Sumitomo Drive Technologies

Inverter HF-520 series

Sensorless Vector Control Inverter

Operating and Maintenance Manual

Type HF520□-□□□

Models 200 V Class, Three-Phase Input: 0.2 to 7.5 kW
200 V Class, Single-Phase Input: 0.2 to 2.2 kW
400 V Class, Three-Phase Input: 0.2 to 7.5 kW

NOTICE

1. Make sure that this operating and maintenence manual is delivered to the end user of inverter unit.
2. Read this manual before installing or operating the inverter unit, and store it in a safe place for reference.

Sumitomo Heavy Industries, Ltd.

Manual No.DM2301E-2

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Preface & General Safety

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

i.1 Preface

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

This manual is designed to ensure correct and suitable application of HF-520 Series drives. Read this manual before attempting to install, operate, maintain, or inspect a drive and keep it in a safe, convenient location for future reference. Be sure you understand all precautions and safety information before attempting application.

◆ Applicable Documentation

The following manuals are available for HF-520 series drives:

	HF-520 Series Operating and Maintenance Manual No. DM2301E
	Read this manual first. This guide is packaged together with the product. It contains basic information required to install and wire the drive. This guide provides basic programming and simple setup and adjustment. Refer to the HF-520 Technical Manual for complete descriptions of drive features and functions.
	HF-520 Series Technical Manual No. DM2302E
	This manual describes installation, wiring, operation procedures, functions, troubleshooting, maintenance, and inspections to perform before operation.

◆ Symbols

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

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

Terms and Abbreviations

- **Drive:** HF-520 Series Inverter
- **PG:** Pulse Generator
- **r/min:** Revolutions per Minute
- **V/f:** V/f Control
- **SV:** Sensorless Vector Control

i.2 General Safety

◆ Supplemental Safety Information

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

⚠ WARNING

Read and understand this manual before installing, operating or servicing this drive. The drive must be installed according to this manual and local codes.

The following conventions are used to indicate safety messages in this manual. Failure to heed these messages could result in serious or possibly even fatal injury or damage to the products or to related equipment and systems.

⚠ DANGER

Indicates a hazardous situation, which, if not avoided, will result in death or serious injury.

⚠ WARNING

Indicates a hazardous situation, which, if not avoided, could result in death or serious injury.

WARNING! *will also be indicated by a bold key word embedded in the text followed by an italicized safety message.*

⚠ CAUTION

Indicates a hazardous situation, which, if not avoided, could result in minor or moderate injury.

CAUTION!: *will also be indicated by a bold key word embedded in the text followed by an italicized safety message*

NOTICE

Indicates a property damage message.

NOTICE: *will also be indicated by a bold key word embedded in the text followed by an italicized safety message.*

◆ Safety Messages

⚠ DANGER

Heed the safety messages in this manual.

Failure to comply will result in death or serious injury.

The operating company is responsible for any injuries or equipment damage resulting from failure to heed the warnings in this manual.

Electrical Shock Hazard

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

Failure to comply will result in death or serious injury.

Before servicing, disconnect all power to the equipment. The internal capacitor remains charged even after the power supply is turned off. The charge indicator LED will extinguish when the DC bus voltage is below 50 Vdc. To prevent electric shock, wait at least five minutes after all indicators are OFF and measure the DC bus voltage level to confirm safe level.

⚠ WARNING

Sudden Movement Hazard

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

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

Electrical Shock Hazard

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

Failure to comply could result in death or serious injury.

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

Do not allow unqualified personnel to use equipment.

Failure to comply could result in death or serious injury.

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

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

Failure to comply could result in death or serious injury.

Fire Hazard

Do not use an improper voltage source.

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

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

⚠ WARNING

Crush Hazard

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

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

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

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

⚠ CAUTION

Crush Hazard

Do not carry the drive by the front cover

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

NOTICE

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

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

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

Improper equipment sequencing could result in damage to the drive.

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

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

Do not operate damaged equipment.

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

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

Install adequate branch circuit short circuit protection per applicable codes.

Failure to comply could result in damage to the drive.

The drive is suitable for circuits capable of delivering not more than 31,000 RMS symmetrical Amperes, 240 Vac maximum (200 V Class) and 480 Vac maximum (400 V Class).

NOTICE

Do not expose the drive to halogen group disinfectants.

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

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

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

◆ Drive Label Warnings

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

WARNING Risk of electric shock.

- Read manual before installing.
- Wait 5 minutes for capacitor discharge after disconnecting power supply.
- To conform to CE requirements, make sure to ground the supply neutral for 400V class.

Figure i.1 Warning Information

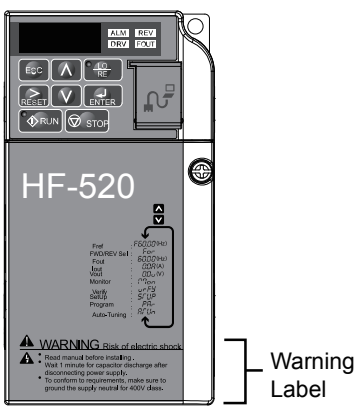

Figure i.2 Warning Information Position

i.3 Application Precautions

◆ General Application Precautions

■ Selecting a Reactor

An AC or DC reactor can be used for the following:

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

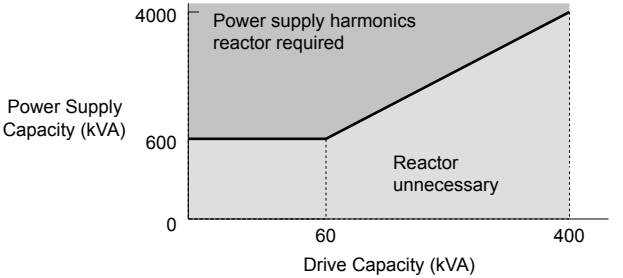

Figure i.3 Installing a Reactor

■ Drive Capacity

Make sure that the motor rated current is less than the rated nameplate output current of the drive. When running more than one motor in parallel from a single drive, the drive rated current should 1.1 times larger than the total motor rated current for all connected motors or nuisance drive faults may occur.

■ Starting Torque

The overload rating of the drive determines the starting and accelerating characteristics of the motor. Expect lower running torque than when running the motor from line power. To get more starting torque, use a larger drive or increase both the motor and drive capacity.

■ Emergency/Fast Stop

During a drive fault condition, a protective circuit is activated and drive output is shut off. The motor may coast to a stop or attempt to decelerate depending on parameter settings. If the emergency/fast stop cannot stop the load as fast as desired, a customer-supplied mechanical brake may be required. Test emergency stop circuitry before putting drive into operation.

■ Options

The B1, B2, +1, +2, and +3 terminals are used to connect optional power devices. Connect only devices compatible with the drive.

■ Repetitive Starting/Stopping

Applications with frequent starts and stops often exceed 150% of their rated current values. Heat stress generated from repetitive high current can shorten the life span of the IGBTs. The expected lifetime for the IGBTs is about 8 million start and stop cycles with a 4 kHz carrier frequency and a 150% peak current.

Sumitomo recommends lowering the carrier frequency, particularly when audible noise is not a concern. The user can also choose to reduce the load, increase the acceleration and deceleration times, or switch to a larger drive. This will help keep peak current levels under 150%. Be sure to check the peak current levels when starting and stopping repeatedly during the initial test run, and make adjustments accordingly.

For crane-type applications using the inching function in which the motor is quickly started and stopped, Sumitomo recommends the following to ensure motor torque levels:

- Select a large enough drive so that peak current levels remain below 150% of the drive rated current.
- The drive should be one frame size larger than the motor.

◆ Installation Environment

■ Enclosure Panels

Keep the drive in a clean environment by either selecting an area free of airborne dust, lint, and oil mist, or install the drive in an enclosure panel. Be sure to leave the required space between drives to provide for cooling, and that proper measures are taken so that the ambient temperature remains within allowable limits. Keep flammable materials away from the drive.

■ Installation Direction

The drive should be installed upright as specified in the manual.

◆ Settings

■ Upper Limits

The drive is capable of running the motor up to 400 Hz. Due to the danger of accidentally operating the motor at high speed, be sure to set the upper frequency limit. The default setting for the maximum output frequency is 60 Hz.

■ DC Injection Braking

Motor overheat can result if there is too much current used during DC Injection Braking, or if the DC Injection Braking time is too long.

■ Acceleration/Deceleration Times

Acceleration and deceleration times are affected by how much torque the motor generates, the load torque, and the inertia moment ($(GD^2)/4$). Set a longer accel/decel time when Stall Prevention is enabled. The accel/decel times are lengthened for as long as the Stall Prevention function is operating. For faster acceleration and deceleration, install a braking option or increase the capacity of the drive.

◆ Compliance with Harmonic Suppression Guidelines

The drive conforms to strict guidelines in Japan covering harmonic suppression for power conversion devices. Defined in JEM-TR201 and JEM-TR226 and published by the Japan Electrical Manufacturers' Association, these guidelines define the amount of harmonic current output acceptable for new installation. Instructions on calculation harmonic output are available at www.e-mechatronics.com.

◆ General Handling

NOTICE: *Wiring Check. Never connect the power supply lines to output terminals U/T1, V/T2, or W/T3. Doing so will destroy the drive. Be sure to perform a final check of all control wiring and other connections before applying line power. Make sure there are no short circuits on the control terminals (+V, AC, etc.), as this could damage the drive.*

■ Selecting a Circuit Breaker or Leakage Circuit Breaker

Sumitomo recommends installing an Earth leakage Circuit Breaker (ELCB) to the power supply side to protect drive wiring and prevent other damage in the event of component failure. A Molded Case Circuit Breaker (MCB) may also be used if permitted by the power system.

The ELCB should be designed for use with an AC drive (i.e., protected against harmonics). MCB selection depends on the power factor for the drive, determined by the power supply voltage, output frequency, and load. Refer to the Peripheral Devices & Options chapter of the Technical Manual for more information on breaker installation. Note that a larger capacity is needed when using a fully electromagnetic MCB, as operation characteristics vary with harmonic current.

■ Magnetic Contactor (MC) Installation

Use an MC to ensure that line power to the drive can be completely shut off when necessary. The MC should be wired so that it opens when the drive fault output is triggered.

Avoid switching the MC on the power supply side more frequently than once every 30 minutes. Frequent switching can cause damage to the drive.

■ Inspection and Maintenance

DANGER! *Electrical Shock Hazard. Do not connect or disconnect wiring while the power is on. Failure to comply will result in death or serious injury. Disconnect all power to the drive, wait at least five minutes after all indicators are OFF, measure the DC bus voltage to confirm safe level, and check for unsafe voltages before servicing to prevent electrical shock. The internal capacitor remains charged even after the power supply is turned off. The charge indicator LED will extinguish when the DC bus voltage is below 50 Vdc.*

CAUTION! *Burn Hazard. Do not touch a hot drive heatsink. Failure to comply could result in minor or moderate injury. Shut off the power to the drive when replacing the cooling fan. To prevent burns, wait at least 15 minutes and make sure the heatsink has cooled to a safe level.*

WARNING! *Sudden Movement Hazard. Install a switch disconnect between the motor and the drive in applications where the machine can still rotate even though the drive has fully stopped. Unpredictable equipment operation may result in death or serious injury.*

WARNING! *Sudden Movement Hazard. Do not attempt to move a load that could potentially rotate the motor faster than the maximum allowable r/min when the drive has been shut off. Unpredictable equipment operation may result in death or serious injury.*

NOTICE: *Do not open and close the motor disconnect switch while the motor is running, as this may damage the drive.*

NOTICE: *If the motor is coasting, make sure the power to the drive is turned on and the drive output has completely stopped before closing the load switch.*

■ Wiring

All wire ends should use ring terminals for UL/cUL compliance. Use only the tools recommended by the terminal manufacturer for crimping.

■ Transporting the Drive

NOTICE: *Prevent the drive from contact with salts, fluorine, bromine, phthalate ester, and other such harmful chemicals. Never steam clean the drive. Failure to comply may cause damage to the drive components.*

◆ Notes on Motor Operation

■ Using a Standard Motor

Low Speed Range

The cooling fan of a standard motor is usually designed to sufficiently cool the motor at the rated speed. As the self-cooling capability of such a motor reduces with the speed, applying full torque at low speed will possibly damage the motor. To prevent motor damage from overheat, reduce the load torque as the motor slows. Inverter motor (AF) for operation with a drive should be used when 100% continuous torque is needed at low speeds.

Insulation Tolerance

Consider motor voltage tolerance levels and motor insulation in applications with an input voltage of over 440 V or particularly long wiring distances. Contact your Sumitomo agent for consultation.

High Speed Operation

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

Torque Characteristics

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

Vibration and Shock

The drive settings allow the user to choose between high carrier PWM control and low carrier PWM. Selecting high carrier PWM can help reduce motor oscillation.

Take particular caution when using a variable speed drive for an application that is conventionally run from line power at a constant speed. If mechanical resonance occurs, install shock-absorbing rubber around the base of the motor and enable the Jump frequency selection parameter to prevent continuous operation in the resonant frequency range.

Audible Noise

Noise created during run varies by the carrier frequency setting. When using a high carrier frequency, audible noise from the motor is comparable to the motor noise generated when running from line power. Operating above the rated r/min, however, can create unpleasant motor noise.

■ Applications with Specialized Motors

Multi-Pole Motor

Because the rated current will differ from a standard motor, be sure to check the maximum current when selecting a drive. Always stop the motor before switching between the number of motor poles. If a regen overvoltage (oV) fault occurs or if overcurrent protection (oC) is triggered, the motor will coast to stop.

Explosion-Proof Motor

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

Single-Phase Motor

Variable speed AC drives are not designed for operation with single phase motors. Using capacitors to start the motor causes excessive current to flow and can damage drive components. A split-phase start or a repulsion start can end up burning out the starter coils because the internal centrifugal switch is not activated. The drive is for use with 3-phase motors only.

Motor with Brake

Caution should be taken when using a drive to operate a motor with a built-in holding brake. If the brake is connected to the output side of the drive, it may not release at start due to low voltage levels. A separate power supply should be installed for the motor brake. Motors with a built-in brake tend to generate a fair amount of noise when running at low speeds.

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1

Receiving

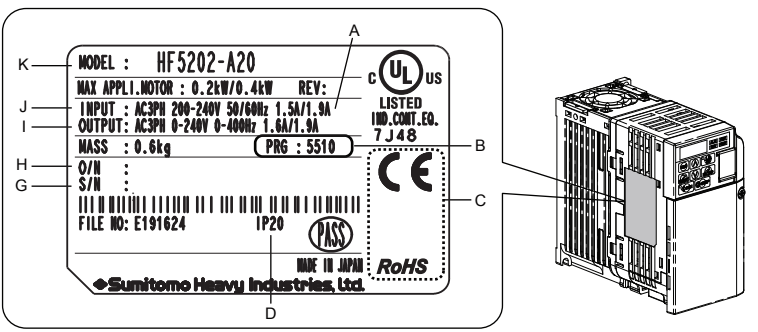
This chapter describes the proper inspections to perform after receiving the drive and illustrates the different enclosure types and components.

1.1 Model Number and Nameplate Check

Please perform the following tasks after receiving the drive:

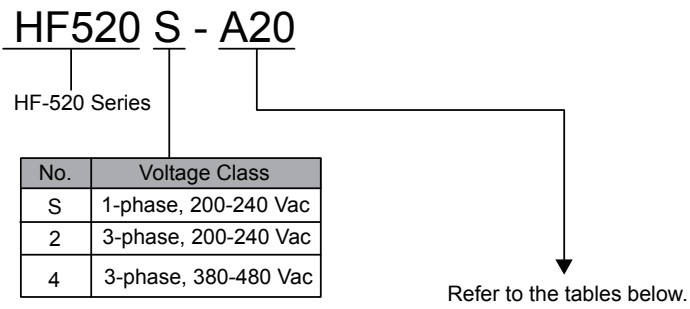
- Inspect the drive for damage.
  If the drive appears damaged upon receipt, contact the shipper immediately.
- Verify receipt of the correct model by checking the information on the nameplate.
- If you have received the wrong model or the drive does not function properly, contact yoursupplier.

◆ Nameplate



A – Normal Duty Amps / Heavy Duty Amps
B – Software version
C – CE and TÜV Certification
D – Enclosure type
G – Serial number
H – Lot number
I – Output specifications
J – Input specifications
K – AC drive model

Figure 1.1 Nameplate Information Example



■ Single-Phase 200 V

Heavy Duty		
No.	Max. Motor Capacity kW	Rated Output Current A
A20	0.2	1.6
A40	0.4	3.0
A75	0.75	5.0
1A5	1.5	8.0
2A2	2.2	11.0

Normal Duty		
No.	Max. Motor Capacity kW	Rated Output Current A
A20	0.4	1.9
A40	0.75	3.3
A75	1.1	6.0
1A5	2.2	9.6
2A2	3.0	12.0

Three-Phase 200 V

Heavy Duty		
No.	Max. Motor Capacity kW	Rated Output Current A
A20	0.2	1.6
A40	0.4	3.0
A75	0.75	5.0
1A5	1.5	8.0
2A2	2.2	11.0
3A7	3.7	17.5
5A5	5.5	25.0
7A5	7.5	33.0

Normal Duty		
No.	Max. Motor Capacity kW	Rated Output Current A
A20	0.4	1.9
A40	0.75	3.5
A75	1.1	6.0
1A5	2.2	9.6
2A2	3.0	12.0
3A7	5.5	19.6
5A5	7.5	30.0
7A5	11	40.0

Three-Phase 400 V

Heavy Duty		
No.	Max. Motor Capacity kW	Rated Output Current A
A20	0.2	1.2
A40	0.4	1.8
A75	0.75	3.4
1A5	1.5	4.8
2A2	2.2	5.5
3A7	3.7	9.2
5A5	5.5	14.8
7A5	7.5	18.0

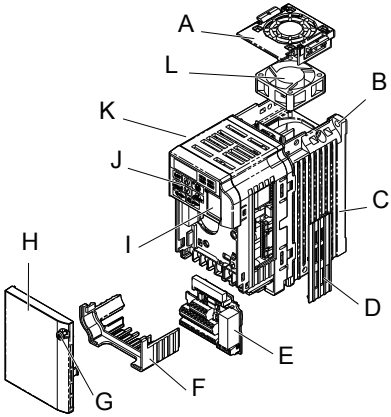
Normal Duty		
No.	Max. Motor Capacity kW	Rated Output Current A
A20	0.4	1.2
A40	0.75	2.1
A75	1.5	4.1
1A5	2.2	5.4
2A2	3.0	6.9
3A7	5.5	11.1
5A5	7.5	17.5
7A5	11	23.0

1.2 Component Names

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

◆ IP20/Open-Chassis

■ Single-Phase AC 200 V HF520S-A20, A40 Three-Phase AC 200 V HF5202-A20 to A75

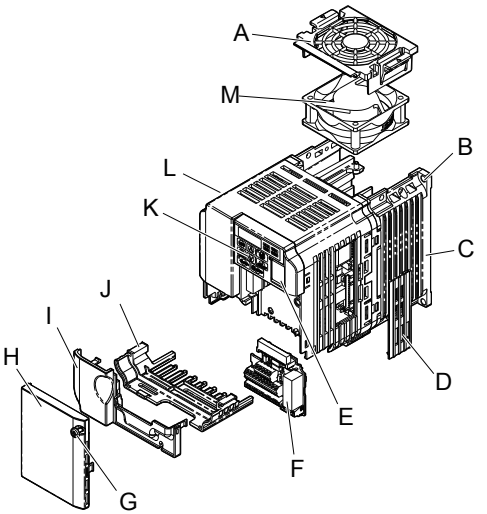


A – Fan cover <1>
B – Mounting hole
C – Heatsink
D – Cover
E – Terminal board *Refer to Control Circuit Terminal Block Functions on page 64*
F – Terminal cover
G – Front cover screw
H – Front cover
I – Comm port
J – LED operator *Refer to Using the Digital LED Operator on page 78*
K – Case
L – Cooling fan <1>

Figure 1.2 Exploded View of IP20/Open-Chassis Type Components (HF5202-A75)

<1> HF520S-A20, A40 and HF5202-A20, A40 do not have a cooling fan or a cooling fan cover.

Single-Phase AC 200 V HF520S-A75 to 2A2
Three-Phase AC 200 V HF5202-1A5 to 3A7
Three-Phase AC 400 V HF5204-A20 to 3A7



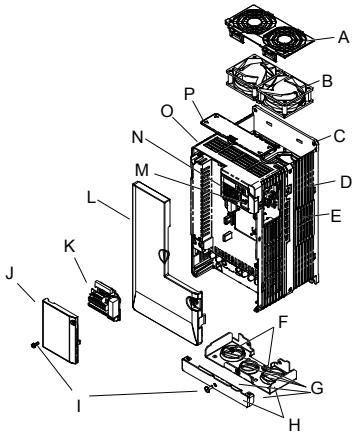
A – Fan cover <1>
B – Mounting hole
C – Heatsink
D – Cover
E – Comm port
F – Terminal board *Refer to Control Circuit Terminal Block Functions on page 64*
G – Front cover screw
H – Front cover
I – Terminal cover
J – Bottom cover
K – LED operator *Refer to Using the Digital LED Operator on page 78*
L – Case
M – Cooling fan <1>

Figure 1.3 Exploded View of IP20/Open-Chassis Type Components (HF5202-2A2)

<1> HF520S-A75 and HF5204-A20 to A75 do not have a cooling fan or a cooling fan cover.

◆ IP20/NEMA Type 1 Enclosure

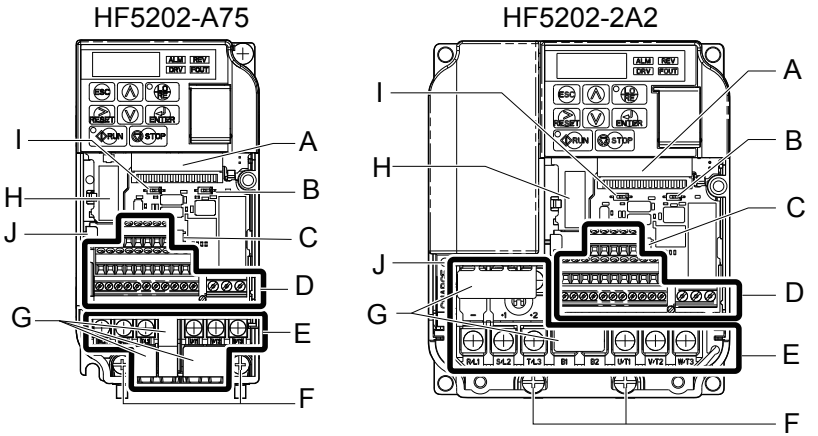
■ Three-Phase AC 200 V HF5202-5A5, 7A5
Three-Phase AC 400 V HF5204-5A5, 7A5



A – Fan cover
B – Cooling fan
C – Mounting Hole
D – Case and Heatsink
E – Cover
F – Cover screws
G – Rubber bushing
H – Bottom cover
I – Front cover screws
J – Terminal cover
K – Terminal board *Refer to Control Circuit Terminal Block Functions on page 64*
L – Front cover
M – Comm port
N – LED operator *Refer to Using the Digital LED Operator on page 78*
O – Case
P – Top cover

Figure 1.4 Exploded View of IP20/NEMA Type 1 Components (HF5204-5A5)

◆ Front Views



A – Terminal board connector
B – DIP switch S1 *Refer to DIP Switch S1 Analog Input Signal Selection on page 73*
C – DIP switch S3 *Refer to Sinking/Sourcing Mode Switch on page 70*
D – Control circuit terminal *Refer to Control Circuit Wiring on page 64*
E – Main circuit terminal *Refer to Wiring the Main Circuit Terminal on page 63*
F – Ground terminal
G – Terminal cover
H – Option card connector
I – DIP switch S2
J – Charge Lamp

Figure 1.5 Front Views of Drives

2

Mechanical Installation

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

2.1 Mechanical Installation

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

◆ Installation Environment

To help prolong the optimum performance life of the drive, install the drive in the proper environment. ***Table 2.1*** describes the appropriate environment for the drive.

Table 2.1 Installation Environment

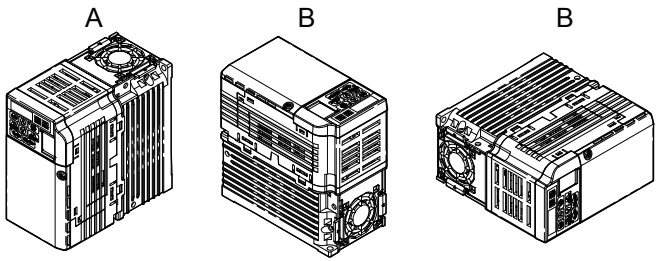
Environment	Conditions
Installation Area	Indoors
Ambient Temperature	IP20/NEMA Type 1 enclosure: -10 °C to +40 °C IP20/IP00 Open-Chassis enclosure: -10 °C to +50 °C Drive reliability improves in environments without wide temperature fluctuations. When using an enclosure panel, install a cooling fan or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

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

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

◆ Installation Orientation and Spacing

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

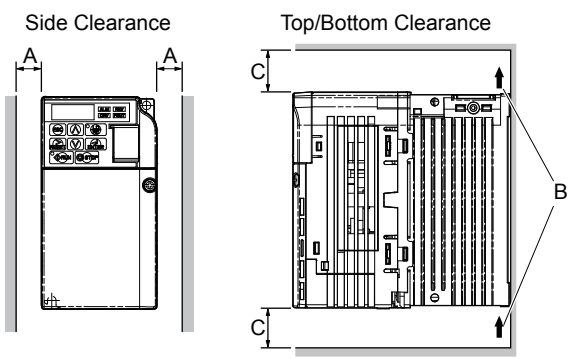


A – Correct **B – Incorrect**

Figure 2.1 Correct Installation Orientation

■ Single Drive Installation

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



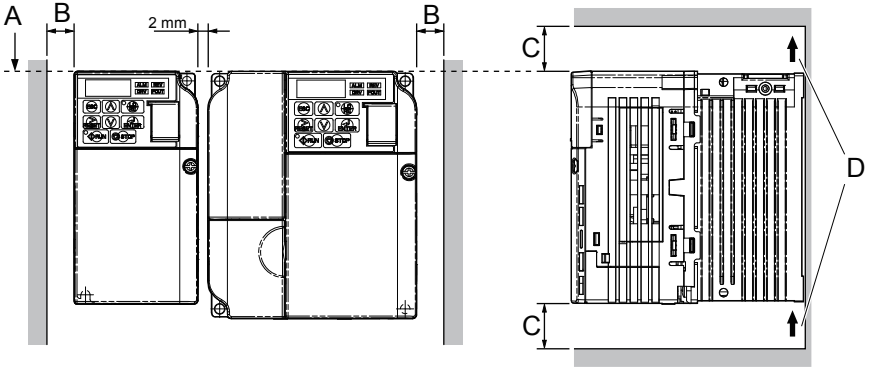
A – 30 mm minimum
B – Airflow direction
C – 100 mm minimum

Figure 2.2 Correct Installation Spacing

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

■ Multiple Drive Installation

When installing multiple drives into the same enclosure panel, mount the drives according to ***Figure 2.2*** . When mounting drives with a minimum side-by-side clearance of 2 mm according to ***Figure 2.3***, derating must be considered and parameter L8-35 must be set. ***Refer to Parameter List on page 167***.



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

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

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

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

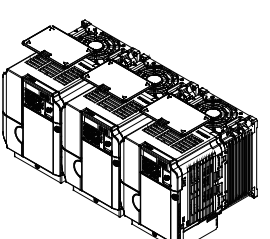
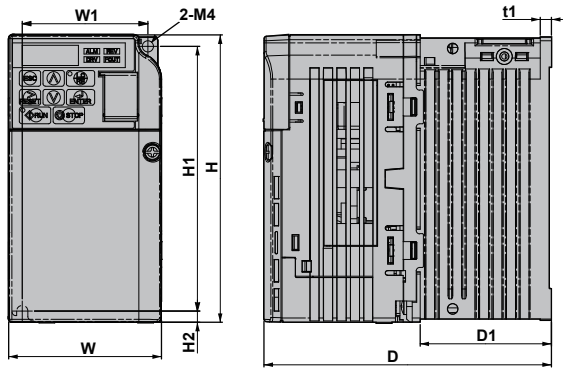


Figure 2.4 IP20/NEMA Type 1 Side-by-Side Mounting in Enclosure

◆ Exterior and Mounting Dimensions

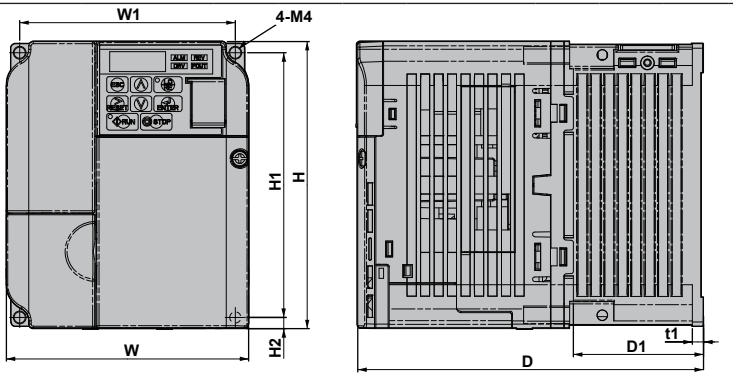
■ IP20/Open-Chassis Drives

Table 2.2 IP20/Open-Chassis



Voltage Class	Drive Model	Dimensions (mm)								
		W	H	D	W1	H1	H2	D1	t1	Wt. (kg)
Single-Phase 200 V Class	HF520S-A20	68	128	76	56	118	5	6.5	3	0.6
	HF520S-A40	68	128	118	56	118	5	38.5	5	1.0
Three-Phase 200 V Class	HF5202-A20	68	128	76	56	118	5	6.5	3	0.6
	HF5202-A40	68	128	108	56	118	5	38.5	5	0.9
	HF5202-A75	68	128	128	56	118	5	58.5	5	1.1

Table 2.3 IP20/Open-Chassis

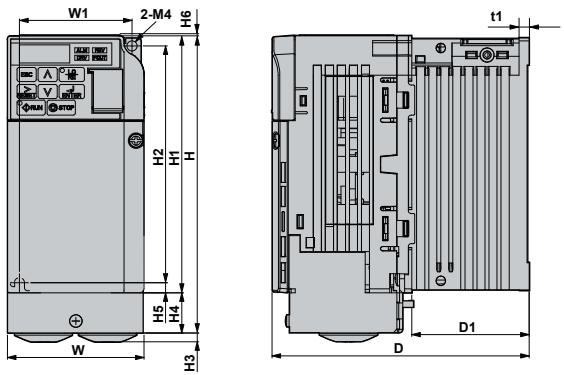


Voltage Class	Drive Model	Dimensions (mm)								
		W	H	D	W1	H1	H2	D1	t1	Wt. (kg)
Single-Phase 200 V Class	HF520S-A75	108	128	137.5	96	118	5	58	5	1.7
	HF520S-1A5	108	128	154	96	118	5	58	5	1.8
	HF520S-2A2	140	128	163	128	118	5	65	5	2.4
Three-Phase 200 V Class	HF5202-1A5	108	128	129	96	118	5	58	5	1.7
	HF5202-2A2	108	128	137.5	96	118	5	58	5	1.7
	HF5202-3A7	140	128	143	128	118	5	65	5	2.4
Three-Phase 400 V Class	HF5204-A20	108	128	81	96	118	5	10	5	1.0
	HF5204-A40	108	128	99	96	118	5	28	5	1.2
	HF5204-A75	108	128	137.5	96	118	5	58	5	1.7
	HF5204-1A5	108	128	154	96	118	5	58	5	1.7
	HF5204-2A2	108	128	154	96	118	5	58	5	1.7
	HF5204-3A7	140	128	143	128	118	5	65	5	2.4

IP20/Open-Chassis Enclosure Drives Converted to IP20/NEMA Type 1 Enclosure Drives

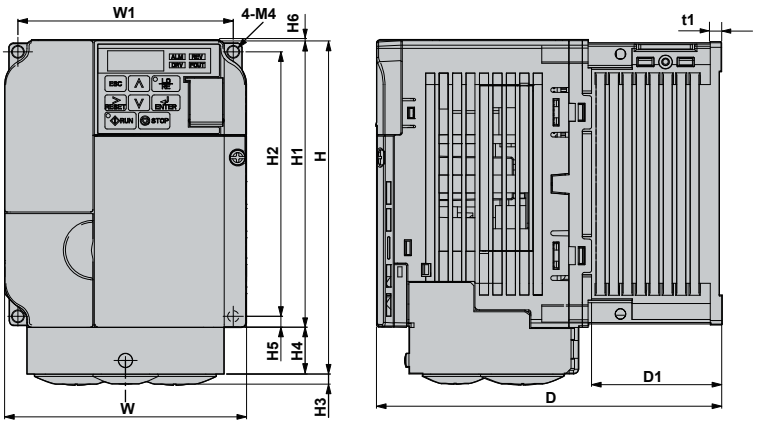
Converting an IP20/Open-Chassis design to an IP20/NEMA Type 1 requires the NEMA Type1 Kit option. The values appearing in ***Table 2.4, Table 2.5*** , and ***Table 2.6*** represent the dimensions after the NEMA Type 1 Kit has been installed.

Table 2.4 IP20/Open-Chassis Design Fitted with NEMA Type 1 Kit



Drive Model	NEMA Type 1 Kit Model	Dimensions (mm)												Wt. (kg)
		W	H	D	W1	H1	H2	H3	H4	H5	H6	D1	t1	
Single-Phase 200 V Class														
HF520S-A20	Option	68	149.5	76	56	128	118	4	20	5	1.5	6.5	3	0.8
HF520S-A40	Option	68	149.5	118	56	128	118	4	20	5	1.5	38.5	5	1.2
Three-Phase 200 V Class														
HF5202-A20	Option	68	149.5	76	56	128	118	4	20	5	1.5	6.5	3	0.8
HF5202-A40	Option	68	149.5	108	56	128	118	4	20	5	1.5	38.5	5	1.1
HF5202-A75	Option	68	149.5	128	56	128	118	4	20	5	1.5	58.5	5	1.3

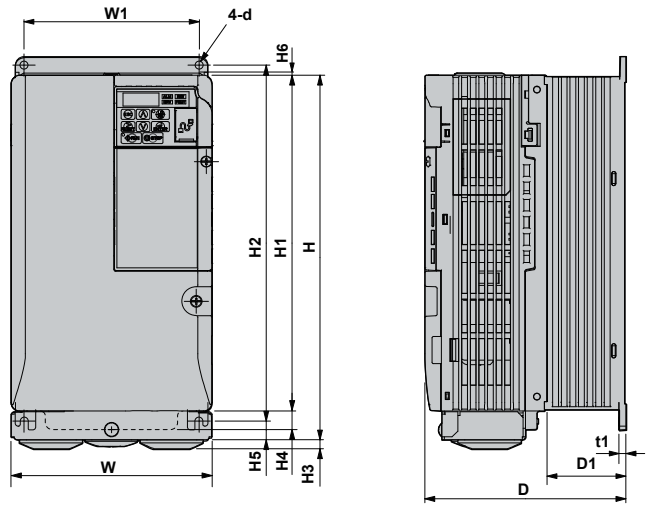
Table 2.5 IP20/Open-Chassis Design Fitted with the NEMA Type 1 Kit



Drive Model	NEMA Type 1 Kit Model	Dimensions (mm)												Wt. (kg)
		W	H	D	W1	H1	H2	H3	H4	H5	H6	D1	t1	
Single-Phase 200 V Class														
HF520S-A75	Option	108	149.5	137.5	96	128	118	4	20	5	1.5	58	5	1.9
HF520S-1A5	Option	108	149.5	154	96	128	118	4	20	5	1.5	58	5	2.0
HF520S-2A2	Option	140	153	163	128	128	118	4.8	20	5	5	65	5	2.6
Three-Phase 200 V Class														
HF5202-1A5	Option	108	149.5	129	96	128	118	4	20	5	1.5	58	5	1.9
HF5202-2A2	Option	108	149.5	137.5	96	128	118	4	20	5	1.5	58	5	1.9
HF5202-3A7	Option	140	153	143	128	128	118	4.8	20	5	5	65	5	2.6
Three-Phase 400 V Class														
HF5204-A20	Option	108	149.5	81	96	128	118	4	20	5	1.5	10	5	1.2
HF5204-A40	Option	108	149.5	99	96	128	118	4	20	5	1.5	28	5	1.4
HF5204-A75	Option	108	149.5	137.5	96	128	118	4	20	5	1.5	58	5	1.9
HF5204-1A5	Option	108	149.5	154	96	128	118	4	20	5	1.5	58	5	1.9
HF5204-2A2	Option	108	149.5	154	96	128	118	4	20	5	1.5	58	5	1.9
HF5204-3A7	Option	140	153	143	128	128	118	4.8	20	5	5	65	5	2.6

IP20/NEMA Type 1 Drives

Table 2.6 IP20/NEMA Type 1



Drive Model	Dimensions (mm)													Wt. (kg)
	W	H	D	W1	H1	H2	H3	H4	H5	H6	D1	t1	d	
Single-Phase 200 V Class														
HF5202-5A5	140	254	140	122	234	248	6	13	13	1.5	55	5	M5	3.8
HF5202-7A5	140	254	140	122	234	248	6	13	13	1.5	55	5	M5	3.8
Three-Phase 400V Class														
HF5204-5A5	140	254	140	122	234	248	6	13	13	1.5	55	5	M5	3.8
HF5204-7A5	140	254	140	122	234	248	6	13	13	1.5	55	5	M5	3.8

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3

Electrical Installation

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

3.1 Standard Connection Diagram

Connect the drive and peripheral devices as shown in ***Figure 3.1***. It is possible to run the drive via the digital operator without connecting digital I/O wiring. This section does not discuss drive operation; ***Refer to Start-Up Programming & Operation on page 75*** for instructions on operating the drive.

NOTICE: *Inadequate branch short circuit protection could result in damage to the drive. Install adequate branch circuit short circuit protection per applicable codes. The drive is suitable for circuits capable of delivering not more than 31,000 RMS symmetrical amperes, 240 Vac maximum (200 V Class) and 480 Vac maximum (400 V Class).*

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

NOTICE: *Correctly set Sink/Source jumper S3 for internal power supply. Failure to comply may result in damage to the drive.* ***Refer to I/O Connections on page 68*** *for details.*

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

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

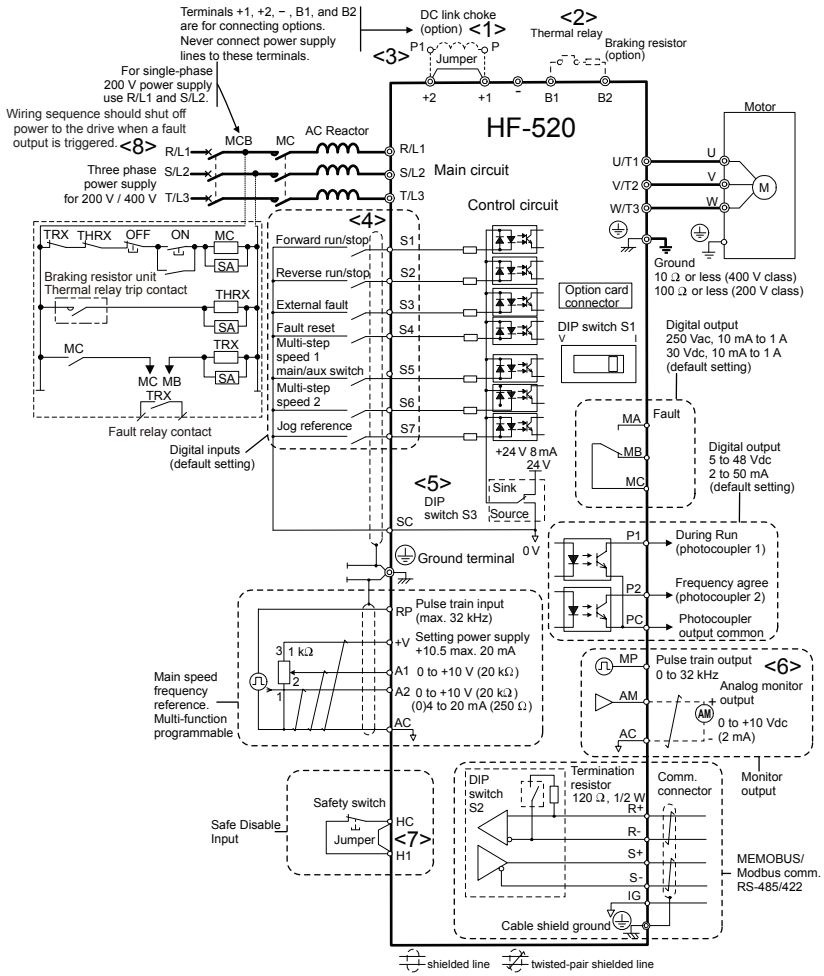


Figure 3.1 Drive Standard Connection Diagram

<1> Remove the jumper when installing an optional DC reactor.

<2> The MC on the input side of the main circuit should open when the thermal relay is triggered.

<3> Self-cooled motors do not require separate cooling fan motor wiring.

<4> Connected using sequence input signal (S1 to S7) from NPN transistor; Default: sink mode (0 V com).

<5> Use only a +24 V internal power supply in sinking mode; the source mode requires an external power supply. ***Refer to I/O Connections on page 68*** for details.

<6> Monitor outputs work with devices such as analog frequency meters, ammeters, voltmeters and wattmeters; they are not intended for use as a feedback-type of signal.

<7> Disconnect the wire jumper between HC and H1 when utilizing the safety input. ***Refer to Wiring Procedure on page 66*** for details on removing the jumper. The wire length for the Safe Disable input should not exceed 30 m.

<8> Note that if the drive is set to trigger a fault output whenever the fault restart function is activated (L5-02 = 1), then a sequence to interrupt power when a fault occurs will result in shutting off the power to the drive as the drive attempts to restart itself. The default setting for L5-02 is 0 (fault output active during restart attempt).

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

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

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

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

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

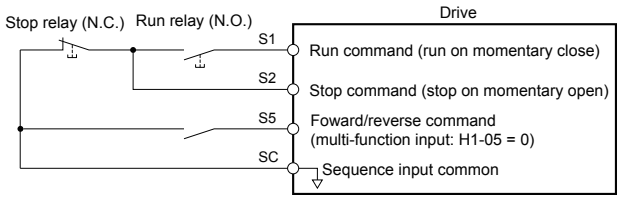


Figure 3.2 3-Wire Sequence

3.2 Terminal Block Configuration

The figures in this section provide illustrations of the main circuit terminal block configurations of the different drive sizes.

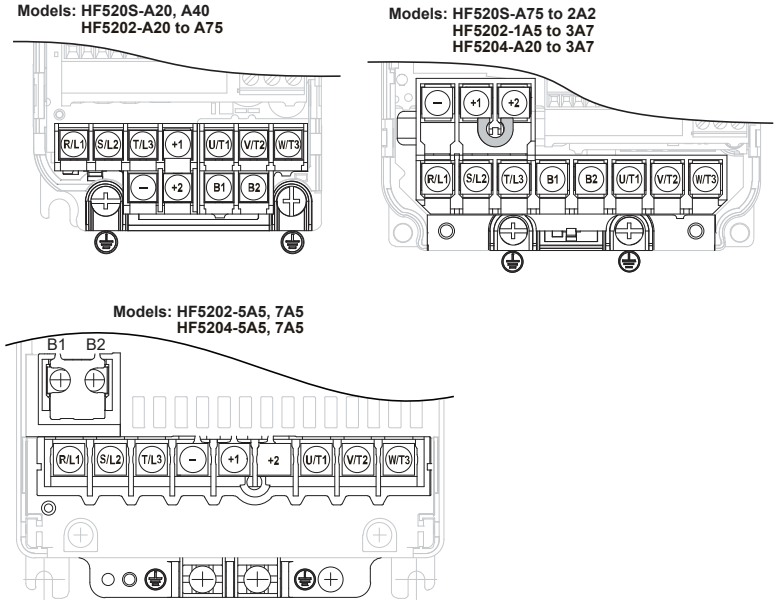


Figure 3.3 Main Circuit Terminal Block Configurations

3.3 Protective Covers

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

◆ IP20/Open-Chassis Front and Bottom Cover Removal and Installation

■ Removing the Protective Covers

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

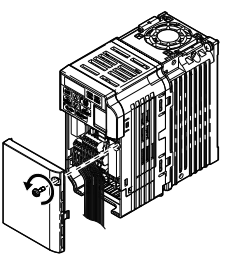


Figure 3.4 Remove the Front Cover on an IP20/Open-Chassis Drive

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

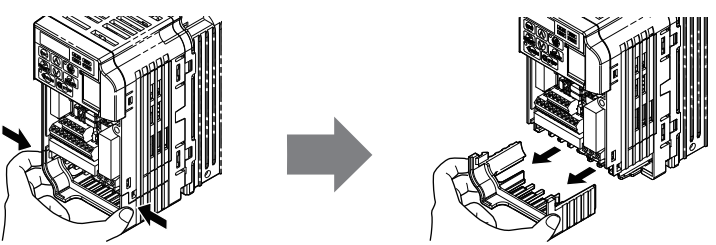


Figure 3.5 Remove the Terminal Cover on an IP20/Open-Chassis Drive

■ Reattaching the Protective Covers

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

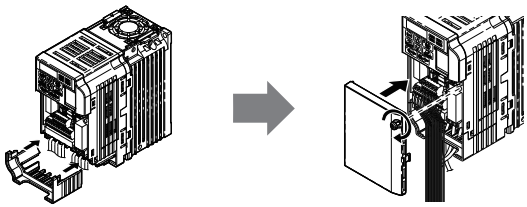


Figure 3.6 Reattach the Protective Covers on an IP20/Open-Chassis Drive

◆ IP20/NEMA Type 1 Front and Bottom Cover Removal and Installation

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

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

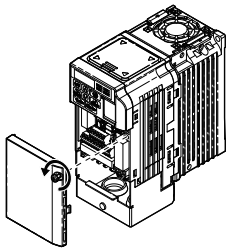
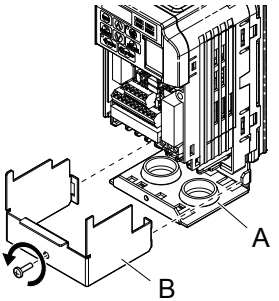


Figure 3.7 Remove the Front Cover on an IP20/NEMA Type 1 Drive

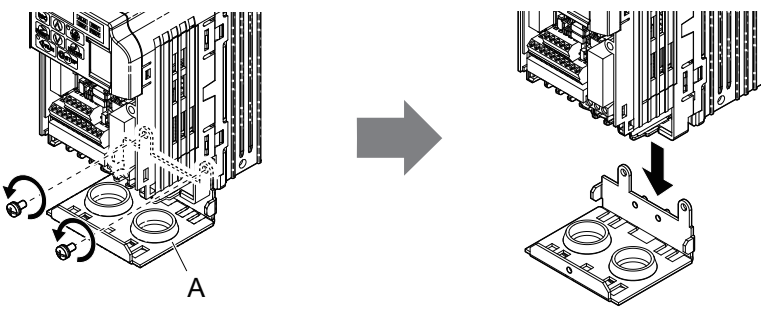
2. Loosen the screw on the terminal cover to remove the terminal cover and expose the conduit bracket.



A – Conduit bracket **B – Terminal cover**

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

3. Loosen two screws attaching the conduit bracket to remove.



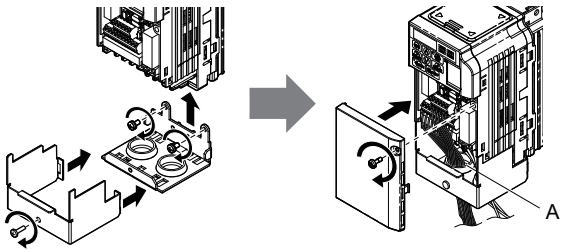
A – Conduit bracket

Figure 3.9 Remove the Conduit Bracket on an IP20/NEMA Type 1 Drive

■ Reattaching the Protective Covers

Pass power wiring and control signal wiring through the exit holes on the bottom of the conduit bracket of the drive. Place power wiring and control signal wiring in separate conduits.

Properly connect all wiring after installing the drive and connecting other devices. Reattach all protective covers when wiring is complete.



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

Figure 3.10 Reattach the Protective Covers and Conduit Bracket on an IP20/NEMA Type 1 Drive

◆ IP20/NEMA Type 1 Top Cover Removal and Installation

To improve the ambient temperature rating of a NEMA Type 1 drive from 40 °C to 50 °C or to mount NEMA Type 1 drives side-by-side, the top cover can be removed. Remove the top cover and set L8-35 to "2".

Note: Removing the top cover of a NEMA Type 1 drive converts the drive to an IP20/Open-Chassis rating, and the drive will no longer have a NEMA Type 1 rating.

■ Removing the Top Cover

Insert the blade of a straight-edge screwdriver into the opening of the top cover. Gently lift up on the front cover as indicated by the arrow in ***Figure 3.11*** to remove it from the drive.

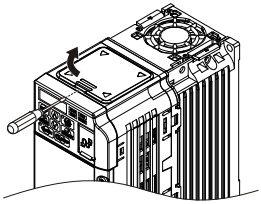


Figure 3.11 Removing the Top Cover

■ Reattaching the Top Cover

Align the connection tabs on the underside of the top cover with the connection tabs on the drive. Pinch in on the top cover to click the cover into place on the drive.

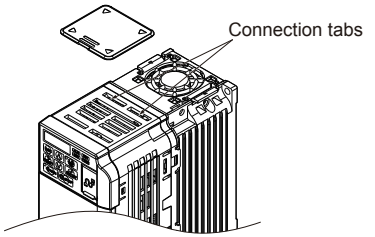


Figure 3.12 Reattaching the Top Cover

3.4 Main Circuit Wiring

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

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

◆ Main Circuit Terminal Functions

Table 3.1 Main Circuit Terminal Functions

Terminal	Type	Function	Reference
R/L1	Main circuit power supply input	Connects line power to the drive. Drives with single-phase 200 V input power use terminals R/ L1 and S/L2 only. T/L3 must not be used.	–
S/L2			
T/L3			
U/T1	Drive output	Connects to the motor.	*62*
V/T2			
W/T3			
B1	Braking resistor	Available for connecting a braking resistor.	–
B2			
⊕1	DC reactor connection	These terminals are shorted at shipment. Remove the shorting bar between ⊕1 and ⊕2 when connecting a DC reactor to this terminal.	–
⊕2			
⊕1	DC power supply input	For connecting a DC power supply.	–
⊖			
⏚ (2 terminals)	Ground	Grounding Terminal	*62*

◆ Wire Gauges and Tightening Torque

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

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

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

- Consider the amount of voltage drop when selecting wire gauges. Increase the wire gauge when the voltage drop is greater than 2% of motor rated voltage. Ensure the wire gauge is suitable for the terminal block. Use the following formula to calculate the amount of voltage drop:
- Line drop voltage (V) = $\sqrt{3}$ x wire resistance (Ω/km) x wire length (m) x current (A) x 10^{-3}

- *Refer to UL Standards Compliance on page 245* for information on UL compliance.

■ Single-Phase 200 V Class

Table 3.2 Wire Gauge and Torque Specifications

Drive Model HF520S	Terminal	For Japan and Asia <1>		For United States <2>		For Europe and China <3>		Screw Size	Tightening Torque N•m (lb.in.)
		Recomm. Gauge mm²	Wire Range mm²	Recomm. Gauge AWG, kcmil	Wire Range AWG, kcmil	Recomm. Gauge mm²	Wire Range mm²		
A20 A40	R/L1, S/L2, T/L3	2	0.75 to 2	14	18 to 14	2.5	0.75 to 2.5	M3.5	0.8 to 1.0 (7.1 to 8.9)
	U/T1, V/T2, W/T3	2	0.75 to 2	14	18 to 14	2.5	0.75 to 2.5		
	⊖, ⊕1, ⊕2	2	0.75 to 2	-	18 to 14	-	0.75 to 2.5		
	B1, B2	2	0.75 to 2	-	18 to 14	-	0.75 to 2.5		
	⏚	2	0.75 to 2	14	18 to 14	2.5	0.75 to 2.5		
A75	R/L1, S/L2, T/L3	2	2 to 5.5	12	14 to 10	2.5	2.5 to 6	M4	1.2 to 1.5 (10.6 to 13.3)
	U/T1, V/T2, W/T3	2	2 to 5.5	14	14 to 10	2.5	2.5 to 6		
	⊖, ⊕1, ⊕2	2	2 to 5.5	-	14 to 10	-	2.5 to 6		
	B1, B2	2	2 to 5.5	-	14 to 10	-	2.5 to 6		
	⏚	3.5	2 to 5.5	10	14 to 10	2.5	2.5 to 6		
1A5	R/L1, S/L2, T/L3	3.5	2 to 5.5	10	14 to 10	2.5	2.5 to 6	M4	1.2 to 1.5 (10.6 to 13.3)
	U/T1, V/T2, W/T3	2	2 to 5.5	14	14 to 10	2.5	2.5 to 6		
	⊖, ⊕1, ⊕2	3.5	2 to 5.5	-	14 to 10	-	2.5 to 6		
	B1, B2	2	2 to 5.5	-	14 to 10	-	2.5 to 6		
	⏚	3.5	2 to 5.5	10	14 to 10	2.5	2.5 to 6		
2A2	R/L1, S/L2, T/L3	5.5	2 to 5.5	10	14 to 10	4	2.5 to 6	M4	1.2 to 1.5 (10.6 to 13.3)
	U/T1, V/T2, W/T3	2	2 to 5.5	14	14 to 10	2.5	2.5 to 6		
	⊖, ⊕1, ⊕2	3.5	2 to 5.5	-	14 to 10	-	2.5 to 6		
	B1, B2	2	2 to 5.5	-	14 to 10	-	2.5 to 6		
	⏚	3.5	2 to 5.5	10	14 to 10	4	2.5 to 6		

<1> Gauges listed here are for use in Japan and Asia.
<2> Gauges listed here are for use in the United States.
<3> Gauges listed here are for use in Europe and China.

