-03* when *oH3* is detected and in accordance with the method selected by *L1-04* when *oH4* is detected. Set *L1-05* when false detections of motor overheating issues occur.

■ F: Not Used

Setting Value	Function	Description
F	Not Used	V/f CL-V/f OLV CLV AOLV Use this setting for unused terminals or to use terminals in through mode.

When you set a terminal that is not in use to F, you can use the signal input to the terminal as PLC analog signal input through MEMOBUS/Modbus communications or the communication option. This input signal does not have an effect on drive operation. This functions the same as setting 1F (Through Mode).

■ 10: Forward Torque Limit

Setting Value	Function	Description
10	Forward Torque Limit	V/f CL-V/f OLV CLV AOLV Enters the forward torque limit if the motor rated torque is 100%.

WARNING! *Sudden Movement Hazard. Set correct torque limits for applications, for example elevator applications. If you set torque limits incorrectly, motor torque that is not sufficient can cause damage to equipment and cause serious injury or death.*

Torque Limit Configuration Method

Use one of these methods to set torque limits:

- Individually set the four torque limit quadrants using *L7-01 to L7-04 [Torque Limit]*.
- Use MFAI to individually set the four torque limit quadrants. Set *H3-02, H3-06,* or *H3-10 [MFAI Function Select]* to *10, 11,* or *12 [Forward/Reverse/Regenerative Torque Limit]*.
- Use MFAI to set all four torque limit quadrants together. Set *H3-02, H3-06,* or *H3-10* to *15 [General Torque Limit]*.

The figure shows the configuration method for each quadrant.

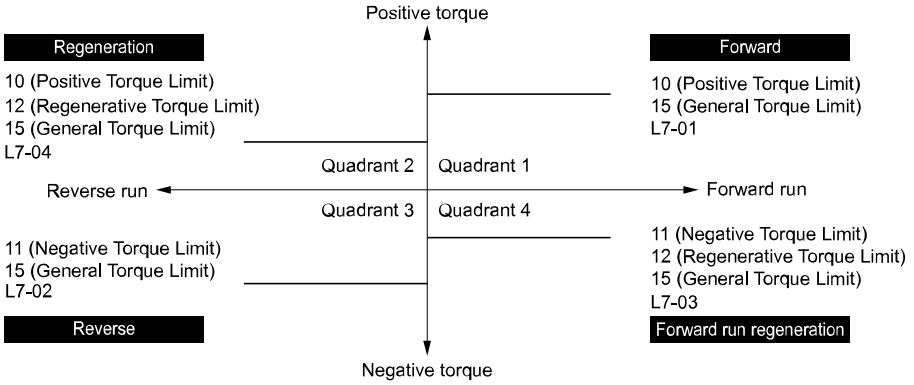


Figure 11.78 Torque Limits and Analog Input Setting Parameters

Note:

- When you use *L7-01 to L7-04* and analog inputs to set torque limits for the same quadrant, it will enable the lower torque limit. In this example of parameter settings, the torque limit for quadrant 1 is 130% and the torque limit for quadrants 2, 3, and 4 is 150%. Settings: *L7-01 = 130%*, *L7-02 to L7-04 = 200%*, and MFAI torque limit = 150%
- The drive output current limits maximum output torque. The actual output torque is not more than the limits of the drive rated output current when you set the torque limit to a high value.

If you use drives in applications where the vertical axis can fall, make sure that you know these items:

- Correctly configure drives and motors.
- Correctly set parameters.
- You can change parameter values after you do Auto-Tuning.
- Use a system that will not let the vertical axis fall if the drive fails.

The figure shows the relation between torque limits from parameters and torque limits from analog input.

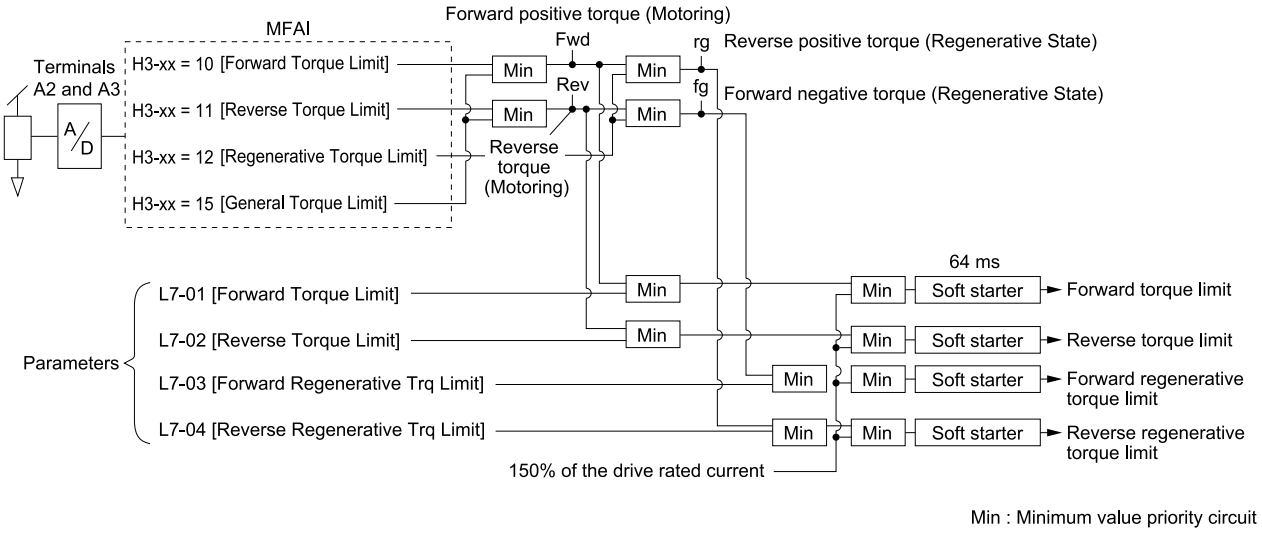


Figure 11.79 Torque Limits from Parameters and Analog Inputs

■ 11: Reverse Torque Limit

Setting Value	Function	Description
11	Reverse Torque Limit	V/f CL-V/f OLV CLV AOLV Enters the load torque limit if the motor rated torque is 100%.

Note:
When you use *L7-01 to L7-04* and analog inputs to set torque limits for the same quadrant, it will enable the lower torque limit.

■ 12: Regenerative Torque Limit

Setting Value	Function	Description
12	Regenerative Torque Limit	V/f CL-V/f OLV CLV AOLV Enters the regenerative torque limit if the motor rated torque is 100%.

Note:
When you use *L7-01 to L7-04* and analog inputs to set torque limits for the same quadrant, it will enable the lower torque limit.

■ 14: Torque Compensation

Setting Value	Function	Description
14	Torque Compensation	V/f CL-V/f OLV CLV AOLV Enters the torque compensation value if the motor rated torque is 100%.

■ 15: General Torque Limit

Setting Value	Function	Description
15	General Torque Limit	V/f CL-V/f OLV CLV AOLV Enters the torque limit that is the same for all quadrants for forward, reverse, and regenerative operation if the motor rated torque is 100%.

■ 1F: Not Used

Setting Value	Function	Description
1F	Not Used	V/f CL-V/f OLV CLV AOLV Use this setting for unused terminals or to use terminals in through mode.

When you set a terminal that you do not use to 1F, you can use the signal that is input to that terminal as the PLC analog signal input from MEMOBUS/Modbus communications or the communication option. This input signal does not have an effect on drive operation. This signal functions the same as F (Through Mode).

◆ H4: Analog Outputs

H4 parameters set the drive analog monitors. These parameters select monitor parameters, adjust gain and bias, and select output signal levels.

■ Calibrate Meters Connected to MFAO Terminals FM and AM

You can use *H4-02, H4-03, H4-05, and H4-06 [Terminal FM/AM Analog Output Gain/Bias]* to calibrate meters connected to terminals FM and AM.

No.	Name	Setting Range	Default
H4-02	Terminal FM Analog Output Gain	-999.9 - 999.9%	100.0%
H4-03	Terminal FM Analog Output Bias	-999.9 - 999.9%	0.0%
H4-05	Terminal AM Analog Output Gain	-999.9 - 999.9%	50.0%
H4-06	Terminal AM Analog Output Bias	-999.9 - 999.9%	0.0%
H4-07	Terminal FM Signal Level Select	0: 0 to 10 Vdc 1: -10 to +10 Vdc	0
H4-08	Terminal AM Signal Level Select	0: 0 to 10 Vdc 1: -10 to +10 Vdc	0

The following diagram illustrates the gain and bias.

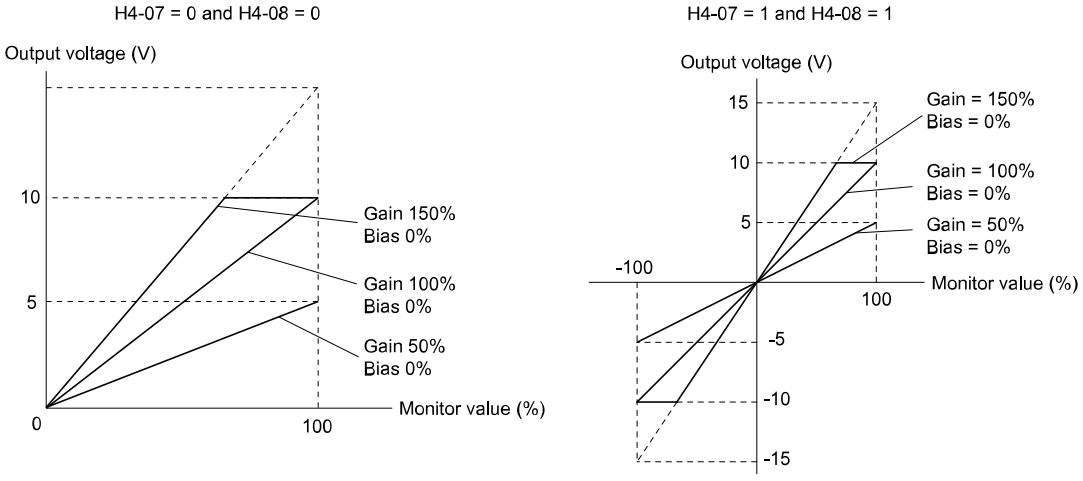


Figure 11.80 Analog Output Gain/Bias Setting Example 1

For example, when the parameter value set to analog output is 0 and a 3 V signal is output to terminal FM, *H3-04 [Terminal FM Analog Output Bias]* is set to 30%.

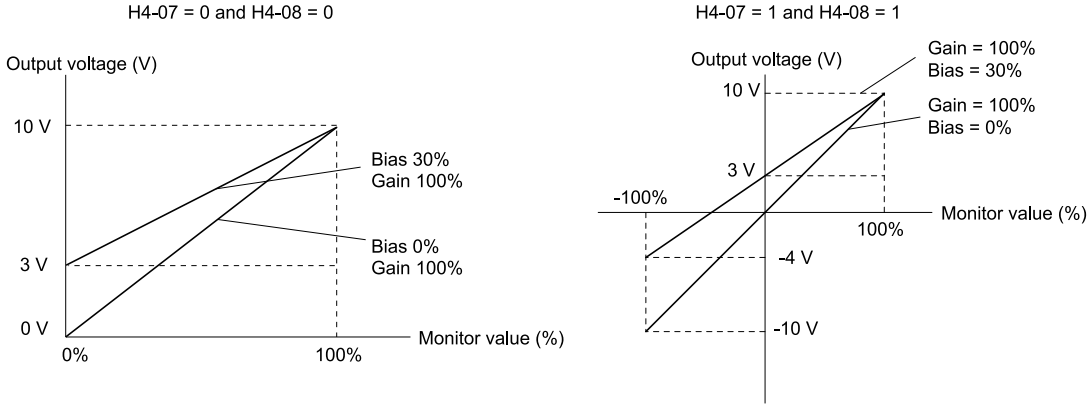


Figure 11.81 Analog Output Gain/Bias Setting Example 2

Calibrate Terminal FM

The output signal is adjustable while the drive is stopped. Use the following procedure to perform calibration.

1. Show *H4-02 [Terminal FM Analog Output Gain]* on the keypad.
   The analog signal at the time when the monitor item selected with *H4-01 [Terminal FM Analog Output Select]* is 100% is output from terminal FM.
2. Adjust *H4-02* while referencing the meter scale connected to terminal FM.
3. Show *H4-03 [Terminal FM Analog Output Bias]* on the keypad.
   The analog signal at the time when the monitor item selected with *H4-01* is 0% is output from terminal FM.
4. Adjust *H4-03* while referencing the meter scale connected to terminal FM.

Calibrate Terminal AM

The output signal is adjustable while the drive is stopped. Use the following procedure to perform calibration.

1. Show *H4-05 [Terminal AM Analog Output Gain]* on the keypad.
   The analog signal at the time when the monitor item selected with *H4-04 [Terminal AM Analog Output Select]* is 100% is output from terminal AM.
2. Adjust *H4-05* while referencing the meter scale connected to terminal AM.
3. Show *H4-06 [Terminal AM Analog Output Bias]* on the keypad.
   The analog signal at the time when the monitor item selected with *H4-04* is 0% is output from terminal AM.
4. Adjust *H4-06* while referencing the meter scale connected to terminal AM.

■ H4-01: Terminal FM Analog Output Select

No. (Hex.)	Name	Description	Default (Range)
H4-01 (041D)	Terminal FM Analog Output Select	V/f CL-V/f OLV CLV AOLV Sets the monitor number to send from MFAO terminal FM.	102 (000 - 999)

Set the *x-xx* part of the *Ux-xx [Monitor]*. For example, set *H4-01 = 102* to monitor *U1-02 [Output Frequency]*.

Note:
- You cannot use all of the monitors in all of the control methods.
- When you use the terminal in through mode, set this parameter to *000* or *031*. You can set the terminal FM output level from the PLC through MEMOBUS/Modbus communications or the communication option.

■ H4-02: Terminal FM Analog Output Gain

No. (Hex.)	Name	Description	Default (Range)
H4-02 (041E) RUN	Terminal FM Analog Output Gain	V/f CL-V/f OLV CLV AOLV Sets the gain of the *Ux-xx* monitor signal set in *H4-01 [terminals FM Monitor Selection]*.	100.0% (-999.9 - +999.9%)

The analog signal output from the terminal FM is a maximum of ±10 V. Select the signal level with *H4-07 [Terminal FM Signal Level Select]*.

■ H4-03: Terminal FM Analog Output Bias

No. (Hex.)	Name	Description	Default (Range)
H4-03 (041F) RUN	Terminal FM Analog Output Bias	V/f CL-V/f OLV CLV AOLV Sets the bias of the *Ux-xx* monitor signal set in *H4-01 [Terminal FM Analog Output Select]*.	0.0% (-999.9 - +999.9%)

The analog signal output from the terminal FM is a maximum of ±10 V. Select the signal level with *H4-07 [Terminal FM Signal Level Select]*.

■ H4-04: Terminal AM Analog Output Select

No. (Hex.)	Name	Description	Default (Range)
H4-04 (0420)	Terminal AM Analog Output Select	V/f CL-V/f OLV CLV AOLV Sets the monitoring number to be output from the MFAO terminal AM.	103 (000 - 999)

Set the *x-xx* part of the *Ux-xx [Monitor]*. For example, set *H4-04 = 103* to monitor *U1-03 [Output Current]*.

Note:
- You cannot use all of the monitors in all of the control methods.
- When you use the terminal in through mode, set this parameter to *000* or *031*. You can set the terminal AM output level from the PLC through MEMOBUS/Modbus communications or the communication option.

■ H4-05: Terminal AM Analog Output Gain

No. (Hex.)	Name	Description	Default (Range)
H4-05 (0421) RUN	Terminal AM Analog Output Gain	V/f CL-V/f OLV CLV AOLV Sets the gain of the *Ux-xx* monitor signal set in *H4-04 [terminals AM Monitor Selection]*.	50.0% (-999.9 - +999.9%)

The analog signal output from the terminal AM is a maximum of ±10 V. Select the signal level with *H4-08 [Terminal AM Signal Level Select]*.
Examples of possible settings:

When the output current of a monitoring item is 100% (drive rated current) in these examples, the voltage of AM terminal outputs at 5 V (50% of 10 V). Subsequently, the output current at the time the AM terminal outputs a maximum voltage of 10 V will be 200% of the drive rated current.

- *H4-04 = 103 [Terminal AM Analog Output Select = Output Current]*
- *H4-05 = 50.0%*
- *H4-06 = 0.0% [Terminal AM Analog Output Bias = 0.0%]*
- *H4-08 = 0 [0 to 10 Vdc]*

■ H4-06: Terminal AM Analog Output Bias

No. (Hex.)	Name	Description	Default (Range)
H4-06 (0422) RUN	Terminal AM Analog Output Bias	V/f CL-V/f OLV CLV AOLV Sets the bias of the *Ux-xx* monitor signal set in *H4-04 [terminals AM Monitor Selection]*.	0.0% (-999.9 - +999.9%)

The analog signal output from the terminal AM is a maximum of ±10 V. Select the signal level with *H4-08 [Terminal AM Signal Level Select]*.

■ H4-07: Terminal FM Signal Level Select

No. (Hex.)	Name	Description	Default (Range)
H4-07 (0423)	Terminal FM Signal Level Select	V/f CL-V/f OLV CLV AOLV Sets the MFAO terminal FM output signal level.	0 (0, 1)

0 : 0 to 10 Vdc
1 : -10 to +10 Vdc

■ H4-08: Terminal AM Signal Level Select

No. (Hex.)	Name	Description	Default (Range)
H4-08 (0424)	Terminal AM Signal Level Select	V/f CL-V/f OLV CLV AOLV Sets the MFAO terminal AM output signal level.	0 (0, 1)

0 : 0 to 10 Vdc
1 : -10 to +10 Vdc

■ H4-20: Analog Power Monitor 100% Level

No. (Hex.)	Name	Description	Default (Range)
H4-20 (0B53)	Analog Power Monitor 100% Level	V/f CL-V/f OLV CLV AOLV Sets the level at 10 V when *U1-08 [Output Power]* is set for analog output.	0.00 kW (0.00 - 650.00 kW)

Note:
When *H4-20 = 0.00 kW*, the output power monitor 10 V level is determined by *E2-11 [Motor Rated Power (kW)]*.

◆ H5: Memobus/Modbus Communication

H5 parameters configure the drive to use MEMOBUS/Modbus communications.

You can use the MEMOBUS/Modbus protocol over the RS-485 port (terminals D+ and D-) in the drive to use serial communication with programmable controllers (PLC).

■ H5-01: Drive Node Address

No. (Hex.)	Name	Description	Default (Range)
H5-01 (0425)	Drive Node Address	V/f CL-V/f OLV CLV AOLV Sets the communication slave address for drives.	1FH (0 - FFH)

Note:
- Re-energize the drive or set *H5-20 = 1 [Communication Parameters Reload = Reload Now]* after you change the parameter setting.
- Setting 0 will not let the drive respond to MEMOBUS/Modbus communications.

To enable the drive to communicate with the controller (master) over MEMOBUS/Modbus communications, you must set the drive with a slave address. Set *H5-01 ≠ 0*.

Set a node address that is different from the master and other slave devices.

■ H5-02: Communication Speed Selection

No. (Hex.)	Name	Description	Default (Range)
H5-02 (0426)	Communication Speed Selection	V/f CL-V/f OLV CLV AOLV Sets the communications speed for MEMOBUS/Modbus communications.	3 (0 - 8)

Note:
Re-energize the drive or set *H5-20 = 1 [Communication Parameters Reload = Reload Now]* after you change the parameter setting.

0 : 1200 bps
1 : 2400 bps
2 : 4800 bps
3 : 9600 bps
4 : 19.2 kbps
5 : 38.4 kbps
6 : 57.6 kbps
7 : 76.8 kbps
8 : 115.2 kbps

■ H5-03: Communication Parity Selection

No. (Hex.)	Name	Description	Default (Range)
H5-03 (0427)	Communication Parity Selection	V/f CL-V/f OLV CLV AOLV Sets the communications parity used for MEMOBUS/Modbus communications.	0 (0 - 2)

Note:
Re-energize the drive or set *H5-20 = 1 [Communication Parameters Reload = Reload Now]* after you change the parameter setting.

0 : No parity
1 : Even parity
2 : Odd parity

■ H5-04: Communication Error Stop Method

No. (Hex.)	Name	Description	Default (Range)
H5-04 (0428)	Communication Error Stop Method	V/f CL-V/f OLV CLV AOLV Sets the motor Stopping Method when the drive detects *CE [MEMOBUS/Modbus Communication Err]* issues.	1 (0 - 3)

0 : Ramp to Stop

The drive ramps the motor to stop according to the deceleration time. Fault relay output terminal MA-MC will turn ON, and MB-MC will turn OFF.

1 : Coast to Stop

The drive output shuts off and the motor coasts to stop. Fault relay output terminal MA-MC will turn ON, and MB-MC will turn OFF.

2 : Fast Stop (Use C1-09)

The drive stops the motor using the deceleration time set in *C1-09 [Fast Stop Time]*. Fault relay output terminal MA-MC will turn ON, and MB-MC will turn OFF.

3 : Alarm Only

CE appears on the keypad, and operation continues. The output terminal set for *Alarm [H2-01 to H2-05 = 10]* switches ON.

■ H5-05: Comm Fault Detection Selection

No. (Hex.)	Name	Description	Default (Range)
H5-05 (0429)	Comm Fault Detection Selection	V/f CL-V/f OLV CLV AOLV Sets the function that detects *CE [Modbus Communication Error]* issues during MEMOBUS/Modbus communications.	1 (0, 1)

If the drive does not receive data from the master during the time set in *H5-09 [CE Detection Time]*, it will detect a *CE* error.

0 : Disabled

Does not detect *CE*. The drive continues operation.

1 : Enabled

Detects *CE*. If the drive detects *CE*, it will operate as specified by the setting of *H5-04 [Communication Error Stop Method]*.

■ H5-06: Drive Transmit Wait Time

No. (Hex.)	Name	Description	Default (Range)
H5-06 (042A)	Drive Transmit Wait Time	V/f CL-V/f OLV CLV AOLV Sets the time to wait to send a response message after the drive receives a command message from the master.	5 ms (0 - 65 ms)

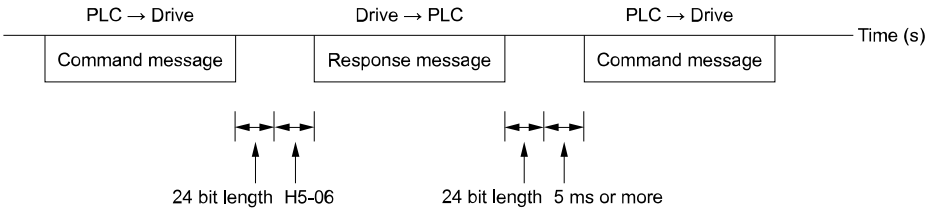


Figure 11.82 Drive Transmit Wait Time

■ H5-09: CE Detection Time

No. (Hex.)	Name	Description	Default (Range)
H5-09 (0435)	CE Detection Time	V/f CL-V/f OLV CLV AOLV Sets the detection time for *CE [Modbus Communication Error]* issues when communication stops.	2.0 s (0.0 - 10.0 s)

■ H5-10: Modbus Register 0025H Unit Sel

No. (Hex.)	Name	Description	Default (Range)
H5-10 (0436)	Modbus Register 0025H Unit Sel	V/f CL-V/f OLV CLV AOLV Sets the unit of measure used for the MEMOBUS/Modbus communications monitor register 0025H (output voltage reference monitor).	0 (0, 1)

0 : 0.1 V units

1 : 1 V units

■ H5-11: Comm ENTER Command Mode

No. (Hex.)	Name	Description	Default (Range)
H5-11 (043C)	Comm ENTER Command Mode	V/f CL-V/f OLV CLV AOLV Sets the function to make the Enter command necessary to change parameters through MEMOBUS/Modbus communications.	0 (0, 1)

0 : ENTER Command Required

You must use the Enter command to enable changes to parameters. Make all parameter changes then input the Enter command.

1 : ENTER Command Not Required

It is not necessary to input the Enter command to change parameters.

■ H5-17: ENTER command response @CPU BUSY

No. (Hex.)	Name	Description	Default (Range)
H5-17 (11A1) Expert	ENTER command response @CPU BUSY	V/f CL-V/f OLV CLV AOLV Sets operation when the EEPROM write command is sent without EEPROM write available. Usually it is not necessary to change this setting.	0 (0, 1)

0 : Ignore Command(No ROM/RAM Write)

1 : Write to RAM Only

■ H5-18: Motor Speed Filter over Comms

No. (Hex.)	Name	Description	Default (Range)
H5-18 (11A2)	Motor Speed Filter over Comms	V/f CL-V/f OLV CLV AOLV Sets the filter time constant used when monitoring motor speed during MEMOBUS/Modbus communications or with a communication option.	0 ms (0 - 100 ms)

Sets the filter time constant when you monitor the output frequency or motor speed during MEMOBUS/Modbus communications or use of the communication option.

These are the MEMOBUS registers:

- 003EH (Output Frequency)
- 003FH (Output Frequency)
- 0044H (*U1-05*: Motor Speed)
- 00ACH (*U1-05*: Motor Speed)
- 00ADH (*U1-05*: Motor Speed)

■ H5-20: Communication Parameters Reload

No. (Hex.)	Name	Description	Default (Range)
H5-20 (0B57)	Communication Parameters Reload	V/f CL-V/f OLV CLV AOLV Sets the function to immediately enable updated MEMOBUS/Modbus communications parameters.	0 (0, 1)

0 : Reload at Next Power Cycle

1 : Reload Now

Note:

- The setting value automatically returns to *H5-20 = 0* after you enable MEMOBUS/Modbus communications parameter changes.
- The setting values of these parameters are enabled:
  - *H5-01 [Drive Node Address]*
  - *H5-02 [Communication Speed Selection]*
  - *H5-03 [Communication Parity Selection]*
  - *H5-06 [Drive Transmit Wait Time]*

■ H5-25: Function 5A Register 1 Selection

No. (Hex.)	Name	Description	Default (Range)
H5-25 (1589) RUN	Function 5A Register 1 Selection	V/f CL-V/f OLV CLV AOLV Returns the contents of the specified MEMOBUS/Modbus communications register when responding to the master device.	0044H (U1-05) (0000H - FFFFH)

■ H5-26: Function 5A Register 2 Selection

No. (Hex.)	Name	Description	Default (Range)
H5-26 (158A) RUN	Function 5A Register 2 Selection	V/f CL-V/f OLV CLV AOLV Returns the contents of the specified MEMOBUS/Modbus communications register when responding to the master device.	0045H (U1-06) (0000H - FFFFH)

■ H5-27: Function 5A Register 3 Selection

No. (Hex.)	Name	Description	Default (Range)
H5-27 (158B) RUN	Function 5A Register 3 Selection	V/f CL-V/f OLV CLV AOLV Returns the contents of the specified MEMOBUS/Modbus communications register when responding to the master device.	0042H (U1-03) (0000H - FFFFH)

■ H5-28: Function 5A Register 4 Selection

No. (Hex.)	Name	Description	Default (Range)
H5-28 (158C) RUN	Function 5A Register 4 Selection	V/f CL-V/f OLV CLV AOLV Returns the contents of the specified MEMOBUS/Modbus communications register when responding to the master device.	0049H (U1-10) (0000H - FFFFH)

◆ H7: Virtual MFIO Selection

The virtual I/O function performs the following.

- Inputs the result of the output from the MFDO terminal to the MFDI terminal without external wiring.
- Inputs the result of the output from the MFAO terminal to the MFAI terminal without external wiring.

WARNING! *Sudden Movement Hazard. Before you do a test run, make sure that the setting values for virtual input and output function parameters are correct. Virtual input and output functions can have different default settings and operation than wired input and output functions. Incorrect function settings can cause serious injury or death.*

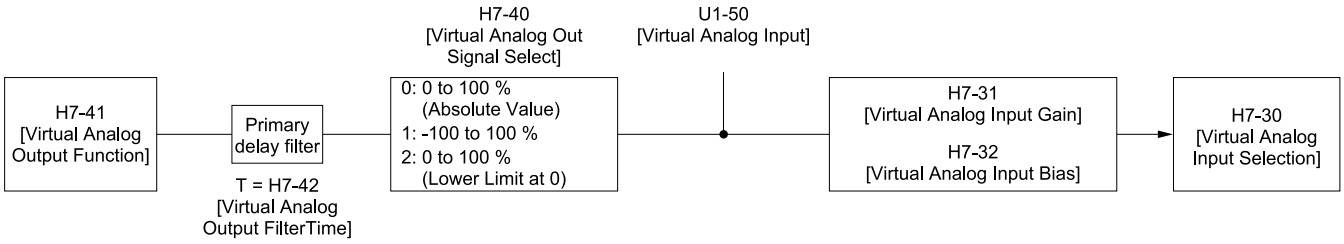


Figure 11.83 Virtual Analog I/O Functional Block Diagram

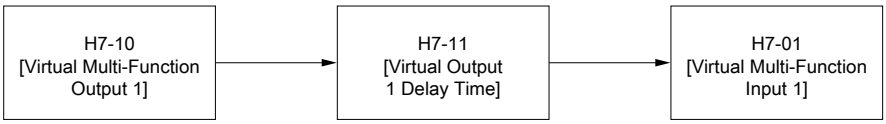


Figure 11.84 Virtual Digital I/O Functional Block Diagram

Note:

- Refer to H1-xx "MFDI Setting Values" for more information on the virtual digital input setting values.
- Refer to H2-xx "MFDO Setting Values" for more information on the virtual digital output setting values.
- Refer to H3-xx "MFAI Setting Values" for more information on the virtual analog input setting values.
- Refer to H4-xx "MFAO Setting Values" for more information on the virtual analog output setting values.
- You cannot set *20 or 2F [External Fault]* to *H7-01 to H7-04 [Virtual Multi-Function Input 1 to 4]*.
- If the terminal is not used, set *H7-01 to H7-04 = F*. This does not support the through mode.
- You cannot use the virtual I/O function selection and the multi-function input for DI-A3 at the same time.

■ H7-00: Virtual MFIO selection

No. (Hex.)	Name	Description	Default (Range)
H7-00 (116F) Expert	Virtual MFIO selection	V/f CL-V/f OLV CLV AOLV Sets the function to enable and disable the virtual I/O function. Set this parameter to 1 to operate the virtual I/O function.	0 (0, 1)

0 : Disabled

1 : Enabled

■ H7-01: Virtual Multi-Function Input 1

No. (Hex.)	Name	Description	Default (Range)
H7-01 (1185) Expert	Virtual Multi-Function Input 1	V/f CL-V/f OLV CLV AOLV Sets the function that enters the virtual input set in *H7-10 [Virtual Multi-Function Output 1]*.	F (0 - 1FF)

■ H7-02: Virtual Multi-Function Input 2

No. (Hex.)	Name	Description	Default (Range)
H7-02 (1186) Expert	Virtual Multi-Function Input 2	V/f CL-V/f OLV CLV AOLV Sets the function that enters the virtual input set in *H7-12 [Virtual Multi-Function Output 2]*.	F (0 - 1FF)

■ H7-03: Virtual Multi-Function Input 3

No. (Hex.)	Name	Description	Default (Range)
H7-03 (1187) Expert	Virtual Multi-Function Input 3	V/f CL-V/f OLV CLV AOLV Sets the function that enters the virtual input set in *H7-14 [Virtual Multi-Function Output 3]*.	F (0 - 1FF)

■ H7-04: Virtual Multi-Function Input 4

No. (Hex.)	Name	Description	Default (Range)
H7-04 (1188) Expert	Virtual Multi-Function Input 4	V/f CL-V/f OLV CLV AOLV Sets the function that enters the virtual input set in *H7-16 [Virtual Multi-Function Output 4]*.	F (0 - 1FF)

■ H7-10: Virtual Multi-Function Output 1

No. (Hex.)	Name	Description	Default (Range)
H7-10 (11A4) Expert	Virtual Multi-Function Output 1	V/f CL-V/f OLV CLV AOLV Sets the function for virtual digital output 1.	F (0 - 1FF)

■ H7-11: Virtual Output 1 Delay Time

No. (Hex.)	Name	Description	Default (Range)
H7-11 (11A5) Expert	Virtual Output 1 Delay Time	V/f CL-V/f OLV CLV AOLV Sets the minimum ON time for virtual digital output 1.	0.1 s (0.0 - 25.0 s)

■ H7-12: Virtual Multi-Function Output 2

No. (Hex.)	Name	Description	Default (Range)
H7-12 (11A6) Expert	Virtual Multi-Function Output 2	V/f CL-V/f OLV CLV AOLV Sets the function for virtual digital output 2.	F (0 - 1FF)

■ H7-13: Virtual Output 2 Delay Time

No. (Hex.)	Name	Description	Default (Range)
H7-13 (11A7) Expert	Virtual Output 2 Delay Time	V/f CL-V/f OLV CLV AOLV Sets the minimum ON time for virtual digital output 2.	0.1 s (0.0 - 25.0 s)

■ H7-14: Virtual Multi-Function Output 3

No. (Hex.)	Name	Description	Default (Range)
H7-14 (11A8) Expert	Virtual Multi-Function Output 3	V/f CL-V/f OLV CLV AOLV Sets the function for virtual digital output 3.	F (0 - 1FF)

■ H7-15: Virtual Output 3 Delay Time

No. (Hex.)	Name	Description	Default (Range)
H7-15 (11A9) Expert	Virtual Output 3 Delay Time	V/f CL-V/f OLV CLV AOLV Sets the minimum ON time for virtual digital output 3.	0.1 s (0.0 - 25.0 s)

■ H7-16: Virtual Multi-Function Output 4

No. (Hex.)	Name	Description	Default (Range)
H7-16 (11AA) Expert	Virtual Multi-Function Output 4	V/f CL-V/f OLV CLV AOLV Sets the function for virtual digital output 4.	F (0 - 1FF)

■ H7-17: Virtual Output 4 Delay Time

No. (Hex.)	Name	Description	Default (Range)
H7-17 (11AB) Expert	Virtual Output 4 Delay Time	V/f CL-V/f OLV CLV AOLV Sets the minimum ON time for virtual digital output 4.	0.1 s (0.0 - 25.0 s)

■ H7-30: Virtual Analog Input Selection

No. (Hex.)	Name	Description	Default (Range)
H7-30 (1177) Expert	Virtual Analog Input Selection	V/f CL-V/f OLV CLV AOLV Sets the virtual analog input function.	F (0 - FF)

■ H7-31: Virtual Analog Input Gain

No. (Hex.)	Name	Description	Default (Range)
H7-31 (1178) RUN Expert	Virtual Analog Input Gain	V/f CL-V/f OLV CLV AOLV Sets the virtual analog input gain.	100.0% (-999.9 - 999.9%)

■ H7-32: Virtual Analog Input Bias

No. (Hex.)	Name	Description	Default (Range)
H7-32 (1179) RUN Expert	Virtual Analog Input Bias	V/f CL-V/f OLV CLV AOLV Sets the virtual analog input bias.	0.0% (-999.9 - 999.9%)

■ H7-40: Virtual Analog Out Signal Select

No. (Hex.)	Name	Description	Default (Range)
H7-40 (1163)	Virtual Analog Out Signal Select	V/f CL-V/f OLV CLV AOLV Sets the signal level of the virtual analog output.	0 (0 - 2)

0 : 0 to 100% (Absolute Value)

1 : -100 to 100%

2 : 0 to 100% (Lower Limit at 0)

■ H7-41: Virtual Analog Output Function

No. (Hex.)	Name	Description	Default (Range)
H7-41 (1164)	Virtual Analog Output Function	V/f CL-V/f OLV CLV AOLV Sets the monitor to be output from the virtual analog output.	102 (0 - 999)

Set the *x-xx* part of the *Ux-xx [Monitor]*. For example, set *H7-41 = 102* to monitor *U1-02 [Output Frequency]*.

■ H7-42: Virtual Analog Output FilterTime

No. (Hex.)	Name	Description	Default (Range)
H7-42 (1165)	Virtual Analog Output FilterTime	V/f CL-V/f OLV CLV AOLV Sets the time constant for a primary filter of the virtual analog output.	0.00 s (0.00 - 2.00 s)

11.9 L: Protection Function

L parameters set the following functions.

- Motor Overload Protection
- Operation During Momentary Power Loss
- Stall Prevention
- Speed Detection
- Torque Limit
- Hardware Protection

◆ L1: Motor Protection

L1 parameters set the motor overload protection function.

■ Motor Protection Using Positive Temperature Coefficient (PTC) Thermistors

The temperature resistance characteristics of three PTC thermistors in the motor stator winding protect the motor from overheat.

The PTC thermistors must have the characteristics in motor 1 phase as shown in the following graph.

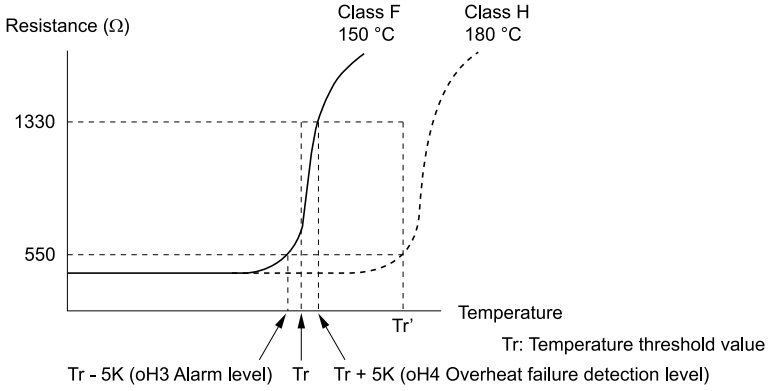


Figure 11.85 PTC Thermistor Temperature and Resistance

When the PTC input signal input to the drive is more than the overload alarm level, the drive detects *oH3 [Motor Overheat (PTC Input)]*. The drive continues the operation set in *L1-03 [Motor Thermistor oH Alarm Select]*.

The overheat fault level triggers an *oH4 [Motor Overheat Fault (PTC Input)]* fault, and outputs a fault signal. The drive outputs a fault signal, and stops the motor with the stop method set in *L1-04 [Motor Thermistor oH Fault Select]*.

Note:

PTC is an acronym for Positive Temperature Coefficient.

The following figure shows the setting procedure when you use terminal A3.

1. Connect the PTC thermistor input from the motor to analog input terminal A3 on the drive.

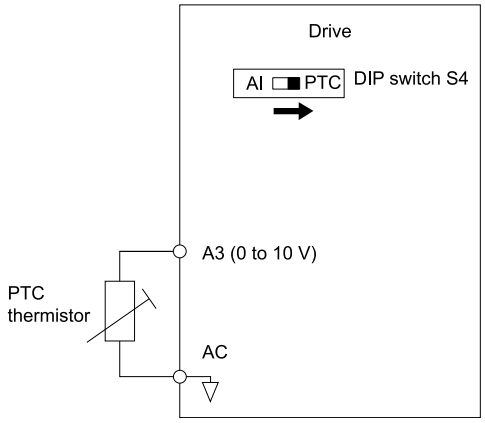


Figure 11.86 Connect Motor PTC

2. Set drive DIP Switch S4 to PTC.

3. Set these MFAI terminals:
   - Set *H3-05 = 0 [Terminal A3 Signal Level Select = 0 to 10V (Lower Limit at 0)]*.
   - Set *H3-06 = E [Terminal A3 Function Selection = Motor Temperature (PTC Input)]*.
4. Set these *L1 parameters*.
   - *L1-03 [Motor Thermistor oH Alarm Select]*
   - *L1-04 [Motor Thermistor oH Fault Select]*
   - *L1-05 [Motor Thermistor Filter Time]*

■ L1-01: Motor Overload (oL1) Protection

No. (Hex.)	Name	Description	Default (Range)
L1-01 (0480)	Motor Overload (oL1) Protection	V/f CL-V/f OLV CLV AOLV Sets the motor overload protection with electronic thermal protectors.	Determined by A1-02 (0 - 3, 6)

Parameter *L1-01* enables and disables the motor overload protection with electronic thermal protectors.

The cooling capability of the motor changes when the speed control range of the motor changes. Use an electronic thermal protector that aligns with the permitted load characteristics of the motor to select motor protection.

The electronic thermal protector of the drive uses Output current, Output frequency, Motor thermal characteristics, and Time characteristics to calculate motor overload tolerance and supply overload protection for the motor. If the drive detects motor overload, the drive will trigger an *oL1 [Motor Overload]* and stop the drive output.

You can set a motor overload alarm. Set *H2-02 = 1F [Term M3-M4 Function Selection = Motor Overload Alarm (oL1)]* to enable this function. If the motor overload level is more than 90% of the *oL1* detection level, the output terminal activates and triggers an overload alarm.

Note:

When you connect only one motor to a drive, set *L1-01 = 1 to 3 or 6 [Enabled]*. External thermal relays are not necessary in these conditions.

0 : Disable

Disable motor protection when motor overload protection is not necessary or when the drive is operating more than one motor.

Refer to the figure for an example of the circuit configuration to connect more than one motor to one drive.

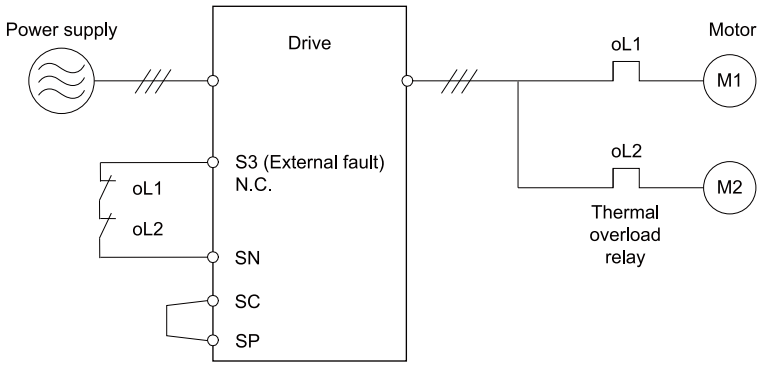


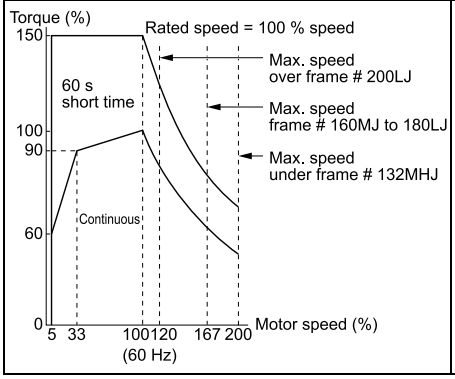
Figure 11.87 Protection Circuit Configuration to Connect More than One Motor to One Drive

NOTICE: *When you connect more than one motor to one drive or when the motor amp rating is higher than the drive amp rating, set L1-01 =0 [Motor Overload (oL1) Protection = Disabled] and install thermal overload relays for each motor. The electronic thermal protection of the drive will not function and it can cause damage to the motor.*

1 : Variable Torque

Use this setting for general-purpose motors with a 60 Hz base frequency.

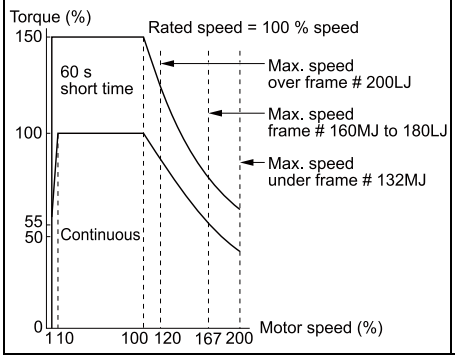
The overload tolerance decreases as Run decreases because the cooling fan speed decreases and the ability of the motor to cool decreases in the low speed range. The overload tolerance characteristics of the motor change the trigger point for the electronic thermal protector. This provides motor overheat protection from low speed to high speed across the full speed range.

Load Tolerance	Cooling Capability	Overload Characteristics (at 100% motor load)
	This motor is designed to operate with commercial line power. Operate at a 60 Hz base frequency to maximize the motor cooling ability.	If the motor operates at frequencies less than 60 Hz, the drive will detect *oL1*. The drive triggers a fault relay output and the motor coasts to stop.

2 : Constant Torque 10:1 Speed Range

Use this setting for drive-dedicated motors with a speed range for constant torque of 1:10.

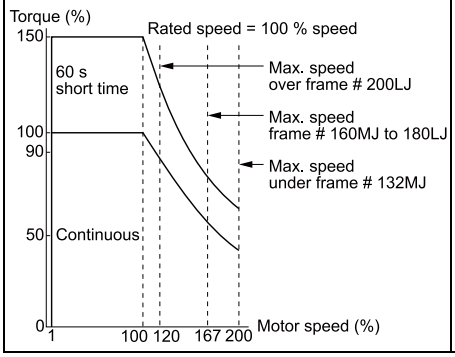
The speed control for this motor is 10% to 100% when at 100% load. Operating slower than 10% speed at 100% load will cause motor overload.

Load Tolerance	Cooling Capability	Overload Characteristics (at 100% motor load)
	This motor is designed to withstand increased temperatures during continuous operation in the low speed range (10% base frequency).	The motor operates continuously at 10% to 100% base frequency.

3 : Constant Torque 100:1 SpeedRange

Use this setting for vector motors with a speed range for constant torque of 1:100.

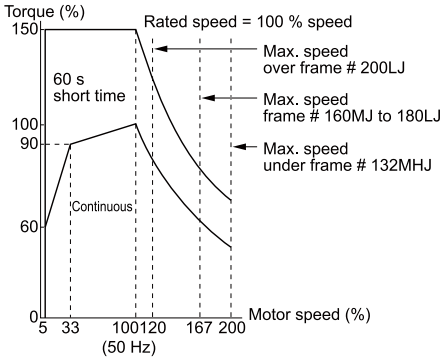
The speed control for this motor is 1% to 100% when at 100% load. Operating slower than 1% speed at 100% load will cause motor overload.

Load Tolerance	Cooling Capability	Overload Characteristics (at 100% motor load)
	This motor is designed to withstand increased temperatures during continuous operation in the more low speed range (1% base frequency).	The motor operates continuously at 1% to 100% base frequency. Operating slower than 1% speed at 100% load will cause motor overload.

6 : Variable Torque (50Hz)

Use this setting for general-purpose motors with a 50 Hz base frequency.

The overload tolerance decreases as Run decreases because the cooling fan speed decreases and the ability of the motor to cool decreases in the low speed range. The overload tolerance characteristics of the motor change the trigger point for the electronic thermal protector. This provides motor overheat protection from low speed to high speed across the full speed range.

Load Tolerance	Cooling Capability	Overload Characteristics (at 100% motor load)
	This motor is designed to operate with commercial line power. Operate at a 50 Hz base frequency to maximize the motor cooling ability.	If the motor operates at frequencies less than commercial line power, the drive will detect *oL1*. The drive triggers a fault relay output and the motor coasts to stop.

■ L1-02: Motor Overload Protection Time

No. (Hex.)	Name	Description	Default (Range)
L1-02 (0481)	Motor Overload Protection Time	V/f CL-V/f OLV CLV AOLV Sets the operation time for the electronic thermal protector of the drive to prevent damage to the motor. Usually it is not necessary to change this setting.	1.0 min (0.1 - 5.0 min)

Set the overload tolerance time to the length of time that the motor can operate at 150% load from continuous operation at 100% load.

When the motor operates at 150% load continuously for 1 minute after continuous operation at 100% load (hot start), the default setting triggers the electronic thermal protector.

Figure 11.88 shows an example of the electronic thermal protector operation time. Motor overload protection operates in the range between a cold start and a hot start.

This example shows a general-purpose motor operating at the base frequency with *L1-02* set to 1.0 min.

- Cold start
  Shows the motor protection operation time characteristics when the overload occurs immediately after starting operation from a complete stop.
- Hot start
  Shows the motor protection operation time characteristics when overload occurs from continuous operation below the motor rated current.

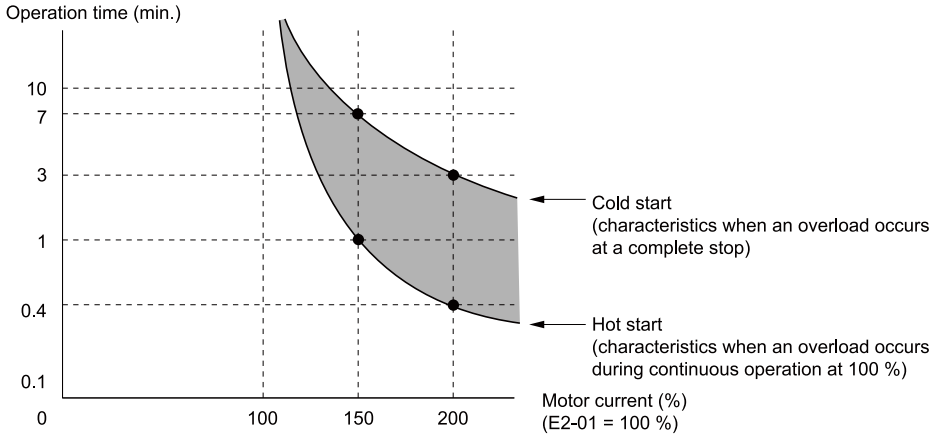


Figure 11.88 Protection Operation Time for a General-purpose Motor at Rated Output Frequency

■ L1-03: Motor Thermistor oH Alarm Select

No. (Hex.)	Name	Description	Default (Range)
L1-03 (0482)	Motor Thermistor oH Alarm Select	V/f CL-V/f OLV CLV AOLV Sets the drive operation when the PTC input signal to the drive is at the *oH3 [Motor Overheat (PTC Input)]* detection level.	3 (0 - 3)

0 : Ramp to Stop

The drive ramps the motor to stop according to the deceleration time. Fault relay output terminal MA-MC will turn ON, and MB-MC will turn OFF.

1 : Coast to Stop

The drive output shuts off and the motor coasts to stop. Fault relay output terminal MA-MC will turn ON, and MB-MC will turn OFF.

2 : Fast Stop (Use C1-09)

The drive stops the motor using the deceleration time set in *C1-09 [Fast Stop Time]*. Fault relay output terminal MA-MC will turn ON, and MB-MC will turn OFF.

3 : Alarm Only

oH3 appears on the keypad, and operation continues. The output terminal set for *Alarm [H2-01 to H2-05 = 10]* switches ON.

■ L1-04: Motor Thermistor oH Fault Select

No. (Hex.)	Name	Description	Default (Range)
L1-04 (0483)	Motor Thermistor oH Fault Select	V/f CL-V/f OLV CLV AOLV Sets the drive operation when the PTC input signal to the drive is at the *oH4 [Motor Overheat Fault (PTC Input)]* detection level.	1 (0 - 2)

0 : Ramp to Stop

The drive ramps the motor to stop in the deceleration time. Fault relay output terminal MA-MC turns ON, and MB-MC turns OFF.

1 : Coast to Stop

The output turns OFF and the motor coasts to stop. Fault relay output terminal MA-MC turns ON, and MB-MC turns OFF.

2 : Fast Stop (Use C1-09)

The drive stops the motor in the deceleration time set in *C1-09 [Fast Stop Time]*. Fault relay output terminal MA-MC turns ON, and MB-MC turns OFF.

■ L1-05: Motor Thermistor Filter Time

No. (Hex.)	Name	Description	Default (Range)
L1-05 (0484)	Motor Thermistor Filter Time	V/f CL-V/f OLV CLV AOLV Sets the primary delay time constant for the PTC input signal entered to the drive. This parameter prevents accidental motor overheat faults.	0.20 s (0.00 - 10.00 s)

■ L1-08: oL1 Current Level

No. (Hex.)	Name	Description	Default (Range)
L1-08 (1103)	oL1 Current Level	V/f CL-V/f OLV CLV AOLV Sets the reference current for the motor 1 thermal overload detection.	0.0A (0.0 A or 10% to 150% of the drive rated current)

When L1-08 = 0.0 A, the motor overload protection is detected on the basis of *E2-01 [Motor Rated Current (FLA)]*.

When *L1-08 ≠ 0.0 A*, the set value is used as the reference for motor overload protection.

Note:
- Display is in the following units:
  – 2003 to 2033, 4002 to 4018: 0.01 A units
  – 2047 to 2415, 4024 to 4605: 0.1 A units
- Values greater than 0.0 A and less than 10% of the drive rated current cannot be set.

■ L1-09: oL1 Current Level for Motor 2

No. (Hex.)	Name	Description	Default (Range)
L1-09 (1104)	oL1 Current Level for Motor 2	V/f CL-V/f OLV CLV AOLV Sets the reference current for the motor 2 thermal overload detection.	0.0A (0.0 A or 10 to150% of the drive rated current)

When you set this parameter to 0.0 A, *E4-01 [Motor 2 Rated Current]* is used as the reference for motor overload protection.

When you set this parameter to other than 0.0 A, the value of *L1-09* is used as the reference for motor overload protection.