■ Three-Phase 200 V Class

Table 3.3 Wire Gauge and Torque Specifications

Drive Model HF5202	Terminal	For Japan and Asia <1>		For United States <2>		For Europe and China <3>		Screw Size	Tightening Torque N•m (lb.in.)
		Recomm. Gauge mm²	Wire Range mm²	Recomm. Gauge AWG, kcmil	Wire Range AWG, kcmil	Recomm. Gauge mm²	Wire Range mm²		
A20 A40 A75	R/L1, S/L2, T/L3	2	0.75 to 2	14	18 to 14	2.5	0.75 to 2.5	M3.5	0.8 to 1.0 (7.1 to 8.9)
	U/T1, V/T2, W/T3	2	0.75 to 2	14	18 to 14	2.5	0.75 to 2.5		
	⊖, ⊕1, ⊕2	2	0.75 to 2	-	18 to 14	-	0.75 to 2.5		
	B1, B2	2	0.75 to 2	-	18 to 14	-	0.75 to 2.5		
	⏚	2	0.75 to 2	14	18 to 14	2.5	0.75 to 2.5		
1A5	R/L1, S/L2, T/L3	2	2 to 5.5	14	14 to 10	2.5	2.5 to 6	M4	1.2 to 1.5 (10.6 to 13.3)
	U/T1, V/T2, W/T3	2	2 to 5.5	14	14 to 10	2.5	2.5 to 6		
	⊖, ⊕1, ⊕2	2	2 to 5.5	-	14 to 10	-	2.5 to 6		
	B1, B2	2	2 to 5.5	-	14 to 10	-	2.5 to 6		
	⏚	2	2 to 5.5	10	14 to 10	2.5	2.5 to 6		

3.4 Main Circuit Wiring

Drive Model HF5202	Terminal	For Japan and Asia <1>		For United States <2>		For Europe and China <3>		Screw Size	Tightening Torque N•m (lb.in.)
		Recomm. Gauge mm^2	Wire Range mm^2	Recomm. Gauge AWG, kcmil	Wire Range AWG, kcmil	Recomm. Gauge mm^2	Wire Range mm^2		
2A2	R/L1, S/L2, T/L3	2	2 to 5.5	12	14 to 10	2.5	2.5 to 6	M4	1.2 to 1.5 (10.6 to 13.3)
	U/T1, V/T2, W/T3	2	2 to 5.5	14	14 to 10	2.5	2.5 to 6		
	⊖, ⊕1, ⊕2	2	2 to 5.5	-	14 to 10	-	2.5 to 6		
	B1, B2	2	2 to 5.5	-	14 to 10	-	2.5 to 6		
	⏚	2	2 to 5.5	10	14 to 10	2.5	2.5 to 6		
3A7	R/L1, S/L2, T/L3	5.5	2 to 5.5	10	14 to 10	4	2.5 to 6	M4	1.2 to 1.5 (10.6 to 13.3)
	U/T1, V/T2, W/T3	3.5	2 to 5.5	10	14 to 10	2.5	2.5 to 6		
	⊖, ⊕1, ⊕2	5.5	2 to 5.5	-	14 to 10	-	2.5 to 6		
	B1, B2	2	2 to 5.5	-	14 to 10	-	2.5 to 6		
	⏚	3.5	2 to 5.5	10	14 to 10	4	2.5 to 6		
5A5	R/L1, S/L2, T/L3	14	5.5 to 14	8	10 to 6	6	4 to 16	M5	2.1 to 2.3 (18.6 to 20.4)
	U/T1, V/T2, W/T3	8	5.5 to 14	8	10 to 6	6	4 to 16		
	⊖, ⊕1, ⊕2	14	5.5 to 14	-	10 to 6	-	4 to 16		
	B1, B2	3.5	2 to 5.5	-	14 to 10	-	4 to 6		
	⏚	5.5	5.5 to 14	8	10 to 6	6	6 to 16		2 to 2.5 (17.7 to 22.1)

Drive Model HF5202	Terminal	For Japan and Asia <1>		For United States <2>		For Europe and China <3>		Screw Size	Tightening Torque N•m (lb.in.)
		Recomm. Gauge mm^2	Wire Range mm^2	Recomm. Gauge AWG, kcmil	Wire Range AWG, kcmil	Recomm. Gauge mm^2	Wire Range mm^2		
7A5	R/L1, S/L2, T/L3	14	5.5 to 14	6	10 to 6	10	6 to 16	M4	2.1 to 2.3 (18.6 to 20.4)
	U/T1, V/T2, W/T3	14	5.5 to 14	8	10 to 6	10	6 to 16		
	⊖, ⊕1, ⊕2	14	5.5 to 14	-	10 to 6	-	6 to 16		
	B1, B2	5.5	2 to 5.5	-	14 to 10	-	4 to 6		
	⏚	14	5.5 to 14	6	10 to 6	10	6 to 16	M5	2 to 2.5 (17.7 to 22.1)

<1> Gauges listed here are for use in Japan and Asia.

<2> Gauges listed here are for use in the United States.

<3> Gauges listed here are for use in Europe and China.

■ Three-Phase 400 V Class

Table 3.4 Wire Gauge and Torque Specifications

Drive Model HF5204	Terminal	For Japan and Asia <1>		For United States <2>		For Europe and China <3>		Screw Size	Tightening Torque N•m (lb.in.)
		Recomm. Gauge mm²	Wire Range mm²	Recomm. Gauge AWG, kcmil	Wire Range AWG, kcmil	Recomm. Gauge mm²	Wire Range mm²		
A20 A40 A75	R/L1, S/L2, T/L3	2	2 to 5.5	14	14 to 10	2.5	2.5 to 6	M4	1.2 to 1.5 (10.6 to 13.3)
	U/T1, V/T2, W/T3	2	2 to 5.5	14	14 to 10	2.5	2.5 to 6		
	⊖, ⊕1, ⊕2	2	2 to 5.5	-	14 to 10	-	2.5 to 6		
	B1, B2	2	2 to 5.5	-	14 to 10	-	2.5 to 6		
	⏚	2	2 to 5.5	14	14 to 10	2.5	2.5 to 6		
1A5 2A2	R/L1, S/L2, T/L3	2	2 to 5.5	14	14 to 10	2.5	2.5 to 6	M4	1.2 to 1.5 (10.6 to 13.3)
	U/T1, V/T2, W/T3	2	2 to 5.5	14	14 to 10	2.5	2.5 to 6		
	⊖, ⊕1, ⊕2	2	2 to 5.5	-	14 to 10	-	2.5 to 6		
	B1, B2	2	2 to 5.5	-	14 to 10	-	2.5 to 6		
	⏚	2	2 to 5.5	10	14 to 10	2.5	2.5 to 6		
3A7	R/L1, S/L2, T/L3	2	2 to 5.5	12	14 to 10	2.5	2.5 to 6	M4	1.2 to 1.5 (10.6 to 13.3)
	U/T1, V/T2, W/T3	2	2 to 5.5	14	14 to 10	2.5	2.5 to 6		
	⊖, ⊕1, ⊕2	2	2 to 5.5	-	14 to 10	-	2.5 to 6		
	B1, B2	2	2 to 5.5	-	14 to 10	-	2.5 to 6		
	⏚	2	2 to 5.5	10	14 to 10	2.5	2.5 to 6		
5A5	R/L1, S/L2, T/L3	3.5	2 to 14	10	14 to 6	2.5	2.5 to 16	M4	2.1 to 2.3 (18.6 to 20.4)
	U/T1, V/T2, W/T3	3.5	2 to 14	10	14 to 6	2.5	2.5 to 16		
	⊖, ⊕1, ⊕2	3.5	2 to 14	-	14 to 6	-	2.5 to 16		
	B1, B2	2	2 to 5.5	-	14 to 10	-	4 to 6		
	⏚	5.5	2 to 14	8	14 to 6	2.5	2.5 to 16	M5	2 to 2.5 (17.7 to 22.1)

Drive Model HF5204	Terminal	For Japan and Asia <1>		For United States <2>		For Europe and China <3>		Screw Size	Tightening Torque N•m (lb.in.)
		Recomm. Gauge mm^2	Wire Range mm^2	Recomm. Gauge AWG, kcmil	Wire Range AWG, kcmil	Recomm. Gauge mm^2	Wire Range mm^2		
7A5	R/L1, S/L2, T/L3	5.5	3.5 to 14	10	10 to 6	4	4 to 16	M4	2.1 to 2.3 (18.6 to 20.4)
	U/T1, V/T2, W/T3	5.5	3.5 to 14	10	10 to 6	4	4 to 16		
	⊖, ⊕1, ⊕2	5.5	3.5 to 14	-	10 to 6	-	4 to 16		
	B1, B2	2	2 to 5.5	-	14 to 10	-	2.5 to 6		
	⏚	5.5	5.5 to 14	8	10 to 6	4	4 to 16	M5	2 to 2.5 (17.7 to 22.1)

<1> Gauges listed here are for use in Japan and Asia.

<2> Gauges listed here are for use in the United States.

<3> Gauges listed here are for use in Europe and China.

◆ Main Circuit Terminal Power Supply and Motor Wiring

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

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

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

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

■ Cable Length Between Drive and Motor

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

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

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

Table 3.5 Cable Length Between Drive and Motor

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

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

■ Ground Wiring

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

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

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

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

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

Refer to ***Figure 3.13*** when using multiple drives. Do not loop the ground wire.

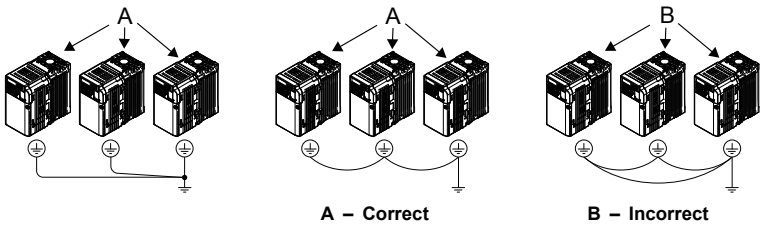
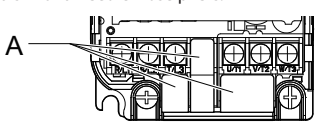


Figure 3.13 Multiple Drive Wiring

■ Wiring the Main Circuit Terminal

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

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



A – Protective Cover to Prevent Miswiring

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

3.5 Control Circuit Wiring

◆ Control Circuit Terminal Block Functions

Drive parameters determine which functions apply to the multi-function digital inputs (S1 to S7), multi-function digital outputs (MA, MB), multi-function pulse inputs and outputs (RP, MP) and multi-function photocoupler outputs (P1, P2). The default is called out next to each terminal in ***Figure 3.1.***

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

WARNING! *Confirm the drive I/O signals and external sequence before starting test run. Setting parameter A1-06 may change the I/O terminal function automatically from the factory setting.* ***Refer to Application Selection on page 89****. Failure to comply may result in death or serious injury.*

■ Input Terminals

Table 3.6 Control Circuit Input Terminals

Type	No.	Terminal Name (Function)	Function (Signal Level) Default Setting
Multi-Function Digital Inputs	S1	Multi-function input 1 (Closed: Forward run, Open: Stop)	Photocoupler 24 Vdc, 8 mA **Note:** Drive preset to sinking mode. When using source mode, set DIP switch S3 to allow for a 24 Vdc (±10%) external power supply. ***Refer to Sinking/ Sourcing Mode Switch on page 68.***
	S2	Multi-function input 2 (Closed: Reverse run, Open: Stop)	
	S3	Multi-function input 3 (External fault (N.O.)	
	S4	Multi-function input 4 (Fault reset)	
	S5	Multi-function input 5 (Multi-step speed reference 1)	
	S6	Multi-function input 6 (Multi-step speed reference 2)	
	S7	Multi-function input 7 (Jog reference)	
	SC	Multi-function input common (Control common)	Sequence common
Safe Disable Input	HC	Power supply for safe disable input	+24 Vdc (max 10 mA allowed)
	H1	Safe disable input	Open: Output disabled Closed: Normal operation **Note:** Disconnect wire jumper between HC and H1 when using the safe disable input. The wire length should not exceed 30 m.

Type	No.	Terminal Name (Function)	Function (Signal Level) Default Setting
Main Frequency Reference Input	RP	Multi-function pulse train input (frequency reference)	Response frequency: 0.5 to 32 kHz (Duty Cycle: 30 to 70%) (High level voltage: 3.5 to 13.2 Vdc) (Low level voltage: 0.0 to 0.8 Vdc) (input impedance: 3 kΩ)
	+V	Analog input power supply	+10.5 Vdc (max allowable current 20 mA)
	A1	Multi-function analog input 1 (frequency reference)	Input voltage 0 to +10 Vdc (20 kΩ) resolution 1/1000
	A2	Multi-function analog input 2 (frequency reference)	Input voltage or input current (Selected by DIP switch S1 and H3-09) 0 to +10 Vdc (20 kΩ), Resolution: 1/1000 4 to 20 mA (250 Ω) or 0 to 20 mA (250 Ω), Resolution: 1/500
	AC	Frequency reference common	0 Vdc

■ Input Terminals

Table 3.7 Control Circuit Output Terminals

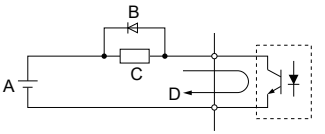
Type	No.	Terminal Name (Function)	Function (Signal Level) Default Setting
Multi-Function Digital Output *<1>*	MA	N.O. (fault)	Digital output 30 Vdc, 10 mA to 1 A; 250 Vac, 10 mA to 1 A Minimum load: 5 Vdc, 10 mA (reference value)
	MB	N.C. output (fault)	
	MC	Digital output common	
Multi-Function Photocoupler Output	P1	Photocoupler output 1 (During run)	Photocoupler output 48 Vdc, 2 to 50 mA *<2>*
	P2	Photocoupler output 2 (Frequency agree)	
	PC	Photocoupler output common	
Monitor Output	MP	Pulse train output (Output frequency)	32 kHz (max) *<3>* *<4>* DC 5 to 12V
	AM	Analog monitor output	0 to 10 Vdc (2 mA or less) Resolution: 1/1000
	AC	Monitor common	0 V

<1> Do not assign functions to digital relay outputs that involve frequent switching. This may shorten relay performance life. Switching life is estimated at 200,000 times (assumes 1 A, resistive load).

<2> Connect a suppression diode as shown in ***Figure 3.14*** when driving a reactive load such as a relay coil. Ensure the diode rating is greater than the circuit voltage.

<3> When set for sourcing. +5 V/1.5 kΩ or higher, +8 V/3.5 kΩ or higher, +10 V/10 kΩ or higher.

<4> When set for sinking, the external power supply should be +12 Vdc, ±5% with 16 mA or less. Pulse train output is 50% duty.



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

Figure 3.14 Connecting a Suppression Diode

■ Serial Communication Terminals

Table 3.8 Control Circuit Terminals: Serial Communications

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

◆ Terminal Configuration

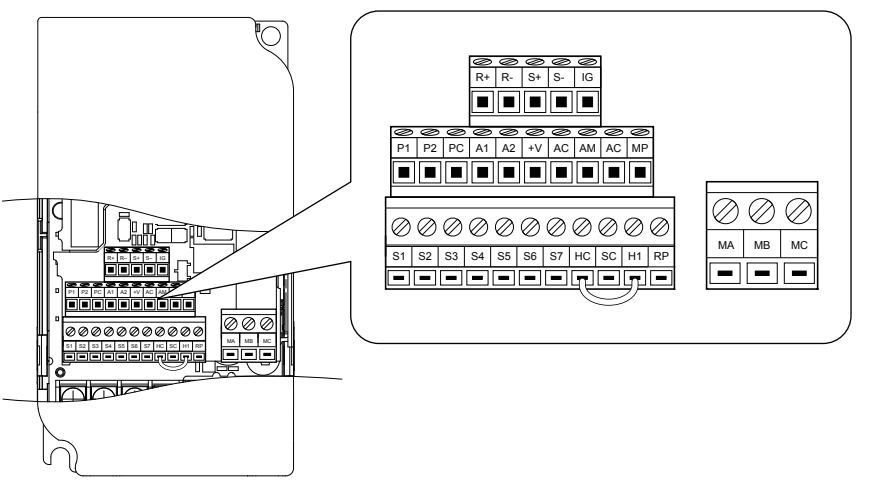


Figure 3.15 Removable Control Circuit Terminal Block

■ Wire Size and Torque Specifications

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

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

Terminal	Screw Size	Tightening Torque N•m (in-lbs)	Bare Wire Terminal		Ferrule-Type Terminal		
			Applic. wire size mm^2 (AWG)	Recomm. mm^2 (AWG)	Applic. wire size mm^2 (AWG)	Recomm. mm^2 (AWG)	Wire Type
MA, MB, MC	M3	0.5 to 0.6 (4.4 to 5.3)	Stranded: 0.25 to 1.5 (24 to 16) Single: 0.25 to 1.5 (24 to 16)	0.75 (18)	0.25 to 1.0 (24 to 17)	0.5 (20)	Shielded line, etc.
S1-S7, SC, RP, +V, A1, A2, AC, HC, H1, P1, P2, PC, MP, AM, AC, S+, S-, R+, R-, IG	M2	0.22 to 0.25 (1.9 to 2.2)	Stranded: 0.25 to 1.0 (24 to 18) Single: 0.25 to 1.5 (24 to 16)	0.75 (18)	0.25 to 0.5 (24 to 20)	0.5 (20)	

■ Ferrule-Type Wire Terminations

Crimp a ferrule to signal wiring to improve wiring simplicity and reliability. Use CRIMPFOX 6, a crimping tool manufactured by PHOENIX CONTACT.

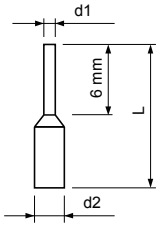


Figure 3.16 Ferrule Dimensions

Table 3.10 Ferrule Terminal Types and Sizes

Size mm² (AWG)	Type	L (mm)	d1 (mm)	d2 (mm)	Manufacturer
0.25 (24)	AI 0.25-6YE	10.5	0.8	2.0	PHOENIX CONTACT
0.34 (22)	AI 0.34-6TQ	10.5	0.8	2.0	
0.5 (20)	AI 0.5-6WH	12	1.1	2.5	
0.75 (18)	AI 0.75-6GY	12	1.3	2.8	
1.0	AI 1-6RD	12	1.5	3.0	

◆ Wiring Procedure

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

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

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

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

NOTICE: *Use a class 2 power supply (UL standard) when connecting to the control terminals. Improper application of peripheral devices could result in drive performance degradation due to improper power supply.*

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

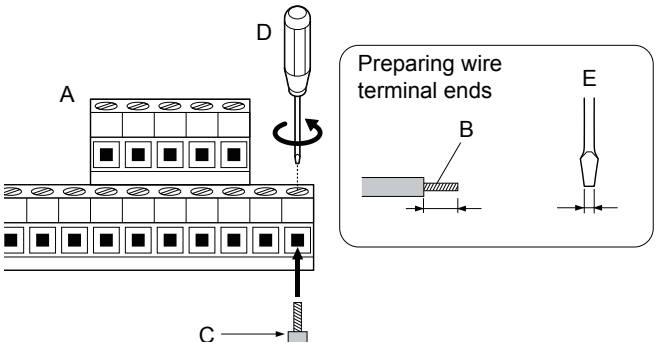
NOTICE: *Connect the shield of shielded cable to the appropriate ground terminal. Improper equipment grounding could result in drive or equipment malfunction or nuisance trips.*

Wire the control terminals using ***Figure 3.17*** as a guide. Prepare the ends of the control circuit wiring as shown in ***Figure 3.18. Refer to Wire Size and Torque Specifications on page 65***.

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

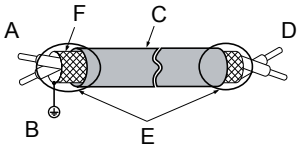
NOTICE: *Use shielded twisted-pair cables as indicated to prevent operating faults. Improper wiring practices could result in drive or equipment malfunction due to electrical interference.*

Connect control wires as shown in the following figure:



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

Figure 3.17 Terminal Board Wiring Guide



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

Figure 3.18 Preparing the Ends of Shielded Cables

3.6 I/O Connections

◆ Sinking/Sourcing Mode Switch

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

Table 3.11 Sinking/Sourcing Mode Setting

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

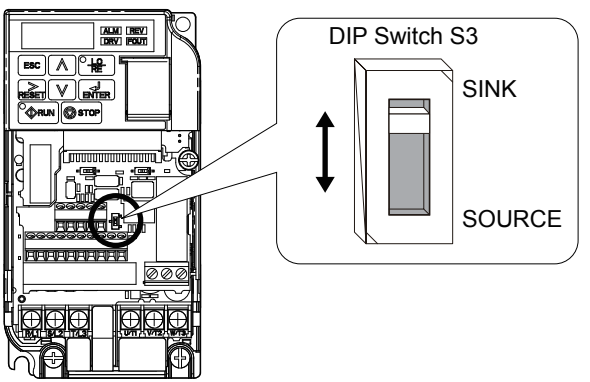


Figure 3.19 DIP Switch S3

■ Transistor Input Signal Using 0 V Common/Sink Mode

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

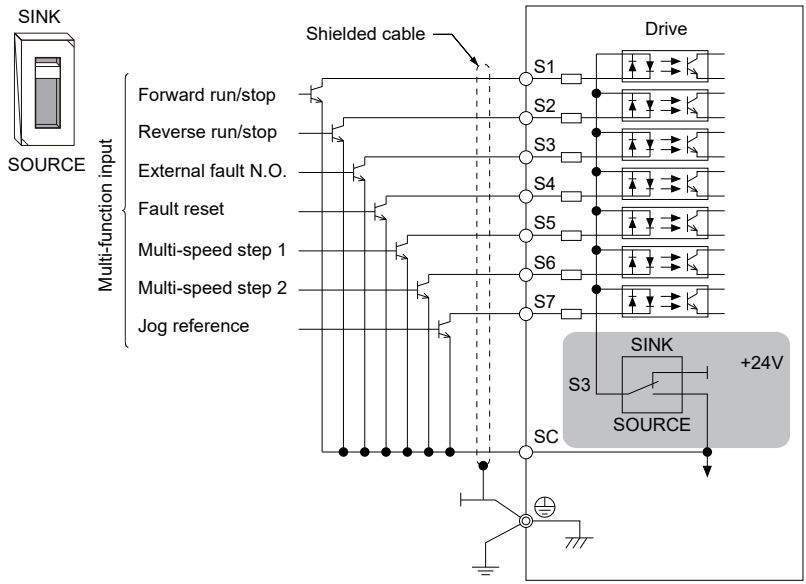


Figure 3.20 Sinking Mode: Sequence from NPN Transistor (0 V Common)

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

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

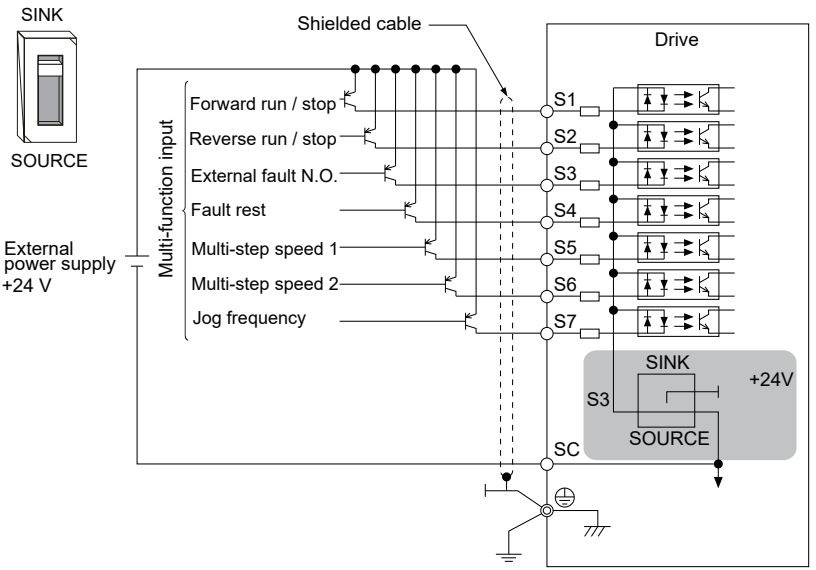


Figure 3.21 Source Mode: Sequence from PNP Transistor (+24 V Common)

3.7 Main Frequency Reference

◆ DIP Switch S1 Analog Input Signal Selection

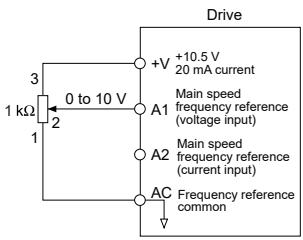
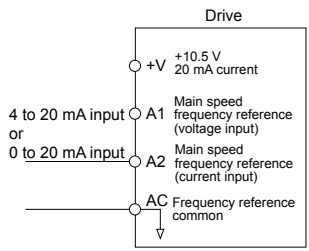
The main frequency reference can either be a voltage or current signal input. For voltage signals both analog inputs, A1 and A2, can be used, for current signals A2 must be used.

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

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

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

Table 3.12 Frequency Reference Configurations

Voltage Input	Current Input
	

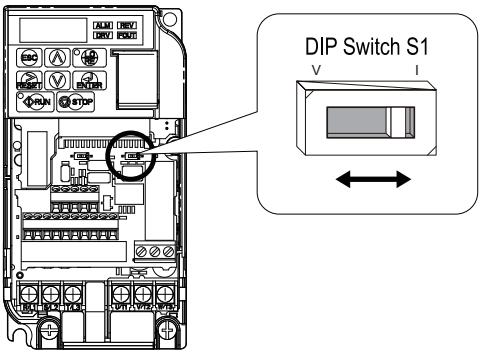


Figure 3.22 DIP Switch S1

Table 3.13 DIP Switch S1 Settings

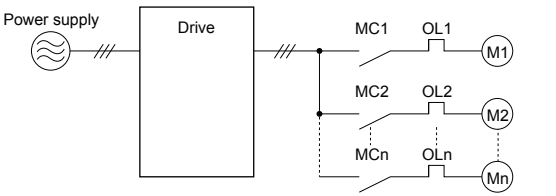
Setting Value	Description
V (left position)	Voltage input (0 to 10 V)
I (right position)	Current input (4 to 20 mA or 0 to 20 mA): default setting

Table 3.14 Parameter H3-09 Details

No.	Parameter Name	Description	Setting Range	Default Setting
H3-09	Frequency ref. (current) terminal A2 signal level selection	Selects the signal level for terminal A2. 0: 0 to +10 V, unipolar input (with lower limit) 1: 0 to +10 V, bipolar input (no lower limit) 2: 4 to 20 mA 3: 0 to 20 mA	0 to 3	2

3.8 Wiring Checklist

☑	No.	Item	Page
		Drive, peripherals, option cards	
☐	1	Check drive model number to ensure receipt of correct model.	*28*
☐	2	Check for correct braking resistors, DC reactors, noise filters, and other peripheral devices.	–
☐	3	Check for correct option card model.	–
		Installation area and physical setup	
☐	4	Ensure area surrounding the drive complies with specifications.	*36*
		Power supply voltage, output voltage	
☐	5	The voltage from the power supply should fall within the input voltage specification range of the drive.	–
☐	6	The voltage rating for the motor should match the drive output specifications.	*28*
		Main circuit wiring	
☐	7	Confirm proper branch circuit protection exists per National and Local codes.	*46*
☐	8	Properly wire the power supply to drive terminals R/L1, S/L2 and T/L3.	–
☐	9	Properly wire the drive and motor together. The motor lines and drive output terminals R/T1, V/T2 and W/T3 should match in order to produce the desired phase order. If the phase order is incorrect, the drive will rotate in the opposite direction.	*62*
☐	10	Use 600 Vac vinyl-sheathed wire for the power supply and motor lines.	*55*
☐	11	Use the correct wire gauges for the main circuit. Refer to ***Table 3.2, Table 3.3,*** or ***Table 3.4***.	*55*
		• When using comparatively long motor cable, calculate the amount of voltage drop. Motor rated voltage (V) x 0.02 ≥ 3 x voltage resistance (Ω/km) x cable length (m) x motor rated current (A) x 10^{-3}	*55*
		• If the cable between the drive and motor exceeds 50 m, adjust the carrier frequency (C6-02) accordingly.	*62*
☐	12	Properly ground the drive.	*62*
☐	13	Tightly fasten all terminal screws (control circuit terminals, grounding terminals). Refer to ***Table 3.2, Table 3.3,*** or ***Table 3.4***.	*55*

☑	No.	Item	Page
☐	14	Set up overload protection circuits when running multiple motors from a single drive.  MC1 - MCn ... magnetic contactor OL 1 - OL n ... thermal relay **Note:** Close MC1 through MCn before operating the drive.	–
☐	15	If using a braking resistor, install a magnetic contactor. Properly install the resistor, and ensure that overload protection shuts off the power upply.	–
☐	16	Verify phase advancing capacitors are NOT installed on the output side of the drive.	–
		Control circuit wiring	
☐	17	Use twisted-pair cables for all drive control circuit wiring.	***64***
☐	18	Ground the shields of shielded wiring to the GND ⏚ terminal.	***68***
☐	19	If using a 3-Wire sequence, properly set parameters for multi-function contact input terminals S1 through S7, and properly wire control circuits.	***48***
☐	20	Properly wire any option cards.	–
☐	21	Check for any other wiring mistakes. Only use a multimeter to check wiring.	–
☐	22	Properly fasten the control circuit terminal screws in the drive. Refer to ***Table 3.2,*** ***Table 3.3,*** or ***Table 3.4***.	***55***
☐	23	Pick up all wire clippings.	–
☐	24	Ensure that no frayed wires on the terminal block are touching other terminals or connections.	–
☐	25	Properly separate control circuit wiring and main circuit wiring.	–
☐	26	Analog signal line wiring should not exceed 50 m.	–
☐	27	Safe Disable Input wiring should not exceed 30 m.	–

4

Start-Up Programming & Operation

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

4.1 Using the Digital LED Operator

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

◆ Keys, Displays, and LEDs

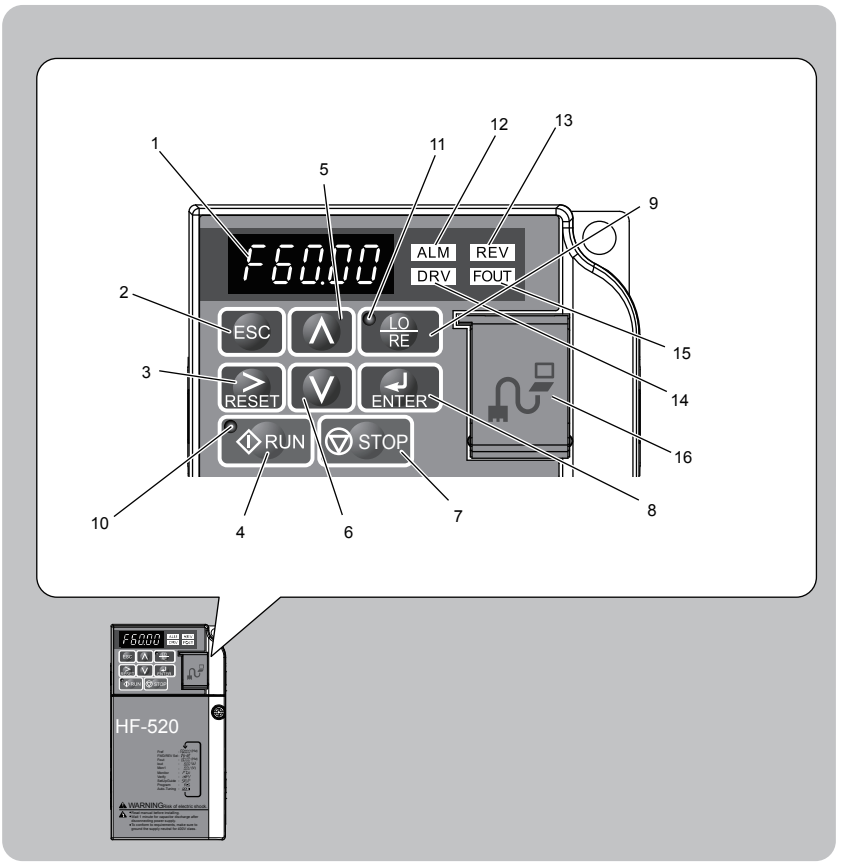


Table 4.1 Keys and Displays on the LED Operator

No.	Display	Name	Function
1		Data Display Area	Displays the frequency reference, parameter number, etc.
2		ESC Key	Returns to the previous menu.
3		RESET Key	Moves the cursor to the right. Resets the drive to clear a fault situation.
4		RUN Key	Starts the drive.
5		Up Arrow Key	Scrolls up to select parameter numbers, setting values, etc.
6		Down Arrow Key	Scrolls down to select parameter numbers, setting values, etc.
7		STOP Key	Stops the drive. **Note:** Stop priority circuit. Pressing the STOP key will always cause the drive to stop the motor, even when a Run command is active at an external Run command source. Set parameter o2-06 to 0 to disable the STOP key priority.
8		ENTER Key	Selects all modes, parameters, settings, etc. Selects a menu item to move from one display screen to the next.
9		LO/RE Selection Key	Switches drive control between the operator (LOCAL) and the control circuit terminals (REMOTE). **Note:** LOCAL/REMOTE key effective during stop in drive mode. If the digital operator could change from REMOTE to LOCAL by incorrect operation, set o2-01 (LOCAL/REMOTE Key Function Selection) to "0" (disabled) to disable LOCAL/REMOTE key.
10		RUN Light	Lit while the drive is operating the motor.
11		LO/RE Light	Lit while the operator (LOCAL) is selected to run the drive.
12		ALM LED Light	*Refer to LED Screen Displays on page 80.*
13		REV LED Light	
14		DRV LED Light	
15		FOUT LED Light	

No.	Display	Name	Function
16	–	Communication Port	Port used for LED Operator Keypad, and for connecting to a PC. **NOTICE:** Use only specified cable when making connections to the drive. Failure to comply may damage the drive. **NOTICE:** Do not open the port cover wider than 90 degrees. Failure to comply may break the port cover and leave the unprotected port susceptible to damage.

◆ LED Screen Displays

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

◆ LO/RE LED and RUN LED Indications

LED	Lit	Flashing	Flashing Quickly <1>	Off
	When a Run command is selected from the LED operator (LOCAL)	–	–	Run command is selected from device other than LED operator (REMOTE)
	During Run	• During deceleration to stop • When a Run command is input and frequency reference is 0	• During deceleration at a fast-stop. • During stop by interlock operation. <2>	During stop

LED	Lit	Flashing	Flashing Quickly <1>	Off
As shown	RUN	RUN	RUN	RUN

<1> Refer to ***Figure 4.1*** for the difference between "flashing" and "flashing quickly".

<2> Refer to the description for parameter U4-21 on page ***225*** for information on verifying operation interlock.

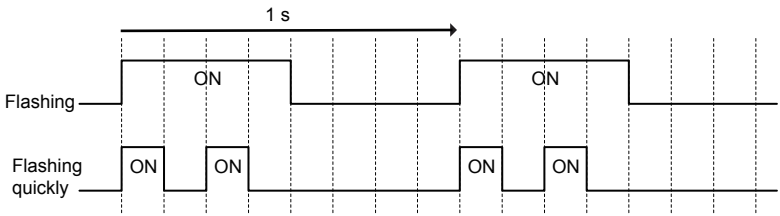


Figure 4.1 RUN LED Status and Meaning

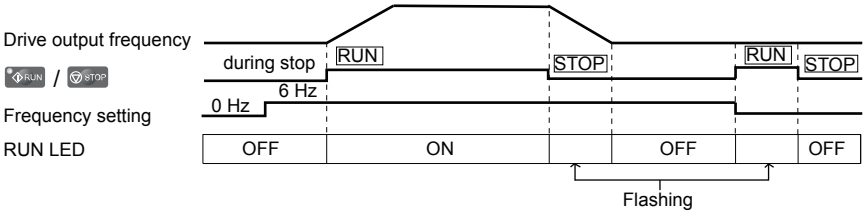


Figure 4.2 RUN LED and Drive Operation

◆ Menu Structure for Digital LED Operator

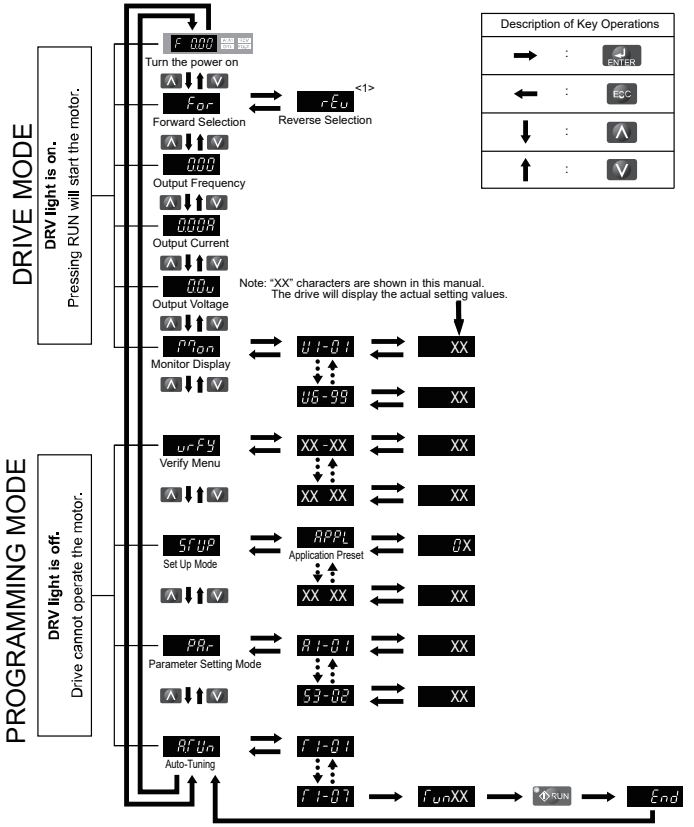


Figure 4.3 Digital LED Operator Screen Structure

<1> Reverse can only be selected when LOCAL is set.

4.2 The Drive and Programming Modes

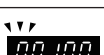
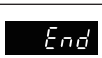
The drive functions are divided into two main groups accessible via the Digital LED Operator:

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

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

◆ Changing Parameter Settings or Values

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

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

◆ Switching Between LOCAL and REMOTE

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

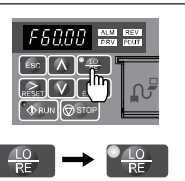
WARNING! *Sudden Movement Hazard. The drive may start unexpectedly if the Run command is already applied when switching from LOCAL mode to REMOTE mode when b1-07 = 1, resulting in death or serious injury. Be sure all personnel are clear of rotating machinery and electrical connections prior to switching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

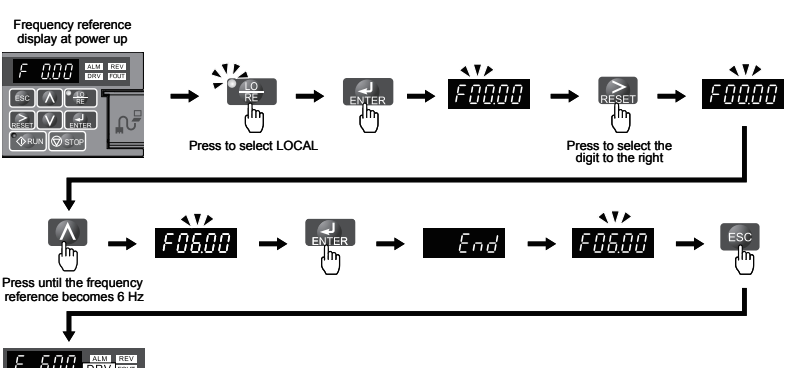
There are two ways to switch between LOCAL and REMOTE.

Note: 1. After selecting LOCAL, the LO/RE light will remain lit.

2. The drive will not allow the user to switch between LOCAL and REMOTE during run.

■ Using the LO/RE Key on the LED Operator

	Step		Display/Result
1.	Turn on the power to the drive. The initial display appears.	➡	
2.	Press LO/RE. The LO/RE light will light up. The drive is now in Local. To set the drive for REMOTE operation, press the LO/RE key again.	➡	
3.	Changing the default frequency reference of F 0.00 (0 Hz) to F 6.00 (6 Hz) while in Drive Mode. This example assumes the drive is set to LOCAL.		



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

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

Note: **1.** *Refer to Parameter List on page 169* for a list of digital input selections.
2. Setting a multi-function input terminal to a value of 1 disables the LO/RE key on the LED operator.

◆ Parameters Available in the Setup Group

■ Setup Mode (STUP)

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

1. To set a parameter, the Setup Mode must be displayed first. Press the Up/Down key until STUP is displayed.

2. Select the parameter and change the setting. ***Table 4.2*** lists parameters available in the Setup group. If the desired parameter cannot be set in the Setup mode, use the Parameter Setting mode.

Note: **1.** When parameter A1-02 (Control Method Selection) is changed, some parameter set values are also changed automatically.
2. Use the "Par" menu in the Programming mode to access parameters not listed in the Setup Group.
3. Display parameters depend on A1-06. ***Refer to Application Selection on page 92.***

Table 4.2 Setup Group Parameters

Parameter	Name
A1-02	Control Method Selection
b1-01	Frequency Reference Selection 1
b1-02	Run Command Selection 1
b1-03	Stop Method Selection
C1-01	Acceleration Time 1
C1-02	Deceleration Time 1
C6-01	Duty Selection
C6-02	Carrier Frequency Selection
d1-01	Frequency Reference 1
d1-02	Frequency Reference 2
d1-03	Frequency Reference 3
d1-04	Frequency Reference 4
d1-17	Jog Frequency Reference
E1-01	Input Voltage Reference

Parameter	Name
E1-03	V/f Pattern Selection
E1-04	Maximum Output Frequency
E1-05	Maximum Voltage
E1-06	Base Frequency
E1-09	Minimum Output Frequency
E1-13	Base Voltage
E2-01	Motor Rated Current
E2-04	Number of Motor Poles
E2-11	Motor Rate Capacity
H4-02	Terminal AM Gain Setting
L1-01	Motor Protection Function Selection
L3-04	Stall Prevention Selection during Deceleration

4.3 Start-up Flowcharts

The flowcharts in this section summarize basic steps required to start the drive. Use the flowcharts to determine the most appropriate start-up method for a given application. The charts are intended as a quick reference to help familiarize the user with start-up procedures.

Flowchart	Subchart	Objective	Page
A		Basic startup procedure and motor tuning.	*87*
	A-1	Simple motor setup with Energy Savings or Speed Search using V/f mode.	*88*
	A-2	High-performance operation using Sensorless Vector (SV) motor control.	*89*
	-	Setup of drive using application specific selections. *Refer to Application Selection on page 89.*	-

◆ Verifying Parameter Changes: Verify Menu

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

Note: The Verify Menu will not display A1-□□ parameters (except for A1-02), nor will it display parameters A2-01 to A2-32 or E5-01 even if those parameters have been changed from default settings.

The following example is a continuation of the steps beginning on page *81*. Here, parameter C1-01 is accessed using the Verify Menu and is changed again to 20.0 s.
To check the list of edited parameters:

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

◆ Flowchart A: Basic Start-up and Motor Tuning

Figure 4.4, Flowchart A, describes basic start-up sequence for the drive and motor system. This sequence varies slightly depending on application. Use drive default parameter settings in simple applications that do not require high precision.

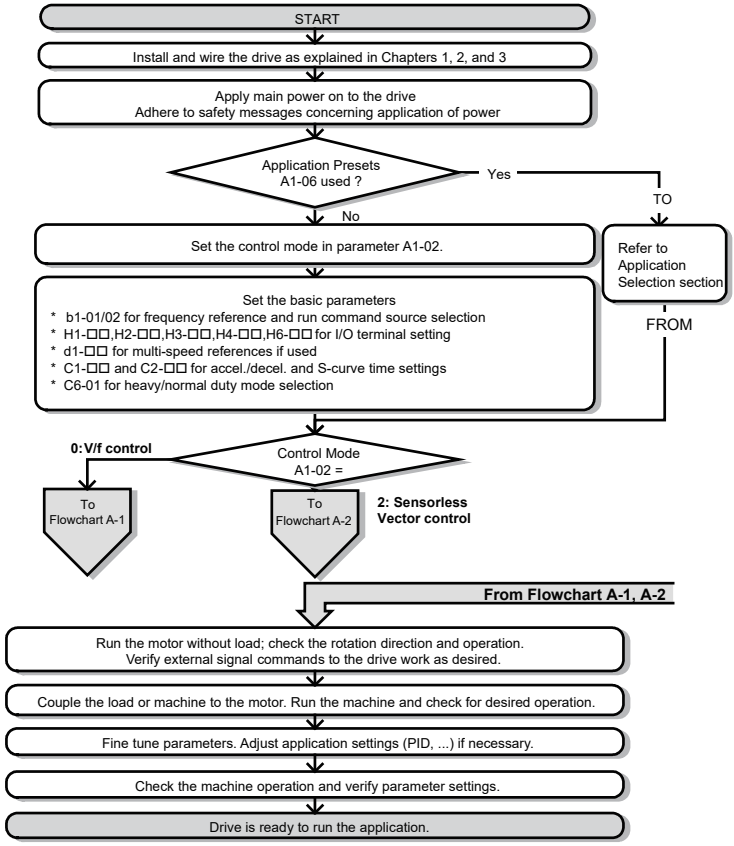


Figure 4.4 Basic Start-up and Motor Tuning

◆ Subchart A1: Simple Motor Setup with Energy Savings or Speed Search Using V/f Mode

Figure 4.5, Flowchart A1, describes simple motor setup for V/f control. V/f Motor Control is suited for the most basic applications such as fans or pumps. This procedure illustrates using Energy Savings and Speed Estimation Speed Search. V/f control can be used where rotational auto-tuning cannot be performed.

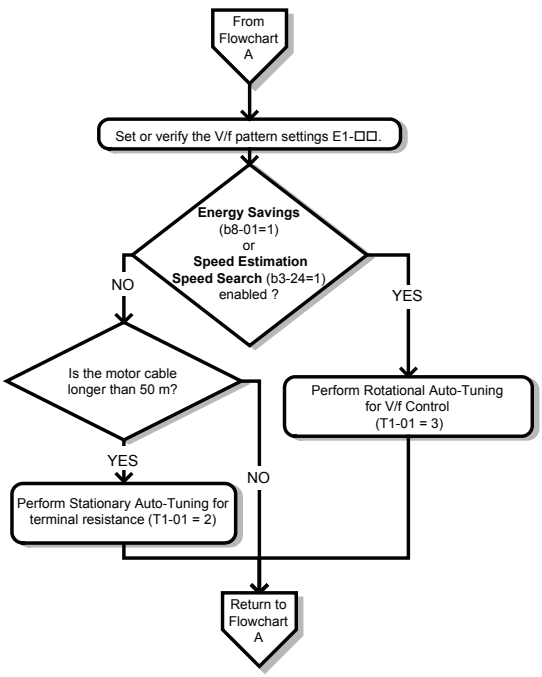


Figure 4.5 Simple Motor Setup with Energy Savings or Speed Search Using V/f Mode

◆ Subchart A2: High Performance Operation Using Sensorless Vector Motor Control

Figure 4.6, Flowchart A2, describes Sensorless Vector Control for high-performance motor operation. This is appropriate for applications requiring high starting torque, torque limits, and improved speed regulation.

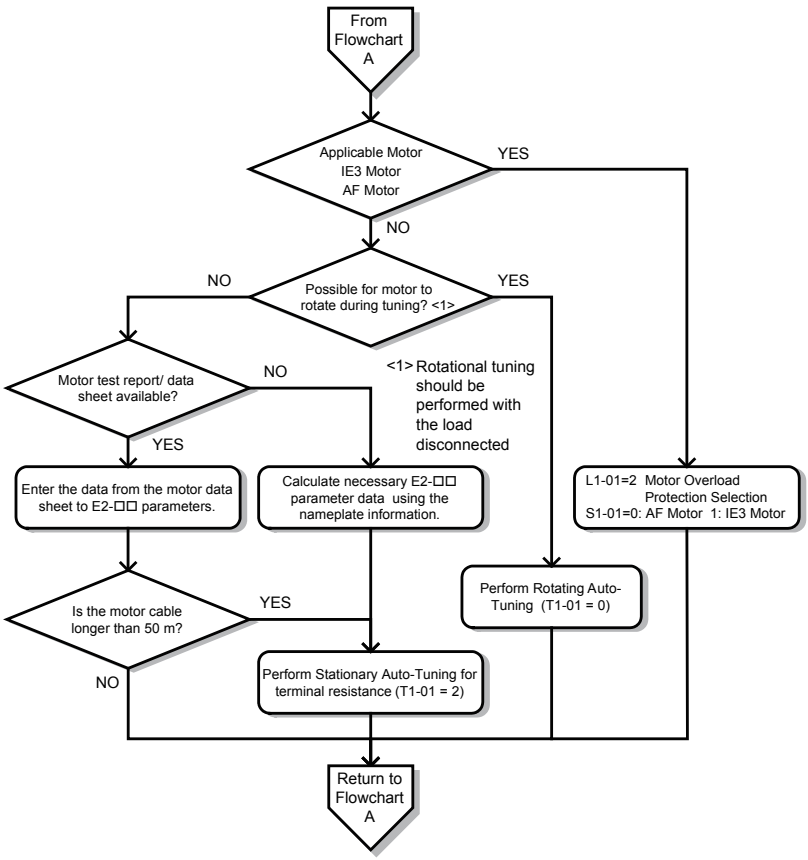


Figure 4.6 Flowchart A2: High Performance Operation Using Sensorless Vector Motor Control

4.4 Powering Up the Drive

◆ Powering Up the Drive and Operation Status Display

■ Powering Up the Drive

Review the following checklist before turning the power on.

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

■ Status Display

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

No.	Name	Description
Normal Operation		The data display area displays the frequency reference. DRV is lit.
Fault	 Main circuit low voltage (ex)	Data displayed varies by the type of fault. ***Refer to Fault Displays, Causes, and Possible Solutions on page 125*** for more information and possible solution. ALM and DRV are lit.

Note: Display will vary depending on drive settings.

4.5 Application Selection

Several Application Presets are available to facilitate drive setup for commonly used applications. Selecting one of these Application Presets automatically sets the required parameters to the Application Preset default values and selects I/Os. In addition, the parameters most likely to be changed are assigned to the list of User Parameters, A2-01 through A2-16. These can be accessed in the Setup Mode and provide quicker application adjustment by eliminating the need to scroll through multiple menus.

The following presets can be selected:

Note: 1. Do not set any value outside the allowable range for A1-06. Setting an out-of-range value will cause "APPL" to flash on the display in the Setup group and disable the up and down arrow keys on the digital operator. To fix this error, press the ESC key to return to the Setup group and then it will then be possible to switch to another mode using the up and down arrow keys.

2. A1-06 setting can only be changed by initializing the drive by first setting A1-03 to 2220. Setting A1-06 to a value that is out of range will not adversely affect drive operation. When the drive should not be initialized because initialization will cause other problems, then A1-06 does not need to be changed.

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

No.	Parameter Name	Setting Range	Default
A1-06	Application Presets	0: Disabled 1: Water supply pump 2: Conveyor 3: Exhaust fan 4: HVAC 5: Compressor 6: Hoist 7: Traveling 8: Conveyor 2	0

◆ Setting 1: Water Supply Pump Application

Table 4.3 Water Supply Pump Parameter Settings

No.	Name	Default Setting
A1-02	Control Method Selection	0: V/f Control
b1-04	Reverse Operation Selection	1: Reverse Prohibited
C1-01	Acceleration Time 1	1.0 s
C1-02	Deceleration Time 1	1.0 s
C6-01	Drive Duty Selection	1: Normal Duty

No.	Name	Default Setting
E1-03	V/f Pattern Selection	0FH
E1-07	Middle Output Frequency	30.0 Hz
E1-08	Middle Output Frequency Voltage	50.0 V
L2-01	Momentary Power Loss Operation Selection	1: Enabled
L3-04	Stall Prevention Selection during Deceleration	1: Enabled

Table 4.4 Water Supply Pump: User Parameters (A2-01 to A2-16)

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

◆ Setting 2: Conveyor Application

Table 4.5 Conveyor: Parameter Settings

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

Table 4.6 Conveyor: User Parameters (A2-01 to A2-16)

No.	Parameter Name	No.	Parameter Name
A1-02	Control Method Selection	C1-02	Deceleration Time 1
b1-01	Frequency Reference Selection 1	E2-01	Motor Rated Current

No.	Parameter Name	No.	Default Setting
b1-02	Run Command Selection 1	L3-04	Stall Prevention Selection during Deceleration
C1-01	Acceleration Time 1	–	–

◆ Setting 3: Exhaust Fan Application

Table 4.7 Exhaust Fan: Parameter Settings

No.	Parameter Name	Default Setting
A1-02	Control Method Selection	0: V/f Control
b1-04	Reverse Operation Selection	1: Reverse Prohibited
C6-01	Drive Duty Selection	1: Normal Duty
E1-03	V/f Pattern Selection	0FH
E1-07	Middle Output Frequency	30.0 Hz
E1-08	Middle Output Frequency Voltage	50.0 V
L2-01	Momentary Power Loss Operation Selection	1: Enabled
L3-04	Stall Prevention Selection during Deceleration	1: Enabled

Table 4.8 Exhaust Fan: User Parameters (A2-01 to A2-16)

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

◆ Setting 4: HVAC Fan Application

Table 4.9 HVAC Fan: Parameter Settings

No.	Parameter Name	Default Setting
A1-02	Control Method Selection	0: V/f Control
b1-04	Reverse Operation Selection	1: Reverse Prohibited
C6-01	Drive Duty Selection	1: Normal Duty
C6-02	Carrier Frequency Selection	3: 8.0 kHz
H2-03	Terminals P2 Function Selection	39: Watt Hour Pulse Output
L2-01	Momentary Power Loss Operation Selection	2: CPU Power Active - Drive will restart if power returns prior to control power supply shut down.
L8-03	Overheat Pre-Alarm Operation Selection	4: Operation at lower speed
L8-38	Carrier Frequency Reduction	2: Enabled across entire frequency range.

Table 4.10 HVAC Fan: User Parameters (A2-01 to A2-16)

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

◆ Setting 5: Compressor Application

Table 4.11 Compressor: Parameter Settings

No.	Parameter Name	Default Setting
A1-02	Control Method Selection	0: V/f Control
b1-04	Reverse Operation Selection	1: Reverse Prohibited
C1-01	Acceleration Time 1	5.0 s
C1-02	Deceleration Time 1	5.0 s
C6-01	Drive Duty Selection	0: Heavy Duty

No.	Parameter Name	Default Setting
E1-03	V/f Pattern Selection	0FH
L2-01	Momentary Power Loss Operation Selection	1: Enabled
L3-04	Stall Prevention Selection during Deceleration	1: Enabled

Table 4.12 Compressor: User Parameters (A2-01 to A2-16):

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

◆ Setting 6: Hoist Application

Note: **1.** Read the instructions listed on page *97* when using Hoist Application Preset.

2. Perform Auto-Tuning after selecting the Hoist Application Preset.

3. If UL3 appears on the operator display after Auto-Tuning is complete, set L6-01 to 0 to repeat the Auto-Tuning process.

Table 4.13 Hoist: Parameters and Settings

No.	Parameter Name	Default Setting
A1-02	Control Method Selection	2: Sensorless Vector Control
b1-01	Frequency Reference Selection 1	0: Operator
b6-01	Dwell Reference at Start	3.0 Hz
b6-02	Dwell Time at Start	0.3 s
C1-01	Acceleration Time 1	3.0 s
C1-02	Deceleration Time 1	3.0 s
C6-01	Drive Duty Selection	0: Heavy Duty
C6-02	Carrier Frequency Selection	2: 5 kHz
d1-01	Frequency Reference 1	6.0 Hz
d1-02	Frequency Reference 2	30.0 Hz
d1-03	Frequency Reference 3	60.0 Hz
E1-03	V/f Pattern Selection	0FH
H2-02	Terminals P1 Function Selection	37: During Frequency Output

No.	Parameter Name	Default Setting
H2-03	Terminals P2 Function Selection	5: Frequency Detection 2
L2-03	Momentary Power Loss Minimum Baseblock Time	0.3 s
L3-04	Momentary Power Loss Voltage Recovery Ramp Time	0: Disabled
L4-01	Speed Agreement Detection Level	2.0 Hz
L4-02	Speed Agreement Detection Width	0.0 Hz
L6-01	Torque Detection Selection 1	8: UL3 at RUN - Fault
L6-02	Torque Detection Level 1	5%
L6-03	Torque Detection Time 1	0.5 s
L8-05	Input Phase Loss Protection Selection	1: Enabled *<1>*
L8-07	Output Phase Loss Protection Selection	1: Enabled
L8-38	Carrier Frequency Reduction	1: Enabled below 6 Hz
L8-41	High Current Alarm Selection	1: Enabled (alarm is output)

<1> Disable L8-05 for single-phase models.

Table 4.14 Hoist: User Parameters (A2-01 to A2-16):

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

◆ Notes on Controlling the Brake when Using the Hoist Application Preset

Preventing Inadvertent Brake Release by Disabling Frequency Detection During a Baseblock Condition

The frequency detection function is used for controlling the brake.

Although the drive output will be shut off, the drive will maintain the frequency reference if an external Baseblock command is given (H1-xx = 8/9) and the Run command remains active. Disable the Frequency detection during Baseblock by setting parameter L4-07 = "0" to prevent the brake remaining open during Baseblock condition.

Brake Control During Safe Disable Input

If the Safe Disable input is released, the drive output will shut off and the frequency reference will reset to 0 and the brake will close, regardless if the Run command is active. The Run command must be cycled before the drive can restart.

The table below shows how to set up the drive when using output terminals P2-PC as brake control output.

Function	Parameter	Setting	V/f	SV
Frequency Detection 2 Digital Output (Brake Control)	H2-03	***5***	O	O
Frequency Detection during Baseblock	L4-07	***0***	O	O
Frequency Detection Level (Brake Open Frequency)	L4-01	1.0 to 3.0 Hz ***<1>***	O	O
Frequency Detection Width (Brake Close Bandwidth)	L4-02	0.0 to 0.5 Hz ***<2>***	O	O

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

<2> Hysteresis for Frequency Detection 2 can be adjusted by changing the Frequency Detection Width (L4-02) between 0.0 and 0.5 Hz. If the load slips during stop, make changes in steps of 0.1 Hz until the load no longer slips.

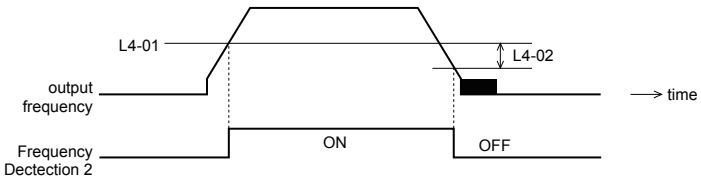


Figure 4.8 Frequency Detection 2

The braking sequence should be designed as follows:

- A normally open signal (N.O.) should be used to control the brake so that it is released when terminal P2-PC closes.

- When a fault signal is output, the brake should close.

  Note: The drawing below shows a control wiring example for the crane application preset:

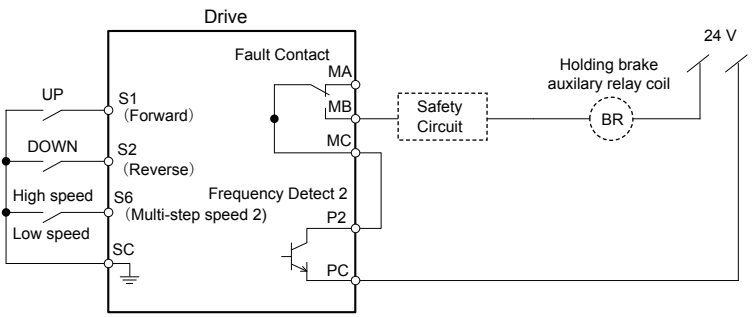


Figure 4.9 Brake Control Wiring

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

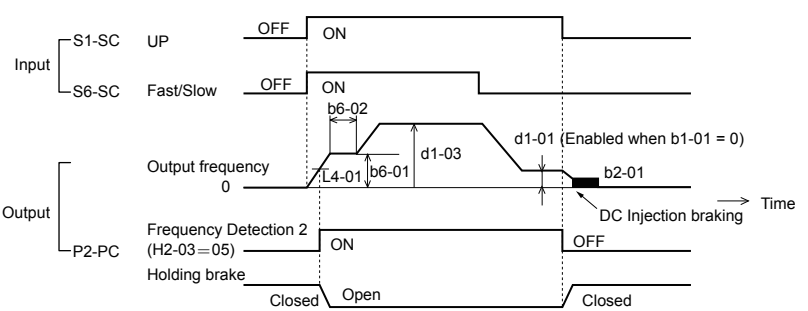


Figure 4.10 Holding Brake Time Chart

◆ Setting 7: Traveling Application

Table 4.15 Traveling: Parameters and Settings

No.	Parameter Name	Default Setting
A1-02	Control Method Selection	0: V/f Control
b1-01	Frequency Reference Selection 1	0: Operator
C1-01	Acceleration Time 1	3.0 s
C1-02	Deceleration Time 1	3.0 s
C6-01	Drive Duty Selection	0: Heavy Duty
C6-02	Carrier Frequency Selection	2: 5 kHz
d1-01	Frequency Reference 1	6.0 Hz
d1-02	Frequency Reference 2	30.0 Hz
d1-03	Frequency Reference 3	60.0 Hz
H1-05	Multi-Function Digital Input Terminal S5 Function	3: Multi-Step Speed 1
H1-06	Multi-Function Digital Input Terminal S6 Function	4: Multi-Step Speed 2
H2-02	Terminals P1 Function Selection	37: During frequency output
L3-04	Stall Prevention Selection during Deceleration	0: Disabled
L8-05	Input Phase Loss Protection Selection	1: Enabled <1>
L8-07	Output Phase Loss Protection Selection	1: Triggered when a single phase is lost
L8-38	Carrier Frequency Reduction	1: Enabled below 6 Hz
L8-41	High Current Alarm Selection	1: Enabled (alarm output)

<1> Disable L8-05 for single-phase models.

Table 4.16 Traveling: User Parameters (A2-01 to A2-16):

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

No.	Parameter Name	No.	Parameter Name
d1-02	Frequency Reference 2	L1-01	Motor Overload Protection Selection

◆ Setting 8: Conveyor Application 2

Table 4.17 Conveyor 2: Parameters and Settings

No.	Parameter Name	Default Setting
A1-02	Control Method Selection	0: V/f Control
C1-01	Acceleration Time 1	3.0 s
C1-02	Deceleration Time 1	3.0 s
C6-01	Drive Duty Selection	0: Heavy Duty
L3-04	Stall Prevention Selection during Deceleration	0: Disabled
n3-13	Overexcitation Deceleration Gain	1.4
n3-21	High-Slip Suppression Current Level	150%

Table 4.18 Conveyor 2: User Parameters (A2-01 to A2-16):

No.	Parameter Name	No.	Parameter Name
A1-02	Control Method Selection	E2-01	Motor Rated Current
b1-01	Frequency Reference Selection 1	L3-04	Stall Prevention Selection during Deceleration
b1-02	Run Command Selection 1	n3-13	Overexcitation Deceleration Gain
C1-01	Acceleration Time 1	n3-21	High-Slip Suppression Current Level
C1-02	Deceleration Time 1	–	–

4.6 Basic Drive Setup Adjustments

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

If more information is required for parameters not listed in this section, ***Refer to Parameter List on page 167*** as required for a complete listing of drive parameters.

◆ Control Mode Selection: A1-02

Note: **1.** Be sure to perform Auto-Tuning when using one of the vector control modes.

2. Reinitializing the drive does not reset A1-02 to the factory default value.

■ Available Control Modes

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

Control Mode	Parameter	Main Applications
V/f Control	A1-02 = 0 (default)	• General variable speed applications • For running multiple motors from a single drive • When replacing a drive in which parameter settings are unknown.
Sensorless Vector Control	A1-02 = 2	• General variable speed applications • Applications requiring high precision, high speed control.

◆ Initialize Parameter Values: A1-03

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

Note: **1.** Save all changed parameter settings by setting o2-03 = "1" before initializing the drive. Settings will be lost if performing a 2-Wire or 3-Wire initialization using 2220 or 3330 if user parameters are not saved first.

2. If using Open Loop Vector Control (A1-02 = 2), Auto-Tuning will need to be performed again after the drive is initialized. ***Refer to Auto-Tuning on page 107*** for details.

■ Different Methods of Drive initialization

1110: Resets all parameters to user-defined default values

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

Note: Set o2-03 to "1" to save the current parameter settings and changes for a "user-initialization." After saving all parameter setting changes, parameter o2-03 automatically returns to 0.

2220: 2-Wire Initialization

Returns all parameters to factory default values for 2-Wire control. A 2-Wire sequence assigns functions to input terminals S1 and S2.

3330: 3-Wire Initialization

Returns all parameters to factory default values for 3-Wire control. A 3-Wire sequence assigns functions to input terminals S1, S2, and S5.

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

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

Note: ***Refer to Run Command Input Selection: b1-02 on page 103*** for more information on a 2-Wire and 3-Wire sequence.

Note: Initializing the drive for 2-Wire sequence (A1-03 = 2220) returns all drive parameters to factory settings. Back up all parameters in the event of accidental initialization. the data with 2-Wire sequence returns all the set parameters to the factory settings.

◆ Frequency Reference Source: b1-01

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

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

When b1-01 = 0 the frequency reference will be provided by the LED operator. ***Refer to The Drive and Programming Modes on page 81*** for information on how to set the frequency reference.

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

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

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

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

Control Circuit Terminal A1 (Voltage Input):

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

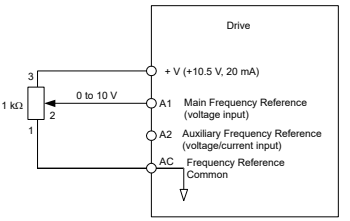


Figure 4.11 Voltage Input for the Main Frequency Reference

Control Circuit Terminal A2 (Voltage/Current Input):

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

Switching between Main/Auxiliary Frequency References

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

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

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

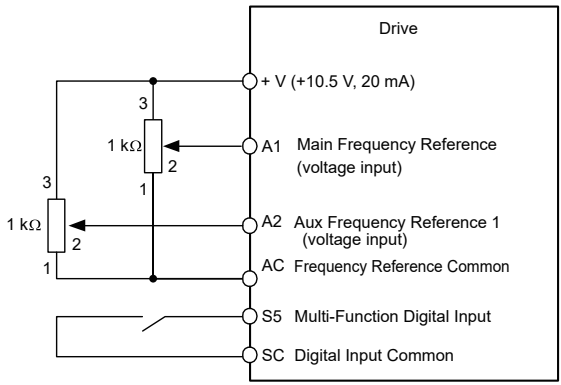


Figure 4.12 Switching between Main/Auxiliary Frequency References

◆ Run Command Input Selection: b1-02

This section explains how to assign the run command input.

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

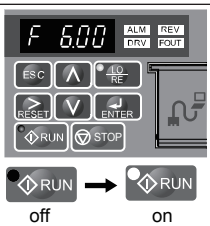
WARNING! ***Sudden Movement Hazard. When the run command is given by turning on the power to the drive, the motor will begin rotating as soon as the drive is powered up. Be sure to take proper precautions if using this setting. Ensure the area around the motor is safe. Failure to comply could result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

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

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

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

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

Step			Display/Result
1.	Turn on the power to the drive. The initial display appears.	➡	
2.	Set the frequency reference to F6.00 (6 Hz).	➡	
3.	Press the RUN key to start the motor.	–	–
4.	The motor should accelerate up to 6 Hz while the RUN light is on.	➡	
5.	Press the STOP key to stop the motor. The RUN light will flash until the motor comes to a complete stop.	➡	

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

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

Using a 2-Wire Sequence

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

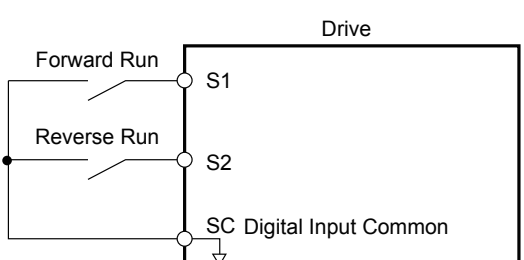


Figure 4.13 Example Wiring Diagram for 2-Wire Sequence

Using a 3-Wire Sequence

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

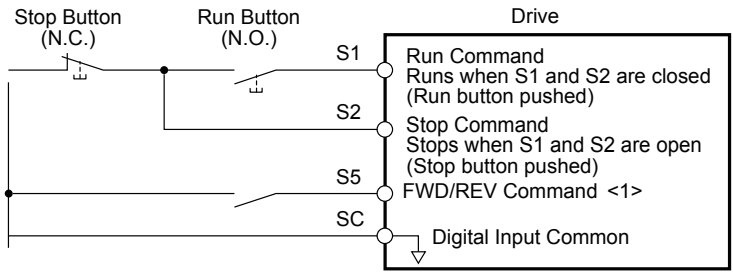


Figure 4.14 Example Wiring Diagram for 3-Wire Sequence Using Terminal S5

<1> When terminal S5 is open, the motor rotates forward. When closed, the motor rotates in reverse.

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

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

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

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

■ Drive Duty Selection: C6-01

The drive has two different duty modes from which to select based on the load characteristics.The drive rated current, overload capacity, carrier frequency, and maximum output frequency will change depending upon the duty mode selection. Use parameter C6-01 to select Heavy Duty (HD) or Normal Duty (ND) for the application. The factory setting is ND. ***Refer to Specifications on page 155*** for details about the rated current.

■ Carrier Frequency Selection: C6-02

Fixed Carrier Frequencies

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

Parameter	Name	Description	Setting Range	Default
C6-02	Carrier Frequency Selection	1 : 2.0 kHz 2 : 5.0 kHz 3 : 8.0 kHz 4 : 10.0 kHz 5 : 12.5 kHz 6 : 15.0 kHz 7: Swing PWM 1 8: Swing PWM 2 9: Swing PWM 3 A: Swing PWM 4 B: Leakage Current Rejection PWM <1> F : User defined (C6-03 to C6-05)	1 to B, F	2

<1> Available in drive software versions PRG: 1020 and later. Setting B uses a PWM pattern that reduces the amount of leakage current detected over long wiring distances. This can help reduce alarm detection and problems with the current monitor that result from leakage current over long wiring distances. This is the same as setting the carrier frequency to 2 kHz.

Note: 1. Swing PWM uses 2.0 kHz carrier frequency as a base. Applying special PWM patterns minimizes the audible noise of the motor.

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

◆ Drive Input Voltage Setting: E1-01

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

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

Parameter	Name	Description	Setting Range	Default
E1-01	Input Voltage Setting	Set to the nominal voltage of the incoming line. Sets the maximum and base voltage used by preset V/f patterns (E1-03), and adjusts the levels of drive protective features (e.g., overvoltage, braking resistor level, stall prevention, etc.).	200 V Class: 155 to 255 400 V Class: 310 to 510	200 V <1>

<1> The default value shown here is for 200 V class drives. Double the value for 400 V class drives.

4.7 Auto-Tuning

◆ Types of Auto-Tuning

There are three types of Auto-Tuning. Select the best type of Auto-Tuning for the application. ***Refer to Auto-Tuning Procedure on page 109***.

Type	Setting	Application Conditions and Benefits	Description
Rotational Auto-Tuning for V/f Control	T1-01 = 3	• Assumes the motor can rotate during the Auto-Tuning process. • Improves torque compensation, slip compensation, energy savings, and Speed Search performance. • Should be performed when Speed Estimation Type Speed Search or Energy Saving is used in V/f Control.	V/f Control
Rotational Auto-Tuning for SV Control	T1-01 = 0	• Assumes the motor can rotate during the Auto-Tuning process. • Achieves high-performance motor control and should be performed whenever Sensorless Vector Control is used.	Sensorless Vector Control
Stationary Auto-Tuning for Line-to-Line Resistance (V/f and SV Control)	T1-01 = 2	For use when: • The motor cable exceeds 50 m. • The motor cable length has been modified after Auto-Tuning has been previously performed. • When motor capacity and drive capacity differ.	V/f Control, Sensorless Vector Control

◆ Before Auto-Tuning the Drive

When driving the Inverter Motor (AF Motor or IE3 Motor), Auto-Tuning becomes unnecessary.

Set the below parameters.

- A1-02= 2 Sensorless Vector Control
- L1-01= 2 AF Motor or IE3 Motor
- S1-01= 0 AF Motor (0.2 to 7.5kW)
  2 IE3 Motor (0.75 to 7.5kW)

■ Basic Auto-Tuning Preparations

- Auto-Tuning automatically determines the electrical characteristics of the motor. This is fundamentally different from other types of Auto-Tuning features used in servo systems.
- Auto-Tuning requires the user to input data from the motor nameplate. Make sure the information written on the nameplate is available before Auto-Tuning the drive.
- For best performance, be sure the drive input supply voltage equals or exceeds the motor rated voltage.

  Note: Performance can be enhanced by using a motor with a base voltage that is 20 V (40 V for 400 V class models) lower than the input supply voltage. This may be of special importance when operating the motor above 90% of base speed, where high torque precision is required.
- To cancel Auto-Tuning, press the STOP key on the LED operator.
- ***Table 4.19*** describes digital input and output terminal status during Auto-Tuning.

Table 4.19 Digital Input and Output Operation During Auto-Tuning

Auto-Tuning Type	Digital Input	Digital Output
Rotational Auto-Tuning for V/f Control	Not available	Functions the same as during normal operation
Rotational Auto-Tuning for SV Control	Not available	Functions the same as during normal operation
Stationary Auto-Tuning for Line-to-Line Resistance	Not available	Maintains the status at the start of Auto-Tuning

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

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

■ Notes on Rotational Auto-Tuning

- For optimal performance, Auto-Tuning should only be done with the motor uncoupled from the load for applications requiring high performance over a wide speed range.
- Performing Rotational Auto-Tuning with a higher load will set motor parameters incorrectly, and can cause irregular motor rotation.
- Ensure the motor-mounted brake is fully released if installed.
- Connected machinery should be allowed to rotate the motor.

■ Notes on Stationary Auto-Tuning for Terminal Resistance Only

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

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

◆ Auto-Tuning Interruption and Fault Codes

If tuning results are abnormal or the STOP key is pressed before completion, Auto-Tuning will be interrupted and a fault code will be displayed on the digital operator.

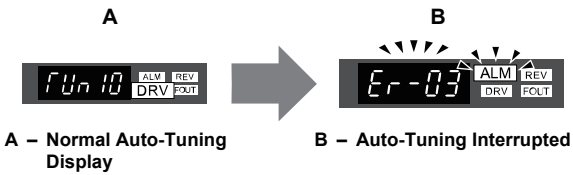


Figure 4.15 Auto-Tuning Interruption Display

◆ Performing Auto-Tuning

■ Auto-Tuning Procedure

Auto-Tuning should generally be performed in the following steps.

1. ***Refer to Before Auto-Tuning the Drive on page 107***.
2. Determine which type of Auto-Tuning best fits the application requirements following ***Figure 4.16***.

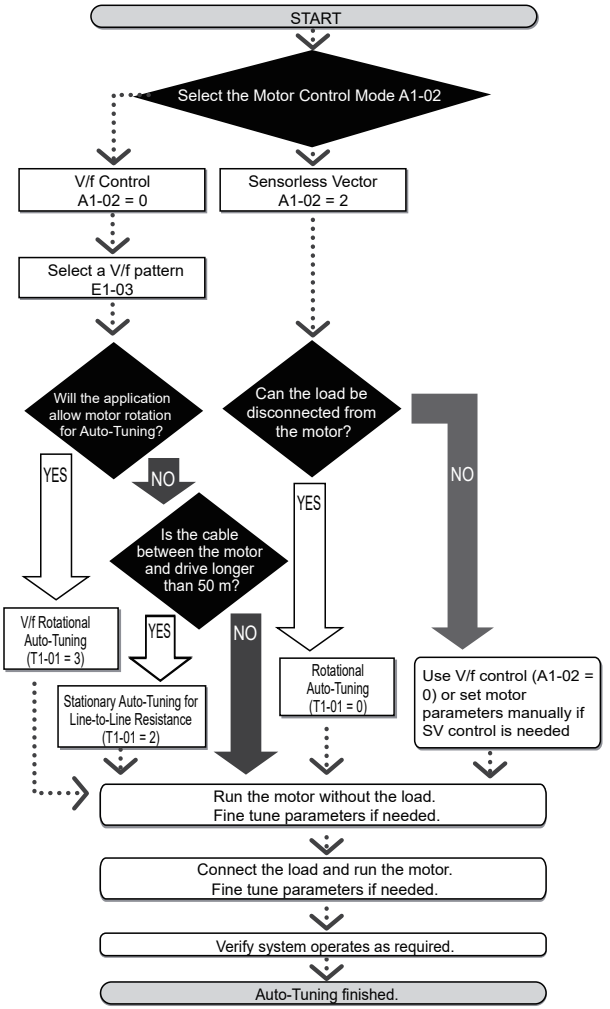


Figure 4.16 Auto-Tuning Selection

3. Enter the type of Auto-Tuning to parameter T1-01.

4. Enter the motor nameplate data.

5. Start the Auto-Tuning process when prompted by the drive.
6. If Auto-Tuning was successfully performed, do a test run without the load and make any necessary parameter adjustments.
7. If the test run was successful, do a test run with the load connected and make parameter adjustments if necessary.

◆ Auto-Tuning Example

The following example illustrates how to perform Rotational Auto-Tuning for Sensorless Vector Control (A1-02 = 2).

■ Set the Selected Type of Auto-Tuning

Step			Display/Result
1.	Turn on the power to the drive. The initial display appears.	→	
2.	Press the V key until the Auto-Tuning display appears.	→	
3.	Press ENTER to begin setting parameters.	→	
4.	Press ENTER to display the value for T1-01.	→	
5.	Press RESET to select the digit to edit.	→	
6.	Press ∧ and set the drive to perform Rotational Auto-Tuning (00).	→	
7.	Save the setting by pressing ENTER.	→	
8.	The display automatically returns to the display shown in Step 3.	→	

■ Enter Data from the Motor Nameplate

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

Note: These instructions continue from Step 8 in "Set the Selected Type of Auto-Tuning".

Step			Display/Result
1.	Press ∧ to access the motor output power parameter T1-02.	→	T1-02
2.	Press ENTER to view the default setting.	→	000.40
3.	Press RESET to select the digit to edit.	→	000.40
4.	Press ∧ and enter the motor power nameplate data in kW.	→	000.20
5.	Press ENTER to save the setting.	→	End
6.	The display automatically returns to the display in Step 1.	→	T1-02
7.	Repeat Steps 1 through 5 to set the following parameters: • T1-03, Motor Rated Voltage • T1-04, Motor Rated Current • T1-05, Motor Base Frequency • T1-06, Number of Motor Poles • T1-07, Motor Base Speed	→	T1-03 ⋮ T1-10

Note: 1. For the details on each setting, ***Refer to Input Data for Auto-Tuning on page 116***.

2. For Stationary Auto-Tuning for Line-to-Line resistance only, set T1-02 and T1-04.

■ Starting Auto-Tuning

WARNING! *Sudden Movement Hazard. The drive and motor may start unexpectedly during Auto-Tuning, which could result in death or serious injury. Ensure the area surrounding the drive motor and load are clear before proceeding with Auto-Tuning.*

WARNING! *Electrical Shock Hazard. High voltage will be supplied to the motor when Stationary Auto-Tuning is performed even with the motor stopped, which could result in death or serious injury. Do not touch the motor until Auto-Tuning has been completed.*

NOTICE: *Rotational Auto-Tuning will not function properly if a holding brake is engaged on the load. Failure to comply could result in improper operation of the drive. Ensure the motor can freely spin before beginning Auto-Tuning.*

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

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

Note: These instructions continue from Step 7 in "Enter Data from the Motor Nameplate".

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

◆ Input Data for Auto-Tuning

The T1-☐☐ parameters are used to set the Auto-Tuning input data.

Note: 1. Cycling power to the drive will reset the T1-07 (Motor Base Speed), set during the Auto-Tuning process to factory defaults.

2. For motors that are to be operated in the field weakening range, first perform the Auto-Tuning with the base data, i.e. the frequency at which the motor is operating with its rated voltage (base frequency). After Auto-Tuning is complete, change the maximum frequency E1-04 to the desired value.

■ T1-00: Motor 1/Motor 2 Selection

Selects the motor to be tuned when motor 1/2 switching is enabled, i.e., a digital input is set for function H1-☐☐ = 16. This parameter is not displayed if motor 1/2 switching is disabled.

No.	Name	Setting Range	Default
T1-00	Motor 1/2 Selection	1 or 2	1

Setting 1: Motor 1

Auto-Tuning automatically sets parameters E1-☐☐ and E2-☐☐ for motor 1.

Setting 1: Motor 2

Auto-Tuning automatically sets parameters E3-☐☐ and E4-☐☐ for motor 2. Make sure that motor 2 is connected to the drive for Auto-Tuning.

■ T1-01: Tuning Mode Selection

Sets the type of Auto-Tuning to be used. *Refer to Types of Auto-Tuning on page 107* for details on different types of Auto-Tuning.

No.	Name	Setting Range	Default
T1-01	Auto-Tuning Mode Selection	0, 2 (SV) 2, 3 (V/f)	0 (SV) 2 (V/f)

Setting 0: Rotating Auto-Tuning for Sensorless Vector Control

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

Setting 3: Rotating Auto-Tuning for V/f Control

■ T1-02: Motor Rated Power

Used to set the motor rated power according to the motor nameplate value. For optimal performance, the motor rated power should be between 50 and 100% of the drive rating.

No.	Name	Setting Range	Default
T1-02	Motor Rated Power	0.03~650.00	Determined by o2-04 and C6-01

■ T1-03: Motor Rated Voltage (T1-01 = 0 or 3)

Used to set the motor rated voltage according to the motor nameplate value. If the motor is used above its base speed, enter the voltage at base speed here.

For higher tuning precision and better control performance, enter the motor no-load voltage here if known. The motor no-load voltage is referred as to the voltage needed to operate the motor under no-load condition at its rated speed. Refer to the motor data sheet.

No.	Name	Setting Range	Default
T1-03	Motor Rated Voltage	0.0 to 255.5 V *<1>*	200.0 V *<1>*

<1> Values shown here are for 200 V class drives. Double values when using a 400 V class drive.

■ T1-04: Motor Rated Current

Used to set the motor rated current according to the motor nameplate value. For optimal performance in Sensorless Vector Control, the motor rated current should be between 50 and 100% of the drive rating. Enter the current at the motor base speed.

No.	Name	Setting Range	Default
T1-04	Motor Rated Current	10 to 200% of drive rated current	Determined by o2-04 and C6-01

■ T1-05: Motor Rated Frequency (T1-01 = 0 or 3)

Used to set the motor rated frequency according to the motor nameplate value. If a motor with an extended speed range is used or the motor is used in the field weakening area, enter the base frequency here.

For higher tuning precision and better control performance, enter the motor no-load frequency here if known. The "no-load frequency" refers to the frequency needed to operate the motor under no-load condition at its rated speed. Refer to the motor data sheet.

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

■ T1-06: Number of Motor Poles (T1-01 = 0 or 3)

Used to set the number of motor poles according to the motor nameplate value.

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

■ T1-07: Motor Base Speed (T1-01 = 0 or 3)

Used to set the motor rated speed according to the motor nameplate value. If a motor with an extended speed range is used or the motor is used in the field weakening area, enter the speed at base frequency here.

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

■ T1-11: Motor Iron Loss (T1-01 = 3)

Provides iron loss information for determining the Energy Saving coefficient. If E2-10 has been changed and the power has been cycled, the value set to E2-10 will appear as the default in T1-11. If the value of T1-02 is not changed during Auto-Tuning data input, the drive will select a value that is typical for the motor power entered to T1-02.

No.	Name	Setting Range	Default
T1-11	Motor Iron Loss	0 to 65535 W	Determined by o2-04 and C6-01

4.8 No-Load Operation Test Run

◆ No-Load Operation Test Run

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

■ Before Starting the Motor

Check the following items before operation:

- Ensure the area around the motor is safe.
- Ensure external emergency stop circuitry is working properly and other safety precautions have been taken.

■ During Operation

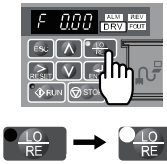
Check the following items during operation:

- The motor should rotate smoothly (i.e., no abnormal noise or oscillation).
- The motor should accelerate and decelerate smoothly.

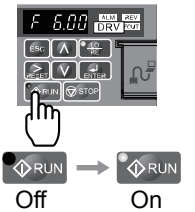
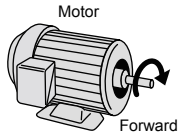
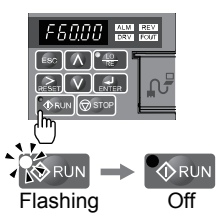
■ No-Load Operation Instructions

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

Note: Before starting the motor, set the frequency reference d1-01 to 6 Hz.

Step			Display/Result
1.	Turn on the power to the drive. The initial display appears.	➡	
2.	Press the LO/RE key to select LOCAL. The LO/RE LED will turn on.	➡	

4.8 No-Load Operation Test Run

Step			Display/Result
3.	Press RUN to give the drive a Run command. RUN will light and the motor will rotate at 6 Hz.	➡	
4.	Ensure the motor is rotating in the correct direction and no faults or alarms occur.	➡	
5.	If there is no error in step 4, press ∧ to increase the frequency reference. Increase the frequency in 10 Hz increments verifying smooth operation results at all speeds. For each frequency, monitor the drive output current (U1-03) through the LED operator to confirm the current is well below the motor rated current. Example: 6 Hz → 60 Hz.	–	–
6.	The drive should operate normally. Press STOP to stop the motor. RUN flashes until the motor comes to a complete stop.	➡	

4.9 Test Run with Load Connected

◆ Test Run with the Load Connected

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

■ Notes on Connected Machinery

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

■ Checklist Before Operation

- The motor should rotate in the proper direction.
- The motor should accelerate and decelerate smoothly.

■ Operating the Motor under Loaded Conditions

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

- Check monitor parameter U1-03 to ensure there is no overcurrent.
- If the application permits running the load in the reverse direction, try changing motor direction and the frequency reference while watching for abnormal motor oscillation or vibration.
- Correct any problems that occurs with hunting, oscillation, or other control-related issues.

4.10 Test Run Checklist

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

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

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

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

☑	No.	Checklist	Page
V/f Control (A1-02 = 0)			
☐	4	Select the best V/f pattern according to the application and motor characteristics. Example: If using a motor with a rated frequency of 60.0 Hz, set E1-03 to "1".	–
☐	5	Perform Auto-Tuning for Energy Savings if using Energy Saving functions.	*110*
Sensorless Vector Control (A1-02 = 2)			
☐	6	Uncouple the load from the motor when performing Rotational Auto-Tuning.	*110*
☐	7	Perform Rotational Auto-Tuning.	*110*
☐	8	The following data entered during Auto-Tuning should match the information written on the motor nameplate: • motor rated output power (kW) → T1-02 • rated voltage (V) → T1-03 • rated current (A) → T1-04 • base frequency (Hz) → T1-05 • number of motor poles → T1-06 • motor rotations per minutes (r/min) → T1-07	–

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

☑	No.	Checklist	Page
☐	10	The DRV should illuminate after giving a run command.	–
☐	11	To give a run command and frequency reference from the LED Digital Operator, press LO/RE to set to LOCAL. The LO/RE key lights while LOCAL is displayed.	*84*
☐	12	If the motor rotates in the opposite direction during the test run, switch two of the drive output terminals (U/T1, V/T2, W/T3).	*91*
☐	13	Select the correct duty rating (C6-01) for the application.	–
☐	14	Set the correct values for the Electrothermal Level Setting 1 (L1-08) and the motor protection selection (L1-01) to ensure motor thermal protection.	–
☐	15	If the run command and frequency reference are provided via the control circuit terminals, set the drive for REMOTE and be sure the LO/RE light is out.	*84*
☐	16	If the control circuit terminals should supply the frequency reference, select the correct voltage input signal level (0 to 10 V) or the correct current input signal level (4 to 20 mA or 0 to 20 mA).	*84*
☐	17	Set the proper voltage to terminal A1. (0 to 10 V).	–
☐	18	Set the proper current to terminal A2. (4 to 20 mA or 0 to 20 mA).	–
☐	19	When current input is used, set H3-09 to "2" (4 to 20 mA) or "3" (0 to 20 mA) and set H3-10 to "0".	–
☐	20	When current input is used, switch the drive built-in DIP switch S1 from the V-side (OFF) to I-side (ON).	–
☐	21	Set the minimum and maximum frequency references to the desired values. Make the following adjustments if the drive does not operate as expected: Gain adjustment: Set the maximum voltage/current signal and adjust the analog input gain (H3-03 for input A1, H3-11 for input A2) until the frequency reference value reaches the desired value. Bias adjustment: Set the minimum voltage/current signal and adjust the analog input bias (H3-04 for input A1, H3-12 for input A2) until the frequency reference value reaches the desired minimum value.	–

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5

Troubleshooting

This chapter provides descriptions of the drive faults, alarms, errors, related displays, and possible solutions. This chapter can also serve as a reference guide for tuning the drive during a trial run.

5.1 Drive Alarms, Faults, and Errors

◆ Types of Alarms, Faults, and Errors

Table 5.1 Types of Alarms, Faults, and Errors

Type	Drive Responses to Alarms, Faults, and Errors
Faults	When the drive detects a fault: • The digital operator displays text that indicates the specific fault and the ALM indicator LED remains lit until the fault is reset. • The fault interrupts drive output and the motor coasts to a stop. • Depending on the setting, the drive and motor may stop via different methods than listed. • If a digital output is programmed for fault output (H2-□□ = E), it will close if a fault occurs. When the drive detects a fault, it will remain inoperable until that fault has been reset. ***Refer to Fault Reset Methods on page 153***.
Minor Faults and Alarms	When the drive detects an alarm or a minor fault: • The digital operator displays text that indicates the specific alarm or minor fault and the ALM indicator LED flashes. • The motor does not stop. • One of the multi-function contact outputs closes if set to be tripped by a minor fault (H2-□□ = 10), but not by an alarm. • The digital operator displays text indicating a specific alarm and ALM indicator LED flashes. Remove the cause of an alarm or minor fault to automatically reset.
Operation Errors	When parameter settings conflict with one another or do not match hardware settings (such as with an option card), it results in an operation error. When the drive detects an operation error: • The digital operator displays text that indicates the specific error. • Multi-function contact outputs do not operate. When the drive detects an operation error, it will not operate the motor until the error has been reset. Correct the settings that caused the operation error to reset.
Tuning Errors	Tuning errors occur while performing Auto-Tuning. When the drive detects a tuning error: • The digital operator displays text indicating the specific error. • Multi-function contact outputs do not operate. • Motor coasts to stop. • Remove the cause of the error and repeat the Auto-Tuning process.

5.2 Fault Detection

◆ Fault Displays, Causes, and Possible Solutions

Table 5.2 Detailed Fault Displays, Causes, and Possible Solutions

LED Operator Display		Fault Name
bUS	bUS	Option Communication Error
		• After establishing initial communication, the connection was lost. • Only detected when the run command frequency reference is assigned to an option card.
Cause		**Possible Solution**
No signal received from the PLC.		• Check for faulty wiring. • Correct the wiring. • Check for loose wiring and short circuits. Repair as needed.
The communication cable is faulty or a short circuit exists.		
A communications data error occurred due to noise.		• Check the various options available to minimize the effects of noise. • Counteract noise in control circuit, main circuit, and ground wiring. • Ensure that other equipment such as switches or relays do not cause noise and use surge suppressors if required. • Use cables of shielded line. Ground the shield on the controller side or on the drive input power side. • Separate all wiring for communications devices from drive input power lines. Install an EMC noise filter to the input side of the drive input power.
The option card is damaged.		• Replace the option card if there are no problems with the wiring and the error continues to occur.
The option card is not properly connected to the drive.		• The connector pins on the option card are not properly lined up with the connector pins on the drive. • Reinstall the option card.
LED Operator Display		**Fault Name**
CE	CE	MEMOBUS/Modbus Communication Error
		Control data was not received for the CE detection time set to H5-09.
Cause		**Possible Solution**
Faulty communications wiring, or a short circuit exists.		• Check for faulty wiring. • Correct the wiring. • Check for loose wiring and short circuits. Repair as needed.

A communications data error occurred due to noise.	• Check the various options available to minimize the effects of noise. • Counteract noise in control circuit, main circuit, and ground wiring. • Use cables of shielded line. Ground the shield on the controller side or on the drive input power side. • Ensure that other equipment such as switches or relays do not cause noise and use surge suppressors if required. • Separate all wiring for communications devices from drive input power lines. Install an EMC noise filter to the input side of the drive input power.
LED Operator Display	**Fault Name**
CF	Control Fault
	A torque limit was reached continuously for three seconds or longer during a ramp to stop while in Sensorless Vector Control.
Cause	**Possible Solution**
Motor parameters are not set properly.	Check the motor parameter settings and repeat Auto-Tuning.
Torque limit is too low.	Set the torque limit to the most appropriate setting (L7-01 through L7-04).
Load inertia is too big.	• Adjust the deceleration time (C1-02, -04, -06, -08). • Set the frequency to the minimum value and interrupt the run command when the drive finishes decelerating.
LED Operator Display	**Fault Name**
CoF	Current Offset Fault
	The current sensor is damaged or there was residual induction current in the motor (e.g., during sudden deceleration or when coasting) when the drive attempted to start the motor.
Cause	**Possible Solution**
Due to residual induction current in the motor when the drive attempted to start the motor, the drive attempted to adjust the current offset value beynd the allowable range.	• Create a motor restart sequence that allows enough time for the residual induction voltage to dissipate. • Enable Speed Search at start (b3-01 = 1). Use the multi-function terminals to execute External Speed Search 1 and 2 (H1-□□ = 61 or 62).
LED Operator Display	**Fault Name**
CPF02	A/D Conversion Error 1
	An A/D conversion error occurred.
Cause	**Possible Solution**
Control circuit is damaged.	Cycle power to the drive. If the problem continues, replace the drive.
Control circuit terminals have shorted out (+V, AC).	• Check for wiring errors along the control circuit terminals. • Correct the wiring.
	Check the resistance of the speed potentiometer and related wiring.
Control terminal input current has exceeded allowable levels.	• Check the input current. • Reduce the current input to control circuit terminal (+V) to 20 mA.

LED Operator Display		Fault Name
CPF03	CPF03	PWM Data Error
		There is a problem with the PWM data.
Cause		**Possible Solution**
Drive hardware is damaged.		Replace the drive.
LED Operator Display		**Fault Name**
CPF06	CPF06	EEPROM Data Error
		There is an error in the data saved to EEPROM.
Cause		**Possible Solution**
Control circuit is damaged.		Cycle power to the drive. If the problem continues, replace the drive.
The power supply was switched off when parameters were written (e.g., using a communications option card).		• Cycle power to the drive and check operation again. • Initialize the drive using A1-03. • If the problem persists after initializing the drive, replace the drive.
LED Operator Display		**Fault Name**
CPF07	CPF07	Terminal Board Communications Error
		A communication error occurred at the terminal board.
Cause		**Possible Solution**
There is a fault connection between the terminal board and control board.		Turn the power off and reconnect the control circuit terminals.
LED Operator Display		**Fault Name**
CPF08	CPF08	EEPROM Serial Communication Fault
		EEPROM communications are not functioning properly.
Cause		**Possible Solution**
Terminal board or control board is not connected properly.		Turn the power off and check the control terminal connections.
LED Operator Display		**Fault Name**
CPF11	CPF11	RAM Fault
Cause		**Possible Solution**
Hardware is damaged.		Replace the drive.
LED Operator Display		**Fault Name**
CPF12	CPF12	FLASH Memory Fault
		Problem with the ROM (FLASH memory).
Cause		**Possible Solution**
Hardware is damaged.		Replace the drive.

LED Operator Display		Fault Name
CPF 13	CPF13	Watchdog Circuit Exception
		Self-diagnostics problem.
Cause		**Possible Solution**
Hardware is damaged.		Replace the drive.
LED Operator Display		**Fault Name**
CPF 14	CPF14	Control Circuit Fault 1
		CPU error (CPU operates incorrectly due to noise, etc.)
Cause		**Possible Solution**
Hardware is damaged.		Replace the drive.
LED Operator Display		**Fault Name**
CPF 16	CPF16	Clock Fault
		Standard clock error.
Cause		**Possible Solution**
Hardware is damaged.		Replace the drive.
LED Operator Display		**Fault Name**
CPF 17	CPF17	Timing Fault
		A timing error occurred during an internal process.
Cause		**Possible Solution**
Hardware is damaged.		Replace the drive.
LED Operator Display		**Fault Name**
CPF 18	CPF18	Control Circuit Fault 2
		CPU error. Non-Maskable Interrupt (An unusual interrupt was triggered by oise, etc.)
Cause		**Possible Solution**
Hardware is damaged.		Replace the drive.
LED Operator Display		**Fault Name**
CPF 19	CPF19	Control Circuit Fault 3
		CPU error (Manual reset due to noise, etc.)
Cause		**Possible Solution**
Hardware is damaged.		Replace the drive.

LED Operator Display		Fault Name
CPF20 or CPF21	CPF20 or CPF21	One of the following faults occurred: RAM fault, FLASH memory error, watchdog circuit exception, clock error
		• RAM fault. • FLASH memory error (ROM error). • Watchdog circuit exception (self-diagnostic error). • Clock error.
Cause		**Possible Solution**
Hardware is damaged.		Replace the drive.
LED Operator Display		**Fault Name**
CPF22	CPF22	A/D Conversion Fault 2
		A/D conversion error.
Cause		**Possible Solution**
Control circuit is damaged.		• Cycle power to the drive. ***Refer to Diagnosing and Resetting Faults on page153***. • If the problem continues, replace the drive.
LED Operator Display		**Fault Name**
CPF23	CPF23	PWM Feedback Fault
		PWM feedback error.
Cause		**Possible Solution**
Hardware is damaged.		Replace the drive.
LED Operator Display		**Fault Name**
CPF24	CPF24	Drive Capacity Signal Fault
		Entered a capacity that does not exist. (Checked when the drive is powered up.)
Cause		**Possible Solution**
Hardware is damaged.		Replace the drive.
LED Operator Display		**Fault Name**
CPF25	CPF25	Terminal Board Not Connected
Cause		**Possible Solution**
Terminal board is not connected correctly.		Reconnect the terminal board to the connector on the drive, then cycle the power to the drive.
LED Operator Display		**Fault Name**
dEv	dEv	Speed Deviation (for Simple V/f with PG)
		According to the pulse input (RP), the speed deviation is greater than the setting in F1-10 for longer than the time set to F1-11.
Cause		**Possible Solution**
Load is too heavy.		Reduce the load.

Acceleration and deceleration times are set too short.		Increase the acceleration and deceleration times (C1-01 through C1-08).
The load is locked up.		Check the machine.
Parameters are not set appropriately.		Check the settings of parameters F1-10 and F1-11.
Motor brake engaged.		Ensure the motor brake releases properly.
LED Operator Display		**Fault Name**
EF0	EF0	Option Card External Fault
		An external fault condition is present.
Cause		**Possible Solution**
An external fault was received from the PLC with other than F6-03 = 3 "alarm only" (the drive continued to run after external fault).		• Remove the cause of the external fault. • Remove the external fault input from the PLC.
Problem with the PLC program.		Check the PLC program and correct problems.
LED Operator Display		**Fault Name**
EF1	EF1	External Fault (input terminal S1)
		External fault at multi-function input terminal S1.
EF2	EF2	External Fault (input terminal S2)
		External fault at multi-function input terminal S2.
EF3	EF3	External Fault (input terminal S3)
		External fault at multi-function input terminal S3.
EF4	EF4	External Fault (input terminal S4)
		External fault at multi-function input terminal S4.
EF5	EF5	External Fault (input terminal S5)
		External fault at multi-function input terminal S5.

EF6	EF6	External Fault (input terminal S6)
		External fault at multi-function input terminal S6.
EF7	EF7	External Fault (input terminal S7)
		External fault at multi-function input terminal S7
Cause		**Possible Solution**
An external device has tripped an alarm function.		Remove the cause of the external fault and reset the fault.
Wiring is incorrect.		• Ensure the signal lines have been connected properly to the terminals assigned for external fault detection (H1-□□ = 20 to 2F). • Reconnect the signal line.
Incorrect setting of multi-function contact inputs.		• Check if the unused terminals set for H1-□□ = 20 to 2F (External Fault). • Change the terminal settings.
LED Operator Display		**Fault Name**
Err	Err	EEPROM Write Error
		Data does not match the EEPROM being written to.
Cause		**Possible Solution**
-		•Press the ENTER button. • Correct the parameter settings. • Cycle power to the drive. ***Refer to Diagnosing and Resetting Faults on page 155.***
LED Operator Display		**Fault Name**
FbH	FbH	Excessive PID Feedback
		PID feedback input is greater than the level set b5-36 for longer than the time set to b5-37. To enable fault detection, set b5-12 = "2" or "5".
Cause		**Possible Solution**
Parameters are not set appropriately.		Check the settings of parameters b5-36 and b5-37.
Wiring for PID feedback is incorrect.		Correct the wiring.
There is a problem with the feedback sensor.		• Check the sensor on the control side. • Replace the sensor if damaged.
LED Operator Display		**Fault Name**
FbL	FbL	PID Feedback Loss
		This fault occurs when PID Feedback Loss Detection is programmed to fault (b5-12 = 2) and the PID Feedback < PID Feedback Loss Detection Level (b5-13) for the PID Feedback Loss Detection Time (b5-14).
Cause		**Possible Solution**
Parameters are not set appropriately.		Check the settings of parameters b5-13 and b5-14.

Wiring for PID feedback is incorrect.	Correct the wiring.
There is a problem with the feedback sensor.	Check the sensor on the controller side. If damaged, replace the sensor.
LED Operator Display	**Fault Name**
GF	Ground Fault
	• Current shorted to ground exceeded 50% of rated current on output side of the drive. • Setting L8-09 to 1 enables ground fault detection in models HF5202-3A7 to 7A5 and HF5204-3A7 to 7A5.
Cause	**Possible Solution**
Motor insulation is damaged.	• Check the insulation resistance of the motor. • Replace the motor.
A damaged motor cable is creating a short circuit.	• Check the motor cable. • Remove the short circuit and turn the power back on.
	• Check the resistance between the cable and the ground terminal ⏚ . • Replace the cable.
The leakage current at the drive output is too high.	• Reduce the carrier frequency. • Reduce the amount of stray capacitance.
The drive started to run during Current Offset Fault or while coasting to a stop.	• The value set exceeds the allowable setting range while the drive automatically adjusts the current offset (this happens only attempting to restart a PM motor that is coasting to stop). • Enable Speed Search at start (b3-01 = 1). • Perform Speed Search 1 or 2 (H1-□□ = 61 or 62) via one of the external terminals.
Hardware problem.	• Replace the drive.
LED Operator Display	**Fault Name**
LF	Output Phase Loss
	• Phase loss on the output side of the drive. • Phase Loss Detection is enabled when L8-07 is set to "1" or "2".
Cause	**Possible Solution**
The output cable is disconnected.	• Check for wiring errors and ensure the output cable is connected properly. • Correct the wiring.
The motor winding is damaged.	• Check the resistance between motor lines. • Replace the motor if the winding is damaged.
The output terminal is loose.	• Apply the tightening torque specified in this manual to fasten the terminals. ***Refer to Wire Size and Torque Specifications on page 65.***
The motor being used is less than 5% of the drive rated current.	Check the drive and motor capacities.
An output transistor is damaged.	Replace the drive.
A single-phase motor is being used.	The drive being used cannot operate a single phase motor.

LED Operator Display		Fault Name
LF2	LF2	Output current imbalance
		One or more of the phases in the output current is lost.
Cause		**Possible Solution**
Phase loss has occurred on the output side of the drive.		• Check for faulty wiring or poor connections on the output side of the drive. • Correct the wiring.
Terminal wires on the output side of the drive are loose.		Apply the tightening torque specified in this manual to fasten the terminals. ***Refer to Wire Size and Torque Specifications on page 65***.
No signal displays from the gate driver board.		Replace the drive.
Motor impedance or motor phases are uneven.		• Measure the line-to-line resistance for each motor phase. Ensure all values are the same. • Replace the motor.
LED Operator Display		**Fault Name**
nSE	nSE	Node Setup Error
		A terminal assigned to the node setup function closed during Run.
Cause		**Possible Solution**
The node setup terminal closed during Run.		• Check whether a Run command was accidentally entered via the terminals or from a comm. option unit. • Turn off the Run command when using the node setup function.
A Run command was issued while the node setup function was active.		
LED Operator Display		**Fault Name**
oC	oC	Overcurrent
		Drive sensors have detected an output current greater than the specified overcurrent level.
Cause		**Possible Solution**
The motor has been damaged due to overheating or the motor insulation is damaged.		• Check the insulation resistance. • Replace the motor.
One of the motor cables has shorted out or there is a grounding problem.		• Check the motor cables. • Remove the short circuit and power the drive back up.
		• Check the resistance between the motor cables and the ground terminal ⏚. • Replace damaged cables.
The load is too heavy.		• Measure the current flowing into the motor. • Replace the drive with a larger capacity unit if the current value exceeds the rated current of the drive. • Determine if there is sudden fluctuation in the current level. • Reduce the load to avoid sudden changes in the current level or switch to a larger drive.

The acceleration or deceleration times are too short.	Calculate the torque needed during acceleration relative to the load inertia and the specified acceleration time. If the right amount of torque cannot be set, make the following changes: • Increase the acceleration time (C1-01, -03, -05, -07). • Increase the S-curve characteristics (C2-01 through C2-04). • Increase the capacity of the drive.
The drive is attempting to operate a specialized motor or a motor larger than the maximum size allowed.	• Check the motor capacity. • Ensure that the rated capacity of the drive is greater than or equal to the capacity rating found on the motor nameplate.
Magnetic contactor (MC) on the output side of the drive has turned on or off.	Set up the operation sequence so that the MC is not tripped while the drive is outputting current.
V/f setting is not operating as expected.	• Check the ratios between the voltage and frequency. • Set parameter E1-04 through E1-10 appropriately. Set E3-04 through E3-10 when using a second motor. • Lower the voltage if it is too high relative to the frequency.
Excessive torque compensation.	• Check the amount of torque compensation. • Reduce the torque compensation gain (C4-01) until there is no speed loss and less current.
Drive fails to operate properly due to noise interference.	• Review the possible solutions provided for handling noise interference. • Review the section on handling noise interference and check the control circuit lines, main circuit lines and ground wiring.
Overexcitation gain is set too high.	• Check if fault occurs simultaneously to overexcitation function operation. • Consider motor flux saturation and reduce the value of n3-13 (Overexcitation Deceleration Gain).
Run command applied while motor was coasting.	• Enable Speed Search at start (b3-01 = "1"). • Program the Speed Search command input through one of the multi-function contact input terminals (H1-□□ = "61" or "62").
The motor control method and motor do not match.	Check which motor control method the drive is set to (A1-02). • For IM motors, set A1-02 = "0" or "2".
The motor cable is too long	Use a larger drive.
LED Operator Display	**Fault Name**
oFA00	Option Card Connection Error at Option Port CN5-A
	The option card is incompatible with the drive.
Cause	**Possible Solution**
The option card is incompatible with the drive.	Use a compatible option card.

LED Operator Display		Fault Name
oFA01	oFA01	Option Card Fault (Port A)
		Replace the option card.
Cause		**Possible Solution**
The option card is not connected properly to the drive.		Turn the power off and reconnect the option card.
LED Operator Display		**Fault Name**
oFA03	oFA03	Option Card Fault (port A)
		Option card self-diagnostic error
oFA04	oFA04	Option Card Fault (port A)
		An error occurred attempting to write to the option card memory.
oFA30 to oFA43	oFA30 to oFA43	Option Card Fault (port A)
		Communication ID error
Cause		**Possible Solution**
Option card or hardware is damaged.		Replace the option card. Contact Sumitomo for consultation.
LED Operator Display		**Fault Name**
oH	oH	Heatsink Overheat
		The temperature of the heatsink exceeded the value set to L8-02. Default value for L8-02 is determined by drive capacity (o2-04).
Cause		**Possible Solution**
Surrounding temperature is too high.		• Check the temperature surrounding the drive. Verify temperature is within drive specifications. • Improve the air circulation within the enclosure panel. • Install a fan or air conditioner to cool the surrounding area. • Remove anything near the drive that might be producing excessive heat.
Load is too heavy.		• Measure the output current. • Decrease the load. • Lower the carrier frequency (C6-02).
Internal cooling fan is stopped.		• Replace the cooling fan. • After replacing the drive, reset the cooling fan maintenance parameter (o4-03 = "0").
LED Operator Display		**Fault Name**
oH1	oH1	Overheat 1 (Heatsink Overheat)
		The temperature of the heatsink has exceeded 10 °C plus the default value of L8-02.
Cause		**Possible Solution**

Surrounding temperature is too high.	• Check the temperature surrounding the drive. • Improve the air circulation within the enclosure panel. • Install a fan or air conditioner to cool the surrounding area. • Remove anything near the drive that might be producing excessive heat.
Load is too heavy.	• Measure the output current. • Lower the carrier frequency (C6-02). • Reduce the load.
The internal cooling fan has reached its performance life or has malfunctioned.	• Check the maintenance time for the cooling fan (U4-04). • If U4-04 exceeds 90%, replace the cooling fan. • After replacing fan, reset the fan maintenance time (o4-03 = "0").
Current flowing to control circuit terminal + V exceeded the tolerance level.	• Check the current level of the terminal. • Set the current to the control circuit terminal to be 20 mA or less.
LED Operator Display	**Fault Name**
oH3	Motor Overheat Alarm (PTC Input)
	• The motor overheat signal to analog input terminal A1 or A2 exceeded the alarm detection level. • Detection requires multi-function analog input H3-02 or H3-10 be set to "E".
Cause	**Possible Solution**
Motor has overheated	• Check the size of the load, the accel/decel times and the cycle times. • Decrease the load. • Increase the acceleration and deceleration times (C1-01 through C1-08).
	• Adjust the preset V/f pattern (E1-04 through E1-10). This will mainly involve reducing E1-08 and E1-10. • Be careful not to lower E1-08 and E1-10 excessively, as this reduces load tolerance at low speeds.
	• Check the motor-rated current. • Enter the motor-rated current as indicated on the motor nameplate (E2-01). • Ensure the motor cooling system is operating normally. • Repair or replace the motor cooling system.
LED Operator Display	**Fault Name**
oH4	Motor Overheat Fault (PTC Input)
	• The motor overheat signal to analog input terminal A1 or A2 exceeded the fault detection level. • Detection requires that multi-function analog input H3-02 or H3-10 = "E".
Cause	**Possible Solution**

Motor has overheated.	• Check the size of the load, the accel/decel times and the cycle times. • Decrease the load. • Increase the acceleration and deceleration times (C1-01 through C1-08).
	• Adjust the preset V/f pattern (E1-04 through E1-10). This will mainly involve reducing E1-08 and E1-10. Be careful not to lower E1-08 and E1-10 excessively because this reduces load tolerance at low speeds.
	• Check the motor-rated current. • Enter the motor-rated current as indicated on the motor nameplate (E2-01). • Ensure the motor cooling system is operating normally. • Repair or replace the motor cooling system.
LED Operator Display	**Fault Name**
oL 1 oL1	Motor Overload
	The electrothermal sensor tripped overload protection. **Note:** The U4-16 value must be less than 100 before oL1 can be reset.
Cause	**Possible Solution**
Load is too heavy.	Reduce the load.
Cycle times are too short during acceleration and deceleration.	Increase the acceleration and deceleration times (C1-01 through C1-08).
• Drive overloaded at low speeds. • Overload may occur at low speeds when using a general-purpose motor, even if operating within the rated current limitation.	• Reduce the load. • Increase the speed. • If the drive is supposed to operate at low speeds, either increase the motor capacity or use a motor specifically designed to operate with the drive.
Although a special type of motor is being used, the motor protection selection is set for a general-purpose motor (L1-01 = 1).	Set L1-01 = "2".
Voltage is too high for the V/f characteristics.	• Adjust the user set V/f patterns (E1-04 through E1-10). Parameters E1-08 and E1-10 may need to be reduced. • If E1-08 and E1-10 are set too high, there may be very little load tolerance at low speed.
The wrong motor-rated current is set to E2-01.	• Check the motor-rated current. • Enter the value written on the motor nameplate to parameter E2-01.
The motor base frequency for the drive input power is set too low.	• Check the rated frequency indicated on the motor nameplate. • Enter the rated frequency to E1-06 (Base Frequency).
Multiple motors are running off the same drive.	Disable the Motor Protection function (L1-01 = "0") and install a thermal relay to each motor.
The electrical thermal protection characteristics and motor overload characteristics do not match.	• Check the motor characteristics. • Correct the value set to L1-01 (Motor Protection Function). • Install an external thermal relay.