Note:
- Display is in the following units:
  – 2003 to 2033, 4002 to 4018: 0.01 A units
  – 2047 to 2415, 4024 to 4605: 0.1 A units
- Values greater than 0.0 A and less than 10% of the drive rated current cannot be set.

■ L1-13: Motor Overload Memory Selection

No. (Hex.)	Name	Description	Default (Range)
L1-13 (046D)	Motor Overload Memory Selection	V/f CL-V/f OLV CLV AOLV Sets the function that keeps the current electronic thermal protector value when the drive stops receiving power.	1 (0, 1)

0 : Disabled

1 : Enabled

Sets if the drive will calculate the motor again when the drive is energized again.

◆ L2: Power Loss Ride Through

L2 parameters are used to set the drive operation during momentary power loss.

■ L2-03: Minimum Baseblock Time

No. (Hex.)	Name	Description	Default (Range)
L2-03 (0487)	Minimum Baseblock Time	V/f CL-V/f OLV CLV AOLV Sets the minimum time to continue the drive output block (baseblock) after a baseblock.	Determined by o2-04 (0.1 - 5.0 s)

Sets the time for the drive waits for the residual voltage in the motor to dissipate in approximation to the secondary circuit time constant of the motor. Increase this setting if an *oC [Overcurrent]* or *ov [Overvoltage]* occurs at the beginning of DC Injection Braking after power loss.

■ L2-05: Undervoltage Detection Lvl (Uv1)

No. (Hex.)	Name	Description	Default (Range)
L2-05 (0489)	Undervoltage Detection Lvl (Uv1)	V/f CL-V/f OLV CLV AOLV Sets the voltage at which a *Uv1 [DC Bus Undervoltage]* fault is triggered. Usually it is not necessary to change this setting.	Determined by E1-01 (Determined by E1-01)

NOTICE: *Damage to Equipment. When you set this parameter to a value lower than the default, you must install an AC reactor on the input side of the power supply. If you do not install an AC reactor, it will cause damage to the drive circuitry.*

◆ L3: Stall Prevention

L3 parameters are used to set the Stall Prevention function.

■ Stall Prevention

The motor may experience excessive slip because it cannot keep up with the frequency reference when the load is too high or acceleration and deceleration times are too short. If the motor stalls during acceleration, current increases in accordance with the increase in slip, which causes an *oC [Overcurrent]*, *oL2 [Drive Overloaded]*, or *oL1 [Motor Overload]* and the drive to stop. If the motor stalls during deceleration, it can cause excessive regenerative power to flow back into the DC bus capacitors, and eventually cause the drive to fault out from *ov [Overvoltage]* to be detected and the drive to stop.

The Stall Prevention function prevents motors from stalling. This function enables operation to continue while acceleration or deceleration occurs until the target speed is reached without having to change the setting values for acceleration and deceleration time. The stall prevention function can be set separately for acceleration, operating at constant speeds, and deceleration.

■ L3-01: Stall Prevention during Accel

No. (Hex.)	Name	Description	Default (Range)
L3-01 (048F)	Stall Prevention during Accel	V/f CL-V/f OLV CLV AOLV Sets the method of the Stall Prevention During Acceleration.	1 (0 - 3)

Stall prevention during acceleration will not let motors stall or stop when the drive detects *oC [Overcurrent]*, *oL2 [Drive Overload]*, or *oL1 [Motor Overload]* and large loads are applied during acceleration or when setting sudden acceleration times regarding load inertia.

0 : Disabled

The Stall Prevention function does not operate during acceleration, and acceleration occurs for the set acceleration time. If the acceleration time is too short, the motor does fully accelerate during the set time, which causes the drive to detect *oL1* or *oL2* and the motor to stop.

1 : Enabled

Enables the Stall Prevention During Acceleration function. Operation is different for different control methods.

- **V/f Control or OLV Control**
  When the output current is more than the value set in *L3-02 [Stall Prevent Level during Accel]*, the drive stops acceleration. When the output current is less than the value set in *L3-02* - 15%, the drive starts to accelerate again. The Stall Prevention function level automatically falls for constant output ranges.

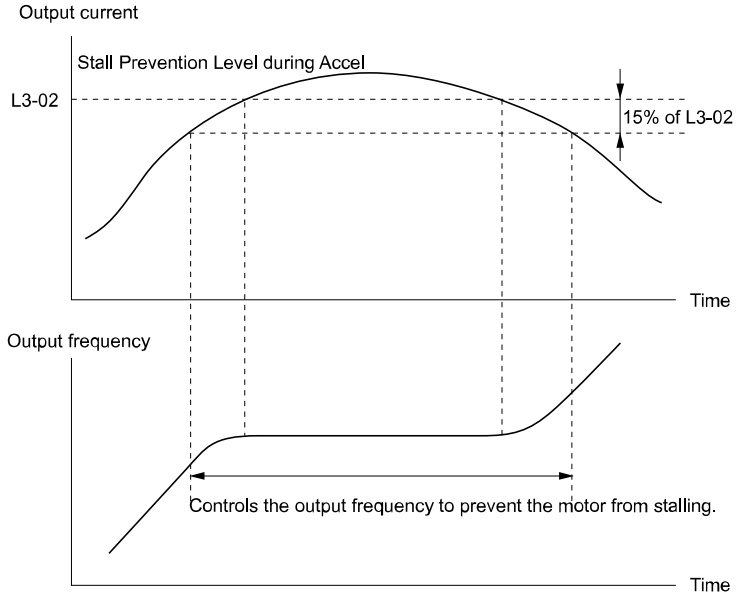


Figure 11.89 Stall Prevention During Acceleration when Using Induction Motors

2 : Intelligent (Ignore Accel Ramp)

The drive ignores the acceleration time setting and the drive starts to accelerate in the minimum length of time. The drive automatically adjusts the acceleration rate and the output current will not be more than the value set in *L3-02*.

3 : Current Limit Method

This function limits the output current with the value set for *L3-02* and automatically adjusts the acceleration rate. When the load (output current) increases to more than the current limit level during acceleration, the drive automatically adjusts the acceleration rate.

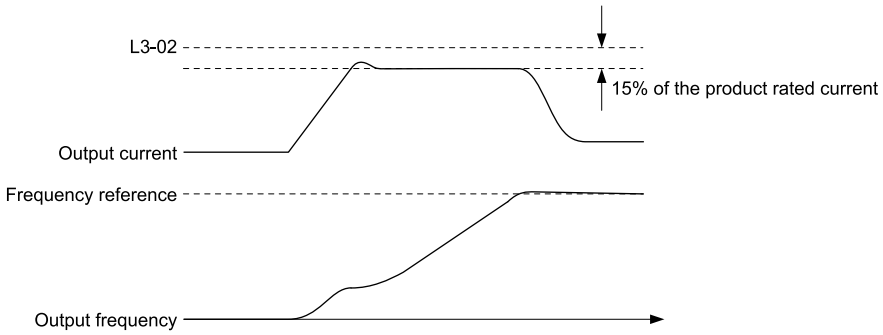


Figure 11.90 Current Limit Method

■ L3-02: Stall Prevent Level during Accel

No. (Hex.)	Name	Description	Default (Range)
L3-02 (0490)	Stall Prevent Level during Accel	V/f CL-V/f OLV CLV AOLV Sets the output current level as a percentage of the drive rated output current that the drive uses when the Stall Prevention function is enabled during acceleration.	Determined by L8-38 (0 - 150%)

Note:
- The upper limit of this setting is determined by *L8-38 [Carrier Frequency Reduction]*.
- Motors may stall if continuing to operate at default settings when motor output is small relative to drive capacity. Decrease the setting value if stalls occur.
- When you operate the motor in the constant power range, set *L3-03 [Stall Prevent Limit during Accel]*.

■ L3-03: Stall Prevent Limit during Accel

No. (Hex.)	Name	Description	Default (Range)
L3-03 (0491)	Stall Prevent Limit during Accel	V/f CL-V/f OLV CLV AOLV Sets the lower limit for the stall prevention level used in the constant output range as a percentage of the drive rated output current.	50% (0 - 100%)

The stall prevention level set in *L3-02 [Stall Prevent Level during Accel]* is automatically reduced when the motor is running within the constant output range. Parameter *L3-03* is the limit value used to prevent the stall prevention level during constant output ranges to fall below the minimum required level.

Note:

The function to automatically reduce the stall prevention level does not operate when *L3-01 = 3 [Stall Prevention during Accel = Current Limit Method]*.

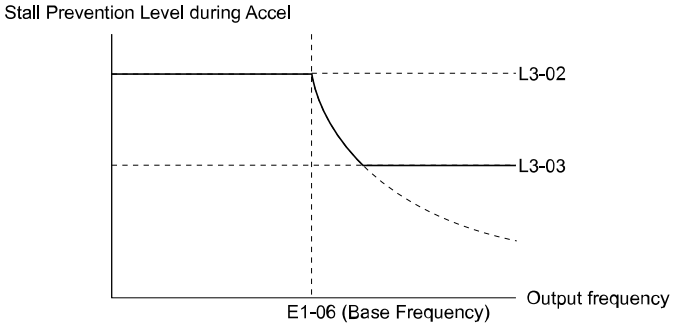


Figure 11.91 Stall Prevent Level during Accel/Limit

■ L3-04: Stall Prevention during Decel

No. (Hex.)	Name	Description	Default (Range)
L3-04 (0492)	Stall Prevention during Decel	V/f CL-V/f OLV CLV AOLV Sets the method that the drive will use to prevent overvoltage faults when it decelerates.	0 (0 - 5)

Note:

To connect a dynamic braking option (braking resistor or braking resistor unit) to the drive, set this parameter to 0 or 3. If this parameter is set to a value other than 0 or 3, then the Stall Prevention function during deceleration will be enabled, and the dynamic braking option will not function.

Stall Prevention during deceleration controls the deceleration as specified by the DC bus voltage and does not let high inertia or fast deceleration cause *ov [Overvoltage]* faults.

0 : Disabled

The drive decelerates as specified by the deceleration time. If the deceleration time is too short, the drive can detect an *ov* fault.

Note:

If an *ov* fault occurs, connect a dynamic braking option to the drive. If an *ov* fault occurs while operating the drive with a dynamic braking option and *A1-02 = 0 or 2 [Control Method Selection = V/f Control, Open Loop Vector]* and *L3-04 = 0*, set *L3-04 = 3*.

1 : General Purpose

The drive decelerates as specified by the deceleration time. When the DC bus voltage is more than the Stall Prevention level during deceleration, the drive stops deceleration and continues operation at the current frequency. The drive resumes deceleration at the set deceleration time once the DC bus voltage drops below the stall prevention level. Frequent use of Stall Prevention will help prevent *ov* faults when the deceleration time is set shorter than the drive can usually accept.

Note:

The Stall Prevention during Deceleration function will increase the deceleration time to stop and the deceleration time will be longer than the setting. This function is not applicable for applications such as conveyors, where the precision of the stop position is very important. Consider using a dynamic braking option instead in such applications.

The DC bus voltage level for Stall Prevention depends on the input voltage setting of *E1-01 [Input AC Supply Voltage]*.

Table 11.34 Stall Prevention Level during Deceleration

Drive Input Voltage	Stall Prevention Level during Deceleration
200 V class	377 V
400 V class	754 V

This figure shows the Stall Prevention during Deceleration function.

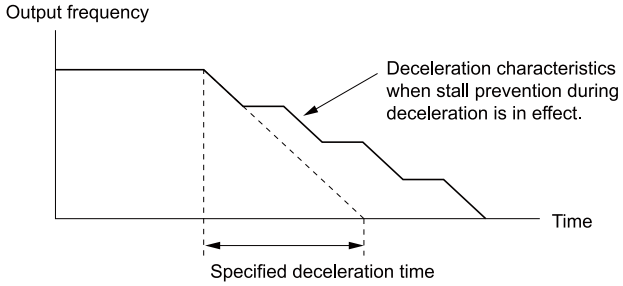


Figure 11.92 Stall Prevention Operation during Deceleration

2 : Intelligent (Ignore Decel Ramp)

The drive adjusts the deceleration rate to keep the DC bus voltage is kept at the level set to *L3-17 [DC Bus Regulation Level]*. This makes the shortest possible deceleration time and will not let the motor stall. The drive ignores the selected deceleration time and the possible deceleration time cannot be less than 1/10 of the set deceleration time.

This function uses these parameters to adjust the deceleration rate:

- *L3-20 [DC Bus Voltage Adjustment Gain]*
- *L3-21 [OVSuppression Accel/Decel P Gain]*
- *L3-24 [Motor Accel Time @ Rated Torque]*
- *L3-25 [Load Inertia Ratio]*

Note:

The deceleration time is not constant. For applications where the precision of the stop position is very important, use a dynamic braking option and do not change the setting from *L3-04 = 0*. If an *ov* occurs, set *L3-04 = 3*.

3 : General Purpose w/ DB resistor

A braking resistor is necessary for this setting. The braking resistor and the drive work together for the Stall Prevention during Deceleration function.

4 : Overexcitation/High Flux

Enables Overexcitation/High Flux 1. Enables a shorter deceleration time than when *L3-04 = 0*.

Note:
- If you decelerate frequently and the overexcitation time is long, the drive can detect *oL1 [Motor Overload]* faults. If the drive detects *oL1*, decrease the deceleration time or install a braking resistor to the drive.
- The deceleration time during Overexcitation Deceleration changes when the motor characteristics and machine inertia change. Adjust the *n3-13 [OverexcitationBraking (OEB) Gain]* and *n3-23 [Overexcitation Braking Operation]* levels. Refer to "n3: Overexcite Braking" for more information.

5 : Overexcitation/High Flux 2

Enables Overexcitation/High Flux 2. This function decreases the possible deceleration time more than Overexcitation/High Flux.

The drive decreases motor speed and tries to keep the DC bus voltage at the *L3-17* level.

If the drive detects *oL1*, decrease the values set in *n3-13* and *n3-21*. If the drive detects *ov*, increase the value set in *C1-02, C1-04, C1-06, and C1-08 [Deceleration Times]*.

Note:
- During Overexcitation/High Flux 2, the drive disables Hunting Prevention in V/f Control and also disables Speed Control that uses torque limit in OLV Control.
- Refer to "n3: Overexcite Braking" for more information.

■ L3-05: Stall Prevention during RUN

No. (Hex.)	Name	Description	Default (Range)
L3-05 (0493)	Stall Prevention during RUN	V/f CL-V/f OLV CLV AOLV Sets the function to enable and disable Stall Prevention During Run.	1 (0 - 2)

Stall Prevention function during run prevents the motor from stalling by automatically reducing the speed when an *oL1 [Motor Overload]* occurs while the motor is running at constant speed.

Note:

The Stall Prevention during Run function is disabled regardless of the setting of *L3-05* and *L3-06 [Stall Prevent Level during Run]* if the output frequency falls below 6 Hz.

0 : Disabled

Drive runs at the set frequency reference. A heavy load may cause the motor to stall and trip the drive with an *oC [Overcurrent]* or *oL1*.

1 : Deceleration Time 1 (*C1-02*)

The drive will decelerate for the time set in *C1-02 [Deceleration Time 1]* .If the current exceeds the Stall Prevention level set in *L3-06*. When the current level drops below "*L3-06* setting value - 2%" for 100 ms, drive accelerates again for the acceleration time valid at that time until the set frequency is reached.

2 : Deceleration Time 2 (*C1-04*)

This setting functions in the same manner as setting 1. If the Stall Prevention function is enabled, the drive decelerates with the value set in *C1-04 [Deceleration Time 2]*.

■ L3-06: Stall Prevent Level during Run

No. (Hex.)	Name	Description	Default (Range)
L3-06 (0494)	Stall Prevent Level during Run	V/f CL-V/f OLV CLV AOLV Sets the output current level at which the Stall Prevention function is enabled during run when the drive rated output current is 100%.	Determined by L8-38 (30 - 150%)

Note:
- This parameter is applicable if *L3-05 = 1, 2 [Stall Prevention during RUN = Deceleration Time 1 (C1-02), Deceleration Time 2 (C1-04)]*.
- The upper limit of this setting is determined by *L8-38 [Carrier Frequency Reduction]*.
- Depending on the setting of *L3-23 [Stall P Reduction at Constant HP]* the level is automatically decreased in the constant power range.

Use an Analog Input to Change the Stall Prevent Level during Run

When *H3-xx = 8 [MFAI Function Selection = Stall Prevent Level During Run]*, you can change the stall prevention level during run through the input gain and bias settings for terminals A1, A2, and A3.

If you set the input level for terminals A1, A2, and A3 *[H3-xx = 8]* and *L3-06*, the drive will use the smaller value for Stall Prevent Level during Run.

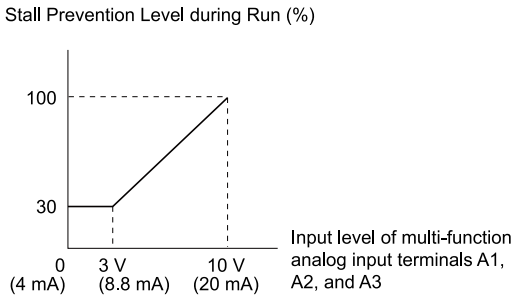


Figure 11.93 Stall Prevention Level during Run with Analog Input

■ L3-17: DC Bus Regulation Level

No. (Hex.)	Name	Description	Default (Range)
L3-17 (0462)	DC Bus Regulation Level	V/f CL-V/f OLV CLV AOLV Sets the target value for the DC bus voltage when the Decel Stall Prevention function (Intelligent Stall Prevention) are active.	200 V Class: 375 V, 400 V Class: 750 V (200 V Class: 150 to 400 V, 400 V Class: 300 to 800 V)

Note:
This value is initialized when *E1-01 [Input AC Supply Voltage]* is changed.

Set this parameter when *L3-04 = 2 [Stall Prevention during Decel = Intelligent (Ignore Accel Ramp)]*.

■ L3-20: DC Bus Voltage Adjustment Gain

No. (Hex.)	Name	Description	Default (Range)
L3-20 (0465) Expert	DC Bus Voltage Adjustment Gain	V/f CL-V/f OLV CLV AOLV Sets the proportional gain used to control the DC bus voltage.	Determined by A1-02 (0.00 - 5.00)

This parameter is enabled when *L3-04 = 2 [Stall Prevention during Decel = Intelligent (Ignore Accel Ramp)]*.

■ L3-21: OVSuppression Accel/Decel P Gain

No. (Hex.)	Name	Description	Default (Range)
L3-21 (0466) Expert	OVSuppression Accel/ Decel P Gain	V/f CL-V/f OLV CLV AOLV Sets the proportional gain to calculate acceleration and deceleration rates.	Determined by A1-02 (0.10 - 10.00)

This parameter is enabled when *L3-04 = 2 [Stall Prevention during Decel = Intelligent (Ignore Accel Ramp)]*.

■ L3-23: Stall P Reduction at Constant HP

No. (Hex.)	Name	Description	Default (Range)
L3-23 (04FD)	Stall P Reduction at Constant HP	V/f CL-V/f OLV CLV AOLV Sets the function to automatically decrease the Stall Prevention Level during Run for Constant Horse Power (CHP) part of the speed range.	0 (0, 1)

0 : Use L3-06 for Entire Speed Range

The drive uses the level set in *L3-06 [Stall Prevent Level during Run]* through the full speed range.

1 : Automatic Reduction @ CHP Region

The drive decreases the Stall Prevention level during run in the constant power range. The lower limit is 40% of the *L3-06* value.

■ L3-24: Motor Accel Time @ Rated Torque

No. (Hex.)	Name	Description	Default (Range)
L3-24 (046E) Expert	Motor Accel Time @ Rated Torque	V/f CL-V/f OLV CLV AOLV Sets the motor acceleration time to reach the maximum frequency at the motor rated torque for stopped single-drive motors.	Determined by o2-04 and E2-11 (0.001 - 10.000 s)

This parameter is enabled when *L3-04 = 2 [Stall Prevention during Decel = Intelligent (Ignore Accel Ramp)]*.

Note:

The value of Yaskawa standard motors (4 poles) is automatically set to the value of *L3-24* when the setting of *E2-11 [Motor Rated Power (kW)]* is changed by the Auto-Tuning process.

Automatic Adjustment of Parameters

Execute Inertia Tuning when *A1-02 = 3 [Control Method Selection = Closed Loop Vector]*. Parameters are automatically adjusted.

Manual Parameter Input

Derive the motor acceleration time using the following expression.

$$\text{L3-24} = \frac{2\pi \cdot J_{Motor} \cdot n_{rated}}{60 \cdot T_{rated}}$$

- J_{Motor} = Moment of inertia of motor (kg m^2)
- n_{rated} = Motor rated speed (min^{-1}, r/min)
- T_{rated} = Motor rated torque (N·m)

The rated torque is calculated using the following expression.

$$T_{rated} = \frac{60 \cdot P_{Motor} \cdot 10^3}{2\pi \cdot n_{rated}}$$

P_{Motor} = Motor Rated Power (kW)

■ L3-25: Load Inertia Ratio

No. (Hex.)	Name	Description	Default (Range)
L3-25 (046F) Expert	Load Inertia Ratio	V/f CL-V/f OLV CLV AOLV Sets the ratio between motor inertia and machine inertia.	1.0 (1.0 - 1000.0)

This parameter is enabled when *L3-04 = 2 [Stall Prevention during Decel = Intelligent (Ignore Accel Ramp)]*.

Automatic Adjustment of Parameters

Execute Inertia Tuning when *A1-02 = 3 [Control Method Selection = Closed Loop Vector]*. Parameters are automatically adjusted.

Manual Parameter Input

The load inertia ratio is calculated using the following expression.

$$\text{Load inertia ratio} = \frac{\text{Machine inertia (Motor shaft conversion value)}}{\text{Motor inertia}}$$

■ L3-26: Additional DC Bus Capacitors

No. (Hex.)	Name	Description	Default (Range)
L3-26 (0455) Expert	Additional DC Bus Capacitors	V/f CL-V/f OLV CLV AOLV Sets the capacity for external main circuit capacitors. Usually it is not necessary to change this parameter.	0 µF (0 to 65000 µF)

■ L3-27: Stall Prevention Detection Time

No. (Hex.)	Name	Description	Default (Range)
L3-27 (0456)	Stall Prevention Detection Time	V/f CL-V/f OLV CLV AOLV Sets a delay time between reaching the Stall Prevention level and starting the Stall Prevention function.	50 ms (0 - 5000 ms)

■ L3-35: Speed Agree Width for Auto Decel

No. (Hex.)	Name	Description	Default (Range)
L3-35 (0747) Expert	Speed Agree Width for Auto Decel	V/f CL-V/f OLV CLV AOLV Sets the width for speed agreement when *L3-04 = 2 [Stall Prevention during Decel = Intelligent (Ignore Decel Ramp)]*. Usually it is not necessary to change this setting.	0.00 Hz (0.00 - 1.00 Hz)

Set this parameter when hunting occurs while you use a frequency reference through an analog input.

■ L3-36: Current Suppression Gain@Accel

No. (Hex.)	Name	Description	Default (Range)
L3-36 (11D0)	Current Suppression Gain@Accel	V/f CL-V/f OLV CLV AOLV Sets the gain to suppress current and motor speed hunting during operation when *L3-01 = 3 [Stall Prevention during Accel = Current Limit Method]*. Usually it is not necessary to change this setting.	Determined by A1-02 (0.0 - 100.0)

If there is vibration in the output current during acceleration, increase the setting value.

Note:

Set *L3-01 = 3 [Stall Prevention during Accel = Current Limit Method]* to enable this function.

■ L3-37: Current Limit P Gain @ Accel

No. (Hex.)	Name	Description	Default (Range)
L3-37 (11D1) Expert	Current Limit P Gain @ Accel	V/f CL-V/f OLV CLV AOLV Suppresses current hunting during acceleration. Usually it is not necessary to change this setting.	5 ms (0 - 100 ms)

Note:

Set *L3-01 = 3 [Stall Prevention during Accel = Current Limit Method]* to enable this function.

■ L3-38: Current Limit I Time @ Accel

No. (Hex.)	Name	Description	Default (Range)
L3-38 (11D2) Expert	Current Limit I Time @ Accel	V/f CL-V/f OLV CLV AOLV Suppresses current hunting and overshooting that occurs when the drive stalls during acceleration. Usually it is not necessary to change this setting.	10.0 (0.0 - 100.0)

Note:

Set *L3-01 = 3 [Stall Prevention during Accel = Current Limit Method]* to enable this function.

■ L3-39: Current Limit Filter Time @Accel

No. (Hex.)	Name	Description	Default (Range)
L3-39 (11D3)	Current Limit Filter Time @Accel	V/f CL-V/f OLV CLV AOLV Sets the time constant to adjust the acceleration rate when *L3-01 = 3 [Stall Prevention during Accel = Current Limit Method]*. Usually it is not necessary to change this setting.	100.0 ms (1.0 - 1000.0 ms)

Note:

Set *L3-01 = 3 [Stall Prevention during Accel = Current Limit Method]* to enable this function.

■ L3-40: Current Limit S-Curve @ Acc/Dec

No. (Hex.)	Name	Description	Default (Range)
L3-40 (11D4)	Current Limit S-Curve @ Acc/Dec	V/f CL-V/f OLV CLV AOLV Sets the function to enable and disable the best S-curve characteristic used for current-limited acceleration.	0 (0, 1)

Makes the best motor acceleration rate for start up. If you set this parameter to *1*, it will make acceleration smoother, but it can also increase the acceleration time to be longer than the set time. If the drive detects *oC [Overcurrent]* faults immediately after acceleration starts, set this parameter.

0 : Disable

1 : Enabled

Note:

Set *L3-01 = 3 [Stall Prevention during Accel = Current Limit Method]* to enable this function.

◆ L4: Speed Detection

L4 parameters set the output of signals such as frequency agree and speed detection to the MFDO terminals. The motor speed is used for searches when using Closed Loop Vector Control.

■ L4-01: Speed Agree Detection Level

No. (Hex.)	Name	Description	Default (Range)
L4-01 (0499)	Speed Agree Detection Level	V/f CL-V/f OLV CLV AOLV Sets the level to detect speed agree or motor speed.	Determined by A1-02 (Determined by A1-02)

Sets the speed agree detection level or motor speed detection level when *H2-01 to H2-05 = 2, 3, 4, 5 [MFDO Function Selection = Speed Agree 1, User-Set Speed Agree 1, Frequency Detection 1, Frequency Detection 2]*.

■ L4-02: Speed Agree Detection Width

No. (Hex.)	Name	Description	Default (Range)
L4-02 (049A)	Speed Agree Detection Width	V/f CL-V/f OLV CLV AOLV Sets the width to detect speed agree or motor speed.	Determined by A1-02 (Determined by A1-02)

Sets the speed detection width or motor speed detection width when *H2-01 to H2-05 = 2, 3, 4, 5 [MFDO Function Selection = Speed Agree 1, User-set Speed Agree 1, Frequency Detection 1, Frequency Detection 2]*.

■ L4-03: Speed Agree Detect Level (+/-)

No. (Hex.)	Name	Description	Default (Range)
L4-03 (049B)	Speed Agree Detection Level(+/-)	V/f CL-V/f OLV CLV AOLV Sets the level to detect speed agree or motor speed.	Determined by A1-02 (Determined by A1-02)

Sets the speed agree detection level or motor speed detection level when *H2-01 to H2-05 = 13, 14, 15, 16 [MFDO Function Selection = Speed Agree 2, User-Set Speed Agree 2, Frequency Detection 3, Frequency Detection 4]*.

■ L4-04: Speed Agree Detection Width(+/-)

No. (Hex.)	Name	Description	Default (Range)
L4-04 (049C)	Speed Agree Detection Width(+/-)	V/f CL-V/f OLV CLV AOLV Sets the width to detect speed agree or motor speed.	Determined by A1-02 (Determined by A1-02)

Sets the speed detection width or motor speed detection width when *H2-01 to H2-05 = 13, 14, 15, 16 [MFDO Function Selection = Speed Agree 2, User-set Speed Agree 2, Frequency Detection 3, Frequency Detection 4]*.

■ L4-05: Fref Loss Detection Selection

No. (Hex.)	Name	Description	Default (Range)
L4-05 (049D)	Fref Loss Detection Selection	V/f CL-V/f OLV CLV AOLV Sets the operation when the drive detects a loss of frequency reference.	0 (0, 1)

Enables the detection of a loss of an analog frequency reference when the frequency reference is input from the MFAI terminals (A1, A2, and A3). Set *H2-01 to H2-05 = C [MFDO Function Selection = Frequency Reference Loss]* to enable this function.

Frequency reference loss is detected when the frequency reference drops below 10% within 400 ms.

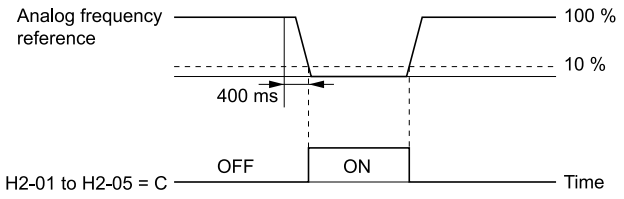


Figure 11.94 Detection of Frequency Reference Loss

0 : Stop

The drive follows the frequency reference and stops the motor.

1 : Run at (*L4-06* x Last Reference)

The drive will continue operation at the frequency reference value set to *L4-06 [FreqReference at Reference Loss]*. When the external frequency reference value is restored, the operation is continued with the frequency reference.

■ L4-06: Frequency Reference @Loss of Ref

No. (Hex.)	Name	Description	Default (Range)
L4-06 (04C2)	Frequency Reference @Loss of Ref	V/f CL-V/f OLV CLV AOLV Sets the frequency reference as a percentage to continue drive operation after it detects a frequency reference loss. The value is a percentage of the frequency reference before the drive detected the loss.	80.0% (0.0 - 100.0%)

Set *L4-05 = 1 [Fref Loss Detection Selection = Run at (L4-06 x Last Reference)]* to enable this parameter.

■ L4-07: Speed Agree Detection Selection

No. (Hex.)	Name	Description	Default (Range)
L4-07 (0470)	Speed Agree Detection Selection	V/f CL-V/f OLV CLV AOLV Sets the condition that activates speed detection.	0 (0, 1)

0 : No Detection during Baseblock

Detects the frequency while the drive is operating. When the drive turns off its output, it will not detect frequency.

1 : Detection Always Enabled

◆ L7: Torque Limit

The torque limit function limits torque generated by the motor to a constant amount by limiting the internal torque reference for the drive. This function is used to keep torque applied to loads and the generation of regenerative torque below a specific amount. This function protects machinery and improves reliability of continuous operation. Torque limits can be set individually for the four quadrants, which include torque direction (motoring/regeneration) and direction of motor rotation (forward/reverse). When the torque reference value reaches the set torque limit, the MFDO terminal set for *During Torque Limit [H2-xx = 30]* turns ON.

Note:

- Maximum output torque is limited by the drive output current. The actual output torque cannot exceed the limits of the drive rated output current even if the torque limit is set to a high value.
- When using torque limits for lifting applications, do not decrease the torque limit value too much. When the torque limit function is triggered, falls and load slipping may occur because of sudden acceleration stops and stalls of the motor.

■ Setting Method

Use one of these methods to set torque limits:

- Individually set the 4 torque limit quadrants using *L7-01 to L7-04 [Torque Limit]*.
- Individually set the 4 torque limit quadrants with MFAI. Set *H3-02, H3-06, H3-10 = 10, 11, 12 [MFAI Function Select = Forward/Reverse/Regenerative Torque Limit]*.
- Set all 4 torque limit quadrants commonly with MFAI. Set *H3-02, H3-06, H3-10 = 15 [General Torque Limit]*.
- Set all four torque limit quadrants commonly by the communication option.

The following figure illustrates the setting method for each quadrant.

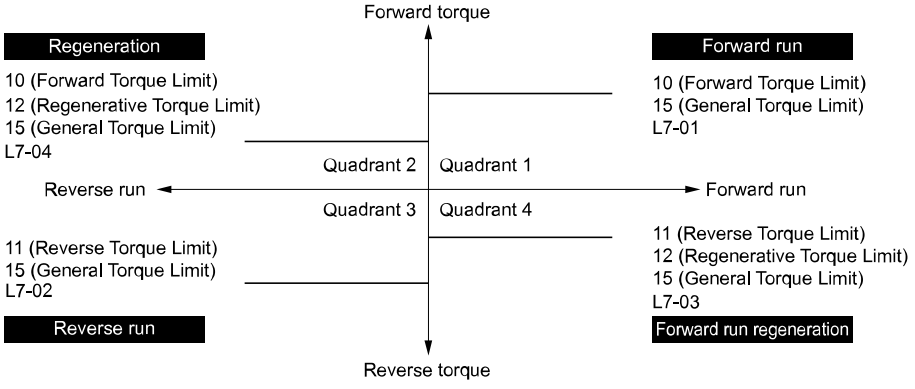


Figure 11.95 Torque Limits and Analog Input Settings Parameters

Note:

The lower value is enabled when both *L7-01 to L7-04* and either analog inputs or communication option torque limits set torque limits for the same quadrant.

As in the following example of parameter settings, the torque limit for quadrant 1 is 130% and the torque limit for quadrants 2, 3, and 4 is 150%.

Settings: *L7-01* = 130%, *L7-02*, *L7-03*, *L7-04* = 200%, MFAI torque limit = 150%

■ L7-01: Forward Torque Limit

No. (Hex.)	Name	Description	Default (Range)
L7-01 (04A7) RUN	Forward Torque Limit	V/f CL-V/f OLV CLV AOLV Sets the torque limit value for forward motoring as a percentage, where motor rated torque is the 100% value.	200% (0 - 300%)

Note:

- Use this method to set the torque limit and enable the lower torque limit:
  - Set *H3-02*, *H3-06*, or *H3-10 = 10, 15 [MFAI Function Select = Forward, Reverse/Regenerative Torque Limit]*.
  - Use a communication option to set the torque limits
- You must think about drive capacity when a large quantity of torque is necessary. If you set the value too high, the drive can detect *oC [Overcurrent]*.
- If you set the value too low with large loads, the motor can stall.

■ L7-02: Reverse Torque Limit

No. (Hex.)	Name	Description	Default (Range)
L7-02 (04A8) RUN	Reverse Torque Limit	V/f CL-V/f OLV CLV AOLV Sets the torque limit value for reversed motoring as a percentage, where motor rated torque is the 100% value.	200% (0 - 300%)

Note:

- Use this method to set the torque limit and enable the lower torque limit:
  - Set *H3-02*, *H3-06*, or *H3-10 = 10, 15 [MFAI Function Select = Forward, Reverse/Regenerative Torque Limit]*.
  - Use a communication option to set the torque limits
- You must think about drive capacity when a large quantity of torque is necessary. If you set the value too high, the drive can detect *oC [Overcurrent]*.
- If you set the value too low with large loads, the motor can stall.

■ L7-03: Forward Regenerative Trq Limit

No. (Hex.)	Name	Description	Default (Range)
L7-03 (04A9) RUN	Forward Regenerative Trq Limit	V/f CL-V/f OLV CLV AOLV Sets the torque limit value for forward regenerative conditions as a percentage of the motor rated torque.	200% (0 - 300%)

Note:

- Use this method to set the torque limit and enable the lower torque limit:
  - Set *H3-02*, *H3-06*, or *H3-10 = 10, 15 [MFAI Function Select = Forward, Reverse/Regenerative Torque Limit]*.
  - Use a communication option to set the torque limits
- You must think about drive capacity when a large quantity of torque is necessary. If you set the value too high, the drive can detect *oC [Overcurrent]*.
- If you set the value too low with large loads, the motor can stall.

■ L7-04: Reverse Regenerative Trq Limit

No. (Hex.)	Name	Description	Default (Range)
L7-04 (04AA) RUN	Reverse Regenerative Trq Limit	V/f CL-V/f OLV CLV AOLV Sets the torque limit value for reversed regenerative conditions as a percentage of the motor rated torque.	200% (0 - 300%)

Note:
- Use this method to set the torque limit and enable the lower torque limit:
  – Set *H3-02*, *H3-06*, or *H3-10 = 10, 15 [MFAI Function Select = Forward, Reverse/Regenerative Torque Limit]*.
  – Use a communication option to set the torque limits
- You must think about drive capacity when a large quantity of torque is necessary. If you set the value too high, the drive can detect *oC [Overcurrent]*.
- If you set the value too low with large loads, the motor can stall.

■ L7-06: Torque Limit Integral Time

No. (Hex.)	Name	Description	Default (Range)
L7-06 (04AC)	Torque Limit Integral Time	V/f CL-V/f **OLV** CLV AOLV Sets the integral time constant for the torque limit function.	200 ms (5 - 10000 ms)

Decrease the setting value to increase torque limit responsiveness when you use torque limits and *L7-07 = 1 [Torque Limit during Accel/Decel = Proportional & Integral control]*.

If there is hunting when torque limits are active, increase the setting value.

■ L7-07: Torque Limit during Accel/Decel

No. (Hex.)	Name	Description	Default (Range)
L7-07 (04C9)	Torque Limit during Accel/ Decel	V/f CL-V/f **OLV** CLV AOLV Sets the torque limit function during acceleration and deceleration.	0 (0, 1)

0 : Proportional only

The torque limit function works with proportional control during acceleration and deceleration, and switches to integral control at constant speed. Use this setting when quickly reaching the target speed is more important than the torque limit during speed changes.

1 : Proportional & Integral control

The torque limit function always uses integral control. Use this setting when a very accurate torque limit is necessary during speed changes, for example in winding machine applications.

If you make the torque limit the most important, it can:

- Increase the acceleration and deceleration times.
- Not let the motor speed reach the frequency reference value during run at constant speed.

■ L7-16: Torque Limit Process at Start

No. (Hex.)	Name	Description	Default (Range)
L7-16 (044D)	Torque Limit Process at Start	V/f CL-V/f **OLV** **CLV** **AOLV** Assigns a time filter to allow the torque limit to build at start.	1 (0, 1)

0 : Disabled

There is torque limit at start without a delay time.

Use this setting to maximize the response time when sudden acceleration or deceleration at start is necessary.

1 : Enabled

There is a delay time of 64 ms at start to build the torque limit.

■ L7-35: Low Freq Regen Torque Limit Lvl

No. (Hex.)	Name	Description	Default (Range)
L7-35 (1B57) Expert	Low Freq Regen Torque Limit Lvl	V/f CL-V/f OLV CLV **AOLV** Sets the torque limit used during low-speed regeneration. Usually it is not necessary to change this setting.	50.0% (0.0 - 200.0%)

Reduces the regenerative torque limit to the level set with *L7-35* when using low frequencies such that the output frequency is less than *L7-36 [Regen Torque Limit Derate Freq]*. The drive does not decrease torque limits during ramp to stop operation. Decrease the setting of *L7-35* when *oC [Overcurrent]* issues occur while a regenerative load is input and the speed reference is constant.

Note:
- Reduce the setting value of *L7-35* in increments of 10.0% and reduce the setting value of *L7-36* in increments of 2.0 Hz when faults occur during regenerative loads at low speed.
- Setting values that are too high can cause faults.
- The torque limit reduction function does not operate when *L7-35* is set with a value larger than *L7-03 [Forward Regenerative Trq Limit] or L7-04 [Reverse Regenerative Trq Limit]*.
- The motor may rotate slightly faster than the reference when a regenerative load is input at low speeds while *L7-35* is set to a low value.

■ L7-36: Regen Torque Limit Derate Freq

No. (Hex.)	Name	Description	Default (Range)
L7-36 (1B58) Expert	Regen Torque Limit Derate Freq	V/f CL-V/f OLV CLV AOLV Sets the frequency width at which *L7-35 [Low Freq Regen Torque Limit Lvl]* operates.	6.0 Hz (0.0 - 30.0 Hz)

If the drive detects *oC [Overcurrent]* faults when you connect regenerative loads at low speed, increase the setting value. Decreases the torque limit as specified by the setting of *L7-35* in a range of 0 ≤ output frequency < *L7-36*. When the torque limit gradually changes as specified by the output frequency until the output frequency = *L7-36*, the value changes to the setting of *L7-03 [Forward Regenerative Trq Limit]* and *L7-04 [Reverse Regenerative Trq Limit]*.

Note:
If you increase the setting of *L7-36*, the motor will rotate at a speed higher than specified when a you input a regenerative load. Do not set the value higher than necessary.

◆ L8: Drive Protection

L8 parameters set protective functions that prevent faults such as overheating, phase loss, and ground faults.

■ L8-01: 3% ERF DB Resistor Protection

No. (Hex.)	Name	Description	Default (Range)
L8-01 (04AD)	3% ERF DB Resistor Protection	V/f CL-V/f OLV CLV AOLV Sets the function to enable braking resistor protection with a Yaskawa ERF series braking resistor (3% ED).	0 (0, 1)

0 : Disabled

Disables dynamic braking protection. Use this setting for any dynamic braking option other than the Yaskawa ERF-type resistor.

1 : Enabled

Enables protection for Yaskawa ERF-type resistors.

Note:
Set *L8-01 = 1* and *H2-01 to H2-05 = D [MFDO Function Selection = Braking Resistor Fault]*. Use a sequence that shuts the power OFF by using MFDO.

■ L8-02: Overheat Alarm Level

No. (Hex.)	Name	Description	Default (Range)
L8-02 (04AE)	Overheat Alarm Level	V/f CL-V/f OLV CLV AOLV Sets the *oH* detection level in temperature.	Determined by o2-04 (50 - 150 °C)

The alarm is output when the heatsink temperature exceeds the temperature set in *L8-02*. To enable this function, set one of *H2-01 to H2-05 [MFDO Function Selection]* to *20 [Drive Overheat Pre-Alarm (oH)]*.

If the temperature reaches the overheat fault level, the drive will trigger an *oH1 [Heatsink Overheat]* fault and stop operation.

■ L8-03: Overheat Pre-Alarm Selection

No. (Hex.)	Name	Description	Default (Range)
L8-03 (04AF)	Overheat Pre-Alarm Selection	V/f CL-V/f OLV CLV AOLV Sets operation after the drive detects an *oH* alarm.	3 (0 - 4)

0 : Ramp to Stop

The drive ramps the motor to stop according to the deceleration time. Fault relay output terminal MA-MC will turn ON, and MB-MC will turn OFF.

1 : Coast to Stop

The drive output shuts off and the motor coasts to stop. Fault relay output terminal MA-MC will turn ON, and MB-MC will turn OFF.

2 : Fast Stop (Use C1-09)

The drive stops the motor using the deceleration time set in *C1-09 [Fast Stop Time]*. Fault relay output terminal MA-MC will turn ON, and MB-MC will turn OFF.

3 : Alarm Only

The keypad shows *oH*, and the drive continues operation. The output terminal set for *Alarm [H2-01 to H2-05 = 10]* switches ON.

4 : Operate at Reduced Speed (L8-19)

The drive performs deceleration to the level set in *L8-19 [Freq Reduction @ oH Pre-Alarm]* and continues operation. *oH* flashes on the keypad.

The drive decelerates again if the overheat alarm is still ON after 10 s. The drive continues to decelerate every 10 s while the alarm continues to be output. If the overheat alarm is still output after the drive decelerated 10 times, the output terminal set for *oH Pre-Alarm Reduction Limit [H2-01 to H2-05 = 4D]* switches ON. When the overheat alarm stops being output during deceleration, the drive accelerates until the frequency reference valid prior to this overheat alarm output being turned OFF is reached. The following diagram shows the output of the overheat alarm and the drive operation at a diminished output frequency.

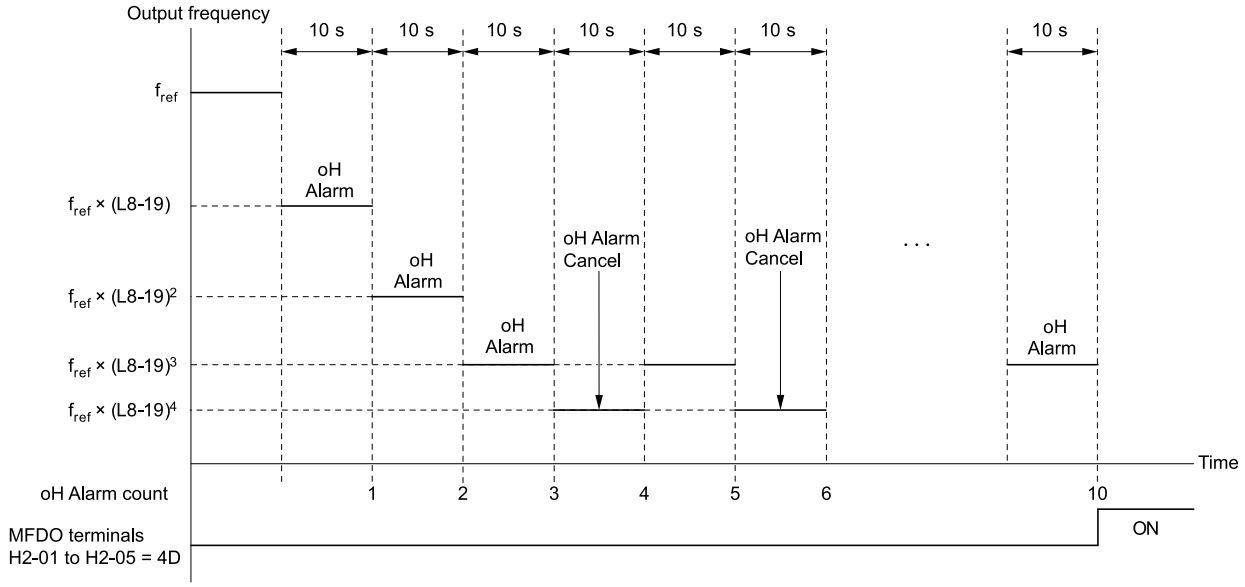


Figure 11.96 Drive Operation at a Diminished Output Frequency when the Overheat Alarm is Output

■ L8-05: Input Phase Loss Protection Sel

No. (Hex.)	Name	Description	Default (Range)
L8-05 (04B1)	Input Phase Loss Protection Sel	V/f CL-V/f OLV CLV AOLV Sets the function to enable and disable input phase loss detection.	1 (0, 1)

0 : Disable

1 : Enabled

The drive measures ripples in DC bus voltage to detect input phase loss.

The drive detects phase loss when power supply phase loss occurs or the main circuit capacitor becomes unusable, which causes *PF [Input Phase Loss]* to show on the keypad.

Disable the detection of the input power supply phase loss function in these conditions:

- During deceleration
- The run command is not input

• The output current is less than 30% of the drive rated current.

■ L8-07: Output Phase Loss Protection Sel

No. (Hex.)	Name	Description	Default (Range)
L8-07 (04B3)	Output Phase Loss Protection Sel	V/f CL-V/f OLV CLV AOLV Sets the function to enable and disable output phase loss detection. The drive starts output phase loss detection and the motor coasts to stop when the output current decreases to less than 5% of the drive rated current.	1 (0 - 2)

Note:

Output phase loss detection can mistakenly be triggered in the following situations. Disable output phase loss protection.
• The motor rated current is very small compared to the drive rating.

0 : Disabled

1 : Fault when one phase is lost

An *LF [Output Phase Loss]* is triggered when one output phase is lost.

The drive output shuts off and the motor coasts to stop.

2 : Fault when two phases are lost

An *LF [Output Phase Loss]* is triggered when two or more output phases are lost.

The drive output shuts off and the motor coasts to stop.

■ L8-08: Output Phase Loss Detection Lvl

No. (Hex.)	Name	Description	Default (Range)
L8-08 (04B4)	Output Phase Loss Detection Lvl	V/f CL-V/f OLV CLV AOLV Sets the output phase loss detection level.	5.0% (0.0 - 20.0%)

■ L8-09: Output Ground Fault Detection

No. (Hex.)	Name	Description	Default (Range)
L8-09 (04B5)	Output Ground Fault Detection	V/f CL-V/f OLV CLV AOLV Sets the function to enable and disable ground fault protection.	Determined by o2-04 (0, 1)

0 : Disabled

The drive will not detect ground faults.

1 : Enabled

If there is high leakage current or a ground short circuit in one or two output phases, the drive will detect *GF [Ground Fault]*.

Note:

If the ground path impedance is low, the drive can detect *oC [Overcurrent]*, *SC [Short Circuit/IGBT Failure]*, or *ov [Overvoltage]* instead of *GF*.

■ L8-10: Heatsink Fan Operation Selection

No. (Hex.)	Name	Description	Default (Range)
L8-10 (04B6)	Heatsink Fan Operation Selection	V/f CL-V/f OLV CLV AOLV Sets operation of the heatsink cooling fan.	0 (0 - 2)

0 : During Run, w/ L8-11 Off-Delay

The drive turns on the fan when a Run command is active.

When you release the Run command and the delay time set in *L8-11 [Heatsink Fan Off-Delay Time]* is expired, the fan stops. This setting extends the fan lifetime.

1 : Always On

The fan turns on when you supply power to the drive.

2 : Temperature-Dependent Fan Ctrl.

The fan turns on when the drive detects that the main circuit is overheating.

■ L8-11: Heatsink Fan Off-Delay Time

No. (Hex.)	Name	Description	Default (Range)
L8-11 (04B7)	Heatsink Fan Off-Delay Time	V/f CL-V/f OLV CLV AOLV Sets the length of time that the drive will wait before it stops the cooling fan after it cancels the Run command when *L8-10 = 0 [Heatsink Fan Operation Selection = During Run, w/ L8-11 Off-Delay]*.	60 s (0 - 300 s)

■ L8-12: Ambient Temperature Setting

No. (Hex.)	Name	Description	Default (Range)
L8-12 (04B8)	Ambient Temperature Setting	V/f CL-V/f OLV CLV AOLV Sets the ambient temperature of the drive installation area.	40 °C (-10 °C - +50 °C)

The drive automatically adjusts the drive rated current to the best value as specified by the set temperature. Set the ambient temperature of the area where you install the drive to a value that is more than the drive rating.

■ L8-15: Drive oL2 @ Low Speed Protection

No. (Hex.)	Name	Description	Default (Range)
L8-15 (04BB)	Drive oL2 @ Low Speed Protection	V/f CL-V/f OLV CLV AOLV Sets the function to decrease the drive overload level at which the drive will trigger *oL2 [Drive Overload]* during low speed operation (6 Hz or slower) to prevent damage to the main circuit transistors.	1 (0, 1)

Note:

Contact Yaskawa or your nearest sales representative before disabling this function at low speeds. If you frequently operate drives with high output current in low speed ranges, it can cause heat stress and decrease the life span of drive IGBTs.

0 : Disabled (No Additional Derate)

The drive does not decrease the overload protection level.

1 : Enabled (Reduced oL2 Level)

When the drive detects *oL2* during low speed operation, it automatically decreases the overload detection level.

At zero speed, the drive derates the overload by 50%.

■ L8-18: Software Current Limit Selection

No. (Hex.)	Name	Description	Default (Range)
L8-18 (04BE)	Software Current Limit Selection	V/f CL-V/f OLV CLV AOLV Set the software current limit selection function to prevent damage to the main circuit transistor caused by too much current.	0 (0, 1)

0 : Disabled

When the output current is at the software current limit value, the drive does not restrict the output voltage.

Note:

The drive may detect an *oC [Overcurrent]* when loads are particularly heavy or the acceleration time is particularly short.

1 : Enabled

When the output current is at the software current limit value, the drive decreases output voltage to decrease output current.

When the output current decreases to the software current limit level, the drive starts usual operation.

■ L8-19: Freq Reduction @ oH Pre-Alarm

No. (Hex.)	Name	Description	Default (Range)
L8-19 (04BF)	Freq Reduction @ oH Pre-Alarm	V/f CL-V/f OLV CLV AOLV Sets the ratio at which the drive derates the frequency reference during an *oH* alarm.	0.8 (0.1 - 0.9)

When these two conditions are correct, this function is enabled:

- *L8-03 = 4 [Overheat Pre-Alarm Ope Selection = Run@L8-19 Rate]*
- *oH* alarm is output

■ L8-32: Cooling Fan Failure Selection

No. (Hex.)	Name	Description	Default (Range)
L8-32 (04E2)	Cooling Fan Failure Selection	V/f CL-V/f OLV CLV AOLV Sets operation when the drive detects *FAn [Internal Fan Fault]*.	1 (0 - 4)

0 : Ramp to Stop

The drive ramps the motor to stop according to the deceleration time. Fault relay output terminal MA-MC will turn ON, and MB-MC will turn OFF.

1 : Coast to Stop

The drive output shuts off and the motor coasts to stop. Fault relay output terminal MA-MC will turn ON, and MB-MC will turn OFF.

2 : Fast Stop (Use C1-09)

The drive stops the motor using the deceleration time set in *C1-09 [Fast Stop Time]*. Fault relay output terminal MA-MC will turn ON, and MB-MC will turn OFF.

3 : Alarm Only

FAn appears on the keypad, and the drive continues operating. The output terminal set for *Alarm [H2-01 to H2-05 = 10]* switches ON.