The electrical thermal relay is operating at the wrong level.	• Check the current rating listed on the motor nameplate. • Check the value set for the Electrothermal Level Setting 1 (L1-08).
Motor overheated by overexcitation operation.	• Overexcitation increases the motor losses and the motor temperature. If applied too long, motor damage can occur. Prevent excessive overexcitation operation or apply proper cooling to the motor. • Reduce the excitation deceleration gain (n3-13). • Set L3-04 (Stall Prevention during Deceleration) to a value other than 4.
Speed Search related parameters are not set to the proper values.	• Check values set to Speed Search related parameters. • Adjust the Speed Search current and Speed Search deceleration times (b3-02 and b3-03 respectively). • After Auto-Tuning, enable Speed Estimation Type Search (b3-24 = "1").
Output current fluctuation due to input phase loss	Check the power supply for phase loss.
LED Operator Display	**Fault Name**
oL2	Drive Overload
	The thermal sensor of the drive triggered overload protection.
Cause	**Possible Solution**
Load is too heavy.	Reduce the load.
Cycle times are too short during acceleration and deceleration.	Increase the settings for the acceleration and deceleration times (C1-01 through C1-08).
Voltage is too high for the V/f characteristics.	• Adjust the preset V/f pattern (E1-04 through E1-10). This will mainly involve reducing E1-08 and E1-10. • Be careful not to lower E1-08 and E1-10 excessively because this reduces load tolerance at low speeds.
Drive capacity is too small.	Replace the drive with a larger model.
Overload occurred when operating at low speeds.	• Reduce the load when operating at low speeds. • Replace the drive with a model that is one frame size larger. • Lower the carrier frequency (C6-02).
Excessive torque compensation.	Reduce the torque compensation gain (C4-01) until there is no speed loss but less current.
Speed Search related parameters are not set correctly.	• Check the settings for all Speed Search related parameters. • Adjust the current used during Speed Search and the Speed Search deceleration time (b3-03 and b3-02 respectively). • After Auto-Tuning the drive, enable the Speed Search Estimation Type (b3-24 = "1").
Output current fluctuation due to input phase loss	Check the power supply for phase loss.
LED Operator Display	**Fault Name**
oL3	Overtorque Detection 1
	The current has exceeded the value set for torque detection (L6-02) for longer than the allowable time (L6-03).
Cause	**Possible Solution**

Parameter settings are not appropriate for the type of load.	Check the settings of parameters L6-02 and L6-03.
There is a fault on the machine side (e.g., the machine is locked up).	Check the status of the load. Remove the cause of the fault.
LED Operator Display	**Fault Name**
oL4	Overtorque Detection 2
	The current has exceeded the value set for Overtorque Detection 2 (L6-05) for longer than the allowable time (L6-06).
Cause	**Possible Solution**
Parameter settings are not appropriate for the type of load.	Check the settings of parameters L6-05 and L6-06.
LED Operator Display	**Fault Name**
oL5	Mechanical Weakening Detection 1
	Overtorque occurred, matching the conditions specified in L6-08.
Cause	**Possible Solution**
Overtorque occurred, triggering the mechanical weakening level set to L6-08.	Check for the cause of mechanical weakening.
LED Operator Display	**Fault Name**
oL7	High-Slip Braking oL
	The output frequency stayed constant for longer than the time set in n3-04 during High-slip Braking.
Cause	**Possible Solution**
Excessive load inertia. Motor is driven by the load. Something on the load side is restricting deceleration.	• Reduce deceleration times using parameters C1-02, -04, -06 and -08 in applications that do not use High-slip Braking. • Use a braking resistor to shorten deceleration time.
The overload time during High-slip Braking is too short.	• Increase parameter n3-04 (High-slip Braking Overload Time). • Install a thermal relay and increase the parameter setting of n3-04 to the maximum value.

LED Operator Display		Fault Name
oS	oS	Overspeed (Simple V/f with PG)
		Pulse input (RP) indicates that motor speed feedback exceeded F1-08 setting.
Cause		**Possible Solution**
Overshoot or undershoot is occurring.		• Adjust the gain by using the pulse train input parameters (H6-02 through H6-05). • Increase the settings for C5-01 (Speed Control Proportional Gain 1) and reduce C5-02 (Speed Control Integral Time 1).
Incorrect PG pulse settings.		Set the H6-02 (Pulse Train Input Scaling) = 100%, the frequency of the PG pulses at maximum motor speed.
Inappropriate parameter settings.		Check the setting for the overspeed detection level and the overspeed detection time (F1-08 and F1-09).
LED Operator Display		**Fault Name**
ov	ov	Overvoltage
		Voltage in the DC bus has exceeded the overvoltage detection level. • For 200 V class: approximately 410 V • For 400 V class: approximately 820 V (740 V when E1-01 is less than 400)
Cause		**Possible Solution**
Deceleration time is too short and regenerative energy flows from the motor into the drive.		• Increase the deceleration time (C1-02, -04, -06, -08). • Install a braking resistor or a dynamic braking resistor unit. • Enable stall prevention during deceleration (L3-04 = "1").
Fast acceleration time causes the motor to overshoot the speed reference.		• Check if sudden drive acceleration triggers an overvoltage alarm. • Increase the acceleration time. • Use longer S-curve acceleration and deceleration times.
Excessive braking load.		The braking torque was too high, causing regenerative energy to charge the DC bus. Reduce the braking torque, use a braking resistor, or lengthen decel time.
Surge voltage entering from the drive input power.		Install a DC reactor. **Note:** Voltage surge can result from thyristor convertor and phase advancing capacitor using same drive main input power supply.
Ground fault in the output circuit causing the DC bus capacitor to overcharge.		• Check the motor wiring for ground faults. • Correct grounding shorts and turn the power back on.

Improper Setting of Speed Search related parameters. (Includes Speed Search after a momentary power loss and after a fault restart.)	• Check the settings for Speed Search related parameters. • Enable Speed Search Retry function (b3-19 greater than or equal to 1 to 10). • Adjust the current level during Speed Search and the deceleration time (b3-02 and b3-03 respectively). • Perform Line-to-Line Resistance Auto-Tuning and then enable Speed Estimation Type Speed Search (b3-24 = 1).
Excessive regeneration when overshoot occurs after acceleration.	• Enable the Overvoltage Suppression function (L3-11 = 1). • Lengthen the S-curve at acceleration end.
Drive input power voltage is too high.	• Check the voltage. • Lower drive input power voltage within the limits listed in the specifications.
The dynamic braking transistor is damaged.	Replace the drive.
The braking transistor is wired incorrectly.	• Check braking transistor wiring for errors. • Properly rewire the braking resistor device.
Drive fails to operate properly due to noise interference.	• Review the list of possible solutions provided for controlling noise. • Review the section on handling noise interference and check the control circuit lines, main circuit lines and ground wiring.
Load inertia has been set incorrectly.	• Check the load inertia settings when using KEB, overvoltage suppression or Stall Prevention during deceleration. • Adjust L3-25 (Load Inertia Ratio) in accordance with the load.
Braking function is being used in PM Open Loop Vector Control.	Connect a braking resistor.
Motor hunting occurs.	• Adjust the parameters that control hunting. • Set the hunting prevention gain (n1-02). • Adjust the AFR time constant 1 (n2-02) and the AFR time constant 2 (n2-03) when in Sensorless Vector Control.
LED Operator Display	**Fault Name**
PF	Input Phase Loss
	Drive input power has an open phase or has a large imbalance of voltage between phases. Detected when L8-05 = 1 (enabled).
Cause	**Possible Solution**
There is phase loss in the drive input power.	• Check for wiring errors in the main circuit drive input power. • Correct the wiring.
There is loose wiring in the drive input power terminals.	• Ensure the terminals are tightened properly. • Apply the tightening torque specified in this manual to fasten the terminals. ***Refer to Wire Gauges and Tightening Torque on page 55*** for details.

There is excessive fluctuation in the drive input power voltage.	• Check the voltage from the drive input power. • Review the possible solutions for stabilizing the drive input power. • Disable Input Phase Loss Detection (L8-05 = "0"). PF is detected if DC bus ripple is too high. If it is disabled, there is no fault but the ripple is still too high, thereby the capacitors are stressed more and lose lifetime.
There is poor balance between voltage phases.	• Stabilize drive input power or disable phase loss detection.
The main circuit capacitors are worn.	• Check the maintenance time for the capacitors (U4-05). • Replace the drive if U4-05 is greater than 90%.
	• Check for anything wrong with the drive input power. • If nothing is wrong with the drive input power, try the following solutions if the alarm continues: • Disable Input Phase Loss Protection selection (L8-05 = "0"). PF is detected if DC bus ripple is too high. If it is disabled, there is no fault but the ripple is still too high, thereby the capacitors are stressed more and lose lifetime. • Replace the drive.
LED Operator Display	**Fault Name**
PGo	PG Disconnect (for Simple V/f with PG)
	No PG pulses are received for longer than the time set to F1-14.
Cause	**Possible Solution**
Pulse input (RP) is disconnected.	Reconnect the pulse input (RP).
Pulse input (RP) wiring is wrong.	Correct the wiring.
Motor brake engaged.	Ensure the motor brake releases properly.

LED Operator Display		Fault Name
rr	rr	Dynamic Braking Transistorrr
		The built-in dynamic braking transistor failed.
Cause		**Possible Solution**
The braking transistor is damaged.		• Cycle power to the drive and check if the fault reoccurs. ***Refer to Diagnosing and Resetting Faults on page 153***. • Replace the drive if the fault continues.
The control circuit is damaged.		
LED Operator Display		**Fault Name**
SC	SC	IGBT Short Circuit
Cause		**Possible Solution**
IGBT fault		• Check motor wiring • Cycle power to the drive. • Replace the drive if the fault continues.
IGBT short circuit detection and circuit fault		
LED Operator Display		**Fault Name**
SEr	SEr	Too Many Speed Search Restarts
		The number of speed search restarts exceeded the number set to b3-19.
Cause		**Possible Solution**
Speed Search parameters are set to the wrong values.		• Reduce the detection compensation gain during Speed Search (b3-10). • Increase the current level when attempting Speed Search (b3-17). • Increase the detection time during Speed Search (b3-18). • Repeat Auto-Tuning.
The motor is coasting in the opposite direction of the run command.		Enable Bi-directional Speed Search (b3-14 = "1").

LED Operator Display		Fault Name
UL3	UL3	Undertorque Detection 1
		The current has fallen below the minimum value set for torque detection (L6-02) for longer than the allowable time (L6-03).
Cause		**Possible Solution**
Parameter settings are not appropriate for the type of load.		Check the settings of parameters L6-02 and L6-03.
There is a fault on the machine side.		Check the load for any problems.
LED Operator Display		**Fault Name**
UL4	UL4	Undertorque Detection 2
		The current has fallen below the minimum value set for torque detection (L6-05) for longer than the allowable time (L6-06).
Cause		**Possible Solution**
Parameter settings are not appropriate for the type of load.		Check the settings of parameters L6-05 and L6-06.
There is a fault on the machine side.		Check the load for any problems.
LED Operator Display		**Fault Name**
UL5	UL5	Mechanical Weakening Detection 2
		The operation conditions matched the conditions set to L6-08.
Cause		**Possible Solution**
Undertorque was detected and matched the condition of mechanical loss detection operation selection (L6-08).		Check the load side for any problems.
LED Operator Display		**Fault Name**
Uv1	Uv1	DC Bus Undervoltage
		One of the following conditions occurred while the drive was in operation: • Voltage in the DC bus fell below the undervoltage detection level (L2-05). • For 200 V class: approximately 190 V (160 V for single phase drives) • For 400 V class: approximately 380 V (350 V when E1-01 is less than 400.) The fault is output only if L2-01 = 0 or L2-01 = 1 and the DC bus voltage is under L2-05 for longer than L2-02.
Cause		**Possible Solution**
Input power phase loss.		• The main circuit drive input power is wired incorrectly. • Correct the wiring.
One of the drive input power wiring terminals is loose.		• Ensure there are no loose terminals. • Apply the tightening torque specified in this manual to fasten the terminals. ***Refer to Wire Gauges and Tightening Torque on page 53*** for details.
There is a problem with the voltage from the drive input power.		• Check the voltage. • Correct the voltage to within range listed in drive input power specifications.
The power has been interrupted.		Correct the drive input power.

Drive internal circuitry has become worn.	• Check the maintenance time for the capacitors (U4-05). • Replace the drive if U4-05 exceeds 90%.
The drive input power transformer is not large enough and voltage drops after switching on power.	Check the capacity of the drive input power transformer.
Air inside the drive is too hot.	Check the drive internal temperature.
Problem with the CHARGE indicator.	Replace the drive.
LED Operator Display	**Fault Name**
Uv2	Control Power Supply Voltage Fault
	Voltage is too low for the control drive input power.
Cause	**Possible Solution**
L2-02 changed from its default value in drive that is 7.5 kW or smaller without installing a Momentary Power Loss Ride-Thru.	Correct parameter L2-02 setting or install optional Momentary Power Loss Ride- Thru unit.
The wiring for the control power supply is damaged.	• Cycle power to the drive. Check if the fault reoccurs. • Replace the drive if the fault continues to occur.
Internal circuitry is damaged.	• Cycle power to the drive. Check if the fault reoccurs. • Replace the drive if the fault continues to occur.
LED Operator Display	**Fault Name**
Uv3	Undervoltage 3 (Inrush Prevention Circuit Fault)
	The inrush prevention circuit has failed.
Cause	**Possible Solution**
The contactor on the inrush prevention circuit is damaged.	• Cycle power to the drive. Check if the fault reoccurs. • Replace the drive if the fault continues to occur. • Check monitor U4-06 for the performance life of the inrush prevention circuit. • Replace the drive if U4-06 exceeds 90%.

5.3 Alarm Detection

◆ Alarm Codes, Causes, and Possible Solutions

Table 5.3 Alarm Codes, Causes, and Possible Solutions

LED Operator Display		Minor Fault Name
AEr	AEr	Station Address Setting Error (CC-Link)
		Option card node address is outside the acceptable setting range.
bb	bb	Baseblock
		Drive output interrupted as indicated by an external baseblock signal.
bUS	bUS	Option Communication Error
		• After initial communication was established, the connection was lost. • Assign a Run command frequency reference to the option card.
CALL	CALL	Serial Communication Transmission Error
		Communication has not yet been established.
CE	CE	MEMOBUS/Modbus Communication Error
		Control data was not received correctly for two seconds.
CrST	CrST	Can Not Reset
dEv	dEv	Speed Deviation (for Simple V/f with PG)
		According to the pulse input (RP), the speed deviation is greater than the setting in F1-10 for a time longer than the setting in F1-11.
dnE	dnE	Drive Disabled
EF	EF	Forward/Reverse Run Command Input Error
		Both forward run and reverse run closed simultaneously for over 0.5 s.
EF0	EF0	Option Card External Fault
		An external fault condition is present.
EF1	EF1	External fault (input terminal S1)
		External fault at multi-function input terminal S1.
EF2	EF2	External fault (input terminal S2)
		External fault at multi-function input terminal S2.
EF3	EF3	External fault (input terminal S3)
		External fault at multi-function input terminal S3.

EF4	EF4	External fault (input terminal S4)
		External fault at multi-function input terminal S4.
EF5	EF5	External fault (input terminal S5)
		External fault at multi-function input terminal S5.
EF6	EF6	External fault (input terminal S6)
		External fault at multi-function input terminal S6.
EF7	EF7	External fault (input terminal S7)
		External fault at multi-function input terminal S7.
FbH	FbH	Excessive PID Feedback
		The PID feedback input is higher than the level set in b5-36 for longer than the time set in b5-37, and b5-12 is set to 1 or 4.
FbL	FbL	PID Feedback Loss
		The PID feedback input is lower than the level set in b5-13 for longer than the time set in b5-14, and b5-12 is set to 1 or 4.
Hbb	Hbb	Safe Disable Signal Input
		The Safe Disable Input channel is open.
HbbF	HbbF	Safe Disable Signal Input
		One of the Safe Disable input channels is open.
HCA	HCA	Current Alarm
		Drive current exceeded overcurrent warning level (150% of the rated current).
LT-1	LT-1	Cooling Fan Maintenance Time
		The cooling fan has reached its expected maintenance period and may need to be replaced. **Note:** An alarm output (H2-□□ = 10) will only be triggered if H2-□□ = 2F.
LT-2	LT-2	Capacitor Maintenance Time
		The main circuit and control circuit capacitors are nearing the end of their expected performance life. **Note:** An alarm output (H2-□□ = 10) will only be triggered if H2-□□ = 2F.
LT-3	LT-3	Soft Charge Bypass Relay Maintenance Time
		The DC bus soft charge relay is nearing the end of its expected performance life. **Note:** An alarm output (H2-□□ = 10) will only be triggered if H2-□□ = 2F.
LT-4	LT-4	IGBT Maintenance Time (50%)
		IGBTs have reached 50% of their expected performance life. **Note:** An alarm output (H2-□□ = 10) will only be triggered if H2-□□ = 2F.
oH	oH	Heatsink Overheat
		The temperature exceeded the value set to L8-02.
oH2	oH2	Drive Overheat Warning
		"Drive Overheat Warning" was input to a multi-function input terminal, S1 through S7 (H1-□□= B).

5.3 Alarm Detection

oH3	oH3	Motor Overheat
		The motor overheat signal entered to a multi-function analog input terminal exceeded the alarm level (H3-02 or H3-10 = E).
oL3	oL3	Overtorque 1
		Drive output current (or torque in SV) was greater than L6-02 for longer than the time set in L6-03.
oL4	oL4	Overtorque 2
		Drive output current (or torque in SV) was greater than L6-05 for longer than the time set in L6-06.
oL5	oL5	Mechanical Weakening Detection 1
		Overtorque occurred, matching the conditions specified in L6-08.
oS	oS	Overspeed (for Simple V/f with PG)
		Pulse input (RP) indicates that motor speed feedback exceeded F1-08 setting.
ov	ov	DC Bus Overvoltage
		The DC bus voltage exceeded the trip point. For 200 V class: approximately 410 V For 400 V class: approximately 820 V (740 V when E1-01 < 400)
PGo	PGo	PG Disconnect (for Simple V/f with PG)
		Detected when no PG pulses received for a time longer than setting in F1-14.
rUn	rUn	Motor Switch during Run
		A command to switch motors was entered during run.
SE	SE	MEMOBUS/Modbus Communication Test Mode Error
TrPC	TrPC	IGBT Maintenance Time (90%)
		IGBTs have reached 90% of their expected performance life.
UL3	UL3	Undertorque Detection 1
		Drive output current (or torque in SV) less than L6-02 for longer than L6-03 time.
UL4	UL4	Undertorque Detection 2
		Drive output current (or torque in SV) less than L6-05 for longer than L6-06 time.
Uv	Uv	Undervoltage
		One of the following conditions was true when the drive was stopped and a run command was entered: • DC bus voltage dropped below the level specified in L2-05. • Contactor to suppress inrush current in the drive was open. • Low voltage in the control drive input power. This alarm outputs only if L2-01 is not 0 and DC bus voltage is under L2-05.

5.4 Operator Programming Errors

An Operator Programming Error (oPE) occurs when an inappropriate parameter is set or an individual parameter setting is inappropriate.

◆ oPE Codes, Causes, and Possible Solutions

Table 5.4 oPE Codes, Causes, and Possible Solutions

LED Operator Display		Error Name
oPE01	oPE01	Drive Capacity Setting Fault Drive capacity and the value set to o2-04 do not match.
oPE02	oPE02	Parameter Range Setting Error Use U1-18 to find parameters set outside the range.
oPE03	oPE03	Multi-Function Input Selection Error A contradictory setting is assigned to multi-function contact inputs H1-01 to H1-07.
oPE04	oPE04	Initialization required.
oPE05	oPE05	Run Command/Frequency Reference Source Selection Error
oPE07	oPE07	Multi-Function Analog Input Selection Error A contradictory setting is assigned to multi-function analog inputs H3-02 through to H3-10 and PID functions conflict.
oPE08	oPE08	Parameter Selection Error A function has been set that cannot be used in the motor control method selected.
oPE09	oPE09	PID Control Selection Fault PID control function selection is incorrect. Requires that PID control is enabled (b5-01 = 1 to 4).
oPE10	oPE10	V/f Data Setting Error One or more of the parameters listed below are not set according to the formula: • E1-09 ≤ E1-07 < E1-06 ≤ E1-11 ≤ E1-04 • E3-09 ≤ E3-07 < E3-06 ≤ E3-11 ≤ E3-04
oPE11	oPE11	Carrier Frequency Setting Error Correct the setting for the carrier frequency.
oPE13	oPE13	Pulse Monitor Selection Error Incorrect setting of monitor selection for Pulse Train (H6-06).

5.5 Auto-Tuning Fault Detection

Auto-Tuning faults are shown below. When the following faults are detected, the fault is displayed on the Digital Operator and the motor coasts to a stop. No fault or alarm outputs will occur

◆ Auto-Tuning Codes, Causes, and Possible Solutions

Table 5.5 Auto-Tuning Codes, Causes, and Possible Solutions

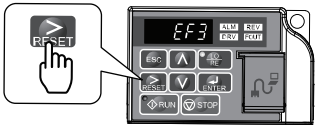
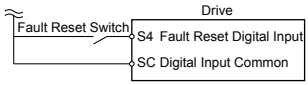
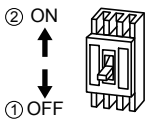
LED Operator Display		Error Name
End1	End1	Excessive V/f Setting. Displayed after Auto-Tuning is complete.
Cause		**Possible Solutions**
The torque reference exceeded 20% during Auto-Tuning. The no-load current exceeded 80% of the drive rated current during Auto-Tuning.		• Before Auto-Tuning the drive, verify the information written on the motor nameplate and enter that data to T1-03 through T1-05. • Enter proper information to parameters T1-03 to T1-05 and repeat Auto-Tuning. • If possible, disconnect the motor from the load and perform Auto-Tuning.
LED Operator Display		**Error Name**
End2	End2	Motor Iron-Core Saturation Coefficient. Detected only during Rotational Auto-Tuning and displayed after Auto-Tuning is complete.
Cause		**Possible Solutions**
Motor data entered during Auto-Tuning was incorrect.		• Enter the correct data. • Restart Auto-Tuning and enter the correct information.
Auto-Tuning calculated values outside the parameter setting range, assigning the iron-core saturation coefficient (E2-07, E2-08) a temporary value.		• Check and correct faulty motor wiring. • Disconnect the motor from machine and perform Rotational Auto-Tuning.
LED Operator Display		**Error Name**
End3	End3	Rated Current Setting Alarm (displayed after Auto-Tuning is complete).
Cause		**Possible Solutions**
• The motor line-to-line resistance and the motor-rated current are not consistent with one another. • The correct current rating printed on the nameplate was not entered into T1-04.		• Check the setting of parameter T1-04. • Check the motor data and repeat Auto-Tuning.
LED Operator Display		**Error Name**
Er-01	Er-01	Motor Data Error
Cause		**Possible Solutions**

Motor data entered during Auto-Tuning was incorrect.	• Enter the correct data. • Restart Auto-Tuning and enter the correct information.
Motor output and motor-rated current settings (T1-02 and T1-04) do not match.	• Check the drive and motor capacities. • Correct the settings of parameters T1-02 and T1-04.
Motor output and no-load current settings (T1-04 and E2-03) do not match. Data required when Auto-Tuning for OLV Control or Stationary Auto-Tuning.	• Check the motor-rated current and no-load current. • Correct the settings of parameters T1-04 and E2-03.
Base frequency and base motor rotations (T1-05 and T1-07) do not match.	Set T1-05 and T1-07 to the correct value.
LED Operator Display	**Error Name**
Er-02 Er-02	Minor Fault
Cause	**Possible Solutions**
Motor data entered during Auto-Tuning was incorrect.	• Enter the correct data. • Restart Auto-Tuning and enter the correct information.
The wiring is faulty.	• Check the wiring and correct defective connections. • Check around the machine. • Check the load.
Load is too heavy.	
LED Operator Display	**Error Name**
Er-03 Er-03	STOP Button Input
Cause	**Possible Solutions**
Auto-Tuning canceled by pressing STOP button.	Auto-Tuning did not complete properly and will have to be performed again.
LED Operator Display	**Error Name**
Er-04 Er-04	Line-to-Line Resistance Error
Cause	**Possible Solutions**
Motor data entered during Auto-Tuning was incorrect.	• Enter the correct data. • Restart Auto-Tuning and enter the correct information.
Auto-Tuning did not complete within designated time frame.	• Check and correct faulty motor wiring. • Disconnect the motor from machine and perform Rotational Auto-Tuning.
Drive-calculated values outside parameter setting range.	
LED Operator Display	**Error Name**
Er-05 Er-05	No-Load Current Error
Cause	**Possible Solutions**
Motor data entered during Auto-Tuning was incorrect.	• Enter the correct data. • Restart Auto-Tuning and enter the correct information.

Auto-Tuning did not complete within designated time frame.	• Check and correct faulty motor wiring. • Disconnect the motor from machine and perform Rotational Auto-Tuning.
Drive-calculated values outside parameter setting range.	
LED Operator Display	**Error Name**
Er-08 Er-08	Rated Slip Error
Cause	**Possible Solutions**
Motor data entered during Auto-Tuning was incorrect.	• Enter the correct data. • Restart Auto-Tuning and enter the correct information.
Auto-Tuning did not complete within designated time frame	• Check and correct faulty motor wiring. • Disconnect the motor from machine and perform Auto-Tuning.
Values calculated by the drive are outside the allowable parameter setting ranges.	
LED Operator Display	**Error Name**
Er-09 Er-09	Acceleration Error (detected only during Rotational Auto-Tuning)
Cause	**Possible Solutions**
The motor did not accelerate for the specified acceleration time.	• Increase the acceleration time (C1-01). • Check if it is possible to disconnect the machine from the motor.
Torque limit when motoring is too low (L7-01 and L7-02).	• Check the settings of parameters L7-01 and L7-02. • Increase the setting.
LED Operator Display	**Error Name**
Er-11 Er-11	Motor Speed Fault (detected only when Auto-Tuning is enabled)
Cause	**Possible Solutions**
Torque reference is too high. (Enabled in SV only.)	• Increase the acceleration time (C1-01). • Disconnect the machine from the motor, if possible.
LED Operator Display	**Error Name**
Er-12 Er-12	Current Detection Error
Cause	**Possible Solutions**
One of the motor phases is missing (U/T1, V/T2, W/T3).	Check motor wiring and correct problems.
Current exceeded the current rating of the drive.	• Check the motor wiring for a short between motor lines. • If a magnetic contactor is used between motors, ensure it is on. • Replace the drive.
The current is too low.	
Attempted Auto-Tuning without motor connected to the drive	Connect the motor and perform Auto-Tuning.
Current detection signal error.	Replace the drive.

5.6 Diagnosing and Resetting Faults

◆ Fault Reset Methods

After the Fault Occurs	Procedure	
Fix the cause of the fault, restart the drive, and reset the fault.	Press RESET on the digital operator.	
Fix the cause of the fault and reset via Fault Reset Digital Input S4.	Close then open the fault signal digital input via terminal S4. S4 is set fault reset as default (H1-04 = 12).	
If the above methods do not reset the fault, turn off the drive main power supply. Reapply power after LED operator display is out.		

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Appendix: A

Specifications

A.1 Heavy Duty and Normal Duty Ratings

The capacity of the drive is based on two types of load characteristics: Heavy Duty (HD) and Normal Duty (ND).

Refer to Selecting the Appropriate Load Rating for the differences between HD and ND. Specifications for capacity ratings are listed on the following pages.

Table A.1 Selecting the Appropriate Load Rating

Setting Parameter C6-01	Rated Output Current	Overload Tolerance	Default Carrier Frequency
0: Heavy Duty (default)	HD Rating varies by model *<1>*	150% rated output current for 60 s	5 kHz
1: Normal Duty	ND Rating varies by model *<1>*	120% rated output current for 60 s varies by model	2 kHz, Swing PWM

<1> The following pages list information on rating changes based on drive model.

- **HD and ND:** HD refers to applications requiring constant torque output, while ND refers to applications with variable torque needs. The drive allows the user to select HD or ND torque depending on the application. Fans, pumps, and blowers should use ND (C6-01 = 1), and other applications generally use HD (C6-01 = 0 : default)
- **Swing PWM:** Swing PWM equivalent to a 2 kHz audible noise. This function turns the motor noise into a less obtrusive white noise.

Note: Differences between HD ratings and ND ratings for the drive include rated input and output current, overload capacity, carrier frequency, and current limit. The default setting is for HD (C6-01 = 0).

A.2 Single/Three-Phase 200 V Class Drive

Table A.2 Power Ratings

Item				Specification						
Three-Phase Drive Model HF5202				A20	A40	A75	1A5	2A2	3A7
Single-Phase Drive Model HF520S <1>									—
Maximum Motor Size Allowed (kW) <2>			HD Rating	0.2	0.4	0.75	1.5	2.2	3.7
			ND Rating	0.4	0.75	1.1	2.2	3.0	5.5 <2>
Input	Input Current (A) <3>	Three-Phase	HD Rating	1.5	2.9	5.8	7.5	11.0	18.9
			ND Rating	1.9	3.9	7.3	10.8	13.9	24.0
		Single-Phase	HD Rating	2.8	5.5	11.0	14.1	20.6	35.0
			ND Rating	3.6	7.3	13.8	20.2	24.0	-
Output	Rated Output Capacity (kVA) <4>		HD Rating	0.6	1.1	1.9	3.0	4.2	6.7
			ND Rating	0.7	1.3	2.3	3.7	4.6	7.5
	Output Current (A)		HD Rating	1.6 <6>	3.0 <6>	5.0 <6>	8.0 <7>	11.0 <7>	17.5 <7>
			ND Rating <5>	1.9	3.5 (3.3)<9>	6.0	9.6	12.0	19.6
	Overload Tolerance			HD Rating: 150% of rated output current for 1 minute ND Rating: 120% of rated output current for 1 minute (Derating may be required for applications that start and stop frequently)					
	Carrier Frequency			5 kHz (user-set, 2 to 15 kHz)					
	Max Output Voltage (V)			Three-phase power: 200 to 240 V Single-phase power: 200 to 240 V (both proportional to input voltage)					
	Max Output Frequency (Hz)			400 Hz (user-adjustable)					

A.2 Single/Three-Phase 200 V Class Drive

Item			Specification					
Three-Phase Drive Model HF5202			A20	A40	A75	1A5	2A2	3A7
Single-Phase Drive Model HF520S<1>								—
Power Supply	Rated Voltage Rated Frequency		Three-phase power: 200 to 240 V 50/60 Hz Single-phase power: 200 to 240 V 50/60 Hz DC power supply: 270 to 340 V <8>					
	Allowable Voltage Fluctuation		-15 to 10%					
	Allowable Frequency Fluctuation		±5%					
Harmonic Corrective Actions		DC Reactor	Optional					

<1> Drives with a single-phase power supply input output three-phase power, and cannot run a single-phase motor.

<2> The motor capacity (kW) refers to a Sumitomo 4-pole motor. The rated output current of the drive output amps should be equal to or greater than the motor rated current.

<3> Input current rating varies depending on the power supply transformer, input reactor, wiring connections, and power supply impedance.

<4> Rated motor capacity is calculated with a rated output voltage of 220 V.

<5> Carrier frequency is set to 2 kHz (Swing PWM). Current derating is required to raise the carrier frequency.

<6> Carrier frequency is set to 10 kHz. Current derating is required to raise the carrier frequency.

<7> Carrier frequency is set to 8 kHz. Current derating is required to raise the carrier frequency.

<8> DC is not available for UL standards.

<9> Single phase drive.

Table A.3 Power Ratings Continued

Item				Specification	
Three-Phase Drive Model HF5202				5A5	7A5
Single-Phase Drive Model <1>				-	-
Maximum Motor Size Allowed (kW) <2>			HD Rating	5.5	7.5
			ND Rating	7.5	11.0
Input	Input Current (A) <3>	Three-Phase	HD Rating	24.0	37.0
			ND Rating	37.0	52.0
		Single-Phase	HD Rating	-	-
			ND Rating	-	-
Output	Rated Output Capacity (kVA) <4>		HD Rating	9.5	12.6
			ND Rating	11.4	15.2
	Output Current (A)		HD Rating	25.0 <7>	33.0 <7>
			ND Rating <5>	30.0	40.0
	Overload Tolerance			HD Rating: 150% of rated output current for 1 minute ND Rating: 120% of rated output current for 1 minute (Derating may be required for applications that start and stop frequently)	
	Carrier Frequency			5 kHz (user-set, 2 to 15 kHz)	
	Max Output Voltage (V)			Three-phase power: 200 to 240 V Single-phase power: 200 to 240 V (both proportional to input voltage)	
	Max Output Frequency (Hz)			400 Hz (user-adjustable)	
Power Supply	Rated Voltage Rated Frequency			Three-phase power: 200 to 240 V 50/60 Hz Single-phase power: 200 to 240 V 50/60 Hz DC power supply: 270 to 340 V <6>	
	Allowable Voltage Fluctuation			-15 to 10%	
	Allowable Frequency Fluctuation			±5%	
Harmonic Corrective Actions		DC Reactor		Optional	

<1> Drives with single-phase power supply input will output three-phase power and cannot run a single-phase motor.

<2> The motor capacity (kW) refers to a Sumitomo 4-pole motor. The rated output current of the drive output amps should be equal to or greater than the motor rated current.

<3> Input current rating varies depending on the power supply transformer, input reactor, wiring connections, and power supply impedance.

<4> Rated motor capacity is calculated with a rated output voltage of 220 V.

<5> Carrier frequency is set to 2 kHz (Swing PWM). Current derating is required to raise the carrier frequency.

<6> DC is not available for UL standards.

<7> Carrier frequency is set to 8 kHz. Current derating is required to raise the carrier frequency.

Note: Differences between Heavy Duty (HD) ratings and Normal Duty (ND) ratings for the drive include rated input and output current, overload capacity, carrier frequency and current limit. Set parameter C6-01 to "0" for HD (default) or "1" for ND.

A.3 Three-Phase 400 V Class Drives

Table A.4 Power Ratings

Item			Specification					
Three-Phase Drive Model HF5204			A20	A40	A75	1A5	2A2	3A7
Maximum Applicable Motor Capacity (kW) <1>		HD Rating	0.2	0.4	0.75	1.5	2.2	3.7
		ND Rating	0.4	0.75	1.5	2.2	3.0	5.5
Input	Input Current (A) <2>	HD Rating	1.2	1.8	3.2	4.4	6.0	10.4
		ND Rating	1.2	2.1	4.3	5.9	8.1	14.0
Output	Output Current (kVA) <3>	HD Rating <5>	0.9	1.4	2.6	3.7	4.2	7.0
		ND Rating <4>	0.9	1.6	3.1	4.1	5.3	8.5
	Output Current (A)	HD Rating <5>	1.2	1.8	3.4	4.8	5.5	9.2
		ND Rating <4>	1.2	2.1	4.1	5.4	6.9	11.1
	Overload Tolerance		HD Rating: 150% of rated output current for 60 s ND Rating: 120% of rated output current for 60 s (Derating may be required for applications that start and stop frequently)					
	Carrier Frequency		5 kHz (user-adjustable from 2 to 15 kHz)					
	Maximum Output Voltage (V)		Three-phase power: 380 to 480 V (proportional to input voltage)					
	Maximum Output Frequency (Hz)		400 Hz (user-adjustable)					
Power Supply	Rated Voltage Rated Frequency		Three-phase power: 380 to 480 V 50/60 Hz DC power supply: 510 to 680 V <6>					
	Allowable Voltage Fluctuation		-15 to 10%					
	Allowable Frequency Fluctuation		±5%					
Harmonic Corrective Actions		DC Reactor	Optional					

<1> The motor capacity (kW) refers to a Sumitomo 4-pole motor. The rated output current of the drive output amps should be equal to or greater than the motor rated current.

<2> Input current rating varies depending on the power supply transformer, input reactor, wiring conditions, and power supply impedance.

<3> Rated motor capacity is calculated with a rated output voltage of 440 V.

<4> Carrier frequency is set to 2 kHz (Swing PWM). Current derating is required in order to raise the carrier frequency.

<5> Carrier frequency is set to 8 kHz. Current derating is required in order to raise the carrier frequency.

<6> DC is not available for UL standards.

Table A.5 Power Ratings Continued

Item			Specification	
Three-Phase Drive Model HF5204			5A5	7A5
Maximum Applicable Motor Capacity (kW) <1>		HD Rating	5.5	7.5
		ND Rating	7.5	11.0
Input	Input Current (A) <2>	HD Rating	15.0	20.0
		ND Rating	20.0	24.0
Output	Output Current (kVA) <3>	HD Rating <5>	11.3	13.7
		ND Rating <4>	13.3	17.5
	Output Current (A)	HD Rating <5>	14.8	18.0
		ND Rating <4>	17.5	23.0
	Overload Tolerance		HD Rating: 150% of rated output current for 60 s ND Rating: 120% of rated output current for 60 s (Derating may be required for applications that start and stop frequently)	
	Carrier Frequency		5 kHz (user-adjustable from 2 to 15 kHz)	
	Maximum Output Voltage (V)		Three-phase power: 380 to 480 V (proportional to input voltage)	
	Maximum Output Frequency (Hz)		400 Hz (user-adjustable)	
Power Supply	Rated Voltage Rated Frequency		Three-phase power: 380 to 480 V 50/60 Hz DC power supply: 510 to 680 V <6>	
	Allowable Voltage Fluctuation		-15 to 10%	
	Allowable Frequency Fluctuation		±5%	
Harmonic Corrective Actions		DC Reactor	Optional	

<1> The motor capacity (kW) refers to a Sumitomo 4-pole motor. The rated output current of the drive output amps should be equal to or greater than the motor rated current.

<2> Input current rating varies depending on the power supply transformer, input reactor, wiring conditions, and power supply impedance.

<3> Rated motor capacity is calculated with a rated output voltage of 440 V.

<4> Carrier frequency is set to 2 kHz (Swing PWM). Current derating is required in order to raise the carrier frequency.

<5> Carrier frequency is set to 8 kHz. Current derating is required in order to raise the carrier frequency.

<6> DC is not available for UL standards.

Note: Differences between Heavy Duty (HD) ratings and Normal Duty (ND) ratings for the drive include rated input and output current, overload capacity, carrier frequency and current limit. Set parameter C6-01 to "0" for HD (default) or "1" for ND.

A.4 Drive Specifications

Note: 1. Perform rotational Auto-Tuning to obtain Sensorless Vector Control performance specifications.

2. For optimum performance life of the drive, install the drive in an environment that meets the environmental conditions.

Item		Specification
Control Characteristics	Control Method	The following control methods are available: Sensorless Vector Control , V/f Control
	Frequency Control Range	0.01 to 400 Hz
	Frequency Accuracy	Digital input: within ±0.01% of the max output frequency (-10 to +50 °C) Analog input: within ±0.5% of the max output frequency (25 °C ±10 °C)
	Frequency Setting Resolution	Digital inputs: 0.01 Hz Analog inputs: 1/1000 of maximum output frequency
	Output Frequency Calculation Resolution	$1/2^{20}$ x Maximum output frequency (E1-04)
	Frequency Setting Signal	Main frequency reference: 0 to +10 Vdc (20 kΩ), 4 to 20 mA (250 Ω), 0 to 20 mA (250 Ω) Main speed reference: Pulse Train Input (max 32 kHz)
	Starting Torque	200%/0.5 Hz (Sensorless Vector Control, HD rating, 3.7 kW or smaller)
	Speed Control Accuracy	±0.2% in Sensorless Vector Control *<1>*
	Speed Response	5 Hz (25 °C ±10 °C) in Open Loop Vector Control (excludes temperature fluctuation when performing Rotational Auto-Tuning)
	Torque Limit	Sensorless Vector Control only. Adjustable in 4 quadrants.
	Accel/Decel Time	0.00 to 6000.0 s (allows four separate settings for accel and decel)
	Braking Torque	Instantaneous Average Decel Torque *<2>* : 0.1/0.2 kW: over 150%, 0.4/0.75 kW: over 100%, 1.5 kW: over 50%, 2.2 kW and above: over 20% Continuous Regen Torque: 20%, 125% with a Braking Resistor Unit *<3>* : (10% ED) 10 s with an internal braking resistor.
	V/f Characteristics	Preset V/f patterns and user-set program available.

Item		Specification
Control Characteristics	Functions	Momentary Power Loss Ride-Thru Speed Search Over/Undertorque Detection Torque Limit, Multi-Step Speed (17 steps max) Accel/Decel Time Switch S-Curve Accel/Decel, 2-Wire/3-Wire Sequence Rotational Auto-Tuning Stationary Auto-Tuning of Line-to-Line Resistance Dwell Cooling Fan ON/OFF Slip Compensation Torque Compensation Jump Frequencies (reference dead band) Frequency Reference Upper/Lower Limit DC Injection Braking (start and stop), High Slip Braking PID Control (with Sleep Function) Energy Saving MEMOBUS/Modbus (RS-485/RS-422 Max 115.2 kbps) Fault Reset Parameter Copy Fault Restart Removable Terminals with Parameter Backup Function
Protection Functions	Motor Protection	Motor overheat protection via output current sensor
	Overcurrent Protection	Drives stops when output exceeds 200% of the rated current (Heavy Duty)
	Overload Protection	A stop command will be entered after operating at 150% for 60 s (Heavy Duty) <4>
	Overvoltage Specification	200 V Class: Stops when DC bus voltage exceeds approx. 410 V 400 V Class: Stops when DC bus voltage exceeds approx. 820 V
	Low Voltage Protection	Drive stops when DC bus voltage falls below the levels indicated: <5> 190 V (3-phase 200 V), 160 V (single-phase 200 V), 380 V (3-phase 400 V), 350 V (3-phase 380 V)
	Momentary Power Loss Ride-Thru	3 selections available: Ride-Thru disabled (stops after 15 ms), time base of 0.5 s, and continue running as long as the drive control board is powered up. <6>
	Heatsink Overheat Protection	Protected by thermistor
	Stall Prevention	Stall prevention is available during acceleration, deceleration, and during run. Separate settings for each type of stall prevention determine the current level at which stall prevention is triggered
	Cooling Fan Failure Protection	Circuit protection ("fan-lock" sensor)
	Ground Fault Protection	Electronic circuit protection <6>
	DC Bus Charge LED	Remains lit until DC bus voltage falls below 50 V

Item		Specification
Environment	Storage/Installation Area	Indoors
	Ambient Temperature	IP20/NEMA Type 1 enclosure: -10 °C to +40 °C IP20/IP00 Open-Chassis enclosure: -10 °C to +50 °C
	Humidity	95% RH or less with no condensation
	Storage Temperature	-20 to +60 °C allowed for short-term transport of the product <7>
	Altitude	Up to 1000 meters without derating; up to 3000 meters with output current and voltage derating.
	Shock, Impact	10 to 20 Hz: 9.8 m/s^2 20 to 55 Hz: 5.9 m/s^2
	Surrounding Area	Install the drive in an area free from: • oil mist and dust • metal shavings, oil, water or other foreign materials • radioactive materials • combustible materials • harmful gases and liquids • excessive vibration • chlorides • direct sunlight
	Orientation	Install the drive vertically to maintain maximum cooling effects
Standards		• UL508C • IEC/EN 61800-3, IEC/EN 61800-5-1
Protective Enclosure		IP20/Open-Chassis or IP00/Open-Chassis <8> IP20/NEMA Type 1 <9>
Cooling Method		HF520S-A20 to A75: self-cooled HF520S-1A5, 2A2: cooling fan HF5202-A20, A40: self-cooled HF5202-A75 to 7A5: cooling fan HF5204-A20 to A75: self-cooled HF5204-1A5 to 7A5: cooling fan

<1> Speed control accuracy varies somewhat according to the type of motor and drive settings.

<2> Instantaneous average deceleration torque refers to the torque required to decelerate the motor (uncoupled from the load) from the rated motor speed down to zero in the shortest time.

<3> Ensure that Stall Prevention Selection during Deceleration is disabled (L3-04 = 0 : default) or set to 3 when using a braking resistor or the Braking Resistor Unit. The default setting for the stall prevention function will interfere with the braking resistor.

<4> Overload protection may be triggered when operating with 150% of the rated output current if the output frequency is less than 6 Hz.

<5> Parameter settings allow up to 150 V.

<6> Ground protection cannot be provided under the following circumstances when a ground fault is likely in the motor windings during run: Low ground resistance for the motor cable and terminal block; low ground resistance for the motor cable and terminal block; or the drive is powered up from a ground short.

<7> In the case that the inverter is used after that the storage period of 2 years has expired, before the first use please refer to the aging process under the following conditions:

- First, apply for 1 hour the 80% of the capacitor rated voltage at ambient temperature.
- Then, raise the voltage to 90%, and keep it for 1 more hour.
- Finally, apply for 5 hours the rated voltage at ambient temperature.

<8> The following models have an IP20/Open-Chassis enclosure as standard.
HF520S-A20 to 2A2
HF5202-A20 to 3A7
HF5204-A20 to 3A7

<9> The following models have an IP20/NEMA Type 1 enclosure as standard. For an IP20/Open-Chassis or IP00/ Open-Chassis design, remove the top and bottom covers:
HF5202-5A5, 7A5
HF5204-5A5, 7A5

Note: Time from input open to drive output stop is less than 1 ms.

Appendix: B

Parameter List

This appendix contains a full list of parameters and settings available in the drive.

B.1 Parameter Groups

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B.2 Parameter Table

An "A" in the "Control Mode" column indicates that the parameter is available in the Advanced menu of the respective control mode.

An "S" in the "Control Mode" column indicates that the parameter is available in the Startup menu of the respective control mode.

A "–" in the "Control Mode" column indicates that the parameter is NOT available in the respective control mode.

An "O" in the "Control Mode" column indicates that the multi-function selection is available in the respective control mode.

◆ A: Initialization Parameters

The A parameter group creates the operating environment for the drive. This includes the parameter Access Level, Motor Control Method, Password, User Parameters and more.

No.	Name	Description	Range	Def.	Control Mode		Addr. Hex
					V/f	SV	
A1: Initialization Parameters Use A1 parameters to configure the basic environment for drive operation.							
A1-01 <1> <3>	Access Level Selection	Selects which parameters are accessible via the digital operator. 0: Operation only 1: User Parameters (access to a set of parameters selected by the user) 2: Advanced Access Level	0 to 2	2	A	A	101
A1-02 <2>	Control Method Selection	Selects the Control Method of the drive. Auto-Tuning must be performed when selecting one of the vector control modes. 0: V/f Control without PG 2: Sensorless Vector Control (SV) **Note: 1.** Does not return to the default setting after initialization.	0, 2	0	S	S	102
A1-03	Initialize Parameters	Resets all parameters to factory default settings. (Initializes the drive then returns A1-03 to 0) 0: No Initialization 1110: User Initialize (First set user parameter values must be stored using parameter o2-03) 2220: 2-Wire Initialization 3330: 3-Wire Initialization 5550: oPE04 Error Reset	0 to 5550	0	A	A	103
			The following parameters are not reset when the performing initialization: A1-00, A1-02, A1-07, E1-03, F6-08, L8-35, o2-04, o2-09, and all U2 and U3 monitors.				

No.	Name	Description	Range	Def.	Control Mode		Addr. Hex
					V/f	SV	
A1-04	Password	When the value set into A1-04 does not match the value set into A1-05, parameters A1-01 through A1-03, A1-06, and A2-01 through A2-32 cannot be changed.	0 to 9999	0	A	A	104
A1-05	Password Setting		0 to 9999	0	A	A	105
			This parameter is hidden from view. To access A1-05, first display A1-04. Then press the STOP key while holding down the up arrow key. Parameter A1-05 will appear.				
A1-06	Application Preset	Sets parameters that are commonly used in certain applications to A2-01 through A2-16 for easier access. 0: General-purpose (A2 parameters are not affected) 1: Water supply pump 2: Conveyor 3: Exhaust fan 4: HVAC fan 5: Air compressor 6: Elevator 7: Hoist 8: Conveyor 2	0 to 8	0	A	A	127
A2: User Parameters Use A2 parameters to program the drive.							
A2-01 to A2-32	User Parameters, 1 to 32	Parameters that were recently edited are listed here. The user can also select parameters to appear here for quick access. Parameters will be stored here for quick access when A1-01 = 1.	A1-00 to o2-08	<3>	A	A	106 to 125
A2-33	User Parameter Automatic Selection	0: Parameters A2-01 through A2-32 are reserved for the user to create a list of User Parameters. 1: Save history of recently viewed parameters. Recently edited parameters will be saved to A2-17 through A2-32 for quick access.	0, 1	<4>	A	A	126

<1> Parameter can be changed during run.

<2> Parameter setting value is not reset to the default value during drive initialization, A1-03 = 1110, 2220, 3330.

<3> Default setting value is dependent on parameter A1-06, Application Selection.

<4> Default setting value is dependent on parameter A1-06. This setting value is 0 when A1-06 = 0, and 1 when A1-06 ≠ 0.

<5> A1-00 and A1-07 Reserved Parameters

◆ b: Application

Application parameters configure the Run Command Source, DC Injection Braking, Speed Search, Timer functions, PID control, the Dwell function, Energy Savings and a variety of other application-related settings.

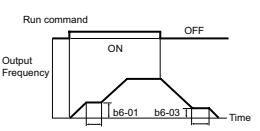
No.	Name	Description	Range	Def.	Control Mode		Addr. Hex
					V/f	SV	
b1: Operation Mode Selection Use b1 parameters to configure the operation mode.							
b1-01	Frequency Reference Selection 1	Selects the frequency reference input source. 0: Digital operator - Digital preset speed d1-01 to d1-17. 1: Terminals - Analog input terminal A1 or A2. 2: MEMOBUS communications 3: Option PCB 4: Pulse Input (Terminal RP)	0 to 4	1	S	S	180
b1-02	Run Command Selection 1	Selects the run command input source. 0: Digital operator - RUN and STOP keys on the digital operator. 1: Digital input terminals 2: MEMOBUS communications 3: Option PCB.	0 to 3	1	S	S	181
b1-03	Stopping Method Selection	Selects the stopping method when the run command is removed. 0: Ramp to Stop 1: Coast to Stop 2: DC Injection Braking to Stop 3: Coast with Timer (A new run command is ignored if received before the timer expires.)	0 to 3	0	S	S	182
b1-04	Reverse Operation Selection	Permits or prohibits reverse operation. 0: Reverse enabled. 1: Reverse disabled.	0, 1	0	A	A	183
b1-07	LOCAL/REMOTE Run Selection	Determines the operation when the Run command source is switched from LOCAL to REMOTE or between Run source 1 and 2 while an external Run command is active at the new source. 0: External Run command has to be cycled at the new source to be activated. 1: External Run command at new source is accepted immediately.	0, 1	0	A	A	186
b1-08	Run Command Selection while in Programming Mode	0: Run command accepted only in the operation menu. 1: Run command accepted in all menus. 2: Prohibit entering Programming Mode during Run	0 to 2	0	A	A	187
b1-14	Phase Order Selection	Sets the phase order for drive output terminals U/T1, V/T2 and W/T3. 0 : Standard 1 : Switch phase order	0, 1	0	A	A	1C3

No.	Name	Description	Range	Def.	Control Mode		Addr. Hex
					V/f	SV	
b1-15	Frequency Reference Selection 2	Selects the frequency reference input source 2. 0: Operator - Digital preset speed d1-01 to d1-17. 1: Terminals - Analog input terminal A1 or A2 2: MEMOBUS communications 3: Option PCB 4: Pulse Input (Terminal RP)	0 to 4	0	A	A	1C4
b1-16	Run Command Selection 2	Selects the run command input source 2. 0: Operator - RUN and STOP keys on the digital operator. 1: Digital input terminals 2: MEMOBUS communications 3: Option PCB	0 to 3	0	A	A	1C5
b1-17	Run Command at Power Up	Determines the operation when a Run command is active at power up of the drive. 0: Run command not issued, needs to be cycled 1: Run command issued, motor operation start	0, 1	1	A	A	1C6
b2: DC Injection Braking Use b2 parameters to configure DC Injection Braking operation.							
b2-01	DC Injection Braking Start Frequency	Sets the frequency at which DC Injection Braking starts when Ramp to Stop (b1-03 = 0) is selected. If b2-01< E1-09, DC Injection Braking starts at E1-09.	0.0 to 10.0	0.5 Hz	A	A	189
b2-02	DC Injection Braking Current	Sets the DC Injection Braking current as a percentage of the drive rated current.	0 to 75	50%	A	A	18A
b2-03	DC Injection Braking Time/ DC Excitation Time at Start	Sets DC Injection Braking time at start. Disabled when set to 0.00 seconds.	0.00 to 10.00	0.00 s	A	A	18B
b2-04	DC Injection Braking Time at Stop	Sets DC Injection Braking time at stop. When b1-03 = 2, actual DC Injection time is calculated as follows: (b2-04) x 10 x (Output Freq)/(E1-04). When b1-03 = 0, this parameter sets the amount of DC Injection time applied to the motor at the end of the decel ramp or High Slip Braking. Disabled when set to 0.00.	0.00 to 10.00	0.00 s	A	A	18C
b2-08	Magnetic Flux Compensation Value	Sets the magnetic flux compensation as a percentage of the no-load current value (E2-03).	0 to 1000	0%	–	A	190
b3: Speed Search Use b3 parameters to configure Speed Search function operation.							
b3-01	Speed Search Selection at Start	Enables/disables the Speed Search function at start. 0: Disabled - Speed Search is not automatically performed at start. 1: Enabled - Speed Search is automatically performed at start.	0, 1	0	A	A	191
b3-02	Speed Search Deactivation Current	Sets the current level at which the speed is assumed to be detected and Speed Search is ended. Set as a percentage of the drive rated current.	0 to 200	120 <3>	A	A	192
b3-03	Speed Search Deceleration Time	Sets the time constant used to reduce the output frequency during Speed Search. Related to a change from max. output frequency to 0.	0.1 to 10.0	2.0 s	A	A	193

No.	Name	Description	Range	Def.	Control Mode		Addr. Hex
					V/f	SV	
b3-05	Speed Search Delay Time	Delays the Speed Search operation after a momentary power loss to allow time for an external output contactor to close.	0.0 to 100	0.2 s	A	A	195
b3-06	Output Current 1 during Speed Search	Sets the current injected to the motor at the beginning of Estimation type Speed Search. Set as a factor of the motor rated current.	0.0 to 2.0	<4>	A	A	196
b3-08	Current Control Gain during Speed Search (Speed Estimation Type)	Sets the proportional gain for the current controller during Speed Search. There is normally no need to change this parameter from the default value.	0.00 to 6.00	0.5	A	A	198
b3-10	Speed Search Detection Compensation Gain	Sets the gain which is applied to the speed detected by Speed Estimation Speed Search before the motor is reaccelerated. Increase this setting if ov occurs when performing Speed Search.	1.00 to 1.20	1.05	A	A	19A
b3-14	Bi-Directional Speed Search Selection	Selects if Speed Search detects the motor rotation direction during Speed Search. 0: Disabled–Frequency reference direction used 1: Enabled–Detected direction used	0, 1	0	A	A	19E
b3-17	Speed Search Restart Current Level	Sets the Speed Search restart current level as a percentage of the drive rated current.	0 to 200	150%	A	A	1F0
b3-18	Speed Search Restart Detection Time	Sets the time in seconds for Speed Search restart to be detected.	0.00 to 1.00	0.10 s	A	A	1F1
b3-19	Number of Speed Search Restarts	Sets the number of restarts possible for Speed Search restart operations.	0 to 10	3	A	A	1F2
b3-24	Speed Search Method Selection	Sets the Speed Search detection mode. 0: Current Detection Type 1: Speed Estimation Type	0, 1	0	A	A	1C0
b3-25	Speed Search Retry Interval Time	Sets the wait time before Speed Search restarts.	0 to 30.0	0.5 s	A	A	1C8
b4: Timer Function Use b4 parameters to configure timer function operation.							
b4-01	Timer Function On-Delay Time	Used in conjunction with a multi-function digital input (H1-□□ = 18) and a multi-function digital output (H2-□□ = 12) programmed for the timer function. This sets the amount of time between digital input closure and digital output activation.	0.0 to 300.0	0.0 s	A	A	1A3
b4-02	Timer Function Off-Delay Time	Used in conjunction with a multi-function digital input (H1-□□ = 18) and a multi-function digital output programmed for the timer function. This sets the amount of time the output remains activated after the digital input is opened.	0.0 to 300.0	0.0 s	A	A	1A4
b5: PID Control Use b5 parameters to configure the PID control drive function.							

No.	Name	Description	Range	Def.	Control Mode		Addr. Hex
					V/f	SV	
b5-01	PID Function Setting	Sets the PID control mode. 0: Disabled 1: Enable (PID output = freq. ref., PID input is D-controlled) 2: (PID output = freq. ref., PID feedback is D-controlled) 3: Enable (PID output added to freq. ref., PID input is D- controlled) 4: Enable (PID output added to freq. ref., PID feedback is D- controlled)	0 to 4	0	A	A	1A5
b5-02 <5>	Proportional Gain Setting (P)	Sets the proportional gain of the PID controller. A setting of 0.00 disables P control.	0.00 to 25.00	1.00	A	A	1A6
b5-03 <5>	Integral Time Setting (I)	Sets the integral time for the PID controller. A setting of 0.0 s disables integral control.	0.0 to 360.0	1.0 s	A	A	1A7
b5-04 <5>	Integral Limit Setting	Sets the maximum output possible from the integrator.	0.0 to 100.0	100.0 %	A	A	1A8
b5-05 <5>	Derivative Time (D)	Sets D control derivative time. A setting of 0.00 s disables derivative control.	0.00 to 10.00	0.00 s	A	A	1A9
b5-06 <5>	PID Output Limit	Sets the maximum output possible from the entire PID controller.	0.0 to 100.0	100.0 %	A	A	1AA
b5-07 <5>	PID Offset Adjustment	Applies an offset to the PID controller output.	-100.0 to +100.0	0.0%	A	A	1AB
b5-08 <5>	PID Primary Delay Time Constant	Sets the amount of time for the filter on the output of the PID controller.	0.00 to 10.00	0.00 s	A	A	1AC
b5-09	PID Output Level Selection	Sets the PID controller output direction. 0: Normal Output (direct acting) 1: Reverse Output (reverse acting)	0, 1	0	A	A	1AD
b5-10	PID Output Gain Setting	Sets the gain applied to the PID output.	0.00 to 25.00	1.00	A	A	1AE
b5-11	PID Output Reverse Selection	Sets the drive operation with negative PID output. 0: Negative PID output triggers zero limit and drive stops. 1: Rotation direction reverses with negative PID output. When using setting 1 make sure, reverse operation is permitted by parameter b1-04.	0, 1	0	A	A	1AF

No.	Name	Description	Range	Def.	Control Mode		Addr. Hex
					V/f	SV	
b5-12	PID Feedback Reference Missing Detection Selection	Configures the PID feedback loss detection. With all setting a digital output programmed for H2-01/02/03 = 3E/3F (PID feedback low/PID feedback high) is operated when the detection condition becomes true. 0: Digital output only. 1: Feedback loss detected when PID enabled. Alarm output, operation is continued without triggering a fault contact. 2: Feedback loss detected when PID enabled. Fault output, operation is stopped and a fault contact is triggered. 3: Feedback loss detection even when PID is disabled by digital input. No alarm/fault output. 4: PID Feedback error detection even when PID is disabled by digital input. An alarm is triggered and the drive continues to run. 5: PID Feedback error detection even when PID is disabled by digital input. Fault is triggered and output is shut off.	0 to 5	0	A	A	1B0
b5-13	PID Feedback Loss Detection Level	Sets the PID feedback loss detection level.	0 to 100	0%	A	A	1B1
b5-14	PID Feedback Loss Detection Time	Sets the PID feedback loss detection delay time in terms of seconds.	0.0 to 25.5	1.0 s	A	A	1B2
b5-15	PID Sleep Function Start Level	Sets the sleep function start frequency. Note: Also enabled when PID is not active.	0.0 to 400.0	0.0 Hz	A	A	1B3
b5-16	PID Sleep Delay Time	Sets the sleep function delay time.	0.0 to 25.5	0.0 s	A	A	1B4
b5-17	PID Accel/Decel Time	Applies an accel/decel time to the PID setpoint.	0 to 255	0 s	A	A	1B5
b5-18	PID Setpoint Selection	Selects b5-19 as PID setpoint value. 0: Disabled 1: Enabled, b5-19 becomes PID target	0, 1	0	A	A	1DC
b5-19	PID Setpoint Value	Sets the PID target value when b5-18 = 1.	0.00 to 100.00	0.00 %	A	A	1DD
b5-20	PID Setpoint Scaling	Sets the units for setting/display b5-19, and for parameter monitors U5-01 (PID Feedback) and U5-04 (PID Setpoint). 0: 0.01Hz units 1: 0.01% units (100% = max output frequency) 2: r/min (number of motor poles must be set up) 3: User-set (set to b5-38 and b5-39)	0 to 3	1	A	A	1E2
b5-34 <5>	PID Output Lower Limit	Sets the minimum output possible from the PID controller.	-100.0 to +100.0	0.00 %	A	A	19F
b5-35 <5>	PID Input Limit	Limits the PID control input (deviation signal). Acts as a bipolar limit.	0.0 to 1000.0	1000. 0%	A	A	1A0
b5-36	PID Feedback High Detection Level	Sets the PID feedback high detection level.	0 to 100	100%	A	A	1A1
b5-37	PID Feedback High Level Detection Time	Sets the PID feedback high level detection delay time.	0.0 to 25.5	1.0 s	A	A	1A2

No.	Name	Description	Range	Def.	Control Mode		Addr. Hex
					V/f	SV	
b5-38	PID Setpoint / User Display	Sets the display value of U5-01 and U5-04 when the maximum frequency is output. Changeable only if b5-20 = 3. 0 to 60000: User-Set Display if b5-20 = 3	1 to 60000	<6>	A	A	1FE
b5-39	PID Setpoint Display Digits	Sets the number of digits of U5-01 and U5-04. Changeable only if b5-20 = 3. 0: No decimal places 1: One decimal places 2: Two decimal places 3: Three decimal places	0 to 3	<6>	A	A	1FF
b5-40	Frequency Reference Monitor Content during PID	0: Display the frequency reference (U1-01) after PID compensation has been added. 1: Display the frequency reference (U1-01) before PID compensation has been added.	0, 1	0	A	A	17F
b5-47	Reverse Operation Selection 2 by PID Output	Reverses operation selection when b5-01 = 3 or 4 0: Zero limit when PID output is a negative value 1: Reverse operation when PID output is a negative value (Zero limit if the reverse operation is prohibited by b1-04).	0, 1	1	A	A	17D
b6: Dwell Function Use b6 parameters to configure dwell function operation.							
b6-01	Dwell Reference at Start	The Dwell function is used to temporarily hold the frequency when driving a motor with a heavy load. Parameters b6-01 and b6-02 set the frequency to hold and the time to maintain that frequency at start. Parameters b6-03 and b6-04 set the frequency to hold and the time to maintain that frequency at stop.  	0.0 to 400.0	0.0 Hz	A	A	1B6
b6-02	Dwell Time at Start		0.0 to 10.0	0.0 s	A	A	1B7
b6-03	Dwell Frequency at Stop		0.0 to 400.0	0.0 Hz	A	A	1B8
b6-04	Dwell Time at Stop		0.0 to 10.0	0.0 s	A	A	1B9
b8: Energy Saving Use b8 parameters to configure the energy saving/conservation drive function.							
b8-01	Energy Saving Control Selection	Selects the Energy Savings function. 0: Disabled 1: Enabled	0, 1	0	A	A	1CC
b8-02 <5>	Energy Saving Gain	Sets energy savings control gain when in Sensorless Vector Control.	0.0 to 10.0	0.7	–	A	1CD
b8-03 <5>	Energy Saving Control Filter Time Constant	Sets energy saving control filter time constant when in Open Loop Vector Control.	0.00 to 10.00	0.50 <4>	–	A	1CE
b8-04	Energy Saving Coefficient Value	Sets the Energy Saving coefficient and is used to fine adjustments in V/f Control.	0.0 to 655.00	<7> <8>	A	–	1CF
b8-05	Power Detection Filter Time	Sets a filter time for the Power Detection used by Energy Savings in V/f Control.	0 to 2000	20 ms	A	–	1D0
b8-06	Search Operation Voltage Limit	Sets the limit for the voltage search operation performed by Energy Savings in V/f Control. Set as a percentage of the motor base voltage. Disabled when set to 0%.	0 to 100	0%	A	–	1D1

<1> Default setting value is dependent on parameter A1-02, Control Method Selection. The value shown is for A1-02 = 2-SV control.

<2> A coasting motor may require a braking resistor circuit to bring the motor to a stop in the required time.

<3> Default setting value is dependent on parameter A1-02, Control Method Selection. The value shown is for A1-02 = 0-V/f Control.

<4> Default setting value is dependent on parameter o2-04, Drive Model Selection.

<5> Parameter can be changed during Run.

<6> Default setting is dependent on parameter b5-20, PID Setpoint Scaling.

<7> Default setting value is dependent on parameter o2-04, Drive Model Selection and C6-01, Drive Duty Selection.

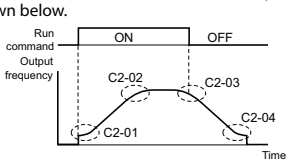
<8> Parameter value is changed if E2-11 is manually changed or changed by Auto-Tuning.

<9> Default setting is determined by A1-02, Control Method Selection

◆ C: Tuning

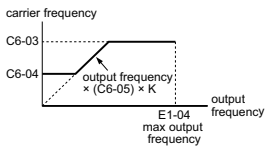
C parameters are used to adjust the acceleration and deceleration times, S-curves, slip and torque compensation functions and carrier frequency selections.

No.	Name	Description	Range	Def.	Control Mode		Addr. Hex
					V/f	SV	
C1: Acceleration and Deceleration Times Use C1 parameters to configure motor acceleration and deceleration.							
C1-01 <1>	Acceleration Time 1	Sets the time to accelerate from 0 to maximum frequency.	0.0 to 6000.0 <2>	10.0 s	S	S	200
C1-02 <1>	Deceleration Time 1	Sets the time to decelerate from maximum frequency to 0.			S	S	201
C1-03 <1>	Acceleration Time 2	Sets the time to accelerate from 0 to maximum frequency when Accel/Decel times 2 are selected by a digital input.			A	A	202
C1-04 <1>	Deceleration Time 2	Sets the time to decelerate from maximum frequency to 0 when Accel/Decel times 2 are selected by a digital input.			A	A	203
C1-05 <1>	Acceleration Time 3 (Motor 2 Accel Time 1)	Sets the time to accelerate from 0 to maximum frequency when Accel/Decel times 3 are selected by a digital input.			A	A	204
C1-06 <1>	Deceleration Time 3 (Motor 2 Decel Time 1)	Sets the time to decelerate from maximum frequency to 0 when Accel/Decel times 3 are selected by a digital input.			A	A	205
C1-07 <1>	Acceleration Time 4 (Motor 2 Accel Time 2)	Sets the time to accelerate from 0 to maximum frequency when Accel/Decel times 4 are selected by a digital input.			A	A	206
C1-08 <1>	Deceleration Time 4 (Motor 2 Decel Time 2)	Sets the time to decelerate from maximum frequency to 0 when Accel/Decel times 4 are selected by a digital input.			A	A	207

No.	Name	Description	Range	Def.	Control Mode		Addr. Hex
					V/f	SV	
C1-09	Fast-Stop Time	Sets the time to decelerate from maximum frequency to 0 for the multi-function input fast-stop function. **Note:** This parameter is also used by selecting "Fast-Stop" as a Stop Method when a fault is detected.	0.0 to 6000.0 <2>	10.0 s	A	A	208
C1-10	Accel/Decel Time Setting Units	Sets the resolution of C1-01 to C1-09. 0: 0.01 s (0.00 to 600.00 s) 1: 0.1 s (0.0 to 6000.0 s)	0, 1	1	A	A	209
C1-11	Accel/Decel Time Switching Frequency	Sets the frequency for automatic acceleration/deceleration switching. Below set frequency: Accel/Decel Time 4 Above set frequency: Accel/Decel Time 1 The multi-function input "Accel/Decel Time 1" or "Accel/Decel Time 2" take priority.	0.0 to 400.0 Hz	0.0 Hz	A	A	20A
C1-14 <3>	Accel/Decel Rate Frequency	Sets the base frequency used to calculate acceleration and deceleration times. When set to 0.0 Hz, the drive calculates the time required to accelerate from 0 Hz to E1-04, and decelerate from E1-04 down to 0 Hz (conventional setting). When set to any other value above 0.0 Hz, the drive calculates the time required to accelerate from 0 Hz to C1-14, and to decelerate from C1-14 down to 0 Hz.	0.0 to 400.0 Hz	0.0 Hz	A	A	264
C2: S-Curve Characteristics Use C2 parameters to configure S-curve operation.							
C2-01	S-Curve Characteristic at Accel Start	The S-curve can be controlled in the four points shown below.  S-curve is used to further soften the starting and stopping ramp. The longer the S-curve time, the softer the starting and stopping ramp.	0.00 to 10.00	0.00 s <4>	A	A	20B
C2-02	S-Curve Characteristic at Accel End		0.00 to 10.0	0.00 s	A	A	20C
C2-03	S-Curve Characteristic at Decel Start		0.00 to 10.0	0.00 s	A	A	20D
C2-04	S-Curve Characteristic at Decel End		0.00 to 10.0	0.00 s	A	A	20E
C3: Slip Compensation Use C3 parameters to configure the slip compensation function.							
C3-01 <1>	Slip Compensation Gain	Sets the slip compensation gain. Decides for what amount the output frequency is boosted in order to compensate the slip. **Note:** Adjustment is not normally required.	0.0 to 2.5	0.0 <4>	A	A	20F
C3-02	Slip Compensation Primary Delay Time	Adjusts the slip compensation function delay time. Decrease the setting when the slip compensation response is too slow, increase it when the speed is not stable. Disabled when Simple V/f Control with PG (H6-01 = 3) is used.	0 to 10000	2000 ms <4>	A	A	210

No.	Name	Description	Range	Def.	Control Mode		Addr. Hex
					V/f	SV	
C3-03	Slip Compensation Limit	Sets the slip compensation upper limit. Set as a percentage of motor rated slip (E2-02). Disabled when Simple V/f Control with PG (H6-01 = 3) is used.	0 to 250	200%	A	A	211
C3-04	Slip Compensation Selection during Regeneration	Selects slip compensation during regenerative operation. 0: Disabled 1: Enabled Using the Slip Compensation function during regeneration may require a braking registor to handle momentary increasing regenerative energy.	0, 1	1	A	A	212
C3-05	Output Voltage Limit Operation Selection	Selects if the motor magnetic flux is reduced during output voltage saturation. 0: Disabled 1: Enabled	0, 1	1	–	A	213
C3-18	Output Voltage Limit Level	Sets the maximum percentage of output voltage reduction when C3-05 is enabled.	70.0 to 100.0	90.0%	–	A	263
C4: Torque Compensation Use C4 parameters to configure Torque Compensation function.							
C4-01	Torque Compensation Gain	V/f Control: Sets the gain for the automatic torque (voltage) boost function and helps to produce better starting torque. Increase this setting when using a long motor cable or when the motor is significantly smaller than the drive capacity. Decrease this setting when motor oscillation occurs. Set the value so that the current at low speed does not exceeds the drives rated current. Sensorless Vector: Sets the torque compensation function gain. Normally no change is required.	0.00 to 2.50	1.00	A	A	215
C4-02	Torque Compensation Primary Delay Time	Sets the torque compensation filter time. Increase this setting when motor oscillation occurs. Reduce the setting if there is not enough response from the motor.	0 to 60000	200 ms	A	A	216
C4-03	Torque Compensation at Forward Start	Sets torque compensation at forward start as a percentage of motor torque.	0.0 to 200.0	0.0%	–	A	217
C4-04	Torque Compensation at Reverse Start	Sets torque compensation at reverse start as a percentage of motor torque.	-200.0 to 0.0	0.0%	–	A	218
C4-05	Torque Compensation Time Constant	Sets the time constant for torque compensation at forward start and reverse start (C4-03 and C4-04). The filter is disabled if the time is set to 4 ms or less.	0 to 200	10 ms	–	A	219
C4-06	Torque Compensation Primary Delay Time 2	Sets the torque compensation time 2. When an ov fault occurs with sudden load changes or at the and of an acceleration, increase the setting. **Note:** Adjustment is not normally required. If adjusted then AFR time 2 (n2-03) should be adjusted too.	0 to 10000	150 ms	–	A	21AH

No.	Name	Description	Range	Def.	Control Mode		Addr. Hex
					V/f	SV	
C5: Speed Control (ASR) Use C5 parameters to configure the Automatic Speed Regulator (ASR). C5 parameters are available only when using V/f Control with Simple PG Feedback (H6-01 = 3).							
C5-01 <1>	ASR Proportional Gain 1	Sets the proportional gain of the speed control loop (ASR).	0.00 to 300.00	0.20	A	–	21B
C5-02 <1>	ASR Integral Time 1	Sets the integral time of the speed control loop (ASR).	0.000 to 10.000	0.200	A		21C
C5-03 <1>	ASR Proportional Gain 2	Sets the speed control gain 2 of the speed control loop (ASR).	0.00 to 300.00	0.02	A	–	21D
C5-04 <1>	ASR Integral Time 2	Sets the integral time 2 of the speed control loop (ASR).	0.000 to 10.000	0.050 s	A	–	21E
C5-05 <1>	ASR Limit	Sets the upper limit for the speed control loop (ASR) as a percentage of the maximum output frequency (E1-04).	0.0 to 20.0	5.0%	A		21F
C6: Carrier Frequency Use C6 parameters to configure the carrier frequency drive settings.							
C6-01	Drive Duty Selection	Selects the load rating for the drive. 0: Heavy Duty (HD) for constant torque applications. 1: Normal Duty (ND) for variable torque applications. This setting affects the Rated output current and overload tolerance of the drive.	0, 1	0	S	S	223
C6-02	Carrier Frequency Selection	Selects the carrier frequency. 1 : 2.0 kHz 2 : 5.0 kHz 3 : 8.0 kHz 4 : 10.0 kHz 5 : 12.5 kHz 6 : 15.0 kHz 7 : Swing PWM1 (Audible sound 1) 8 : Swing PWM2 (Audible sound 2) 9 : Swing PWM3 (Audible sound 3) A : Swing PWM4 (Audible sound 4) B: Leakage Current Rejection PWM C to E: No setting possible F : User defined (determined by C6-03 through C6-05)	1 to B, F	2	S	S	224

No.	Name	Description	Range	Def.	Control Mode		Addr. Hex
					V/f	SV	
C6-03	Carrier Frequency Upper Limit	**Note:** Set C6-02 to F before setting C6-03. Sensorless Vector: C6-03 defines the fixed carrier frequency if C6-02 = F. V/f Control: C6-03 and C6-04 set upper and lower limits for the carrier frequency.  The coefficient K depends on C6-03: C6-03 ≥ 10.0 kHz: K = 3 10.0 kHz > C6-03 ≥ 5.0 kHz: K = 2 5.0 kHz > C6-03: K = 1 When C6-05 ≤ 6, C6-04 is disabled (makes the carrier frequency C6-03 value).	1.0 to 15.0	<6>	A	A	225
C6-04	Carrier Frequency Lower Limit		1.0 to 15.0	<6>	A	–	226
C6-05	Carrier Frequency Proportional Gain	Sets the relationship of output frequency to carrier frequency when C6-02 = F.	00 to 99	<6>	A	–	227

<1> Parameter can be changed during run.

<2> Setting range value is dependent on parameter C1-10, Accel/Decel Time Setting Units. When C1-10 = 0 (units of 0.01 seconds), the setting range becomes 0.00 to 600.00 seconds.

<3> Default setting value is dependent on parameter A1-02, Control Method Selection. The value shown is for A1-02 = 0-V/f Control.

<4> Default setting value is dependent on parameter A1-02, Control Method Selection. The value shown is for A1-02 = 2-SV control.

<5> Default setting value is dependent on parameters o2-04, Drive Model Selection, A1-02, Control Method Selection and C6-01, Drive Duty Selection.

<6> Default setting value is dependent on parameter C6-02, Carrier Frequency Selection.

◆ d: References

Reference parameters are used to set the various frequency reference values during operation.

No.	Name	Description	Range	Def.	Control Mode		Addr. Hex
					V/f	SV	
d1: Frequency Reference Use d1 parameters to configure the drive frequency reference.							
d1-01 <1>	Frequency Reference 1	Frequency reference. *Refer to b1-01: Frequency Reference Selection 1 on page 171* for instructions to use d1-01 as the main frequency reference.	0.00 to 400.00 Hz <2> <3>	0.00 Hz	S	S	280
d1-02 <1>	Frequency Reference 2	Frequency reference when digital input "Multi-Step Speed Reference 1" (H1-□□ = 3) is on.		0.00 Hz	S	S	281
d1-03 <1>	Frequency Reference 3	Frequency reference when digital input "Multi-Step Speed Reference 2" (H1-□□ = 4) is on.	0.00 to 400.00 Hz <2> <3>	0.00 Hz	S	S	282
d1-04 <1>	Frequency Reference 4	Frequency reference when digital inputs "Multi-Step Speed Reference 1, 2" (H1-□□ = 3 and 4) are on.		0.00 Hz	S	S	283
d1-05 <1>	Frequency Reference 5	Frequency reference when digital input "Multi-Step Speed Reference 3" (H1-□□ = 5) is on.	0.00 to 400.00 Hz <2> <3>	0.00 Hz	A	A	284
d1-06 <1>	Frequency Reference 6	Frequency reference when digital inputs "Multi-Step Speed Reference 1, 3 " (H1-□□ = 3 and 5) are on.		0.00 Hz	A	A	285
d1-07 <1>	Frequency Reference 7	Frequency reference when digital inputs "Multi-Step Speed Reference 2, 3" (H1-□□ = 4 and 5) are on.	0.00 to 400.00 Hz <2> <3>	0.00 Hz	A	A	286
d1-08 <1>	Frequency Reference 8	Frequency reference when multi-function input "Multi-Step speed reference 1, 2, 3" (H1-□□ = 3, 4, 5) are on.		0.00 Hz	A	A	287
d1-09 <1>	Frequency Reference 9	Frequency reference when multi-function input "Multi-Step Speed Reference 4" (H1-□□= 32) is on.	0.00 to 400.00 Hz <2> <3>	0.00 Hz	A	A	288
d1-10 <1>	Frequency Reference 10	Frequency reference when digital input "Multi-Step Speed Reference 1, 4" (H1-□□ = 3 and 32) are on.		0.00 Hz	A	A	28B
d1-11 <1>	Frequency Reference 11	Frequency reference when digital inputs "Multi-Step Speed Reference 2, 4" (H1-□□ = 4 and 32) are on.	0.00 to 400.00 Hz <2> <3>	0.00 Hz	A	A	28C
d1-12 <1>	Frequency Reference 12	Frequency reference when digital inputs "Multi-Step Speed Reference 1, 2, 4" (H1-□□ = 3, 4, 32) are on.		0.00 Hz	A	A	28D
d1-13 <1>	Frequency Reference 13	Frequency reference when digital inputs "Multi-Step Speed Reference 3, 4" (H1-□□ = 5 and 32) are on.	0.00 to 400.00 Hz <2> <3>	0.00 Hz	A	A	28E
d1-14 <1>	Frequency Reference 14	Frequency reference when digital inputs "Multi-Step Speed Reference 1, 3, 4" (H1-□□ = 3, 5, 32) are on.		0.00 Hz	A	A	28F

No.	Name	Description	Range	Def.	Control Mode		Addr. Hex
					V/f	SV	
d1-15 <1>	Frequency Reference 15	Frequency reference when digital inputs "Multi-Step Speed Reference 2, 3, 4" (H1-□□ = 4, 5, 32) are on.	0.00 to 400.00 Hz <2> <3>	0.00 Hz	A	A	290
d1-16 <1>	Frequency Reference 16	Frequency reference when digital inputs "Multi-Step Speed Reference 1, 2, 3, 4" (H1-□□ = 3, 4, 5, 32) are on.		0.00 Hz	A	A	291
d1-17 <1>	Jog Frequency Reference	Frequency reference when digital inputs "Jog Frequency Reference", "Forward Jog", or "Reverse Jog." are on. "Jog Frequency Reference" has priority over "Multi-Step Speed Reference 1 to 16".	0.00 to 400.00 Hz <2> <3>	5.00 Hz	S	S	292
d2: Frequency Upper and Lower Limits Use d2 parameters to configure the frequency reference limits.							
d2-01	Frequency Reference Upper Limit	Sets the frequency reference upper limit as a percentage of maximum output frequency (E1-04). Output speed is limited to this value even if the frequency reference is higher. This limit applies to all frequency reference sources.	0.0 to 110.0	100.0 %	A	A	289
d2-02	Frequency Reference Lower Limit	Sets the frequency reference lower limit as a percentage of maximum output frequency (E1-04). Output speed is limited to this value even if the frequency reference is lower. This limit applies to all frequency reference sources.	0.0 to 110.0	0.0%	A	A	28A
d2-03	Master Speed Reference Lower Limit	Sets the minimum frequency reference lower limit if the frequency reference is input using an analog input. Set as a percentage of maximum output frequency (E1-04). The higher of both values d2-02 and d2-03 will be the lower limit.	0.0 to 110.0	0.0%	A	A	293
d3: Jump Frequency Use d3 parameters to configure the drive Jump Frequency settings.							
d3-01	Jump Frequency 1	d3-01 to d3-04 allow programming of three prohibited frequency reference points for eliminating problems with resonant vibration of the motor / machine. This feature does not eliminate the selected frequency values, but accelerates and decelerates the motor through the prohibited bandwidth. The parameters must be according to the rule d3-01 ≥ d3-02 ≥ d3-03.	0.0 to 400.0	0.0 Hz	A	A	294
d3-02	Jump Frequency 2			0.0 Hz	A	A	295
d3-03	Jump Frequency 3			0.0 Hz	A	A	296
d3-04	Jump Frequency Width	This parameter sets the dead-band width around each selected prohibited frequency reference point. The bandwidth becomes the designated Jump frequency, plus or minus d3-04.	0.0 to 20.0	1.0 Hz	A	A	297

No.	Name	Description	Range	Def.	Control Mode		Addr. Hex
					V/f	SV	
d4: Frequency Reference Hold Use d4 parameters to configure the drive frequency reference hold function.							
d4-01	Frequency Reference Hold Function Selection	Determines if the frequency reference or frequency reference bias is saved when the Run command is removed or the power goes off. 0: Disabled 1: Enabled This parameter is effective when the multi-function inputs "Accel/Decel Ramp Hold", "Up/Down" or "Up/Down 2" commands are selected (H1-□□ = A or 10/11 or 75/76).	0, 1	0	A	A	298
d4-03 <1>	Frequency Reference Bias Step (Up/Down 2)	Sets the bias added to the frequency reference when the Up/ Down 2 digital inputs are set. When set to 0.00 Hz, the bias value is increased or decreased according to d4-04. When greater than 0.0 Hz, the bias value d4-03 is added or subtracted to/from the frequency reference. The acceleration or deceleration rate is ultimately determined by d4-04.	0.00 to 99.99 Hz	0.00 Hz	A	A	2AA
d4-04 <1>	Frequency Reference Bias Accel/Decel (Up/Down 2)	Selects how the bias or frequency reference is increased when using the Up/Down 2 function. 0: Use selected accel/decel time. 1: Use Accel/Decel Time 4 (C1-07 and C1-08).	0, 1	0	A	A	2AB
d4-05 <1>	Frequency Reference Bias Operation Mode Selection (Up/Down 2)	0: Bias value is held if no input Up 2 or Down 2 is active. 1: When the Up 2 reference and Down 2 reference are both on or both off, the applied bias becomes 0. Currently selected accel / decel. times are used. Enabled only when d4-03 = 0.	0, 1	0	A	A	2AC
d4-06	Frequency Reference Bias (Up/Down 2)	The Up/Down 2 bias value is saved in d4-06 when the frequency reference is not input by the digital operator. The function depends on the setting of d4-01. It is limited by d4-08 and d4-09.	-99.9 to +100.0	0.0%	A	A	2AD
d4-07 <1>	Analog Frequency Reference Fluctuation Limit (Up/Down 2)	When an Up 2 or Down 2 input is active and the frequency reference value from analog or pulse input changes for more than the level set in d4-07, the bias value is hold and the frequency reference is changed to the new value. After the speed reaches the frequency reference the bias hold is released.	0.1 to +100.0	1.0%	A	A	2AE
d4-08 <1>	Frequency Reference Bias Upper Limit (Up/Down 2)	Sets the upper limit for the bias and the value that can be saved in d4-06. Set as a percentage of the maximum output frequency E1-04.	0.1 to 100.0	100.0 %	A	A	2AF
d4-09 <1>	Frequency Reference Bias Lower Limit (Up/Down 2)	Sets the lower limit for the bias and the value that can be saved in d4-06. Set as a percentage of the maximum output frequency E1-04.	-99.9 to 0.0	0.0%	A	A	2B0

No.	Name	Description	Range	Def.	Control Mode		Addr. Hex
					V/f	SV	
d4-10	Up/Down Frequency Reference Limit Selection	Selects which value is used as frequency reference lower limit if the Up/Down function is used. 0: The lower limit is determined by d2-02 or analog input (H3-02/10 = 0). The higher of both values becomes the reference limit. 1: The lower limit is determined by d2-02.	0 or 1	0	A	A	2B6
d7: Offset Frequency Use d7 parameters to set the offset frequency.							
d7-01 <1>	Offset Frequency 1	Added to the frequency reference when the digital input "Frequency Offset 1" (H1-□□ = 44) is switched on.	-100.0 to +100.0	0.0%	A	A	2B2
d7-02 <1>	Offset Frequency 2	Added to the frequency reference when the digital input "Frequency Offset 2" (H1-□□ = 45) is switched on.	-100.0 to +100.0	0.0%	A	A	2B3
d7-03 <1>	Offset Frequency 3	Added to the frequency reference when the digital input "Frequency Offset 3" (H1-□□ = 46) is switched on.	-100.0 to +100.0	0.0%	A	A	2B4

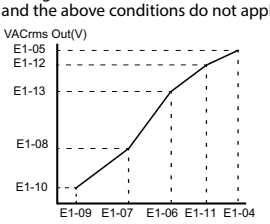
<1> Parameter can be changed during Run.

<2> Default setting value is dependent on parameter o1-03, Digital Operator Display Selection.

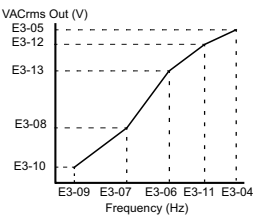
<3> Range upper limit is dependent on parameters E1-04, Maximum Output Frequency, and d2-01, Frequency Reference Upper Limit.

◆ E: Motor Parameters

No.	Name	Description	Range	Def.	Control Mode		Addr. Hex
					V/f	SV	
E1: V/f Pattern Characteristics Use E1 parameters to set V/f characteristics for the motor.							
E1-01 <1>	Input Voltage Setting	This parameter must be set to the power supply voltage. It sets the maximum and base voltage used by preset V/f patterns (E1-03 = 0 to E) and adjusts levels used by certain functions. **WARNING!** Electrical Shock Hazard. Drive input voltage (not motor voltage) must be set in E1-01 for the protective features of the drive to function properly. failure to do so may result in equipment damage and/or death or personal injury.	155 to 255	200 V	S	S	300

No.	Name	Description	Range	Def.	Control Mode		Addr. Hex
					V/f	SV	
E1-03 <2>	V/f Pattern Selection	Selects a preset V/f pattern. 0: 50 Hz Constant torque 1 1: 60 Hz Constant torque 2 2: 60 Hz Constant torque 3 (50 Hz base) 3: 72 Hz Constant torque 4 (60 Hz base) 4: 50 Hz Variable torque 1 5: 50 Hz Variable torque 2 6: 60 Hz Variable torque 3 7: 60 Hz Variable torque 4 8: 50 Hz High starting torque 1 9: 50 Hz High starting torque 2 A: 60 Hz High starting torque 3 B: 60 Hz High starting torque 4 C: 90 Hz (60 Hz base) D: 120 Hz (60 Hz base) E: 180 Hz (60 Hz base) F: Custom V/f. E1-04 through E1-13 settings define the V/f pattern	0 to F	F	A	A	302
E1-04	Maximum Output Frequency	E1-04 and E1-06 to E1-13 can only be changed when E1-03 is set to F. To set linear V/f characteristics, set the same values for E1-07 and E1-09. In this case, the setting for E1-08 will be disregarded. When E1-13 = 0.0 V, then the drive uses the value set to E1-05 to control the voltage level. Ensure that the five frequencies are set according to these rules to prevent triggering an oPE10 fault: E1-09 ≤ E1-07 < E1-06 ≤ E1-11 ≤ E1-04 **Note:** Setting E1-11 to 0 disables both E1-11 and E1-12, and the above conditions do not apply.  	40.0 to 400.0 <3>	60 Hz	S	S	303
E1-05 <1>	Maximum Output Voltage		0.0 to 255.0	200 V	S	S	304
E1-06	Base Frequency		0.0 to E1-04	60 Hz	S	S	305
E1-07	Middle Output Frequency		0.0 to E1-04	3.0 Hz	A	A	306
E1-08 <1>	Middle Output Frequency Voltage		0.0 to 255.0	13.6 V <4> <5>	A	A	307
E1-09	Minimum Output Frequency		0.0 to E1-04	1.5 Hz <4>	S	S	308
E1-10 <1>	Minimum Output Frequency Voltage		0.0 to 255.0	9.1 V <4> <5>	A	A	309
E1-11	Middle Output Frequency 2		0.0 to E1-04	0.0 Hz	A	A	30A
E1-12 <1> <7>	Middle Output Frequency Voltage 2		0.0 to 255.0	0.0 V	A	A	30B
E1-13 <1> <9>	Base Voltage		0.0 to 255.0	0.0 V	A	S	30C
E2: Motor Parameters Use E2 parameters to set motor-related data.							
E2-01 <7>	Motor Rated Current	Sets the motor nameplate full load current in amperes (A). Automatically set during Auto-Tuning. **Note:** Set E2-03 (Motor No-Load Current) before making changes to E2-01. An oPE01 error will be triggered if E2-01 < E2-03.	10 to 200% of drive rated current <8>	<9>	S	S	30E

No.	Name	Description	Range	Def.	Control Mode		Addr. Hex
					V/f	SV	
E2-02	Motor Rated Slip	Sets the motor rated slip in Hertz. Automatically set during rotational Auto-Tuning.	0.00 to 20.00	<9>	A	A	30F
E2-03	Motor No-Load Current	Sets the magnetizing current of the motor in Ampere. Automatically set during rotational Auto-Tuning. **Note:** Set E2-03 (Motor No-Load Current) before making changes to E2-01. An oPE01 error will be triggered if E2-01 < E2-03.	0 to less than E2-01	<9>	A	A	310
E2-04	Number of Motor Poles	Sets the number of motor poles. Automatically set during Auto-Tuning.	2 to 48	4 poles	A	A	311
E2-05	Motor Line-to-Line Resistance	Sets the phase-to-phase motor resistance in ohms. Automatically set during Auto-Tuning.	0.000 to 65.000 <10>	<9>	A	A	312
E2-06	Motor Leakage Inductance	Sets the voltage drop due to motor leakage inductance as a percentage of motor rated voltage. Automatically set during Auto-Tuning.	0.0 to 40.0	<9>	A	A	313
E2-07	Motor Iron-Core Saturation Coefficient 1	Sets the motor iron saturation coefficient at 50% of magnetic flux. Automatically set during Auto-Tuning.	0.00 to 0.50	0.50	–	A	314
E2-08	Motor Iron-Core Saturation Coefficient 2	Sets the motor iron saturation coefficient at 75% of magnetic flux. Automatically set during Auto-Tuning.	E2-07 to 0.75	0.75	–	A	315
E2-09	Motor Mechanical Loss	Sets the motor mechanical loss as a percentage of motor rated power (kW). Adjust in the following circumstances: When there is a large amount of torque loss due to motor bearing friction. When there is a large amount of torque loss.	0.0 to 10.0	0.0%	–	A	316
E2-10	Motor Iron Loss for Torque Compensation	Sets the motor iron loss in watts (W).	0 to 65535	<9>	A	–	317
E2-11	Motor Rated Output	Sets the motor rated power in kilowatts (kW). Automatically set during Auto-Tuning. (1 HP = 0.746 kW).	0.00 to 650.00	<5>	S	S	318
E2-12	Motor Iron-Core Saturation Coefficient 3	Set to the motor iron saturation coefficient at 130% of magnetic flux. Automatically set during rotational Auto-Tuning.	1.30 to 5.00	1.30	–	A	328
E3: Motor 2 V/f Characteristics Use E3 parameters to set the V/f pattern for a second motor.							
E3-01	Motor 2 Control Method	0: V/f Control 2: Sensorless Vector (SV)	0 or 2	0	A	A	319

No.	Name	Description	Range	Def.	Control Mode		Addr. Hex
					V/f	SV	
E3-04	Motor 2 Max Output Frequency	To set linear V/f characteristics, set the same values for E3-07 and E3-09. In this case, the setting for E3-08 will be disregarded. Ensure that the five frequencies are set according to these rules to prevent triggering an oPE10 fault: E3-09 ≤ E3-07 < E3-06 ≤ E3–11 ≤ E3-04 **Note:** Setting E3-11 to 0 disables both E3-11 and E3-12, and the above conditions do not apply. 	40.0 to 400.0	60 Hz	A	A	31A
E3-05 <1>	Motor 2 Max Voltage		0.0 to 255.0	200.0 V	A	A	31B
E3-06	Motor 2 Base Frequency		0.0 to E3-04	60 Hz	A	A	31C
E3-07	Motor 2 Mid Output Freq.		0.0 to E3-04	3.0 Hz <11>	A	A	31D
E3-08 <1>	Motor 2 Mid Output Freq. Voltage		0.0 to 255.0	13.6 V <5> <11>	A	A	31E
E3-09	Motor 2 Min. Output Freq.		0.0 to E3-04	1.5 Hz <11>	A	A	31F
E3-10 <1>	Motor 2 Min. Output Freq. Voltage		0.0 to 255.0	9.1 V <5> <11>	A	A	320
E3-11 <6>	Motor 2 Mid Output Frequency 2		0.0 to E3-04	0.0 Hz	A	A	345
E3-12 <1> <12>	Motor 2 Mid Output Frequency Voltage 2		0.0 to 255.0 <1>	0.0 V	A	A	346
E3-13 <1> <8>	Motor 2 Base Voltage		0.0 to 255.0 <1>	0.0 V	A	S	347
E4: Motor 2 Parameters Use E4 parameters to control a second motor operating on the same drive.							
E4-01	Motor 2 Rated Current	Sets the motor 2 nameplate full load current in amperes (A). This value is automatically set during Auto-Tuning.	10 to 200% of drive rated current	<9>	A	A	321
E4-02	Motor 2 Rated Slip	Sets the motor 2 rated slip in Hz. Automatically set during Auto-Tuning.	0.00 to 20.00	<9>	A	A	322
E4-03	Motor 2 Rated No- Load Current	Sets the magnetizing current of motor 2 in Ampere. Automatically set during Rotational Auto-Tuning.	0 to less than E4-01 <8>	<9>	A	A	323
E4-04	Motor 2 Motor Poles	Sets the number of poles of motor 2. This value is automatically set during Auto-Tuning.	2 to 48	4 poles	A	A	324
E4-05	Motor 2 Line-to- Line Resistance	Sets the phase-to-phase resistance of motor 2 in ohms. Automatically during Auto-Tuning.	0.000 to 65.000 <10>	<9>	A	A	325
E4-06	Motor 2 Leakage Inductance	Sets the voltage drop due to motor leakage inductance as a percentage of rated voltage of motor 2. Automatically set during Auto-Tuning.	0.0 to 40.0	<9>	A	A	326
E4-07	Motor 2 Motor Iron-Core Saturation Coefficient 1	Set to the motor iron saturation coefficient at 50% of magnetic flux. Automatically set during Rotational Auto-Tuning.	0.00 to 0.50	0.50	–	A	343

No.	Name	Description	Range	Def.	Control Mode		Addr. Hex
					V/f	SV	
E4-08	Motor 2 Motor Iron-Core Saturation Coefficient 2	Set to the motor iron saturation coefficient at 75% of magnetic flux. This value is automatically set during Rotational Auto-Tuning.	Setting for E4-07 to 0.75	0.75	–	A	344
E4-09	Motor 2 Mechanical Loss	Sets the motor mechanical loss as a percentage of motor rated power (kW) capacity. Adjust in the following circumstances: • When there is a large amount of torque loss due to motor bearing friction. • When there is a large amount of torque loss.	0.00 to 10.0	0.0	–	A	33F
E4-10	Motor 2 Iron Loss	Sets the motor iron loss in watts.	0 to 65535	<9>	A	–	340
E4-11	Motor 2 Rated Capacity	Sets the motor rated capacity in kW. Automatically set during Auto-Tuning.	0.00 to 650.00	<5>	A	A	327
E4-12	Motor 2 Iron-Core Saturation Coefficient 3	Set to the motor iron saturation coefficient at 130% of magnetic flux. Automatically set during Rotational Auto-Tuning.	1.30 to 5.00	1.30	–	A	342
E4-14 <13>	Motor 2 Slip Compensation Gain	Sets the slip compensation gain for motor 2. The function is the same as C3-01 for motor 1. *Refer to C3-01: Slip Compensation Gain on page 146.*	0.0 to 2.5	0.0 <11>	A	A	341
E4-15	Torque Compensation Gain - Motor 2	Sets the torque compensation gain for motor 2. The function is the same as C4-01 for motor 1. *Refer to C4-01: Torque Compensation Gain on page 147.*	0.00 to 2.50	1.00	A	A	341
E5-39	Current Detection Delay Time	Sets the current detection delay time at the time of d-Axis and q-Axis current feedback calculation. Changing this parameter from the default setting is not normally required.	-1000 to 1000	0 µs	A	A	5E2

<1> Values shown here are for 200 V class drives. Double the value when using a 400 V class drive.

<2> Parameter setting value is not reset to the default value during drive initialization, A1-03 = 1110, 2220, 3330.

<3> Range upper limit is dependent on parameter E4-01 Motor 2 Rated Current.

<4> Default setting value is dependent on parameter A1-02, Control Method Selection. The value shown is for A1-02 = 0-V/f Control.

<5> Default setting value is dependent on parameter o2-04, Drive Model Selection.

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

<7> When setting motor parameters, the motor rated current must be set to a value greater than the motor no-load current (E2-01 > E2-03).

<8> 0.01 A units.

<9> Default setting value is dependent on parameter o2-04, Drive Model Selection and C6-01, Drive Duty Selection.

<10> Setting range becomes 0.00 to 130.00 for drives 0.2 kW.

<11> Default setting depends on the control mode for motor 2 set in parameter E3-01. The given value is for V/f Control.

<12> Parameter ignored when E3-11, Motor 2 Mid Output Frequency 2, and E3-12, Motor 2 Mid Output Frequency Voltage 2, are set to 0.

<13> Parameter can be changed during Run.

◆ F: Options

F parameters are used to program the drive for PG feedback and to function with option cards.

No.	Name	Description	Range	Def.	Control Mode		Addr. Hex
					V/f	SV	
F1: V/f Control with Simple PG Feedback - PG Setup Parameters Use F1 parameters to set up the drive for V/f Control with Simple PG Feedback. These parameters are enabled only when H6-01 = 03.							
F1-02	Operation Selection at PG Open Circuit (PGo)	Sets stopping method when a PG open circuit fault (PGo) occurs. Refer to parameter F1-14. 0: Ramp to Stop - Decelerate to stop using the active deceleration time. 1: Coast to Stop 2: Fast-stop - Decelerate to stop using the deceleration time in C1-09. 3: Alarm only - Drive continues operation.	0 to 3	1	A	–	381
F1-03	Operation Selection at Overspeed (oS)	Sets the stopping method when an overspeed (oS) fault occurs. Refer to F1-08 and F1-09. 0: Ramp to stop - Decelerate to stop using the active deceleration time. 1: Coast to stop 2: Fast-stop - Decelerate to stop using the deceleration time in C1-09. 3: Alarm Only - Drive continues operation.	0 to 3	1	A	–	382
F1-04	Operation Selection at Deviation	Sets the stopping method when a speed deviation (dEv) fault occurs. Refer to F1-10 and F1-11. 0: Ramp to stop - Decelerate to stop using the active deceleration time. 1: Coast to stop 2: Fast-stop - Decelerate to stop using the deceleration time in C1-09. 3: Alarm only - Drive continues operation.	0 to 3	3	A	–	383
F1-08	Overspeed Detection Level	Sets the speed feedback level which has to be exceeded for the time set in F1-09 before an oS fault will occur. Set as a percentage of the maximum output frequency (E1-04).	0 to 120	115%	A	–	387
F1-09	Overspeed Detection Delay Time	Sets the time in seconds for which the speed feedback has to exceed the overspeed detection level F1-08 before an oS fault will occur.	0.0 to 2.0	1.0	A	–	388
F1-10	Excessive Speed Deviation Detection Level	Sets the allowable deviation between motor speed and frequency reference before a speed deviation fault (dEv) is triggered. Set as a percentage of the maximum output frequency (E1-04).	0 to 50	10%	A	–	389
F1-11	Excessive Speed Deviation Detection Delay Time	Sets the time in seconds for which a deviation between motor speed and frequency reference has to exceed the speed deviation detection level F1-10 before a dEv fault will occur.	0.0 to 10.0	0.5 s	A	–	38A

No.	Name	Description	Range	Def.	Control Mode		Addr. Hex
					V/f	SV	
F1-14	PG Open-Circuit Detection Time	Sets the time for which no PG pulses must be detected before a PG Open (PGo) fault is triggered.	0.0 to 10.0	2.0 s	A	–	38D
F6: Serial Communications Option Card Settings Use F6 parameters to program the drive for serial communication.							
F6-01	Communications Error operation Selection	Selects the operation after a communications error occurred. 0: Ramp to stop using current accel/decel time 1: Coast to stop 2: Fast-stop using C1-09 3: Alarm only	0 to 3	1	A	A	3A2
F6-02	External fault from comm. option selection	Sets when an external fault from a comm option is detected. 0: Always detected 1: Detection during Run only	0, 1	0	A	A	3A3
F6-03	External fault from comm. option operation selection	Selects the operation after an external fault set by a communications option (EF0). 0: Ramp to stop using current accel/decel time 1: Coast to stop 2: Fast-stop using C1-09 3: Alarm only	0 to 3	1	A	A	3A4
F6-04	Bus Error Detection Time	Set the delay time for error detection if a bus error occurs.	0.0 to 5.0	2.0 s	A	A	3A5
F6-07	NetRef/ComRef Function Selection	0: Multi-step reference disabled 1: Multi-step reference enabled	0, 1	1	A	A	3A8
F6-08	Reset Communication Parameters	0: Communication-related parameters (F6-☐☐ and F7-☐☐) are not reset when the drive is initialized using A1-03. 1: Reset all communication-related parameters (F6-☐☐ and F7-☐☐) when the drive is initialized using A1-03.	0, 1	0 <1>	A	A	36A
F6-10	CC-Link Node Address	Sets the node address if a CC-Link option card is installed.	0 to 63	0	A	A	3E6
F6-11	CC-Link communications speed	0: 156 Kbps 1: 625 Kbps 2: 2.5 Mbps 3: 5 Mbps 4: 10 Mbps	0 to 4	0	A	A	3E7
F6-14	BUS Error Auto Reset	Selects if a BUS fault can be automatically reset. 0: Disabled 1: Enabled	0, 1	0	A	A	3BB
F6-50	DeviceNet MAC Address	Selects the drives MAC address for DeviceNet.	0 to 64	0	A	A	3C1
F6-51	Device Net Communications Speed	0: 125 kbps 1: 250 kbps 2: 500 kbps 3: Adjustable from Network 4: Detect automatically	0 to 4	0	A	A	3C2
F6-52	DeviceNet PCA setting	I/O Polled Consuming Assembly Data Instance	0 to 255	21	A	A	3C3
F6-53	DeviceNet PPA setting	I/O Polled Producing Assembly Data Instance	0 to 255	71	A	A	3C4

B.2 Parameter Table

No.	Name	Description	Range	Def.	Control Mode		Addr. Hex
					V/f	SV	
F6-54	DeviceNet Idle Mode Fault Detection	Selects if an EF0 fault is detected when no data are received from the master. 0: Detection enabled 1: No detection	0, 1	0	A	A	3C5
F6-55	DeviceNet Baud Rate Monitor	Verifies the baud rate running on the network. 0: 125 kbps 1: 250 kbps 2: 500 kbps	0 to 2	0	A	A	3C6
F6-56	DeviceNet Speed Scaling Factor	Sets the scaling factor for the speed monitor in DeviceNet Class ID 2AH Object.	-15 to 15	0	A	A	3D7
F6-57	DeviceNet Current Scaling Factor	Sets the scaling factor for the output current monitor in DeviceNet Class ID 2AH Object.	-15 to 15	0	A	A	3D8
F6-58	DeviceNet Torque Scaling Factor	Sets the scaling factor for the torque monitor in DeviceNet Class ID 2AH Object.	-15 to 15	0	A	A	3D9
F6-59	DeviceNet Power Scaling Factor	Sets the scaling factor for the power monitor in DeviceNet Class ID 2AH Object.	-15 to 15	0	A	A	3DA
F6-60	DeviceNet Voltage Scaling Factor	Sets the scaling factor for the voltage monitor in DeviceNet Class ID 2AH Object.	-15 to 15	0	A	A	3DB
F6-61	DeviceNet Time Scaling Factor	Sets the scaling factor for the time monitor in DeviceNet Class ID 2AH Object.	-15 to 15	0	A	A	3DC
F6-62	DeviceNet Heartbeat Interval	Sets the heartbeat interval for DeviceNet communications.	0 to 10	0	A	A	3DD
F6-63	Dynamic Output Assembly 109 Parameter 1	Dynamic Output Assembly 109 Parameter 1	0x0 to 0xFFFF	0	A	A	3DE
	MAC ID Memory	Sets the MAC ID memory (Read only).	0 to 63	–	A	A	3DE
F6-64 to F6-67	Dynamic Output Assembly 109 Programmable	Output 1 to 4 (DOA109 1 to 4) Setting Configurable Output 1 to 4 for writing of MEMOBUS register.	0000 to FFFF	0000	A	A	3DF 3E0 3E1 3E2
F6-68 to F6-71	Dynamic Input Assembly 159 Programmable	Input 1 to 4 (DIA159 1 to 4) Setting Configuable Input 1 to 4 for reading of MEMOBUS register.	0000 to FFFF	0000	A	A	3E3 3E4 3C7 3C8

<1> Parameter setting value is not reset to the default value during drive initialization, A1-03 = 1110, 2220, 3330.

<2> F6-20 to F6-41, F6-72 Reserved Parameters

<3> F7-01 to F7-42 Communication Parameters for optional parts

◆ H Parameters: Multi-Function Terminals

H parameters assign functions to the multi-function input and output terminals.

No.	Name	Description	Range	Def.	Control Mode		Addr. Hex
					V/f	SV	
H1: Multi-Function Digital Input H1 parameters to assign functions to the multi-function digital input terminals. Unused terminals should be set to "F".							
H1-01	Multi-Function Digital Input Terminal S1 Function Selection	Assigns a function to the multi- function digital inputs. Refer to H1 Multi-Function Digital Input Selections on page *350* for a description of setting values.	1 to 9F *<1>*	40	A	A	438
H1-02	Multi-Function Digital Input Terminal S2 Function Selection			41	A	A	439
H1-03	Multi-Function Digital Input Terminal S3 Function Selection		0 to 9F *<1>*	24	A	A	400
H1-04	Multi-Function Digital Input Terminal S4 Function Selection			14	A	A	401
H1-05	Multi-Function Digital Input Terminal S5 Function Selection			3 (0) *<2>*	A	A	402
H1-06	Multi-Function Digital Input Terminal S6 Function Selection			4 (3) *<2>*	A	A	403
H1-07	Multi-Function Digital Input Terminal S7 Function Selection			6 (4) *<2>*	A	A	404

<1> The availability of certain functions depends on the control method used.