4 : Operate at Reduced Speed (L8-19)

The drive performs deceleration to the level set in *L8-19 [Freq Reduction @ oH Pre-Alarm]* and continues operation. *FAn* flashes on the keypad. Refer to "L8-03: Overheat Pre-Alarm Ope Selection" for more information on drive derating operation.

■ L8-35: Installation Method Selection

No. (Hex.)	Name	Description	Default (Range)
L8-35 (04EC)	Installation Method Selection	V/f CL-V/f OLV CLV AOLV Sets the type of drive installation.	Determined by the drive (0 - 3)

Note:
- This parameter is not initialized by *A1-03 [Initialize Parameters]*.
- The value is preset to the appropriate value when the drive is shipped. Change the setting value in the following circumstances only.
  – Drives are installed side-by-side
  – Drive cooling fins (heatsinks) are installed externally to the control panel

The overload protection detection level for the drive is automatically adjusted to the optimal value in accordance with the setting value. Change this setting when drives are installed Side-by-Side or when mounting a standard drive with the heatsink outside the enclosure panel.

0 : IP20/Open-Chassis enclosure

Select this setting when installing the IP20 open type enclosure drive.

Ensure that there is at least 30 mm (1.18 in.) of space between drives or between the drive and side of the enclosure panel.

1 : Side-by-Side Mounting

Select this setting when multiple drives are installed Side-by-Side.

Ensure that there is at least 2 mm (0.08 in.) of space between drives when installed side-by-side.

2 : IP21/NEMA Type 1/IP55

Select this setting when installing UL Type 1 enclosed wall-mounted type drives or IP55 drives.

3 : Finless / External Heatsink

Select this setting when installing finless type drives or when the cooling fin (heatsink) is external to the enclosure panel.

■ L8-38: Carrier Frequency Reduction

No. (Hex.)	Name	Description	Default (Range)
L8-38 (04EF)	Carrier Frequency Reduction	V/f CL-V/f OLV CLV AOLV Sets the carrier frequency reduction function. The drive reduces the carrier frequency when the output current is more than a specified level.	Determined by A1-02 and o2-04 (0 - 2)

As decreasing the carrier frequency increases the overload tolerance, the overload capacity is increases temporarily for *oL2 [Drive Overloaded]*, allowing the drive to run through transient load peaks without tripping.

0 : Disabled

No carrier frequency reduction at high current.

1 : Enabled below 6 Hz

The carrier frequency is reduced at speeds below 6 Hz when the current exceeds 100% of the drive rated current.

The drive returns to the normal carrier frequency when the current falls below 88% or the output frequency exceeds 7 Hz.

2 : Enabled for All Speeds

The carrier frequency is reduced at the following speeds:

- Output current is at least 100% of the drive rated current while the frequency reference is lower than 6 Hz.
- Output current is at least 112% of the drive rated current while the frequency reference is higher than or equal to 7 Hz.

The drive uses the delay time set in *L8-40 [CarrierFreqReduct Off DelayTime]* and a hysteresis of 12% when switching the carrier frequency back to the set value.

■ L8-39: Carrier Freq Reduction during oL

No. (Hex.)	Name	Description	Default (Range)
L8-39 (04F0)	Carrier Freq Reduction during oL	V/f CL-V/f OLV CLV AOLV Sets the low carrier frequency when IGBT protection is enabled.	Determined by o2-04 (1.0 - 15.0 kHz)

Sets the low carrier frequency when IGBT protection is enabled.

■ L8-40: Carrier Freq Reduction Off-Delay

No. (Hex.)	Name	Description	Default (Range)
L8-40 (04F1)	Carrier Freq Reduction Off-Delay	V/f CL-V/f OLV CLV AOLV Sets the length of time until the automatically reduced carrier frequency returns to the condition before the reduction.	Determined by A1-02 (0.00 - 2.00 s)

Set *L8-40 ≠ 0.00* to enable the carrier frequency reduction function during start-up. When operation starts, the drive automatically decreases the carrier frequency. When the time set in *L8-40* is expired, the carrier frequency returns to the value set in *C6-02 [Carrier Frequency Selection]*.

■ L8-41: High Current Alarm Selection

No. (Hex.)	Name	Description	Default (Range)
L8-41 (04F2)	High Current Alarm Selection	V/f CL-V/f OLV CLV AOLV Triggers an *HCA [Current Alarm]* when the output current exceeds 150% of the drive rated current.	1 (0, 1)

0 : Disabled

An *HCA* is not detected.

1 : Enabled

An *HCA* is triggered when the output current exceeds 150% of the drive rated current.

The MFDO terminal set for Alarm *[H2-01 to H2-05 = 10]* turns ON.

■ L8-55: Internal DB TransistorProtection

No. (Hex.)	Name	Description	Default (Range)
L8-55 (045F)	Internal DB TransistorProtection	V/f CL-V/f OLV CLV AOLV Sets the protection function for the internal braking transistor.	1 (0, 1)

0 : Disable

Disables braking transistor protection.

Use this setting in the following situation. Enabling the braking transistor in the following situations may cause an *rF [Braking Resistor Fault]*.

- When using a regenerative converter, such as the D1000.
- When using a regenerative unit, such as the R1000.
- When connecting braking resistor options to the drive, such as CDBR units.
- When using no internal braking transistor.

1 : Protection Enabled

Protects internal braking transistor when using a braking transistor or optional braking resistors.

The following models have a built-in braking transistor .

- 2003 to 2115
- 4002 to 4150

◆ L9: Drive Protection 2

L9 parameters are used to configure the protection function used to detect cooling fan faults.

■ L9-16: FAn1 Detect Time

No. (Hex.)	Name	Description	Default (Range)
L9-16 (11DC) Expert	FAn1 Detect Time	V/f CL-V/f OLV CLV AOLV Sets the detection time for *FAn1 [Drive Cooling Fan Fault]*. Yaskawa recommends that you do not change this parameter value.	4.0 s (0.0 - 30.0 s)

11.10 n: Special Adjustment

n parameters are used to set the following functions.

- Hunting Prevention
- Motor line-to-line resistance online tuning
- Fine tune the parameters that adjust motor control

◆ n1: Hunting Prevention

The Hunting Prevention function will not let low inertia or operation with a light load cause hunting. Hunting frequently occurs when you have a high carrier frequency and an output frequency less than 30 Hz.

■ n1-01: Hunting Prevention Selection

No. (Hex.)	Name	Description	Default (Range)
n1-01 (0580)	Hunting Prevention Selection	V/f CL-V/f OLV CLV AOLV Sets the function to prevent hunting.	Determined by o2-04 (0 - 2)

Disable this function to prioritize responsiveness over motor vibration reduction.

Greater suppression of hunting can be obtained by selecting *n1-01 = 2* if hunting occurs, or when using a high carrier frequency.

0 : Disabled

1 : Enabled (Normal)

2 : Enabled (High Carrier Frequency)

■ n1-02: Hunting Prevention Gain Setting

No. (Hex.)	Name	Description	Default (Range)
n1-02 (0581) Expert	Hunting Prevention Gain Setting	V/f CL-V/f OLV CLV AOLV Sets the performance of the hunting prevention function. Usually it is not necessary to change this parameter.	1.00 (0.00 - 2.50)

Adjust this parameter in these conditions:

- When *n1-01 = 1, 2 [Hunting Prevention Selection = Enabled (Normal), Enabled (High Carrier Frequency)]*: If oscillation occurs when you operate a motor with a light load, increase the setting value in 0.1-unit increments.
- When *n1-01 = 1, 2*, if the motor stalls: Decrease the setting value in 0.1-unit increments.

■ n1-03: Hunting Prevention Time Constant

No. (Hex.)	Name	Description	Default (Range)
n1-03 (0582) Expert	Hunting Prevention Time Constant	V/f CL-V/f OLV CLV AOLV Sets the primary delay time constant of the hunting prevention function. Usually it is not necessary to change this parameter.	Determined by o2-04 (0 - 500 ms)

Adjust this parameter in these conditions:

- Load inertia is large: Increase the setting value. If the setting value is too high, response will be slower. Also, there will be oscillation when the frequency is low.
- Oscillation occurs at low frequencies: Decrease the setting value.

■ n1-05: Hunting Prevent Gain in Reverse

No. (Hex.)	Name	Description	Default (Range)
n1-05 (0530) Expert	Hunting Prevent Gain in Reverse	V/f CL-V/f OLV CLV AOLV Sets the performance of the hunting prevention function. This parameter adjusts Reverse run. Usually it is not necessary to change this parameter.	0.00 (0.00 - 2.50)

Note:

When you set this parameter to 0, the value set in *n1-02 [Hunting Prevention Gain Setting]* is effective when the motor rotates in reverse.

Adjust this parameter in these conditions:

- When *n1-01 = 1, 2 [Hunting Prevention Selection = Enabled (Normal), Enabled (High Carrier Frequency)]*: If oscillation occurs when you operate a motor with a light load, increase the setting value in 0.1-unit increments.
- When *n1-01 = 1, 2*, if the motor stalls: Decrease the setting value in 0.1-unit increments.

■ n1-08: Current Detection Method

No. (Hex.)	Name	Description	Default (Range)
n1-08 (1105) Expert	Current Detection Method	V/f CL-V/f **OLV** **CLV** **AOLV** Sets how the drive decreases the motor vibration that is caused by leakage current. Usually it is not necessary to change this parameter.	0 (0, 1)

0 : 2-Phases

1 : 3-Phases

Note:

The *n1-08 = 1* setting is effective in suppressing motor vibrations due to leakage current when the wiring distance is long.

■ n1-13: DC Bus Stabilization Control

No. (Hex.)	Name	Description	Default (Range)
n1-13 (1B59) Expert	DC Bus Stabilization Control	**V/f** **CL-V/f** OLV CLV AOLV Sets the oscillation suppression function for the DC bus voltage.	0 (0, 1)

0 : Disabled

1 : Enabled

Note:

If the DC bus voltage does not become stable with light loads and the drive detects *ov [Overvoltage]*, set this parameter to 1.

■ n1-14: DC Bus Stabilization Time

No. (Hex.)	Name	Description	Default (Range)
n1-14 (1B5A) Expert	DC Bus Stabilization Time	**V/f** **CL-V/f** OLV CLV AOLV Adjusts the responsiveness of the oscillation suppression function for the DC bus voltage. Set *n1-13 = 1 [DC Bus Stabilization Control = Enabled]* to enable this parameter.	100.0 ms (50.0 - 500.0 ms)

Note:

Adjust this parameter in 100 ms increments.

■ n1-15: PWM Voltage Offset Calibration

No. (Hex.)	Name	Description	Default (Range)
n1-15 (0BF8) Expert	PWM Voltage Offset Calibration	**V/f** **CL-V/f** **OLV** **CLV** **AOLV** Sets the calibration method that the drive uses to decrease torque/current ripple.	Determined by A1-02 (0 - 2)

This calibration function lets the drive suppress the torque ripple of a motor. Usually it is not necessary to change this setting.

0 : No Calibration

1 : One Time Calibrate at Next Start

2 : Calibrate Every Time at Start

■ n1-16: Hunting Prevention High Fc Gain

No. (Hex.)	Name	Description	Default (Range)
n1-16 (0BFB)	Hunting Prevention High Fc Gain	**V/f** **CL-V/f** OLV CLV AOLV Sets the gain for the hunting prevention function. This parameter functions best with a high carrier frequency. Usually it is not necessary to change this parameter.	Determined by o2-04 (0.00 - 2.50)

Set *n1-01 = 2 [Hunting Prevention Selection = Enabled (High Carrier Frequency)]* to enable this function.

If the motor oscillates, set *n1-01 = 2*. If that does not have an effect, increase this parameter in 0.2-unit increments.

■ n1-17: Hunting Prevent High Fc Filter

No. (Hex.)	Name	Description	Default (Range)
n1-17 (0BFC) Expert	Hunting Prevent High Fc Filter	V/f CL-V/f OLV CLV AOLV Sets the responsiveness of the hunting prevention function. Usually it is not necessary to change this parameter.	500 ms (0 - 1000 ms)

When *n1-01 = 2 [Hunting Prevention Selection = Enabled (High Carrier Frequency)]*, if the motor stalls when the load changes, increase the value set in this parameter in 100 ms increments.

If you set *n1-01 = 2* and you cannot suppress hunting, increase the value set in this parameter in 100 ms increments.

■ n1-20: Voltage Calibration Duration

No. (Hex.)	Name	Description	Default (Range)
n1-20 (1588) Expert	Voltage Calibration Duration	V/f CL-V/f OLV CLV AOLV Sets the calibration time at start. Usually it is not necessary to change this parameter.	50 ms (10 - 500 ms)

◆ n2: Auto Freq Regulator (AFR)

The speed feedback detection reduction function (or AFR: Automatic Frequency Regulator) helps the speed become stable when you suddenly apply or remove a load.

Note:

Before you change *n2-xx parameters*, do one of these procedures:

- Set the motor parameters and V/f pattern correctly.
- Do Rotational Auto-Tuning.

■ n2-01: Automatic Freq Regulator Gain(F)

No. (Hex.)	Name	Description	Default (Range)
n2-01 (0584)	Automatic Freq Regulator Gain(F)	V/f CL-V/f OLV CLV AOLV Sets the gain of the AFR function for forward run as a magnification value. Usually it is not necessary to change this setting.	1.00 (0.00 - 10.00)

Adjust this parameter in these conditions:

- If hunting or oscillation occurs with light loads, increase the setting value in 0.05-unit increments and examine the response.
- When torque is not sufficient with heavy loads or to make the torque or speed response better, decrease the setting value in 0.05-unit increments and examine the response.

■ n2-02: Automatic Freq Regulator Time 1

No. (Hex.)	Name	Description	Default (Range)
n2-02 (0585)	Automatic Freq Regulator Time 1	V/f CL-V/f OLV CLV AOLV Sets the time constant that sets the rate of change for the AFR function. Usually it is not necessary to change this setting.	50 ms (0 - 2000 ms)

Adjust this parameter in these conditions:

- If there is hunting or oscillation with a light load, increase the setting value in 50 ms increments and examine the response. If the load inertia is large, increase the setting value in 50 ms increments and examine the response.
- If torque is not sufficient with a heavy load or if you must increase torque or speed responsiveness, decrease the setting value in 10 ms increments and examine the response.

Note:

- Set *n2-02 ≤ n2-03 [Automatic Freq Regulator Time 2]*. If *n2-02 > n2-03*, the drive will detect *oPE08 [Parameter Selection Error]*.
- When you change the value in *n2-02*, also change the value in *C4-02 [Torque Compensation Delay Time]* by the same ratio.

■ n2-03: Automatic Freq Regulator Time 2

No. (Hex.)	Name	Description	Default (Range)
n2-03 (0586)	Automatic Freq Regulator Time 2	V/f CL-V/f **OLV** CLV AOLV Sets the time constant to determine the variation in speed of the AFR function. Use this parameter during regeneration. Usually it is not necessary to change this setting.	750 ms (0 - 2000 ms)

Adjust this parameter in these conditions:

- If the drive detects *ov [Overvoltage]* when acceleration stops under high-inertia loads, increase the setting value in 50 ms increments.
  If the drive detects *ov* when the load changes suddenly, increase the setting value in 50 ms increments.
- To increase the responsiveness of torque and speed, decrease the setting value in 10 ms increments and examine the response.

Note:
- Set *n2-03* ≤ *n2-02 [Automatic Freq Regulator Time 1]*. If *n2-02* > *n2-03*, the drive will detect *oPE08 [Parameter Selection Error]*.
- When you change the value in *n2-03*, also change the value in *C4-06 [Motor 2 Torque Comp Delay Time]* by the same ratio.

■ n2-06: Automatic Freq Regulator Gain(R)

No. (Hex.)	Name	Description	Default (Range)
n2-06 (1567)	Automatic Freq Regulator Gain(R)	V/f CL-V/f **OLV** CLV AOLV Sets the gain of the AFR function for reverse run as a magnification value. Usually it is not necessary to change this setting.	1.00 (0.00 - 10.00)

◆ n3: Overexcitation Braking

n3 parameters are used to set overexcitation deceleration.

■ Overexcitation Deceleration

Overexcitation deceleration is used to quickly decelerate motors without connecting braking resistors to the drive.

This enables motors to be stopped more quickly than with normal ramp to stop processes.

Overexcitation deceleration generates significant braking torque through motor overexcitation by increasing excitation current during deceleration.

The deceleration time can be adjusted for overexcitation deceleration by specifying the deceleration speed. Reacceleration of motors can also be performed during deceleration. Entering the Run command during overexcitation deceleration cancels overexcitation deceleration and the drive reaccelerates to the specified speed.

To enable this function, set *L3-04 =4, 5 [Stall Prevention during Decel = Overexcitation/High Flux, Overexcitation/High Flux 2]*.

When *L3-04 = 4*, motors decelerate for the currently valid *Deceleration Times [C1-02, C1-04, C1-06, or C1-08]*. Increase the deceleration time when *ov [Overvoltage]* issues occur.

When *L3-04 = 5*, the drive decelerates with the *Deceleration Times [C1-02, C1-04, C1-06, or C1-08]* while adjusting the deceleration rate to keep the DC bus voltage at the level set in *L3-17 [DC Bus Regulation Level]*. The actual stopping time will be longer or shorter than the set deceleration time depending on the motor characteristics and the load inertia.

Notes on Overexcitation Deceleration

- Do not use Overexcitation Deceleration in combination with a braking resistor option.
- Do not use Overexcitation Deceleration for the following applications. Connect a braking resistor to the drive instead of using Overexcitation Deceleration.
  - Frequent repetition of sudden decelerations
  - Continuous regenerative loads
  - Low inertia machines
  - Machines that have no tolerance for torque ripples
- Motor loss increases during overexcitation deceleration. Use this function under conditions of duty time factors of 5% ED or less and braking times of 90 seconds or less. Braking time varies depending on the load inertia and motor characteristics.

- Overexcitation deceleration can be used with OLV control and CLV control, but cannot provide as significant effect as V/f Control because it needs to secure torque accuracy.
- The following functions are disabled during braking using Overexcitation Deceleration 2, depending on the control mode combined.
  - Hunting Prevention Function (V/f Control Mode)
  - Torque Limit Speed Control (Open Loop Vector Control Mode)

■ n3-13: OverexcitationBraking (OEB) Gain

No. (Hex.)	Name	Description	Default (Range)
n3-13 (0531)	OverexcitationBraking (OEB) Gain	V/f CL-V/f OLV CLV AOLV Sets the gain value that the drive multiplies by the V/f pattern output value during overexcitation deceleration to calculate the overexcitation level.	1.10 (1.00 - 1.40)

The V/f pattern output value goes back to its usual level after the motor stops or accelerates again to the frequency reference speed.

The best value of this parameter changes when the flux saturation characteristics of the motor change.

- Gradually increase the value of *n3-13* to 1.25 or 1.30 to increase the braking power of Overexcitation Deceleration. If the gain is too much, the motor can have flux saturation and cause a large quantity of current to flow.
- This can increase the deceleration time. Decrease the setting value if flux saturation causes overcurrent. If you increase the setting value, the drive can detect *oC [Overcurrent]*, *oL1 [Motor Overload]*, and *oL2 [Drive Overload]*. Decrease the value of *n3-21 [HSB Current Suppression Level]* to prevent *oC* and *oL*.
- If you use overexcitation deceleration frequently or if you use overexcitation deceleration for an extended period of time, it can increase motor temperature. Decrease the setting value in these conditions.
- If *ov [Overvoltage]* occurs, increase the deceleration time.

■ n3-14: OEB High Frequency Injection

No. (Hex.)	Name	Description	Default (Range)
n3-14 (0532) Expert	OEB High Frequency Injection	V/f CL-V/f OLV CLV AOLV Sets the function that injects harmonic signals during overexcitation deceleration.	0 (0, 1)

Enable this parameter to set a shorter deceleration time.

Note:
- If you frequently use overexcitation deceleration on a motor, the motor loss will increase the risk of burn damage.
- When you set this parameter to *1*, the motor can make a loud excitation sound during overexcitation deceleration. If the excitation sound is unwanted, set this parameter to *0* to disable the function.

0 : Disabled

1 : Enabled

The drive injects harmonic signals at the time of overexcitation deceleration. You can decrease the deceleration time because motor loss increases.

■ n3-21: HSB Current Suppression Level

No. (Hex.)	Name	Description	Default (Range)
n3-21 (0579)	HSB Current Suppression Level	V/f CL-V/f OLV CLV AOLV Sets the upper limit of the current that is suppressed at the time of overexcitation deceleration as a percentage of the drive rated current.	100% (0 - 150%)

If flux saturation during Overexcitation Deceleration makes the motor current become more than the value set in *n3-21*, the drive will automatically decrease the overexcitation gain. If *oC [Overcurrent]*, *oL1 [Motor Overload]*, or *oL2 [Drive Overload]* occur during overexcitation deceleration, decrease the setting value.

If repetitive or long overexcitation deceleration cause the motor to overheat, decrease the setting value.

■ n3-23: Overexcitation Braking Operation

No. (Hex.)	Name	Description	Default (Range)
n3-23 (057B)	Overexcitation Braking Operation	V/f CL-V/f OLV CLV AOLV Sets the direction of motor rotation where the drive will enable overexcitation.	0 (0 - 2)

0 : Disabled

1 : Enabled Only when Rotating FWD

2 : Enabled Only when Rotating REV

Note:

When *n3-23 = 1, 2*, the drive enables overexcitation only in the direction of motor rotation in which a regenerative load is applied. Increased motor loss can decrease *ov [Overvoltage]* faults.

◆ n4: Adv Open Loop Vector Tune

To make special adjustments for *Advanced Open Loop [A1-02 = 4]* (AOLV) control, note these items:

- Do Rotational Auto-Tuning first.
- When there is a load, applications must stay constant around zero speed in AOLV control. If the application will not stay constant around zero speed, set *A1-02 = 3 [Closed Loop Vector]*.
- The tolerance of regenerative torque at low speeds decreases in AOLV control. When regenerative torque is necessary in the low speed range, set *A1-02 = 3*.
- You cannot use AOLV control in elevators or other lifting applications because there is a risk that the load could slip.
- If you operate the drive at a frequency lower than *n4-70 [Speed Command Comp @ Low Freq]* (default setting: 1.00 Hz), the motor can rotate at a frequency that is approximately 1/2 of the *n4-70* setting. Set *E1-09 [Minimum Output Frequency] > 0* to not let the motor to rotate at a lower frequency than the *n4-70* setting. When the frequency reference ≤ *E1-09*, the drive output will turn OFF.

■ n4-60: Motoring Low Speed Comp Gain

No. (Hex.)	Name	Description	Default (Range)
n4-60 (1B80)	Motoring Low Speed Comp Gain	V/f CL-V/f OLV CLV AOLV Sets a compensation gain to improve the control qualities for motoring loads in the low speed range.	100.0% (50.0 - 200.0%)

Note:

- To improve torque accuracy in the motoring direction when running at low speeds, either perform only Stationary Auto-Tuning for Line-to-Line Resistance, or increase the setting value in 5% increments. The recommended setting is 100% to 120%.
- If the output frequency changes when you operate at low speeds, do Stationary Auto-Tuning for Line-to-Line Resistance only. If it is not better, increase this parameter in 10% increments. The recommended setting is 50% to 100%.

■ n4-61: Low Speed Comp Frequency Level

No. (Hex.)	Name	Description	Default (Range)
n4-61 (1B81)	Low Speed Comp Frequency Level	V/f CL-V/f OLV CLV AOLV Sets a frequency at which the settings *n4-60 [Motoring Low Speed Comp Gain]* and *n4-62 [Regen Low Speed Comp Gain]* are enabled. When the output frequency < n4-61, the drive adjusts the torque to agree with the settings for *n4-60* and *n4-62*. Usually it is not necessary to change this setting.	6.00 Hz (0.50 - 12.00 Hz)

■ n4-62: Regen Low Speed Comp Gain

No. (Hex.)	Name	Description	Default (Range)
n4-62 (1B82)	Regen Low Speed Comp Gain	V/f CL-V/f OLV CLV AOLV Sets a compensation gain to improve the control qualities for regenerative loads in the low speed range.	100.0 % (50.0 - 500.0%)

Note:

If you do not apply a regenerative load when you operate at low speeds, do stationary Auto-Tuning for Line-to-Line Resistance only. If this does not make it better, increase the setting value in 5% increments. The recommended setting is 100% to 150%. If you set this parameter too high, the drive will detect *CF [Control Fault]* at stop.

■ n4-63: Speed EstimateResponse@High Freq

No. (Hex.)	Name	Description	Default (Range)
n4-63 (1B83)	Speed EstimateResponse@High Freq	V/f CL-V/f OLV CLV **AOLV** In high speed ranges, where the output frequency is ≥ *n4-67 [SwitchingFreq forEstimation gain]*, this adjusts the responsiveness of the speed estimation.	60.0 (0.1 - 300.0)

When an improvement in the response of speed estimation is desired, or when the motor speed oscillates, or when there is a significant amount of torque ripple, increase the setting value in 10.0 increments. If no improvement is obtained, decrease the setting value in 10.0 increments.

Note:

Before adjusting *n4-63, n4-64 [Speed Estimate Response@Low Freq], n4-65 [Flux Estimate Response@High Freq], n4-66 [Flux Estimate Response @Low Freq]*, carry out rotational Auto-Tuning.

■ n4-64: Speed Estimate Response@Low Freq

No. (Hex.)	Name	Description	Default (Range)
n4-64 (1B84)	Speed Estimate Response@Low Freq	V/f CL-V/f OLV CLV **AOLV** In low speed ranges, where 0 ≤ the output frequency, which is < *n4-67 [SwitchingFreq forEstimation gain]*, this adjusts the responsiveness of the speed estimation.	60.0 (0.1 - 300.0)

When an improvement in the response of speed estimation is desired, or when the motor speed oscillates, or when there is a significant amount of torque ripple, increase the setting value in 10.0 increments. If no improvement is obtained, decrease the setting value in 10.0 increments.

Note:

Before adjusting *n4-63 [Speed EstimateResponse@High Freq]*, *n4-64*, *n4-65 [Flux Estimate Response@High Freq]*, *n4-66 [Flux Estimate Response @Low Freq]*, carry out rotational Auto-Tuning.

■ n4-65: Flux Estimate Response@High Freq

No. (Hex.)	Name	Description	Default (Range)
n4-65 (1B85)	Flux Estimate Response@High Freq	V/f CL-V/f OLV **CLV** **AOLV** In high speed ranges, where the output frequency is ≥ *n4-67 [SwitchingFreq forEstimation gain]*, this adjusts the responsiveness of the magnetic flux estimation. Usually it is not necessary to change this setting.	1.00 (0.50 - 3.00)

If, under no-load conditions, *oS [Overspeed]* is detected, or if for any other reason the speed does not stabilize within the high speed range, adjust the setting value up or down in increments of 0.05.

■ n4-66: Flux Estimate Response @Low Freq

No. (Hex.)	Name	Description	Default (Range)
n4-66 (1B86)	Flux Estimate Response @Low Freq	V/f CL-V/f OLV **CLV** **AOLV** Sets the responsiveness of the magnetic flux estimation in low speed ranges, where 0 ≤ the output frequency, which is < *n4-67 [Estimate Gain Switchover Freq]*. Usually it is not necessary to change this setting.	1.50 (0.50 - 3.00)

if, under no-load conditions, *oS [Overspeed]* is detected, or if for any other reason the speed does not stabilize within the low speed range, adjust the setting value up or down in increments of 0.05.

■ n4-67: Estimate Gain Switchover Freq

No. (Hex.)	Name	Description	Default (Range)
n4-67 (1B87)	Estimate Gain Switchover Freq	V/f CL-V/f OLV **CLV** **AOLV** Set the switching frequency for estimation gain for each of the following: *n4-63 [SpdEstimationResponseForHighFreq]*, *n4-64 [SpdEstimationResponse forLowFreq]*, *n4-65 [FluxEstimationResponseForHighFrq]*, and *n4-66 [FluxEstimationResponseForLowFreq]*. Usually it is not necessary to change this setting.	6.00 Hz (0.00 - E1-04)

If the output frequency is greater than *n4-67*, *n4-63* and *n4-65* are selected. If the output frequency is less than *n4-67*, *n4-64* and *n4-66* are selected.

■ n4-68: Speed Estimation Filter Time

No. (Hex.)	Name	Description	Default (Range)
n4-68 (1B88)	Speed Estimation Filter Time	V/f CL-V/f OLV CLV AOLV Sets the primary delay time constant for the speed estimation value. Usually it is not necessary to change this setting.	0.001 s (0.001 - 0.010 s)

If the motor speed oscillates in the high speed range, set the value to 0.010 s.

■ n4-69: Flux Control Response

No. (Hex.)	Name	Description	Default (Range)
n4-69 (1B89)	Flux Control Response	V/f CL-V/f OLV CLV AOLV Unifies control of magnetic flux to make motor vibrations more stable.	1.00 (0.00 - 60.00)

If step-out occurs when the load changes, decrease the setting value in 1.00 increments.

Note:

If heavy loads decrease motor speed, increase the setting value in 1.00 increments. If it does not get better, increase *n4-74 [Limit of Flux Loop]* in 20% increments.

■ n4-70: Speed Command Comp @ Low Freq

No. (Hex.)	Name	Description	Default (Range)
n4-70 (1B8A)	Speed Command Comp @ Low Freq	V/f CL-V/f OLV CLV AOLV Sets the function to make the drive more stable when it operates at low speeds. Usually it is not necessary to change this parameter.	1.00 Hz (0.00 - 6.00 Hz)

This function improves control stability when writing at low speeds. Increase the setting in 0.3 Hz increments at the time of low-speed references with no load.

Note:

Although the stability of speed references for low speeds is improved when *n4-70* is increased, it can sometimes negatively impact speed control accuracy.

■ n4-71: Flux Estimation Method

No. (Hex.)	Name	Description	Default (Range)
n4-71 (1B8B) Expert	Flux Estimation Method	V/f CL-V/f OLV CLV AOLV Sets the flux estimation method. Usually it is not necessary to change this setting.	0 (0, 1)

0 : Method 1
1 : Method 2

■ n4-72: Speed Feedback Mode

No. (Hex.)	Name	Description	Default (Range)
n4-72 (1B8C)	Speed Feedback Mode	V/f CL-V/f OLV CLV AOLV Sets the requirement for an encoder option when *A1-02 = 4 [Control Method Selection = Advanced Open Loop Vector]*.	0 (0, 1)

You can connect a PG-B3 or PG-X3 encoder option in AOLV control. You can use the encoder option for better speed control precision.

Note:

- When you use an encoder option in AOLV control to operate machinery, specialized tuning of the drive can be necessary. You should usually set *A1-02 = 3 [Control Method Selection = Closed Loop Vector]* when you use an encoder option.
- When you set this parameter to 1, also set the number of PG pulses in *F1-01 [Encoder 1 Pulse Count (PPR)]*.

0 : Without Encoder
1 : With Encoder

■ n4-73: PGo Recovery Selection

No. (Hex.)	Name	Description	Default (Range)
n4-73 (1B8D)	PGo Recovery Selection	V/f CL-V/f OLV CLV AOLV Sets the restart mode to Without Encoder Mode or the With Encoder Mode when an encoder is disconnected.	0 (0, 1)

Set *A1-02 = 4 [Control Method Selection = AOLV]* and *n4-72 = 1 [Speed Feedback Mode = With Encoder]* to use this parameter.

Parameter *F1-02 [Encoder Signal Loss Detect Sel]* sets the drive response when the drive detects a disconnected encoder. This parameter sets the drive to start up in the Without Encoder Mode or With Encoder Mode if the drive detects *PGo [Encoder (PG) Feedback Loss]*.

Note:

A PG-B3 encoder option is necessary to use this parameter. When you use a PG-X3 option, it is not necessary to set this parameter.

If the drive detects *PGo*, de-energize the drive and examine the wiring for the encoder.

0 : Without Encoder

1 : With Encoder

■ n4-74: Limit of Flux Loop

No. (Hex.)	Name	Description	Default (Range)
n4-74 (1B8E)	Limit of Flux Loop	V/f CL-V/f OLV CLV AOLV Sets the control level for flux loop control output.	250% (100 - 500%)

Increase the setting value in 20% increments when the torque is insufficient due to loads of at least 100%. Note that if the setting is too high, overexcitation could occur causing the motor generate heat.

◆ n5: Feed Forward Control

Feed forward control improves responsiveness of acceleration and deceleration in accordance with the speed reference.

Increasing the values set in *C5-01 and C5-03 [ASR Proportional Gain]* is effective in applying feed forward control to machines with low rigidity for which hunting and vibration are likely to occur or to machines with significant inertia. Applying this function while using CLV control also helps prevent overshooting. Refer to Figure 11.97. Refer to Figure 11.98 for more information about parameters related to Feed Forward control.

Feed forward control is enabled when *A1-02 [Control Method Selection]* is set to any of the following.

- 3: Closed Loop Vector
- 4: Advanced Open Loop Vector

Note:

- Responsiveness cannot be improved with feed forward control for applications in which loads are applied externally during run at constant speed.
- When using the Droop control function, set *n5-01 = 0 [Feed Forward Control Selection = Disabled]*.
- Feed forward control cannot be used with motor 2.

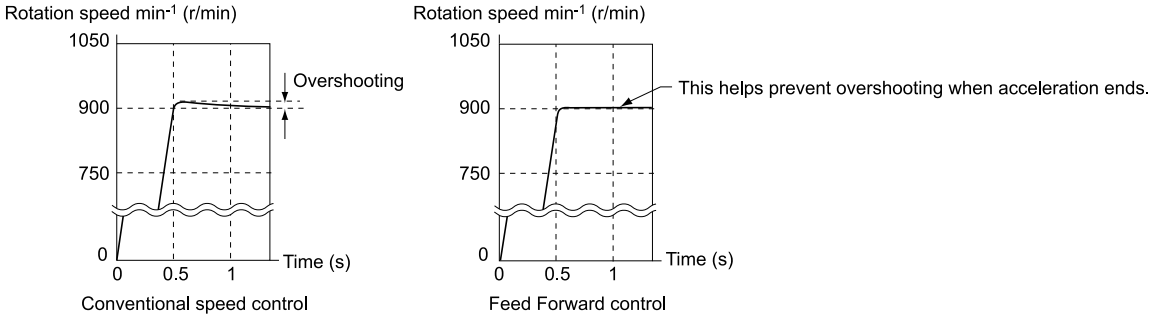


Figure 11.97 Suppress Overshooting with Feed Forward Control

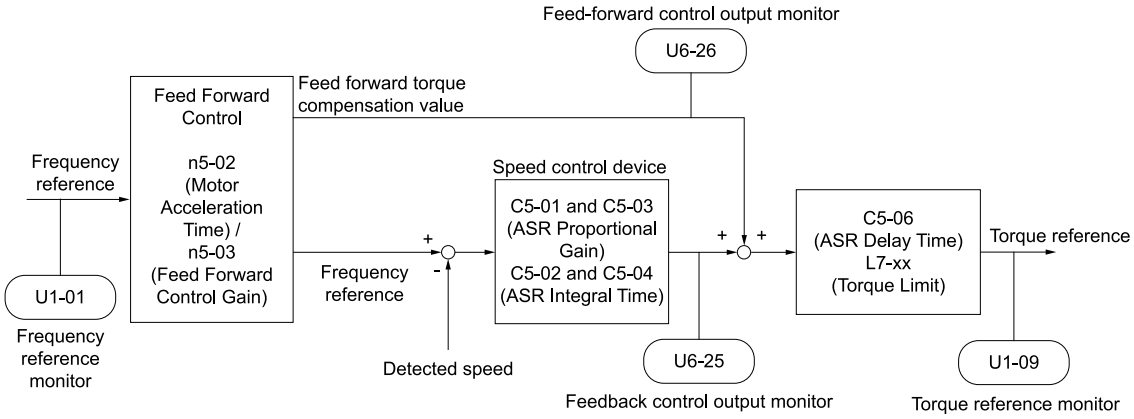


Figure 11.98 Setting Feed Forward Control

■ Preparation Before Executing Feed Forward Control

Perform any of the following procedures before executing feed forward control.

- Run Auto-Tuning to set motor parameters.
  When Auto-Tuning cannot be performed, manually set *E2 parameters* using the information found on the motor nameplate or test reports.
- Set *C5 parameters [Auto Speed Regulator (ASR)]* individually to adjust the speed control loop (ASR).
- Perform Inertia Tuning if a motor can be connected to a machine and rotated when running Auto-Tuning. Parameters related to Feed Forward control are automatically adjusted when Inertia Tuning is carried out.
- If the inertia tuning process cannot be performed, refer to Figure 11.98 and set the parameters related to Feed Forward control individually.

■ n5-01: Feed Forward Control Selection

No. (Hex.)	Name	Description	Default (Range)
n5-01 (05B0)	Feed Forward Control Selection	V/f CL-V/f OLV **CLV** **AOLV** Sets the feed forward function.	0 (0, 1)

0 : Disabled

1 : Enabled

■ n5-02: Motor Inertia Acceleration Time

No. (Hex.)	Name	Description	Default (Range)
n5-02 (05B1)	Motor Inertia Acceleration Time	V/f CL-V/f OLV **CLV** **AOLV** Sets the length of time for the motor to accelerate from the stopped to the maximum frequency with a single motor at the rated torque. Inertia Tuning automatically sets the motor acceleration time.	Determined by o2-04 (0.001 - 10.000 s)

If Inertia Tuning process cannot be performed, calculate the motor acceleration time as illustrated below or measure the motor acceleration time and set *n5-02* to this value.

Calculate the Motor Acceleration Time

Derive the motor acceleration time using the following expression.

$$\text{n5-02} = \frac{2\pi \cdot J_{Motor} \cdot n_{rated}}{60 \cdot T_{rated}}$$

- J_{Motor} = Moment of inertia of motor (kg m^2)
- n_{rated} = Motor rated speed (min^{-1}, r/min)
- T_{rated} = Motor rated torque (N·m)

The motor acceleration time can also be derived using the following calculation expression.

$$\text{n5-02} = \frac{4\pi \cdot J_{Motor} \cdot f_{rated}}{p \cdot T_{rated}}$$

- f_{rated} = Motor rated frequency (Hz)
- P = Number of motor poles

Measure the Motor Acceleration Time

Use the following procedure to measure the motor acceleration time.

1. Select a control method via *A1-02 [Control Method Selection]*.
2. Disconnect the motor and load.
3. Run Auto-Tuning to set motor parameters.
   When Auto-Tuning cannot be performed, manually set *E2 parameters* using the information found on the motor nameplate or test reports.
4. Set *C5 parameters [Auto Speed Regulator (ASR)]*.
5. Set *C1-01 [Acceleration Time 1] = 0*.
6. Set *L7-01 [Forward Torque Limit]* to 100%.
7. Set the frequency reference to the same value as the motor rated speed.
8. Measure the time taken by the motor to reach the rated speed.
   Display *U1-05 [Motor Speed]* on the keypad and enter the Run command (forward run).
9. Stop the motor.
10. Set *n5-02* to the actual measured motor acceleration time value.

Reset all parameters changed to measure the motor acceleration time to the previous setting values.

■ n5-03: Feed Forward Control Gain

No. (Hex.)	Name	Description	Default (Range)
n5-03 (05B2)	Feed Forward Control Gain	V/f CL-V/f OLV **CLV** **AOLV** Sets the ratio between load inertia and motor inertia. Inertia Tuning automatically sets the Feedforward Control Gain value.	1.00 (0.00 - 100.00)

When you cannot do Inertia Tuning, use this procedure to set n5-03:

Set *n5-02 [Motor Inertia Acceleration Time]*.

1. Connect the motor and load.
2. Set *C1-01 [Acceleration Time 1] = 0*.
3. Use *L7-01 to L7-04 [Torque Limit]* to set the expected test run torque limit levels.
4. Set the frequency reference as specified by the high speed range of the machine.
5. Measure the length of time for the motor to reach the command reference speed.
   Show *U1-05 [Motor Speed]* on the keypad and enter the Run command.
6. Stop the motor.
7. Replace the values in the this formula and set *n5-03* to the value of the formula.

$$\text{n5-03} = \frac{t_{accel} \cdot T_{Lim_Test} \cdot f_{rated}}{\text{n5-02} \cdot f_{ref_Test} \cdot 100} - 1$$

- t_{accel} = Acceleration time (s)
- f_{rated} = Motor rated frequency (Hz)
- T_{Lim_Test} = Test run torque limit (%)
- f_{ref_Test} = Test run frequency reference (Hz)

WARNING! *Sudden Movement Hazard. Machinery can accelerate suddenly. Do not use this function with machinery that must not accelerate suddenly. Sudden starts can cause serious injury or death.*

Reset all of the parameters that you changed to the previous setting values.

Note:

- If response to the speed reference is slow, increase the value set in *n5-03*.
- Increase the value set in *n5-03* when response to the speed reference is slow.
  - The speed is overshooting.
  - A negative torque reference is output when acceleration ends.

■ n5-04: Speed Response Frequency

No. (Hex.)	Name	Description	Default (Range)
n5-04 (05B3) RUN Expert	Speed Response Frequency	V/f CL-V/f OLV **CLV** **AOLV** Sets the response frequency for the speed reference. Usually it is not necessary to change this parameter.	Determined by A1-02 (0.00 - 500.00 Hz)

If you set *n5-03 [Feed Forward Control Gain]* too high, the motor speed will momentarily increase to more than the set frequency.

◆ n6: Online Tuning

n6 parameters are used to set the online tuning function for motor line-to-line resistance.

The Online Tuning for motor line-to-line resistance is used to prevent degradation of speed control accuracy due to motor temperature fluctuation and motor stalls due to insufficient torque.

■ n6-01: Online Tuning Selection

No. (Hex.)	Name	Description	Default (Range)
n6-01 (0570)	Online Tuning Selection	V/f CL-V/f **OLV** CLV AOLV Sets the type of motor data that Online Tuning uses for OLV control.	0 (0 - 2)

0 : Disabled

1 : Line-to-Line Resistance Tuning

The drive adjusts the motor line-to-line resistance during run. This function is effective when the motor speed is 6 Hz or less. This function improves overload tolerance within the low speed range.

2 : Voltage Correction Tuning

The drive adjusts the output voltage during run. This function improves overload tolerance and suppresses issues of speed precision losses because of increasing motor temperatures.

■ n6-05: Online Tuning Gain

No. (Hex.)	Name	Description	Default (Range)
n6-05 (05C7) Expert	Online Tuning Gain	V/f CL-V/f **OLV** CLV AOLV Sets the compensation gain when *n6-01 = 2 [Online Tuning Selection = Voltage Correction Tuning]*. Usually it is not necessary to change this parameter.	1.0 (0.1 - 50.0)

When you use a motor that has a large secondary circuit time constant, decrease the setting value.

If the drive detects *oL1 [Motor Overload]*, increase the setting value in 0.1-unit increments.

■ n6-11: Online Resistance Tuning

No. (Hex.)	Name	Description	Default (Range)
n6-11 (1B56) Expert	Online Resistance Tuning	V/f CL-V/f OLV **CLV** **AOLV** Sets the responsiveness for online resistor tuning. Set this parameter to approximately *1.000* to enable the function. The function is disabled when the value is *0.000*.	0.000 (0.000 - 1.000)

11.11 o: Keypad-Related Settings

o parameters set keypad functions.

Note:
You cannot set these parameters with the optional LED keypad.

Table 11.35 Parameters You Cannot Set with the LED Keypad

No.	Name
o1-05	LCD Contrast Adjustment
o1-24 to o1-35:	Custom Monitor 1 to 12
o1-36	LCD Backlight Brightness
o1-37	LCD Backlight ON/OFF Selection
o1-38	LCD Backlight Off-Delay
o1-39	Show Initial Setup Screen
o1-40	Home Screen Display Selection
o1-41 to o1-46:	1st to 3rd Monitor Area Selections/Settings
o1-47 to o1-51:	Trend Plot 1 or 2 Scale Settings
o1-55 to o1-56:	Analog Gauge Area Selection/Setting
o2-27	bCE Detection Selection

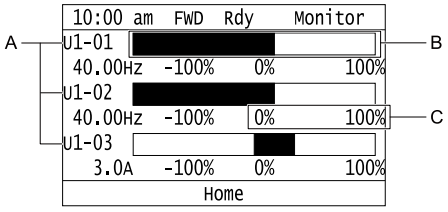
No.	Name
o3-04	Select Backup/Restore Location
o3-05	Select Items to Backup/Restore
o3-06	Auto Parameter Backup Selection
o3-07	Auto Parameter Backup Interval
o4-22	Time Format
o4-23	Date Format
o4-24	bAT Detection Selection
o5-01	Log Start/Stop Selection
o5-02	Log Sampling Interval
o5-03 to o5-12:	Log Monitor Data 1 to 10

◆ o1: Keypad Display Selection

o1 parameters select the parameters shown on the initial keypad screen and to configure the parameter setting units and display units. These parameters also adjust the backlight and contrast of the LCD display.

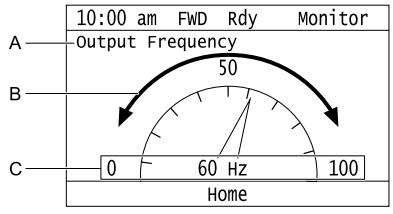
■ Home Screen Display Format

o1-40 [Home Screen Display Selection] changes the display of the monitor shown on the Home screen. You can show numerical values or one of these three displays on the Home screen monitor:



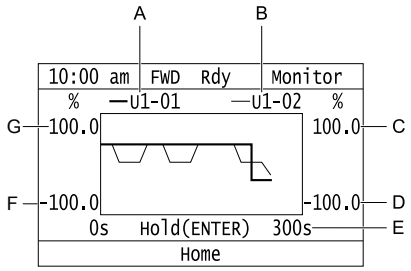
A - Set *Ux-xx [Monitors]* to *o1-24*, *o1-25*, and *o1-26*.
B - Set display regions to *o1-41*, *o1-43*, and *o1-45*.
C - Set display ranges to *o1-42*, *o1-44*, and *o1-46*.

Figure 11.99 Bar Graph Display



A - Set *Ux-xx [Monitors]* to *o1-24*.
B - Set display regions to *o1-56*.
C - Set display ranges to *o1-55*.

Figure 11.100 Analog Gauge Display



A - Set *Ux-xx [Monitors]* (Monitor 1) to *o1-24*.
B - Set *Ux-xx [Monitors]* (Monitor 2) to *o1-25*.
C - Set the maximum value of Monitor 2 to *o1-50*.
D - Set the minimum value of Monitor 2 to *o1-49*.
E - Set the time scale to *o1-51*.
F - Set the minimum value of Monitor 1 to *o1-47*.
G - Set the maximum value of Monitor 1 to *o1-48*.

Figure 11.101 Trend Plot Display

■ o1-01: User Monitor Selection

No. (Hex.)	Name	Description	Default (Range)
o1-01 (0500) RUN	User Monitor Selection	V/f CL-V/f OLV CLV AOLV Sets the *U monitor* for the Drive Mode. This parameter is only available with an LED keypad.	106 (104 - 999)

When the drive is in Drive Mode, each time pushing ⌃ on the keypad will show the following data: frequency reference → rotational direction → output frequency → output current → *o1-01* selection.

Set the *x-xx* portion of the monitoring parameter *Ux-xx* that appears in the fifth position in Drive Mode. For example, to display *U1-05 [Motor Speed]*, set *o1-01 = 105*.

Note:
- You cannot select *U2 monitor [Fault Trace]* and *U3 Monitor [Fault History]*.
- The selectable monitors vary depending on the control method.

■ o1-02: Monitor Selection at Power-up

No. (Hex.)	Name	Description	Default (Range)
o1-02 (0501) RUN	Monitor Selection at Power-up	V/f CL-V/f OLV CLV AOLV Sets the monitor item that the keypad screen shows after you energize the drive. Refer to "U: Monitors" for information about the monitor items that the keypad screen can show. This parameter is only available with an LED keypad.	1 (1 - 5)

1 : Frequency Reference (U1-01)
2 : Direction
3 : Output Frequency (U1-02)
4 : Output Current (U1-03)
5 : User Monitor (o1-01)

Shows the monitor item selected in *o1-01 [User Monitor Selection]*.

■ o1-03: Frequency Display Unit Selection

No. (Hex.)	Name	Description	Default (Range)
o1-03 (0502)	Frequency Display Unit Selection	V/f CL-V/f OLV CLV AOLV Sets the display units for the frequency reference and output frequency.	Determined by A1-02 (0 - 4)

Note:
When the setting value of *o1-03* is changed, the these monitor and parameter units change.
- *U1-01 [Frequency Reference]*
- *U1-02 [Output Frequency]*
- *U1-05 [Motor Speed]*
- *U1-16 [SFS Output Frequency]*
- *d1-01 to d1-17 [Reference 1 to 8 and Jog Reference]*

0 : 0.01Hz

1 : 0.01% (100% = E1-04)

The maximum output frequency is 100%.

2 : Revolutions Per Minute (RPM)

Calculated automatically based on the maximum output frequency and number of motor poles.

Note:

If you set *o1-03 = 2 [Revolutions Per Minute (RPM)]*, be sure to set the number of motor poles to these parameters.
- *E2-04 [Motor Pole Count]*
- *E4-04 [Motor 2 Motor Poles]*
- *E7-24 [Motor 3 Motor Poles]*

3 : User Units (o1-10 & o1-11)

If *o1-03 = 3*, you can set units as desired with *o1-10 [User Units Maximum Value]* and *o1-11 [User Units Decimal Position]*. Parameter *o1-10* is set to the value resulting from removing the decimal point from the maximum output frequency. Parameter *o1-11* is set to the number of digits after the decimal point in the maximum output frequency.

To display a maximum output frequency of 100.00, set the following parameters as follows.

- *o1-10 = 10000*
- *o1-11 = 2 [Two Decimal Places (XXX.XX)]*

4 : 0.01m/min

The hoisting speed is calculated with the following expression.

Hoisting speed (m/min) = (Frequency (Hz) × 60 × 2 / pole) × (1 / Roping ratio ×1 / Gear ratio) × (Drum diameter π)

Note:

Set the following parameters to populate the variables in the expression.
- *o1-20 [Sheave Diameter]*
- *o1-21 [Roping Ratio]*
- *o1-22 [Gear Ratio]*

■ o1-04: V/f Pattern Display Unit

No. (Hex.)	Name	Description	Default (Range)
o1-04 (0503)	V/f Pattern Display Unit	V/f CL-V/f OLV CLV AOLV Sets the setting unit for parameters that set the V/f pattern frequency.	Determined by A1-02 (0, 1)

Note:
- Sets the setting unit of these parameters for motor 1.
  - *E1-04 [Maximum Output Frequency]*
  - *E1-06 [Base Frequency]*
  - *E1-07 [Mid Point A Frequency]*
  - *E1-09 [Minimum Output Frequency]*
  - *E1-11 [Mid Point B Frequency]*
- The values for motor 2 are always *0 [Hz]*.

0 : Hz

1 : Revolutions Per Minute (RPM)

E2-04 [Motor Pole Count] must be set if *o1-04 = 1 [Revolutions Per Minute (RPM)]*.

■ o1-05: LCD Contrast Adjustment

No. (Hex.)	Name	Description	Default (Range)
o1-05 (0504) RUN	LCD Contrast Adjustment	V/f CL-V/f OLV CLV AOLV Sets the contrast of the LCD display on the keypad.	5 (0 - 10)

When you decrease the setting value, the contrast of the LCD display decreases. When you increase the setting value, the contrast increases.

■ o1-10: User Units Maximum Value

No. (Hex.)	Name	Description	Default (Range)
o1-10 (0520)	User Units Maximum Value	V/f CL-V/f OLV CLV AOLV Sets the value that the drive shows as the maximum output frequency.	Determined by o1-03 (1 - 60000)

To display a maximum output frequency of 100.00, set parameters to these values:

- *o1-10 = 10000*
- *o1-11 = 2 [User Units Decimal Position = Two Decimal Places (XXX.XX)]*

Note:

Set *o1-03 = 3 [Frequency Display Unit Selection = User Units (o1-10 & o1-11)]* before you set *o1-10* and *o1-11*.

■ o1-11: User Units Decimal Position

No. (Hex.)	Name	Description	Default (Range)
o1-11 (0521)	User Units Decimal Position	V/f CL-V/f OLV CLV AOLV Sets the number of decimal places for frequency reference and monitor values.	Determined by o1-03 (0 - 3)

0 : No Decimal Places (XXXXX)
1 : One Decimal Places (XXXX.X)
2 : Two Decimal Places (XXX.XX)
3 : Three Decimal Places (XX.XXX)

Note:

Set *o1-03 = 3 [Frequency Display Unit Selection = User Units (o1-10 & o1-11)]* before you set *o1-10 [User Units Maximum Value]* and *o1-11*.