<2> Parenthetical value is the default when parameter A1-03 = 3330 3-Wire Initialization.

H1 Multi-Function Digital Input Selections				
H1-□□ Setting	Function	Description	Control Mode	
			V/f	SV
0	3-Wire Sequence	Closed: Reverse rotation (only if the drive is set up for 3-Wire sequence)	O	O
1	LOCAL/REMOTE Selection	Open: REMOTE, Reference 1 or 2 (b1-01/02 or b1-15/16) Closed: LOCAL, LED operator is run and reference source	O	O
2	External Reference 1/2	Open: Run and frequency reference source 1 (b1-01/02) Closed: Run and frequency reference source 2 (b1-15/16)	O	O
3	Multi-Step Speed Reference 1	Used to select Multi-Step Speeds set in d1-01 to d1-16	O	O
4	Multi-Step Speed Reference 2		O	O
5	Multi-Step Speed Reference 3		O	O
6	Jog Reference Selection	Open: Selected speed reference Closed: Jog Frequency reference (d1-17). Jog has priority over all other reference sources.	O	O
7	Accel/Decel Time 1	Used to switch between Accel/Decel. Time 1/2	O	O
8	Baseblock Command (N.O.)	Open: Normal operation Closed: No drive output	O	O
9	Baseblock Command (N.C.)	Open: No drive output Closed: Normal operation	O	O

H1 Multi-Function Digital Input Selections				
H1-□□ Setting	Function	Description	Control Mode	
			V/f	SV
A	Accel/Decel Ramp Hold	Closed: The drive pauses during acceleration or deceleration and maintains the output frequency.	O	O
B	Drive Overheat Alarm (oH2)	Closed: Closes when an oH2 alarm occurs.	O	O
C	Terminal A1/A2 Enable	Open: Analog input selected by H3-14 is disabled. Closed: Analog input selected by H3-14 is enabled.	O	O
F	Not used/Through Mode	Select this setting when not using the terminal or when using the terminal in a pass-through mode.	O	O
10	Up Command	Open: Maintains the current frequency reference Closed: Increases or decreases the current frequency reference. Ensure that the increase and decrease commands are set in conjunction with one another.	O	O
11	Down Command		O	O
12	Forward Jog	Closed: Runs forward at the Jog Frequency d1-17.	O	O
13	Reverse Jog	Closed: Runs reverse at the Jog Frequency d1-17.	O	O
14	Fault Reset	Closed: Resets faults if the cause is cleared and the Run command is removed.	O	O
15	Fast-Stop (N.O.)	Closed: Decelerates at the Fast-Stop time C1-09. To restart the Fast-Stop input must be released and Run must be cycled.	O	O
16	Motor 2 Selection	Open: Motor 1 (E1-□□, E2-□□) Closed: Motor 2 (E3-□□, E4-□□)	O	O
17	Fast-stop (N.C.)	Open: Decelerates according to C1-09 (Fast-stop Time)	O	O
18	Timer Function Input	Set the timer delay using parameters b4-01 and b4-02. Ensure this function is set in conjunction with the multi-function output timer (H2-□□ = 12).	O	O
19	PID Disable	Closed: PID control disabled	O	O
1A	Accel/Decel Time Selection 2	Switches Accel/Decel times.	O	O
1B	Program Lockout	Open: Parameters can not be edited. Closed: Parameters may be edited and saved.	O	O
1E	Reference Sample Hold	Closed: Samples the analog frequency reference and operates the drive at that speed.	O	O
20 to 2F	External Fault	20: N.O., Always Detected, Ramp To Stop 21: N.C., Always Detected, Ramp To Stop 22: N.O., During Run, Ramp To Stop 23: N.C., During Run, Ramp To Stop 24: N.O., Always Detected, Coast To Stop 25: N.C., Always Detected, Coast To Stop 26: N.O., During Run, Coast To Stop 27: N.C., During Run, Coast To Stop 28: N.O., Always Detected, Fast-stop 29: N.C., Always Detected, Fast-stop 2A: N.O., During Run, Fast-stop 2B: N.C., During Run, Fast-stop 2C: N.O., Always Detected, Alarm Only (continue running) 2D: N.C., Always Detected, Alarm Only (continue running) 2E: N.O., During Run, Alarm Only (continue running) 2F: N.C., During Run, Alarm Only (continue running)	O	O
30	PID Integral Reset	Closed: Resets the PID control integral value.	O	O

H1 Multi-Function Digital Input Selections				
H1-□□ Setting	Function	Description	Control Mode	
			V/f	SV
31	PID Integral Hold	Closed: Maintains the current PID control integral value.	O	O
32	Multi-Step Speed Reference 4	Used to select Multi-Step Speeds set in d1-01 to d1-16	O	O
34	PID Soft Starter	Closed: Disables the PID soft starter b5-17.	O	O
35	PID Input Switch	Closed: Inverses the PID input signal.	O	O
40	Forward Run Command (2-Wire sequence)	Open: Stop Closed: Forward run **Note:** Can not be set together with Settings 42 or 43.	O	O
41	Reverse Run Command (2-Wire sequence)	Open: Stop Closed: Reverse run **Note:** Can not be set together with Settings 42 or 43.	O	O
42	Run Command (2-Wire sequence 2)	Open: Stop Closed: Run **Note:** Can not be set together with Settings 40 or 41.	O	O
43	FWD/REV Command (2-Wire sequence 2)	Open: Forward Closed: Reverse **Note:** Can not be set together with Settings 40 or 41.	O	O
44	Offset Frequency 1 Addition	Closed: Adds d7-01 to the frequency reference.	O	O
45	Offset Frequency 2 Addition	Closed: Adds d7-02 to the frequency reference.	O	O
46	Offset Frequency 3 Addition	Closed: Adds d7-03 to the frequency reference.	O	O
47	Node Setup	Closed: Node setup for SI-S3/V enabled.	O	O
60	DC Injection Braking Command	Closed: Triggers DC Injection Braking (b2-02)	O	O
61	External Search Command 1	Closed: Activates Current Detection Speed Search from the max. output frequency (E1-04) if b3-01 = 0. Activates Speed Estimation Type Speed search if b3-01 = 0.	O	O
62	External Search Command 2	Closed: Activates Current Detection Speed Search from the frequency reference b3-01 = 0. Activates Speed Estimation Type Speed search if b3-01 = 0.	O	O
65	KEB Ride-Thru 1 (N.C.)	Open: KEB Ride-Thru 1 enabled Closed: Normal operation	O	O
66	KEB Ride-Thru 1 (N.O.)	Open: Normal operation Closed: KEB Ride-Thru 1 enabled	O	O
67	Communications Test Mode	Tests the MEMOBUS/Modbus RS-485/422 interface.	O	O
68	High-Slip Braking	Closed: High-Slip braking is executed. Drive stops.	O	-
6A	Drive Enable	Open: Drive disabled. If this input is opened during run, then the drive will stop as specified by parameter b1-03. Closed: Ready for operation.	O	O
75	Up 2 Command	Open: Maintains the current frequency reference. Closed: Increases or decreases the frequency reference. UP 2 and Down 2 commands must be set in combination with each other. The frequency reference source must be assigned to the operator (b1-01 = "0").	O	O
76	Down 2 Command		O	O
7A	KEB Ride-Thru 2 (N.C.)	Open: KEB Ride-Thru 2 enabled Closed: Normal operation	O	O
7B	KEB Ride-Thru 2 (N.O.)	Open: Normal operation Closed: KEB Ride-Thru 2 enabled	O	O
7E	Forward/Reverse Detection	Direction of rotation detection (for V/f with Simple PG Feedback)	O	-

No.	Name	Description	Range	Def.	Control Mode		Addr. Hex
					V/f	SV	
H2: Multi-Function Digital Outputs Use H2 parameters to assign functions to the multi-function digital outputs.							
H2-01	Terminal MA, MB and MC Function Selection (relay)	Refer to H2 Multi-Function Digital Output	0 to 192 <1>	E	A	A	40B
H2-02	Terminal P1 Function Selection (open- collector)			0	A	A	40C
H2-03	Terminal P2 Function Selection (open- collector)			2	A	A	40D
H2-06	Watt Hour Output Unit Selection	Sets the output units for the watt hours when Watt Hour Pulse Output is selected as the digital output (H2-01, H2-02, or H2-03 = 39). Outputs a 200 ms pulse signal when the watt-hour counter increases by the units selected. 0: 0.1 kWh units 1: 1 kWh units 2: 10 kWh units 3: 100 kWh units 4: 1000 kWh units	0 to 4	0	A	A	437

<1> The availability of certain functions depends on the control method used.

H2 Multi-Function Digital Output Settings				
H2-□□ Setting	Function	Description	Control Mode	
			V/f	SV
0	During Run	Closed: A Run command is active or voltage is output.	O	O
1	Zero Speed	Closed: Output frequency is 0.	O	O
2	Speed Agree 1	Closed: Output frequency equals the speed reference (plus or minus the hysteresis set to L4-02).	O	O
3	User Set Speed Agree 1	Closed: Output frequency and speed reference equal the value in L4-01 (plus or minus the hysteresis of L4-02).	O	O
4	Frequency Detection 1	Closed: Output frequency is less than or equal to the value in L4-01 with hysteresis determined by L4-02.	O	O
5	Frequency Detection 2	Closed: Output frequency is greater than or equal to the value in L4-01, with hysteresis determined by L4-02.	O	O
6	Drive Ready	Closed: Drive Ready. The drive is powered up, not in a fault state, and in the Drive mode.	O	O
7	DC Bus Undervoltage	Closed: DC bus voltage is below the Uv trip level set in L2-05.	O	O
8	During Baseblock (N.O.)	Closed: There is no output voltage.	O	O
9	Frequency reference selection	Open: External Reference 1 or 2 supplies the frequency reference Closed: Digital operator supplies the frequency reference.	O	O
A	Run command selection	Open: External Reference 1 or 2 supplies the Run command Closed: Digital operator supplies the Run command.	O	O
B	Torque Detection 1 (N.O.)	Closed: Output current/torque exceeds the torque value set in parameter L6-02 for longer than the time set in parameter L6-03.	O	O

H2 Multi-Function Digital Output Settings				
H2-□□ Setting	Function	Description	Control Mode	
			V/f	SV
C	Frequency Reference Loss	Closed: Loss of the analog frequency reference detected. Enabled when L4-05 = 1.	O	O
D	Reserved	–	–	–
E	Fault	Closed: Fault occurred (other than CPF00 and CPF01).	O	O
F	Not used/Through Mode	Set this value when the terminal is not used, or when using the terminal in the pass- through mode.	O	O
10	Minor Fault	Closed: An alarm is triggered.	O	O
11	Reset Command Active	Closed: The drive has received a reset command from the multi-function input terminals or from serial network, or the digital operator RESET key has been pressed.	O	O
12	Timer Output	Timer output, controlled by b4-01 and b4-02. Used in conjunction with the digital input (H1-□□ = 18 "timer function").	O	O
13	Speed Agree 2	Closed: When drive output frequency equals the frequency reference +/- L4-04.	O	O
14	User Set Speed Agree 2	Closed: When the drive output frequency is equal to the value in L4-03 (plus or minus L4-04).	O	O
15	Frequency Detection 3	Closed: When the drive output frequency is less than or equal to the value in L4-03 with the hysteresis determined by L4-04.	O	O
16	Frequency Detection 4	Closed: When the output frequency is greater than or equal to the value in L4-03 with the hysteresis determined by L4-04.	O	O
17	Torque Detection 1 (N.C.)	Open: When the output current/torque exceeds the value set in parameter L6-02 for more time than is set in parameter L6-03.	O	O
18	Torque Detection 2 (N.O.)	Closed: When the output current/torque exceeds the value set in parameter L6-05 for more time than is set in parameter L6-06.	O	O
19	Torque Detection 2 (N.C.)	Open: Output current/torque exceeds the value set in parameter L6-05 for more time than is set in parameter L6-06.	O	O
1A	Reverse Direction	Closed: Drive is running in the reverse direction.	O	O
1B	During Baseblock (N.C.)	Open: Drive is in Baseblock condition. Output is disabled.	O	O
1C	Motor 2 Selection	Closed: Motor 2 is selected by a digital input (H1-□□ = 16).	O	O
1E	Restart Enabled	Closed: An automatic restart is performed.	O	O
1F	Overload Alarm oL1	Closed: oL1 is at 90% of its trip point or greater.	O	O
20	oH Pre alarm	Closed: Heatsink temperature exceeds the parameter L8-02 value.	O	O
22	Mechanical Weakening (N.O.)	Closed: Mechanical Weakening detected.	O	O
2F	Maintenance Period	Closed: Cooling fan, electrolytic capacitors, IGBTs, or the soft charge bypass relay may require maintenance.	O	O
30	During Torque Limit	Closed: When the torque limit has been reached.	–	O
37	During Frequency Output	Open: No frequency output from drive if stopped, with baseblock, with DC injection braking during initial excitation, or with short-circuit braking. Closed: Drive is outputting a frequency.	O	O
38	Drive Enable	Closed: Multi-function input closes (H1-□□ = 6A).	O	O

H2 Multi-Function Digital Output Settings				
H2-□□ Setting	Function	Description	Control Mode	
			V/f	SV
39	Watt Hour Pulse Output	Output units are determined by H2-06, outputs 200 ms pulse for each incremented kWh count.	O	O
3C	LOCAL/REMOTE Status	Closed: LOCAL Open: REMOTE	O	O
3D	Speed Search	Closed: Speed search is being executed.	O	O
3E	PID Feedback Loss Low	Closed: PID Feedback Loss Low. PID feedback value is below the level set to b5-13 for longer than the time set in b5-14.	O	O
3F	PID Feedback Loss High	Closed: PID Feedback Loss High. PID feedback value exceeds the level set to b5-36 for longer than the time set to b5-37.	O	O
4A	KEB Operation	Closed: KEB is being performed.	O	O
4C	During Fast-stop	Closed: Fast-stop command is entered	O	O
4D	oH Pre-alarm Time Limit	Closed: oH Pre-alarm time limit is passed.	O	O
4E	Braking Transistor Fault (rr)	Closed: The built-in dynamic braking transistor failed.	O	O
4F	Reserved	–	–	–
100 to 14F	H2 Parameter Functions Reversed Output Switching of 0 to 4F	Reverse the output switching of the multi-function output functions. Set the last two digits of 1□□ to reverse the output signal of that specific function. Examples: Setting "108" reverses the output of "During baseblock," which is setting value 08. Setting "14A" reverses the output of "During KEB operation", which is setting "4A".	O	O

No.	Name	Description	Range	Def.	Control Mode		Addr. Hex
					V/f	SV	
H3: Analog Inputs Use H3 parameters to set the multi-function analog input terminals.							
H3-01	Terminal A1 Signal Level Selection	Sets the input level for terminal A1. 0: 0 to +10 V (lower limit) 1: 0 to +10 V (no lower limit)	0, 1	0	A	A	410
H3-02	Terminal A1 Function Selection	Sets the function of terminal A1. When terminal A1 is not used or is used as a through terminal, this parameter must be set to "F".	0 to 41 <1>	0	A	A	434
H3-03 <2>	Terminal A1 Gain Setting	Sets the level of the input value selected in H3-02 when 10 V is input at terminal A1.	-999.9 to 999.9	100.0 %	A	A	411
H3-04 <2>	Terminal A1 Bias Setting	Sets the level of the input value selected in H3-02 when 0 V is input at terminal A1.	-999.9 to 999.9	0.0%	A	A	412
H3-09	Terminal A2 Signal Level Selection	Sets the input signal level for terminal A2. 0: 0 to +10 V (with lower limit) 1: 0 to +10 V (no lower limit) 2: 4 to 20 mA 3: 0 to 20 mA	0 to 3 Use DIP switch S1 to set input terminal A2 for a current or a voltage input signal.	2	A	A	417

No.	Name	Description	Range	Def.	Control Mode		Addr. Hex
					V/f	SV	
H3-10	Terminal A2 Function Selection	Sets the function of terminal A2. When terminal A2 is not used or is used as a through terminal, this parameter must be set to "F".	0 to 41 <1>	0	A	A	418
H3-11 <2>	Terminal A2 Gain Setting	Sets the level of the input value selected in H3-10 when 10 V (20 mA) is input at terminal A2.	-999.9 to 999.9	100.0 %	A	A	419
H3-12 <2>	Terminal A2 Bias Setting	Sets the level of the input value selected in H3-10 when 0 V (0 or 4 mA) is input at terminal A2.	-999.9 to 999.9	0.0%	A	A	41A
H3-13	Analog Input Filter Time Constant	Sets the primary delay filter time constant for terminals A1 and A2. Used for noise filtering.	0.00 to 2.00	0.03 s	A	A	41B
H3-14	Analog Input Terminal Enable Selection	Determines which analog input terminal will be enabled when a digital input programmed for "Analog input enable" (H1-□□ = C) is activated. 1: Terminal A1 only 2: Terminal A2 only 7: All terminals enabled	1, 2, 7	7	A	A	41C
H3-16	Terminal A1 Offset	Enter a 0 V signal to terminal A1. Next adjust the offset in H3-16 until the monitor U1-13 for the terminal A1 input voltage reads 0.0%. The process is the same for terminal A2.	-500 to 500	0	A	A	440
H3-17	Terminal A2 offset	Enter a 0 V signal, and adjust the offset for terminal A2 in H3-17 until the monitor U1-14 for terminal A2 input voltage reads 0.0%.	-500 to 500	0	A	A	441

<1> The availability of certain parameters depends on the control method used.

<2> Parameter can be changed during Run.

H3 Multi-Function Analog Input Settings				
H3-□□ Setting	Function	Maximum Input Level Possible	Control Mode	
			V/f	SV
0	Frequency Bias	Max output frequency (E1-04). Same value can be set using H3-02 and H3-10.	O	O
1	Frequency Gain	10 V = 100%	O	O
2	Auxiliary Frequency Reference (used as a Multi-Step Speed 2)	Maximum output frequency (E1-04)	O	O
4	Output Voltage Bias	Motor rated voltage (E1-05).	O	–
7	Overtorque/Undertorque Detection Level	Sensorless Vector: Motor rated torque V/f Control: Drive rated current	O	O
B	PID Feedback	10 V = 100%	O	O
C	PID Set Point	10 V = 100%	O	O
E	Motor Temperature (PTC input)	10 V = 100.00%	O	O
F	Not used/Through Mode	–	O	O
10	FWD Torque Limit	Motor rated torque	–	O
11	REV Torque Limit	Motor rated torque	–	O
12	Regenerative Torque Limit	Motor rated torque	–	O

H3 Multi-Function Analog Input Settings				
H3-□□ Setting	Function	Maximum Input Level Possible	Control Mode	
			V/f	SV
15	FWD/REV Torque Limit	Motor rated torque	–	O
16	Differential PID Feedback	10 V = 100%	O	O
41	Output Voltage Gain	10 V = 100%	O	–

No.	Name	Description	Range	Def.	Control Mode		Addr. Hex
					V/f	SV	
H4: Multi-Function Analog Outputs Use H4 parameters to configure the multi-function analog output terminals.							
H4-01	Multi-Function Analog Output Terminal AM	Selects the data to be output through multi-function analog output terminal AM. Set the desired monitor parameter to the digits available in U□-□□. For example, enter "103" for U1-03. When using this terminal in through mode or when not using it at all, set "000" or "031".	000 to 999 <1>	102	A	A	41D
H4-02 <2>	Multi-Function Analog Output Terminal AM Gain	Sets terminal AM output gain. Maximum output voltage is 10 V.	-999.9 to 999.9	100.0 %	S	S	41E
H4-03 <2>	Multi-Function Analog Output Terminal AM Bias	Sets terminal AM output bias.	-999.9 to 999.9	0.0%	A	A	41F
H5: MEMOBUS/Modbus Communications Use H5 Parameters to connect the drive to a MEMOBUS/Modbus network. The settings for MEMOBUS/Modbus communications become effective when the drive is restarted.							
H5-01 <3>	Drive Node Address	Selects drive station node number (address) for MEMOBUS/Modbus terminals R+, R-, S+, S-. Cycle power for the setting to take effect.	0 to FF	1F	A	A	425
H5-02	Communication Speed Selection	Selects the baud rate for MEMOBUS/Modbus terminals R+, R-, S+ and S-. Cycle power for the setting to take effect. 0 : 1200 bps 1 : 2400 bps 2 : 4800 bps 3 : 9600 bps 4 : 19200 bps 5 : 38400 bps 6 : 57600 bps 7 : 76800 bps 8 : 115200 bps	0 to 8	3	A	A	426
H5-03	Communication Parity Selection	Selects the communication parity for MEMOBUS/Modbus terminals R+, R-, S+ and S-. Cycle power for the setting to take effect. 0: No parity 1: Even parity 2: Odd parity	0 to 2	0	A	A	427

No.	Name	Description	Range	Def.	Control Mode		Addr. Hex
					V/f	SV	
H5-04	Stopping Method After Communication Error	Selects the stopping method when a communication time- out fault (CE) is detected. 0: Ramp to stop 1: Coast to stop 2: Fast-stop 3: Alarm only	0 to 3	3	A	A	428
H5-05	Communication Fault Detection Selection	Enables or disables the communications time-out fault (CE) detection. 0: Disabled 1: Enabled - If communication is lost for more than two seconds, a CE fault will occur.	0, 1	1	A	A	429
H5-06	Drive Transmit Wait Time	Set the wait time between receiving and sending data.	5 to 65	5 ms	A	A	42A
H5-07	RTS Control Selection	Selects "request to send" (RTS) control: 0: Disabled - RTS is always on. 1: Enabled - RTS turns on only when sending.	0, 1	1	A	A	42B
H5-09	CE Detection Time	Sets the time required to detect a communications error. Adjustment may be need when networking several drives.	0.0 to 10.0 s	2.0 s	A	A	435
H5-10	Unit Selection for MEMOBUS/Modbus Register 0025H	Selects the units used for MEMOBUS/Modbus register 0025H (Output Voltage Reference Monitor). 0: 0.1 V units 1: 1 V units	0, 1	0	A	A	436
H5-11	Communications ENTER Function Selection	Select the function for the enter command that saves parameter data to the drive. 0: Parameter changes are activated when ENTER command is entered. 1: Parameter changes are activated immediately without ENTER command.	0, 1	1	A	A	43C
H5-12	Run Command Method Selection	0: FWD/STOP, REV/STOP Method 1: RUN/STOP, FWD/REV Method	0, 1	0	A	A	43D
H6: Pulse Train Input/Output Use H6 parameters to configure Pulse Train I/O operation.							
H6-01	Pulse Train Input Terminal RP Function Selection	Selects pulse train input function. 0: Frequency reference 1: PID feedback value 2: PID setpoint value 3: V/f Control with Simple PG Feedback (can be set only when using motor 1 in V/f Control)	0 to 3	0	A	A	42C
H6-02 <2>	Pulse Train Input Scaling	Sets the terminal RP input signal frequency that is equal to 100% of the value selected in H6-01.	100 to 32000	1440 Hz	A	A	42D
H6-03 <2>	Pulse Train Input Gain	Sets the level of the value selected in H6-01 when a frequency with the value set in H6-02 is input.	0.0 to 1000.0	100.0 %	A	A	42E
H6-04 <2>	Pulse Train Input Bias	Sets the level of the value selected in H6-01 when 0 Hz is input.	-100.0 to +100.0	0.0%	A	A	42F
H6-05 <2>	Pulse Train Input Filter Time	Sets the pulse train input filter time constant.	0.00 to 2.00	0.10 s	A	A	430

No.	Name	Description	Range	Def.	Control Mode		Addr. Hex
					V/f	SV	
H6-06 <2>	Pulse Train Monitor Terminal MP Selection	Select the pulse train monitor output function (value of the □-□□ part of U□-□□). Refer to U: Monitors on page 371 for the list of U monitors. Example: To select U5-01, set "501. "When not using this parameter or when using in the through mode, set "000". <4>	000, 031, 101, 102, 105, 116, 501, 502	102	A	A	431
H6-07 <2>	Pulse Train Monitor Scaling	Sets the terminal MP output signal frequency when the monitor value is 100%. Set H6-06 to 102 and H6-07 to 0 to make the pulse train monitor output equal to the output frequency.	0 to 32000	1440 Hz	A	A	432
H6-08	Pulse Train Minimum Frequency	Sets the terminal MP output signal minimum frequency.	0.1 to 1000.0	0.5 Hz	A	A	43F

<1> The availability of certain functions depends on the control method used.

<2> Parameter can be changed during Run.

<3> If this parameter is set to 0, the drive will be unable to respond to MEMOBUS/Modbus commands.

<4> When set for sourcing, +5 V/1.5 kΩ or higher, +8 V/3.5 kΩ or higher, +10 V/10 kΩ or higher. When set for sinking, the external power supply should be +12 Vdc, ±5% with 16 mA or less.

Note: Cycle power to the drive to enable MEMOBUS/Modbus settings.

◆ L: Protection Function

L parameters provide protection to the drive and motor, such as: control during momentary power loss, Stall Prevention, frequency detection, fault restarts, overtorque detection, torque limits and other types of hardware protection.

No.	Name	Description	Range	Def.	Control Mode		Addr. Hex
					V/f	SV	
L1: Motor Protection Functions Use L1 parameters to configure motor protective functions.							
L1-01	Motor Overload Protection Selection	Sets the motor thermal overload protection (oL1) based on the cooling capacity of the motor. 0: Disabled 1: General Purpose Motor (Standard Fan Cooled) 2: Drive Dedicated Motor with a Speed Range of 1:10 6: General Purpose Motor (50 Hz) **Note:** When using multiple motors the drive may not be able to provide protection, even if overload is enabled in L1-01. Set L1-01 to 0 and ensure each motor has separate thermal relays installed.	0 to 2; 6	1 <1>	S	S	480

No.	Name	Description	Range	Def.	Control Mode		Addr. Hex
					V/f	SV	
L1-02	Motor Overload Protection Time	Sets the motor thermal overload protection (oL1) time. A larger L1-02 time will increase the time for an oL1 fault to occur. This parameter does not typically require adjustment. Should be set in accordance with the overload tolerance of the motor.	0.1 to 5.0	1.0 min	A	A	481
L1-03	Motor Overheat Alarm Operation Selection (PTC input)	Sets operation when the motor temperature analog input (H3-02/10 = E) exceeds the oH3 alarm level. 0: Ramp to Stop 1: Coast to Stop 2: Fast-stop using C1-09 3: Alarm Only ("oH3" will flash)	0 to 3	3	A	A	482
L1-04	Motor Overheat Fault Operation Selection (PTC input)	Sets stopping method when the motor temperature analog input (H3-02/10 = E) exceeds the oH4 fault level. 0: Ramp to Stop 1: Coast to Stop 2: Fast-stop	0 to 2	1	A	A	483
L1-05	Motor Temperature Input Filter Time (PTC input)	This parameter adjusts the filter on the motor temperature analog input (H3-02 or H3-10 = E). Increase to add stability, decrease to improve response.	0.00 to 10.00	0.20 s	A	A	484
L1-08	Electrothermal Level Setting 1	Electrothermal level for motor 1	□.□□A 10 to 150%	<1>	A	A	1103
L1-09	Electrothermal Level Setting 2	Electrothermal level for motor 2	□.□□A 10 to 150%	<1>	A	A	1104
L1-13	Continuous Electrothermal Operation Selection	Determines whether or not to hold the electrothermal value when the power supply is interrupted. 0: Disabled 1: Enabled	0, 1	1	A	A	46D
L1-22 <16>	Leakage Current Filter Time Constant 1	Sets the time constant for reducing the sensitivity level when detecting leakage current. Set in seconds and used when operating at constant speed. **Note:** This parameter is available only when C6-02 is set to B. To display this parameter, first set C6-02 = B.	0.0 to 60.0	20.0 s	A	A	768
L1-23 <16>	Leakage Current Filter Time Constant 2	Sets the time constant for reducing the sensitivity level when detecting leakage current. Set in seconds and used during acceleration and deceleration operation. **Note:** This parameter is available only when C6-02 is set to B. To display this parameter, first set C6-02 = B.	0.0 to 60.0	1.0 s	A	A	769

No.	Name	Description	Range	Def.	Control Mode		Addr. Hex
					V/f	SV	
L2: Momentary Power Loss Use L2 parameters to configure drive functions for momentary power loss conditions.							
L2-01	Momentary Power Loss Operation Selection	Enables and disables the momentary power loss function. 0: Disabled - Drive trips on (Uv1) fault when power is lost. 1: Power Loss Ride-Thru Time - Drive will restart if power returns within the time set in L2-02. 2: CPU Power Active - Drive will restart if power returns as long as the CPU is working.	0 to 2	0	A	A	485
			For a restart to occur, the run command must be maintained throughout the Ride-Thru period.				
L2-02	Momentary Power Loss Ride-Thru Time	Sets the Power Loss Ride-Thru time. Only effective when L2-01 = 1.	0.0 to 25.5	<2>	A	A	486
L2-03	Momentary Power Loss Minimum Baseblock Time	Sets the minimum wait time for residual motor voltage decay before the drive output reenergizes after power loss Ride- Thru. If L2-03 is greater than L2-02, operation resumes after the time set in L2-03.	0.1 to 5.0	<3>	A	A	487
L2-04	Momentary Power Loss Voltage Recovery Ramp Time	Sets the time for the output voltage to return to the preset V/ f pattern during Speed Search.	0.0 to 5.0	<2>	A	A	488
L2-05 <4>	Undervoltage Detection Level (Uv)	Sets the DC Bus undervoltage trip level. If this is set lower than the default setting, additional AC input impedance or DC bus reactance may be necessary. This value is used for KEB activation if L2-01 > 0.	150 to 210	<2> <5>	A	A	489
L2-06	KEB Deceleration Time	Sets the time required to decelerate from the speed when KEB was activated to zero speed.	0.0 to 200.0	0.0 s	A	A	48A
L2-07	KEB Acceleration Time	Sets the time to accelerate to the frequency reference when momentary power loss is over. If set to 0.0, the active acceleration time (C1-01, C1-03, C1-05, or C1-07) is used.	0.0 to 25.5	0.0 s	A	A	48B
L2-08	KEB Start Output Frequency Reduction	Sets the percentage of output frequency reduction at the beginning of deceleration when the KEB function is started. Reduction = (slip frequency before KEB) x (L2-08/100) x 2	0 to 300	100%	A	A	48C
L2-11 <4>	Desired DC Bus Voltage during KEB	Sets the desired value of the DC bus voltage during KEB.	150 to 400 V	E1-01 x 1.20	A	A	461
L3: Stall Prevention Function Use L3 parameters to configure the Stall Prevention function.							
L3-01	Stall Prevention Selection during Acceleration	Selects the Stall Prevention method used to prevent excessive current during acceleration. 0: Disabled - Motor accelerates at active acceleration rate. The motor may stall if load is too heavy or accel time is too short. 1: General Purpose - When output current exceeds L3-02 level, acceleration stops. Acceleration will continue when the output current level falls below the L3-02 level. 2: Intelligent - The active acceleration rate is ignored. Acceleration is completed in the shortest amount of time without exceeding the current value set in L3-02.	0 to 2	1	A	A	48F

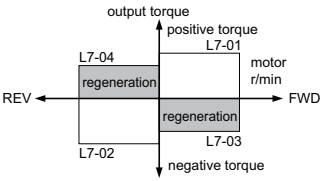
No.	Name	Description	Range	Def.	Control Mode		Addr. Hex
					V/f	SV	
L3-02	Stall Prevention Level during Acceleration	Used when L3-01 = 1 or 2. 100% is equal to the drive rated current. Decrease the set value if stalling or excessive current occurs with default setting.	0 to 150 <7> <13>	<7> <13>	A	A	490
L3-03	Stall Prevention Limit during Acceleration	Sets Stall Prevention lower limit during acceleration when operating in the constant power range. Set as a percentage of the drive's rated current.	0 to 100	50%	A	A	491
L3-04	Stall Prevention Selection during Deceleration	When using a braking resistor, use setting "0". Setting "3" is used in specific applications. 0: Disabled - The drive decelerates at the active deceleration rate. If the load is too large or the deceleration time is too short, an ov fault may occur. 1: General Purpose - The drive decelerates at the active deceleration rate, but if the main circuit DC bus voltage reaches the Stall Prevention level, deceleration will stop. Deceleration will continue once the DC bus level drops below the Stall Prevention level. 2: Intelligent - The active deceleration rate is ignored and the drive decelerates as fast as possible without hitting ov fault level. Range: C1-02 / 10. 3: Stall Prevention with Braking Resistor - Stall Prevention during deceleration is enabled in coordination with dynamic braking. 4: Overexcitation Deceleration - Decelerates with the flux level determined by n3-13 (Overexcitation Gain). 7: Overexcitation Deceleration 3 - Applies more braking power than normal overexcitation deceleration.	0 to 4; 7	0	S	S	492
L3-05	Stall Prevention Selection during Run	Selects the Stall Prevention method to use to prevent drive faults during run. 0: Disabled - Drive runs a set frequency. A heavy load may cause the drive to trip on an oC or oL fault. 1: Decel Time 1 - The drive will decelerate at Decel Time 1 (C1-02) if the output current exceeds the level set by L3-06. Once the current level drops below the L3-06 level, the drive will accelerate back to its frequency reference at the active acceleration rate. 2: Decel Time 2 - Same as setting 1 except the drive decelerates at Decel Time 2 (C1-04). When output frequency is 6 Hz or less, Stall Prevention during run is disabled regardless of the setting in L3-05.	0 to 2	1	A	–	493
L3-06	Stall Prevention Level during Run	Enabled when L3-05 is set to "1" or "2". 100% is equal to the drive rated current. Decrease the set value if stalling or excessive current occurs with the default settings.	30 to 150 <13>	<7> <13>	A	–	494

No.	Name	Description	Range	Def.	Control Mode		Addr. Hex
					V/f	SV	
L3-11	ov Suppression Function Selection	Enables or disables ov suppression function, which allows the drive to change the output frequency as the load changes, thus preventing an ov fault. 0: Disabled 1: Enabled **Note:** The frequency reference and motor speed diverge as the regenerative energy begins to flow back into the DC bus and triggers the ov suppression function. Disable this function when using a braking resistor.	0, 1	0	A	A	4C7
L3-17 <4>	Overvoltage Suppression and Stall Prevention Desired DC Bus Voltage	Sets the desired value for the DC bus voltage during overvoltage suppression and Stall Prevention during deceleration. Enabled only when L3-04 = 2 or L3-11 = 1.	150 to 400 V	370 V <5>	A	A	462
L3-20	Main Power Circuit Voltage Adjustment Gain	Sets the proportional gain used by KEB, Stall Prevention and overvoltage suppression. If ov or Uv1 occurs at the beginning of KEB deceleration, slowly increase this setting by 0.1.	0.00 to 5.00	1.00	A	A	465
L3-21	Accel/Decel Rate Calculation Gain	Sets the proportional gain used to calculate the deceleration rate during KEB, ov suppression function and Stall Prevention during deceleration (L3-04 = 2). This parameter does not typically require adjustment. Increase the value in steps of 1.0 if overcurrent and overvoltage occur.	0.00 to 200.00	1.00	A	A	466
L3-23	Automatic Reduction Selection for Stall Prevention during Run	0: Sets the Stall Prevention level throughout the entire frequency range to the value in parameter L3-06. 1: Automatically lowers the Stall Prevention level in the constant output range. The lower limit value is 40% of L3-06.	0, 1	0	A	A	4FD
L3-24	Motor Acceleration Time for Inertia Calculations	Sets the time needed to accelerate the uncoupled motor at rated torque from stop to the maximum frequency. Setting the drive capacity to parameter o2-04 or changing E2-11 will automatically set this parameter for a 4-pole motor.	0.001 to 10.000	<3> <9>	A	A	46E
L3-25	Load Inertia Ratio	Sets the ratio between the motor and machine inertia.	0.0 to 1000.0	1.0	A	A	46F
L4: Frequency Detection Use L4 parameters to configure frequency detection operation.							
L4-01	Speed Agreement Detection Level	These parameters configure the multi-function output (H2- □□ = 2, 3, 4, 5) settings "Speed Agree 1", "User Set Speed Agree 1", "Frequency Detection 1," and "Frequency detection 2". Parameter L4-01 sets the level while parameter L4-02 sets the hysteresis for the Speed Detection Output Function.	0.0 to 400.0	0.0 Hz	A	A	499
L4-02	Speed Agreement Detection Width		0.0 to 20.0	2.0 Hz	A	A	49A

No.	Name	Description	Range	Def.	Control Mode		Addr. Hex
					V/f	SV	
L4-03	Speed Agreement Detection Level (+/-)	These parameters configure the Multi-Function Output (H2- □□ = 13, 14, 15, 16) settings "Speed Agree 2", "User Set Speed Agree 2", "Frequency Detection 3," or "Frequency Detection 4". Parameter L4-03 sets the level while parameter L4-04 sets the hysteresis for the Speed Detection Output Function.	-400.0 to +400.0	0.0 Hz	A	A	49B
L4-04	Speed Agreement Detection Width (+/-)		0.0 to 20.0	2.0 Hz	A	A	49C
L4-05	Frequency Reference Loss Detection Selection	Sets operation when the frequency reference is lost (reference drops 90% or more within 400 ms). 0: Stop - Drive will stop. 1: Run at L4-06 Level - Drive will run at the percentage set in L4-06 of the frequency reference before loss.	0, 1	0	A	A	49D
L4-06	Frequency Reference at Reference Loss	Sets the frequency reference when a reference loss was detected and L4-05 = 1. Reference will be: Fref = Fref at time of loss x L4-06.	0.0 to 100.0	80.0 %	A	A	4C2
L4-07	Frequency Detection Conditions	0: No detection during baseblock. 1: Detection always enabled.	0, 1	0	A	A	470
L4-08	Speed Agreement Detection Conditions	0: Match speed with the soft-starter output 1: Match frequency reference and motor speed **Note:** In V/f Control, the drive ignores the value set to L4-08 and refers to the soft-starter output to determine whether a speed agree situation has been reached.	0, 1	0	–	A	47F
L5: Fault Reset Use L5 parameters to configure Automatic Restart after fault.							
L5-01	Number of Auto Restart Attempts	Sets the counter for the number of times the drive attempts to restart when one of the following faults occurs: GF, LF, oC, oH1, ov, PF, rr, oL1, oL2, oL3, oL4, Uv1. Parameter L5-05 determines the how the restart counter is incremented. When the drive operates without fault for 10 minutes, the counter will be reset.	0 to 10	0	A	A	49E
L5-02	Auto Restart Operation Selection	Sets fault contact (H2-□□ = E) activation during automatic restart attempts. 0: Fault output not active. 1: Fault output active during restart attempt.	0, 1	0	A	A	49F
L5-04	Fault Reset Interval Time	Sets the amount of time to wait between performing fault restarts. Enabled when L5-05 is set to 1.	0.5 to 600.0 s	10.0 s	A	A	46C
L5-05	Fault Reset Operation Selection	Selects the method of incrementing the restart counter. 0: Continuously attempt to restart and increment counter after successful restart. 1: Attempt to restart with the interval time set in L5-04. Every trial increments the counter.	0, 1	0	A	A	467

No.	Name	Description	Range	Def.	Control Mode		Addr. Hex
					V/f	SV	
L6: Overtorque Detection Use L6 parameters to configure overtorque detection.							
L6-01	Torque Detection Selection 1	Selects the overtorque/undertorque operation. overtorque and undertorque are determined by the settings in parameters L6-02 and L6-03. The multi-function output settings (H2- □□= B and 17) are also active if programmed. 0: Disabled 1: oL3 at Speed Agree - Alarm (overtorque detection only active during Speed Agree and operation continues after detection). 2: oL3 at RUN - Alarm (overtorque detection is always active and operation continues after detection). 3: oL3 at Speed Agree - Fault (overtorque detection only active during Speed Agree and drive output will shut down on an oL3 fault). 4: oL3 at RUN - Fault (overtorque detection is always active and drive output will shut down on an oL3 fault). 5: UL3 at Speed Agree - Alarm (undertorque detection is only active during Speed Agree and operation continues after detection). 6: UL3 at RUN - Alarm (undertorque detection is always active and operation continues after detection). 7: UL3 at Speed Agree - Fault (undertorque detection only active during Speed Agree and drive output will shut down on an oL3 fault). 8: UL3 at RUN - Fault (undertorque detection is always active and drive output will shut down on an oL3 fault).	0 to 8	0	A	A	4A1
L6-02	Torque Detection Level 1	Sets the overtorque/undertorque detection level. 100% is equal to the motor rated current in V/f Control and the motor rated torque in Sensorless Vector Control.	0 to 300	150%	A	A	4A2
L6-03	Torque Detection Time 1	Sets the length of time an overtorque/ undertorque condition must exist before Torque Detection 1 is triggered.	0.0 to 10.0	0.1 s	A	A	4A3

No.	Name	Description	Range	Def.	Control Mode		Addr. Hex
					V/f	SV	
L6-04	Torque Detection Selection 2	Sets the response to an overtorque/undertorque condition. overtorque and undertorque are determined by the settings in parameters L6-05 and L6-06. The multi-function output settings (H2-□□ = 18 and 19). 0: Disabled 1: oL4 at Speed Agree - Alarm (overtorque Detection only active during Speed Agree and Operation continues after detection). 2: oL4 at RUN - Alarm (overtorque Detection is always active and operation continues after detection). 3: oL4 at Speed Agree - Fault (overtorque Detection only active during Speed Agree and drive output will shut down on an oL4 fault). 4: oL4 at RUN - Fault (overtorque Detection is always active and drive output will shut down on an oL4 fault). 5: UL4 at Speed Agree - Alarm (undertorque Detection is only active during Speed Agree and operation continues after detection). 6: UL4 at RUN - Alarm (undertorque Detection is always active and operation continues after detection). 7: UL4 at Speed Agree - Fault (undertorque Detection only active during Speed Agree and drive output will shut down on an oL4 fault). 8: UL4 at RUN - Fault (undertorque Detection is always active and drive output will shut down on an oL4 fault).	0 to 8	0	A	A	4A4
L6-05	Torque Detection Level 2	Sets the overtorque/undertorque detection level. 100% is equal to the motor rated current in V/f Control and equal to the motor rated torque in Sensorless Vector Control.	0 to 300	150%	A	A	4A5
L6-06	Torque Detection Time 2	Sets the length of time an overtorque/undertorque condition must exist before torque detection 2 is recognized by the drive.	0.0 to 10.0	0.1 s	A	A	4A6

No.	Name	Description	Range	Def.	Control Mode		Addr. Hex
					V/f	SV	
L6-08	Mechanical Weakening (oL5) Detection Operation	This function can detect an over/undertorque in a certain speed range as a result of machine fatigue. It is triggered by a certain operation time and uses the oL1 detection settings (L6-01 to L6-02). 0: Mechanical Weakening Detection disabled. 1: Continue running (alarm only). Detected when the speed (signed) is greater than L6-09. 2: Continue running (alarm only). Detected when the speed (not signed) is greater than L6-09. 3: Interrupt drive output (fault). Detected when the speed (signed) is greater than L6-09. 4: Interrupt drive output (fault). Detected when the speed (not signed) is greater than L6-09. 5: Continue running (alarm only). Detected when the speed (signed) is less than L6-09. 6: Continue running (alarm only). Detected when the speed (not signed) is less than L6-09. 7: Interrupt drive output (fault). Detected when the speed (signed) is less than L6-09. 8: Interrupt drive output (fault). Detected when the speed (not signed) is less than L6-09.	0 to 8	0	A	A	468
L6-09	Mechanical Weakening Detection Speed Level	Sets the speed that triggers mechanical weakening detection. When L6-08 is set for an unsigned value, the absolute value is used even if the setting is negative.	-110.0 to +110.0%	110%	A	A	469
L6-10	Mechanical Weakening Detection Time	Sets the time a mechanical weakening has to be detected before an Alarm/Fault is triggered.	0.0 to 10.0 s	0.1 s	A	A	46A
L6-11	Mechanical Weakening Detection Start Time	Sets the operation time (U1-04) that has to be passed before Mechanical weakening detection is active.	0 to 65535	0	A	A	46B
L7: Torque Limit Use L7 parameters to configure the torque limit function.							
L7-01	Forward Torque Limit	Sets the torque limit value as a percentage of the motor rated torque. Four individual quadrants can be set.  	0 to 300	<2>	–	A	4A7
L7-02	Reverse Torque Limit		0 to 300	<2>	–	A	4A8
L7-03	Forward Regenerative Torque Limit		0 to 300	<2>	–	A	4A9
L7-04	Reverse Regenerative Torque Limit		0 to 300	<2>	–	A	4AA
L7-06	Torque Limit Integral Time Constant	Sets the integral time constant for the torque limit.	5 to 10000	50 ms	–	A	4AC

No.	Name	Description	Range	Def.	Control Mode		Addr. Hex
					V/f	SV	
L7-07	Torque Limit Control Method Selection during Accel/Decel	Selects the method of torque limit control during accel/decel. 0: Proportional Control (change to integral controls at fixed speeds). Use this setting when acceleration to the desired speed has priority over torque limitation. 1: Integral Control. Use this setting if the torque limitation has priority. When torque limit is applied to the motor, accel/decel time may increase and motor speed may not meet the speed reference.	0, 1	1	–	A	4C9
L8: Hardware Protection Use L8 parameters to configure hardware protection functions.							
L8-01	Reserved	–	–	–	–	–	–
L8-02	Overheat Alarm Level	When the heatsink temperature exceeds the value set in this parameter, an Overheat Alarm (oH) will occur.	50 to 130	<2>	A	A	4AE
L8-03	Overheat Pre-Alarm Operation Selection	Sets the drive operation when an overheat alarm oH is detected. 0: Ramp to Stop using the active decel time. 1: Coast to Stop. 2: Fast-stop using the time set in C1-09. 3: Alarm Only. Drive continues running, but displays an alarm. 4: Reduced Speed Operation. Drive continues to run with reduced frequency reference as specified in L8-19. Settings 0 through 2 trigger a fault relay if the heatsink becomes too hot.	0 to 4	3	A	A	4AF
L8-05	Input Phase Loss Protection Selection	Selects the detection of input current phase loss, power supply voltage imbalance, or main circuit electrolytic capacitor deterioration. 0: Disabled 1: Enabled **Note:** This parameter is disabled in 200 V single-phase drives.	0, 1	0	A	A	4B1
L8-07	Output Phase Loss Protection Selection	Selects the output phase loss detection. 0: Disabled 1: Enabled (triggered by a single phase loss) 2: Enabled (triggered when two phases are lost) Output phase loss is detected when operating with less than 5% of the drive rated current. Detection can mistakenly occur if the motor is small relative to the drive capacity rating (this parameter should be disabled in such cases).	0 to 2	0	A	A	4B3
L8-09	Output Ground Fault Detection Selection	Selects the output ground fault detection. 0: Disabled 1: Enabled	0, 1	<2>	A	A	4B5

No.	Name	Description	Range	Def.	Control Mode		Addr. Hex
					V/f	SV	
L8-10	Heatsink Cooling Fan Operation Selection	Controls the heatsink cooling fan operation. 0: Run with timer (Fan operates only during run and for L8-11 seconds after stop.) 1: Run always (Cooling fan operates whenever the drive is powered up.)	0, 1	0	A	A	4B6
L8-11	Heatsink Cooling Fan Operation Delay Time	This parameter sets the delay time for the cooling fan to shut off after the run command is removed when L8-10 = 0.	0 to 300	60 s	A	A	4B7
L8-12	Ambient Temperature Setting	Used to input the ambient temperature. This value adjusts the drives oL2 detection level.	-10 to 50	40 °C	A	A	4B8
L8-15	oL2 Characteristics Selection at Low Speeds	Sets the oL2 characteristics at output frequencies below 6 Hz. 0: No oL2 level reduction below 6 Hz. 1: oL2 level is reduced linearly below 6 Hz. It is halved at 0 Hz.	0, 1	1	A	A	4BB
L8-18	Soft Current Limit Selection	Selects the software current limit function. Typically no adjustment is required. 0: Disabled 1: Enabled	0, 1	0	A	A	4BE
L8-19	Frequency Reduction Rate during oH Pre-Alarm	Specifies the frequency reference reduction gain at overheat pre-alarm when L8-03 = 4.	0.1 to 1.0	0.8	A	A	4BF
L8-35	Installation Method Selection	Selects the installation type: 1: Side-by-Side Mounting 2: NEMA Type 1 Drive	0 to 2	<2>	A	A	4EC
L8-38	Carrier Frequency Reduction	Provides protection to the IGBTs by reducing the carrier frequency at low speeds. 0: Disabled 1: Enabled below 6 Hz 2: Enabled for the whole speed range	0 to 2	<2>	A	A	4EF
L8-40	Carrier Frequency Reduction Time	Sets the time for that the drive continues running with reduced carrier frequency after the carrier reduction condition has gone (see also L8-38). A setting of 0.00 s disables the carrier frequency reduction time.	0.00 to 2.00	0.50	A	A	4F1
L8-41	High Current Alarm Selection	Configures an alarm when the output current exceeds 150% of the drive rated current. 0: Alarm disabled. 1: Alarm enabled.	0, 1	0	A	A	4F2

<1> Default setting value is dependent on parameter A1-02, Control Method Selection. The value shown is for A1-02 = 0-V/f Control.

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

<3> Default setting value is dependent on parameter o2-04, Drive Model Selection and C6-01, Drive Duty Selection.

<4> Values shown here are for 200 V class drives. Double the value when using a 400 V class drive.

<5> Default setting value is dependent on parameter E1-01, Input Voltage Setting.

<6> When enabled, the drive stops accelerating when it exceeds the value of L3-02, Stall Prevention Level. The drive decelerates after 100 ms and begins accelerating again after restoring the current level.

<7> Default setting value is 120% when C6-01 is set to 1 (ND) and 150% when C6-01 is set to 0 (HD).

<8> The setting range depends on the control mode set in A1-02. For PM OLV Control the setting range is 0 to 2 and 7.

<9> Parameter value is changed if E2-11 is manually changed or changed by Auto-Tuning.

<10> Parameter setting value is not reset to the default value during drive initialization, A1-03 = 1110, 2220, 3330.

<11> Default setting is determined by drive software version and C6-02 setting. Drive software versions PRG: 1021 and later have a default setting of 0 when the carrier frequency is set for Leakage Current Rejection PWM (C6-02 = B), and 1 when C6-02 is set to any other value.

<12> Parameter can be changed during Run.

<13> The default setting and the upper limit of the setting range are determined by C6-01, Drive Duty Mode, and L8-38, Carrier Frequency Reduction Selection.

◆ n: Special Adjustments

The n parameters are used to adjust more advanced performance characteristics such as hunting prevention, speed feedback detection, high-slip braking and R1 online tuning.

No.	Name	Description	Range	Def.	Control Mode		Addr. Hex
					V/f	SV	
n1: Hunting Prevention Use n1 parameters to configure hunting prevention operation.							
n1-01	Hunting Prevention Selection	If the motor vibrates while lightly loaded, Hunting Prevention may reduce the vibration. 0: Disabled 1: Enabled When quick response is needed disable Hunting Prevention.	0, 1	1	A	–	580
n1-02	Hunting Prevention Gain Setting	Sets the gain for the Hunting Prevention Function. If the motor vibrates while lightly loaded and n1-01 = 1, increase the gain by 0.1 until vibration ceases. If the motor stalls while n1-01 = 1, decrease the gain by 0.1 until the stalling ceases.	0.00 to 2.50	1.00	A	–	581
n1-03	Hunting Prevention Time Constant	Sets the time constant used for hunting prevention.	0 to 500	10	A	–	582
n1-05	Hunting Prevention Gain while in Reverse	Sets the gain used for Hunting Prevention. When set to 0, the gain n1-02 is used for operation in reverse direction.	0.00 to 2.50	0.00	A	–	530

No.	Name	Description	Range	Def.	Control Mode		Addr. Hex
					V/f	SV	
n2: Speed Feedback Detection Control Function Use n2 parameters to configure the Speed Feedback Detection Control function operation.							
n2-01	Speed Feedback Detection Control (AFR) Gain	Sets the internal speed feedback detection control gain in the automatic frequency regulator (AFR). This parameter does not typically require adjustment. Adjust this parameter as follows: If hunting occurs, increase the set value. If response is low, decrease the set value.	0.00 to 10.00 Adjust the setting by 0.05 units at a time, while checking the response.	<3>	–	A	584
n2-02	Speed Feedback Detection Control (AFR) Time Constant	Sets the AFR time constant 1.	0 to 2000	50 ms	–	A	585
n2-03	Speed Feedback Detection Control (AFR) Time Constant 2	Sets the AFR time constant 2. Increase the setting if overvoltage occurs during sudden load changes or the speed overshoots during fast acceleration.	0 to 2000	750 ms	–	A	586
n3: High-Slip Braking Use n3 parameters to configure the high-slip braking function.							
n3-01	High-Slip Braking Deceleration Frequency Width	Sets the output frequency reduction step width when the drive stops the motor using high-slip braking (HSB). If Overvoltage (ov) faults occur during HSB, this parameter may need to be increased.	1 to 20	5%	A	–	588
n3-02	High-Slip Braking Current Limit	Sets the current limit during HSB. Higher n3-02 settings will shorten motor stopping times but increase the motor current, and therefore motor heating.	100 to 200	150%	A	–	589
n3-03	High-Slip Braking Dwell Time at Stop	Sets the time the drive will run with minimum frequency (E1-09) at the end of deceleration. If this time is set too low, the machine inertia can cause the motor to rotate slightly after HSB completion.	0.0 to 10.0	1.0 s	A	–	58A
n3-04	High-Slip Braking Overload Time	Sets the time required for an HSB overload fault (oL7) to occur when the drive output frequency does not change during an HSB stop. This parameter does not typically require adjustment.	30 to 1200	40 s	A	–	58B
n3-13	Overexcitation Deceleration Gain	Applies a gain to the V/f pattern during deceleration (L3-04 = 4). Returns to normal values after ramp to stop or at re-acceleration. To increase the braking power of overexcitation, increase the gain by 1.25 to 1.30.	1.00 to 1.40	1.10	A	A	531
n3-21	High-Slip Suppression Current Level	If overcurrent or overload occur during high-slip deceleration, reduce the high-slip suppression current level. Set as a percentage of the drive rated current.	0 to 150	100%	A	A	579
n3-23	Overexcitation Operation Selection	0: Enabled in both directions 1: Enabled only when rotating forward 2: Enabled only when in reverse	0 to 2	0	A	A	57B

No.	Name	Description	Range	Def.	Control Mode		Addr. Hex
					V/f	SV	
n6: Online Tuning of Motor Line-to-Line Resistance Use n6 parameters to adjust the motor line-to-line resistance while the drive is online.							
n6-01	Line-to-Line Motor Resistance Online Tuning	Tunes the line-to-line motor resistance continuously during operation. 0: Disabled 1: Enabled	0, 1	1	–	A	570

<1> Default setting value is dependent on parameter o2-04, Drive Model Selection.

<2> Values shown here are for 200 V class drives. Double the value when using a 400 V class drive.

<3> Default setting is determined by drive model.
Models HF520S-A20 to 2A2, HF5202-A20 to 3A7, and HF5204-A40 to 3A7: Setting 1.00.
Models HF5202-5A5, 7A5 and HF5204-5A5, 7A5: Setting 1.50.

◆ o: Operator Related Parameters

o parameters are used to set up the LED digital operator displays.

No.	Name	Description	Range	Def.	Control Mode		Addr. Hex
					V/f	SV	
o1: Display Settings Use o1 parameters to configure the digital operator display.							
o1-01 <1>	Drive Mode Unit Monitor Selection	Switches the display after the power has been turned on. When using an LED operator, pressing the up arrow key will display the following data: frequency reference → rotational direction → output frequency → output current → output voltage. (This is done by entering the 1□□ part of U1-□□. Certain monitors are not available in some control modes.)	104 to 699	106	A	A	500
			Set to U1-06 as a default (Output Voltage Reference).				
o1-02 <1>	User Monitor Selection After Power Up	Selects the information that is displayed when the power is turned on. 1: Frequency Reference (U1-01) 2: Forward/Reverse 3: Output Frequency (U1-02) 4: Output Current (U1-03) 5: User Monitor (set by o1-01)	1 to 5	1	A	A	501
o1-03	Digital Operator Display Selection	Sets the units to display the frequency reference and output frequency. 0: Hz 1: % (100% = E1-04) 2: r/min (enter the number of motor poles into E2-04/E4-04/E5-04) 3: User defined by parameters o1-10 and o1-11	0 to 3	0	A	A	502

o1-05 is reserved parameter.

No.	Name	Description	Range	Def.	Control Mode		Addr. Hex
					V/f	SV	
o1-10	Frequency Reference Setting and User-Set Display	These settings define the display values when o1-03 is set to 3. o1-10 sets display values when operating at the maximum output frequency. o1-11 sets the position of the decimal positions.	1 to 60000	<2>	A	A	520
o1-11	Frequency Reference Setting / Decimal Display		0 to 3	<2>	A	A	521
o2: Operator Keypad Functions Use o2 parameters to configure LED digital operator key functions.							
o2-01	LO/RE Key Function Selection	Enables/Disables the digital operator LO/RE key. 0: Disabled 1: Enabled	0, 1	1	A	A	505
o2-02	STOP Key Function Selection	Enables/Disables the operator panel STOP key when the drive is operated form external sources (not operator). 0: Disabled 1: Enabled	0, 1	1	A	A	506
o2-03	User Parameter Default Value	Allows storing of parameter settings as a User Initialization Selection (value 1110 for A1-03). The value returns to 0 after entering 1 or 2. 0: No Change 1: Set Defaults - Saves current parameter settings as user initialization. 2: Clear All - Clears the currently saved user initialization.	0 to 2	0	A	A	507
o2-04 <3>	Drive Model Selection	Sets the drive model. This parameter only needs to be set when installing a new control board. Do not change for other reason.	0 to FF	<4>	A	A	508
o2-05	Frequency Reference Setting Method Selection	Selects if the ENTER key must be pressed when inputting the frequency reference by the operator keypad. 0: Data/Enter key must be pressed to enter a frequency reference. 1: Data/Enter key is not required. The output frequency changes immediately when the reference is changed by the UP or DOWN keys on the digital operator. The ENTER key does not need to be pressed.	0, 1	0	A	A	509
o2-06	Operation Selection when LED Operator is Disconnected	Sets drive action when LED operator is removed in LOCAL mode or with b1-02 = 0 (valid for optional remote operator only). 0: The drive will continue operation. 1: The drive will trigger a fault (oPr) and the motor will coast to stop.	0, 1	0	A	A	50A
o2-07	Motor Direction at Power Up when Using Operator	0: Forward 1: Reverse This parameter requires that drive operation be assigned to the digital operator.	0, 1	0	A	A	527

No.	Name	Description	Range	Def.	Control Mode		Addr. Hex
					V/f	SV	
o3: Copy Function Use o3 parameters to Read, Copy and Verify the parameter settings to and from the drive.							
o3-01	Copy Function Selection	0: Copy select 1: INV → OP READ (Read parameters from the drive, saving them onto the digital operator.) 2: OP → INV WRITE (Copy parameters from the digital operator, writing them to the drive.) 3: OP → INV VERIFY (Verify parameter settings on the drive to check if they match the data saved on the operator.) To read the drive parameter settings into the digital operator, set o3-02 to 1 (to allow reading).	0 to 3	0	A	A	515
o3-02	Copy Allowed Selection	Locks the READ operation to prevent accidental overwriting of the data stored in the LED operator. 0: READ operation prohibited 1: READ operation allowed	0, 1	0	A	A	516
o4: Maintenance Period Use o4 parameters to perform maintenance.							
o4-01	Accumulated Operation Time Setting	Sets the value for the cumulative operation time of the drive in units of 10 h.	0 to 9999	0	A	A	50B
o4-02	Accumulated Operation Time Selection	Determines, how the cumulative operation time (U4-01) is counted. 0: Logs power-on time 1: Logs operation time when the drive output is active (output operation time).	0, 1	1	A	A	50C
o4-03	Cooling Fan Operation Time Setting	Sets the value of the fan operation time monitor U4-03 in units of 10 h. <5>	0 to 9999	0	A	A	50E
o4-05	Capacitor Maintenance Setting	Sets the value of the capacitor maintenance time monitor U4-05.	0 to 150	0%	A	A	51D
o4-07	DC Bus Pre-Charge Relay Maintenance Setting	Sets the value of the Soft Charge Bypass Relay Maintenance monitor U4-06.	0 to 150	0%	A	A	523
o4-09	IGBT Maintenance Setting	Sets the value of the IGBT Maintenance monitor U4-07.	0 to 150	0%	A	A	525
o4-11	U2, U3 Initialization	0: U2-□□ and U3-□□ monitor data are not reset when the drive is initialized using A1-03. 1: U2-□□ and U3-□□ monitor data are reset when the drive is initialized using A1-03. (The value of o4-11 is automatically returned to 0.)	0, 1	0	A	A	510
o4-12	kWh Monitor Initialization	0: U4-10 and U4-11 monitor data are not reset when the drive is initialized using A1-03. 1: U4-10 and U4-11 monitor data are reset when the drive is initialized using A1-03. (The value of o4-12 is automatically returned to 0.)	0, 1	0	A	A	512
o4-13	Number of Run Commands Initialize Selection	0: U4-02 monitor data is not reset when the drive is initialized using A1-03. 1: U4-02 monitor data is reset when the drive is initialized using A1-03. (The value of o4-13 is automatically returned to 0.)	0, 1	0	A	A	528

<1> Parameter can be changed during run.

<2> Default setting value is dependent on parameter o1-03, Digital Operator Display Selection.

<3> Parameter setting value is not reset to the default value during drive initialization, A1-03 = 1110, 2220, 3330

<4> Default setting value is dependent on parameter o2-04, Drive Model Selection.

<5> Parameter o4-03 is set in 10 h units. When o4-03 = 30, the operation time for the cooling fan will start counting from 300 hours, and monitor U4-03 will display "300".

◆ S: Special Adjustments 1

It is necessary to set motor parameters to HF-520 in case using by sensorless vector control mode. Motor parameters (E2-01, E2-02, E2-03, E2-05, E2-06) are automatically set for Sumitomo AF Motor (Standard efficiency inverter motor) or Sumitomo Premium Efficiency (IE3) based on the value of this parameter.

No.	Name	Description	Range	Def.	Control Mode		Addr. Hex
					V/f	SV	
S1-01	Motor Selection	Motor parameters (E2) are automatically set based on the value of this parameter. 0 : AF Motor 2 : IE3 Motor	0, 2	2	○	○	680H

*1 Parameter initialization disabled. Parameter verificaton disabled.
*2 This parameter can not save User Parameters (A2-01 to A2-32)
*3 Available in software versions PRG: 5550 and later.

0 : AF Motor

Motor parameters (E2-01, E2-02, E2-03, E2-05, E2-06) are automatically set for Sumitomo AF Motor. Set S1-01 to 0 in case using Sumitomo AF Motor by sensorless vector control mode.

Motor parameters set to the same parameters as the default settings of conventional software version (PRG:5511) by setting S1-01 to 0.

2 : Premium Efficiency (IE3) Motor

Motor parameters (E2-01, E2-02, E2-03, E2-05, E2-06) are automatically set for Premium efficiency (IE3) Motor. Set S1-01 to 2 in case using Premium efficiency (IE3) Motor by sensorless vector control mode.

Note) Motor parameters of 0.2kW and 0.4kW are set for Sumitomo AF Motor because of exempt from IE3 regulation. Refer to Chapter 3 on this manual in detail.

Perform Auto-Tuning or set motor parameters manually in case using motors except Sumitomo AF Motor or Sumitomo Premium efficiency (IE3) Motor by sensorless vector control. Refer to the Chapter 4.7 about Auto-Tuning.

The tables bellow show the motor parameters automatically set based on the value of S1-01 (Motor Selection).

S2-01 to 04 and S3-01 to 02 are parameters of factory use.

■ 3-Phase 200V Class, 1-Phase 200V Class

Motor Parameters	S1-01(Motor Selection) setting S1-01=0 AF Motor							
	0.2kW	0.4kW	0.75kW	1.5kW	2.2kW	3.7kW	5.5kW	7.5kW
E2-01 (Motor Rated Current)	1.50	2.30	3.90	6.60	9.30	14.80	21.50	29.10
E2-02 (Motor Rated Slip)	1.56	1.62	1.40	1.97	1.27	1.48	1.19	1.09
E2-03 (Motor No-Load Current)	1.28	1.96	2.90	3.66	5.11	6.57	9.07	12.60
E2-05 (Motor Resistance)	10.85	7.075	2.933	1.706	0.804	0.497	0.337	0.212
E2-06 (Motor Leakage Inductance)	24.1	13.5	13.2	15.3	14.2	15.3	15.4	14.5

Motor Parameters	S1-01(Motor Selection) setting S1-01=2 IE3 Motor (Default setting)							
	0.2kW	0.4kW	0.75kW	1.5kW	2.2kW	3.7kW	5.5kW	7.5kW
E2-01 (Motor Rated Current)	1.50	2.30	3.58	6.43	8.96	14.30	20.90	28.80
E2-02 (Motor Rated Slip)	1.56	1.62	1.74	1.99	1.41	1.09	0.99	0.87
E2-03 (Motor No-Load Current)	1.28	1.96	2.15	3.05	4.04	5.82	8.74	10.70
E2-05 (Motor Resistance)	10.85	7.075	3.191	1.639	0.894	0.592	0.311	0.182
E2-06 (Motor Leakage Inductance)	24.1	13.5	16.0	18.3	16.5	15.0	13.5	19.9

*1 Motor parameters of 0.2kW and 0.4kW are set for AF Motor because of exempt from IE3 regulation.

■ 3-Phase 400V Class

Motor Parameters	S1-01(Motor Selection) setting S1-01=0 AF Motor							
	0.2kW	0.4kW	0.75kW	1.5kW	2.2kW	3.7kW	5.5kW	7.5kW
E2-01 (Motor Rated Current)	0.74	1.20	1.90	3.30	4.70	7.40	10.70	14.60
E2-02 (Motor Rated Slip)	1.50	1.62	1.40	1.97	1.27	1.48	1.19	1.09
E2-03 (Motor No-Load Current)	0.66	0.98	1.45	1.83	2.56	3.29	4.54	6.29
E2-05 (Motor Resistance)	47.91	28.301	11.734	6.823	3.218	1.984	1.345	0.848
E2-06 (Motor Leakage Inductance)	23.0	14.1	12.8	15.3	14.4	15.3	15.4	14.6

Motor Parameters	S1-01(Motor Selection) setting S1-01=2 IE3 Motor (Default setting)							
	0.2kW	0.4kW	0.75kW	1.5kW	2.2kW	3.7kW	5.5kW	7.5kW
E2-01 (Motor Rated Current)	0.74	1.20	1.79	3.22	4.48	7.16	10.40	14.40
E2-02 (Motor Rated Slip)	1.50	1.62	1.74	1.99	1.41	1.09	0.99	0.87
E2-03 (Motor No-Load Current)	0.66	0.98	1.08	1.52	2.02	2.91	4.37	5.36
E2-05 (Motor Resistance)	47.91	28.301	12.764	6.556	3.577	2.370	1.245	0.730
E2-06 (Motor Leakage Inductance)	23.0	14.1	16.0	18.4	16.5	15.1	13.4	19.9

*1 Motor parameters of 0.2kW and 0.4kW are set for AF Motor because of exempt from IE3 regulation.

◆ T: Motor Tuning

Enter data into the following parameters to tune the motor and drive for optimal performance.

No.	Name	Description	Range	Def.	Control Mode		Addr. Hex
					V/f	SV	
T1-00	Motor Selection 1/2	Selects which set of motor parameters are used and set during Auto-Tuning. If Motor 2 selection (H1-□□ = 16) is not selected, this parameter will not be displayed. 1: Motor 1 (sets E1-□□, E2-□□) 2: Motor 2 (sets E3-□□, E4-□□. This selection is not displayed if motor 2 has not been selected.)	1, 2	1	A	A	700
T1-01	Auto-Tuning Mode Selection	Selects the Auto-Tuning mode. 0: Rotational Auto-Tuning 2: Stationary Auto-Tuning for Line-to-Line Resistance 3: Rotational Auto-Tuning for V/f Control (necessary for Energy Savings and Speed Estimation type Speed Search)	0, 2, 3 <1>	2 or 3 in V/f 0 or 2 in SV 2 in Motor 2	A	A	701
T1-02	Motor Rated Power	Sets the motor rated power in kilowatts (kW). Note: If motor power is given in horsepower, power in kW can be calculated using the following formula: kW = HP x 0.746.	0.03 to 650.00 kW	<2>	A	A	702
T1-03 <3>	Motor Rated Voltage	Sets the motor rated voltage in volts (V).	0.0 to 255.5	200.0 V	A	A	703
T1-04	Motor Rated Current	Sets the motor rated current in amperes (A).	10 to 200% of drive rated current	<2>	A	A	704
T1-05	Motor Base Frequency	Sets the base frequency of the motor in Hertz (Hz).	0.0 to 400.0	60.0 Hz	A	A	705
T1-06	Number of Motor Poles	Sets the number of motor poles.	2 to 48	4	A	A	706
T1-07	Motor Base Speed	Sets the base speed of the motor in revolutions per minute r/min (RPM).	0 to 24000	1750 r/min	A	A	707
T1-11	Motor Iron Loss	Provides the iron loss for determining the Energy Saving coefficient. The value set to E2-10 (motor iron loss) when the power is cycled. If T1-02 is changed, an initial value valid for the selected capacity will be shown.	0 to 65535	14 W	A	–	70B
				These values differ depending on the motor code value and motor parameter settings.			

<1> The available tuning methods depend on control mode. Select values 2 or 3 in V/f Control, 0 or 2 in OLV control, and 2 for Motor 2 control.

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

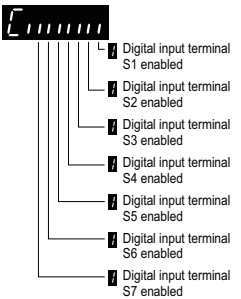
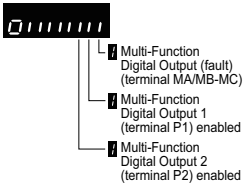
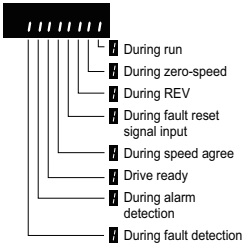
<3> Values shown here are for 200 V class drives. Double the value when using a 400 V class drive.

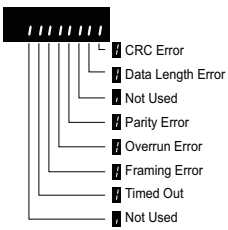
◆ U: Monitors

Monitor parameters allow the user to view drive status, fault information, and other information about drive operation.

No.	Name	Description	Analog Output Level	Unit	Control Mode		Addr. Hex
					V/f	SV	
U1: Operation Status Monitors Use U1 monitors to display the operation status of the drive.							
U1-01	Frequency Reference	Monitors the frequency	10 V: Max frequency	0.01 Hz	A	A	40
U1-02	Output Frequency	Displays the output frequency. Display units are determined by o1-03.	10 V: Max frequency	0.01 Hz	A	A	41
U1-03	Output Current	Displays the output current.	10 V: Drive rated current	0.01 A <1> <2>	A	A	42
U1-04	Control Mode	Control method set in A1-02. 0: V/f without PG 2: Sensorless Vector Control (SV)	No output signal available	–	A	A	43
U1-05	Motor Speed	Displays the motor speed feedback. Display units are determined by o1-03.	10 V: Maximum speed	0.01 Hz	–	A	44
U1-06	Output Voltage Reference	Displays the output voltage.	10 V: 200 Vrms (400 Vrms)	0.1 V	A	A	45
U1-07	DC Bus Voltage	Displays the DC bus voltage.	10 V: 400 V (800 V)	1 V	A	A	46
U1-08	Output Power	Displays the output power (this value is determined internally).	10 V: Drive capacity (kW) (rated motor capacity)	<1>	A	A	47
U1-09	Torque Reference	Monitor of internal torque reference value for Sensorless Vector (SV) control	10 V: Motor rated torque	0.1%	–	A	48

B.2 Parameter Table

No.	Name	Description	Analog Output Level	Unit	Control Mode		Addr. Hex
					V/f	SV	
U1-10	Input Terminal Status	Displays the input terminal status. 	No output signal available	–	A	A	49
U1-11	Output Terminal Status	Displays the output terminal status. 	No output signal available	–	A	A	4A
U1-12	Drive Status	Verifies the drive operation status. 	No output signal available	–	A	A	4B
U1-13	Terminal A1 Input Level	Displays analog input A1 level: 100% when input is 10 V.	10 V: 100%	0.1%	A	A	4E
U1-14	Terminal A2 Input Level	Displays analog input A2 level: 100% when input is 10 V.	10 V: 100%	0.1%	A	A	4F
U1-16	Output Frequency after Soft Starter	Displays output frequency with ramp time and S-curves. Units determined by o1-03.	10 V: Max frequency	0.01 Hz	A	A	53
U1-18	oPE Fault Parameter	Displays parameter no. for oPE□□ or Err where error occurred.	No output signal available	–	A	A	61

No.	Name	Description	Analog Output Level	Unit	Control Mode		Addr. Hex
					V/f	SV	
U1-19	MEMOBUS/Modbus Error Code	Displays the contents of a MEMOBUS/ Modbus error. 	No output signal available	–	A	A	66
U1-24	Input Pulse Monitor	Displays the Pulse Train input RP frequency.	32000	1 Hz	A	A	7D
U1-25	Software No. (Flash)	Flash ID	No signal output avail.	–	A	A	4D
U1-26	Software No. (ROM)	ROM ID	No signal output avail.	–	A	A	5B
U1-27	Operator Message ID	Displays the numeric code of the remote operator (for use by the manufacturer).	No signal output avail.	–	A	A	7A8
U1-28	Drive Message ID	Displays the numeric code of the drive (for use by the manufacturer).	No signal output avail.	–	A	A	7A9
		U2: Fault Trace Use U2 monitors to view fault trace data. <3>					
U2-01	Current Fault	Displays the current fault.	No signal output avail.	–	A	A	80
U2-02	Previous Fault	Displays the previous fault.	No signal output avail.	–	A	A	81
U2-03	Frequency Reference at Previous Fault	Displays the frequency reference at the previous fault.	No signal output avail.	0.01 Hz	A	A	82
U2-04	Output Frequency at Previous Fault	Displays the output frequency at the previous fault.	No signal output avail.	0.01 Hz	A	A	83
U2-05	Output Current at Previous Fault	Displays the output current at the previous fault.	No signal output avail.	<1> <2>	A	A	84
U2-06	Motor Speed at Previous Fault	Displays the motor speed at the previous fault.	No signal output avail.	0.01 Hz	–	A	85
U2-07	Output Voltage at Previous Fault	Displays the output voltage at the previous fault.	No signal output avail.	0.1 V	A	A	86
U2-08	DC Bus Voltage at Previous Fault	Displays the DC bus voltage at the previous fault.	No signal output avail.	1 V	A	A	87
U2-09	Output Power at Previous Fault	Displays the output power at the previous fault.	No signal output avail.	0.1 kW	A	A	88
U2-10	Torque Reference at Previous Fault	Displays the torque reference at the previous fault.	No signal output avail.	0.1%	–	A	89
U2-11	Input Terminal Status at Previous Fault	Displays the input terminal status at the previous fault. Displayed as in U1-10.	No signal output avail.	–	A	A	8A
U2-12	Output Terminal Status at Previous Fault	Displays the output status at the previous fault. Displays the same status displayed in U1-11.	No signal output avail.	–	A	A	8B

No.	Name	Description	Analog Output Level	Unit	Control Mode		Addr. Hex
					V/f	SV	
U2-13	Drive Operation Status at Previous Fault	Displays the operation status of the drive at the previous fault. Displays the same status displayed in U1-12.	No signal output avail.	–	A	A	8C
U2-14	Cumulative Operation Time at Previous Fault	Displays the cumulative operation time at the previous fault.	No signal output avail.	1 H	A	A	8D
U2-15	Soft Starter Speed Reference at Previous Fault	Displays the run speed after a soft start when a previous fault occurred. Displayed as in U1-16.	No signal output avail.	0.01 %	A	A	7E0
U2-16	Motor q-Axis Current at Previous Fault	Displays the q-axis current for the motor at the previous fault.	No signal output avail.	0.10 %	A	A	7E1
U2-17	Motor d-Axis Current at Previous Fault	Displays the d-axis current for the motor at the previous fault.	No signal output avail.	0.10 %	–	A	7E2
U3: Fault History Use U3 monitors to display fault data. <3>							
U3-01	Most Recent Fault	Displays the most recent fault.	No signal output avail.	–	A	A	90 (800)
U3-02	2nd Most Recent Fault	Displays the second most recent fault.	No signal output avail.	–	A	A	91 (801)
U3-03	3rd Most Recent Fault	Displays the third most recent fault.	No signal output avail.	–	A	A	92 (802)
U3-04	4th Most Recent Fault	Displays the fourth most recent fault.	No signal output avail.	–	A	A	93 (803)
U3-05	5th Most Recent Fault	Displays the fifth most recent fault.	No signal output avail.	–	A	A	804
U3-06	6th Most Recent Fault	Displays the sixth most recent fault.	No signal output avail.	–	A	A	805
U3-07	7th Most Recent Fault	Displays the seventh most recent fault.	No signal output avail.	–	A	A	806
U3-08	8th Most Recent Fault	Displays the eighth most recent fault.	No signal output avail.	–	A	A	807
U3-09	9th Most Recent Fault	Displays the ninth most recent fault.	No signal output avail.	–	A	A	808
U3-10	10th Most Recent Fault	Displays the tenth most recent fault.	No signal output avail.	–	A	A	809
U3-11	Cumulative Operation Time at Most Recent Fault	Displays the cumulative operation time at the most recent fault.	No signal output avail.	1 h	A	A	94 (80A)
U3-12	Cumulative Operation Time at 2nd Most Recent Fault	Displays the cumulative operation time at the second most recent fault.	No signal output avail.	1 h	A	A	95 (80B)
U3-13	Cumulative Operation Time at 3rd Most Recent Fault	Displays the cumulative operation time at the third most recent fault.	No signal output avail.	1 h	A	A	96 (80C)
U3-14	Cumulative Operation Time at 4th Most Recent Fault	Displays the cumulative operation time at the fourth most recent fault.	No signal output avail.	1 h	A	A	97 (80D)
U3-15	Cumulative Operation Time at 5th Most Recent Fault	Displays the cumulative operation time at the fifth most recent fault.	No signal output avail.	1 h	A	A	80E

No.	Name	Description	Analog Output Level	Unit	Control Mode		Addr. Hex
					V/f	SV	
U3-16	Cumulative Operation Time at 6th Most Recent Fault	Displays the cumulative operation time at the sixth most recent fault.	No signal output avail.	1 h	A	A	80F
U3-17	Cumulative Operation Time at 7th Most Recent Fault	Displays the cumulative operation time at the seventh most recent fault.	No signal output avail.	1 h	A	A	810
U3-18	Cumulative Operation Time at 8th Most Recent Fault	Displays the cumulative operation time at the eighth most recent fault.	No signal output avail.	1 h	A	A	811
U3-19	Cumulative Operation Time at 9th Most Recent Fault	Displays the cumulative operation time at the ninth most recent fault.	No signal output avail.	1 h	A	A	812
U3-20	Cumulative Operation Time at 10th Most Recent Fault	Displays the cumulative operation time at the tenth most recent fault.	No signal output avail.	1 h	A	A	813
U4: Maintenance Monitors Use U4 monitors to display drive maintenance information.							
U4-01 <5>	Accumulated Operation Time	Displays the cumulative operation time of the drive. The value for the cumulative operation time counter can be reset in parameter o4-01. Use parameter o4-02 to determine if the operation time should start as soon as the power is switched on or only while the run command is present. The maximum number displayed is 99999, after which the value is reset to 0.	No signal output avail.	1 h	A	A	4C
U4-02	Number of Run Commands	Displays the number of times the run command is entered. Reset the number of run commands using parameter o4-13. This value will reset to 0 and start counting again after reaching 65535.	No signal output avail.	–	A	A	75
U4-03 <4> <6>	Cooling Fan Operation Time	Displays the cumulative operation time of the cooling fan. The default value for the fan operation time is reset in parameter o4-03. This value will reset to 0 and start counting again after reaching 99999.	No signal output avail.	1 h	A	A	67
U4-04	Cooling Fan Maintenance	Displays main cooling fan usage time in as a percentage of their expected performance life. Parameter o4-03 can be used to reset this monitor.	No signal output avail.	1%	A	A	7E
U4-05	Capacitor Maintenance	Displays main circuit capacitor usage time in as a percentage of their expected performance life. Parameter o4-05 can be used to reset this monitor.	No signal output avail.	1%	A	A	7C
U4-06 <4>	Soft Charge Bypass Relay Maintenance	Displays the soft charge bypass relay maintenance time as a percentage of the estimated product life. Parameter o4-07 can be used to reset this monitor.	No signal output avail.	1%	A	A	7D6
U4-07 <4>	IGBT Maintenance	Displays IGBT usage time as a percent of expected performance life. Parameter o4-09 can be used to reset this monitor.	No signal output avail.	1%	A	A	7D7

No.	Name	Description	Analog Output Level	Unit	Control Mode		Addr. Hex
					V/f	SV	
U4-08	Heatsink Temperature	Displays the heatsink temperature.	10 V: 100 °C	1 °C	A	A	68
U4-09	LED Check	Lights all segments of the LED to verify that the display is working properly.	No signal output avail.	–	A	A	3C
U4-10	kWh, Lower 4 Digits	Monitors the drive output power. The value is shown as a 9 digit number displayed across two monitor parameters, U4-10 and U4-11. Example: 12345678.9 kWh is displayed as: U4-10: 678.9 kWh U4-11: 12345 MWh	No signal output avail.	kWh	A	A	5C
U4-11	kWh, Upper 5 Digits			MWh	A	A	5D
U4-13	Peak Hold Current	Displays the peak hold current during run.	No signal output avail.	0.01 A <2>	A	A	7CF
U4-14	Peak Hold Output Frequency	Displays the output frequency when operating at the peak hold current.	No signal output avail.	0.01 Hz	A	A	7D0
U4-16	Motor Overload Estimate (oL1)	100% = oL1 detection level	100% = oL1 detection level	0.1%	A	A	7D8
U4-18	Frequency Reference Source Selection	Displays the source for the frequency reference as XY-nn. X: indicates which reference is used: 1 = Reference 1 (b1-01) 2 = Reference 2 (b1-15) Y-nn: indicates the reference source 0-01 = Operator (d1-01) 1-01 = Analog (terminal A1) 1-02 = Analog (terminal A2) 2-02 to 17 = Multi-step speed (d1-02 to 17) 3-01 = MEMOBUS/Modbus comm. 4-01 = Option 5-01 = Pulse Input 6-01 = CASE 7-01 = DWEZ	–	–	A	A	7DA
U4-19	Frequency Reference from MEMOBUS/Modbus Comm.	Displays the frequency reference provided by MEMOBUS/Modbus (decimal).	–	–	A	A	7DB
U4-20	Option Frequency Reference	Displays the frequency reference input by an option card (decimal).	–	–	A	A	7DD

No.	Name	Description	Analog Output Level	Unit	Control Mode		Addr. Hex
					V/f	SV	
U4-21	Run Command Source Selection	Displays the source for the Run command as XY-nn. X: Indicates which Run source is used: 1 = Reference 1 (b1-02) 2 = Reference 2 (b1-16) Y: Input power supply data 0 = Operator 1 = External terminals 2 = Not used 3 = MEMOBUS/Modbus communications 4 = Option 5 = Not used 6 = CASE nn: Run command limit status data 00: No limit status. 01: Run command was left on when stopped in the PRG mode. 02: Run command was left on when switching from LOCAL to REMOTE operation. 03: Waiting for the soft charge bypass contactor after the power is switched on (Uv or Uv1 flashes after 10 seconds). 04: Waiting for "Run Command Prohibited" time period to end. 05: Fast-stop (digital input (H1-□□ = 15), operator) 06: b1-17 (run command given at power-up). 07: During Baseblock while coast to stop with timer. 08: Frequency reference is below minimal reference during Baseblock. 09: Waiting for Enter command 10: Run command was switched on while copying parameters.	–	–	A	A	7DD
U4-22	MEMOBUS/Modbus Communications Reference	Displays the drive control data set by MEMOBUS/Modbus communications register No. 0001H as a 4 digit hexadecimal number.	–	–	A	A	7DE
U4-23	Option Card Reference	Displays drive control data set by an option card as a 4 digit hexadecimal number.	–	–	A	A	7DF

No.	Name	Description	Analog Output Level	Unit	Control Mode		Addr. Hex
					V/f	SV	
U5: PID Monitor Use U5 monitors to view application-specific settings.							
U5-01	PID Feedback	Displays the PID feedback value in.	10 V: 100% (max. freq.)	0.01 %	A	A	57
U5-02	PID Input	Displays the amount of PID input (deviation between PID target and feedback).		0.01 %	A	A	63
U5-03	PID Output	Displays PID control output.		0.01 %	A	A	64
U5-04	PID Setpoint	Displays the PID setpoint.		0.01 %	A	A	65
U5-05	PID Differential Feedback	Displays the 2nd PID feedback value if differential feedback is used.		0.01 %	A	A	7D2
U5-06	PID Adjusted Feedback	Displays the difference of both feedback values if differential feedback is used (U5-01) - (U5-05). If differential feedback is not used, then U5-01 and U5-06 will be the same.		0.01 %	A	A	7D3
U6: Control Monitor Use U6 monitors to display drive control information.							
U6-01	Motor Secondary Current (Iq)	Displays the value of the motor secondary current (Iq).	10 V: 100%	0.1%	A	A	51
U6-02	Motor Excitation Current (Id)	Displays the value calculated for the motor excitation current (Id).	10 V: 100%	0.1%	–	A	52
U6-03	ASR Input	Displays the ASR input value if V/f Control with Simple PG Feedback is enabled.	10 V: 100% (max. freq.)	0.1%	A	–	54
U6-04	ASR Output	Displays the ASR output value if V/f Control with Simple PG Feedback is enabled.	10 V: 100% (max. freq.)	0.1%	A	–	55
U6-05	Output voltage reference (Vq)	Output voltage reference (Vq). (q-axis)	10 V: 200 V (400 V)	0.1 Vac	–	A	59
U6-06	Output Voltage Reference (Vd)	Output voltage reference (Vd). (d-axis)	10 V: 200 V (400 V)	0.1 Vac	–	A	5A
U6-07	q-axis ACR Output	Displays the current control (ACR) output of for the motor secondary current (Iq).	10 V: 100%	0.1%	–	A	5F
U6-08	d-Axis ACR Output	Displays the current control (ACR) output of for the motor excitation current (Id).	10 V: 100%	0.1%	–	A	60
U6-20	Frequency Reference Bias (Up/Down 2)	Displays the bias value used to adjust the frequency reference.	10 V: max. frequency	0.1%	A	A	7D4
U6-21	Offset Frequency	The total value of the offset frequencies d7-01, d7-02 and d7-03 selected with digital inputs 44 to 46 is displayed.	10 V: max. frequency	0.1%	A	A	7D5
U6-80 to U6-99	Option Monitors 1 to 20	Monitors reserved for use by the communication option card. Monitor content varies based on the communication option connected to the drive. Refer to the instruction manual for the option card for more information.	No signal output avail.	–	A	A	7B0 to 7F9

<1> 0.01 A units.

<2> U1-03, U2-05, and U4-13 display monitor contents in amp units. When reading the value of these monitors

via MEMOBUS/Modbus, a value of 8192 is equal to 100% of the drive rated output current.

<3> Parameter setting value is not reset to the default value during drive initialization, A1-03 = 1110, 2220, 3330

<4> When this value reaches 100%, the maintenance period has been reached for the component in question and the drive is at risk of faulting out due to component failure. Periodically check the maintenance monitors to avoid this situation.

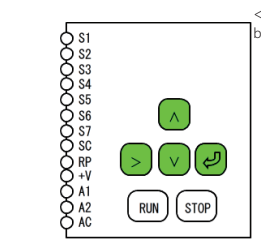
<5> MEMOBUS/Modbus communications data is in 10 h units. If data in 1 h units are also required, refer to register 0099H.

<6> MEMOBUS/Modbus communications data is in 10 h units. If data in 1 h units are also required, refer to register 009BH.

B.3 Applied Operation (Samples for Parameter Setting)

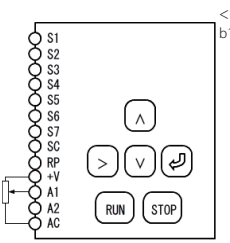
(1) Setting the operation frequency

① Operation panel key setting



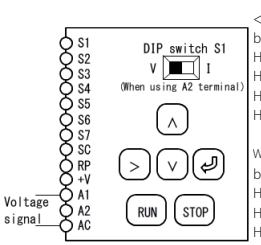
<Parameter>
b1-01=00

② External potentiometer setting



<Parameter>
b1-01=01

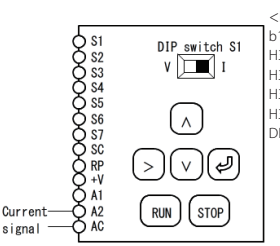
③ Input voltage setting (0-10V, 0-60Hz)



<Parameter>
b1-01=01
H3-01=0or1
H3-02=00
H3-03=100
H3-04=0

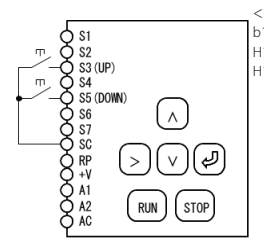
When using A2 terminal
b1-01=01
H3-09=0or1
H3-10=00
H3-11=100
H3-12=0
DIP switch S1=V

④ Input current setting (4-20mA, 0-60Hz)



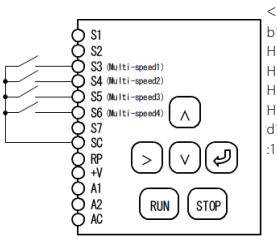
<Parameter>
b1-01=01
H3-09=2
H3-10=00
H3-11=100
H3-12=0
DIP switch S1=I

⑤ External contact UP/DOWN



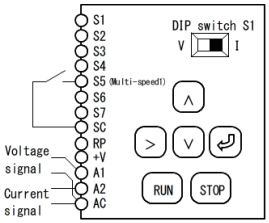
<Parameter>
b1-01=00
H1-03=10
H1-05=11

⑥ Preset-speed



<Parameter>
b1-01=00
H1-03=03
H1-04=04
H1-05=05
H1-06=32
d1-01 - d1-16
:1-16 speed

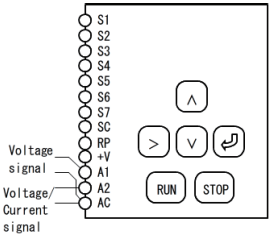
⑦ Voltage/current switching



<Parameter>
b1-01=01
H1-05=03
H3-02=00
H3-09=02
H3-10=02

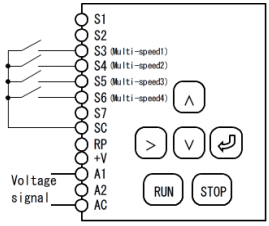
S5-SC open
:Voltage signal
S5-SC close
:Current signal

⑧ Analog addition setting



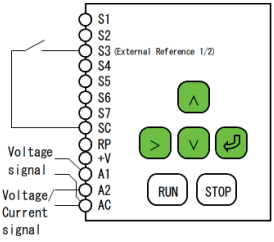
<Parameter>
b1-01=01
H3-02=00
H3-09=00or02
H3-10=00

⑨ Switching between analog setting and preset speed setting



<Parameter>
b1-01=01
H1-03=03
H1-04=04
H1-05=05
H1-06=32
d1-02 - d1-16
:2-16 speed

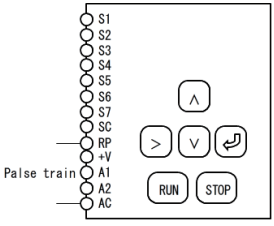
⑩ Switching between analog setting and terminal setting from the operation panel



<Parameter>
b1-01=01
b1-15=00
H1-03=02

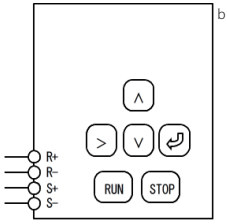
S3-SC open
:analog
S3-SC close
:panel

⑪ Input pulse train setting



<Parameter>
b1-01=04
H6-01=00
Adjust H6-02

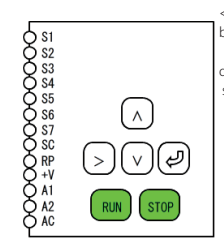
⑫ Setting by communication



<Parameter>
b1-01=02

(2) Setting the operation mode

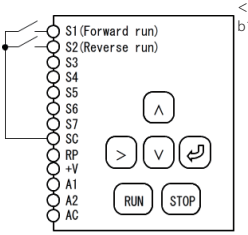
① Operation panel operation



<Parameter>
b1-02=00

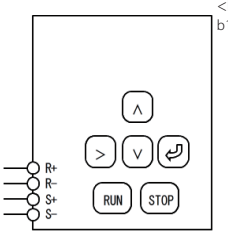
direction of rotation
selected in b1-14

② Terminal board operation



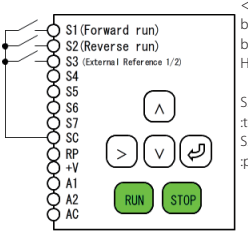
<Parameter>
b1-02=01

③ Operation from communication



<Parameter>
b1-02=02

④ Switching between panel and terminal board



<Parameter>
b1-02=01
b1-16=00
H1-03=02

S3-SC open
:terminal board
S3-SC close
:panel

Appendix: C

Standards Compliance

This appendix explains the guidelines and criteria for maintaining CE and UL standards.

C.1 European Standards

Figure C.1 CE Mark

The CE mark indicates compliance with European safety and environmental regulations and is required for engaging in business and commerce in Europe.

European standards include the Machinery Directive for machine manufacturers, the Low Voltage Directive for electronics manufacturers and the EMC guidelines for controlling noise.

This drive displays the CE mark based on the EMC guidelines and the Low Voltage Directive.

- Devices used in combination with this drive must also be CE certified and display the CE mark. When using drives displaying the CE mark in combination with other devices, it is ultimately the responsibility of the user to ensure compliance with CE standards. After setting up the device, verify that conditions meet European standards.
- EMC Directive: 2014/30/EU
- **Low Voltage Directive:** 2014/35/EU

◆ CE Low Voltage Directive Compliance

This drive has been tested according to European standard IEC/EN 61800-5-1, and it fully complies with the Low Voltage Directive.

To comply with the Low Voltage Directive, be sure to meet the following conditions when combining this drive with other devices:

■ Area of Use

Do not use drives in areas with pollution higher than severity 2 and overvoltage category 3 in accordance with IEC/EN 664.

■ Factory Recommended Branch Circuit Protection

Sumitomo recommends installing one of the following types of branch circuit protection to maintain compliance with UL508C. Semiconductor protective type fuses are preferred. Alternate branch circuit protection devices are also listed in ***Table C.1***.

NOTICE: *If a fuse is blown or an Earth Leakage Circuit Breaker (ELCB) is tripped, check the wiring and the selection of peripheral devices to identify the cause. Contact Yaskawa before restarting the drive or the peripheral devices if the cause cannot be identified.*

Table C.1 Factory Recommended Drive Branch Circuit Protection

Drive Model	Fuse Type	
	Manufacturer: Bussmann	
	Model	Fuse Ampere Rating (A)
Single-Phase 200 V Class		
HF520S-A20	FWH-25A14F	25
HF520S-A40	FWH-60B	60
HF520S-A75	FWH-80B	80
HF520S-1A5	FWH-100B	100
HF520S-2A2	FWH-125B	125
Three-Phase 200 V Class		
HF5202-A20	FWH-25A14F	25
HF5202-A40	FWH-25A14F	25
HF5202-A75	FWH-25A14F	25
HF5202-1A5	FWH-70B	70
HF5202-2A2	FWH-70B	70
HF5202-3A7	FWH-90B	90
HF5202-5A5	FWH-100B	100
HF5202-7A5	FWH-200B	200
Three-Phase 400 V Class		
HF5204-A20	FWH-40B	40
HF5204-A40	FWH-40B	40
HF5204-A75	FWH-50B	50
HF5204-1A5	FWH-70B	70
HF5204-2A2	FWH-70B	70
HF5204-3A7	FWH-90B	90
HF5204-5A5	FWH-80B	80
HF5204-7A5	FWH-100B	100

■ Grounding

The drive is designed to be used in T-N (grounded neutral point) networks.

■ CE Standards Compliance for DC Power Supply Input

Install the fuses in the following tables to meet CE standards.

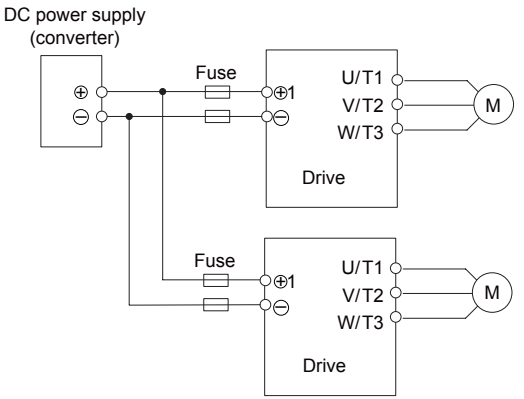


Figure C.2 Example of DC Power Supply Input (Two Drives Connected in Series)

Note: 1. When connecting multiple drives together, make sure that each drive has its own fuse. Replace all fuses when one fuse blows.

2. ***Refer to on page 44*** for an AC power supply.

3. The recommended fuses and fuse holders are made by Fuji Electric.

Table C.2 Single-Phase 200 V Class Fuses and Fuse Holders

Drive Model HF502S	DC Power Supply Input				
	Fuse			Fuse Holder	
	Manufacturer: Fuji Electric				
	Type	Rated Short Circuit Braking Current (kA)	Qty.	Type	Qty.
A20	CR6L-30/UL	100	2	CMS-4	2
A40	CR6L-50/UL			CMS-4	
A75	CR6L-75/UL			CMS-5	
1A5	CR6L-100/UL			CMS-5	
2A2	CR6L-100/UL			CMS-5	

Table C.3 Three-Phase 200 V Class Fuses and Fuse Holders

Drive Model HF5202	DC Power Supply Input				
	Fuse			Fuse Holder	
	Manufacturer: Fuji Electric				
	Type	Rated Short Circuit Braking Current (kA)	Qty.	Type	Qty.
A20	CR6L-20/UL	100	2	CMS-4	2
A40	CR6L-20/UL			CMS-4	
A75	CR6L-30/UL			CMS-4	
1A5	CR6L-50/UL			CMS-4	
2A2	CR6L-50/UL			CMS-4	
3A7	CR6L-75/UL			CMS–5	
5A5	CR6L-100/UL			CMS–5	
7A5	CR6L-150/UL			CMS–5	

Table C.4 Three-Phase 400 V Class Fuses and Fuse Holders

Drive Model HF5204	DC Power Supply Input				
	Fuse			Fuse Holder	
	Manufacturer: Fuji Electric				
	Type	Rated Short Circuit Braking Current (kA)	Qty.	Type	Qty.
A20	CR6L-20/UL	100	2	CMS-4	2
A40	CR6L-20/UL			CMS-4	
A75	CR6L-50/UL			CMS-4	
1A5	CR6L-50/UL			CMS-4	
2A2	CR6L-50/UL			CMS-4	
3A7	CR6L-50/UL			CMS-4	
5A5	CR6L-50/UL			CMS-4	
7A5	CR6L-75/UL			CMS--5	

■ Guarding Against Harmful Materials

When installing IP20/Open-Chassis enclosure drives, use an enclosure that prevents foreign material from entering the drive from above or below.

◆ EMC Guidelines Compliance

This drive is tested according to European standards IEC/EN 61800-3 and it complies with the EMC guidelines.

■ EMC Filter Installation

The following conditions must be met to ensure continued compliance with guidelines. ***Refer to EMC Filters on page 242*** for EMC filter selection.

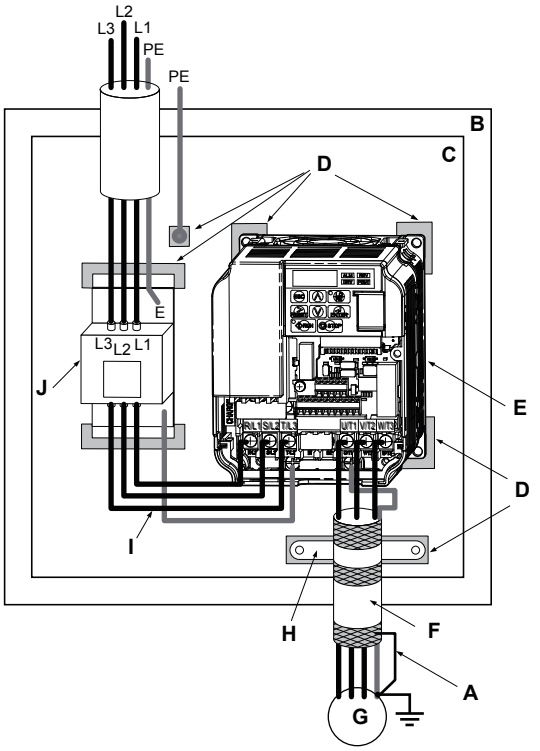
Installation Method

Verify the following installation conditions to ensure that other devices and machinery used in combination with this drive also comply with EMC guidelines.

1. Install an EMC noise filter to the input side specified by Sumitomo for compliance with European standards.
2. Place the drive and EMC noise filter in the same enclosure.
3. Use braided shield cable for the drive and motor wiring or run the wiring through a metal conduit.

4. Keep wiring as short as possible. Ground the shield on both the drive side and the motor side.
5. Ground the largest possible surface area of the shield to the metal conduit when using braided shield cable. Sumitomo recommends using a cable clamp.

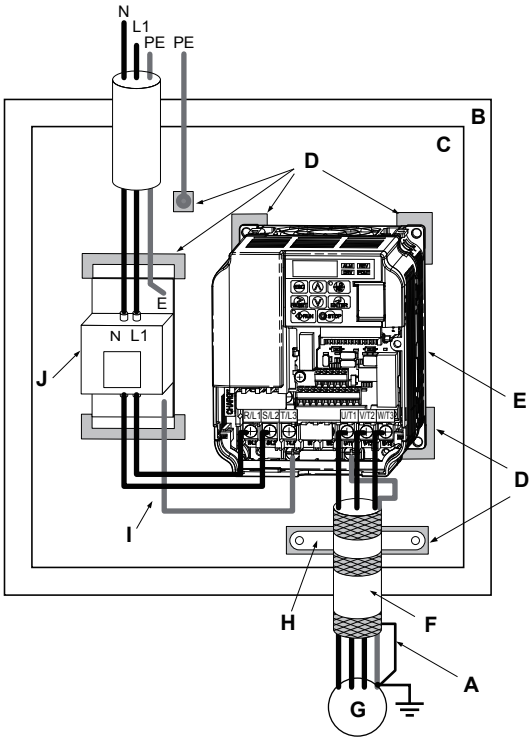
Three-Phase 200 V / 400 V Class



A – Ground the cable shield
B – Enclosure panel
C – Metal plate
D – Grounding surface (remove any paint or sealant)
E – Drive
F – Motor cable (braided shield cable, max. 20 m)
G – Motor
H – Cable clamp
I – Wiring distance as short as possible
J – EMC noise filter

Figure C.3 EMC Filter and Drive Installation for CE Compliance (Three-Phase 200 V / 400 V Class)

Single-Phase 200 V Class



A – Ground the cable shield
B – Enclosure panel
C – Metal plate
D – Grounding surface (remove any paint or sealant)
E – Drive
F – Motor cable (braided shield cable, max. 20 m)
G – Motor
H – Cable clamp
I – Wiring distance as short as possible
J – EMC noise filter

Figure C.4 EMC Filter and Drive Installation for CE Compliance (Single-Phase 200 V Class)

■ EMC Filters

The drive should be installed with the EMC filters listed below in order to comply with the IEC/EN 61800-3, category C1 requirements.

Table C.5 IEC/EN 61800-3 Category C1 Filters

Drive Model	Filter Data (Manufacturer: Schaffner)						
	Type	Rated Current (A)	Weight (kg)	Dimensions [W x L x H] (mm)	Mounting Dimensions [Y x X] (mm)	Drive Mounting Screw A	Filter Mounting Screw
200 V Single-Phase Units							
HF520S-A20	FS23638-10-07	10	0.4	71 x 169 x 45	51 x 156	M4	M5
HF520S-A40	FS23638-10-07	10	0.4	71 x 169 x 45	51 x 156	M4	M5
HF520S-A75	FS23638-20-07	20	0.8	111 x 169 x 50	91 x 156	M4	M5
HF520S-1A5	FS23638-20-07	20	0.8	111 x 169 x 50	91 x 156	M4	M5
HF520S-2A2	FS23638-30-07	30	1.2	144 x 174 x 50	120 x 161	M4	M5
200 V Three-Phase Units							
HF5202-A20	FS23637-8-07	8	0.4	71 x 169 x 40	51 x 156	M4	M5
HF5202-A40	FS23637-8-07	8	0.4	71 x 169 x 40	51 x 156	M4	M5
HF5202-A75	FS23637-8-07	8	0.4	71 x 169 x 40	51 x 156	M4	M5
HF5202-1A5	FS23637-14-07	14	0.6	111 x 169 x 45	91 x 156	M4	M5
HF5202-2A2	FS23637-14-07	14	0.6	111 x 169 x 45	91 x 156	M4	M5
HF5202-3A7	FS23637-24-07	24	0.9	144 x 174 x 50	120 x 161	M4	M5
HF5202-5A5	FS23637-52-07	52	2.0	137 x 304 x 56	100 x 289	M5	M5
HF5202-7A5	FS23637-52-07	52	2.0	137 x 304 x 56	100 x 289	M5	M5
400 V Three-Phase Units							
HF5204-A20	FS23639-5-07	5	0.5	111 x 169 x 45	91 x 156	M4	M5
HF5204-A40	FS23639-5-07	5	0.5	111 x 169 x 45	91 x 156	M4	M5
HF5204-A75	FS23639-5-07	5	0.5	111 x 169 x 45	91 x 156	M4	M5
HF5204-1A5	FS23639-10-07	10	0.7	111 x 169 x 45	91 x 156	M4	M5
HF5204-2A2	FS23639-10-07	10	0.7	111 x 169 x 45	91 x 156	M4	M5

Drive Model	Filter Data (Manufacturer: Schaffner)						
	Type	Rated Current (A)	Weight (kg)	Dimensions [W x L x H] (mm)	Mounting Dimensions [Y x X] (mm)	Drive Mounting Screw A	Filter Mounting Screw
HF5204-3A7	FS23639-15-07	15	0.9	144 x 174 x 50	120 x 161	M4	M5
HF5204-5A5	FS23639-30-07	30	1.8	137 x 304 x 56	100 x 289	M5	M5
HF5204-7A5	FS23639-30-07	30	1.8	137 x 304 x 56	100 x 289	M5	M5

Note: EMC filters for models HF5202-5A5 and 7A5 are in compliance with IEC/EN 61800-3, Category 2. All other models comply with Category 1.

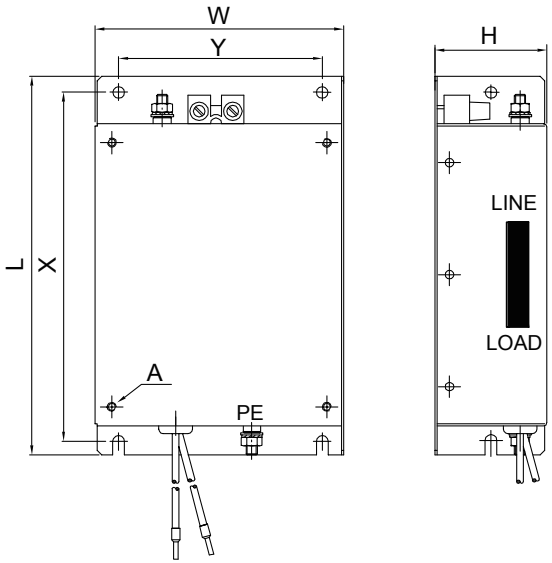


Figure C.5 EMC Filter Dimensions

■ DC Reactors for IEC/EN 61000-3-2 Compliance

Drive Model	DC Reactor	
	Model	Rating
200V Three-Phase Units		
HF5202-A40	UZDA-B	5.4 A 8 mH
HF5202-A75		
400 V Three-Phase Units		
HF5204-A40	UZDA-B	3.2 A 28 mH
HF5204-A75		

Note: Models not listed in the above table do not require a DC reactor for EMC compliance..

C.2 UL Standards

◆ UL Standards Compliance

The UL/cUL mark applies to products in the United States and Canada and indicates that UL has performed product testing and evaluation and determined that their stringent standards for product safety have been met. For a product to receive UL certification, all components inside that product must also receive UL certification.

Figure C.6 UL/cUL Mark

This drive is tested in accordance with UL standard UL508C and complies with UL requirements. The following conditions must be met to maintain compliance when using this drive in combination with other equipment:

■ Installation Area

Do not install the drive to an area greater than pollution severity 2 (UL standard).

■ Ambient Temperature

IP20/NEMA Type 1 enclosure: -10 °C to +40 °C

IP20/IP00 Open-Chassis enclosure: -10 °C to +50 °C

■ Main Circuit Terminal Wiring

Sumitomo recommends using closed-loop crimp terminals on all drive models. UL/cUL approval requires the use of UL Listed closed-loop crimp terminals when wiring the drive main circuit terminals. Use only the tools recommended by the terminal manufacturer for crimping. The wire gauges listed in ***Table C.6, Table C.7***, and ***Table C.8*** are Yaskawa recommendations. Refer to local codes for proper wire gauge selections.