■ o1-20: Sheave Diameter

No. (Hex.)	Name	Description	Default (Range)
o1-20 (0575)	Sheave Diameter	V/f CL-V/f OLV CLV AOLV Sets the sheave diameter.	400 mm (100 - 2000 mm)

■ o1-21: Roping Ratio

No. (Hex.)	Name	Description	Default (Range)
o1-21 (0576)	Roping Ratio	V/f CL-V/f OLV CLV AOLV Sets the roping ratio.	2 (1 - 4)

1 : 1:1
2 : 1:2
3 : 1:3
4 : 1:4

■ o1-22: Gear Ratio

No. (Hex.)	Name	Description	Default (Range)
o1-22 (0577)	Gear Ratio	V/f CL-V/f OLV CLV AOLV Sets the gear ratio.	14.00 (0.10 - 50.00)

■ o1-24 to o1-35: Custom Monitor 1 to 12

No. (Hex.)	Name	Description	Default (Range)
o1-24 to o1-35: (11AD - 11B8) RUN	Custom Monitor 1 to 12	V/f CL-V/f OLV CLV AOLV Sets a maximum of 12 monitors as user monitors. This parameter is only available when using an LCD keypad.	o1-24: 101 o1-25: 102 o1-26: 103 o1-27 to o1-35: 0 (0, 101 - 999)

These parameters save the monitor items selected by the LCD keypad [Custom Monitor].

Note:

- You can show a maximum of three selected monitors on one LCD keypad screen.
  - –When you select only one monitor, the text size of this monitor increases. For example, when *o1-25 to o1-35 = 0*, the text size of the monitor saved in o1-24 increases.
  - –When you select two monitors, the text size of these monitors increase.
  - –When you select four or more monitors, the fourth monitor and all additional monitors are shown on the next screens.
- Monitors selected with *o1-24* to *o1-26* can be displayed as a bar graph, analog gauge, or trend plot.
  - –Bar graph display: 3 monitors maximum
    Select with *o1-24*, *o1-25*, and *o1-26*.
  - –Analog gauge display: 1 monitor
    Select with *o1-24*.
  - –Trend plot display: 2 monitors
    Select with *o1-24* and *o1-25*.
- You can only set parameters *o1-24* to *o1-26* with analog output monitors.
- You can set all monitors to parameters *o1-27* to *o1-35*.

■ o1-36: LCD Backlight Brightness

No. (Hex.)	Name	Description	Default (Range)
o1-36 (11B9) RUN	LCD Backlight Brightness	V/f CL-V/f OLV CLV AOLV Sets the intensity of the LCD keypad backlight.	3 (1 - 5)

When you decrease the setting value, the intensity of the backlight decreases.

■ o1-37: LCD Backlight ON/OFF Selection

No. (Hex.)	Name	Description	Default (Range)
o1-37 (11BA) RUN	LCD Backlight ON/OFF Selection	V/f CL-V/f OLV CLV AOLV Sets the automatic shut off function for the LCD backlight.	1 (0, 1)

Note:

Use *o1-36 [LCD Backlight Brightness]* to adjust the intensity of the LCD backlight.

0 : OFF

The backlight will automatically turn off after the time set in *o1-38 [LCD Backlight Off-Delay]* is expired.

When the backlight is off, push a key on the keypad to temporarily turn the backlight on. After the backlight turns on, it will turn off automatically after the time set in *o1-38* is expired.

Note:

When the backlight is off, push a key on the keypad to temporarily turn the backlight on. Push any key to start keypad operation. Push RUN to turn the backlight on, then push RUN again to enter a Run command to the drive.

1 : ON

The backlight will always be ON.

■ o1-38: LCD Backlight Off-Delay

No. (Hex.)	Name	Description	Default (Range)
o1-38 (11BB) RUN	LCD Backlight Off-Delay	V/f CL-V/f OLV CLV AOLV Sets the time until the LCD backlight automatically turns off.	60 s (10 - 300 s)

When *o1-37 = 0 [LCD Backlight ON/OFF Selection= OFF]*, the backlight will automatically turn off after the time set in *o1-38* expires.

When the backlight is off, push a key on the keypad to temporarily turn the backlight on. After the backlight turns on, it will turn off automatically after the time set in *o1-38* is expired.

■ o1-39: Show Initial Setup Screen

No. (Hex.)	Name	Description	Default (Range)
o1-39 (11BC) RUN	Show Initial Setup Screen	V/f CL-V/f OLV CLV AOLV Sets the function to show the LCD keypad initial setup screen each time you energize the drive. This parameter is only available with an LCD keypad.	1 (0, 1)

The initial setup screen shows a menu where you can select the display language, set the date, time, and other basic settings. When you set this parameter to 0, the drive will not show this screen each time you energize the drive.

0 : No

The drive will not show the initial setup display screen each time you energize the drive. The drive will show the Home screen.

1 : Yes

When you input the Run command before you energize the drive or when the you turn on the Run command while the drive shows the initial setup screen, the drive will replace the initial setup screen with the Home screen.

■ o1-40: Home Screen Display Selection

No. (Hex.)	Name	Description	Default (Range)
o1-40 (11BD) RUN	Home Screen Display Selection	V/f CL-V/f OLV CLV AOLV Sets the monitor display mode for the Home screen. This parameter is only available with an LCD keypad.	0 (0 - 3)

0 : Custom Monitor

1 : Bar Graph

2 : Analog Gauge

3 : Trend Plot

■ o1-41: 1st Monitor Area Selection

No. (Hex.)	Name	Description	Default (Range)
o1-41 (11C1) RUN	1st Monitor Area Selection	V/f CL-V/f OLV CLV AOLV Sets the horizontal axis value used to display the monitor set in *o1-24 [Custom Monitor 1]* as a bar graph. This parameter is only available with an LCD keypad.	0 (0 - 1)

0 : +/- Area (- o1-42 ~ o1-42)

1 : + Area (0 ~ o1-42)

■ o1-42: 1st Monitor Area Setting

No. (Hex.)	Name	Description	Default (Range)
o1-42 (11C2) RUN	1st Monitor Area Setting	V/f CL-V/f OLV CLV AOLV Sets the horizontal axis value used to display the monitor set in *o1-24 [Custom Monitor 1]* as a bar graph. This parameter is only available with an LCD keypad.	100.0% (0.0 - 100.0%)

■ o1-43: 2nd Monitor Area Selection

No. (Hex.)	Name	Description	Default (Range)
o1-43 (11C3) RUN	2nd Monitor Area Selection	V/f CL-V/f OLV CLV AOLV Selects the horizontal range used to display the monitor set in *o1-25 [Custom Monitor 2]* as a bar graph. This parameter is only available with an LCD keypad.	0 (0 - 1)

0 : +/- Area (- o1-44 ~ o1-44)

1 : + Area (0 ~ o1-44)

■ o1-44: 2nd Monitor Area Setting

No. (Hex.)	Name	Description	Default (Range)
o1-44 (11C4) RUN	2nd Monitor Area Setting	V/f CL-V/f OLV CLV AOLV Sets the horizontal axis value used to display the monitor set in *o1-25 [Custom Monitor 2]* as a bar graph. This parameter is only available with an LCD keypad.	100.0% (0.0 - 100.0%)

■ o1-45: 3rd Monitor Area Selection

No. (Hex.)	Name	Description	Default (Range)
o1-45 (11C5) RUN	3rd Monitor Area Selection	V/f CL-V/f OLV CLV AOLV Sets the horizontal axis value used to display the monitor set in *o1-26 [Custom Monitor 3]* as a bar graph. This parameter is only available with an LCD keypad.	0 (0 - 1)

0 : +/- Area (- o1-46 ~ o1-46)
1 : + Area (0 ~ o1-46)

■ o1-46: 3rd Monitor Area Setting

No. (Hex.)	Name	Description	Default (Range)
o1-46 (11C6) RUN	3rd Monitor Area Setting	V/f CL-V/f OLV CLV AOLV Sets the horizontal axis value used to display the monitor set in *o1-26 [Custom Monitor 3]* as a bar graph. This parameter is only available with an LCD keypad.	100.0% (0.0 - 100.0%)

■ o1-47: Trend Plot 1 Scale Minimum Value

No. (Hex.)	Name	Description	Default (Range)
o1-47 (11C7) RUN	Trend Plot 1 Scale Minimum Value	V/f CL-V/f OLV CLV AOLV Sets the minimum value for the vertical axis used to display a trend plot from the monitor selected with *o1-24*. This parameter is only available with an LCD keypad.	-100.0% (-300.0 - +99.9%)

■ o1-48: Trend Plot 1 Scale Maximum Value

No. (Hex.)	Name	Description	Default (Range)
o1-48 (11C8) RUN	Trend Plot 1 Scale Maximum Value	V/f CL-V/f OLV CLV AOLV Sets the maximum value for the vertical axis used to display the monitor that was set in *o1-24 [Custom Monitor 1]* as a trend plot. This parameter is only available with an LCD keypad.	100.0% (-299.9 - +300.0%)

Note:
Parameter *o1-47 [Trend Plot 1 Scale Minimum Value]* sets the lower limit. The lower limit is (*o1-47* + 0.1)%.

■ o1-49: Trend Plot 2 Scale Minimum Value

No. (Hex.)	Name	Description	Default (Range)
o1-49 (11C9) RUN	Trend Plot 2 Scale Minimum Value	V/f CL-V/f OLV CLV AOLV Sets the minimum value for the vertical axis used to display a trend plot from the monitor selected with *o1-25*. This parameter is only available with an LCD keypad.	-100.0% (-300.0 - +99.9%)

■ o1-50: Trend Plot 2 Scale Maximum Value

No. (Hex.)	Name	Description	Default (Range)
o1-50 (11CA) RUN	Trend Plot 2 Scale Maximum Value	V/f CL-V/f OLV CLV AOLV Sets the maximum value for the vertical axis used to display the monitor that was set in *o1-25 [Custom Monitor 2]* as a trend plot. This parameter is only available with an LCD keypad.	100.0% (-299.9 - +300.0%)

Note:
Parameter *o1-49 [Trend Plot 2 Scale Minimum Value]* sets the lower limit. The lower limit is (*o1-49* + 0.1)%.

■ o1-51: Trend Plot Time Scale Setting

No. (Hex.)	Name	Description	Default (Range)
o1-51 (11CB) RUN	Trend Plot Time Scale Setting	V/f CL-V/f OLV CLV AOLV Sets the time scale (horizontal axis) to display the trend plot. When you change this setting, the drive automatically adjusts the data sampling time. This parameter is only available with an LCD keypad.	300 s (1 - 3600 s)

■ o1-55: Analog Gauge Area Selection

No. (Hex.)	Name	Description	Default (Range)
o1-55 (11EE) RUN	Analog Gauge Area Selection	V/f CL-V/f OLV CLV AOLV Sets the range used when displaying the monitor set in *o1-24* as an analog gauge. This parameter is only available with an LCD keypad.	1 (0, 1)

0 : +/- Area (- o1-56 ~ o1-56)
1 : + Area (0 ~ o1-56)

■ o1-56: Analog Gauge Area Setting

No. (Hex.)	Name	Description	Default (Range)
o1-56 (11EF) RUN	Analog Gauge Area Setting	V/f CL-V/f OLV CLV AOLV Sets the value used to display the monitor set in *o1-24 [Custom Monitor 1]* as an analog meter. This parameter is only available with an LCD keypad.	100.0% (0.0 - 100.0%)

◆ o2: Keypad Operation

■ o2-02: STOP Key Function Selection

No. (Hex.)	Name	Description	Default (Setting Range)
o2-02 (0506)	STOP Key Function Selection	V/f CL-V/f OLV CLV AOLV Sets the function to use STOP on the keypad to stop the drive when the Run command source for the drive is REMOTE (external) and not assigned to the keypad.	1 (0, 1)

0 : Disabled
1 : Enabled

STOP stays enabled when the Run command source has not been assigned to the keypad.

To start the drive again after you push STOP to stop operation, turn the external Run command OFF and ON again.

■ o2-03: User Parameter Default Value

No. (Hex.)	Name	Description	Default (Range)
o2-03 (0507)	User Parameter Default Value	V/f CL-V/f OLV CLV AOLV Sets the function to keep the settings of changed parameters as user parameter defaults to use during initialization.	0 (0 - 2)

When you set *o2-03 = 1 [Set defaults]*, the drive saves changed parameter settings as user parameter setting values in a part of the memory that is isolated from drive parameters.

When you set *A1-03 = 1110 [Initialize Parameters = User Initialization]* to initialize the drive, the drive resets the internal parameter setting values to those user parameter setting values.

0 : No change
1 : Set defaults

Saves changed parameter setting values as user default settings.

Set *o2-03 = 1* then push ↵ to save the user parameter setting values. After the drive saves the setting value, *o2-03* automatically resets to *0*.

2 : Clear all

Deletes all of the saved user parameter setting values.

Set *o2-03 = 2* then push ⏎ to clear the user parameter setting values. The drive will automatically reset *o2-03* to *0*. If you delete the user parameter setting values, you cannot set *A1-03 = 1110* to initialize parameters.

■ o2-04: Drive Model (KVA) Selection

No. (Hex.)	Name	Description	Default (Range)
o2-04 (0508)	Drive Model (KVA) Selection	V/f CL-V/f OLV CLV AOLV Sets the Drive Model code. Set this parameter after replacing the control board.	Determined by the drive (-)

NOTICE: *Set o2-04 [Drive Model (KVA) Selection] correctly. If you set this parameter incorrectly, it will decrease drive performance, cause the protection function to operate incorrectly, and cause damage to the drive.*

Note:

When the setting value of *o2-04* changes, related parameter setting values also change. Refer to *Parameters Changed by o2-04 [Drive Model (KVA) Selection] on page 557* for more information.

These tables list the relation between *o2-04* setting values and drive models.

■ o2-05: Home Mode Freq Ref Entry Mode

No. (Hex.)	Name	Description	Default (Setting Range)
o2-05 (0509)	Home Mode Freq Ref Entry Mode	V/f CL-V/f OLV CLV AOLV Sets the function that makes it necessary to push ⏎ to use the keypad to change the frequency reference value while in Drive Mode.	0 (0, 1)

0 : ENTER Key Required

You must push ⏎ to use the keypad to change the frequency reference value.

1 : Immediate / MOP-style

The frequency reference changes when you enter it with the keypad. This then changes the output frequency. It is not necessary to push ⏎. The drive keeps the frequency reference for 5 seconds after you use ∧ and ∨ on the keypad to change the frequency reference value.

■ o2-06: Keypad Disconnect Detection

No. (Hex.)	Name	Description	Default (Range)
o2-06 (050A)	Keypad Disconnect Detection	V/f CL-V/f OLV CLV AOLV Sets the function that stops the drive if you disconnect the keypad connection cable from the drive or if you damage the cable while the keypad is the Run command source.	0 (0, 1)

This parameter operates even when the keypad installed to the drive becomes disconnected. This parameter is enabled in the following circumstances.

- When *b1-02 = 0 [Run Command Selection 1 = Keypad]* or *b1-16 = 0 [Run Command Selection 2 = Keypad]*
- Using Local mode

0 : Disabled

The drive continues to operate even when a keypad disconnection is detected.

1 : Enabled

Once a keypad disconnection is detected, the drive stops operating and the *oPr [Keypad Connection Fault]* indicator appears. The motor coasts to stop.

■ o2-07: Keypad RUN Direction @ Power-up

No. (Hex.)	Name	Description	Default (Range)
o2-07 (0527)	Keypad RUN Direction @ Power-up	V/f CL-V/f OLV CLV AOLV Sets the direction of motor rotation when the drive is energized and the keypad is the Run command source.	0 (0, 1)

This parameter is enabled in these conditions:

- When *b1-02 = 0 [Run Command Selection 1 = Keypad]* or *b1-16 = 0 [Run Command Selection 2 = Keypad]*

• In LOCAL Mode

0 : Forward

1 : Reverse

■ o2-23: External 24V Powerloss Detection

No. (Hex.)	Name	Description	Default (Setting Range)
o2-23 (11F8) RUN	External 24V Powerloss Detection	V/f CL-V/f OLV CLV AOLV Sets the function to give a warning if the backup external 24 V power supply turns off when the main circuit power supply is in operation.	0 (0, 1)

Note:

The drive will not run when it is operating from one 24-V external power supply.

0 : Disabled

The drive does not detect the loss of the 24-V external power supply.

1 : Enabled

The keypad shows the *L24v [Loss of External Power 24 Supply]* indicator if the drive detects the loss of the 24-V external power supply.

Note:

A minor fault signal is not output from *H2-xx = 10 [MFDO Function Selection = Alarm]*.

■ o2-24: LED Light Function Selection

No. (Hex.)	Name	Description	Default (Setting Range)
o2-24 (11FE)	LED Light Function Selection	V/f CL-V/f OLV CLV AOLV Sets the function to show the LED status rings and keypad LED lamps.	0 (0 - 2)

0 : Enable Status Ring & Keypad LED

1 : LED Status Ring Disable

2 : Keypad LED Light Disable

■ o2-26: Alarm Display at Ext. 24V Power

No. (Hex.)	Name	Description	Default (Range)
o2-26 (1563)	Alarm Display at Ext. 24V Power	V/f CL-V/f OLV CLV AOLV When you connect a backup external 24 V power supply, this parameter sets the function to trigger an alarm when the main circuit power supply voltage decreases.	0 (0, 1)

0 : Disabled

The drive will not detect *EP24v [External Power 24V Supply]* if the main circuit power supply voltage decreases. The [Ready] light on the LED Status Ring flashes quickly to identify that drive operation is not possible.

1 : Enabled

The drive detects *EP24v* when the main circuit power supply voltage decreases.

Note:

A minor fault signal is not output from *H2-xx = 10 [MFDO Function Selection = Alarm]*.

■ o2-27: bCE Detection Selection

No. (Hex.)	Name	Description	Default (Range)
o2-27 (1565)	bCE Detection Selection	V/f CL-V/f OLV CLV AOLV Sets drive operation if the Bluetooth device is disconnected when you operate the drive in Bluetooth Mode.	3 (0 - 4)

0 : Ramp to Stop

1 : Coast to Stop

2 : Fast Stop (Use C1-09)

3 : Alarm Only

4 : No Alarm Display

◆ o3: Copy Function

o3 parameters set the operation of the parameter backup function.

■ o3-01: Copy Keypad Function Selection

No. (Hex.)	Name	Description	Default (Range)
o3-01 (0515)	Copy Keypad Function Selection	V/f CL-V/f OLV CLV AOLV Sets the function to use the keypad to save and copy drive parameters to a different drive.	0 (0 - 3)

0 : Copy Select

1 : Backup (drive → keypad)

The parameter setting values are read from the drive and stored in the keypad.

2 : Restore (keypad → drive)

Copies the parameter setting values stored in the keypad to another drive.

3 : Verify (check for mismatch)

Verifies that parameter setting values in the drive match the parameters stored in the keypad.

■ o3-02: Copy Allowed Selection

No. (Hex.)	Name	Description	Default (Range)
o3-02 (0516)	Copy Allowed Selection	V/f CL-V/f OLV CLV AOLV Sets the copy function when *o3-01 = 1 [Copy Keypad Function Selection = Backup (drive → keypad)]*.	0 (0, 1)

Note:

When you select [Parameter Backup] on the keypad menu screen to do the backup function, the drive automatically sets *o3-02 = 1*.

0 : Disabled

1 : Enabled

■ o3-04: Select Backup/Restore Location

No. (Hex.)	Name	Description	Default (Range)
o3-04 (0B3E)	Select Backup/Restore Location	V/f CL-V/f OLV CLV AOLV Sets the storage location for drive parameters when you back up and restore parameters. This parameter is only available when using an LCD keypad.	0 (0 - 3)

You can use the LCD keypad to make a maximum of 4 parameter backup sets.

0 : Memory Location 1

1 : Memory Location 2

2 : Memory Location 3

3 : Memory Location 4

■ o3-05: Select Items to Backup/Restore

No. (Hex.)	Name	Description	Default (Range)
o3-05 (0BDA)	Select Items to Backup/ Restore	V/f CL-V/f OLV CLV AOLV Sets which parameters are backed up, restored, and referenced. This parameter is only available on an LCD keypad.	0 (0, 1)

0 : Standard Parameters

1 : Standard + DWEZ Parameters

■ o3-06: Auto Parameter Backup Selection

No. (Hex.)	Name	Description	Default (Range)
o3-06 (0BDE)	Auto Parameter Backup Selection	V/f CL-V/f OLV CLV AOLV Sets the function that automatically backs up parameters. This parameter is only available when using an LCD keypad.	1 (0, 1)

When you connect the drive and keypad, parameters set to the drive are automatically backed up to the keypad as specified by the setting of parameters *o3-06* and *o3-07*.

0 : Disabled

1 : Enabled

Note:

When you replace the LCD keypad then energize the drive, the keypad shows the restore operation screen automatically to restore the drive configuration with the parameters backed up to the LCD keypad. If you connect an LCD keypad that does not have parameter backup data, the keypad will not show the restore operation screen.

■ o3-07: Auto Parameter Backup Interval

No. (Hex.)	Name	Description	Default (Range)
o3-07 (0BDF)	Auto Parameter Backup Interval	V/f CL-V/f OLV CLV AOLV Sets the interval at which the automatic parameter backup function saves parameters from the drive to the keypad.	1 (0 - 3)

The drive saves parameter settings to the keypad at these times:

1. After you energize the drive and the auto backup period passes.
2. When you use ROM enter or the keypad to change parameters, the drive saves those changes in the drive, waits for the auto backup period to pass, then saves those parameters in the keypad.

Note:

The drive can write data to the keypad a maximum of 100,000 times. If you write data to the keypad more than 100,000 times, you must replace the keypad.

0 : Every 10 minutes

1 : Every 30 minutes

2 : Every 60 minutes

3 : Every 12 hours

◆ o4: Maintenance Mon Settings

o4 parameters set the expected service life to help you know when to replace parts. The drive will show an alarm to tell you when the replacement part interval is near.

■ o4-01: Elapsed Operating Time Setting

No. (Hex.)	Name	Description	Default (Range)
o4-01 (050B)	Elapsed Operating Time Setting	V/f CL-V/f OLV CLV AOLV Sets the initial value of the cumulative drive operation time in 10-hour units.	0 h (0 - 9999 h)

When you select *o4-01* on the keypad, it will show the current value of *U4-01* in units of 10 hours (h). When you change the setting of *o4-01* through the monitor, the *U4-01* count starts again as specified by the setting of *o4-01*.

Note:

Set this parameter in 10-hour (h) units. When *o4-01 = 30*, *U4-01 [Cumulative Ope Time] = 300 h*.

■ o4-02: Elapsed Operating Time Selection

No. (Hex.)	Name	Description	Default (Range)
o4-02 (050C)	Elapsed Operating Time Selection	V/f CL-V/f OLV CLV AOLV Sets the condition that counts the cumulative operation time.	0 (0, 1)

0 : U4-01 Shows Total Power-up Time

Counts the time from when the drive is energized to when it is de-energized.

1 : U4-01 Shows Total RUN Time

Counts the time that the drive outputs voltage.

■ o4-03: Fan Operation Time Setting

No. (Hex.)	Name	Description	Default (Range)
o4-03 (050E)	Fan Operation Time Setting	V/f CL-V/f OLV CLV AOLV Sets the value from which to start the cumulative drive cooling fan operation time in 10-hour units.	0 h (0 - 9999 h)

Use monitor *U4-03 [Cooling Fan Ope Time]* to view the total operation time of the cooling fan. When you replace a cooling fan, set *o4-03 = 0* to reset *U4-03*. Select *o4-03* on the keypad to show the current value of *U4-03* in 10-hour (h) units. If you use the monitor to change *o4-03*, the recount of *U4-03* starts with the *o4-03* setting.

Note:

The drive sets *o4-03* in 10-hour (h) units. When *o4-03 = 30*, *U4-03 [Cooling Fan Ope Time]* will show "300 h".

■ o4-05: Capacitor Maintenance Setting

No. (Hex.)	Name	Description	Default (Range)
o4-05 (051D)	Capacitor Maintenance Setting	V/f CL-V/f OLV CLV AOLV Sets the *U4-05 [CapacitorMaintenance]* monitor value.	0% (0 - 150%)

When you replace a drive, set *o4-05 = 0* to reset *U4-05*. When the *o4-05* setting changes, the count of *U4-05* starts again as specified by the setting of *o4-05*. After you complete the configuration, *o4-05* automatically resets to *0*.

Note:

The maintenance period changes for different operating environments.

■ o4-07: Softcharge Relay Maintenance Set

No. (Hex.)	Name	Description	Default (Range)
o4-07 (0523)	Softcharge Relay Maintenance Set	V/f CL-V/f OLV CLV AOLV Sets the *U4-06 [PreChargeRelayMainte]* monitor value.	0% (0 - 150%)

When you replace a drive, set *o4-07 = 0* to reset *U4-06*. When the *o4-07* setting changes, the count of *U4-06* starts again as specified by the setting of *o4-07*. After you complete the configuration, *o4-07* automatically resets to *0*.

Note:

The maintenance period changes for different operating environments.

■ o4-09: IGBT Maintenance Setting

No. (Hex.)	Name	Description	Default (Range)
o4-09 (0525)	IGBT Maintenance Setting	V/f CL-V/f OLV CLV AOLV Sets the *U4-07 [IGBT Maintenance]* monitor value.	0% (0 - 150%)

When you replace a drive, set *o4-09 = 0* to reset *U4-07*. When the *o4-09* setting changes, the count of *U4-07* starts again as specified by the setting of *o4-09*. After you complete the configuration, *o4-09* automatically resets to *0*.

Note:

The maintenance period changes for different operating environments.

■ o4-11: Fault Trace/History Init (U2/U3)

No. (Hex.)	Name	Description	Default (Range)
o4-11 (0510)	Fault Trace/History Init (U2/U3)	V/f CL-V/f OLV CLV AOLV Resets the records of Monitors *U2-xx [Fault Trace]* and *U3-xx [Fault History]*.	0 (0, 1)

Note:

When you initialize the drive with *A1-03 [Initialize Parameters]*, the drive will not reset the records for *U2-xx* and *U3-xx*.

0 : Disabled

Keeps the records of Monitors *U2-xx* and *U3-xx*.

1 : Enabled

Resets the records for Monitors *U2-xx* and *U3-xx*. After the reset, the drive automatically resets *o4-11* to *0*.

■ o4-12: kWh Monitor Initialization

No. (Hex.)	Name	Description	Default (Range)
o4-12 (0512)	kWh Monitor Initialization	V/f CL-V/f OLV CLV AOLV Resets the monitor values for *U4-10 [kWh, Lower 4 Digits]* and *U4-11 [kWh, Upper 5 Digits]*.	0 (0, 1)

Note:

When you initialize the drive with *A1-03 [Initialize Parameters]*, the drive will not reset *U4-10* and *U4-11*.

0 : No Reset

Keeps the monitor values for *U4-10* and *U4-11*.

1 : Reset

Resets the values of *U4-10* and *U4-11*. After the reset, the drive automatically resets *o4-12* to *0*.

■ o4-13: RUN Command Counter @ Initialize

No. (Hex.)	Name	Description	Default (Range)
o4-13 (0528)	RUN Command Counter @ Initialize	V/f CL-V/f OLV CLV AOLV Resets the monitor values for *U4-02 [Num of Run Commands]*, *U4-24 [Number of Runs (Low)]*, and *U4-25 [Number of Runs (High)]*.	0 (0, 1)

0 : No Reset

Keeps the monitor values for *U4-02*, *U4-24, and U4-25*.

1 : Reset

Resets the values of *U4-02*, *U4-24*, and *U4-25*. After the reset, the drive automatically resets *o4-13* to *0*.

■ o4-22: Time Format

No. (Hex.)	Name	Description	Default (Range)
o4-22 (154F) RUN	Time Format	V/f CL-V/f OLV CLV AOLV Sets the time display format. This parameter is only available when using an LCD keypad.	0 (0 - 2)

Sets the display of the time shown in the upper-left of the LCD keypad screen.

0 : 24 Hour Clock

1 : 12 Hour Clock

2 : 12 Hour JP Clock

■ o4-23: Date Format

No. (Hex.)	Name	Description	Default (Range)
o4-23 (1550) RUN	Date Format	V/f CL-V/f OLV CLV AOLV Sets the date display format. This parameter is only available when using an LCD keypad.	0 (0 - 2)

Sets the date format that the drive uses for the fault history and other records.

0 : YYYY/MM/DD

1 : DD/MM/YYYY

2 : MM/DD/YYYY

Note:

The Fault History in the Monitor Mode shows when faults occurred. Refer to *Show Fault History on page 168* for more information.

■ o4-24: bAT Detection Selection

No. (Hex.)	Name	Description	Default (Range)
o4-24 (310F) RUN	bAT Detection Selection	V/f CL-V/f OLV CLV AOLV Selects the operation when the drive detects *bAT [Keypad Battery Low Voltage]* and *TiM [Keypad Time Not Set]*.	0 (0 - 2)

0 : Disable

No detection

1 : Enable (Alarm Detected)

The keypad shows *TiM* or *bAT*, and the drive continues operation. The output terminal set for *Alarm [H2-01 to H2-05 = 10]* switches ON.

2 : Enable (Fault Detected)

The drive output shuts off and the motor coasts to stop. Fault relay output terminal MA-MC will turn ON, and MB-MC will turn OFF.

◆ o5: Log Function

The data log function saves drive status information as a CSV file in the microSD memory card in the keypad. *Monitors Ux-xx* are the source of data log information. You can record a maximum of 10 monitors.

Change the LCD keypad screen from the main menu to the Diagnostic Tools screen and select the data log function. Set the number of the monitor to record and the sampling time, then start to record the data log.

Table 11.36 Setting Parameters for Data Log Items

No.	Name	Default	Data Log Monitors
o5-03	Log Monitor Data 1	101	*U1-01 [Frequency Reference]*
o5-04	Log Monitor Data 2	102	*U1-02 [Output Frequency]*
o5-05	Log Monitor Data 3	103	*U1-03 [Output Current]*
o5-06	Log Monitor Data 4	107	*U1-07 [DC Bus Voltage]*
o5-07	Log Monitor Data 5	108	*U1-08 [Output Power]*
o5-08	Log Monitor Data 6	000	Not selected
o5-09	Log Monitor Data 7	000	Not selected
o5-10	Log Monitor Data 8	000	Not selected
o5-11	Log Monitor Data 9	000	Not selected
o5-12	Log Monitor Data 10	000	Not selected

Note:
- Do not de-energize the drive or disconnect the keypad from the drive during log transfer communication. A loss of connection can cause the log function to fail after you restore power or connect the keypad.
- You can use a microSDHC card that has a maximum of 32 GB capacity.

■ Log File Specifications

Item	Specification
File storage location	A folder called [Log_File] is created in the root directory of the microSD card.
Filename	GLOG0xxx.csv **Note:** [xxx] identifies a 3-digit decimal number
Maximum number of files	999 (GLOG0001.csv to GLOG0999.csv)
Character code	ASCII code
Line break code	<CR><LF>
Separating character	[,] (Commas)
Header rows	First Row: Drive information including the drive model, software version, control method, and sampling time Second Row: Log data information including the monitor number, number decimal points, and unit code

■ Log File Configuration

The [Log_Files] folder is created under the root directory of the micro SD card, in which log data is stored as CSV files. Log data files are created in the following configuration. The number of rows varies depending on the number of selected monitors.

First row	Drive information
Second row	Log data information
Third row	Log data 1
:	Log data 2
:	Log data 3
:	:
Last row	Log data n

First Row: Drive Information

The following example illustrates the data text strings and data generated for the first row of log data.

No.	Item	Number of characters	Ex.	Description
1	Attribute	2	00	[00] represents that the record is a drive information record.
2	File number	4	0012	The [xxx] part of the [GLOG0xxx.csv] filename is a 3-digit decimal number generated in hexadecimal format. Example filename of [GLOG0018.csv]: 018 (Dec.) = 0012 (Hex.)
3	Time stamp *1	12	160107111230	Date file was generated • Date: 20YY/MM/DD • Time in 24-hour format: HH:MM:SS Example data of [160107111230]: 11:12:30 on January 7, 2016
4	Model	5		Drive model information
5	Software number	9		Drive software number
6	Control Method	1	2	Setting value (Hex.) of *A1-02 [Control Method Selection]*
7	Drive capacity	2	62	Setting value (Hex.) of *o2-04 [Drive Model (KVA) Selection]*
8	Sampling time	5 (max.)	1000	Setting value (Dec.) of *o5-02 [Log Sampling Interval]* Unit: ms
9	Row number	6	000001	Row number (Hex.) in the data log file

*1 If the time is not set in the keypad, the text string of [000000000000] is generated to represent the time.

Second Row: Log Data Information

The following example illustrates the data text strings and data generated for the second row of log data.

Example of generated data:
01,0012,160107111230,0101,0201,0102,0201,0103,0206,0107,0005,0108,0209,0000,0000,0000,0000,0000,0000,0000,0000,0000,0000,0000,0000,0000,0000,0000,0000,000002

No.	Item	Number of characters	Description
1	Attribute	2	[01] represents that the record is a log data information record.
2	File number	4	The [xxx] part of the [GLOG0xxx.csv] filename is a 3-digit decimal number generated in hexadecimal format.
3	Time stamp	12	Date file was generated
4	Monitor No. 1 *1	4	Monitor number selected by *o5-03 [Log Monitor Data 1]* Ex.: 0101 (Dec.) for *U1-01*
5	Monitor Unit 1 *2	4	Unit code and number of decimal places used for the monitor selected with *o5-03* Example when *U1-01 = 30.00 Hz*: Number of decimal places = 2, Hz unit code = 01, monitor unit 1 = 0201 (Hex.)
6	Monitor number 2	4	Monitor number (Dec.) selected by *o5-04 [Log Monitor Data 2]*
7	Monitor Unit 2	4	Unit code and number of decimal places used for the monitor selected with *o5-04*
:	:	:	:
22	Monitor number 10	4	Monitor number (Dec.) selected by *o5-12 [Log Monitor Data 10]*
23	Monitor Unit 10	4	Unit code and number of decimal places used for the monitor selected with *o5-12*

No.	Item	Number of characters	Description
24 to 27	Reserved	4	-
28	Row number	6	Row number (Hex.) in the data log file

*1 The text string of [0000] is generated when there is no data log monitor selected.
*2 Refer to the following table for information on unit codes.

Unit code (Hex.)	Unit	Unit code (Hex.)	Unit	Unit code (Hex.)	Unit	Unit code (Hex.)	Unit
00	–	08	PPR	10	H	18	0H
01	Hz	09	kW	11	V	19	–
02	RPM	0A	Ω	12	us	1A	–
03	%	0B	ms	13	min	1B	–
04	VAC	0C	kHz	14	°C	1C	–
05	VDC	0D	PSI	15	W	1D	–
06	A	0E	MPM	16	kWH	1E	–
07	sec	0F	FPM	17	MWH	1F	–

Third and Subsequent Rows: Log Data

The following example illustrates the data text strings and data generated for the third row of log data.

Example of generated data:
02,0012,160107111239,1770,1770,00BE,0118,0028,0000,0000,0000,0000,0000,0000,0000,00000C

No.	Item	Number of characters	Description
1	Attribute	2	[02] represents that the record is a monitor data record.
2	File number	4	The [xxx] part of the [GLOG0xxx.csv] filename is a 3-digit decimal number generated in hexadecimal format.
3	Time stamp	12	Data log data was retrieved (YYMMDDHHMMSS)
4	Log Monitor Data 1	4	Log monitor data (Hex.) of the monitor selected with *o5-03 [Log Monitor Data 1]*
5	Log Monitor Data 2	4	Log monitor data (Hex.) of the monitor selected with *o5-04 [Log Monitor Data 2]*
:	:	:	:
13	Log Monitor Data 10	4	Log monitor data (Hex.) of the monitor selected with *o5-12 [Log Monitor Data 10]*
14	Reserved	4	-
15	Encoding data	4	Encoding data for log monitor data 1 through 10 (Hex.) Bits 0 through 9 represent the encoding of log monitor data 1 1 through 10. A bit value of 1 represents that the data represents a negative value. (Log monitor data 1 through 10 is absolute value data without encoding) Example when log monitor data 2, 5, and 8 represent negative values: Bits 1, 4, and 7 have values of 1, and so the encoding data = 0010010010 (Bin.) = 0092 (Hex.)
16	Row number	6	Row number (Hex.) in the data log file

■ o5-01: Log Start/Stop Selection

No. (Hex.)	Name	Description	Default (Range)
o5-01 (1551) RUN	Log Start/Stop Selection	V/f CL-V/f OLV CLV AOLV Sets the data log function. This parameter is only available when using an LCD keypad.	0 (0 - 1)

0 : OFF

Stops the data log.

1 : ON

Starts the data log as specified by the sampling cycle set in *o5-02 [Log Sampling Interval]*.

■ o5-02: Log Sampling Interval

No. (Hex.)	Name	Description	Default (Range)
o5-02 (1552) RUN	Log Sampling Interval	V/f CL-V/f OLV CLV AOLV Sets the data log sampling cycle. This parameter is only available on an LCD keypad.	1000 ms (100 - 60000 ms)

■ o5-03: Log Monitor Data 1

No. (Hex.)	Name	Description	Default (Range)
o5-03 (1553) RUN	Log Monitor Data 1	V/f CL-V/f OLV CLV AOLV Sets the data log monitor. This parameter is only available when using an LCD keypad.	101 (000, 101 - 999)

Note:

Set the number of the *U monitor* to record the data log.

For example, to show *U1-01 [Frequency Reference]*, set *o5-03 = 101*. When it is not necessary to set data log monitors, set this parameter to *000*. You cannot set *U2 monitor [Fault Trace]* or *U3 Monitor [Fault History]*.

■ o5-04: Log Monitor Data 2

No. (Hex.)	Name	Description	Default (Range)
o5-04 (1554) RUN	Log Monitor Data 2	V/f CL-V/f OLV CLV AOLV Sets the data log monitor. This parameter is only available when using an LCD keypad.	102 (000, 101 - 999)

Note:

Set the *U monitor* number you will log.

For example, to show *U1-02 [Output Frequency]*, set *o5-04 = 102*. When it is not necessary to set data log monitor, set this parameter to *000*.

■ o5-05: Log Monitor Data 3

No. (Hex.)	Name	Description	Default (Range)
o5-05 (1555) RUN	Log Monitor Data 3	V/f CL-V/f OLV CLV AOLV Sets the data log monitor. This parameter is only available when using an LCD keypad.	103 (000, 101 - 999)

Note:

Sets the number of the *U monitor* you will log.

For example, to show *U1-03 [Output Current]*, set *o5-05 = 103*. When it is not necessary to set data log monitors, set this parameter to *000*. You cannot select *U2 monitor [Fault Trace]* or *U3 Monitor [Fault History]*.

■ o5-06: Log Monitor Data 4

No. (Hex.)	Name	Description	Default (Range)
o5-06 (1556) RUN	Log Monitor Data 4	V/f CL-V/f OLV CLV AOLV Sets the data log monitor. This parameter is only available when using an LCD keypad.	107 (000, 101 - 999)

Note:

Sets the number of the *U monitor* you will log.

For example, to show *U1-07 [DC Bus Voltage]*, set *o5-06 = 107*. When it is not necessary to set data log monitors, set this parameter to *000*. You cannot select *U2 monitor [Fault Trace]* or *U3 Monitor [Fault History]*.

■ o5-07: Log Monitor Data 5

No. (Hex.)	Name	Description	Default (Range)
o5-07 (1557) RUN	Log Monitor Data 5	V/f CL-V/f OLV CLV AOLV Sets the data log monitor. This parameter is only available when using an LCD keypad.	108 (000, 101 - 999)

Note:

Sets the number of the *U monitor* you will log.

For example, to show *U1-08 [Output Power]*, set *o5-07 = 108*. When it is not necessary to set data log monitors, set this parameter to *000*. You cannot select *U2 monitor [Fault Trace]* or *U3 Monitor [Fault History]*.

■ o5-08: Log Monitor Data 6

No. (Hex.)	Name	Description	Default (Setting Range)
o5-08 (1558) RUN	Log Monitor Data 6	V/f CL-V/f OLV CLV AOLV Sets the data log monitor. This parameter is only available when using an LCD keypad.	000 (000, 101 - 999)

Note:

Set the *U monitor* number you will log.

For example, to display *U1-01 [Frequency Reference]*, set *o5-08 = 101*. When it is not necessary to set a data log monitor, set *o5-08 = 000*.

■ o5-09: Log Monitor Data 7

No. (Hex.)	Name	Description	Default (Range)
o5-09 (1559) RUN	Log Monitor Data 7	V/f CL-V/f OLV CLV AOLV Sets the data log monitor. This parameter is only available when using an LCD keypad.	000 (000, 101 - 999)

Note:

Set the *U monitor* number you will log.

For example, to show *U1-01 [Frequency Reference]*, set *o5-09 = 101*. When it is not necessary to set data log monitor, set this parameter to *000*.

■ o5-10: Log Monitor Data 8

No. (Hex.)	Name	Description	Default (Range)
o5-10 (155A) RUN	Log Monitor Data 8	V/f CL-V/f OLV CLV AOLV Sets the data log monitor. This parameter is only available when using an LCD keypad.	000 (000, 101 - 999)

Note:

Sets the number of the *U monitor* you will log.

For example, to show *U1-01 [Frequency Reference]*, set *o5-10 = 101*. When it is not necessary to set data log monitors, set this parameter to *000*. You cannot select *U2 monitor [Fault Trace]* or *U3 Monitor [Fault History]*.

■ o5-11: Log Monitor Data 9

No. (Hex.)	Name	Description	Default (Range)
o5-11 (155B) RUN	Log Monitor Data 9	V/f CL-V/f OLV CLV AOLV Sets the data log monitor. This parameter is only available when using an LCD keypad.	000 (000, 101 - 999)

Note:

Sets the number of the *U monitor* you will log.

For example, to show *U1-01 [Frequency Reference]*, set *o5-11 = 101*. When it is not necessary to set data log monitors, set this parameter to *000*. You cannot select *U2 monitor [Fault Trace]* or *U3 Monitor [Fault History]*.

■ o5-12: Log Monitor Data 10

No. (Hex.)	Name	Description	Default (Range)
o5-12 (155C) RUN	Log Monitor Data 10	V/f CL-V/f OLV CLV AOLV Sets the data log monitor. This parameter is only available when using an LCD keypad.	000 (000, 101 - 999)

Note:

Sets the number of the *U monitor* you will log.

For example, to show *U1-01 [Frequency Reference]*, set *o5-12 = 101*. When it is not necessary to set data log monitors, set this parameter to *000*. You cannot select *U2 monitor [Fault Trace]* or *U3 Monitor [Fault History]*.

11.12 T: Auto-Tuning

Numbers identifying the *T parameters* are displayed when an LED keypad is used. The names of the parameters are displayed on the LCD screen of the LCD keypad. Set the following.

- Motor Parameter Auto-Tuning
- ASR and Inertia Tuning

◆ T0: Tuning Mode Selection

■ T0-00: Tuning Mode Selection

When your control method supports Control Tuning, set *T0-00* first. Then, set *T1-00 [Motor Selection]* to select the motor you will tune. Then, set the tuning mode in *T3-00 [Control Loop Tuning Selection]*.

No. (Hex.)	Name	Description	Default (Range)
T0-00 (1197)	Tuning Mode Selection	V/f CL-V/f OLV **CLV** **AOLV** Selects the type of Auto-Tuning to be used.	0 (0, 1)

0 : Motor Parameter Tuning

1 : Control Tuning

Note:

The available tuning modes vary depending on the control mode.

◆ T1: Induction Motor Auto-Tuning

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

Note:

- The base frequency of drive dedicated motors and special motors for use with vector control may be lower than the base frequency of general-purpose motors, which is 50 Hz or 60 Hz. In such cases, this lower frequency is used as the value for *E1-06 [Base Frequency]* and *E1-04 [Maximum Output Frequency]* after Auto-Tuning completes. If the maximum output frequency is too low and causes problems, change the setting of *E1-04* after Auto-Tuning completes.
- The following induction motor parameters are set automatically.
  – *E1-xx [V/f Pattern for Motor 1]*
  – *E2-xx [Motor Parameters]*
  – *E3-xx [V/f Pattern for Motor 2]*
  – *E4-xx [Motor 2 Parameters]*
  – *F1-xx [Encoder Options]* (only with Closed Loop Vector Control)

■ T1-00: Motor Selection

No. (Hex.)	Name	Description	Default (Range)
T1-00 (0700)	Motor Selection	V/f CL-V/f OLV **CLV** **AOLV** Sets which motor to tune when motor switching is enabled. You must use the keypad to set this parameter. You cannot use external input terminals to set it.	1 (1 - 3)

Note:

You can set this parameter when you select motor switching. This parameter does not appear when motor switching is disabled. You cannot switch motors from an external input. Use the keypad to show *T1-00* and change the setting value to switch the motor.

1 : Motor 1 (sets E1-xx, E2-xx)

Auto-Tuning automatically sets parameters *E1-xx* and *E2-xx* for motor 1.

2 : Motor 2 (sets E3-xx, E4-xx)

Auto-Tuning automatically sets parameters *E3-xx* and *E4-xx* for motor 2. Make sure that you connect motor 2 to the drive for Auto-Tuning.

3 : Motor 3 (sets E7-xx)

Auto-Tuning automatically sets parameters *E7-xx* for motor 3. Make sure that motor 3 is connected to the drive for Auto-Tuning.

■ T1-01: Auto-Tuning Mode Selection

No. (Hex.)	Name	Description	Default (Range)
T1-01 (0701)	Auto-Tuning Mode Selection	V/f CL-V/f OLV CLV AOLV Sets the type of Auto-Tuning.	Determined by A1-02 (Determined by A1-02)

0 : Rotational Auto-Tuning

1 : Stationary Auto-Tuning 1

2 : Stationary Line-Line Resistance

■ T1-02: Motor Rated Power

No. (Hex.)	Name	Description	Default (Range)
T1-02 (0702)	Motor Rated Power	V/f CL-V/f OLV CLV AOLV Sets the rated output power (kW) of the motor.	Determined by o2-04 (0.00 - 590.0 kW)

Note:

Capacities 300 kW and less are set in units of 0.01 kW. Capacities above 300 kW are set in units of 0.1 kW.

■ T1-03: Motor Rated Voltage

No. (Hex.)	Name	Description	Default (Range)
T1-03 (0703)	Motor Rated Voltage	V/f CL-V/f OLV CLV AOLV Sets the rated voltage (V) of the motor. Enter the base speed voltage for constant output motors.	Determined by o2-04 (200 V Class: 0.0 - 255.5 V, 400 V Class: 0.0 - 511.0 V)

If auto tuning is carried out with respect to a drive dedicated motor or a special motor for use with vector control, the voltage or frequency derived as the result of the tuning will often be lower than that of a general-purpose motor. For this reason, always compare the data from the nameplate or test report with the results measured by the auto tuning and check for discrepancies. Enter the voltage needed to operate the motor under no-load conditions at rated speed to *T1-03* for better control precision around rated speed. If the motor test report or the motor nameplate is not available, enter approximately 90% of the motor rated voltage.

If the drive input power supply voltage is low, enter approximately 90% of the input voltage. Current will increase if the input power supply voltage is low. For this reason, confirm the main power supply capacity and molded-case circuit breaker for the drive.

■ T1-04: Motor Rated Current

No. (Hex.)	Name	Description	Default (Range)
T1-04 (0704)	Motor Rated Current	V/f CL-V/f OLV CLV AOLV Sets the rated current (A) of the motor.	Determined by o2-04 (10% to 200% of the drive rated current)

Set the motor rated current between 50% and 100% of the drive rated current for the best performance. Enter the current at the motor base speed.

■ T1-05: Motor Base Frequency

No. (Hex.)	Name	Description	Default (Range)
T1-05 (0705)	Motor Base Frequency	V/f CL-V/f OLV CLV AOLV Sets the base frequency (Hz) of the motor.	50.0 Hz (0.0 - 590.0 Hz)

When Auto-Tuning is carried out, the value of *T1-05* is set to *E1-04 [Maximum Output Frequency]*. However, *E1-04* is set to 40 Hz if *T1-05* is set to a value less than 40 Hz. If you operate the drive at a speed that is higher than the base frequency, set *E1-04* (*E3-04* for motor 2, *E7-04* for motor 3) to the maximum output frequency after you complete Auto-Tuning.

■ T1-06: Number of Motor Poles

No. (Hex.)	Name	Description	Default (Range)
T1-06 (0706)	Number of Motor Poles	V/f CL-V/f OLV CLV AOLV Sets the number of motor poles.	4 (2 - 120)

■ T1-07: Motor Base Speed

No. (Hex.)	Name	Description	Default (Range)
T1-07 (0707)	Motor Base Speed	V/f CL-V/f OLV CLV AOLV Sets the motor base speed for Auto-Tuning (min^{-1} (r/min)).	1750 min^{-1} (r/min) (0 - 35400 min^{-1} (r/min))

■ T1-08: Encoder Pulse Count (PPR)

No. (Hex.)	Name	Description	Default (Range)
T1-08 (0708)	Encoder Pulse Count (PPR)	V/f CL-V/f OLV CLV AOLV Sets the number of PG (pulse generator, encoder) pulses.	600 ppr (0 - 60,000 ppr)

Set the actual number of pulses for one full motor rotation.

■ T1-09: Motor No-Load Current

No. (Hex.)	Name	Description	Default (Range)
T1-09 (0709)	Motor No-Load Current	V/f CL-V/f OLV CLV AOLV Sets the no-load current of the motor.	- (0A - T1-04; max. of 2999.9)

Note:

The display units are different for different models:
- 2003 to 2033, 4002 to 4018: 0.01 A units
- 2047 to 2415, 4024 to 4605: 0.1 A units

The value shown is the no-load current that is automatically calculated from the values set in *T1-02 [Motor Rated Power]* and *T1-04 [Motor Rated Current]*. Set the no-load current shown on the motor test report. If the motor test report is not available, do not change this parameter.

■ T1-10: Motor Rated Slip Frequency

No. (Hex.)	Name	Description	Default (Range)
T1-10 (070A)	Motor Rated Slip Frequency	V/f CL-V/f OLV CLV AOLV Sets motor rated slip.	- (0.000 - 20.000 Hz)

Shows 0.000 Hz as the default value. Set the rated slip shown on the motor test report. If the motor test report is not available, do not change this parameter.

■ T1-12: Test Mode Selection

No. (Hex.)	Name	Description	Default (Range)
T1-12 (0BDB)	Test Mode Selection	V/f CL-V/f OLV CLV AOLV Sets the function to enable Test Mode after Stationary Auto-Tuning. When you can operate the motor with a light load attached after Stationary Auto-Tuning is complete, enable this parameter.	0 (0, 1)

0 : No

1 : Yes

After Auto-Tuning, the drive automatically sets *E2-02 [Motor Rated Slip]* and *E2-03 [Motor No-Load Current]* when you operate the motor for the first time in Drive Mode.

Note:

After Auto-Tuning is complete and you set the drive to Drive Mode, operate the motor in these conditions:

- Make sure that you connect all wiring between the drive and motor
- Make sure that a mechanical brake on the motor shaft is not locked
- Keep the motor-load ratio at 30%
- Hold constant speed for longer than 1 second at a minimum of 30% of the speed set in *E1-06 [Base Frequency]* (the default setting is the same as the maximum frequency).

■ T1-13: No-load voltage

No. (Hex.)	Name	Description	Default (Range)
T1-13 (0BDC)	No-Load Voltage	V/f CL-V/f OLV CLV AOLV Sets the no-load voltage of the motor. When the no-load voltage at rated speed is available, for example on the motor test report, set the voltage in this parameter. If the no-load voltage is not available, do not change this parameter.	90% of T1-03 (200 V Class: 0.0 - 255.0 V, 400 V Class: 0.0 - 510.0 V)

Note:

Set this value to the same setting as *T1-03 [Motor Rated Voltage]* to get the same characteristics using a Yaskawa drive 1000 Drive Series or earlier models.

◆ T3: ASR and Inertia Tuning

■ T3-00: Control Loop Tuning Selection

No. (Hex.)	Name	Description	Default (Range)
T3-00 (1198)	Control Loop Tuning Selection	V/f CL-V/f OLV CLV AOLV Sets the Control Loop Auto-Tuning method.	0 (0, 1)

0 : Inertia Tuning

1 : ASR (Speed Regulator)

■ T3-01: Test Signal Frequency

No. (Hex.)	Name	Description	Default (Range)
T3-01 (0760)	Test Signal Frequency	V/f CL-V/f OLV CLV AOLV Usually it is not necessary to change this setting. Sets the frequency of the test signal applied to the motor during Inertia Tuning.	3.0 Hz (0.1 - 20.0 Hz)

Lower the setting value if the load inertia is too significant and a fault is detected after the Inertia Tuning.

■ T3-02: Test Signal Amplitude

No. (Hex.)	Name	Description	Default (Range)
T3-02 (0761)	Test Signal Amplitude	V/f CL-V/f OLV CLV AOLV Sets the amplitude of the test signal applied to the motor during Inertia Tuning. Usually it is not necessary to change this setting.	0.5 rad (0.1 - 10.0 rad)

Lower the setting value if the load inertia is too significant and a fault is detected after the Inertia Tuning. Adjust this parameter if a fault occurs when *T3-01 [Test Signal Frequency]* is set to a low value.

■ T3-03: Motor Inertia

No. (Hex.)	Name	Description	Default (Range)
T3-03 (0762)	Motor Inertia	V/f CL-V/f OLV CLV AOLV Sets the inertia of the motor. This value uses the test signal response to calculate the load inertia.	Determined by o2-04 (0.0001 - 6.0000 kgm^2)

The default setting is for a Yaskawa standard motor as shown in the motor inertia table.

Note:

Capacities smaller than 37 kW are set in units of 0.0001 kgm^2. Capacities 37 kW and larger are set in units of 0.001 kgm^2.

■ T3-04: System Response Frequency

No. (Hex.)	Name	Description	Default (Range)
T3-04 (0763)	System Response Frequency	V/f CL-V/f OLV CLV AOLV This parameter uses the load inertia value from the Inertia Tuning process to automatically calculate and set *C5-01 [ASR Proportional Gain 1]*.	10.0 Hz (0.1 - 50.0 Hz)

Oscillation may result if the value input here is too high.

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Revision History

Date of Publication	Revision Number	Section	Revised Content
July 2021	-	-	First Edition

YASKAWA AC Drive CR700

Technical Manual

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In the event that the end user of this product is to be the military and said product is to be employed in any weapons systems or the manufacture thereof, the export will fall under the relevant regulations as stipulated in the Foreign Exchange and Foreign Trade Regulations. Therefore, be sure to follow all procedures and submit all relevant documentation according to any and all rules, regulations and laws that may apply.
Specifications are subject to change without notice for ongoing product modifications and improvements.

Original instructions.

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YASKAWA

YASKAWA AC Drive CR700 Supplemental Manual (Wire Length Detection & Cargo Swing Suppression)

(Software Version PRG: 010XX)

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1.Revision History

Revision Number	Revised Content	Date of Publication
—	First Edition	2017/05
<1>	Changed range value of S9-19 (Upper limit 50m to 300m) and added notes related to this change.	2019/05
<2>	・ Added S9-31, S9-32, S9-34 ・ Swapped order of explanation of wire length detection function and cargo swing suppression function. ・ Explanation and notes added accompanying addition of S9-14=3. ・ Corrected mistakes	2023/05

2. Basic Specifications

The CR700 is a drive designed especially for use with cranes. The basic specifications of the CR700 are based on the information described in the CR700 Technical Manual. Refer to the CR700 Technical Manual for more information about how to use the keypad and Auto-Tuning methods.

◆ Precautions before Use

When using the drive with a lifting and lowering shaft, wire the drive so that hoisting direction of the machine is the Forward Run command and the lowering direction of the machine is the Reverse Run command (all control modes). If the movement of the machine and the direction of the Run commands do not match, the functions and performance of the crane software will be adversely affected, and it will not be possible to obtain sufficient performance from the machine. If the direction of motor rotation does not match the machine, swap two phases of the power lines to the motor and change F1-05 (Encoder 1 Rotation Selection) if the motor has an encoder to set the hoisting direction of the machine to the Forward Run command and the lowering direction of the machine to the Reverse Run command.
Install a fall detector or overspeed detector for safety.

◆ General Safety

- Install a holding brake.
- Implement safety measures such as fall prevention on the machine side.
- Ensure that the holding brake will be applied by an external sequence when there is an emergency or the power supply is turned OFF.
- Implement a safety circuit that uses the fault relay of this product to apply the holding brake when a fault occurs.

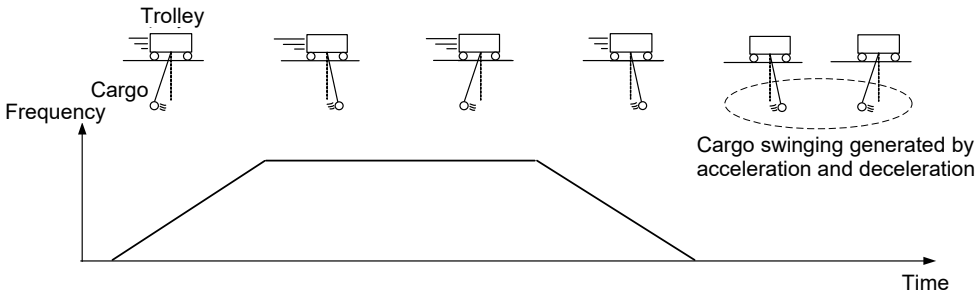
3.Function Details

3.1 Cargo Swing Suppression (Anti Swing Control)

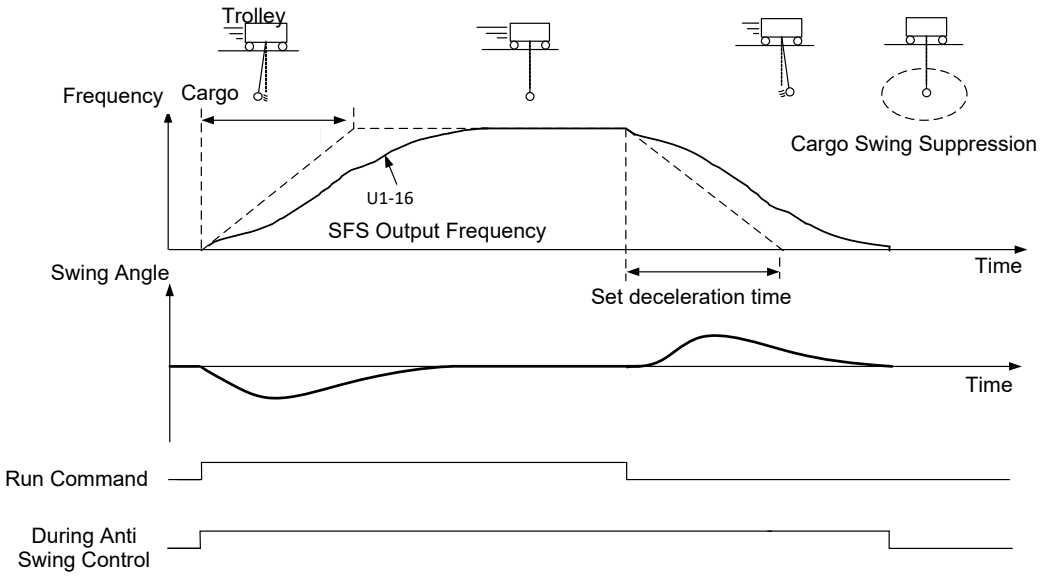
Cargo Swing Suppression suppresses swinging of the cargo that occurs when the traverse shaft or traveling shaft accelerates and decelerates in an overhead crane. This function is effective for suppressing swinging of the cargo and reducing takt time by adjusting the acceleration and deceleration times during operation. When the function is enabled, the acceleration and deceleration times are adjusted to times that can suppress cargo swing based on the acceleration and deceleration times set for the C parameter. For U1-16 [SFS Output Frequency], the adjusted frequency is output by Anti Swing Control.

◆ Applicable Control Modes

- V/f Control (A1-02 = 0)
- V/f Control w/ PG (A1-02 = 1)
- Open Loop Vector (A1-02 = 2)
- Closed Loop Vector (A1-02 = 3)
- Advanced Open Loop Vector (A1-02 = 4)



(a) Function Disabled (S9-11 = 0)



(b) Function Enabled (S9-11 = 1)

Figure 3.1.1 Cargo Swing Suppression (Anti Swing Control)

Note:

- The effect of Cargo Swing Suppression when the traverse shaft or traveling shaft stops is dependent on the mechanical configuration of the crane. Be aware that cargo swinging caused by the lifting and lowering operation of the crane, wind, and/or the mechanical configuration of the crane cannot be suppressed.
- Be aware that effect of Cargo Swing Suppression will be lessened when there is a large degree of error between the length of the center of gravity position of the wire tip from the center of the lifting and lowering shaft drum and U9-06 [Wire Length].

<1>

- If U9-06 [Wire Length] exceeds 50 m, the longer the wire length, the lower the Cargo Swing Suppression effect.
- When this function is enabled, the actual acceleration and deceleration times will be longer than the set acceleration and deceleration times, and the longer the value of U9-06 [Wire Length], the greater the difference will be from the set times.
- Compared to when this function is disabled, the stopping distance will increase when this function is enabled. For this reason, increase the timing of when the Stop command is input or review the deceleration time setting. Install an emergency stop circuit for safety. If the Fast Stop command is input with a multi-function digital input, Anti Swing Control will be disabled and the motor will decelerate according to Fast Stop Time.

<2>

Note the following points when external input (PG2) is set (S9-14 = 3) for the wire length detection method of the traverse and traveling shaft drives and cargo swing suppression is set to enabled.

- When PGoH is detected or cargo swing suppression is felt to be ineffective, check the wiring of the PG option card connected to CN5-B.
- Before moving the traverse and traveling shaft drives when checking the wiring of the PG option card connected to CN5-B, be sure to set cargo swing suppression to disabled. After recovery from a problem, perform origin position detection to ensure that the wire length is correctly detected, and check U9-06 [Wire Length].
- When PG-B3 is used to detect the wire length, encoder (PG) cable disconnection cannot be detected. When encoder (PG) feedback is lost, cargo swing suppression might be less effective. When encoder (PG) feedback loss detection is required, consider remedial action on the system (e.g. PLC) side.

◆ System Configuration

■ When using with wire length fixed <2>

When there is little change in the length of the wire (wire length, A and B in Figure 3.1.2) from the center of the lifting and lowering shaft drum to the center of gravity position of the wire tip, cargo swinging can be suppressed with simple wiring and without external input of the wire length. In this case, set the wire detection method to fixed (S9-14 = 0) and set the wire length at S9-19. Note, however, that if the center of gravity position changes due to the lifting/lowering operation or the condition of the suspended cargo, correct the wire length by switching the enabled and disabled setting using MFDI.

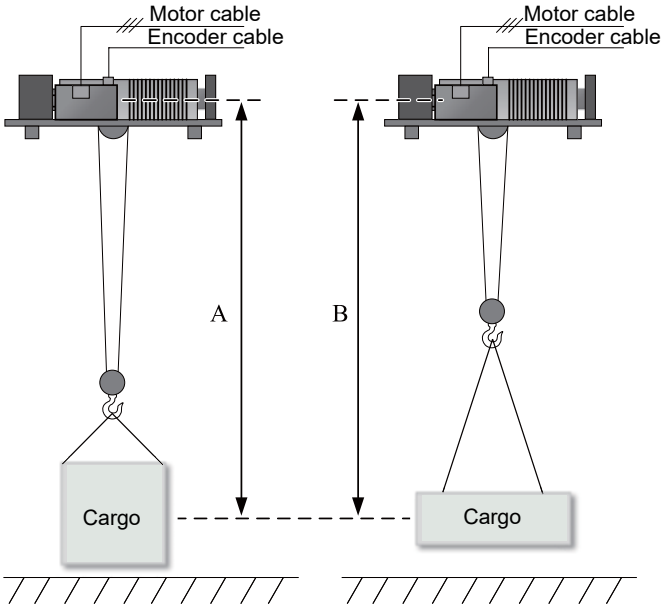


Figure 3.1.2 Wire Length from the Center of the Lifting and Lowering Shaft Drum to the Center of Gravity Position of the Wire Tip
(When There Is Little Change in the Center of Gravity Position of the Wire Tip from the Center of the Lifting and Lowering Shaft Drum (A ≒ B))

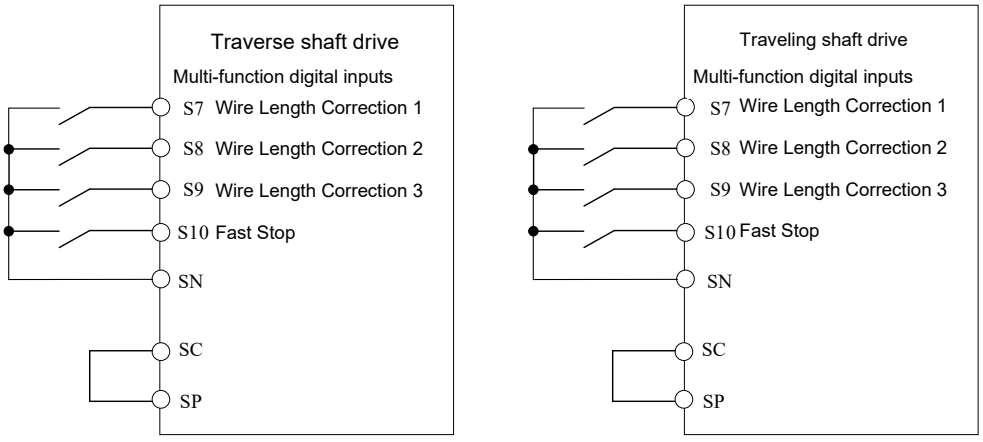


Figure 3.1.3 Example of Connections When There is Little Change in the Center of Gravity Position

■ When there is considerable change in the length of the wire <2>

When there is considerable change in the length (wire length, C and D in Figure 3.1.4) from the center of the lifting and lowering shaft drum to the center of gravity position of the wire tip, the wire length corresponding to the lifting/lowering operation can be input to the traverse and traveling shaft drives. Multi-function analog input, Memobus communication or PG pulse can be selected as the external input of the wire length corresponding to the lifting/lowering operation. In this case, set external input (S9-14 = 1, 2, 3) as the wire detection method. The wire length will be automatically calculated based on the setting value of S9-19 (Figure 3.1.5). For details on the wire length detection function, refer to "3.2 Wire Length Detection Function." Ensure that the wire length to input into the traverse and traveling shaft drives is the wire length on the side on which Anti Swing Control is applied in the main hoisting and auxiliary hoisting of the lifting and lowering shaft. Note, however, that if the center of gravity position changes due to the condition of the suspended cargo, correct the wire length by switching the enabled and disabled setting using MFDI.

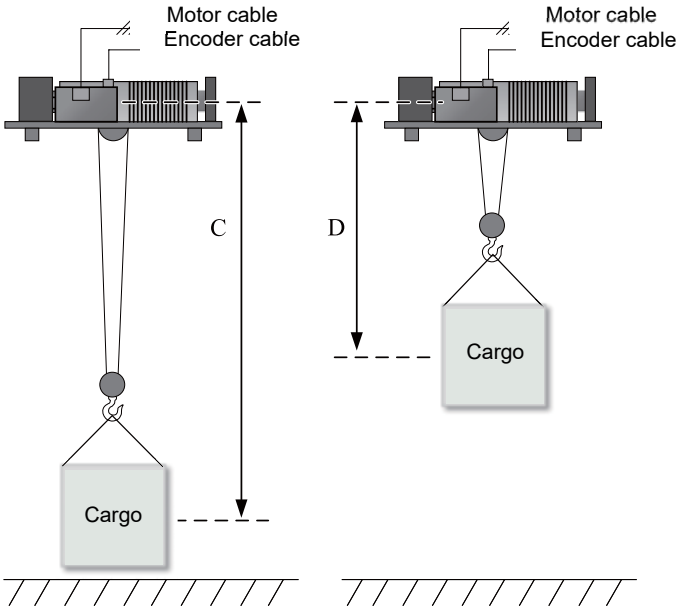


Figure 3.1.4 Wire Length from the Center of the Lifting and Lowering Shaft Drum to the Center of Gravity Position of the Wire Tip

(When There Is a Large Change in the Center of Gravity Position of the Wire Tip from the Center of the Lifting and Lowering Shaft Drum (C ≠ D))

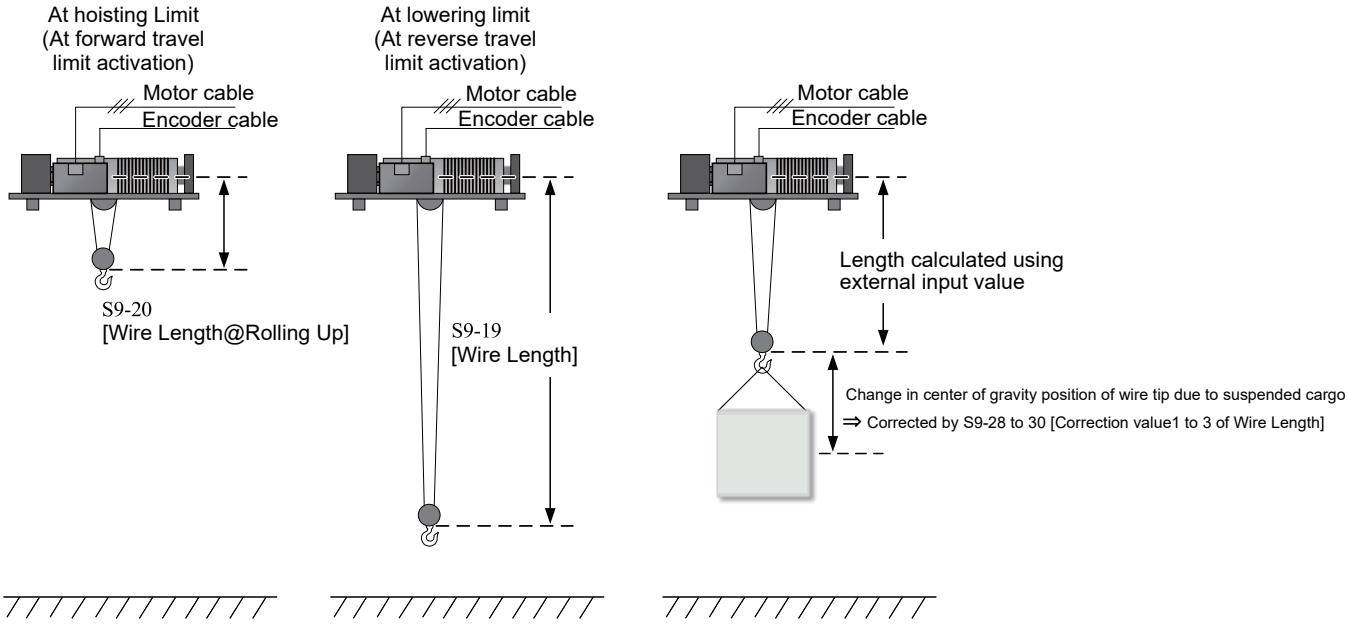


Figure 3.1.5 Settings when S9-14 = 1, 2, or 3 [Wire Length Detection Method = External Input]

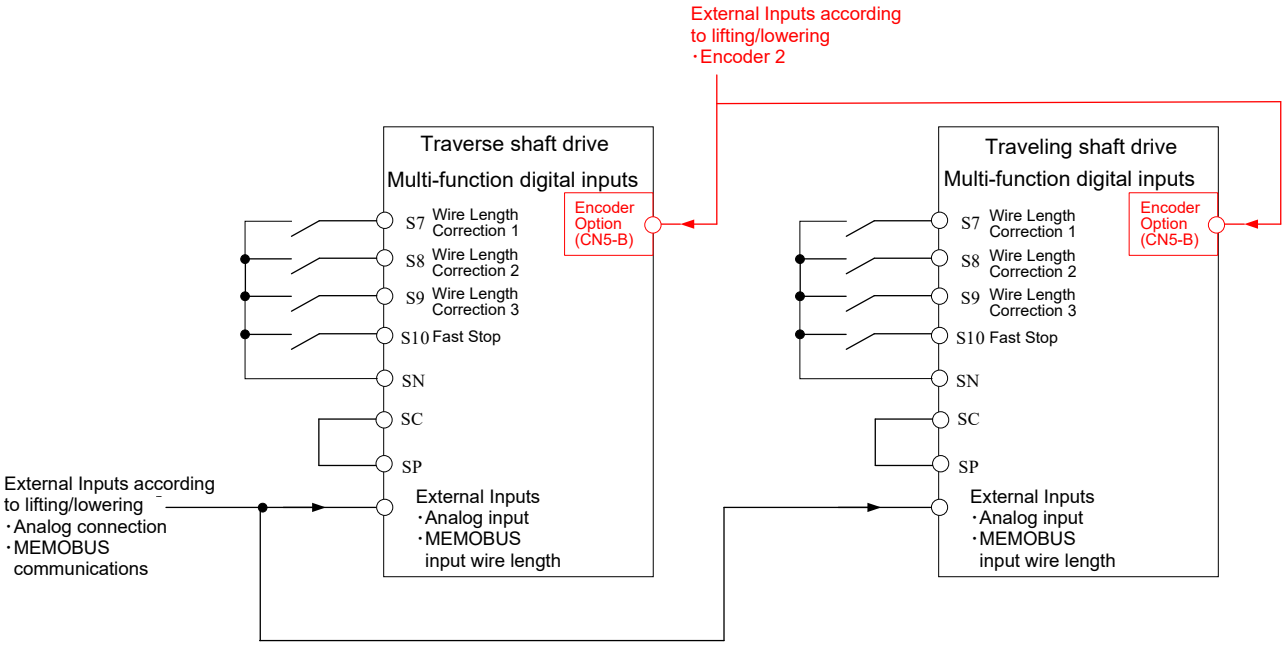


Figure 3.1.6 Example of Connections When There are Large Changes in the Center of Gravity Position

◆ Descriptions of Parameters

■ S9-11 Anti-Swing Control Selection

Enables and disables Anti Swing Control.

No.	Name	Setting Range	Default Setting
S9-11	Anti-Swing Control Selection	0, 1	0

0: Disabled
1: Enabled (Feedforward)

Anti Swing Control changes from enabled to disabled when the following functions are active. Note that any cargo swinging that occurs while Anti Swing Control is disabled cannot be suppressed.

Function	Operation
Fast Stop	When the Fast Stop command is input while Anti Swing Control is active, Anti Swing Control will be disabled and the drive will ramp to stop in the deceleration time set with C1-09 [Fast Stop Time].
Rapid Deceleration	When Rapid Deceleration is enabled while Anti Swing Control is active, Anti Swing Control will be disabled and the drive will ramp to stop according to S2-19 [Rapid Deceleration Time]. If Rapid Deceleration is enabled during operation, Anti Swing Control will not be re-enabled when Rapid Deceleration is disabled.
Brake Sequence	When using S1 [Brake Sequence], Anti Swing Control will be disabled while the Brake Release command is OFF. The effect of Cargo Swing Suppression will decrease when the frequency level that turns ON the Brake Release command is high. Implement the following measures if you need to increase the effect of Cargo Swing Suppression. ・ Lower the frequency level that turns ON the Brake Release command. ・ Set S1-54=0 [Disable Brake Sequence] and assign during bb [Baseblock] to the Brake command.
Motor Switch	Motors 2 and 3 do not support Anti Swing Control. Anti Swing Control is applied to motor 1.

◆ Anti Swing Control Enabled/Disabled Switch

Anti Swing Control can be switched between enabled and disabled by external digital input (H1-□□=50).
(Note, however, that switching between enabled and disabled is possible only during bb [Baseblock].)

■ S9-14 Wire Length Detection Method

Selects the wire length detection method.

No.	Name	Setting Range	Default Setting
S9-14	Wire Length Detection Method	0 to 3*1<2>	0

<2> *1: The setting range changes according to the PRG number. PRG:01025 or later: 0 to 3, earlier than PRG:01025: 0 to 2

0: Fix (S9-19 [Wire Length])
Uses the setting value of S9-19 [Wire Length]. The wire length can also be changed in steps using S9-28 to S9-30 [Correction value1 to 3 of Wire Length].

1: External (Analog Input)
Uses the input value of an analog input terminal. The set wire length can be changed according to the analog input value. When this parameter is used in combination with Wire Length Detection of the lifting and lowering shaft drive, U9-06 [Wire Length] will change according to the analog output of Wire Length Detection. If the center of gravity position of

the wire tip changes due to the condition of the suspended cargo, correct for this using S9-28 to S9-30 [Correction value1 to 3 of Wire Length].

2: External (COM)
Uses the input value from MEMOBUS communications. The set wire length can be changed according to the input value from MEMOBUS communications. When this parameter is used in combination with Wire Length Detection of the lifting and lowering shaft drive, U9-06 [Wire Length] will change according to the detected value of Wire Length Detection. If the center of gravity position of the wire tip changes due to the condition of the suspended cargo, correct for this using S9-28 to S9-30 [Correction value1 to 3 of Wire Length].

3: External (PG 2 Input) <2>
The wire length is detected on the traverse and traveling shaft drives by inputting the PG signal connected to the motor driven by the lifting and lowering shaft drive distributed to the traverse and traveling shaft drives. The PG signal is input to the PG option card connected to CN5-B of the traverse and traveling shaft drives. U9-06 [Wire Length] changes depending on the wire length detection value. Moreover, if the center of gravity position of the wire tip changes due to the condition of the suspended cargo, correct for this by using S9-28 to S9-30 [Correction value1 to 3 of Wire Length].

■ S9-19 Wire Length

Sets the wire length in meters from the center of the lifting and lowering shaft drum to the center of gravity position of the wire tip when the wire is lowered. When using Wire Length Detection, set this parameter so that Wire Length Detection is 100% output when the hook is lowered to the lowering limit. Refer to ″3.2 Wire Length Detection″ for more information about Wire Length Detection.

No.	Name	Setting Range	Default Setting
S9-19	Wire Length	1.0 to 300.0m*1<1>	10.0 m

<1> *1: The setting range is different for different PRG number.
PRG:01017 or later: 1.0 to 300.0 m, earlier than PRG:01017: 1.0 to 50.0 m

The meaning of the wire length setting differs according to the wire length detection method set in S9-14.

S9-14 = 0: Setting value of the wire length.
Sets the wire length from the center of the lifting and lowering shaft drum to the center of gravity position of the wire tip. The wire length can be changed in steps using S9-28 to S9-30 [Correction value1 to 3 of Wire Length].

S9-14 = 1: Sets the wire length when the analog input is 100%.
Sets the wire length in meters from the center of the lifting and lowering shaft drum to the center of gravity position of the wire tip when the wire is lowered to the lowering limit (reverse travel limit activation) with no cargo suspended. If the center of gravity position of the wire tip changes due to the condition of the suspended cargo, correct for this using S9-28 to S9-30 [Correction value1 to 3 of Wire Length].

S9-14 = 2: Sets the wire length when the MEMOBUS input is 100%.
Sets the wire length in meters from the center of the lifting and lowering shaft drum to the center of gravity position of the wire tip when the wire is lowered to the lowering limit (reverse travel limit activation) with no cargo suspended. If the center of gravity position of the wire tip changes due to the condition of the suspended cargo, correct for this using S9-28 to S9-30 [Correction value1 to 3 of Wire Length].

S9-14 = 3: Sets the wire length when U9-02 [Hook Position (%)] is 100% <2>
Sets the wire length in meters from the center of the lifting and lowering shaft drum to the center of gravity position of the wire tip when the wire is lowered to the lowering limit (reverse travel limit activation) with no cargo suspended. If the center of gravity position of the wire tip changes due to the condition of the suspended cargo, correct for this by using S9-28 to S9-30 [Correction value1 to 3 of Wire Length].

■ S9-20 Wire Length@Rolling Up

This parameter is enabled when Wire Length Detection Method is set to an external input (S9-14 = 1, 2, or 3 <2>).
This parameter sets the wire length in meters from the center of the lifting and lowering shaft drum to the center of gravity position of the wire tip when the wire is hoisted to the hoisting limit (forward travel limit activation) with no cargo suspended. When using Wire Length Detection on the hosting/lowering shaft drive, set this parameter so that Wire Length Detection is 0% output at the hoisting limit.

S9-14 = 1: Sets the wire length to S9-20 when the analog input is 0%.
S9-14 = 2: Sets the wire length to S9-20 when the MEMOBUS input is 0%.
S9-14 = 3: Sets the wire length to S9-20 when U9-02 [Hook Position (%)] is 0%.

No.	Name	Setting Range	Default Setting
S9-20	Wire Length@Rolling Up	1.0 to 50.0 m	1.0 m

■ S9-28 Correction value1 of Wire Length

Sets the wire length correction value in meters for the center of gravity position of the wire tip. To enable the correction value, set Wire Length Correction 1 (51 or 151) to a multi-function digital input (H1-□□), and then enable and disable the correction value with external input.

No.	Name	Setting Range	Default Setting
S9-28	Correction value1 of Wire Length	-50.0 to 50.0 m	0.0 m

■ S9-29 Correction value2 of Wire Length

Sets the wire length correction value in meters for the center of gravity position of the wire tip. To enable the correction value, set Wire Length Correction 2 (52 or 152) to a multi-function digital input (H1-□□), and then enable and disable the correction value with external input.

No.	Name	Setting Range	Default Setting
S9-29	Correction value2 of Wire Length	-50.0 to 50.0 m	0.0 m

■ S9-30 Correction value3 of Wire Length

Sets the wire length correction value in meters for the center of gravity position of the wire tip. To enable the correction value, set Wire Length Correction 3 (53 or 153) to a multi-function digital input (H1-□□), and then enable and disable the correction value with external input.

No.	Name	Setting Range	Default Setting
S9-30	Correction value3 of Wire Length	-50.0 to 50.0 m	0.0 m

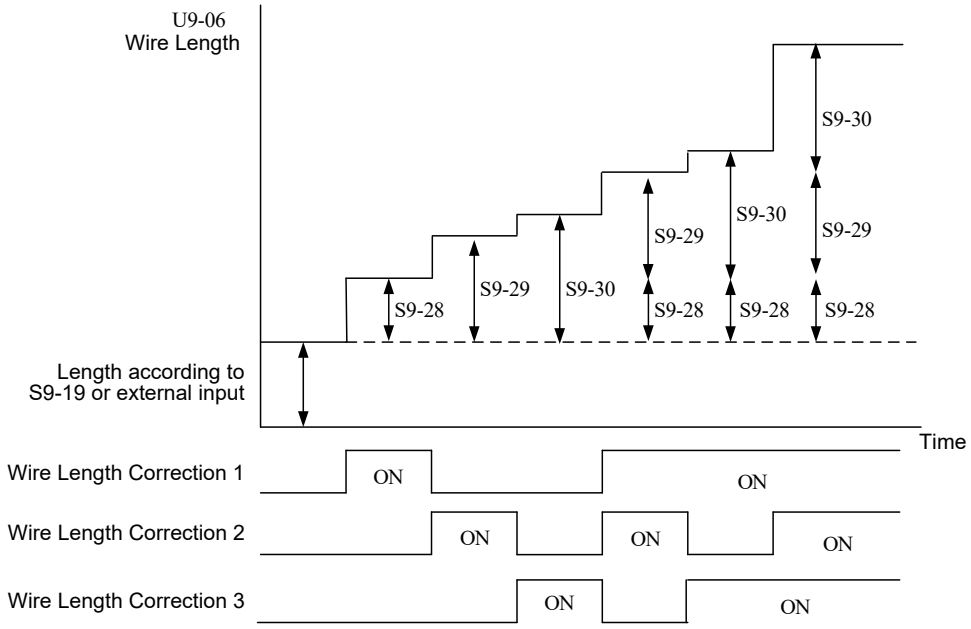


Figure 3.1.7 Wire Length and the Status of Wire Length Correction Multi-Function Digital Inputs

When multiple corrections are enabled using Wire Length Correction 1 to 3, the wire length is corrected with the total value of the enabled correction values. However, the Wire Length (U9-06) is limited by the setting range of Wire Length (S9-19).

■ S9-31 Anti Swing Control Start Frequency Level <2>

Sets the frequency level at which Anti Swing Control starts to operate when S9-11 = 1 [Anti-Swing Control Selection Enabled]. Set to disable operation of Anti Swing Control by short-distance drive such as inching. Anti Swing Control starts to operate when the signal selected at S9-32 [Anti Swing Control Start Judgment Signal Selection] reaches or exceeds the frequency level set at S9-31 [Anti Swing Control Start Frequency Level]. When 0.00 Hz is set, Anti Swing Control starts to operate when drive operation is started.

No.	Name	Setting Range	Default Setting
S9-31	Anti Swing Control Start Frequency Level	0.00 to 30.00 Hz	0.00 Hz

On drives with software versions PRG:01025 and later, S9-31 is enabled.

Note: The setting is compared with the absolute value of the frequency of the signal selected at S9-32 [Anti Swing Control Start Judgment Signal Selection].

■ S9-32 Anti Swing Control Start Judgment Signal Selection <2>

Sets the frequency monitor signal at which Anti Swing Control is started when S9-11 = 1 [Anti Swing Control Selection Enabled].

Anti Swing Control starts to operate when the signal selected at S9-32 [Anti Swing Control Start Judgment Signal Selection] reaches or exceeds the frequency level set at S9-31 [Anti Swing Control Start Frequency Level].

No.	Name	Setting Range	Default Setting
S9-32	Anti Swing Control Start Judgment Signal Selection	0 to 2	0

On drives with software versions PRG:01025 and later, S9-32 is enabled.

0: Output Frequency (U1-02)

This setting can be selected in all control modes.

1: Motor Speed (U1-05)
This setting cannot be selected when control mode is set to A1-02 = 0 [V/f Control].

2: SFS Output Frequency (U1-16)
This setting can be selected in all control modes.

■ S9-34 Anti Swing Control Deceleration Time Gain <2>

When Anti Swing Control is enabled [S9-11 = 1], set the shortening ratio of the deceleration time proportional to the currently selected deceleration time C1-02 (or C1-04, C1-06, C1-08) [Deceleration Time 1 to 4]. The time obtained by multiplying the currently enabled deceleration time by the anti swing control deceleration time gain [S9-34] becomes the deceleration time of anti swing control.

No.	Name	Setting Range	Default Setting
S9-34	Anti Swing Control Deceleration Time Gain	10 to 100%	100%

On drives with software versions PRG:01025 and later, S9-34 is enabled.

Notes: ・ Shock during deceleration increases when a small value is set to S9-34 [Anti Swing Control Deceleration Time Gain].

・ When a multi-function digital input terminal set with an emergency stop [H1-xx = 15, 17] is ON, deceleration is performed for the time set at C1-09 [Fast Stop Time]. ・ When an emergency stop is performed, the S9-34 [Anti Swing Control Deceleration Time Gain] setting value is disabled.

・ When a Run command in the direction opposite to the motor direction is input with S2-18 = 1 [Rapid deceleration function] set to enabled, a rapid deceleration is performed for the time set at S2-19 [Rapid Deceleration Time]. ・ When a rapid deceleration stop is performed, the S9-34 [Anti Swing Control Deceleration Time Gain] setting value is disabled.

3.2 Wire Length Detection

Wire Length Detection detects the length of the wire using information from the encoder connected to the drive used for the lifting and lowering shaft. The proportion of the length from the hoisting limit position (forward travel limit activation position) to the lowering limit position (reverse travel limit activation position) of the lifting and lowering shaft can be externally output as a percentage. Also, by setting S9-14 [Wire Length Detection Method] to 3 [PG2 Input], the PG pulse signal of the lifting and lowering shaft is distributed to the traverse and traveling shaft drives and the wire length can be detected by the traverse and traveling shaft drives. <2>

In cranes with a long lifting range, monitoring the wire length can be used as a guide for changing the speed reference and inputting the Stop command. This function can also be used as wire length information for Cargo Swing Suppression on the traverse shaft or traveling shaft. Refer to ″3.1 Cargo Swing Suppression″ for more information about Cargo Swing Suppression.

◆ Control Modes of the Lifting and Lowering Shaft Drive When Wire Length Is Detected from PG Information of Lifting and Lowering Shaft

- V/f Control w/ PG (A1-02=1) *Use the dual-phase or higher encoder option.
- Closed Loop Vector (A1-02=3)

Precautions

- The PG option cards for wire length detection are PG-B3 and PG-X3. <2>
- This function cannot be used when encoder output is single-phase.
- The multi-function analog output voltage of U9-02 [Hook Position (%)] at the hoisting limit position is 0 V, but the lowering limit position can also be changed to 0 V with S9-05 [AO 0V Reference Hook Position].
- If the wire length has a certain amount of length at the hoisting limit position, adjust that with the analog monitor gain and bias.
- When S9-02=0 [Hook Position Reset @Power down] is selected, oPL [Origin Position Loss Detected] will be output each time the power supply is turned ON. Reset oPL according to the corrective action (hook position reset) listed in ″4. Parameter List.″
- When S9-02=1 [Hook Position Hold @Power down], oPL will not be output. However, to maintain accuracy, regularly detect the origin position according to the information listed for parameter S9-02. Also detect the origin position when the wire length changes while the power supply is turned OFF, such as when maintenance is performed

<2>

Note the following points when the wire length is detected on the traverse and traveling shaft drives (S9-14=3).

- Do not turn the main circuit power supply of the traverse and traveling shaft drives OFF while the main circuit power supply to the lifting and lowering shaft drive is turned ON. When the main circuit power supply is turned OFF, the wire length can no longer be detected correctly.
- Set F1-31/F1-32 of the traverse and traveling shaft drives the same as F1-01/F1-05 of the lifting and lowering shaft drive.
- Make sure that U9-06 [Wire Length] decreases when the lifting and lowering shaft is hoisted and U9-06 increases when it is lowered.
- Always make sure that U9-06 [Wire Length] of the traverse and traveling shaft drives is displayed correctly at the start of operations.

◆ System Configuration

・ When the wire length is detected on the hoisting shaft (lifting and lowering shaft) <2>

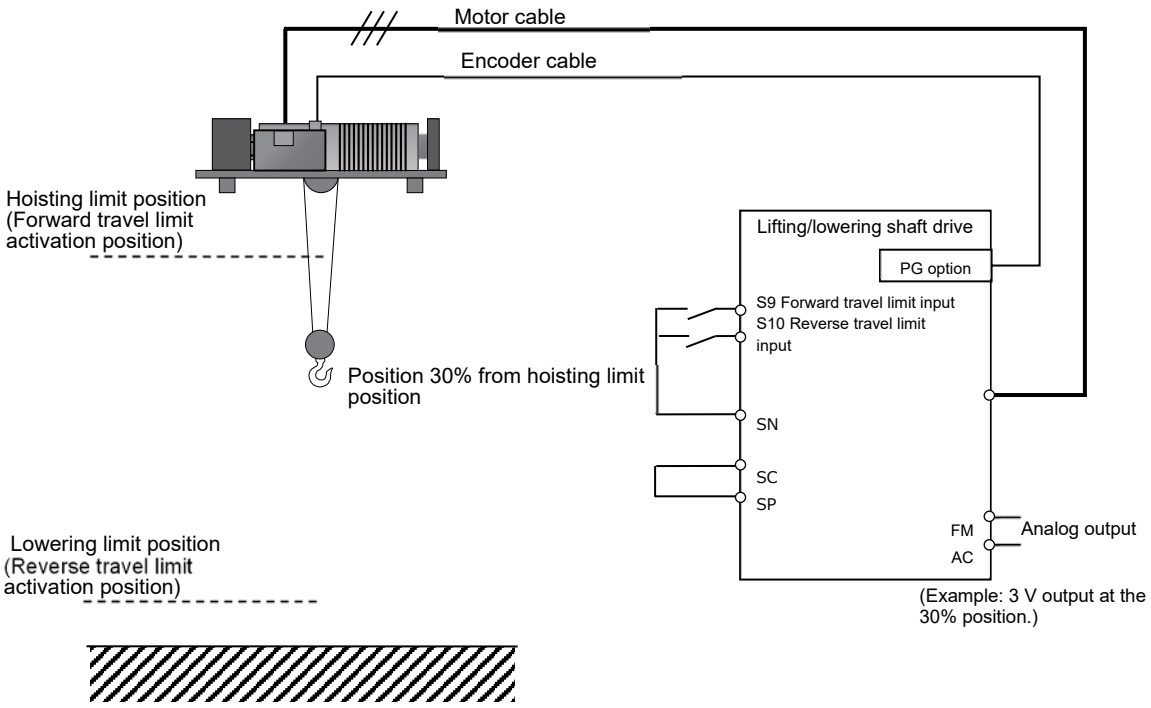


Figure 3.2.1 Example System Configuration of Wire Length Detection (When the wire length is detected on the lifting and lowering shaft)

■Origin position detection method

① Set S9-01 [Wire Length Detection Selection] to ″1″ (enabled). At the same time, the oPL [Origin Position Loss Detected] alarm is detected. The oPL alarm can be canceled by detection of the origin position.

② Hoist the hook to the hoisting upper limit position, input the forward travel limit (H1-xx=31H/32H) by multi-function digital input, or set S9-03 = 1 [Hook Position Reset]. Origin position detection is performed, and U9-01 [Hook Position] is reset to zero (U9-01=0). At the same time, the oPL [Origin Position Loss Detected] alarm is canceled, and U9-01 detection is enabled.

③ Lower the hook to the lowering lower limit position, and set the display value of U9-01 at this time to S9-04 [Hook RangeLim Number of Rotation]. Detection of U9-02 [Hook Position (%)] is enabled. U9-02 is the proportion (%) of the length from the hoisting limit position (forward travel limit activation position) to the lowering limit position (reverse travel limit activation position) of the lifting and lowering shaft.

④ U9-02 [Hook Position (%)] can be output as the wire length information of the cargo swing suppression function on the traverse and traveling shaft drives with multi-function analog output (H4-xx=902).

* When S9-02 [Hook Position Inform @Power down] is set to 0 [Hook Position Reset @Power down], the oPL [Origin Position Loss Detected] alarm is detected when the power is turned ON as the position information is reset each time that the power supply of the drive is shut down.

* When the rotation speed from the origin is already known at any specific position, the setting value of S9-07 can be overwritten to U9-01 as the rotation speed of that specific position by inputting the position set signal (H1-xx=3CH) by multi-function digital input when the oPL alarm is detected. By using this function, origin position detection can be performed without moving the hook to the upper limit or the lower limit position.

・ When the wire length is detected from the PG input of the traverse and traveling shafts <2>

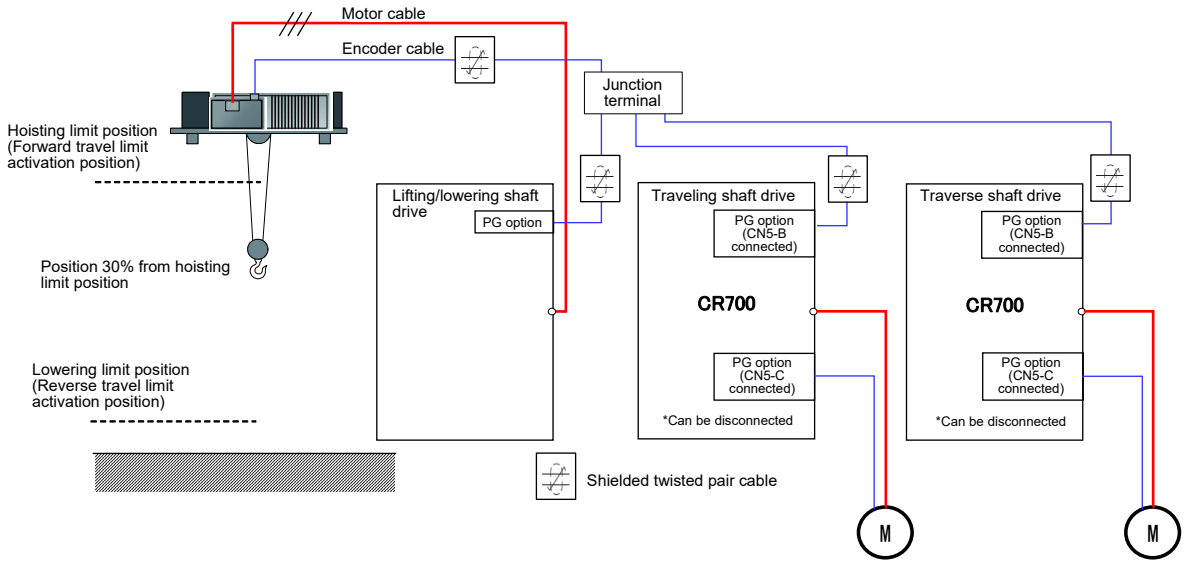


Figure 3.2.2 Example System Configuration of Wire Length Detection (When the wire length is detected on the traverse and traveling shafts)

■Origin position detection method

① Set S9-14 [Wire Length Detection Method] to 3 [PG2 Input] on the traverse and traveling shaft drives.

② Set S9-01 [Wire Length Detection Selection] to "1" (enabled) on the traverse and traveling shaft drives. At the same time, the oPL [Origin Position Loss Detected] alarm is detected. The oPL alarm can be canceled by detection of the origin position by the traverse and traveling shaft drives.

③ Set the same values as F1-01 [Encoder 1 Pulse Count (PPR)] and F1-05 [Encoder 1 Rotation Selection] of the lifting and lowering shaft drive to F1-31 [Encoder 2 Pulse Count (PPR)] and F1-32 [Encoder 2 Rotation Selection] on the traverse and traveling shaft drives.

④ Hoist the hook to the hoisting upper limit position on the lifting and lowering shaft drive, and set S9-03 = 1 [Hook Position Information Reset] on the traverse and traveling shaft drives. Origin position detection is performed, and U9-01 [Hook Position] is reset to zero (U9-01=0). At the same time, the oPL [Origin Position Loss Detected] alarm is canceled, and U9-01 detection is enabled on the traverse and traveling shaft.

⑤ Lower the hook to the lowering lower limit position by the lifting and lowering shaft drive, and set the display value of U9-01 at this time to S9-04 [Hook RangeLim Number of Rotation] on the traverse and traveling shaft drives. Detection of U9-02 [Hook Position (%)] is enabled. U9-02 is the proportion (%) of the length from the hoisting limit position (forward travel limit activation position) to the lowering limit position (reverse travel limit activation position) of the lifting and lowering shaft.

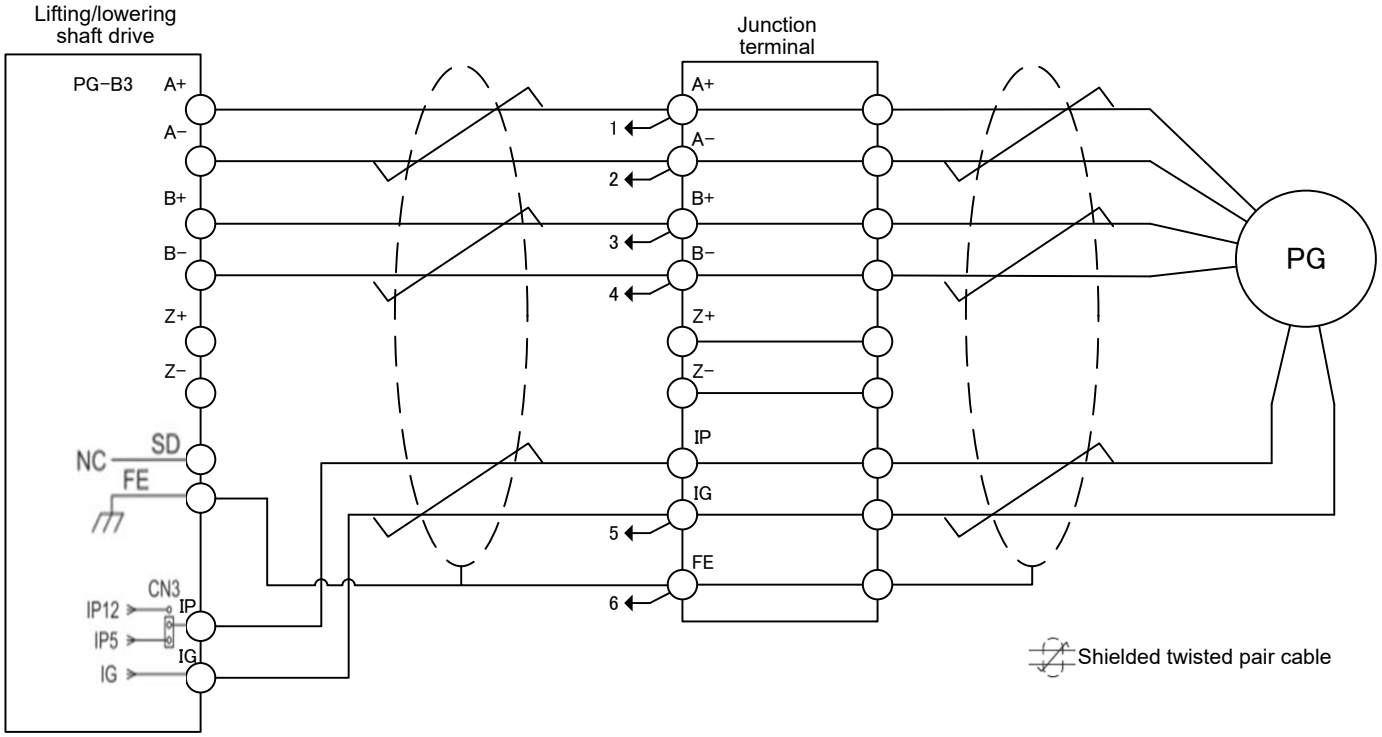
⑥ Set an appropriate length to S9-19 [Wire Length] and S9-20 [Wire Length@Rolling Up] on the traverse and traveling shaft drives. Detection of U9-06 [Wire Length] is enabled. U9-06 is used as the wire length information of the cargo swing suppression function on the traverse and traveling shaft drives.

* When S9-02 [Hook Position Inform @Power down] is set to 0 [Hook Position Reset @Power down], the oPL [Origin Position Loss Detected] alarm is detected when the power is turned ON as the position information is reset each time that the power supply of the drive is shut down.
* When the rotation speed from the origin is already known at any specific position, the setting value of S9-07 can be overwritten to U9-01 as the rotation speed of that specific position by inputting the position set signal (H1-xx=3CH) by multi-function digital input when the oPL alarm is detected. By using this function, origin position detection can be performed without moving the hook to the upper limit or the lower limit position.

◆ PG Option Card Wiring Example (when the wire length is detected on the traverse and traveling shafts) <2>

Precautions

- Connect the PG option card to CN5-B.
- When PG-X3 is used and Anti Swing Control is set to enabled (S9-11 = 1), PGoH [PG Hardware Disconnect] is detected when a PG cable disconnection occurs.
- When PG-B3 is used, a PG cable disconnection cannot be detected. When the PG cable is disconnected, cargo swing suppression might be less effective. When encoder (PG) feedback loss detection is required, consider remedial action on the system (e.g. PLC) side.
- Make sure wiring to the PG option card does not exceed the maximum wiring length.
- PGs that require a supply current that exceeds the output current of 200 mA are not supported.
- Do not short the circuit between the IP terminal and the PG option card. Shorting the circuit might cause the PG option card to malfunction.