Table C.6 Wire Gauge and Torque Specifications

Drive Model HF520S	Terminal	For Japan and Asia <1>		For United States <2>		For Europe and China <3>		Screw Size	Tightening Torque N•m (lb.in.)
		Recomm. Gauge mm^2	Wire Range mm^2	Recomm. Gauge AWG, kcmil	Wire Range AWG, kcmil	Recomm. Gauge mm^2	Wire Range mm^2		
A20 A40	R/L1, S/L2, T/L3	2	0.75 to 2	14	18 to 14	2.5	0.75 to 2.5	M3.5	0.8 to 1.0 (7.1 to 8.9)
	U/T1, V/T2, W/T3	2	0.75 to 2	14	18 to 14	2.5	0.75 to 2.5		
	⊖, ⊕1, ⊕2	2	0.75 to 2	–	18 to 14	–	0.75 to 2.5		
	B1, B2	2	0.75 to 2	–	18 to 14	–	0.75 to 2.5		
	⏚	2	0.75 to 2	14	18 to 14	2.5	0.75 to 2.5		
A75	R/L1, S/L2, T/L3	2	2 to 5.5	12	14 to 10	2.5	2.5 to 6	M4	1.2 to 1.5 (10.6 to 13.3)
	U/T1, V/T2, W/T3	2	2 to 5.5	14	14 to 10	2.5	2.5 to 6		
	⊖, ⊕1, ⊕2	2	2 to 5.5	–	14 to 10	–	2.5 to 6		
	B1, B2	2	2 to 5.5	–	14 to 10	–	2.5 to 6		
	⏚	3.5	2 to 5.5	10	14 to 10	2.5	2.5 to 6		
1A5	R/L1, S/L2, T/L3	3.5	2 to 5.5	10	14 to 10	2.5	2.5 to 6	M4	1.2 to 1.5 (10.6 to 13.3)
	U/T1, V/T2, W/T3	2	2 to 5.5	14	14 to 10	2.5	2.5 to 6		
	⊖, ⊕1, ⊕2	3.5	2 to 5.5	–	14 to 10	–	2.5 to 6		
	B1, B2	2	2 to 5.5	–	14 to 10	–	2.5 to 6		
	⏚	3.5	2 to 5.5	10	14 to 10	2.5	2.5 to 6		
2A2	R/L1, S/L2, T/L3	5.5	2 to 5.5	10	14 to 10	4	2.5 to 6	M4	1.2 to 1.5 (10.6 to 13.3)
	U/T1, V/T2, W/T3	2	2 to 5.5	14	14 to 10	2.5	2.5 to 6		
	⊖, ⊕1, ⊕2	3.5	2 to 5.5	–	14 to 10	–	2.5 to 6		
	B1, B2	2	2 to 5.5	–	14 to 10	–	2.5 to 6		
	⏚	3.5	2 to 5.5	10	14 to 10	4	2.5 to 6		

<1> Gauges listed here are for use in Japan and Asia.

<2> Gauges listed here are for use in the United States.

<3> Gauges listed here are for use in Europe and China.

Table C.7 Wire Gauge and Torque Specifications

Drive Model HF5202	Terminal	For Japan and Asia <1>		For United States <2>		For Europe and China <3>		Screw Size	Tightening Torque N•m (lb.in.)
		Recomm. Gauge mm^2	Wire Range mm^2	Recomm. Gauge AWG, kcmil	Wire Range AWG, kcmil	Recomm. Gauge mm^2	Wire Range mm^2		
A20 A40 A75	R/L1, S/L2, T/L3	2	0.75 to 2	14	18 to 14	2.5	0.75 to 2.5	M3.5	0.8 to 1.0 (7.1 to 8.9)
	U/T1, V/T2, W/T3	2	0.75 to 2	14	18 to 14	2.5	0.75 to 2.5		
	⊖, ⊕1, ⊕2	2	0.75 to 2	–	18 to 14	–	0.75 to 2.5		
	B1, B2	2	0.75 to 2	–	18 to 14	–	0.75 to 2.5		
	⏚	2	0.75 to 2	14	18 to 14	2.5	0.75 to 2.5		
1A5	R/L1, S/L2, T/L3	2	2 to 5.5	14	14 to 10	2.5	2.5 to 6	M4	1.2 to 1.5 (10.6 to 13.3)
	U/T1, V/T2, W/T3	2	2 to 5.5	14	14 to 10	2.5	2.5 to 6		
	⊖, ⊕1, ⊕2	2	2 to 5.5	–	14 to 10	–	2.5 to 6		
	B1, B2	2	2 to 5.5	–	14 to 10	–	2.5 to 6		
	⏚	2	2 to 5.5	10	14 to 10	2.5	2.5 to 6		

C.2 UL Standards

Drive Model HF5202	Terminal	For Japan and Asia <1>		For United States <2>		For Europe and China <3>		Screw Size	Tightening Torque N•m (lb.in.)
		Recomm. Gauge mm^2	Wire Range mm^2	Recomm. Gauge AWG, kcmil	Wire Range AWG, kcmil	Recomm. Gauge mm^2	Wire Range mm^2		
2A2	R/L1, S/L2, T/L3	2	2 to 5.5	12	14 to 10	2.5	2.5 to 6	M4	1.2 to 1.5 (10.6 to 13.3)
	U/T1, V/T2, W/T3	2	2 to 5.5	14	14 to 10	2.5	2.5 to 6		
	⊖, ⊕1, ⊕2	2	2 to 5.5	–	14 to 10	–	2.5 to 6		
	B1, B2	2	2 to 5.5	–	14 to 10	–	2.5 to 6		
	⏚	2	2 to 5.5	10	14 to 10	2.5	2.5 to 6		
3A7	R/L1, S/L2, T/L3	5.5	2 to 5.5	10	14 to 10	4	2.5 to 6	M4	1.2 to 1.5 (10.6 to 13.3)
	U/T1, V/T2, W/T3	3.5	2 to 5.5	10	14 to 10	2.5	2.5 to 6		
	⊖, ⊕1, ⊕2	5.5	2 to 5.5	–	14 to 10	–	2.5 to 6		
	B1, B2	2	2 to 5.5	–	14 to 10	–	2.5 to 6		
	⏚	3.5	2 to 5.5	10	14 to 10	4	2.5 to 6		
5A5	R/L1, S/L2, T/L3	14	5.5 to 14	8	10 to 6	6	4 to 16	M4	2.1 to 2.3 (18.6 to 20.4)
	U/T1, V/T2, W/T3	8	5.5 to 14	8	10 to 6	6	4 to 16		
	⊖, ⊕1, ⊕2	14	5.5 to 14	–	10 to 6	–	4 to 16		
	B1, B2	3.5	2 to 5.5	–	14 to 10	–	4 to 6		
	⏚	5.5 <4>	5.5 to 14	8 <4>	10 to 6	6 <4>	6 to 16	M5	2 to 2.5 (17.7 to 22.1)

Drive Model HF5202	Terminal	For Japan and Asia <1>		For United States <2>		For Europe and China <3>		Screw Size	Tightening Torque N•m (lb.in.)
		Recomm. Gauge mm^2	Wire Range mm^2	Recomm. Gauge AWG, kcmil	Wire Range AWG, kcmil	Recomm. Gauge mm^2	Wire Range mm^2		
7A5	R/L1, S/L2, T/L3	14	5.5 to 14	6	10 to 6	10	6 to 16	M4	2.1 to 2.3 (18.6 to 20.4)
	U/T1, V/T2, W/T3	14	5.5 to 14	8	10 to 6	10	6 to 16		
	⊖, ⊕1, ⊕2	14	5.5 to 14	–	10 to 6	–	6 to 16		
	B1, B2	5.5	2 to 5.5	–	14 to 10	–	4 to 6		
	⏚	14	5.5 to 14	6	10 to 6	10	6 to 16	M5	2 to 2.5 (17.7 to 22.1)

<1> Gauges listed here are for use in Japan and Asia.

<2> Gauges listed here are for use in the United States.

<3> Gauges listed here are for use in Europe and China.

<4> When an EMC filter is installed, additional measures must be taken to comply with IEC/EN 61800-5-1. ***Refer to EMC Filter Installation on page 238*** for details.

Table C.8 Wire Gauge and Torque Specifications

Drive Model HF5204	Terminal	For Japan and Asia <1>		For United States <2>		For Europe and China <3>		Screw Size	Tightening Torque N•m (lb.in.)
		Recomm. Gauge mm²	Wire Range mm²	Recomm. Gauge AWG, kcmil	Wire Range AWG, kcmil	Recomm. Gauge mm²	Wire Range mm²		
A20 A40 A75	R/L1, S/L2, T/L3	2	2 to 5.5	14	14 to 10	2.5	2.5 to 6	M4	1.2 to 1.5 (10.6 to 13.3)
	U/T1, V/T2, W/T3	2	2 to 5.5	14	14 to 10	2.5	2.5 to 6		
	⊖, ⊕1, ⊕2	2	2 to 5.5	–	14 to 10	–	2.5 to 6		
	B1, B2	2	2 to 5.5	–	14 to 10	–	2.5 to 6		
	⏚	2	2 to 5.5	14	14 to 10	2.5	2.5 to 6		
1A5 2A2	R/L1, S/L2, T/L3	2	2 to 5.5	14	14 to 10	2.5	2.5 to 6	M4	1.2 to 1.5 (10.6 to 13.3)
	U/T1, V/T2, W/T3	2	2 to 5.5	14	14 to 10	2.5	2.5 to 6		
	⊖, ⊕1, ⊕2	2	2 to 5.5	–	14 to 10	–	2.5 to 6		
	B1, B2	2	2 to 5.5	–	14 to 10	–	2.5 to 6		
	⏚	2	2 to 5.5	10	14 to 10	2.5	2.5 to 6		
3A7	R/L1, S/L2, T/L3	2	2 to 5.5	12	14 to 10	2.5	2.5 to 6	M4	1.2 to 1.5 (10.6 to 13.3)
	U/T1, V/T2, W/T3	2	2 to 5.5	14	14 to 10	2.5	2.5 to 6		
	⊖, ⊕1, ⊕2	2	2 to 5.5	–	14 to 10	–	2.5 to 6		
	B1, B2	2	2 to 5.5	–	14 to 10	–	2.5 to 6		
	⏚	2	2 to 5.5	10	14 to 10	2.5	2.5 to 6		
5A5	R/L1, S/L2, T/L3	3.5	2 to 14	10	14 to 6	2.5	2.5 to 16	M4	2.1 to 2.3 (18.6 to 20.4)
	U/T1, V/T2, W/T3	3.5	2 to 14	10	14 to 6	2.5	2.5 to 16		
	⊖, ⊕1, ⊕2	3.5	2 to 14	–	14 to 6	–	2.5 to 16		
	B1, B2	2	2 to 5.5	–	14 to 10	–	4 to 6		
	⏚	5.5	2 to 14	8	14 to 6	2.5	2.5 to 16	M5	2 to 2.5 (17.7 to 22.1)

Drive Model HF5204	Terminal	For Japan and Asia <1>		For United States <2>		For Europe and China <3>		Screw Size	Tightening Torque N•m (lb.in.)
		Recomm. Gauge mm^2	Wire Range mm^2	Recomm. Gauge AWG, kcmil	Wire Range AWG, kcmil	Recomm. Gauge mm^2	Wire Range mm^2		
7A5	R/L1, S/L2, T/L3	5.5	3.5 to 14	10	10 to 6	4	4 to 16	M4	2.1 to 2.3 (18.6 to 20.4)
	U/T1, V/T2, W/T3	5.5	3.5 to 14	10	10 to 6	4	4 to 16		
	⊖, ⊕1, ⊕2	5.5	3.5 to 14	–	10 to 6	–	4 to 16		
	B1, B2	2	2 to 5.5	–	14 to 10	–	2.5 to 6		
	⏚	5.5	5.5 to 14	8	10 to 6	4	4 to 16	M5	2 to 2.5 (17.7 to 22.1)

<1> Gauges listed here are for use in Japan and Asia.

<2> Gauges listed here are for use in the United States.

<3> Gauges listed here are for use in Europe and China.

<4> When an EMC filter is installed, additional measures must be taken to comply with IEC/EN 61800-5-1. ***Refer to EMC Filter Installation on page 238*** for details.

Note: Use crimp insulated terminals or insulated tubing for wiring these connections. Wires should have a continuous maximum allowable temperature of 75 °C 600 V UL approved vinyl sheathed insulation. Ambient temperature should not exceed 30 °C.

Closed-Loop Crimp Terminal Recommendations

Sumitomo recommends crimp terminals made by JST and Tokyo DIP for the insulation cap. ***Table C.9*** matches drives models with crimp terminals and insulation caps.

Table C.9 Closed-Loop Crimp Terminal Size

Drive Model	Wire Gauge AWG		Terminal Screws	Crimp Terminal Model No.	Tool		Insulation Cap Model No.
	R/L1, S/L2, T/L3	U/T1, V/T2, W/T3			Machine No.	Die Jaw	
200 V Class Single-Phase Drives							
HF520S-A20 HF520S-A40	18		M3.5	R1.25-3.5	YA-4	AD-900	TP-003
	16						
	14 <1>			R2-3.5			
HF520S-A75	14 <1>		M4	R2-4	YA-4	AD-900	TP-003
	12			R5.5-4			TP-005
	10						
HF520S-1A5	14	14 <1>	M4	R2-4	YA-4	AD-900	TP-003
	12 <1>	12		R5.5-4			TP-005
	10	10					
HF520S-2A2	14	14 <1>	M4	R2-4	YA-4	AD-900	TP-003
	12	12		R5.5-4			TP-005
	10 <1>	10					
200 V Class Three-Phase Drives							
HF5202-A20 HF5202-A40 HF5202-A75	18		M3.5	R1.25-3.5	YA-4	AD-900	TP-003
	16						
	14 <1>			R2-3.5			
HF5202-1A5	14 <1>		M4	R2-4	YA-4	AD-900	TP-003
	12			R5.5-4			TP-005
	10						

Drive Model	Wire Gauge AWG		Terminal Screws	Crimp Terminal Model No.	Tool		Insulation Cap Model No.
	R/L1, S/L2, T/L3	U/T1, V/T2, W/T3			Machine No.	Die Jaw	
HF5202-2A2	14 <1>		M4	R2-4	YA-4	AD-900	TP-003
	12			R5.5-4			TP-005
	10						
HF5202-3A7	14	14	M4	R2-4	YA-4	AD-900	TP-003
	12	12 <1>		R5.5-4			TP-005
	10 <1>	10					
HF5202-5A5	10	10	M4	R5.5-4	YA-4	AD-900	TP-005
	8	8 <1>		8-4		AD-901	TP-008
	6 <1>	6		14-4		AD-902	TP-014
HF5202-7A5	10		M4	R5.5-4	YA-4	AD-900	TP-005
	8			8-4		AD-901	TP-008
	6 <1>			14-4		AD-902	TP-014
400 V Class Three-Phase Drives							
HF5204-A20 HF5204-A40 HF5204-A75	14 <1>		M4	R2-4	YA-4	AD-900	TP-003
	12			R5.5-4			TP-005
	10						
HF5204-1A5 HF5204-2A2	14 <1>		M4	R2-4	YA-4	AD-900	TP-003
	12			R5.5-4			TP-005
	10						

Drive Model	Wire Gauge AWG		Terminal Screws	Crimp Terminal Model No.	Tool		Insulation Cap Model No.
	R/L1, S/L2, T/L3	U/T1, V/T2, W/T3			Machine No.	Die Jaw	
HF5204-3A7	14 <1>		M4	R2-4	YA-4	AD-900	TP-003
	12			R5.5-4			TP-005
	10						
HF5204-5A5	14		M4	R2-4	YA-4	AD-900	TP-003
	12 <1>			R5.5-4			TP-005
	10						
	8			8-4		AD-901	TP-008
	6			14-4		AD-902	TP-014
HF5204-7A5	12		M4	R5.5-4	YA-4	AD-900	TP-005
	10 <1>						
	8			8-4		AD-901	TP-008
	6			14-4		AD-902	TP-014

<1> Recommended wire gauge.

Note: Consider the amount of voltage drop when selecting wire gauges. Increase the wire gauge when the voltage drop is greater than 2% of motor rated voltage. Ensure the wire gauge is suitable for the terminal block. Use the following formula to calculate the amount of voltage drop:
Line drop voltage (V) = $\sqrt{3}$ × wire resistance (Ω/km) × wire length (m) × current (A) × 10^{-3}

■ Factory Recommended Branch Circuit Protection

Sumitomo recommends installing one of the following types of branch circuit protection to maintain compliance with UL508C. Semiconductor protective type fuses are preferred. Alternate branch circuit protection devices are also listed in ***Table C.10***.

Branch circuit protection shall be provided by any of the following:

- Non-time delay Class J, T, or CC fuses sized at 300% of the drive input rating
  Note: The following model/fuse combinations are excluded from the preceding statement: HF5202-A20, A40, HF5204-A75, 1A5 and 2A2.
- Time delay Class J, T, or CC fuses sized at 175% of the drive input rating
- Time-delay Class RK5 fuses sized at 225% of the drive input rating

Table C.10 Factory Recommended Drive Branch Circuit Protection

Drive Model	Non-Time Delay Class T Fuse Type (Manufacturer: Ferraz) Rated Voltage: 600 Vac, 200 kAIR	Fuse Ampere Rating (A)	Fuse Type (Manufacturer: Bussmann) Rated Voltage: 500 Vac, 200 kAIR	Fuse Ampere Rating (A)
200 V Class Single-Phase Drives				
HF520S-A20	A6T10	10	FWH-25A14F	25
HF520S-A40	A6T20	20	FWH-60B	60
HF520S-A75	A6T40	40	FWH-80B	80
HF520S-1A5	A6T40	40	FWH-100B	100
HF520S-2A2	A6T50	50	FWH-125B	125
200 V Class Three-Phase Drives				
HF5202-A20	A6T6	6	FWH-25A14F	25
HF5202-A40	A6T15	15	FWH-25A14F	25
HF5202-A75	A6T20	20	FWH-25A14F	25
HF5202-1A5	A6T25	25	FWH-70B	70
HF5202-2A2	A6T25	25	FWH-70B	70
HF5202-3A7	A6T40	40	FWH-90B	90
HF5202-5A5	–	–	FWH-100B	100
HF5202-7A5	–	–	FWH-200B	200
400 V Class Three-Phase Drives				
HF5204-A20	A6T3	3	FWH-40B	40
HF5204-A40	A6T6	6	FWH-40B	40
HF5204-A75	A6T15	15	FWH-50B	50
HF5204-1A5	A6T20	20	FWH-70B	70

Drive Model	Non-Time Delay Class T Fuse Type (Manufacturer: Ferraz) Rated Voltage: 600 Vac, 200 kAIR	Fuse Ampere Rating (A)	Fuse Type (Manufacturer: Bussmann) Rated Voltage: 500 Vac, 200 kAIR	Fuse Ampere Rating (A)
HF5204-2A2	A6T25	25	FWH-70B	70
HF5204-3A7	A6T30	30	FWH-90B	90
HF5204-5A5	–	–	FWH-80B	80
HF5204-7A5	–	–	FWH-100B	100

■ Low Voltage Wiring for Control Circuit Terminals

Wire low voltage wires with NEC Class 1 circuit conductors. Refer to national state or local codes for wiring. The external power supply shall be a UL-Listed Class 2 power source or equivalent.

Table C.11 Control Circuit Terminal Power Supply

Input / Output	Terminal Signal	Power Supply Specifications
Multi-function photocoupler output	P1, P2, PC	Requires class 2 power supply
Multi-function digital inputs	S1, S2, S3, S4, S5, S6, S7, SC	Use the internal power supply of the drive. Use class 2 for external power supply.
Multi-function analog inputs	A1, A2, AC	Use the internal power supply of the drive. Use class 2 for external power supply.
Pulse train input	RP	Use the internal LVLC power supply of the drive. Use class 2 for external power supply.
Pulse train output	MP	Use the internal LVLC power supply of the drive. Use class 2 for external power supply.

■ Drive Short-Circuit Rating

This drive has undergone the UL short-circuit test, which certifies that during a short circuit in the power supply the current flow will not rise above 31,000 amps maximum at 240 V for 200 V class drives and 480 V for 400 V class drives.

- The MCB and breaker protection and fuse ratings shall be equal to or greater than the short-circuit tolerance of the power supply being used.
- Suitable for use on a circuit capable of delivering not more than 31,000 RMS symmetrical amperes for 240 V in 200 V class drives (up to 480 V for 400 V class drives) motor overload protection.

◆ Drive Motor Overload Protection

Set parameter L1-08 (Electrothermal Level Setting 1) to the appropriate value to enable motor overload protection. The internal motor overload protection is UL listed and in accordance with the NEC and CEC.

■ L1-08: Electrothermal Level Setting 1

Setting Range: Model Dependent

Default Setting: Model Dependent

Parameter L1-08 (Electrothermal Level Setting 1) protects the motor if parameter L1-01 is not set to 0 (default is 1, standard induction motor protection enabled).

■ L1-01: Motor Overload Protection Selection

The drive has an electronic overload protection function (oL1) based on time, output current and output frequency, which protects the motor from overheating. The electronic thermal overload function is UL-recognized, so it does not require an external thermal overload relay for single motor operation.

This parameter selects the motor overload curve used according to the type of motor applied.

Table C.12 Overload Protection Settings

Setting	Description
0	Disabled
1	Standard Fan-Cooled Motor (Default)
2	Drive Duty Motor with a Speed Range of 1:10
6	Standard Fan-Cooled Motor (50 Hz)

Disable the electronic overload protection (L1-01 = 0: Disabled) and wire each motor with its own motor thermal overload when connecting the drive to more than one motor for simultaneous operation.

Enable the motor overload protection (L1-01 = "1", "2") when connecting the drive to a single motor unless there is another means of preventing motor thermal overload. The electronic thermal overload function causes an oL1 fault, which shuts off the output of the drive and prevents additional overheating of the motor. The motor temperature is continually calculated as long as the drive is powered up.

■ L1-02: Motor Overload Protection Time

Setting Range: 0.1 to 5.0 Minutes

Factory Default: 1.0 Minutes

The L1-02 parameter sets the allowed operation time before the oL1 fault occurs when the drive is running at 60 Hz and 150% of the Electrothermal Level Setting 1 (L1-08) of the motor. Adjusting the value of L1-02 can shift the set of oL1 curves up the Y-axis of the diagram below but will not change the shape of the curves.

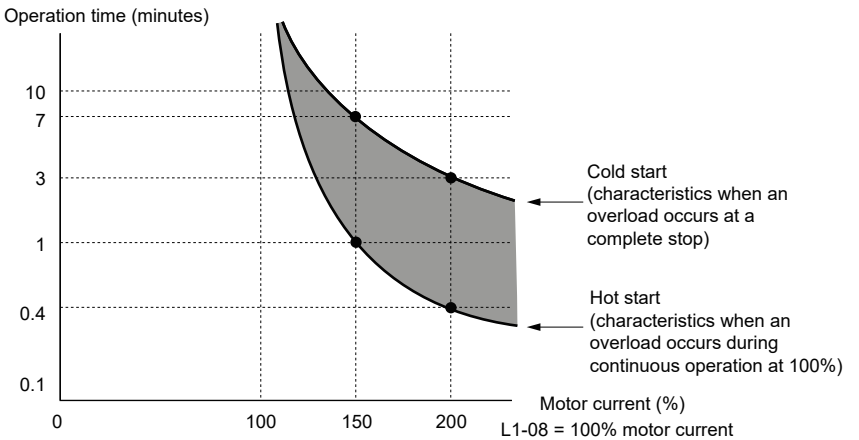


Figure C.7 Motor Overload Protection Time

C.3 Safe Disable Input Precautions

◆ Safe Disable Function Description

The Safe Disable function can be utilized to perform a safe stop.

Removing the voltage from terminal H1 disables the drive output, i.e. the power supply to the motor is cut by stopping the switching of the output transistors in a safe way. "Hbb" is shown on the display. Safe Disable is applicable for induction and permanent magnet motors.

◆ Installation

If the Safe Disable function is utilized, the wire link between the terminals HC and H1 that is installed at shipment must be removed entirely.

Connect the drive to an interrupting device so that in case of a Safe Disable request the connection between the terminals HC and H1 is opened.

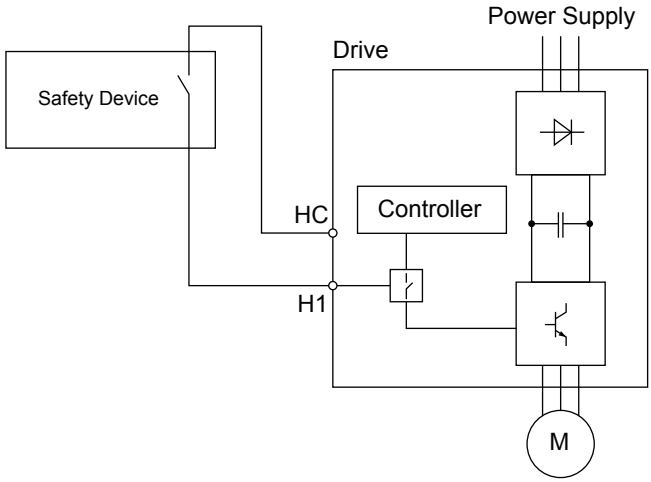


Figure C.10 Safe Disable Wiring Example

C.4 Safety Guideline

Safety Guideline

EN

As "Warning" and "Caution" are critical information to prevent hazardous situation, make sure to read this guideline fully along with the instruction manual and follow the instructions therein.

⚠ Warning : Improper handling may cause hazardous situation (electric shock, fire, personal injury, etc.), resulting in a potentially serious personal injury and/or death.

⚠ Caution : Improper handling may cause hazardous situation (fire, injuries, physical damage, etc.), resulting in a possible medium damage or personal injury. It may cause physical damages only.

⚠ Warning

- Please ensure the grounding (ground wire).
- An electrician with expertise should work on wiring.
- Make sure the power is turned OFF before starting up the system.
- Make sure that the unit is installed before wiring.
- Do not touch internal components or terminals of the inverter (or servo amplifier) or attach/remove the wiring or connectors while an inverter is energized.
- Do not open the front cover of the inverter when it is energized or has residual voltage left.
- Do not manipulate controls using wet hands.
- Do not touch terminals or connectors even while the inverter (or servo amplifier) is energized but suspended.
- Make sure that the inverter has been switched to a mode in which it will not be operative after recovered when otherwise it may be hazardous to the operator.
- Please provide an emergency stop switch separately.
- Reset the alarm after making sure that an operation command has been disabled.
- Turn OFF the power and wait for 10 minutes or more before working on a service.
- Unauthorized operators should not work on maintenance, service, and part replacement.

⚠ Caution

- Attach the inverter to such incombustible as metal, and keep combustibles away.
- Do not contaminate the inverter with foreign materials, including dusts, etc.
- Install the inverter on a vertical wall without oscillations which can reliably support the unit weight described on the instruction manual.
- Keep it away from hot and humid ambient environment with corrosive gas, and explosive gas, etc. and install in a room without direct sunlight.
- Make sure that the product's rated voltage matches the alternator's voltage.
- Do not connect the alternator to output terminals (U, V, and W).
- Do not connect a resistance directly to a direct current terminal.
- Use a power line, leakage detection breaker, or electromagnetic contactor with a designated (rated) capacity or equivalent.
- Do not stop the operation of the inverter (or servo amplifier) by turning ON/OFF the electromagnetic contactor placed at the power supply and output.
- Tighten a screw with a rated torque. In addition, do not leave the screw loosened.
- Do not touch the cooling fan.
- The cooling fin and the damping resistor are heated and hot. Do not touch.
- Check if rotation, abnormal noise, oscillations of the motor could be detected during operation.

Sicherheitsrichtlinien

GR

Da es sich bei „Warnung" und „Achtung" um überaus wichtige Hinweise zur Verhinderung von Gefahrensituationen handelt, müssen Sie diese Richtlinien sowie die Betriebsanleitung gründlich lesen und alle darin angesprochenen Anweisungen befolgen.

⚠ Warnung : Unsachgemäße Handhabung führt unter Umständen zu Gefahrensituationen (elektrischer Schlag, Feuer, Personenschaden, usw.), welche wiederum zu schwerwiegenden körperlichen Verletzungen und/oder Tod führen können.

⚠ Achtung : Unsachgemäße Handhabung führt unter Umständen zu Gefahrensituationen (Feuer, Verletzungen, Sachschaden, etc.), welche wiederum zu mittelschweren Sach- oder Personenschäden führen können.

⚠ Warnung

- Stellen Sie eine ordnungsgemäße Erdung (Erdungskabel) sicher.
- Nur erfahrenes Personal sollte an der Verkabelung arbeiten.
- Vergewissern Sie sich, dass der Strom abgestellt ist, bevor Sie mit der Arbeit am System beginnen.
- Vergewissern Sie sich, dass die Einheit korrekt eingebaut ist, bevor Sie mit dem Verlegen der Kabel beginnen.
- Berühren Sie keine inneren Bauteile oder Klemmen des Frequenzumrichters (oder Servoverstärkers) und und befestigen oder entfernen Sie keinesfalls die Verkabelung oder Anschlüsse, solange der Frequenzumrichter am Stromnetz hängt.
- Öffnen Sie nicht die vordere Abdeckung des Frequenzumrichters, solange dieser am Stromnetz hängt oder Restspannung hat.
- Berühren Sie keine Bedienelemente mit nassen Händen.
- Berühren Sie keine Klemmen oder Anschlüsse, auch dann nicht, wenn der Frequenzumrichter (oder Servoverstärker) bereits abgeklemmt ist, da gefährliche Restspannungen vorhanden sein können.
- Vergewissern Sie sich, dass sich der Frequenzumrichter in einem Modus befindet, in dem er nach Netzwiederkehr nicht arbeitet, da ansonsten eine Gefahrensituation für den Bediener besteht.
- Sorgen Sie bitte für die Bereitstellung eines separaten Not-Aus-Schalters.
- Setzen Sie den Alarm zurück, nachdem Sie sichergestellt haben, dass ein Betriebsbefehl deaktiviert wurde.
- Schalten Sie den Strom AUS und warten Sie mindestens 10 Minuten bevor Sie mit den Wartungsarbeiten beginnen.
- Nicht autorisiertes Personal darf keine Reparatur- und Wartungsarbeiten vornehmen und keine Teile austauschen austauschen,

⚠ Achtung

- Bringen Sie den Frequenzumrichter an nicht brennbaren Oberflächen wie Metall an und halten Sie ihn von brennbaren Flächen fern.
- Verunreinigen Sie den Frequenzumrichter nicht mit Fremdstoffen, wie z.B. Staub o.ä.
- Installieren Sie den Frequenzumrichter an einer senkrechten, feststehenden Wand, die das in der Bedienungsanleitung angegebene Gewicht des Frequenzumrichters sicher tragen kann.
- Installieren Sie den Frequenzumrichter in einem Raum ohne direkte Sonneneinstrahlung und vermeiden Sie feucht-warme Bedingungen und korrosives sowie explosives Atmosphäre.
- Vergewissern Sie sich, dass die Nennspannung des Produkts mit der Netzspannung übereinstimmt.
- Schließen Sie den Generator nicht an Abgangsklemmen (U, V, und W) an.
- Schließen Sie keinen Widerstand direkt an eine Gleichstromklemme an.
- Verwenden Sie für die Netzversorgung einen Motorschutzschalter, ein Schaltschütz oder etwas Ähnliches mit passender Leistung.
- Schalten Sie den Frequenzumrichters (oder Servoverstärker) nicht über das Netzschütz aus.
- Ziehen Sie die Schraube mit dem angegebenen Drehmoment fest. Es ist überaus wichtig, dass Sie die Schraube immer festziehen.
- Berühren Sie nicht das Gerätelüfter.
- Der Bremswiderstand und der Kühlkörper werden heiß. Fassen Sie diese nicht an.
- Überprüfen Sie, ob der Motor dreht, ungewöhnliche Geräusche macht oder ob Vibrationen während des Betriebs auftreten.

Consignes de sécurité

FR

Les sections «Danger» et «Attention» fournissent d'importantes informations sur la prévention des situations dangereuses. Veillez par conséquent à lire les présentes consignes dans leur intégralité, conjointement avec le manuel d'instructions, et à respecter les instructions contenues dans ce manuel.

⚠ Danger : une mauvaise manipulation peut entraîner une situation dangereuse (choc électrique, incendie, blessure, etc.) et par conséquent, des blessures potentiellement graves voire mortelles.

⚠ Attention : une mauvaise manipulation peut entraîner une situation dangereuse (incendie, blessures, dégâts matériels, etc.) et par conséquent, des blessures ou dégâts matériels moyennement sévères. Cela peut entraîner des dégâts matériels uniquement.

⚠ Danger

- Veuillez vérifier la mise à la terre (câble de mise à la terre).
- Un électricien qualifié doit intervenir sur le câblage.
- Assurez-vous que l'alimentation est coupée avant de démarrer le système.
- Assurez-vous que l'unité est installée avant le câblage.
- Ne touchez pas les composants internes ni les bornes de l'onduleur (ou servoamplificateur), ni ne fixez/déposez le câblage ou les connecteurs lorsque l'onduleur est alimenté.
- N'ouvrez pas le capot avant de l'onduleur lorsque celui-ci est alimenté ou parcouru par une tension résiduelle.
- Ne manipulez pas les commandes avec des mains mouillées.
- Ne touchez pas les bornes ni les connecteurs même lorsque l'onduleur (ou servoamplificateur) est alimenté mais que son fonctionnement est suspendu.
- Après rétablissement de l'alimentation électrique, assurez-vous que l'onduleur est dans un mode dans lequel il est inopérant, sinon il peut présenter un risque pour l'opérateur.
- Veuillez fournir un contacteur d'arrêt d'urgence séparément.
- Réinitialisez l'alarme après vous être assuré qu'une commande de fonctionnement a été désactivée.
- Coupez l'alimentation et attendez 10 minutes minimum avant d'effectuer un entretien.
- Les opérateurs non autorisés ne doivent pas effectuer de maintenance, d'entretien ou de remplacement de pièces.

⚠ Attention

- Fixez l'onduleur à un matériau non combustible tel que le métal, et maintenez les combustibles à l'écart.
- Ne contaminez pas l'onduleur avec des matériaux étrangers, notamment de la poussière, etc.
- Installez l'onduleur sur une paroi verticale sans oscillation et pouvant supporter le poids de l'unité, indiqué dans le manuel d'instructions.
- Conservez-le à l'abri de la chaleur, de l'humidité, des gaz corrosifs et explosifs, etc., et installez-le à l'abri du soleil.
- Assurez-vous que la tension nominale du produit correspond à la tension de l'alternateur.
- Ne connectez pas l'alternateur aux bornes de sortie (U, V et W).
- Ne connectez pas de résistance directement à une borne de courant continu.
- Utilisez une ligne d'alimentation, un disjoncteur anti-fuite ou un contacteur électromagnétique avec une capacité (nominale) désignée ou équivalente.
- N'interrompez pas le fonctionnement de l'onduleur (ou servoamplificateur) en allumant/coupant le contacteur électromagnétique placé au niveau de l'alimentation électrique et de la sortie.
- Serrez une vis à un couple nominal. En outre, ne laissez pas la vis desserrée.
- Ne touchez pas le ventilateur de refroidissement.
- Le ventilateur de refroidissement et la résistance d'amortissement sont chauffés et chauds. N'y touchez pas.
- Recherchez d'éventuels bruits anormaux, rotations ou oscillations du moteur pendant son fonctionnement.

Linee guida sulla sicurezza

IT

Poichè "Avvertenza" e "Attenzione" forniscono informazioni fondamentali per prevenire situazioni pericolose, leggere interamente le presenti linee guida e il manuale di istruzioni, attenendosi alle istruzioni fornite.

⚠ Avvertenza : L'errata manipolazione può generare situazioni pericolose (scossa elettrica, incendio, lesioni personali, ecc.), inoltre potrebbe causare gravi lesioni personali e/o il decesso.

⚠ Attenzione : L'errata manipolazione può generare situazioni pericolose (incendio, lesioni, danni fisici, ecc.), inoltre potrebbe causare danni di media entità o lesioni personali. Può causare solo danni fisici.

⚠ Avvertenza

- Controllare la messa a terra (filo di messa a terra).
- Gli interventi sul cablaggio devono essere eseguiti da un elettricista esperto.
- Assicurarsi che l'alimentazione sia SCOLLEGATA prima di avviare il sistema.
- Verificare che l'unità venga installata prima del cablaggio.
- Non toccare i componenti interni o i morsetti dell'inverter (o del servoamplificatore), non collegare/rimuovere il cablaggio o i connettori quando un inverter è sotto tensione.
- Non aprire il coperchio anteriore dell'inverter quando è sotto tensione o in presenza di tensione residua.
- Non toccare i comandi con le mani bagnate.
- Non toccare i morsetti o i connettori neanche quando l'inverter (o il servoamplificatore) è sotto tensione ma è sospeso.
- Assicurarsi che l'inverter sia stato commutato su una modalità in cui non sarà operativo dopo il ripristino dell'alimentazione, poiché altrimenti potrebbe rappresentare un pericolo per l'operatore.
- Predisporre separatamente un interruttore di arresto di emergenza.
- Reimpostare l'allarme dopo essersi assicurati che sia stato disabilitato un comando operativo.
- Scollegare l'alimentazione e attendere 10 o più minuti prima di un intervento di assistenza.
- Gli operatori non autorizzati non devono eseguire interventi di manutenzione, assistenza e sostituzione dei componenti.

⚠ Attenzione

- Collegare l'inverter a materiali non combustibili come il metallo e tenere lontani i combustibili.
- Non contaminare l'inverter con materiali estranei, quali le polveri, ecc.
- Installare l'inverter su una parete verticale che non sia soggetta a oscillazioni e che sia in grado di supportare in maniera affidabile il peso dell'unità descritto nel manuale di istruzioni.
- Mantenerlo lontano da ambienti caldi e umidi, da ambienti con gas corrosivi ed esplosivi, ecc.; installarlo in una stanza in cui non penetri luce solare diretta.
- Assicurarsi che la tensione nominale del prodotto corrisponda alla tensione dell'alternatore.
- Non collegare l'alternatore ai morsetti di uscita (U, V e W).
- Non collegare una resistenza direttamente a un morsetto che porta corrente continua.
- Utilizzare una linea di alimentazione, un interruttore di rilevamento di dispersione, oppure un contattore elettromagnetico con capacità designata (nominale) o equivalente.
- Non interrompere il funzionamento dell'inverter (o del servoamplificatore) accendendo o spegnendo il contattore elettromagnetico posizionato sull'alimentazione e sull'uscita.
- Serrare una vite con coppia nominale. Inoltre, non lasciare la vite allentata.
- Non toccare la ventola di raffreddamento.
- L'aletta di raffreddamento e la resistenza di smorzamento vengono riscaldate e scottano. Non toccare.
- Controllare se, durante il funzionamento, si rilevano rotazione, rumori anomali, oscillazioni del motore.

Directrices de seguridad

ES

"Advertencia" y "Precaución" indican elementos de información esenciales para evitar situaciones peligrosas. Por lo tanto, asegúrese de leer detenidamente estas directrices junto con el manual de instrucciones, y de seguir las indicaciones que contienen.

⚠ Advertencia : Una manipulación incorrecta puede originar situaciones peligrosas (descargas eléctricas, incendios, lesiones personales, etc.), que pueden causar lesiones personales graves e incluso la muerte.

⚠ Precaución : Una manipulación incorrecta puede originar situaciones peligrosas (incendios, lesiones, daños físicos, etc.), que pueden causar daños materiales o lesiones personales. Puede que cause solamente daños físicos.

⚠ Advertencia

- Asegure la conexión a tierra (cable de masa).
- Un electricista cualificado debe ocuparse del cableado.
- Asegúrese de que la alimentación está desconectada antes de activar el sistema.
- Asegúrese de que la unidad está instalada antes de tender el cableado.
- No toque los componentes internos ni los terminales del inversor (o servoamplificador), ni conecte/desconecte el cableado o los conectores con el inversor conectado a la alimentación.
- No abra la cubierta delantera del inversor si está conectado a la alimentación o si tiene tensión residual.
- No manipule los controles con las manos húmedas.
- No toque los terminales o los conectores con el inversor (o el servoamplificador) conectado a la alimentación, ni siquiera aunque esté suspendido.
- Asegúrese de que el inversor se encuentra en un modo en el que no pueda reactivarse cuando se restablezca la alimentación y esto suponga un peligro para el operario.
- Asegúrese de incorporar un interruptor de parada de emergencia independiente.
- Restablezca la alarma una vez se haya asegurado de haber desactivado el comando de funcionamiento.
- Desconecte la alimentación y espere como mínimo 10 minutos antes de iniciar un trabajo de reparación.
- Los operarios que no cuenten con la autorización necesaria no deben realizar tareas de mantenimiento, reparación ni sustitución de piezas.

⚠ Precaución

- Instale el inversor sobre materiales no combustibles, como metales en general, y mantenga los materiales combustibles a una distancia prudencial.
- Evite contaminar el inversor con materiales extraños, como el polvo, etcétera.
- Instale el inversor en una pared vertical sin oscilaciones y lo bastante resistente como para soportar el peso de la unidad, tal y como se describe en el manual de instrucciones.
- Mantenga la unidad alejada de ambientes calurosos y húmedos con gases corrosivos y explosivos. Realice la instalación en una sala sin luz solar directa.
- Asegúrese de que la tensión nominal del producto coincide con la tensión del alternador.
- No conecte el alternador a los terminales de salida (U, V y W).
- No conecte una resistencia directamente a un terminal de corriente continua.
- Use un cable de alimentación, un disyuntor de detección de fugas o un contactor electromagnético con la capacidad nominal designada o equivalente.
- No detenga el inversor (o el servoamplificador) apagando o encendiendo el contactor electromagnético ubicado en la fuente de alimentación y en la salida.
- Apriete el tornillo al par especificado. Asegúrese de no dejar el tornillo sin apretar.
- No toque el ventilador.
- El disipador de calor y la resistencia de amortiguación se calientan considerablemente. No los toque.
- Compruebe si se producen rotaciones, ruidos u oscilaciones anormales en el motor durante su funcionamiento.

Indicações de segurança

PO

As secções "Aviso" e "Cuidado" contêm informações essenciais para evitar situações de perigo; certifique-se de que lê estas indicações na totalidade, juntamente com o manual de instruções e siga as instruções neles contidas.

⚠ Aviso : O manuseamento incorreto pode causar uma situação de perigo (choque elétrico, incêndio, lesões, etc.), resultando em potenciais lesões pessoais sérias e/ou morte.

⚠ Cuidado : O manuseamento incorreto pode causar uma situação de perigo (incêndio, lesões, danos físicos, etc.), resultando num possível dano ou lesão pessoal de dimensões médias. Pode causar apenas danos físicos.

⚠ Aviso

- Certifique-se de que o dispositivo é ligado à terra corretamente (cabo de ligação à terra).
- A instalação elétrica deve ser efetuada por um eletricista com formação para o efeito.
- Certifique-se de que a alimentação está DESLIGADA antes de ligar o sistema.
- Certifique-se de que a unidade está instalada antes da montagem da instalação elétrica.
- Não toque em terminais ou componentes internos do conversor (ou servomecanismo) nem ligue/retire os cabos ou conectores quando o conversor está com corrente.
- Não abra a cobertura dianteira do conversor quando este está com corrente ou tem tensão residual.
- Não manipule os controlos com as mãos molhadas.
- Não toque em terminais ou conectores mesmo quando o conversor (ou servomecanismo) está com corrente mas suspenso.
- Certifique-se de que o conversor foi ligado num modo em que não estará operacional após a restauração da alimentação de corrente, caso contrário pode ser perigoso para o operador.
- Disponibilize um interruptor de paragem de emergência separadamente.
- Reponha o alarme depois de se certificar de que o comando de funcionamento foi desativado.
- DESLIGUE a alimentação e espere pelo menos 10 minutos antes de realizar um trabalho.
- A manutenção, revisão e a substituição de peças não devem ser realizadas por operadores não autorizados.

⚠ Cuidado

- Ligue o conversor a materiais não combustíveis, como metal, e mantenha-o afastado de materiais combustíveis.
- Não contamine o conversor com materiais estranhos, incluindo poeiras, etc.
- Instale o conversor na vertical, numa parede sem oscilações e com capacidade para suportar de forma fiável o peso da unidade descrito no manual de instruções.
- Certifique-se de que o dispositivo não é colocado em locais com ambientes húmidos e quentes com gás corrosivo e gás explosivo, etc.. Instale-o num compartimento sem luz natural direta.
- Certifique-se de que a tensão nominal do produto corresponde à tensão do alternador.
- Não ligue o alternador a terminais de saída (U, V, e W).
- Não ligue uma resistência diretamente a um terminal de corrente contínua.
- Utilize um cabo de alimentação, um disjuntor de deteção de fugas ou um contactor eletromagnético com uma capacidade (nominal) designada ou equivalente.
- Não interrompa o funcionamento do conversor (ou servomecanismo) LIGANDO/DESLIGANDO o contactor eletromagnético localizado na fonte e saída de alimentação.
- Aperte o parafuso ao binário nominal. Para além disso, não deixe o parafuso desapertado.
- Não toque no ventilador de arrefecimento.
- O ventilador de arrefecimento e a resistência de amortecimento estão quentes. Não toque.
- Verifique se ocorrem oscilações, ruídos irregulares ou rotação do motor durante o funcionamento.

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Appendix: D

Warranty

D.1 Warranty

◆ Warranty policy on inverter

Warranty period	The warranty period is 18 months from date of shipment or 12 months after initial operation, whichever comes first.
Warranty condition	In the event that any problem or damage to the Product arises during the "Warranty Period" from defects in the Product whenever the Product is properly installed and combined with the Buyer's equipment or machines maintained as specified in the maintenance manual, and properly operated under the conditions described in the catalog or as otherwise agreed upon in writing between the Seller and Buyer or its customers; the Seller will provide, at its sole discretion, appropriate repair or replacement of the Product without charge at a designated facility, except as stipulated in the "Warranty Exclusions" as described below. However, if the Product is installed or integrated into the Buyer's equipment or machines, the Seller shall not reimburse the cost of: removal or re-installation of the Product or other incidental costs related thereto, any lost opportunity, any profit loss or other incidental or consequential losses or damages incurred by the Buyer or its customers.

Warranty exclusion	Not withstanding the above warranty, the warranty as set forth herein shall not apply to any problem or damage to the Product that is caused by: 1. Installation, connection, combination or integration of the Product in or to the other equipment or machine that rendered by any person or entity other than the Seller. 2. Insufficient maintenance or improper operation by the Buyer or its customers such that the Product is not maintained in accordance with the maintenance manual provided or designated by the Seller; 3. Improper use or operation of the Product by the Buyer or its customers that is not in-formed to the Seller, including, without limitation, the Buyer's or its customers' opera-tion of the Product not in conformity with the specifications; 4. Any problem or damage on any equipment or machine to which the Product is in-stalled, connected or combined or any specifications particular to the buyer or its cus-tomers; 5. Any changes, modifications, improvements or alterations to the Product or those func-tions that are rendered on the Product by any person or entity other than the Seller; 6. Any parts in the Product that are supplied or designated by the Buyer or its customers; 7. Earthquake, fire, flood, salt air, gas, lightning, acts of God or any other reasons be-yond the control of the Seller; 8. Normal wear and tear, or deterioration of the Product's parts, such as the cooling fan bearings; 9. Any other troubles, problems or damage to the Product that are not attributable to the Seller.
Others	The Seller will not be responsibility for the installation and removal of the inverter. Any in-verter transportation cost shall be born by both Seller and Buyer.

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Worldwide Locations

U.S.A

Sumitomo Machinery Corporation of America (SMA)
4200 Holland Blvd. Chesapeake, VA 23323, U.S.A.
TEL (1)757-485-3355 FAX (1)757-485-7490

Canada

SM Cyclo of Canada, Ltd. (SMC)
1453 Cornwall Road, Oakville, Canada ON L6J 7T5
TEL (1)905-469-1050 FAX (1)905-469-1055

Mexico

SM Cyclo de México, S.A. de C.V. (SMME)
Fresnos #201, Pocket Park Oriente, 67258 Juárez, N.L. México
TEL (52)81-8144-5130

Brazil

Sumitomo Industrias Pesadas do Brasil Ltda. (SHIB)
Rodovia do Acucar (SP-075) Km 26
Itu, Sao Paulo, Brasil
TEL (55)11-4886-1000 FAX (55)11-4886-1000

Chile

SM-Cyclo de Chile Ltda. (SMCH)
Camino Lo Echevers 550, Bodegas 5 y 6,
Quilicura, Región Metropolitana, Chile
TEL (56)2-892-7000 FAX (56)2-892-7001

Argentina

SM-Cyclo de Argentina S.A. (SMAR)
Ing Delpini 2230, B1615KGB Grand Bourg,
Malvinas Argentinas, Buenos Aires, Argentina
TEL (54)3327-45-4095 FAX (54)3327-45-4099

Guatemala

SM Cyclo de Guatemala Ensambladora, Ltda. (SMGT)
Parque Industrial Unisur, 0 Calle B 19-50 Zona 3,
Bodega D-1 Delta Bárcenas en Villa Nueva, Guatemala
TEL (502)6648-0500 FAX (502)6631-9171

Colombia

SM Cyclo Colombia, S.A.S. (SMCO)
Parque Industrial Celta, Km 7.0 Autopista Medellín,
Costado Occidental, Funza, Cundinamarca, Colombia
TEL (57)1-300-0673

Peru

SM Cyclo de Perú, S.A.C (SMPE)
Jr. Monte Rosa 255, Oficina 702, Lima,
Santiago de Surco, Perú
TEL (51)1-713-0342 FAX (51)1-715-0223

Germany

Sumitomo (SHI) Cyclo Drive Germany GmbH (SCG)
Cyclostraße 92, 85229 Markt Indersdorf, Germany
TEL (49)8136-66-0 FAX (49)8136-5771

Austria

Sumitomo (SHI) Cyclo Drive Germany GmbH (SCG)
SCG Branch Austria Office
Gruentalerstraße 30A, 4020 Linz, Austria
TEL (43)732-330958 FAX (43)732-331978

Belgium

Hansen Industrial Transmissions NV (HIT)
Leonardo da Vincilaan 1, Edegem, Belgium
TEL (32)34-50-12-11 FAX (32)34-50-12-20

France

SM-Cyclo France SAS (SMFR)
8 Avenue Christian Doppler, 77700 Serris, France
TEL (33)164171717 FAX (33)164171718

Italy

SM-Cyclo Italy Srl (SMIT)
Via dell' Artigianato 23, 20010 Cornaredo (MI), Italy
TEL (39)293-481101 FAX (39)293-481103

Spain

SM-Cyclo Iberia, S.L.U. (SMIB)
C/Gran Vía Nº 63 Bis, Planta 1, Departamento 1B
48011 Bilbao–Vizcaya, Spain
TEL (34)9448-05389 FAX (34)9448-01550

United Kingdom

SM-Cyclo UK Ltd. (SMUK)
Unit 29, Bergen Way, Sutton Fields Industrial Estate,
Kingston upon Hull, HU7 0YQ, East Yorkshire,
United Kingdom
TEL (44)1482-790340 FAX (44)1482-790321

Turkey

SM Cyclo Turkey Güç Aktarım Sis. Tic. Ltd. Sti. (SMTR)
Barbaros Mh. Çiğdem Sk. Ağaoğlu, Office Mrk. No:1 Kat:4 D.18
Ataşehir, İstanbul, Turkey
TEL (90)216-250-6069 FAX (90)216-250-5556

India

Sumi-Cyclo Drive India Private Limited (SDI)
Gat No. 186, Raisoni Industrial Park, Alandi Markal Road,
Fulgaon-Pune, Maharashtra, India
TEL (91)96-0774-5353

China

Sumitomo (SHI) Cyclo Drive Shanghai, Ltd. (SCS)
11F, SMEG Plaza, No. 1386 Hongqiao Road,
Changning District, Shanghai, China 200336
TEL (86)21-3462-7877 FAX (86)21-3462-7922

Hong Kong

SM-Cyclo of Hong Kong Co., Ltd. (SMHK)
Room 19, 28th Floor, Metropole Square, No.2 On
Yiu Street, Shatin, New Territories, Hong Kong
TEL (852)2460-1881 FAX (852)2460-1882

Korea

Sumitomo (SHI) Cyclo Drive Korea, Ltd. (SCK)
Royal Bldg Room #913, 19, Saemunan-ro 5-gil,
Jongno-gu, Seoul, 03173, Korea
TEL (82)2-730-0151 FAX (82)2-730-0156

Taiwan

Tatung SM-Cyclo Co., Ltd. (TSC)
22 Chungshan N. Road 3rd., Sec. Taipei, Taiwan 104,
R.O.C.
TEL (886)2-2595-7275 FAX (886)2-2595-5594

Singapore

Sumitomo (SHI) Cyclo Drive Asia Pacific Pte. Ltd. (SCA)
15 Kwong Min Road, Singapore 628718
TEL (65)6591-7800 FAX (65)6863-4238

Philippines

Sumitomo (SHI) Cyclo Drive Asia Pacific Pte. Ltd. Philippines Branch Office (SMPH)
C4 & C5 Buildings Granville Industrial Complex, Carmona,
Cavite 4116, Philippines
TEL (63)2-584-4921 FAX (63)2-584-4922

Vietnam

SM-Cyclo (Vietnam) Co., Ltd. (SMVN)
Factory 2B, Lot K1-2-5, Road No. 2-3-5A,
Le Minh Xuan Industrial Park, Binh Chanh Dist.,
HCMC, Vietnam
TEL (84)8-3766-3709 FAX (84)8-3766-3710

Malaysia

SM-Cyclo (Malaysia) Sdn. Bhd. (SMMA)
No.7C, Jalan Anggerik Mokara 31/56, Kota Kemuning,
Seksyen 31, 40460 Shah Alam, Selangor Darul Ehsan,
Malaysia
TEL (60)3-5121-0455 FAX (60)3-5121-0578

Indonesia

PT. SM-Cyclo Indonesia (SMID)
Jalan Sungkai Blok F 25 No. 09 K, Delta Silicon III,
Lippo Cikarang, Bekasi 17530, Indonesia
TEL (62)21-2961-2100 FAX (62)21-2961-2211

Thailand

SM-Cyclo (Thailand) Co., Ltd. (SMTH)
195 Empire Tower, Unit 2103-4, 21st Floor, South
Sathorn Road, Yannawa, Sathorn, Bangkok 10120,
Thailand
TEL (66)2670-0998 FAX (66)2670-0999

Australia

Sumitomo (SHI) Hansen Australia Pty. Ltd. (SHAU)
181 Power St, Glendenning, NSW 2761, Australia
TEL (61)2-9208-3000 FAX (61)2-9208-3050

Japan

Sumitomo Heavy Industries, Ltd. (SHI)
ThinkPark Tower, 1-1 Osaki 2-chome, Shinagawa-ku,
Tokyo 141-6025, Japan
TEL (81)3-6737-2511 FAX (81)3-6866-5160

Sumitomo Heavy Industries, Ltd.

Power Transmission & Controls Group

Headquarter ThinkPark Tower, 1-1 Osaki 2-chome, Shinagawa-ku, Tokyo 141-6025, Japan

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