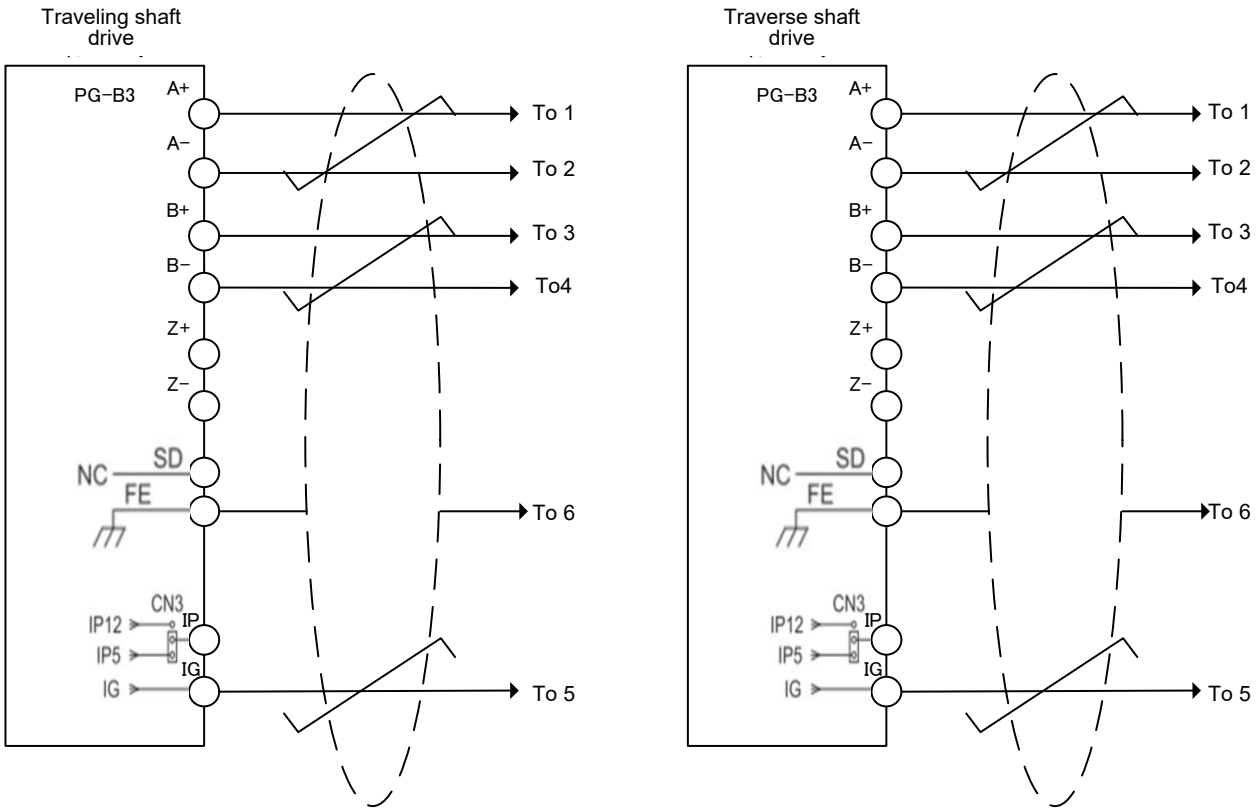
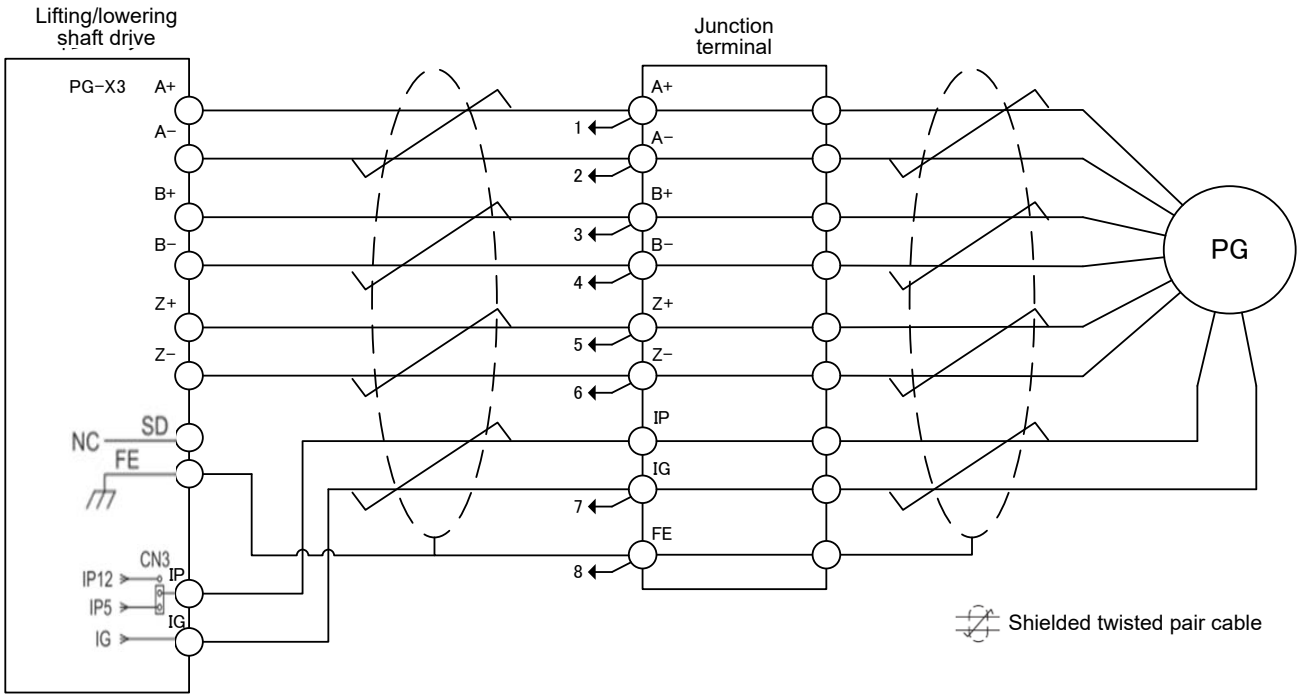


Figure 3.2.3 PG-B3 Connection Wiring Example



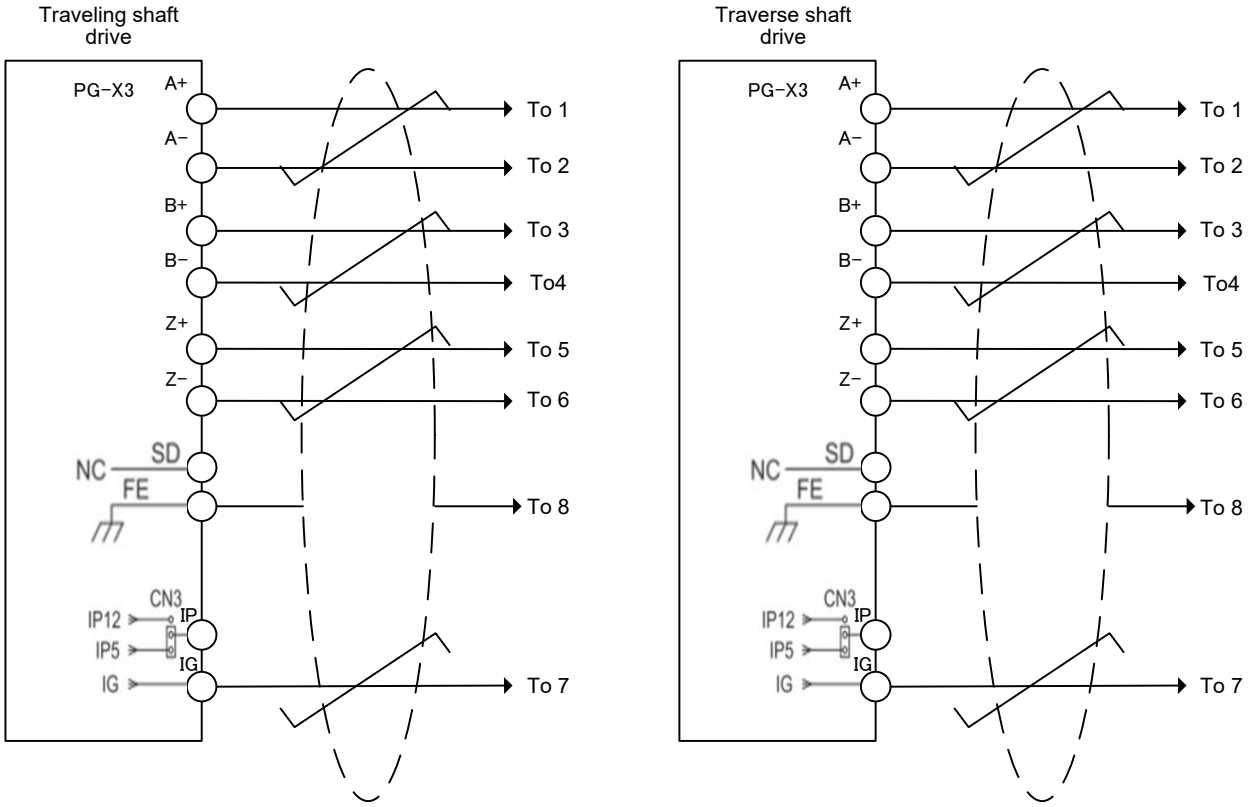


Figure 3.2.4 PG-X3 Connection Wiring Example

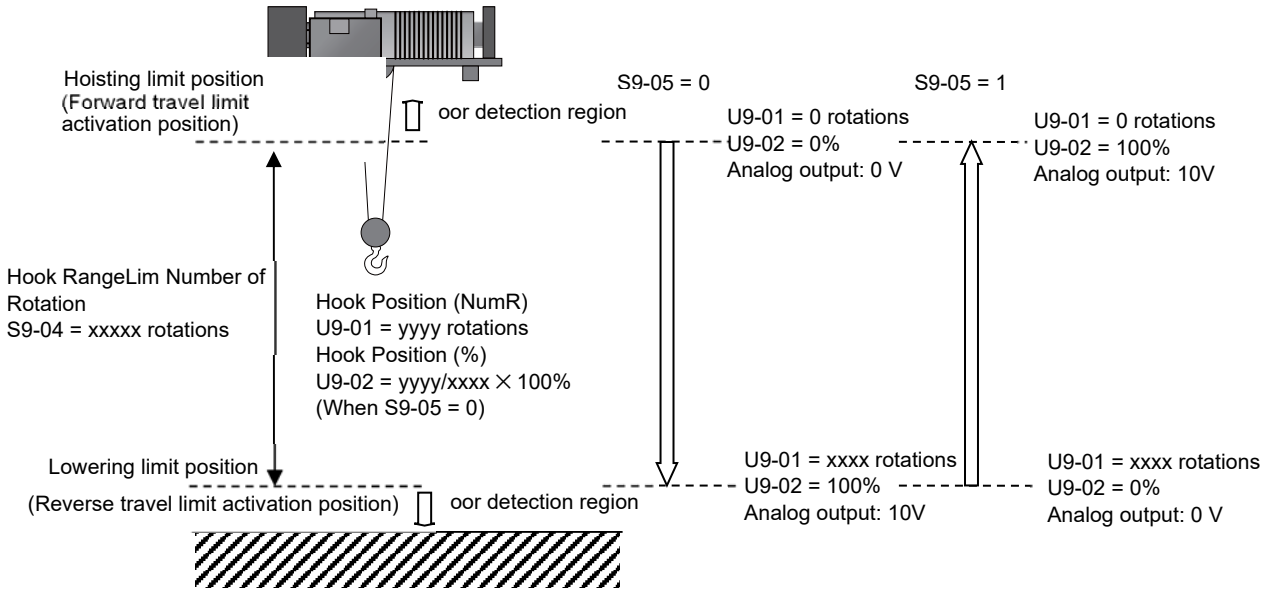


Figure 3.2.5 Wire Length Detection

■ S9-01 Wire Length Detection Selection

Enables and disables Wire Length Detection.

No.	Name	Setting Range	Default Setting
S9-01	Wire Length Detection Selection	0, 1	0

0: Disabled
1: Enabled

For the default settings, refer to "System Configuration, Origin position detection method."

■ S9-02 Hook Position Inform @Power down

Selects whether to hold or reset the hook position information when the power supply is turned OFF.

No.	Name	Setting Range	Default Setting
S9-02	Hook Position Inform @Power down	0, 1	0

0: Hook Position Reset @Power down

Each time that the power is turned ON, the position information is reset, and the oPL [Origin Position Loss Detected] alarm is detected. For details on origin position detection, refer to "System Configuration, Origin position detection method."

1: Hook Position Hold @Power down

The origin position does not need to be detected each time the power supply is turned ON. However, detect the origin position when the wire length changes while the power supply is turned OFF, such as when maintenance is performed, and when an error occurs in Wire Length Detection.

■ S9-03 Hook Position Information Reset

■ Sets the setting value of this parameter to 1 to zero reset U9-01 [Hook Position (NumR)].

No.	Name	Setting Range	Default Setting
S9-03	Hook Position Information Reset	0, 1	0

0: Disabled

1: Enabled

After U9-01 is reset, the setting value of S9-03 is automatically reset to 0.

■ S9-04 Hook RangeLim Number of Rotation

Sets the number of motor rotations when moving from the hoisting limit position (forward travel limit activation position) to the lowering limit position (reverse travel limit activation position).

No.	Name	Setting Range	Default Setting
S9-04	Hook RangeLim Number of Rotation	0 to 20000 rotations	10000 rotations

■ S9-05 AO 0V Reference Hook Position

Selects whether to set the hoisting limit position or the lowering limit position as the reference position when the wire length is set to an analog output (AO). The analog signal is 0 V at the selected reference position.

No.	Name	Setting Range	Default Setting
S9-05	AO 0V Reference Hook Position	0, 1	0

0: Forward Limit Position

Forward travel limit activation position: 0 V, reverse travel limit activation position: 10 V

1: Lower Limit Position

Reverse travel limit activation position: 0 V, forward travel limit activation position: 10 V

■ S9-06 Motion Range Over Detect Select

Displays the oor alarm when the setting value of S9-04 [Hook RangeLim Number of Rotation] is exceeded.

No.	Name	Setting Range	Default Setting
S9-06	Motion Range Over Detect Select	0, 1	0

0: Disabled

1: Enabled

■ S9-07 Home Position Number of Rotation

Sets the value that will overwrite U9-01 (Hook Position) as the number of motor rotations when Home Position Set signal is input. For this setting value, set the number of motor rotations from the hoisting limit position to the home position (an arbitrary position).

No.	Name	Setting Range	Default Setting
S9-07	Home Position Number of Rotation	0 to 20000 rotations	0 rotations

4.Parameter List

◆ S9 Application for Crane

No. (Hex.)	Name	Description	Default Setting (Range)	Ref.
S9: Application for Crane				
S9-01*4 (1A8C) Expert <2>	Wire Length Detection Selection	V/f CL-V/f OLV CLV AOLV Enables and disables Wire Length Detection. 0: Disabled 1: Enabled *oPL [Origin Position Loss Detected] is detected when this setting value changes from 0 to 1.	0 (0, 1)	8
S9-02*4 (1A8D) Expert <2>	Hook Position Inform @Power down	V/f CL-V/f OLV CLV AOLV 0: Hook Position Reset @Power down 1: Hook Position Hold @Power down	0 (0, 1)	8
S9-03*4 (1A8E) Expert <2>	Hook Position Information Reset	V/f CL-V/f OLV CLV AOLV 0: Hook Position Hold 1: Hook Position Reset (U9-01=0) *After U9-01 is reset, the setting value of S9-03 is reset to 0.	0 (0, 1)	9
S9-04*4 (1A8F) Expert <2>	Hook RangeLim Number of Rotation	V/f CL-V/f OLV CLV AOLV Sets the number of motor rotations from the hoisting limit (forward travel limit activation) position to the lowering limit (reverse travel limit activation) position.	10000 rotations (0 to 20000 rotations)	9
S9-05*4 (1A90) Expert <2>	AO 0V Reference Hook Position	V/f CL-V/f OLV CLV AOLV 0: Forward Limit Position: Upper limit 0 V, lower limit 10 V 1: Lower Limit Position: Upper limit 10 V, lower limit 0 V	0 (0, 1)	9
S9-06*4 (1A91) Expert <2>	Motion Range Over Detect Select	V/f CL-V/f OLV CLV AOLV 0: Disabled 1: Enabled	0 (0, 1)	9
S9-07*4 (1A92) Expert <2>	Home Position Number of Rotation	V/f CL-V/f OLV CLV AOLV Sets the number of motor rotations from the hoisting limit position to the home position (an arbitrary position) when Home Position Set is input.	0 rotations (0 to 20000 rotations)	9
S9-11 (1A94) Expert	Anti-Swing Control Selection	V/f CL-V/f OLV CLV AOLV Enables and disables Anti Swing Control. 0: Disabled 1: Enabled (Feedforward)	0 (0, 1)	12
S9-14 (1A97) Expert	Wire Length Detection Method	V/f CL-V/f OLV CLV AOLV Selects the wire length detection method. 0: Fix (S9-19 [Wire Length]) 1: External (AI) 2: External (COM) 3: External (PG2 Input) <2>	0 (0 to 3*3)<2>	12
S9-19 (1A9C) Expert	Wire Length	V/f CL-V/f OLV CLV AOLV The wire length detection method changes according to the setting of S9-14 [Wire Length Detection Method]. ・ S9-14=0 [Fix] Sets the wire length in meters from the center of the hoisting and lowering shaft drum to the center of gravity position of the wire tip in conditions where Cargo Swing Suppression is applicable. ・ S9-14=1, 2, or 3 <2> [Wire Length Detection Method = External Input] Sets the wire length in meters from the center of the lifting and lowering shaft drum to the center of gravity position of the wire tip when the wire is lowered to the lowering limit (reverse travel limit activation) with no cargo suspended.	10.0 m (1.0 to 300.0 m*1)<1>	12

No. (Hex.)	Name	Description	Default Setting (Range)	Ref.
S9-20 (1A9D) Expert	Wire Length@Rolling Up	V/f CL-V/f OLV CLV AOLV When S9-14 = 1, 2, or 3 <2> [Wire Length Detection Method = External Input] is enabled. Sets the wire length in meters from the center of the lifting and lowering shaft drum to the center of gravity position of the wire tip when the wire is hoisted to the hoisting limit (forward travel limit activation) with no cargo suspended.	1.0 m (1.0 to 50.0 m)	12
S9-28 (1AA5) Expert	Correction value1 of Wire Length	V/f CL-V/f OLV CLV AOLV Sets the wire length correction value in meters for the center of gravity position of the wire tip. The correction value is the total value of the correction values that are enabled by multi-function digital input out of the values of Correction value1 to 3 of Wire Length.	0.0 m (-50.0 to 50.0 m)	15
S9-29 (1AA6) Expert	Correction value2 of Wire Length	V/f CL-V/f OLV CLV AOLV Sets the wire length correction value in meters for the center of gravity position of the wire tip. The correction value is the total value of the correction values that are enabled by multi-function digital input out of the values of Correction value1 to 3 of Wire Length.	0.0 m (-50.0 to 50.0 m)	15
S9-30 (1AA7) Expert	Correction value3 of Wire Length	V/f CL-V/f OLV CLV AOLV Sets the wire length correction value in meters for the center of gravity position of the wire tip. The correction value is the total value of the correction values that are enabled by multi-function digital input out of the values of Correction value1 to 3 of Wire Length.	0.0 m (-50.0 to 50.0 m)	15
S9-31*2 (1AA8) Expert <2>	Anti Swing Control Start Frequency Level	V/f CL-V/f OLV CLV AOLV Sets the frequency level at which Anti Swing Control starts to operate when S9-11=1 [Anti-Swing Control Selection Enabled].	0.00 Hz (0.00 to 30.00 Hz)	16
S9-32*2 (1AA9) Expert <2>	Anti Swing Control Start Judgment Signal Selection	V/f CL-V/f OLV CLV AOLV Selects the monitor signal that is compared to the frequency level set at S9-31 [Anti Swing Control Start Frequency Level] when S9-11 = 1 [Anti-Swing Control Selection Enabled]. 0: Output Frequency (U1-02) 1: Motor Speed (U1-05) 2: SFS Output Frequency (U1-16)	0 (0 to 2)	16
S9-34*2 (1AFE) Expert <2>	Anti Swing Control Deceleration Time Gain	V/f CL-V/f OLV CLV AOLV Sets the ratio proportional to C1-02 (or C1-04, C1-06, C1-08) [Deceleration Time 1 to 4] when S9-11 = 1 [Anti-Swing Control Selection Enabled].	100% (10 to 100%)	16

◆ F1 PG Option Setup <2>

No. (Hex.)	Name	Description	Default Setting (Range)	Ref.
F1-31*4 (03B0)	Encoder 2 Pulse Count (PPR)	V/f CL-V/f OLV CLV AOLV Sets the number of output pulses for each motor revolution of PG2. Set this when S9-14 = 3 [Wire Length Detection Method = PG2 Input].	600 (1 to 60000)	-
F1-32*4 (03B1)	Encoder 2 Rotation Selection	V/f CL-V/f OLV CLV AOLV Sets the output sequence for the A and B pulses from the encoder for PG2. This parameter assumes that the motor is operating in the forward direction. Set this when S9-14 = 3 [Wire Length Detection Method = PG2 Input]. 0: A pulse leads in FWD direction 1: B pulse leads in FWD direction	0 (0, 1)	-

◆ Multi-Function Digital Inputs (H1-□□)

H1 Multi-Function Digital Inputs			
Setting Value	Setting Value	Setting Value	Setting Value
31	Forward Travel Limit (N.O.)	V/f CL-V/f OLV CLV AOLV When this multi-function digital input is closed during forward operation, the Brake Release command is opened (brake is applied) and the motor coasts to stop. Only the Reverse Run command is accepted at this time. When this multi-function digital input is closed during reverse operation, the operation does not change. The Forward Run and Reverse Run commands are both valid when this digital input is open.	-
32	Forward Travel Limit (N.C.)	V/f CL-V/f OLV CLV AOLV When this multi-function digital input is opened during forward operation, the Brake Release command is opened (brake is applied) and the motor coasts to stop. Only the Reverse Run command is accepted at this time. When this multi-function digital input is closed during reverse operation, the operation does not change. The Forward Run and Reverse Run commands are both valid when this digital input is open.	-
33	Reverse Travel Limit (N.O.)	V/f CL-V/f OLV CLV AOLV When this multi-function digital input is closed during reverse operation, the Brake Release command is opened (brake is applied) and the motor coasts to stop. Only the Forward Run command is accepted at this time. When this multi-function digital input is closed during forward operation, the operation does not change. The Forward Run and Reverse Run commands are both valid when this digital input is open.	-
34	Reverse Travel Limit (N.C.)	V/f CL-V/f OLV CLV AOLV When this multi-function digital input is opened during reverse operation, the Brake Release command is opened (brake is applied) and the motor coasts to stop. Only the Forward Run command is accepted at this time. When this multi-function digital input is closed during forward operation, the operation does not change. The Forward Run and Reverse Run commands are both valid when this digital input is open.	-
3C*4 <2>	Home Position Set	V/f CL-V/f OLV CLV AOLV Closes Home Position Set to set the setting value of S9-07 [Home Position Number of Rotation] to U9-01.	6
50	Anti Swing Switch	V/f CL-V/f OLV CLV AOLV When S9-11=1 [Anti-Swing Control Selection Enabled], Anti Swing Control can be enabled and disabled by external digital input only during bb [Baseblock]. To disable Anti Swing Control for safety during operation, use Fast Stop or Rapid Deceleration.	9
51	Wire Length Correction 1	V/f CL-V/f OLV CLV AOLV Corrects the center of gravity position of the wire tip using an external digital input. When S9-14=0 [Wire Length Detection Method = Fix], the setting value of S9-19 [Wire Length] is corrected with the setting value of S9-28 [Correction value1 of Wire Length]. When S9-14=1, 2, or 3 <2> [Wire Length Detection Method = External], the wire length calculated from the external input is corrected with the setting value of S9-28 [Correction value1 of Wire Length]. The correction value is the total value of the correction values that are enabled by Wire Length Correction 1 to 3.	12
52	Wire Length Correction 2	V/f CL-V/f OLV CLV AOLV Corrects the center of gravity position of the wire tip using an external digital input. When S9-14=0 [Wire Length Detection Method = Fix], the setting value of S9-19 [Wire Length] is corrected with the setting value of S9-29 [Correction value2 of Wire Length]. When S9-14=1, 2, or 3 <2> [Wire Length Detection Method = External], the wire length calculated from the external input is corrected with the setting value of S9-29 [Correction value1 of Wire Length].	12

H1 Multi-Function Digital Inputs			
Setting Value	Setting Value	Setting Value	Setting Value
		The correction value is the total value of the correction values that are enabled by Wire Length Correction 1 to 3.	
53	Wire Length Correction 3	V/f CL-V/f OLV CLV AOLV Corrects the center of gravity position of the wire tip using an external digital input. When S9-14 = 0 [Wire Length Detection Method = Fix], the setting value of S9-19 [Wire Length] is corrected with the setting value of S9-30 [Correction value3 of Wire Length]. When S9-14 = 1, 2, or 3 [Wire Length Detection Method = External], the wire length calculated from the external input is corrected with the setting value of S9-30. The correction value is the total value of the correction values that are enabled by Wire Length Correction 1 to 3.	12
13C*4 <2>	Home Position Set Inverse Output	V/f CL-V/f OLV CLV AOLV Inverse output of setting value 3C.	-
150	Anti Swing Switch Inverse Input	V/f CL-V/f OLV CLV AOLV Inverse input of setting value 50.	-
151	Wire Length Correction 1 Inverse Input	V/f CL-V/f OLV CLV AOLV Inverse input of setting value 51.	-
152	Wire Length Correction 2 Inverse Input	V/f CL-V/f OLV CLV AOLV Inverse input of setting value 52.	-
153	Wire Length Correction 3 Inverse Input	V/f CL-V/f OLV CLV AOLV Inverse input of setting value 53.	-

◆ Multi-Function Digital Outputs (H2-□□)

H2 Multi-Function Digital Outputs			
Setting Value	Function	Description	Ref.
50	During Anti Swing Control	V/f CL-V/f OLV CLV AOLV Allows you to check the control status of Anti Swing Control when S9-11 = 1 [Anti-Swing Control Selection Enabled]. This output terminal is closed when Anti Swing Control is active.	7
150	During Anti Swing Control Inverse Output	V/f CL-V/f OLV CLV AOLV Inverse output of setting value 50.	-

◆ Multi-Function Analog Inputs (H3-02/H3-06/H3-10)

H3 Multi-Function Analog Inputs			
Setting Value	Function	Description	Ref.
28	Wire Length	V/f CL-V/f OLV CLV AOLV Inputs the wire length to the drive as analog input. This input is used when S9-14 = 1. 100% = S9-19 [Wire Length] 0% = S9-20 [Wire Length@Rolling Up]	9

◆ MEMOBUS Inputs

MEMOBUS Inputs						
Register No. (Hex.)	Function	Range	Resolution	Unit	Description	Ref.
00F4	Wire Length	0.0 to 100.0	0.1	%	V/f CL-V/f OLV CLV AOLV Inputs the wire length to the drive as analog input. This input is used when S9-14 = 2. 100% = S9-19 [Wire Length] 0% = S9-20 [Wire Length@Rolling Up]	9

◆ Monitors

No. (Hex.)	Name	Description	MFAO Signal Level	Unit	Ref.
U9: Dedicated Application Monitors					
U9-01*4 (0820) Expert <2>	Hook Position (NumR)	V/f CL-V/f OLV CLV AOLV Displays the current position of the hook as the number of motor rotations. The number of motor rotations is always the Forward Limit Position (forward travel limit = 0 revolutions).	No signal output available	1 rotation	5
U9-02*4 (0821) Expert <2>	Hook Position (%)	V/f CL-V/f OLV CLV AOLV Displays the current position of the hook (U9-01) as a percentage. The reference position is set with S9-05. The display is limited between 0% and 100%.	10 V: Hook RangeLim Number of Rotation	0.1%	5
U9-06 (0825) Expert	Wire Length	V/f CL-V/f OLV CLV AOLV The monitor value of the wire length. The wire length after wire length correction is output.	10 V: Wire Length (S9-19)	0.1 m	12

<1> *1: The setting range is different for different PRG number.
PRG:01017 or later: 1.0 to 300.0 m, earlier than PRG:01017: 1.0 to 50.0 m

<2> *2: Enabled with PRG:01025 and later.

*3: The setting range changes according to the PRG number. PRG:01025 or later: 0 to 3, earlier than PRG:01025: 0 to 2

*4: When S9-14 = 3, displayed in all control modes.

◆ OPE Errors

For parameter setting errors related to these functions, refer to the following table, check the parameter setting that caused the error, and then remove the cause of the error.

Code	Name	Cause	Possible Solution
oPE03 <2>	Multi-Function Input Setting Err	These parameters are set at the same time: ・ S9-14 = 3 [Wire Length Detection Method = PG2 Input]. ・ E3-01 = 1, 3 [Motor 2 Control Mode Selection = CL-V/f, CLV, CLV/PM] ・ H1-xx = 16 [Motor 2 Selection]	Remove one of the function settings.

oPE08	Parameter Selection Error	Single-phase pulse encoder option (F1-21 = 0) is installed by V/f Control w/ PG (A1-02 = 1) other than S9-14 = 3 [Wire Length Detection Method = PG2 Input] and S9-01 = 1 [Wire Length Detection] set to enabled. (S9-14 ≠ 3 and S9-01 = 1 and F1-21 = 0) <2>	Use a dual-phase or higher pulse encoder.
		Anti Swing Control and Overload Detection were set at the same time. (S9-11≠0 and S5-01≠0 or S5-04≠0)	Check the shaft to which the drive is connected. If the shaft is the traverse shaft or traveling shaft, disable Overload Detection. If the shaft is the lifting and lowering shaft, disable Anti Swing Control.
		Anti Swing Control and Light-Load Acceleration were set at the same time. (S9-11≠0 and S4-01≠0)	Check the shaft to which the drive is connected. If the shaft is the traverse shaft or traveling shaft, disable Light-Load Acceleration. If the shaft is the lifting and lowering shaft, disable Anti Swing Control.
		At a setting other than S9-14 = 3 [Wire Length Detection Method = PG2 Input], Anti Swing Control and Wire Length Detection were set at the same time. (S9-14 ≠ 3 and S9-11 ≠ 0 and S9-01 = 1) <2>	Check the shaft to which the drive is connected. If the shaft is the traverse shaft or traveling shaft, disable Wire Length Detection. If the shaft is the lifting and lowering shaft, disable Anti Swing Control.
oPE34	Anti-Swing Setting Error	H3-xx = 28 (Wire Length) is not set when S9-14 = 1 (Wire Length Detection Method: Analog) is set.	Set H3-xx to 28.
		S9-19 [Wire Length] is set to a value smaller than S9-20 [Wire Length@Rolling Up]. <2>	Correct the parameter settings.
		When S9-14 = 3 [Wire Length Detection Method = PG2 Input], the drive is in one of the following states: ・ S9-01 = 1 [Wire Length Detection Function] is set to enabled ・ A PG option (PG-B3 or PG-X3) is not connected to CN5-B on the drive. <2>	Correct the parameter settings.

◆ Alarm

Code	Name	Cause	Possible Solution
oor	Over Operation Region	The range of the lifting/lowering operation has exceeded the setting value of S9-04 [Hook RangeLim Number of Rotation].	Review the setting value of S9-04 [Hook RangeLim Number of Rotation].
			Detect the origin position with one of the following options. ・ Hoist the hook to the hoisting limit position, and then input Forward Travel Limit or set S9-03 = 1 [Hook Position Reset]. ・ Lower the hook to the lowering limit position, and then input Reverse Travel Limit. ・ When using S9-07 [Home Position Number of Rotation], move the hook to the home position 2, and then input Home Position Set.

oPL	Origin Position Loss Detected	The origin (home) position was not detected when Wire Length Output was enabled.	Detect the origin position with one of the following options. • Hoist the hook to the hoisting limit position, and then input Forward Travel Limit or set S9-03 = 1 [Hook Position Reset]. • Lower the hook to the lowering limit position, and then input Reverse Travel Limit. • When using S9-07 [Home Position Number of Rotation], move the hook to the home position 2, and then input Home Position Set.

YASKAWA AC Drive CR700
Supplemental Manual
(Synchronous Control)

(Software Version PRG: 010XX)

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1. Revision History

Revision	Revised Content	Date
-	First Edition	2017/08

2. Basic Specifications

The CR700 is a drive designed especially for use with cranes. The basic specifications of the CR700 are based on the information described in the CR700 Technical Manual. Refer to the CR700 Technical Manual for more information about how to use the keypad and Auto-Tuning.

◆ Precautions before Use

When using the drive with a hoisting and lowering shaft, wire the drive so that hoisting direction of the machine is the Forward Run command and the lowering direction of the machine is the Reverse Run command (all control modes). If the movement of the machine and the direction of the Run commands do not match, the functions and performance of the crane software will be adversely affected, and it will not be possible to obtain sufficient performance from the machine. If the direction of motor rotation does not match the machine, swap two phases of the power lines to the motor and change F1-05 (Encoder 1 Rotation Selection) if the motor has an encoder to set the hoisting direction of the machine to the Forward Run command and the lowering direction of the machine to the Reverse Run command.

Install a fall detector or overspeed detector for safety.

◆ General Safety

- Install a holding brake.
- Implement safety measures such as fall prevention on the machine side.
- Ensure that the holding brake will be applied by an external sequence when there is an emergency or the power supply is turned OFF.
- Implement a safety circuit that uses the fault relay of this product to apply the holding brake when a fault occurs.

3. Synchronous Control

3.1 Overview

Synchronous Control synchronizes the operation of two motors when the machine will be operated using two independent motors.

This function can control tilting of the transported load caused by unsynchronized operation and stress applied to the movement mechanism of the crane.

Synchronous Control has the following two modes:

- Speed Synchronization Mode (SA-31 = 1)
  The crane is operated by synchronizing the speed of the master and slave. The result of multiplying the speed of the master by the gear ratio is used as the speed reference of the slave.
- Position Synchronization Mode (SA-31 = 2)
  The crane is operated by synchronizing the speed and position of the master and slave. Position Synchronization mode uses multi-function digital inputs, and the deviation in position between the master and slave can be compensated using parameter setting values (Advance/Retard Compensation) and detected value (Alignment).

◆ Applicable Control Modes

- Closed Loop Vector (A1-02=3)

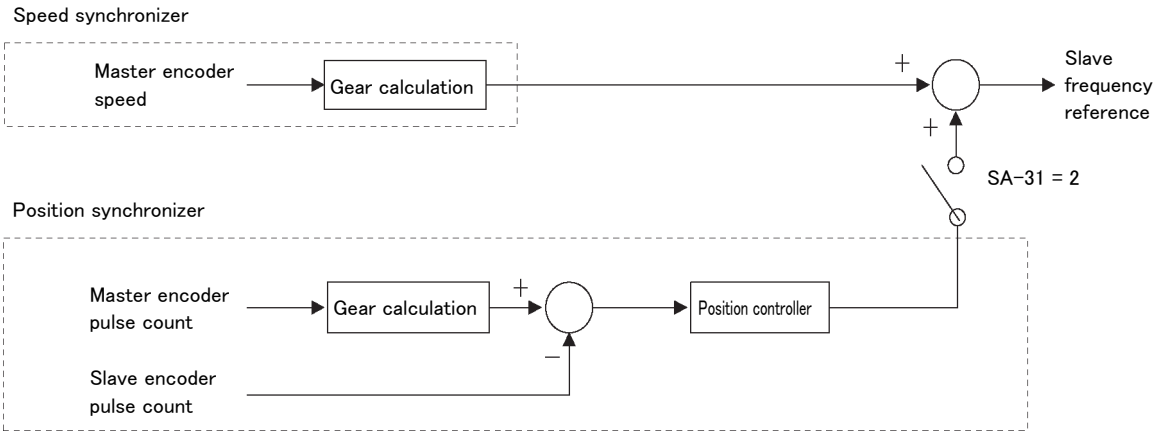

Figure 3.1 Simplified Block Diagram of Synchronous Control

3.2 Application Precautions

- Construct a system that can monitor the READY signals and simultaneously run and stop the motors. Additionally, simultaneously stop the motors when stopping the machine, such as when a fault or Fast Stop occurs. If locking the motors with brakes or other equipment, construct a system that simultaneously releases and applies the brakes. In a system where the motors are mechanically locked, the machine may be damaged if only one motor is locked.
- Set the gear ratio (mechanical gear ratio × digital gear ratio) to match the speed standard for master and slave. If there is an error in the gear ratio, a deviation will occur in the positions of the master and slave over time. The error in the mechanical gear ratio can be adjusted in a stepless manner with the digital gear ratio. Position compensation can also be performed with Advance/Retard Compensation and Alignment using multi-function digital inputs.
- Set Maximum Output Frequency (E1-04) of the slave to a value that is about 10% (Position Control Output Limit) larger than the maximum output frequency of the master.
- In high-speed regions, the accuracy of position compensation using multi-function digital inputs (Advance/Retard Compensation and Alignment) decreases.

- When Pos Err Reset is enabled by multi-function digital input, the frequency reference of the drive may change in steps.
- When the slave is LOCAL mode or for Forward/Reverse Run JOG operations, the frequency reference is restored to the standard frequency reference and the set acceleration and deceleration times (C1-01 and C1-02) are used.

3.3 System Configuration

The master encoder signal is input to the PG option card attached to the CN5-B port of the slave. The slave encoder signal is input to the PG option card attached to the CN5-C port of the slave.

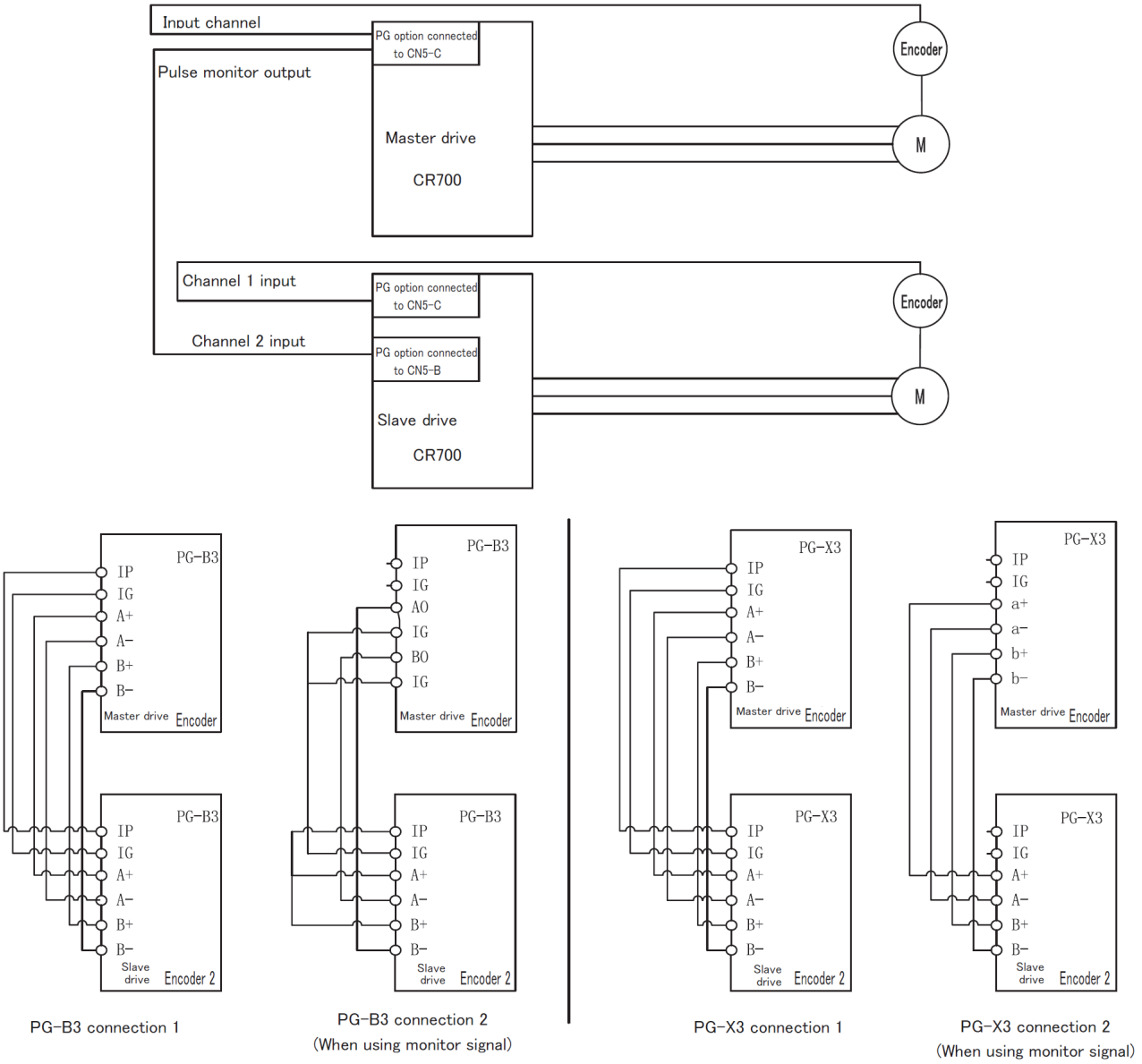

Figure 3.2 Example of Master and Slave Connections

3.4 Block Diagram

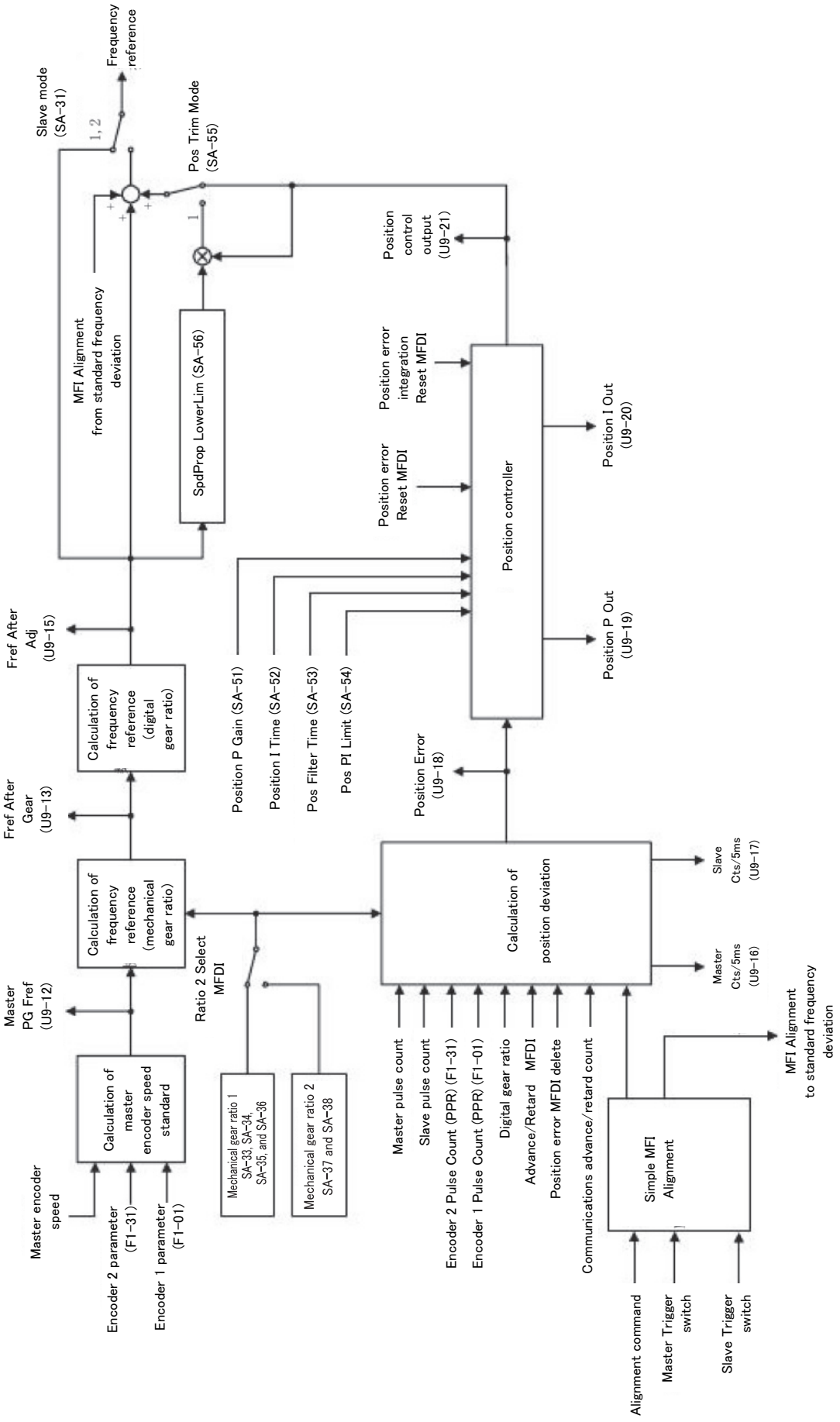

Figure 3.3 Block Diagram of Synchronous Control

3.5 Descriptions of Parameters

The table below lists terms and symbols used in this section to indicate which parameters are available in which control modes.

Table 3.1 Symbols and Icons Used in Parameter Descriptions

Symbol	Description
V/f	The parameter is available when operating the drive with V/f Control.
CL-V/f	The parameter is available when operating the drive with V/f Control w/ PG.
OLV	The parameter is available when operating the drive with Open Loop Vector.
CLV	The parameter is available when operating the drive with Closed Loop Vector.
AOLV	The parameter is available when operating the drive with Advanced Open Loop Vector.
□□□□	The parameter is NOT available when operating the drive in the control mode.
RUN	The parameter can be changed settings during run.
Motor 2	Refers to a second motor when the drive is operating two motors. Switch between motor 1 and motor 2 using the multi-function input terminals.
Expert	The parameter that is available in Expert mode only. * 1

*1 When A1-01 = 3 [Access Level Selection = Expert Level], Expert mode parameters can be displayed on and set with the keypad.

■ SA-31 Slave Mode

No. (Hex.)	Name	Description	Default Setting (Range)
SA-31 (1ABA)	Slave Mode	V/f CL-V/f OLV CLV AOLV Selects the Slave mode.	0 (0 - 2)

0: Disabled

1: Speed

The slave follows the speed of the master.

The direction of motor rotation depends on the direction of motor rotation of the master and the Run command direction of the slave.

2: Position

The slave follows the speed and position of the master.

The direction of motor rotation is always the same direction as the master.

Table 3.2 Slave Settings and Direction of Slave Motor Rotation Corresponding to Direction of Master

b1-04 Reverse Operation Selection	Multi-Function Digital Input	SA-31 = 1		SA-31 = 2	
		Master: Forward	Master: Reverse	Master: Forward	Master: Reverse
b1-04 = 0	Forward Run command	Forward	Reverse	Forward	Reverse
	Reverse Run command	Reverse	Forward	Forward	Reverse
b1-04 = 1	Forward Run command	Forward	Stop	Forward	Stop
	Reverse Run command	Stop	Stop	Stop	Stop

■ SA-32 Speed/Position Sync Control @Dec

No. (Hex.)	Name	Description	Default Setting (Range)
SA-32 (1ADF)	Speed/Position Sync Control @Dec	V/f CL-V/f OLV **CLV** AOLV Selects whether or not to perform speed and position synchronization during ramp to stop.	1 (0, 1)

0: Disabled

1: Enabled

■ SA-33 Ratio Num High

No. (Hex.)	Name	Description	Default Setting (Range)
SA-33 (1ABB) RUN	Ratio Num High	V/f CL-V/f OLV **CLV** AOLV Sets the upper four digits of the numerator of mechanical gear ratio 1.	1000 (0 - 9999)

When the mechanical speed of the master and slave with the same frequency reference is different due to differences in the gear ratio and other factors, the mechanical speed of the master and slave can be matched by setting mechanical gear ratio 1 (SA-33 to SA-36). Mechanical gear ratio 2 (SA-37 and SA-38) can also be used by setting a multi-function digital input to 55 (Ratio 2 Select).
The calculation formula of the mechanical gear ratio is presented next.

- Detected Frequency of Master Motor Used as Standard for Slave Motor

$$\text{Master PG Fref (U9-12)} = \frac{\text{Number of input pulses from master encoder}}{\text{Number of master encoder pulses (Set the slave to F1-31)}} \times \frac{\text{Motor Pole Count (E2- 04)}}{2}$$

- Frequency Reference after Applying Mechanical Gear Ratio

$$\text{Fref After Gear (U9-13)} = \text{Master PG Fref (U9-12)} \times \frac{\text{SA-33} \quad \text{SA-35}}{\text{SA-34} \quad \text{SA-36}} \quad \text{(Mechanical gear ratio 1)}$$

In the calculation of the mechanical gear ratio, if the number of gears in the numerator or denominator is set to five or more digits, set the upper four digits of the numerator to SA-33, the lower four digits of the numerator to SA-35, the upper four digits of the denominator to SA-34, and the lower four digits of the denominator to SA-36. If the number of gears in the numerator or denominator is set to four or fewer digits, use SA-33 (numerator) and SA-34 (denominator). The gear ratio can be switched with a multi-function digital input. SA-37 (numerator) and SA-38 (denominator) are used in this case.
When accuracy is not maintained with only the mechanical gear ratio settings, the gear ratio can be finely adjusted using the digital gear ratio.

$$\text{Fref After Adj (U9-15)} = \text{Fref After Gear (U9-13)} \times (\text{Digital Gear Ratio} + 100\%)$$

The digital gear ratio (%) is the total value of the parameter setting value (SA-41), analog input value, communication input value, and MOP adjustment value. 100% is added to the digital gear ratio and that result is multiplied by U9-13.

■ SA-34 Ratio Den High

No. (Hex.)	Name	Description	Default Setting (Range)
SA-34 (1ABC) RUN	Ratio Den High	V/f CL-V/f OLV **CLV** AOLV Sets the upper four digits of the denominator of mechanical gear ratio 1.	1000 (0 - 9999)

■ SA-35 Ratio Num Low

No. (Hex.)	Name	Description	Default Setting (Range)
SA-35 (1ABD) RUN	Ratio Num Low	V/f CL-V/f OLV CLV AOLV Sets the lower four digits of the numerator of mechanical gear ratio 1.	0 (0 - 9999)

■ SA-36 Ratio Den Low

No. (Hex.)	Name	Description	Default Setting (Range)
SA-36 (1ABE) RUN	Ratio Den Low	V/f CL-V/f OLV CLV AOLV Sets the lower four digits of the denominator of mechanical gear ratio 1.	0 (0 - 9999)

■ SA-37 Ratio 2 Num

No. (Hex.)	Name	Description	Default Setting (Range)
SA-37 (1ABF) RUN	Ratio 2 Num	V/f CL-V/f OLV CLV AOLV Sets the numerator of mechanical gear ratio 2. This gear ratio is enabled when a multi-function digital input is set to 55 (Ratio 2 Select) and that digital input is turned ON.	1 (0 - 65535)

When switching between mechanical gear ratio 1 and mechanical gear ratio 2 during run, the mechanical gear ratio will be switched in the set time of Acceleration Time 2/Deceleration Time 2 (C1-03/C1-04).

When Position Synchronization mode [SA-31=2] is selected, the position deviation is kept as 0 from when the gear ratio first starts to be switched until the drive reaches Speed Agree (refer to SA-57) again.

■ SA-38 Ratio 2 Den

No. (Hex.)	Name	Description	Default Setting (Range)
SA-38 (1AC0) RUN	Ratio 2 Den	V/f CL-V/f OLV CLV AOLV Sets the denominator of mechanical gear ratio 2. This gear ratio is enabled when a multi-function digital input is set to 55 (Ratio 2 Select) and that digital input is turned ON.	1 (0 - 65535)

■ SA-39 Pos Accum Select

No. (Hex.)	Name	Description	Default Setting (Range)
SA-39 (1AC1)	Pos Accum Select	V/f CL-V/f OLV CLV AOLV Selects how to accumulate position deviation of the slave drive. Note: Enabled only when set to Position Synchronization mode.	0 (0, 1)

0: Only During Run

Accumulates the position deviation only when the slave drive is running (excluding during High Slip Braking).

Position deviation is cleared when High-Slip Braking is enabled.

1: Always

Accumulates the position deviation when the power supply to the drive is turned ON.

■ SA-40 Position Units

No. (Hex.)	Name	Description	Default Setting (Range)
SA-40 (1AC2) RUN	Position Units	V/f CL-V/f OLV **CLV** AOLV Selects the unit for Position Error (U9-18). Note: Enabled only when set to Position Synchronization mode.	0 (0 - 3)

0: cnts

Displays the position deviation as an encoder pulse count value.

1: rev

Displays the position deviation as the number of revolutions of the slave motor (0.001 revolutions).

2: deg

Displays the position deviation as the rotation angle of the slave motor (0.1 degrees).

3: rad

Displays the position deviation as the electrical angle of the slave motor (0.001 degrees).

■ SA-41 Digital RatioAdj

No. (Hex.)	Name	Description	Default Setting (Range)
SA-41 (1AC3) RUN	Digital RatioAdj	V/f CL-V/f OLV **CLV** AOLV Sets the digital gear ratio adjustment parameter for the slave. The digital gear ratio is the total value of the parameter setting value, analog input value, MOP output value, and communication input value. 100% is added to the digital gear ratio and that result is multiplied by the mechanical gear ratio.	0.00% (-99.99 - 99.99%)

■ SA-42 MOP Adjust Time

No. (Hex.)	Name	Description	Default Setting (Range)
SA-42 (1AC4) RUN	MOP Adjust Time	V/f CL-V/f OLV **CLV** AOLV Sets the time until the MOP output value changes 100%. The output value can be increased and decreased by switching between multi-function digital inputs.	50.0 s (0.0 - 6000.0 s)

The MOP output can be changed with MOP Adjust Inc (58) and MOP Adjust Dec (59) as multi-function digital inputs to make fine adjustments to the digital gear ratio when online. The increase and decrease time of MOP output is set as the time until the gear ratio changes by 1 (100%).

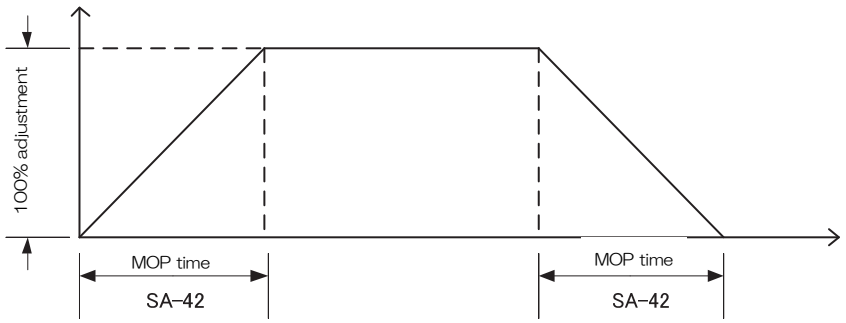

Figure 3.4 MOP Adjust Time

■ SA-43 Ratio Adj Ramp

No. (Hex.)	Name	Description	Default Setting (Range)
SA-43 (1AC5) RUN	Ratio Adj Ramp	V/f CL-V/f OLV **CLV** AOLV Sets the time until the digital gear ratio changes 100%.	10.0 s (0.0 - 6000.0 s)

The digital gear ratio is the total value of the following setting values:
· Parameter setting value: Adjustment value by setting of SA-41 [Digital RatioAdj].
· MOP adjustment value: Value adjusted using the MOP Adjust Inc (58) and MOP Adjust Dec (59) as multi-function digital inputs.
· Analog input value: Adjustment value using the Analog Ratio Adj (29) as multi-function analog input.
· Communication input value: MEMOBUS communications gear ratio adjustment value (register: 15DDH)
Shock due to changing the gear ratio can be reduced by setting the time until the digital gear ratio changes 100%.

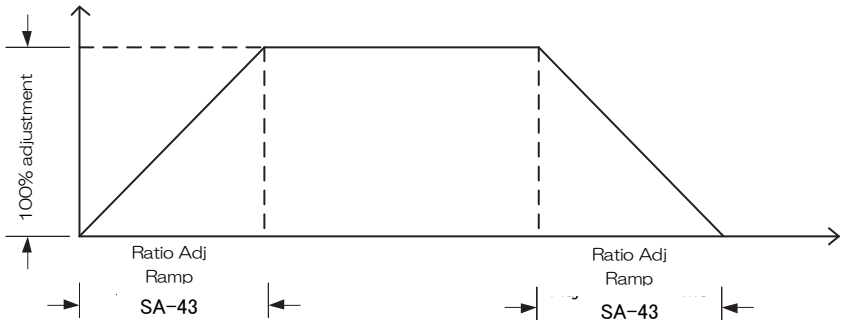

Figure 3.5 Ratio Adj Ramp

■ SA-44 Adv/Ret Mode Sel

No. (Hex.)	Name	Description	Default Setting (Range)
SA-44 (1AC6)	Adv/Ret Mode Sel	V/f CL-V/f OLV **CLV** AOLV Selects the Advance/Retard Compensation mode for the slave drive. Note: Enabled only when set to Position Synchronization mode.	0 (0, 1)

0: Continuous

Compensates the position of the slave in the advance/retard direction for one second with the compensation amount set to SA-45 when the multi-function digital input terminal that has been allocated to Advance Slave or Retard Slave is turned ON.

1: Step

Compensates the position of the slave in the advance/retard direction one time with the compensation amount set to SA-45 when the multi-function digital input terminal that has been allocated to Advance Slave or Retard Slave is turned ON.

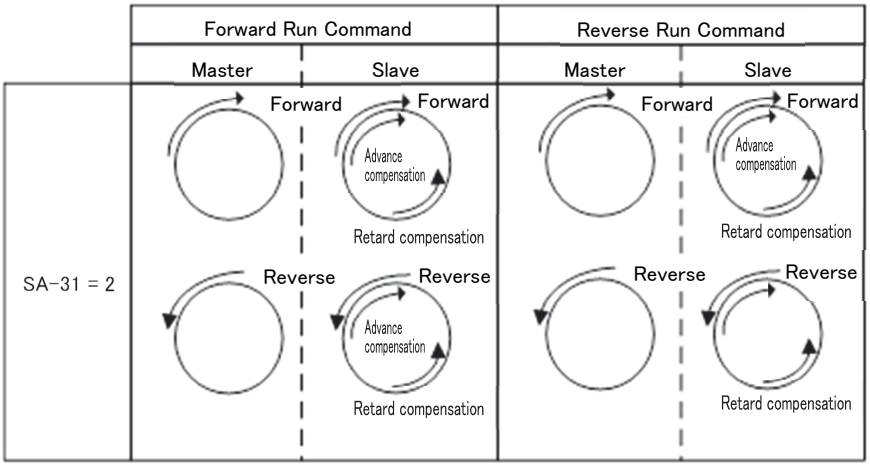

Figure 3.6 Slave Direction and Advance/Retard Operation

■ SA-45 Adv/Ret Amount

No. (Hex.)	Name	Description	Default Setting (Range)
SA-45 (1AC7) RUN	Adv/Ret Amount	V/f CL-V/f OLV **CLV** AOLV Sets the amount of compensation that is used for Advance/Retard Compensation of the slave drive. The Compensation mode can be set with SA-44. Note: Enabled only when set to Position Synchronization mode.	2048 cnt (0 to 65535 cnt)

■ SA-46 Slave Dev Lvl

No. (Hex.)	Name	Description	Default Setting (Range)
SA-46 (1AC8)	Slave Dev Lvl	V/f CL-V/f OLV **CLV** AOLV Sets the position deviation detection level.	4096 cnt (0 to 65535 cnt)

■ SA-47 Slave Dev Sel

No. (Hex.)	Name	Description	Default Setting (Range)
SA-47 (1AC9)	Slave Dev Sel	V/f CL-V/f OLV **CLV** AOLV Selects the slave drive operation when position deviation exceeds the setting value of SA-46.	2 (0 - 2)

0: No Detection

The drive continues operation.

1: Alarm Only

The FdEv alarm is displayed, but the drive continues operation.

2: Coast to Stop

The FdEv alarm is displayed, and the motor coasts to stop.

■ SA-48 MOP Mem @Pwr Off

No. (Hex.)	Name	Description	Default Setting (Range)
SA-48 (1ACA)	MOP Mem @Pwr Off	V/f CL-V/f OLV **CLV** AOLV Selects the handling of the MOP adjustment value when the power supply is turned OFF.	0 (0, 1)

0: Disabled

Resets the MOP adjustment value when the power supply is turned OFF.

1: Enabled

Retains the MOP adjustment value even after the power supply is turned OFF.

■ SA-51 Position P Gain

No. (Hex.)	Name	Description	Default Setting (Range)
SA-51 (1ACB) RUN	Position P Gain	V/f CL-V/f OLV **CLV** AOLV Sets proportional gain for the position controller. Position P Gain (SA-51) is set based on Maximum Output Frequency (E1-04) of the drive. Note: Enabled only when set to Position Synchronization mode. Note: When the setting of E1-04 is changed, position controller output will be affected.	5.00 (0.00 - 100.00)

■ SA-52 Position I Time

No. (Hex.)	Name	Description	Default Setting (Range)
SA-52 (1ACC) RUN	Position I Time	V/f CL-V/f OLV **CLV** AOLV Sets integral time for the position controller. Note: Enabled only when set to Position Synchronization mode.	0.00 s (0.00 - 50.00 s)

■ SA-53 Pos Filter Time

No. (Hex.)	Name	Description	Default Setting (Range)
SA-53 (1ACD) RUN	Pos Filter Time	V/f CL-V/f OLV **CLV** AOLV Sets the filter time for position controller output. Note: Enabled only when set to Position Synchronization mode.	0.00 s (0.00 - 1.50 s)

■ SA-54 Pos PI Limit

No. (Hex.)	Name	Description	Default Setting (Range)
SA-54 (1ACE) RUN	Pos PI Limit	V/f CL-V/f OLV **CLV** AOLV Sets the limit (+/-) on position controller output at maximum output frequency (E1-04) %. Note: Enabled only when set to Position Synchronization mode.	8.00% (0.00 - 10.00%)

■ SA-55 Pos Trim Mode

No. (Hex.)	Name	Description	Default Setting (Range)
SA-55 (1ACF) RUN	Pos Trim Mode	V/f CL-V/f OLV **CLV** AOLV Selects how to adjust output of the position controller.	0 (0, 1)

0: Constant

Position controller output does not depend on the speed level of the master.

1: Speed Prop

Position controller output is directly proportional to the speed level of the master.

Example: When EA-04 is set to 60 Hz, SA-56 is set to 10%, and position controller output is 10%:

• SA-55 = 0

The PI output amount added to the frequency reference is 60 Hz × 10% = 6 Hz, regardless of the speed level of the master.

• SA-55 = 1

① When the slave frequency reference (30 Hz) is larger than 6 Hz (E1-04 (60 Hz) × SA-56 (10%)):

Position controller output after adjustment =

$$\text{E1-04} \times \text{Position controller output (10\%)} \times \frac{\text{Frequency}}{\text{E1-04}} =$$

$$60\ \text{Hz} \times 10\% \times \frac{30\ \text{Hz}}{60\ \text{Hz}} = 3\ \text{Hz}$$

② When the slave frequency reference is smaller than 6 Hz (E1-04 (60 Hz) × SA-56 (10%)):

Position controller output after adjustment =

E1-04 × Position controller output (10%) × SA-56 (10%) = 0.6 Hz

Position controller output is limited by SA-56.

■ SA-56 SpdProp LowerLim

No. (Hex.)	Name	Description	Default Setting (Range)
SA-56 (1AD0) RUN	SpdProp LowerLim	V/f CL-V/f OLV **CLV** AOLV Sets the lower limit value of the speed controller adjustment when SA-55 is set to 1.	10.00% (0.00 - 100.00%)

■ SA-57 RatioChg SpdAgrF

No. (Hex.)	Name	Description	Default Setting (Range)
SA-57 (1AD1) RUN	RatioChg SpdAgrF	V/f CL-V/f OLV **CLV** AOLV Sets the frequency width that determines Speed Agree when the drive accelerates or decelerates for the following reasons. ・ Gear ratio change ・ The multi-function digital input terminal allocated to Slave Disable changed between ON and OFF ・ Run command changed between ON and OFF	0.5 Hz (0.0 - 20.0 Hz)

■ SA-61 Alignment Sel

No. (Hex.)	Name	Description	Default Setting (Range)
SA-61 (1AD2)	Alignment Sel	V/f CL-V/f OLV **CLV** AOLV Enables and disables Alignment. Alignment compensates the position of the slave using the position deviation amount when the Master Trigger and Slave Trigger signals are input. The position deviation when the triggers are input is continuously accumulated. When enabling Alignment, allocate Master Trigger and Slave Trigger to H1-□□ (multi-function digital input) and set parameter SA-61 (Alignment Sel) to a value other than 0. Note: Input of slave Alignment command is detected with the rise of the input signal (15 ms or longer).	0 (0 - 4)

0: Alignment Disable

1: Manual Align

Performs position compensation with Alignment when Align Cmd (H1-□□ = 5F) is input. Position compensation is not performed until the Alignment command is input.

2: Auto Align at Start

Input of Align Cmd (multi-function digital input) for the initial Alignment operation at start is not required. Alignment operates when Slave Trigger and Master Trigger are input. Alignment operations after the initial operation require input of Align Cmd (multi-function digital input) in the same manner as manual Alignment.

3: Continuous Align

Input of Align Cmd is not required. Alignment operates when Slave Trigger and Master Trigger are input.

If the Alignment command is set to a multi-function digital input (H1-xx = 5F), Alignment will not operate until the Alignment command is input.

4: Window Align

Increments U9-23 (Window Counts) if the distance between the triggers is larger than SA-69 (Align Trg Window) when Slave Trigger and Master Trigger are input. Alignment will operate if U9-23 (Window Counts) is larger than SA-70 (Align Trig Count). If the Alignment command is set to a multi-function digital input (H1-xx = 5F), Alignment will not operate until the Alignment command is input.

Alignment will not operate in the following cases:

- Fault occurred on drive.
- Drive is not running.
- Forward Run command and Reverse Run command for the slave are switched at high speed.
- Position Synchronization mode is disabled by multi-function digital input (H1-□□ = 54).
- Position Synchronization mode is disabled by parameter setting (SA-31 = 1).
- Drive is set to LOCAL mode.
- Slave drive has received JOG command.
- Drive speed has drastically changed due to gear ratio change or re-engagement of drive axis.
- Position deviation was cleared by multi-function digital input terminal (H1-□□ = 5B).

(Caution)

- Alignment assumes low speed operation. However, the drive recognizes that a trigger signal has been input when the trigger signal continues for 15 ms.
- When the slave accelerates to follow the master, the maximum Alignment speed of the slave is 95% of maximum output frequency. Alignment will not function if the master is already running at a speed of 95% of maximum output frequency or higher.
- When the slave decelerates to follow the master, the slave may run in reverse. However, when reverse run is disabled (b1-04 = 1) for the slave, the slave drive is limited at zero speed and it does not run in reverse.
- The acceleration and deceleration rates are fixed during Alignment operation. The creep speed for a 1024 PPR encoder is approximately 20 Hz/second. However, the acceleration and deceleration range can be adjusted with SA-62.

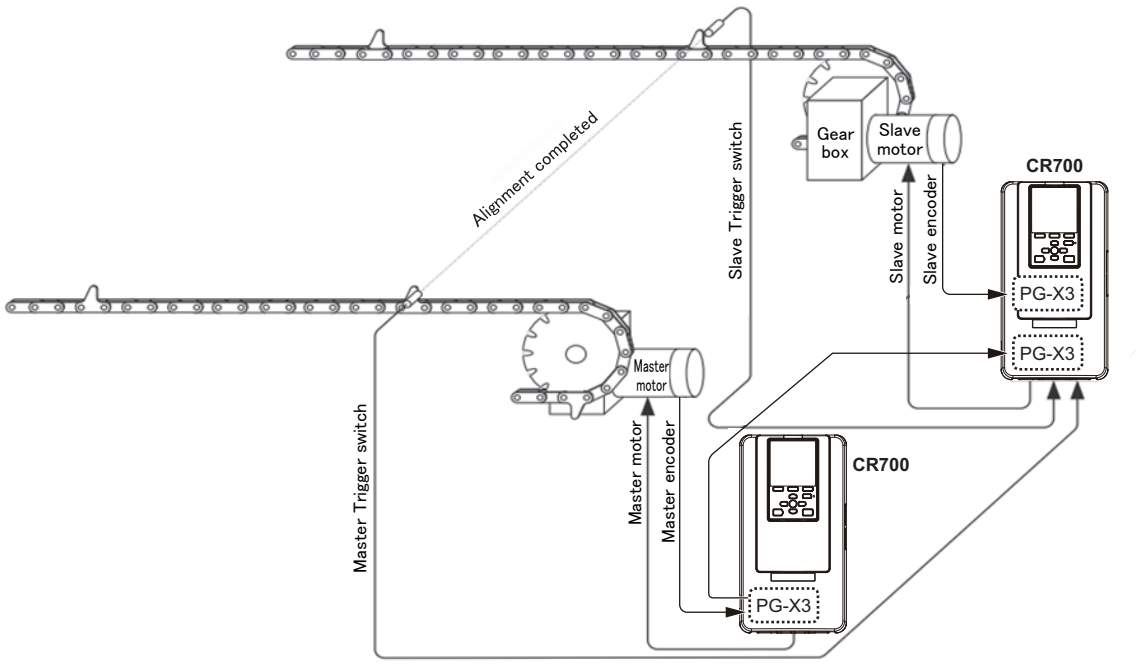

Figure 3.7 Simple Automatic Alignment Diagram

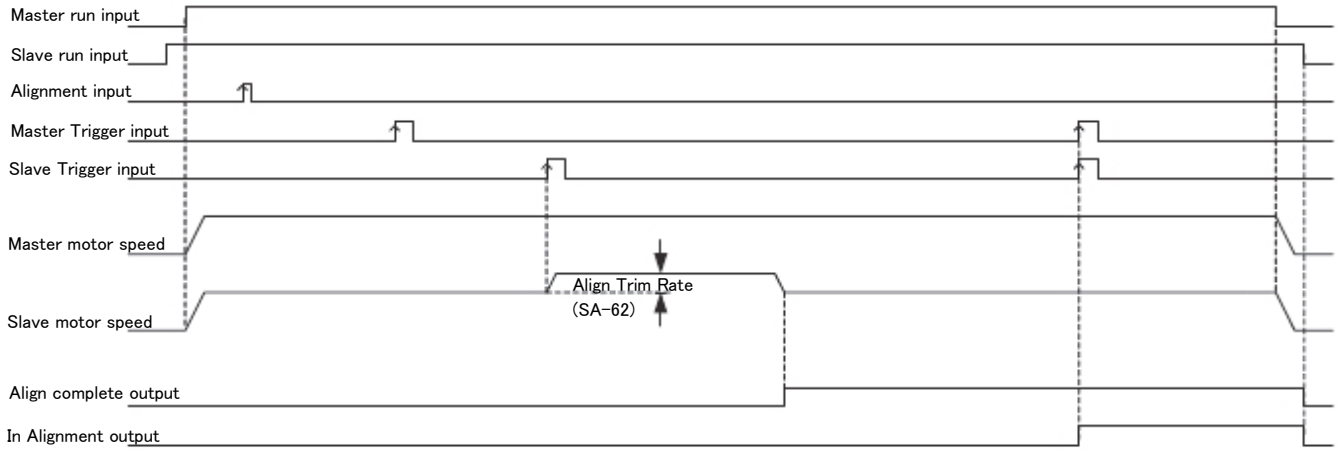

Figure 3.8 Forward Run - Alignment - Master ahead of Slave

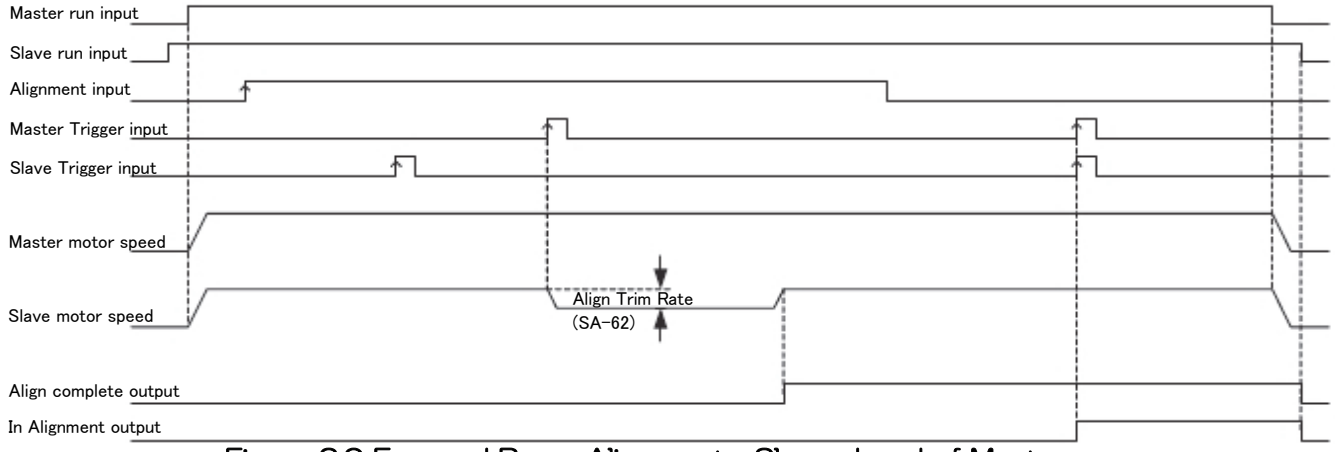

Figure 3.9 Forward Run - Alignment - Slave ahead of Master

Note: The Alignment input is edge triggered. (At least 15 ms.)

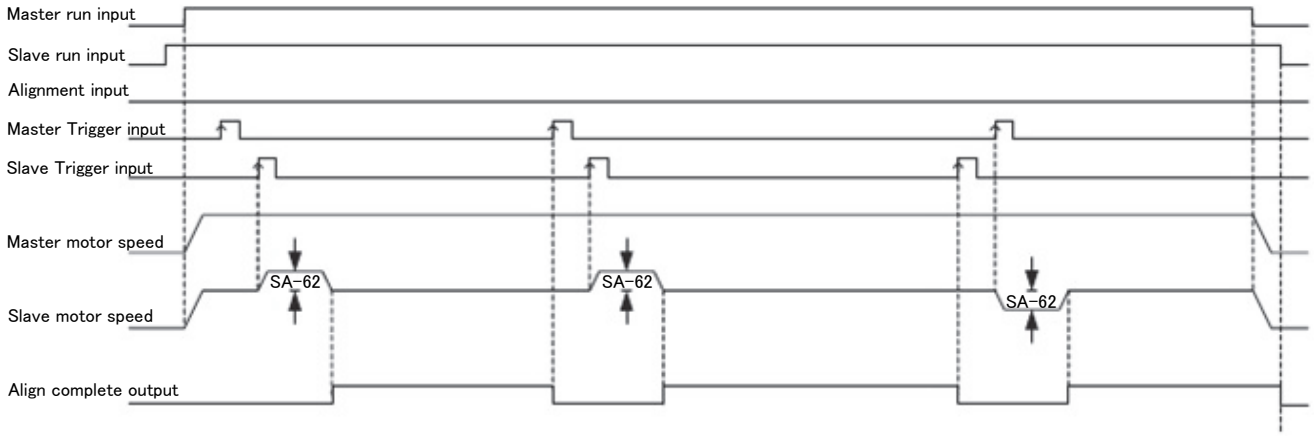

Figure 3.10 Continuous Align (SA-61 = 3)

Note: The Alignment input is edge triggered. (At least 15 ms.)

■ SA-62 Align Trim Rate

No. (Hex.)	Name	Description	Default Setting (Range)
SA-62 (1AD3) RUN	Align Trim Rate	V/f CL-V/f OLV **CLV** AOLV Sets the speed variation range when compensating for the deviation in position between Master Trigger and Slave Trigger. Increasing the setting value shortens the compensation time, and decreasing the setting value lengthens the compensation time.	6.0 Hz (0.1 - 30.0 Hz)

■ SA-63 Align Offset

No. (Hex.)	Name	Description	Default Setting (Range)
SA-63 (1AD4)	Align Offset	V/f CL-V/f OLV **CLV** AOLV Sets the offset value of the trigger position. Position deviation is compensated by the offset. When the Forward Run command is used and the offset is positive, the position of the slave is compensated by the offset in the advancing direction. If the offset is negative, the position of the slave is compensated by the offset in the retarding direction.	0.00 rev (-99.99 - 99.99 rev)

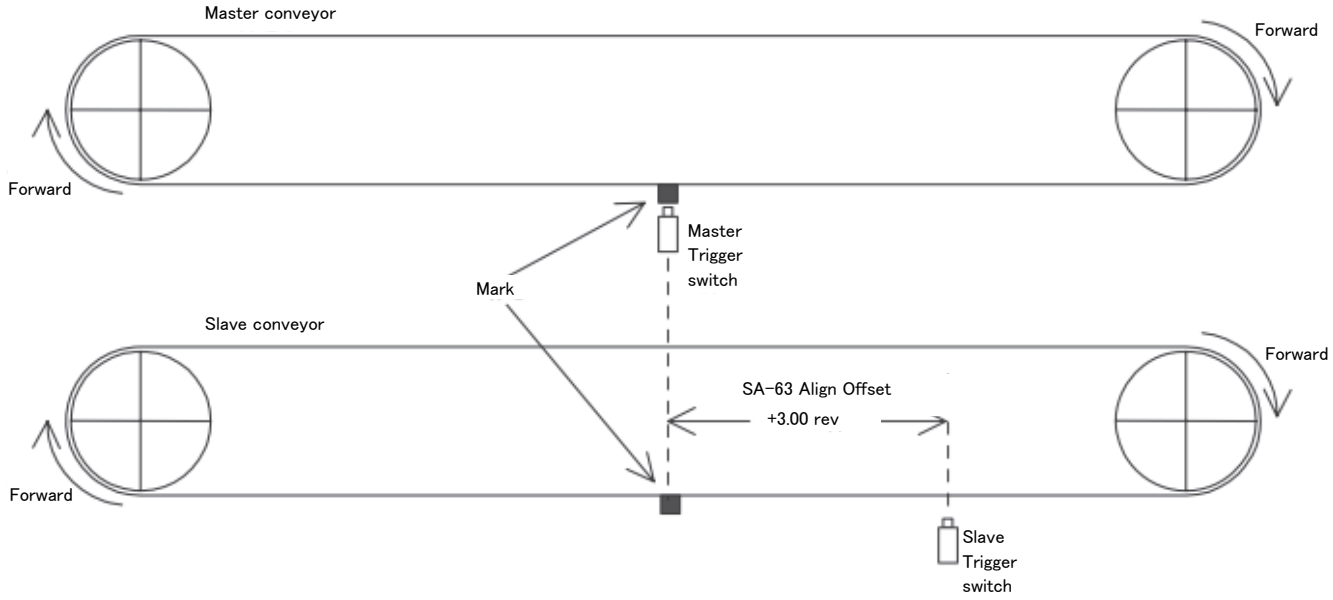

Figure 3.11 Alignment Offset Compensation

■ SA-64 Alignment Check

No. (Hex.)	Name	Description	Default Setting (Range)
SA-64 (1AD5) RUN	Alignment Check	V/f CL-V/f OLV **CLV** AOLV Sets the detection range for Alignment. If the deviation between the pulse count when Master Trigger is input and the pulse count when Slave Trigger is input is smaller than the total value of SA-64 and SA-63, multi-function digital output terminal H2-xx = 55 (In Alignment) turns ON.	100 cnt (0 - 65535 cnt)

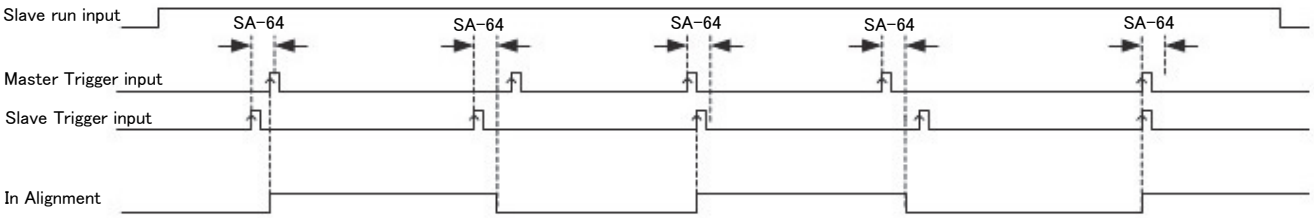

Figure 3.12 In Alignment (Multi-Function Digital Output) without Offset (SA-63 = 0.00 rev and SA-64 = 4096 cnt)

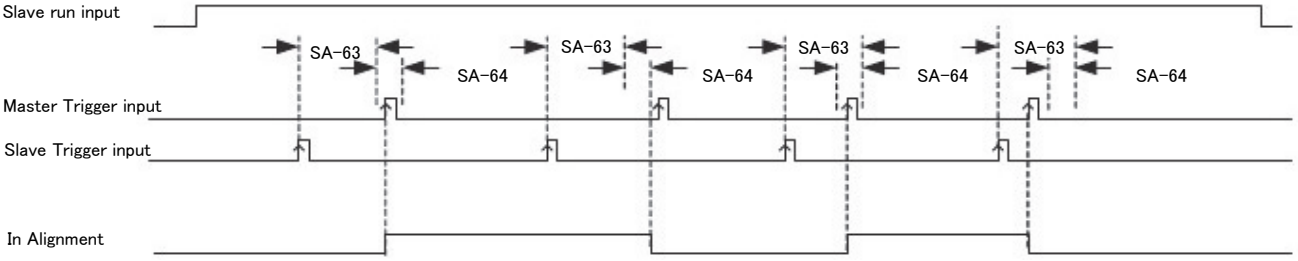

Figure 3.13 In Alignment (Multi-Function Digital Output) with Offset (SA-63 = +3.00 rev and SA-64 = 4096 cnt)

■ SA-65 Trigger Sw Type

No. (Hex.)	Name	Description	Default Setting (Range)
SA-65 (1AD6)	Trigger Sw Type	V/f CL-V/f OLV **CLV** AOLV Selects N.O. and/or N.C. for the inputs of the Master and Slave Trigger switches.	0 (0 - 3)

0: Both NO

1: Master NO Slave NC

2: Master NC Slave NO

3: Both NC

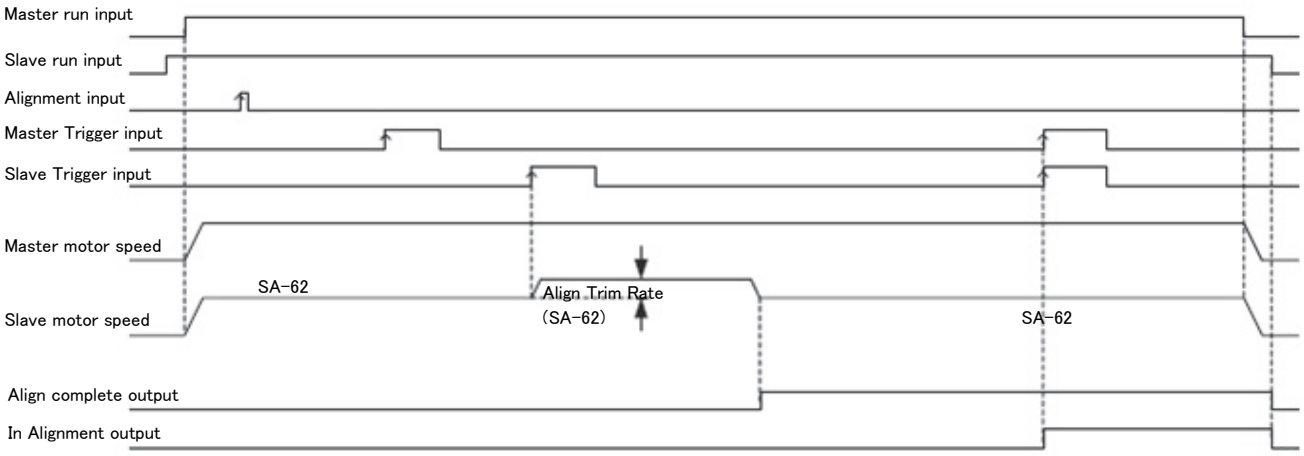

Figure 3.14 N.O. Trigger Input (SA-65 = 0)

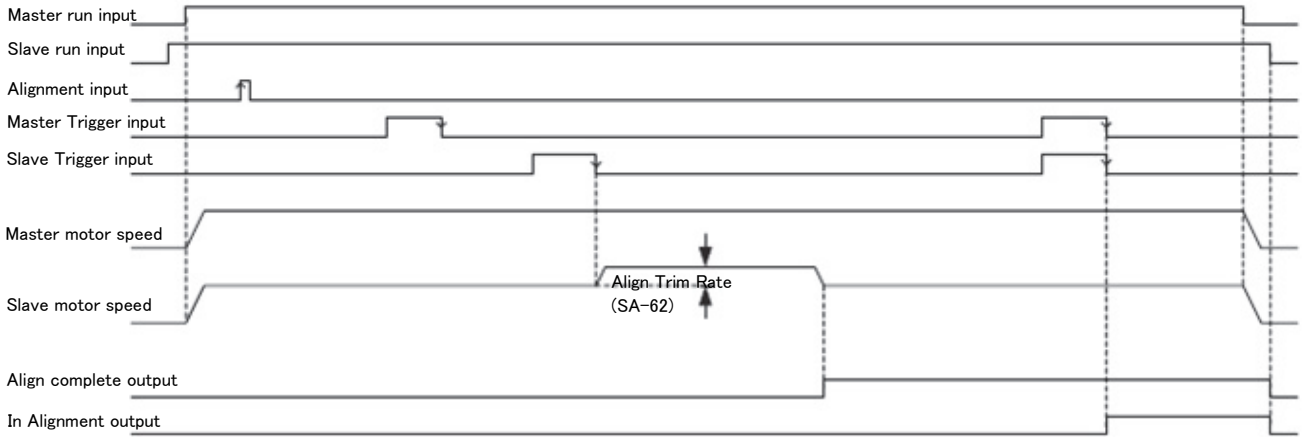

Figure 3.15 NC Trigger Input (SA-65 = 3)

■ SA-66 Align Fault Sel

No. (Hex.)	Name	Description	Default Setting (Range)
SA-66 (1AD7)	Align Fault Sel	V/f CL-V/f OLV **CLV** AOLV Sets the operation when an Alignment fault is detected. An Alignment fault is detected when the interval between Master Trigger and Slave Trigger inputs exceeds the setting value of SA-67. Note: 268,435,456 is the maximum encoder pulse count value between Master Trigger and Slave Trigger inputs. (For a motor with a 1024 PPR encoder, this is equivalent to 65,536 revolutions.)	0 (0 - 2)

0: Disabled

1: Ignore First Trigger

Disables the position deviation between the first triggers. Use this to prevent the mistaken detection of the two trigger patterns used for Alignment. For this setting, set SA-67 to a distance between the sensors of 50% to 70%.

2: Fault

Detects AF (Alignment Fault) and coasts to stop when the position deviation between the triggers exceeds the setting value of SA-67. When using this mode, it is effective to set the deviation of SA-67 larger than the normal distance between triggers.

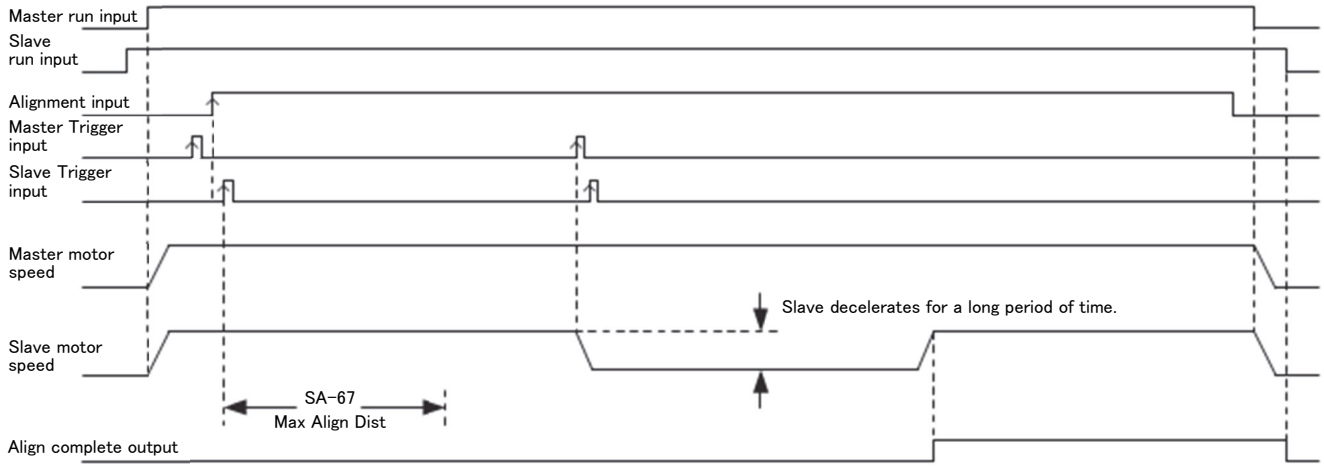

Figure 3.16 Align Fault Sel = Disabled (SA-66 = 0)

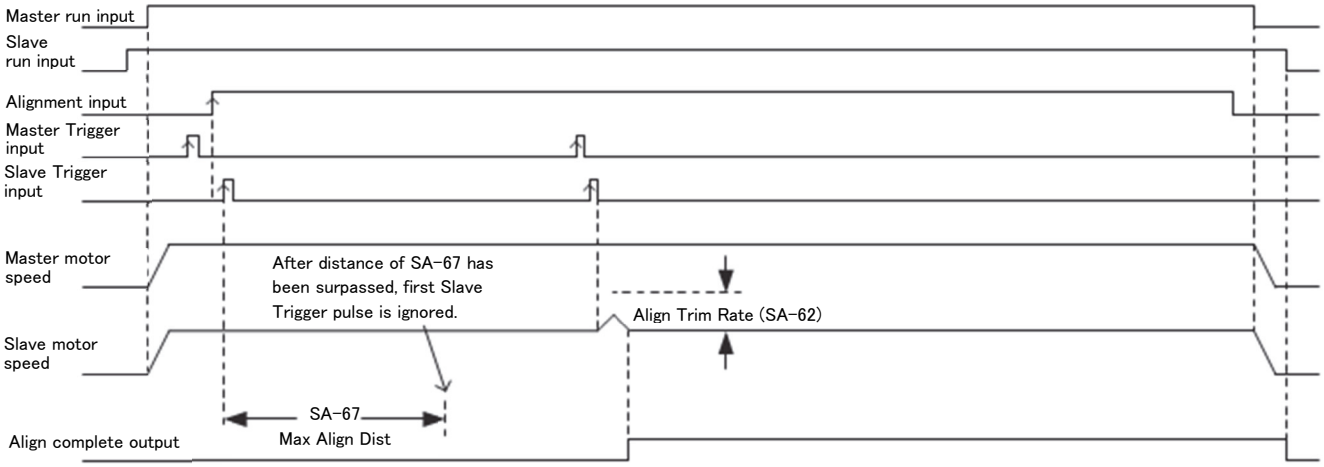

Figure 3.17 Align Fault Sel = Ignore First Trigger (SA-66 = 1)

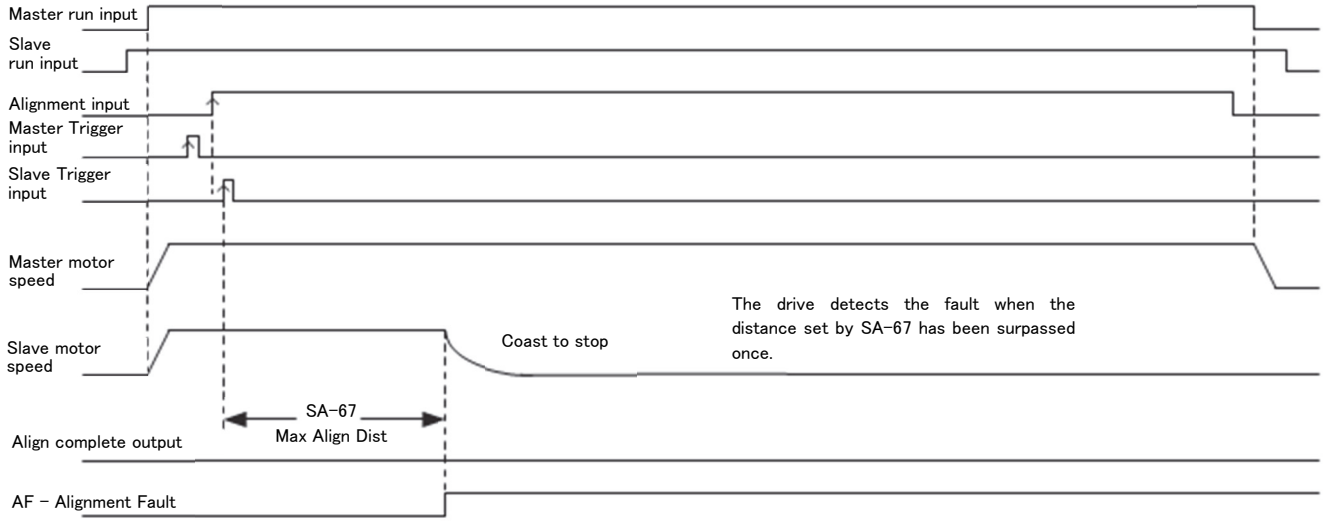

Figure 3.18 Align Fault Sel = Fault (SA-66 = 2)

■ SA-67 Max Align Dist

No. (Hex.)	Name	Description	Default Setting (Range)
SA-67 (1AD8)	Max Align Dist	V/f CL-V/f OLV **CLV** AOLV Sets the maximum distance between Master Trigger and Slave Trigger as the number of revolutions of the slave motor. AF (Alignment Fault) is detected when this distance is surpassed.	1000 rev (1 - 5000 rev)

■ SA-68 Max Align Speed

No. (Hex.)	Name	Description	Default Setting (Range)
SA-68 (1AD9) RUN	Max Align Speed	V/f CL-V/f OLV **CLV** AOLV Sets the maximum Alignment speed. Alignment processing will not be performed when the motor is running at the speed of the setting value or greater. Use this parameter to restrict Alignment processing at high speeds where accuracy decreases. Setting this parameter to 0.0 Hz disables the function.	0.0 Hz (0.0 - 400.0 Hz)

■ SA-69 Align Trg Window

No. (Hex.)	Name	Description	Default Setting (Range)
SA-69 (1ADA) RUN	Align Trg Window	V/f CL-V/f OLV **CLV** AOLV Sets the judgment condition of U9-23 [Window Counts] when SA-61=4. U9-23 is incremented when the Alignment error exceeds the setting value of SA-69 during Alignment operation. The monitor value is decremented when the Alignment error is the setting value of SA-69 or lower.	2.00 rev (0.00 - 100.00 rev)

■ SA-70 Align Trig Count

No. (Hex.)	Name	Description	Default Setting (Range)
SA-70 (1ADB)	Align Trig Count	V/f CL-V/f OLV **CLV** AOLV Sets the count to trigger Alignment when SA-61=4. When U9-23 is the setting value of SA-70, Alignment will operate, and then U9-23 will be cleared after the completion of Alignment.	3 times (1 - 100 times)

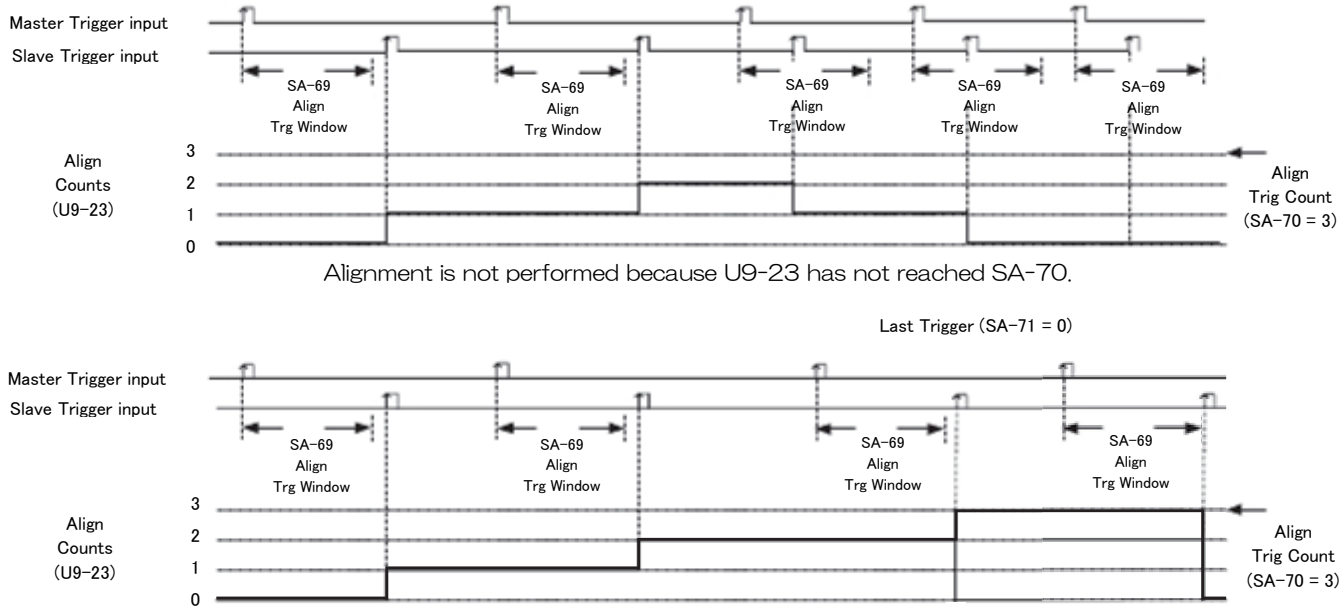

Figure 3.19 SA-61 = 4 and Window Alignment Mode

■ SA-71 Repeat Trig Sel

No. (Hex.)	Name	Description	Default Setting (Range)
SA-71 (1ADC)	Repeat Trig Sel	V/f CL-V/f OLV **CLV** AOLV Selects how to process the trigger when the Master and Slave Trigger counts do not match.	0 (0, 1)

0: Last Trigger

When multiple Master Triggers (or Slave Triggers) are input before the Slave Trigger (or Master Trigger) input, only the last Master Trigger (or Slave Trigger) is valid.

1: First Trigger

When multiple Master Triggers (or Slave Triggers) are input before the Slave Trigger (or Master Trigger) input, only the first Master Trigger (or Slave Trigger) is valid.

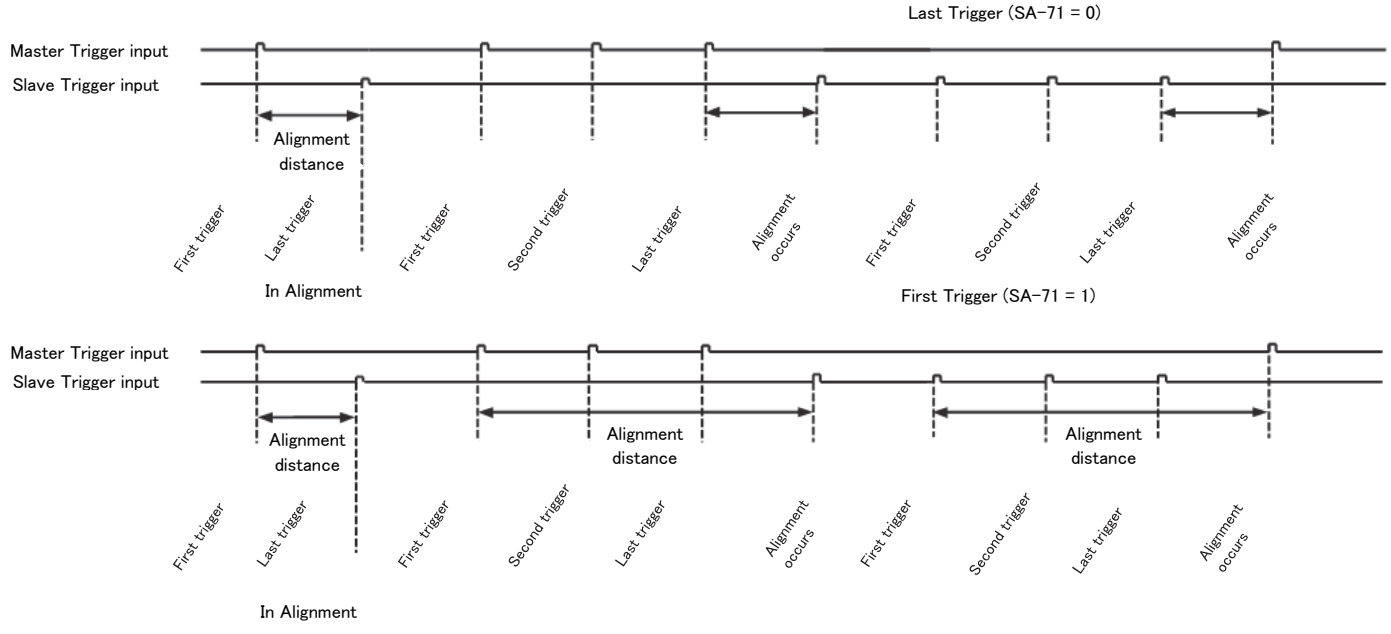

Figure 3.20 Last and First Triggers

4.Parameter List

4.1 F1: PG Option Setup (Encoder)

No. (Hex.)	Name	Description	Default Setting (Range)
F1-01 (380H)	Encoder 1 Pulse Count (PPR)	V/f **CL-V/f** OLV **CLV** **AOLV** Sets the number of output pulses per revolution of the encoder.	Determined by A1-02 *4 (1 - 60000 ppr)
F1-02 (381H)	PG Open Circuit Detection Select	V/f **CL-V/f** OLV **CLV** **AOLV** 0: Ramp to Stop (Stop in C1-02 deceleration time.) 1: Coast to Stop 2: Fast Stop (Ramp to stop in C1-09 Fast Stop time.) 3: Alarm Only (Do not normally use this setting value in order to protect the motor and machine.) 4: No Alarm Display (Do not normally use this setting value.) Note: Faults such as ov and oC may occur depending on the run speed and load conditions.	1 (0 - 4)
F1-05 (384H)	Encoder 1 Rotation Selection	V/f **CL-V/f** OLV **CLV** **AOLV** 0: Pulse A leads in FWD Direction 1: Pulse B leads in FWD Direction	Determined by A1-02 *4 (0, 1)
F1-14 (38DH)	Encoder Open-Circuit Detect Time	V/f **CL-V/f** OLV **CLV** **AOLV** Sets the detection time of PGo (Encoder Disconnection).	2.0 s (0.0 - 10.0 s)
F1-21 (3BCH)	Encoder 1 Signal Selection	V/f **CL-V/f** OLV CLV AOLV 0: A Pulse Detection 1: AB Pulse Detection	0 (0, 1)
F1-31 (3B0H)	Encoder 2 Pulse Count (PPR)	V/f **CL-V/f** OLV **CLV** **AOLV** Sets the number of output pulses per revolution of the encoder.	600 ppr (1 - 60000 ppr)
F1-32 (3B1H)	PG 2 Rotation Selection	V/f **CL-V/f** OLV **CLV** **AOLV** 0: Pulse A leads in FWD Direction 1: Pulse B leads in FWD Direction	0 (0, 1)
F1-36 (3B5H)	Encoder 2 PCB Disconnect Detect	V/f **CL-V/f** OLV **CLV** **AOLV** 0: Disable PG-X3 Hardware Disconnect Detect 1: Enable PG-X3 Hardware Disconnect Detect	1 (0, 1)
F1-37 (3BDH)	Encoder 2 Signal Selection	V/f **CL-V/f** OLV CLV AOLV 0: A Pulse Detection 1: AB Pulse Detection	0 (0, 1)

4.2 H1: Multi-Function Digital Input Settings

Setting Value	Function	Description
54	Slave Disable	V/f CL-V/f OLV **CLV** AOLV ON: Disables Slave Mode (SA-31). The slave drive will run according to the normal frequency reference (setting of b1-01) and use the normal acceleration and deceleration times. Note: Enabled only when set to ELS mode.
55	Ratio 2 Select	V/f CL-V/f OLV **CLV** AOLV ON: Selects gear ratio 2 (SA-37 and SA-38). For Position Synchronization Mode (SA-31 = 2), the slave drive clears the position deviation and transitions to the new ratio according to the acceleration and deceleration times set to C1-03 and C1-04. When the speed agrees, the position loop is once again engaged.

Setting Value	Function	Description
56	Advance Slave	V/f CL-V/f OLV **CLV** AOLV ON: Performs advance compensation on the slave position. Position deviation is not accumulated. Refer to SA-44 and SA=45 for the direction and amount to advance. Note: Enabled only when set to Position Synchronization mode.
57	Retard Slave	V/f CL-V/f OLV **CLV** AOLV ON: Retards the slave position from the master encoder. Position deviation is not accumulated. Refer to the descriptions of parameter SA-44 and SA-45 for more information. Note: Enabled only when set to Position Synchronization mode.
58	MOP Adjust Inc	V/f CL-V/f OLV **CLV** AOLV ON: Increases the MOP ratio adjustment value. Refer to the descriptions of parameter SA-42 and SA-48 for more information.
59	MOP Adjust Dec	V/f CL-V/f OLV **CLV** AOLV ON: Decreases the MOP ratio adjustment value. Refer to the descriptions of parameter SA-42 and SA-48 for more information.
5A	MOP Adj Reset	V/f CL-V/f OLV **CLV** AOLV ON: Resets the MOP ratio adjustment value to 0. Refer to the descriptions of parameter SA-42 and SA-48 for more information.
5B	Pos Err Reset	V/f CL-V/f OLV **CLV** AOLV ON: Resets position deviation to 0. Note: Enabled only when set to Position Synchronization mode.
5C	Pos Reg I Reset	V/f CL-V/f OLV **CLV** AOLV ON: Resets the integral value of the position controller to 0. Note: Enabled only when set to Position Synchronization mode.
5D	Slave Trigger	V/f CL-V/f OLV **CLV** AOLV Inputs the position detection switch for the slave. Select whether to input the switch as N.O. or N.C. with SA-65.
5E	Master Trigger	V/f CL-V/f OLV **CLV** AOLV Inputs the position detection switch for the master. Select whether to input the switch as N.O. or N.C. with SA-65.
5F	Align Cmd	V/f CL-V/f OLV **CLV** AOLV Starts operation of Alignment. Start of the operation is triggered by the rise of the signal. This is enabled when SA-61=1 or 2. When SA-61=3 or 4 and the multi-function digital input terminal is ON, this command is used to enable and disable Alignment (OFF = disabled and ON = enabled). When set to OFF, the Alignment error is measured and displayed for U9-22, but no position compensation is performed by the Alignment of the drive. When SA-61=3 or 4 and the Alignment command is set to a multi-function digital input, Alignment will not operate until the Alignment command is input.

4.3 H2: Multi-Function Digital Output Settings

Setting Value	Function	Description
53	Slave Pos Dev	V/f CL-V/f OLV **CLV** AOLV ON: Position deviation has exceeded Slave Dev Lvl (SA-46). Note: Enabled only when set to Position Synchronization mode.
54	Align Complete	V/f CL-V/f OLV **CLV** AOLV The output turns ON when Alignment processing has completed. The output turns OFF under the following circumstances. • The accumulated distance has exceeded the total value of SA-63 and SA-64 when the first trigger was detected. • A fault occurred and the slave stopped. Or position deviation was cleared or disabled. • The Advance Slave or Retard Slave command was input. • The multi-function digital input terminal allocated to Align Cmd was turned ON when SA-61 was set to 1 or 2. • The multi-function digital input terminal allocated to Master Trigger or Slave Trigger was turned ON when SA-61 was set to 3 or 4.
55	In Alignment	V/f CL-V/f OLV **CLV** AOLV The output turns ON when the deviation between the two triggers is the setting value of SA-64 or less. The output turns OFF under the following circumstances. • The accumulated distance has exceeded the total value of SA-63 and SA-64 when the first trigger was detected. • A fault occurred and the slave stopped. Or position deviation was cleared or disabled. • The Advance Slave or Retard Slave command was input.

4.4 H3: Multi-Function Analog Input Settings (H3-02/H3-06/H3-10)

Setting Value	Function	Description	Analog Output Scale
29	Analog Ratio Adj	V/f CL-V/f OLV **CLV** AOLV Adjusts the analog input value of the digital gear ratio. The digital gear ratio is the total value of the parameter setting value, analog input value, MOP output value, and communication input value.	10 V: 100.00%

4.5 SA: Crane Special Func

No. (Hex.)	Name	Description	Default Setting (Range)	Ref.
SA-31 (1ABA) Expert	Slave Mode	V/f CL-V/f OLV **CLV** AOLV Selects the Slave mode. 0: Disabled 1: Speed 2: Position	0 (0 - 2)	7
SA-32 (1ADF) Expert	Speed/Position Sync Control @Dec	V/f CL-V/f OLV **CLV** AOLV Selects whether or not to perform speed and position synchronization during ramp to stop. 0: Disabled 1: Enabled	1 (0, 1)	8
SA-33 (1ABB) RUN Expert	Ratio Num High	V/f CL-V/f OLV **CLV** AOLV Sets the upper four digits of the numerator of the mechanical gear ratio.	1000 (0 - 9999)	9

No. (Hex.)	Name	Description	Default Setting (Range)	Ref.
SA-34 (1ABC) RUN Expert	Ratio Den High	V/f CL-V/f OLV **CLV** AOLV Sets the upper four digits of the denominator of the mechanical gear ratio.	1000 (0 - 9999)	9
SA-35 (1ABD) RUN Expert	Ratio Num Low	V/f CL-V/f OLV **CLV** AOLV Sets the lower four digits of the numerator of the mechanical gear ratio.	0 (0 - 9999)	10
SA-36 (1ABE) RUN Expert	Ratio Den Low	V/f CL-V/f OLV **CLV** AOLV Sets the lower four digits of the denominator of the mechanical gear ratio.	0 (0 - 9999)	10
SA-37 (1ABF) RUN Expert	Ratio 2 Num	V/f CL-V/f OLV **CLV** AOLV Sets the numerator of gear ratio 2. This gear ratio is enabled when a multi-function digital input is set to 55 (Ratio 2 Select) and that digital input is turned ON.	1 (0 - 65535)	10
SA-38 (1AC0) RUN Expert	Ratio 2 Den	V/f CL-V/f OLV **CLV** AOLV Sets the denominator of gear ratio 2. This gear ratio is enabled when a multi-function digital input is set to 55 (Ratio 2 Select) and that digital input is turned ON.	1 (0 - 65535)	10
SA-39 (1AC1) Expert	Pos Accum Select	V/f CL-V/f OLV **CLV** AOLV Selects how to accumulate position deviation of the slave drive. 0: Only During Run 1: Always	0 (0, 1)	10
SA-40 (1AC2) RUN Expert	Position Units	V/f CL-V/f OLV **CLV** AOLV Selects the unit for Position Error (U9-18). 0: cnts 1: rev 2: deg 3: rad Note: Enabled only when set to Position Synchronization mode.	0 (0 - 3)	11
SA-41 (1AC3) RUN Expert	Digital RatioAdj	V/f CL-V/f OLV **CLV** AOLV Sets the digital gear ratio adjustment parameter for the slave drive. The digital gear ratio is the total value of the parameter setting value, analog input value, MOP output value, and communication input value. 100% is added to the digital gear ratio and that result is multiplied by the mechanical gear ratio.	0.00% (-99.99 - 99.99%)	11
SA-42 (1AC4) RUN Expert	MOP Adjust Time	V/f CL-V/f OLV **CLV** AOLV Sets the time until the MOP output value changes 100.00%. The output value can be increased and decreased by switching between multi-function digital inputs.	50.0 s (0.0 - 6000.0 s)	11

No. (Hex.)	Name	Description	Default Setting (Range)	Ref.
SA-43 (1AC5) RUN Expert	Ratio Adj Ramp	V/f CL-V/f OLV **CLV** AOLV Sets the time until the digital gear ratio changes 100%.	10.0 s (0.0 - 6000.0 s)	12
SA-44 (1AC6) Expert	Adv/Ret Mode Sel	V/f CL-V/f OLV **CLV** AOLV Selects the Advance/Retard Compensation mode for the slave drive. 0: Continuous 1: Step Note: Enabled only when set to Position Synchronization mode.	0 (0, 1)	13
SA-45 (1AC7) RUN Expert	Adv/Ret Amount	V/f CL-V/f OLV **CLV** AOLV Sets the amount of compensation that is used for Advance/Retard Compensation of the slave drive. The compensation mode can be set with SA-44. Note: Enabled only when set to Position Synchronization mode.	2048 cnt (0 to 65535 cnt)	13
SA-46 (1AC8) Expert	Slave Dev Lvl	V/f CL-V/f OLV **CLV** AOLV Sets the position deviation detection level. Note: Enabled only when set to Position Synchronization mode.	4096 cnt (0 to 65535 cnt)	13
SA-47 (1AC9) Expert	Slave Dev Sel	V/f CL-V/f OLV **CLV** AOLV Selects the slave drive operation when position deviation exceeds the setting value of SA-46. 0: No Detection 1: Alarm Only 2: Coast to Stop	2 (0 - 2)	14
SA-48 (1ACA) Expert	MOP Mem @Pwr Off	V/f CL-V/f OLV **CLV** AOLV Selects the handling of the MOP adjustment value when the power supply is turned OFF. 0: Disabled 1: Enabled	0 (0, 1)	14
SA-51 (1ACB) RUN Expert	Position P Gain	V/f CL-V/f OLV **CLV** AOLV Sets proportional gain for the position controller. Note: Enabled only when set to Position Synchronization mode.	5.00 (0.00 - 100.00)	14
SA-52 (1ACC) RUN Expert	Position I Time	V/f CL-V/f OLV **CLV** AOLV Sets integral time for the position controller. Note: Enabled only when set to Position Synchronization mode.	0.00 s (0.00 - 50.00 s)	14
SA-53 (1ACD) RUN Expert	Pos Filter Time	V/f CL-V/f OLV **CLV** AOLV Sets the filter time for position controller output. Note: Enabled only when set to Position Synchronization mode.	0.00 s (0.00 - 1.50 s)	14

No. (Hex.)	Name	Description	Default Setting (Range)	Ref.
SA-54 (1ACE) RUN Expert	Pos PI Limit	V/f CL-V/f OLV **CLV** AOLV Sets the limit (+/-) on position controller output as a percentage of Maximum Output Frequency (E1-04). Note: Enabled only when set to Position Synchronization mode.	8.00% (0.00 - 10.00%)	15
SA-55 (1ACF) RUN Expert	Pos Trim Mode	V/f CL-V/f OLV **CLV** AOLV Selects how to adjust output of the position controller. 0: Constant 1: Speed Prop Note: Enabled only when set to Position Synchronization mode.	0 (0, 1)	15
SA-56 (1AD0) RUN Expert	SpdProp LowerLim	V/f CL-V/f OLV **CLV** AOLV Sets the lower limit value of the speed controller adjustment when SA-55 is set to 1.	10.00% (0.00 - 100.00%)	15
SA-57 (1AD1) RUN Expert	RatioChg SpdAgrF	V/f CL-V/f OLV **CLV** AOLV Selects the frequency width that determines Speed Agree when the drive accelerates or decelerates for the following reasons. • Gear ratio change • The multi-function digital input terminal allocated to Slave Disable changed between ON and OFF • Run command changed between ON and OFF	0.5 Hz (0.0 - 20.0 Hz)	16
SA-61 (1AD2) Expert	Alignment Sel	V/f CL-V/f OLV **CLV** AOLV Enables and disables Alignment. 0: Alignment Disable 1: Manual Align 2: Auto Align at Start 3: Continuous Align 4: Window Align	0 (0 - 4)	16
SA-62 (1AD3) RUN Expert	Align Trim Rate	V/f CL-V/f OLV **CLV** AOLV Sets the speed variation range when compensating for the deviation in position between Master Trigger and Slave Trigger. Increasing the setting value shortens the compensation time, and decreasing the setting value lengthens the compensation time.	6.0 Hz (0.1 - 30.0 Hz)	19
SA-63 (1AD4) Expert	Align Offset	V/f CL-V/f OLV **CLV** AOLV Sets the offset value of the trigger position. Position deviation is compensated by the offset. When the Forward Run command is used and the offset is positive, the position of the slave is compensated by the offset in the advancing direction. If the offset is negative, the position of the slave is compensated by the offset in the retarding direction.	0.00 rev (-99.99 - 99.99 rev)	19
SA-64 (1AD5) RUN Expert	Alignment Check	V/f CL-V/f OLV **CLV** AOLV Sets the detection range for Alignment. If the deviation between the pulse count when Master Trigger is input and the pulse count when Slave Trigger is input is smaller than the setting value of SA-64, multi-function digital output terminal H2-xx = 55 (In Alignment) turns ON.	100 cnt (0 to 65535 cnt)	20

No. (Hex.)	Name	Description	Default Setting (Range)	Ref.
SA-65 (1AD6) Expert	Twigger Sw Type	V/f CL-V/f OLV **CLV** AOLV Selects N.O. and/or N.C. for the inputs of the Master and Slave Trigger switches. 0: Both NO 1: Master NO Slave NC 2: Master NC Slave NO 3: Both NC	0 (0 - 3)	21
SA-66 (1AD7) Expert	Align Fault Sel	V/f CL-V/f OLV **CLV** AOLV Sets the operation when an Alignment fault is detected. An Alignment fault is detected when the interval between Master Trigger and Slave Trigger inputs exceeds the setting value of SA-67. 0: Disabled 1: Ignore First Trigger 2: Fault	0 (0 - 2)	22
SA-67 (1AD8) Expert	Max Align Dist	V/f CL-V/f OLV **CLV** AOLV Sets the maximum distance between Master Trigger and Slave Trigger as the number of revolutions of the slave motor. AF (Alignment fault) is detected when this distance is surpassed.	1000 rev (1 - 5000 rev)	24
SA-68 (1AD9) RUN Expert	Max Align Speed	V/f CL-V/f OLV **CLV** AOLV Sets the maximum Alignment speed. Alignment processing will not be performed when the motor is running at the speed of the setting value or greater. Use this parameter to restrict Alignment processing at high speeds where accuracy decreases. Setting this parameter to 0.0 Hz disables the function.	0.0 Hz (0.0 - 400.0 Hz)	24
SA-69 (1ADA) RUN Expert	Align Trg Window	V/f CL-V/f OLV **CLV** AOLV Sets the judgment condition of U9-23 (Window Counts) when SA-61=4. U9-23 is incremented when the Alignment error exceeds the setting value of SA-69 during Alignment. The monitor value is decremented when the Alignment error is the setting value of SA-69 or lower.	2.00 rev (0.00 - 100.00 rev)	24
SA-70 (1ADB) RUN Expert	Align Trig Count	V/f CL-V/f OLV **CLV** AOLV Sets the count to trigger Alignment when SA-61=4. When U9-23 is the setting value of SA-70, Alignment will operate, and then U9-23 will be cleared.	3 times (1 - 100 times)	24
SA-71 (1ADC) Expert	Repeat Trig Sel	V/f CL-V/f OLV **CLV** AOLV Selects how to process the trigger when the Master and Slave Trigger counts do not match. 0: Last Trigger 1: First Trigger	0 (0, 1)	25

4.6 U9: Crane Monitors

No. (Hex.)	Name	Description	MFAO Signal Level	Unit
U9-12 (82B) Expert	Master PG Fref	V/f CL-V/f OLV **CLV** AOLV Displays the detected frequency of the master motor before the gear ratio (mechanical gear ratio × digital gear ratio) is applied (slave standard). Note: Display of Modbus values is limited to between -3276.8 and 3276.7.* 1	10 V: Maximum frequency	0.1 Hz
U9-13 (82C) Expert	Fref After Gear	V/f CL-V/f OLV **CLV** AOLV Displays the slave frequency reference after the mechanical gear ratio (SA-33 to SA-38) has been applied. Note: Display of MEMOBUS values is limited to between -3276.8 and 3276.7.* 1	10 V: Maximum frequency	0.1 Hz
U9-14 (82D) Expert	Gear Ratio Adj	V/f CL-V/f OLV **CLV** AOLV Displays the digital gear ratio. The digital gear ratio is the total value of the analog input value, parameter setting value, MOP adjustment value, and communication input value.	10 V: 100.00%	0.01%
U9-15 (82E) Expert	Fref After Adj	V/f CL-V/f OLV **CLV** AOLV Displays the frequency reference after the digital gear ratio has been applied. Note: Modbus values are displayed between -3276.8 and 3276.7.* 1	10 V: Maximum frequency	0.1 Hz
U9-16 (82F) Expert	Master Cts/5ms	V/f CL-V/f OLV **CLV** AOLV Displays the count value every 5 ms of the master encoder pulses input to the slave. This monitor can be used to check the receive status of encoder pulses. Note: Enabled only when set to Position Synchronization mode.	10 V: cnt/5 ms @ Maximum Output Frequency (E1-04)	cnt
U9-17 (1A70) Expert	Slave Cts/5ms	V/f CL-V/f OLV **CLV** AOLV Displays the count value every 5 ms from the encoder of the slave drive. This monitor is used only to check the encoder count is being received. Note: • Enabled only when set to Position Synchronization mode. • The count value is that after the gear ratio has been applied.	10 V: cnt/5 ms @ Maximum Output Frequency (E1-04)	cnt
U9-18 (1A71) Expert	Position Error	V/f CL-V/f OLV **CLV** AOLV Displays the deviation between the master and slave encoder pulse counts. Note: • Enabled only when set to Position Synchronization mode. • Modbus values are between -3276.8 and 3276.7. The display range is between -9999 and 99999.* 1	10 V: cnt/5 ms @ Maximum Output Frequency (E1-04)	SA-40 *2*3
U9-19 (1A72) Expert	Position P Out	V/f CL-V/f OLV **CLV** AOLV Displays proportional control output of the position controller. Note: Enabled only when set to Position Synchronization mode.	10 V: 100.00%	0.01%
U9-20 (1A73) Expert	Position I Out	V/f CL-V/f OLV **CLV** AOLV Displays integral control output of the position controller. Note: Enabled only when set to Position Synchronization mode.	10 V: 100.00%	0.01%

No. (Hex.)	Name	Description	MFAO Signal Level	Unit
U9-21 (1A74) Expert	Position PI Out	V/f CL-V/f OLV **CLV** AOLV Displays the output of the position controller. Note: Enabled only when set to Position Synchronization mode.	10 V: 100.00%	0.01%
U9-22 (1A75) Expert	Alignment Error	V/f CL-V/f OLV **CLV** AOLV Displays the deviation in the number of revolutions between the master and slave when Alignment error was judged. The value is positive when the master is ahead of the slave.	10 V: cnt/5 ms @ Maximum Output Frequency (E1-04)	rev
U9-23 (1A76) Expert	Window Counts	V/f CL-V/f OLV **CLV** AOLV Enabled when SA-61 = 4. Displays the count for which position deviation exceeded SA-69 when judging Alignment error. The count of U9-23 is cleared after Alignment has completed.	No	cnt

*1 When the internal value exceeds the range of maximum and minimum values that can be displayed on the keypad, "OVER" and the monitor name will be alternately displayed and flashing.
*2 The unit is dependent on the setting of Position Units (SA-40).
*3 The unit is fixed to encoder pulse count when reading the value over network communications (register 1A71).
*4 Refer to the manual for a description of parameters determined by A1-02.

Table 4.1 MEMOBUS Registers

Register No.	Description	Unit
15DDH	Gear ratio adjustment over network communications. Allows the gear ratio to be adjusted over network communications. The digital gear ratio (%) is the total value of the parameter setting value (SA-41), analog input value, communication input value, and MOP adjustment value. The setting value of the parameter is differentiated by positive and negative, so the setting range of the adjustment value is between -327.67% and 327.67%. Note: The ENTER command is not required when writing to this register.	1 = 0.01%
15DEH	Network communications advance/retard count. Allows advance/retard over network communications for the slave drive. The setting value of the parameter is differentiated by positive and negative, so the setting range of the advance/retard count is between -32768 and 32767. This value is set by the slave encoder count. When this register has finished being set, its data is automatically reset to 0. Note: • Enabled only when set to Position Synchronization mode. • The ENTER command is not required when writing to this register.	1 = 1 encoder pulse

4.7 Troubleshooting

Table 4.2 Display of Faults, Causes, and Possible Solutions

Code	Name	Causes	Possible Solutions
oPE27	PG Opt Card Err	SA-31 was set to 2 (Position Synchronization Mode), but two PG-X3 or PG-B3 option cards were not attached to connectors CN5-B and CN5-C.	Connect the PG (PG) option cards to the appropriate option card connectors. Select the appropriate Position Synchronization mode (SA-31).
		SA-31 was set to 1, but one PG-X3 or PG-B3 option card was not attached to connector CN5-B.	
FdEv	Slave Pos Dev	The slave motor is locked.	Check if the machine runs normally and if the slave motor is locked.
		Slave Dev Lvl (SA-46) is low.	Increase the setting value of SA-46.
		When Pos Accum Select (SA-39) is set to 1, the slave stops while the master encoder is rotating.	If the master encoder rotates even though the slave is stopped by the application, set SA-39 to 0 (Only During Run).
		The master input frequency is larger than Maximum Output Frequency (E1-04) of the slave.	Set E1-04 to a value 10% larger than the maximum input frequency of the master.
PL	Loss of Position	The slave motor is locked.	Check if the machine runs normally and if the slave motor is locked.
		When Pos Accum Select (SA-39) is set to 1, the slave stops while the master encoder is rotating.	If the master encoder rotates even though the slave is stopped by the application, set SA-39 to 0 (Only During Run).
		The set speed of the slave is too high for the PPR of the encoder being used.	Replace the encoder of the slave motor with a low PPR type.
AF	Alignment Fault	Deviation between the master and slave has exceeded the allowable amount (SA-67).	A fault has occurred or the trigger switches are connected wrong.
		There is a problem with the trigger switches and/or wiring.	Check if the trigger switches are connected and whether or not the machine runs correctly.

YASKAWA AC Drive CR700
Supplemental Manual (Load Share)

(Software Version PRG: 010XX)

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1. Revision History

Revision	Revised Content	Date
-	First Edition	2017/08

2. Basic Specifications

The CR700 is a drive designed especially for use with cranes. The basic specifications of the CR700 are based on the information described in the CR700 Technical Manual. Refer to the CR700 Technical Manual for more information on how to use the keypad and Auto-Tuning.

◆ Precautions before Use

When using the drive with a hoisting and lowering shaft, wire the drive so that hoisting direction of the machine is the Forward Run command and the lowering direction of the machine is the Reverse Run command (all control modes). If the movement of the machine and the direction of the Run commands do not match, the functions and performance of the crane software will be adversely affected, and it will not be possible to obtain sufficient performance from the machine. If the direction of motor rotation does not match the machine, swap two phases of the power lines to the motor and change F1-05 (Encoder 1 Rotation Selection) if the motor has an encoder to set the hoisting direction of the machine to the Forward Run command and the lowering direction of the machine to the Reverse Run command.
Install a fall detector or overspeed detector for safety.

◆ General Safety

- Install a holding brake.
- Implement safety measures such as fall prevention on the machine side.
- Ensure that the holding brake will be applied by an external sequence when there is an emergency or the power supply is turned OFF.
- Implement a safety circuit that uses the fault relay of this product to apply the holding brake when a fault occurs.

3. Function Details

Load Share

When controlling multiple motors with multiple drives and those motors drive the same load, an unbalance will occur in the load of the motors due to differences in mechanical characteristics of the motors and mechanical loss.
Load Share can adjust the balance of the load across the motors that drive the same load in Open Loop Vector Control (A1-02 = 2).
This can improve problems where one of the motors becomes overloaded due to an unbalanced load.

◆ Applicable Control Modes

- Open Loop Vector Control (A1-02 = 2)

Precautions

- This function is applicable when two drives are used.
- Confirm the drive operation ready signals of the master and slave drives, and simultaneously operate the master and slave.
- This function is disabled when performing a fast stop. Simultaneously input the Fast Stop command or External Fault to the master and slave synchronized to the fast stop time of the master and slave drives.

◆ Load Share System Configuration

The following configuration diagram shows the Load Share control system.

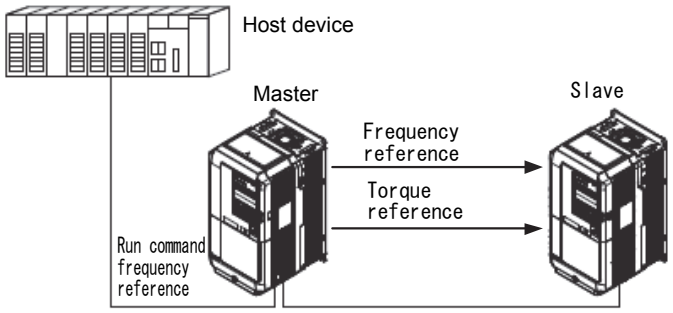

Figure 3.1 Example Connection of Host Device and Drives

■ Inputting Run Command

・ Inputting Using External Terminals

Wire the master and slave so that the Forward Run and Reverse Run commands can be input to the master and slave at the same time. The following diagram shows an example of this connection. In this case, separate the wire jumper between SC and SP on the slave side from the other cables.

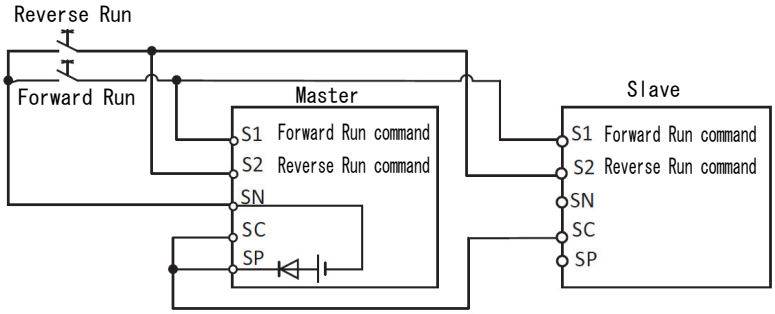

Figure 3.2 Example Connection Using Input References (Using the Internal Power Supply on the Master)

・ Input Method Using MEMOBUS/Modbus Communications

Input the Forward Run or Reverse Run command to the master and slave drives and control running and stopping those drives by writing data to drive register address 0001H (operation signal). Refer to the CR700 Technical Manual to connect the MEMOBUS/Modbus communications to the drives.

■ Inputting Frequency Reference

The master receives the frequency reference from the host device by a method such as external analog input, multi-step speed, or communications, but the slave receives the frequency reference through the connection between the master and slave drives.

■ Connecting between Master and Slave Drives

・ Connection Using External Analog Inputs and Outputs

Connect the Load Share outputs of the master drive (terminals FM and AM) to the analog input terminals of the slave drive (terminals A1, A2, or A3). Example: The following diagram shows the input connections from terminals FM and AM to terminals A1 and A3.

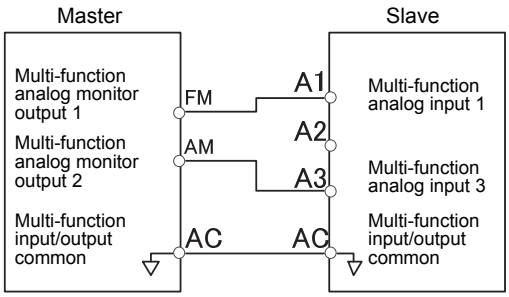

Figure 3.3 Example Connection between Master and Slave Drives

Master (SA-01 = 1) Multi-Function Analog Output Setting Values

Parameter	Setting Value	Description	Output Gain		Signal Level	
			Parameter	Setting Value	Parameter	Setting Value
H4-01	907	Sets the function of terminal FM to Load Share output frequency.	H4-02	100%	H4-07	1 (±10 V)
H4-04	908	Sets the function of terminal AM to Load Share output torque. The output signal type can be changed with SA-03.	H4-05	50%	H4-08	1 (±10 V)

Slave (SA-01 = 2) Multi-Function Analog Input Setting Values

Parameter	Setting Value	Description	Input Gain		Signal Level	
			Parameter	Setting Value	Parameter	Setting Value
H3-02	0	Sets the function of terminal A1 to master frequency reference.	H3-03	100%	H3-01	1 (±10 V)
H3-06	2A	Sets the function of terminal A3 to Load Share torque signal. The input signal type is set with SA-03.	H3-07	200%	H3-05	1 (±10 V)

・ Connection Using MEMOBUS/Modbus Communications

The host device reads Load Share SFS Output Register 826H (U9-07) of the master and writes it to Slave Register Address 0002H (Frequency Reference) to set the frequency reference of the slave. The host device reads the value of Load Share Torque Output Register 827H (U9-08) of the master and writes it to Slave Register Address 0004H (Torque Reference) to set the torque reference of the slave. The following tables give the register addresses of the master and slave and the communications operations.

Operation Register Addresses for Load Share Master

Register No.	Description	
0001H	Run command	
	bit 0	When H5-12 = 0: Forward Run/Stop, 1: Forward Run, 0: Stop When H5-12 = 1: Run/Stop, 1: Run, 0: Stop
	bit 1	When H5-12 = 0: Reverse Run/Stop, 1: Reverse Run, 0: Stop When H5-12 = 1: Forward/Reverse, 1: Reverse, 0: Forward
0002H	Frequency reference	The unit is set with o1-03 (Frequency Display Unit Selection).

Monitor Register Addresses for Load Share Master

Register No.	Description	
826H (U9-07)	Load Share SFS Output	The unit is set with o1-03 (Frequency Display Unit Selection).
827H (U9-08)	Load Share Torque Output (0.1%, signed)	

Operation Register Addresses for Load Share Slave

Register No.	Description	
0001H	Run command	
	bit 0	When H5-12 = 0: Forward Run/Stop, 1: Forward Run, 0: Stop When H5-12 = 1: Run/Stop, 1: Run, 0: Stop
	bit 1	When H5-12 = 0: Reverse Run/Stop, 1: Reverse Run, 0: Stop When H5-12 = 1: Forward/Reverse, 1: Reverse, 0: Forward
0002H	Frequency reference	The unit is set with o1-03 (Frequency Display Unit Selection).
0004H	Torque reference/torque limit (0.1%, signed)	

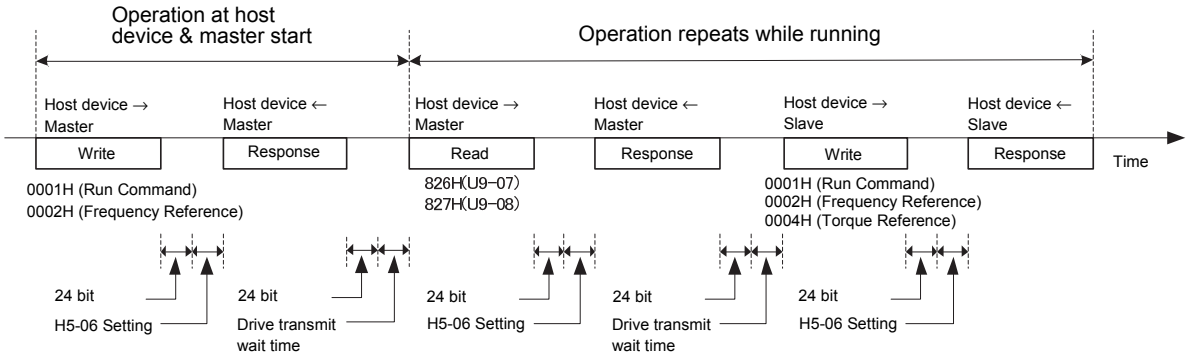

Figure 3.4 MEMOBUS/Modbus Communications Operation Diagram

◆ Load Share Configuration

Use Load Share on the master with SA-01 = 1. Set the torque signal type with SA-03.
For the master, the Load Share output frequency can be monitored with U9-07, and the torque reference signal can be monitored with U9-08. Load Share uses these values for the slave. Use analog outputs or MEMOBUS/Modbus communications to input the values to the slave.
The following diagram shows the configuration of Load Share for the master.

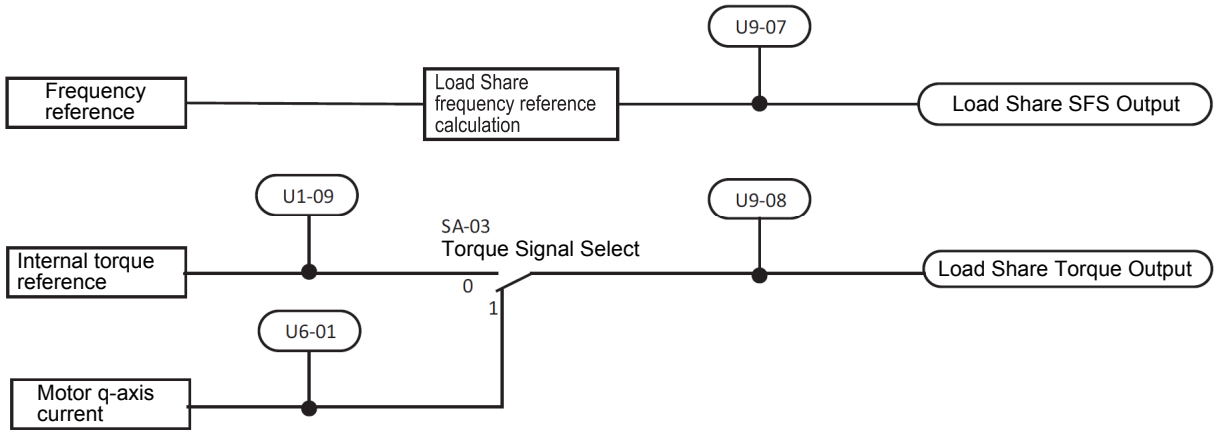

Figure 3.5 Master Control Block Diagram in Load Share

Use Load Share on the slave with SA-01 = 2. Set the torque signal type (SA-03) to the same value as the master.
For the slave, Load Share slip compensation can be monitored with U9-09, Load Share regulator output can be monitored with U9-10, and Load Share regulator input can be monitored with U9-11.
Load Share automatically adjusts the output frequency on the slave based on the frequency and torque signal input from the master to balance the load between the master and slave. The torque signal input from the master is also used as the torque limit on the slave.

The following diagram shows the configuration of Load Share for the slave.

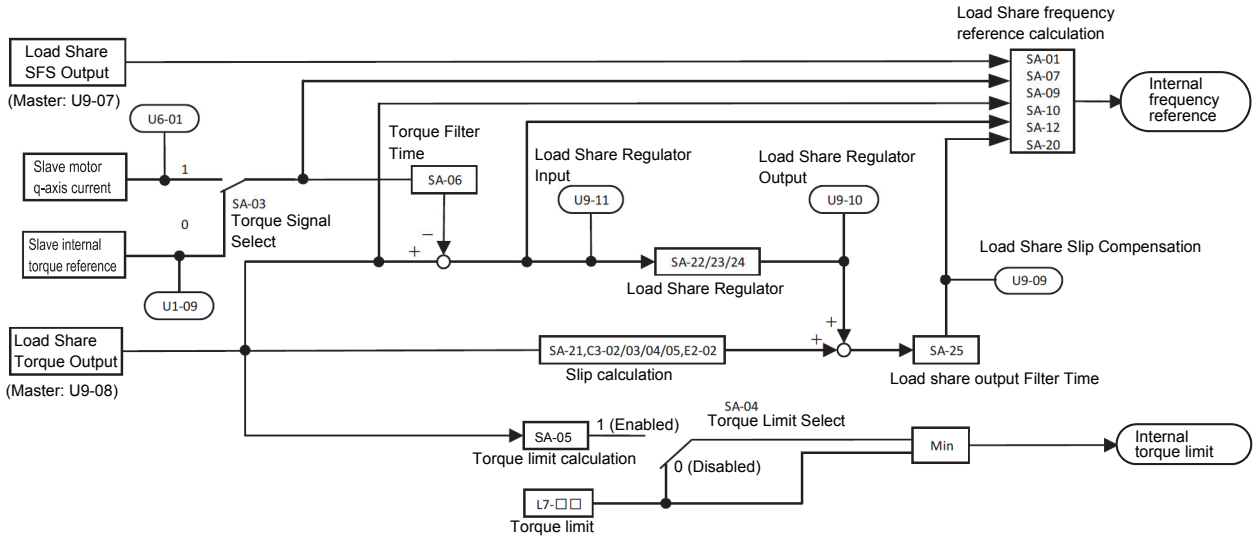

Figure 3.6 Control Block Diagram of Load Share Slave

■ Enabling and Disabling Load Share and Other Functions

• When a drive is selected as the slave with Load Share Function select (SA-01 = 2), the following functions are disabled. To use these functions, set them on the master side.

Setting Value of H1-□□	Function	Setting Value of H1-□□	Function
3H	Multi-Step Speed Reference 1	12H	Forward Jog
4H	Multi-Step Speed Reference 2	13H	Reverse Jog
5H	Multi-Step Speed Reference 3	1EH	Analog Frequency Reference Sampling/Hold
6H	Jog Frequency Selection	32H	Multi-Step Speed Reference 4
AH	Acceleration/Deceleration Ramp Hold	44H	Add Offset Frequency 1
CH	Analog Terminal Enable Selection	45H	Add Offset Frequency 2
10H	Up Command	46H	Add Offset Frequency 3
11H	Down Command		

• When a drive is selected as the slave with Load Share Function select (SA-01 = 2), the following functions are disabled. To use these functions, set them on the master side.

Parameter	Name	Parameter	Name
C2	S-Curve Time Setting	D4	UP/DOWN
D1	Multi-Step Speed	D7	Offset Frequency
D3	Jump Frequency	L3	Stall Prevention during Acceleration and Deceleration

* When Load Share is enabled, Proportional & Integral Control (L7-07 = 1) and Proportional Only (L7-07 = 0) are invalid as the setting of L7-07 (Torque Limit during Accel/Decel).

• Load Share is disabled when the following references are input. Ensure that the following references are simultaneously input to the master and slave.

Setting Value of H1-□□	Function	Setting Value of H1-□□	Function
15H	Fast Stop (N.O.)	20H to 2FH	External Fault
17H	Fast Stop (N.C.)		

• The following functions are executed with a higher priority than Load Share.

Parameter	Name	Parameter	Name
-	Jog Operation (Keypad Input)	T1	Auto-Tuning

■ Slave Reverse Run Specifications

The direction of the output rotation speed of the slave is dependent on the polarity of the frequency reference voltage that was input. It is not dependent on the direction of the Run command (Forward/Reverse).

The direction of the output frequency is as follows.

If the input frequency reference signal is + (positive), the output frequency is positive.

If the input frequency reference signal is - (negative), the output frequency is negative.

* Excluding Auto-Tuning, Jog Operation, and LOCAL Mode.

◆ Descriptions of Parameters

■ SA-01 Load Share Function select

Sets Load Share for the drive to master or slave. Set this parameter to 0 to disable Load Share.

No.	Name	Setting Range	Default Setting
SA-01	Load Share Function select	0 to 2	0

0: Disabled
1: Master enabled (sets Load Share for the drive to master).
2: Slave enabled (sets Load Share for the drive to slave).

■ SA-02 Torque Reference Source select

Selects how to imput the torque reference for the slave.

No.	Name	Setting Range	Default Setting
SA-02	Torque Reference Source select	0, 1	0

0: Control circuit terminal (analog input)
The slave receives the torque reference signal from the master using analog terminal A1, A2, or A3.
1: MEMOBUS communications
The slave receives the torque reference signal from the master using MEMOBUS/Modbus communications.

■ SA-03 Torque Signal Select

Selects the type of torque signal that the slave receives from the master.

No.	Name	Setting Range	Default Setting
SA-03	Torque Signal Select	0, 1	0

Note: The SA-03 parameter on the master and slave must be set to the same value.
0: Internal torque reference
Uses U1-09 as the torque signal between the master and slave.
1: Motor secondary current
Uses U6-01 as the torque signal between the master and slave.

■ SA-04 Torque Limit Select

Enables and disables the Torque Limit function for the slave. Enable this function to use the torque signal received from the master as the torque limit of the slave.

No.	Name	Setting Range	Default Setting
SA-04	Torque Limit Select	0, 1	0

0: Disabled
1: Enabled

■ SA-05 Torque Limit Bias

Sets the offset amount of the torque signal received from the master as a percentage of motor rated torque. This function can be used when SA-04 is enabled.

No.	Name	Setting Range	Default Setting
SA-05	Torque Limit Bias	-100% to 100%	10%

■ SA-06 Torque Filter Time

Sets the primary delay time of the torque feedback value of the slave. Reduce the setting value when the response of Load Share is slow. Increase the setting value when oscillation occurs.

No.	Name	Setting Range	Default Setting
SA-06	Torque Filter Time	0.00 s to 2.00 s	0.10 s

■ SA-07 Load Share Switch Time

Sets the time to switch slave Load Share between enabled and disabled. You can prevent sudden changes in the output frequency by switching Load Share between enabled and disabled at the time set with SA-07. Increase the setting value when oscillation occurs in the motor.

No.	Name	Setting Range	Default Setting
SA-07	Load Share Switch Time	0.0 s to 5.0 s	0.1 s

■ SA-09 Load Share on level1

Sets start level 1 for slave Load Share. This parameter enables slave Load Share when the absolute value of the master or slave torque signal (torque/current) is greater than start level 1. Set this parameter to 0.0% to keep slave Load Share constantly enabled.
This parameter is set as a percentage of motor rated torque.

No.	Name	Setting Range	Default Setting
SA-09	Load Share on level1	0.0% to 100.0%	0.0%

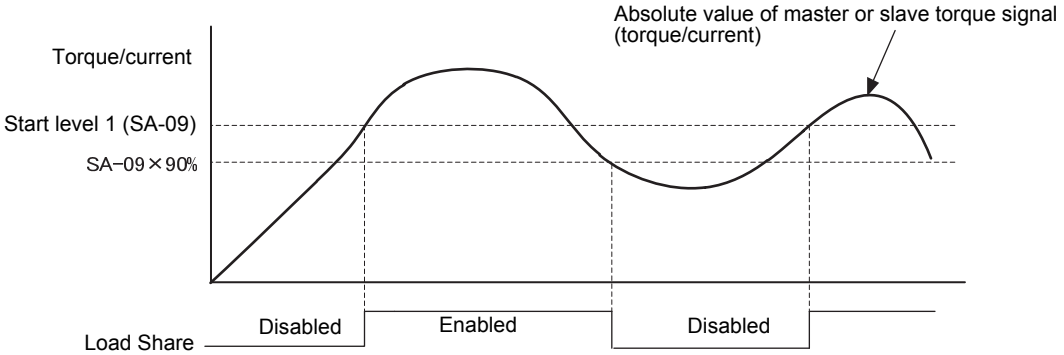

Figure 3.7 Switching Load Share between Enabled and Disabled

■ SA-10 Load Share on level2

Sets start level 2 for slave Load Share. This parameter enables Load Share when the absolute value of the deviation between the master and slave torque signal (torque/current) is greater than start level 2. Set this parameter to 0.0% to keep slave Load Share constantly enabled.

This parameter is set as a percentage of motor rated torque.

No.	Name	Setting Range	Default Setting
SA-10	Load Share on level2	0.0% to 100.0%	0.0%

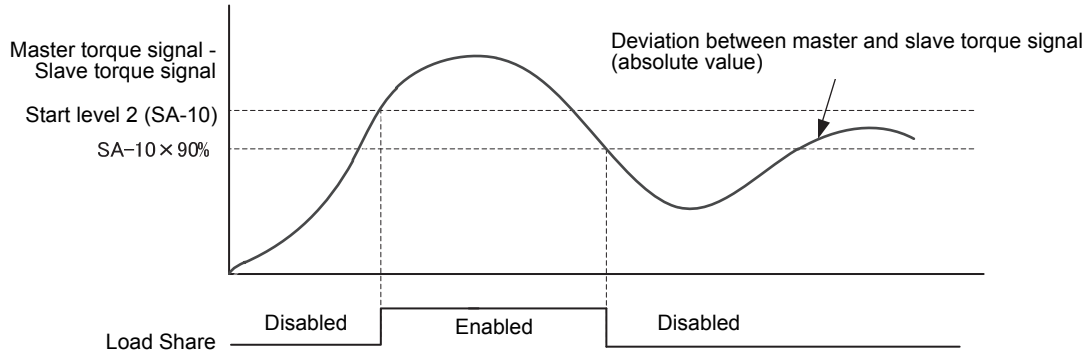

Figure 3.8 Switching Load Share between Enabled and Disabled

The following table gives the relationship between enabling and disabling Load Share when the conditions for Load Share On Lvl1/Lvl2 are satisfied.

Table 3.1 Relationship between Enabling and Disabling Load Share

	Start Level 1 Condition ON	Start Level 1 Condition OFF
Start Level 2 Condition ON	Enabled	Enabled
Start Level 2 Condition OFF	Enabled	Disabled

■ SA-12 Load Share function stop select

Enables and disables Load Share when the slave ramps to stop. Enable this function to continue operation of Load Share until the output frequency is lower than E1-09 and the output shuts off, even when the Run command from the drive is OFF.

No.	Name	Setting Range	Default Setting
SA-12	Load Share function stop select	0, 1	0

0: Disabled

When ramping to stop, Load Share is disabled and the slave stops according to the method selected with b1-03 (Stopping Method Selection).

1: Enabled

When ramping to stop, Load Share control continues to be performed, and the output frequency of the slave changes according to the change in the output frequency of the master. The following diagram is a time chart when stopping.

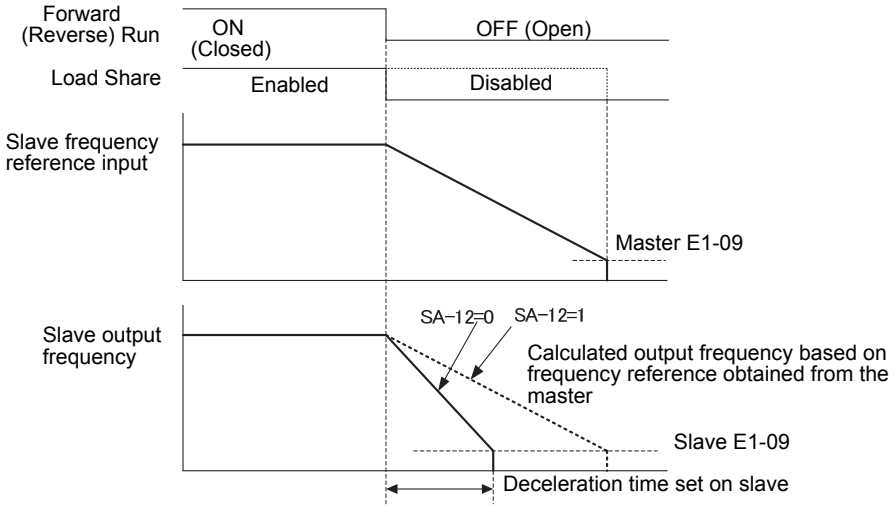

Figure 3.9 Load Share Stopping Method Selection

■ SA-20 Speed Gain

Sets the gain of the frequency reference that the slave receives from the master.

No.	Name	Setting Range	Default Setting
SA-20	Speed Gain	0.000 to 10.000	1.000

■ SA-21 Slip Gain

Sets the slip gain to improve speed accuracy when the slave is operating.
Normally there is no need to change from the default setting. However, adjust it in the following circumstances.
Increase the setting value when the motor speed is lower than the target value.
Reduce the setting value when the motor speed is higher than the target value.

No.	Name	Setting Range	Default Setting
SA-21	Slip Gain	0.000 to 10.000	1.000

■ SA-22 Slip Regulator Proportional Gain

Sets the proportional gain of the slip regulator for the slave. Increase the setting value to increase responsiveness. However, if the setting value is increased too much, oscillation will occur in the motor.

No.	Name	Setting Range	Default Setting
SA-22	Slip Regulator Proportional Gain	0.00 to 20.00	0.00

■ SA-23 Slip Regulator Integral Time

Sets the integral time of the slip adjustment for the slave. An integral time that is too long reduces the responsiveness of the speed control and weakens repulsion against external force. An integral time that is too short can cause oscillation.

No.	Name	Setting Range	Default Setting
SA-23	Slip Regulator Integral Time	0.000 s to 60.000 s	0.000 s

■ SA-24 Slip Regulator Output Limit

Sets the limit value on slip adjustment output for the slave. This parameter sets the output limit as a percentage of E1-04 (Maximum Output Frequency).

No.	Name	Setting Range	Default Setting
SA-24	Slip Regulator Output Limit	0.000% to 20.000%	10.000%

■ SA-25 Load share output Filter Time

Sets the primary delay time of Load Share output for the slave. Increase the setting value when oscillation occurs in the motor. Decrease the setting value when motor responsiveness is low.

No.	Name	Setting Range	Default Setting
SA-25	Load share output Filter Time	0.000 s to 2.000 s	0.000 s

4. Parameter List

No. (Hex.)	Name	Description	Default Setting (Range)	Ref.
SA: Crane Special Func				
SA-01 (1AAA) Expert	Load Share Function select	V/f CL-V/f **OLV** CLV AOLV Sets Load Share for the drive to master or slave. Set this parameter to 0 to disable Load Share. 0: Disabled 1: Enabled. Sets Load Share for the drive to master. 2: Enabled. Sets Load Share for the drive to slave.	0 (0 to 2)	9
SA-02 (1AAB) *1 Expert	Torque Reference Source select	V/f CL-V/f **OLV** CLV AOLV Selects how to imput the torque reference for the slave. 0: Control circuit terminal (analog input) 1: MEMOBUS communications	0 (0, 1)	9
SA-03 (1AAC) Expert	Torque Signal Select	V/f CL-V/f **OLV** CLV AOLV Selects the type of torque signal that the slave receives from the master. 0: Internal torque reference (U1-09) 1: Motor secondary current (U6-01)	0 (0, 1)	9
SA-04 (1AAD) *2 Expert	Torque Limit Select	V/f CL-V/f **OLV** CLV AOLV Enables and disables the Torque Limit function for the slave. Enable this function to use the torque reference value received from the master as the torque limit of the slave. 0: Disabled 1: Enabled	0 (0, 1)	9
SA-05 (1AAE) RUN *2 Expert	Torque Limit Bias	V/f CL-V/f **OLV** CLV AOLV Sets the offset amount of the torque limit reference for the slave.	10% (-100% to 100%)	9
SA-06 (1AAF) *2 Expert	Torque Filter Time	V/f CL-V/f **OLV** CLV AOLV Sets the primary delay time of the torque feedback value of the slave. Reduce the setting value when the response of Load Share control is slow. Increase the setting value when oscillation occurs.	0.10 s (0 s to 2.00 s)	9
SA-07 (1AB0) *2 Expert	Load Share Switch Time	V/f CL-V/f **OLV** CLV AOLV Sets the time to switch Load Share for the slave. Increase the setting value when oscillation occurs in the motor.	0.1 s (0 s to 5.0 s)	10
SA-09 (1AB1) *2 Expert	Load Share on level1	V/f CL-V/f **OLV** CLV AOLV Sets start level 1 for slave Load Share. Set this parameter to 0.0% to keep this function constantly enabled.	0.0% (0.0% to 100.0%)	10
SA-10 (1AB2) *2 Expert	Load Share on level2	V/f CL-V/f **OLV** CLV AOLV Sets start level 2 for slave Load Share. Set this parameter to 0.0% to keep this function constantly enabled.	0.0% (0.0% to 100.0%)	11
SA-12 (1AB3) *2 Expert	Load Share function stop select	V/f CL-V/f **OLV** CLV AOLV Enables and disables Load Share when the slave stops. 0: Disabled 1: Enabled	0 (0, 1)	12
SA-20 (1AB4) RUN *2 Expert	Speed Gain	V/f CL-V/f **OLV** CLV AOLV Sets the gain of the frequency reference that the slave receives from the master.	1.000 (0.000 to 10.000)	12

No. (Hex.)	Name	Description	Default Setting (Range)	Ref.
SA-21 (1AB5) RUN *2 Expert	Slip Gain	V/f CL-V/f **OLV** CLV AOLV Sets the slip gain to improve speed accuracy while load is operating. Increase the setting value when the motor speed is lower than the target value. Reduce the setting value when the motor speed is higher than the target value.	1.000 (0.000 to 10.000)	12
SA-22 (1AB6) RUN *2 Expert	Slip Regulator Proportional Gain	V/f CL-V/f **OLV** CLV AOLV Sets the proportional gain of the slip regulator for the slave. Increase the setting value to increase responsiveness. However, if the setting value is increased too much, oscillation will occur in the motor.	0.00 (0.00 to 20.00)	12
SA-23 (1AB7) RUN *2 Expert	Slip Regulator Integral Time	V/f CL-V/f **OLV** CLV AOLV Sets the integral time of the slip adjustment for the slave. An integral time that is too long reduces responsiveness. An integral time that is too short can cause oscillation.	0.000 s (0.000 s to 60.000 s)	13
SA-24 (1AB8) RUN *2 Expert	Slip Regulator Output Limit	V/f CL-V/f **OLV** CLV AOLV Sets the limit value on slip regulator output for the slave.	10.000% (0.000% to 20.000%)	13
SA-25 (1AB9) RUN *2 Expert	Load share output Filter Time	V/f CL-V/f **OLV** CLV AOLV Sets the primary delay time of Load Share output for the slave. Increase the setting value when oscillation occurs in the motor. Decrease the setting value when motor responsiveness is low.	0.000 s (0.000 s to 2.000 s)	13

*1 This parameter can be set only when the slave is enabled (SA-01 = 2) and b1-01 = 2.
*2 This parameter can be set only when the slave is enabled (SA-01 = 2).

◆ Multi-Function Digital Inputs (H1-□□)

H1 Multi-Function Digital Input Details			
Setting Value	Function	Description	Ref.
Co	Load Share Disable	V/f CL-V/f **OLV** CLV AOLV Closed: Load Share is disabled.	-

◆ Multi-Function Analog Inputs (H3-02/H3-06/H3-10)

H3 Multi-Function Analog Input Details			
Setting Value	Function	Description	Ref.
2A	Load Share Torque Signal	V/f CL-V/f **OLV** CLV AOLV 10 V = Motor rated torque	5

◆ Monitor Items

No. (Hex.)	Name	Description	Multi-Function Analog Output Signal Level	Unit	Ref.
U9: Dedicated Application Monitors					
U9-07 (0826) *3	Load Share SFS Output	V/f CL-V/f **OLV** CLV AOLV Displays the soft start output for Load Share. (The display unit can be changed with o1-03.) (100% = Maximum output frequency)	10 V: Maximum Frequency	0.01 Hz	7
U9-08 (0827) *3	Load Share Torque Output	V/f CL-V/f **OLV** CLV AOLV Displays the torque output for Load Share.	10 V: Motor rated torque	0.1%	7
U9-09 (0828) *4	Load Share Slip Compensation	V/f CL-V/f **OLV** CLV AOLV Displays the slip compensation value for Load Share. (The display unit can be changed with o1-03.) (100% = Maximum output frequency)	10 V: Maximum frequency	0.01 Hz	7
U9-10 (0829) *4	Load Share Regulator Output	V/f CL-V/f **OLV** CLV AOLV Displays the output of the Load Share regulator. (The display unit can be changed with o1-03.) (100% = Maximum output frequency)	10 V: Maximum frequency	0.01 Hz	7
U9-11 (082A) *4	Load Share Regulator Input	V/f CL-V/f **OLV** CLV AOLV Displays the input of the Load Share regulator.	10 V: Motor rated torque	0.01%	7

*3 This parameter can be set only when the drive is set to master (SA-01 = 1).
*4 This parameter can be set only when the drive is set to slave (SA-01 = 2).

◆ oPE Errors

For parameter setting errors related to this function, refer to the following table, check the parameter setting that caused the error, and then eliminate the cause of the error.

Code	Name	Cause	Possible Solutions
oPE26	Load Share Setting Error	The drive was set to slave (SA-01 = 2), but the following conditions were not set. 1. H3-02/H3-06/H3-10 = 0 2. H3-02/H3-06/H3-10 = 2A	Change the multi-function analog input settings.
		The analog input levels for slave Load Share are not set to -10 V to 10 V (H3-01/H3-05/H3-09 = 1).	Change the multi-function analog input level settings.
		The drive was set to master (SA-01 = 1), but the following conditions were not set. 1. H4-01/H4-04 = 907 2. H4-01/H4-04 = 908	Change the multi-function analog output settings.
		The analog output monitor levels for master Load Share were not set to -10 V to 10 V. (H4-07/H4-08 = 1)	Change the multi-function analog output level settings.

Note: The oPE error added for this software does not support the AI/AO option card.